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Of this issue of the Street Railway Journal, 8500 copies are printed. Total circulation for 1906 to date, 114,800 copies, an average of 8200 copies per week.

The Election in Chicago

At the election held April 3 the citizens of Chicago declared themselves in favor of municipal ownership, but not of the municipal operation of the street railway systems of the city. The election was a close one, and the decision in favor of municipal ownership was carried by only 1½ per cent of the total vote cast. This decision required only a majority in its favor. That upon municipal operation required an affirmative vote of 60 per cent, and was lost by a little over 7½ per cent of the total vote. The election was conducted in accordance with the terms of the Mueller law, passed by the Illinois legislature and approved by the citizens of Chicago at the city election held April 5, 1904.

At the election just held, therefore, the citizens have virtually declared themselves in favor of the acquisition by the city of the street railway systems and their lease to the present or other companies, the purchase to be made by the issue of $75,000,000 worth of Mueller certificates. There is some doubt as to whether the Mueller law itself is constitutional, and this question will have to be determined by a test case before the supreme court. Again, the certificates themselves are not a lien against the city and may not be against the city's interest in the railway system. In fact, uncertainty as to just what constitutes the collateral or guarantee of these certificates may prevent purchasers for them being found.

The results of the election seem to be to leave the situation about where it was before the vote was taken. Before the city can acquire the railways as provided in the vote, the legal status of both the law and the certificates must be settled, and this will mean tedious delay. In the meantime, Mayor Dunne is reported as wanting to submit the operation proposition to another vote, which he hopes will be more favorable to his pet plan. The situation is certainly not very encouraging to those longing for better street railway service in Chicago.

Interchangeable Coupon Books in New York State

By the appointment of a committee, with powers to investigate and report at its next annual convention in June, the New York State Street Railway Association, at its Elmira meeting, held March 29, took definite action looking to the joint adoption by all the member companies of an interchangeable coupon ticket book good for passage over the lines of all the companies. The plan as proposed is based very largely upon the agreement now in force among certain members of the Central Electric Railway Association, frequent references to which have been made in these columns. The idea at first was to devise some form of interchangeable mileage book that could be sold at a stated cost per mile, but it soon developed that the lack of uniformity in the rates of fare charged by the interurban companies would prevent the adoption of a straight mileage book, inasmuch as on a few of the roads the regular rates of fare were less than that at which other roads, having higher fares, would be willing to accept mileage tickets. This matter of interchangeable tickets has been brought sharply to a head in New York State by reason of the important work now in progress, both through the cen-

tral portion of the State and also in the southern tier of counties, whereby many of the gaps between important interurban centers are rapidly being closed, making through electric train service between New York and Buffalo, and between many important cities in the southern and western sections of the State, a matter of the very near future. In the form in which the matter was brought before the Elmira meeting of the New York State Association, the proposition is to sell the interchangeable-coupon books, each book containing 240 5-cent coupons, at the rate of $10 per book. This gives the purchaser $12 worth of transportation for $10, and operates as a reduction in fare equivalent to 16 2-3 per cent. J. H. Pardee, general manager of the Rochester & Eastern Rapid Railway, who presented the proposition as a paper before the association, has made a careful analysis of the rate sheets of the important interurban lines in New York State and finds that this reduction of 16 2-3 per cent nets approximately the rate of round-trip tickets. That is to say, if the proposition goes through, the holder of a coupon book will be able to get on a car of any interurban road that is a party to the agreement and make a single trip for virtually the round-trip fare.

There can be no doubt that an agreement between the important electric roads of the Empire State, looking to the issuance of interchangeable-coupon books, would be appreciated by the traveling public generally, and it would be of especial convenience and value to commercial travelers. In the opinion of those present at the Elmira convention the latter form a class of sufficient importance to be entitled to the fullest consideration. Having in mind the longer trolley routes and through service that will be available throughout the Empire State within the year, we venture to predict that if the managers of the important roads in the New York Association will adopt a joint coupon book, that can be carried conveniently in the vest pocket, and will be good for passage over the electric railways in all sections of the State, they will have the satisfaction of increasing their receipts as well as of seeing many a "knight of the grip," who is still prompted to travel in the old-fashioned way, by steam road, enjoying his cigar in the smoking compartment of their interurban electric cars.

Lighting of Interurban Cars

There is one point in street and interurban railway practice in which it might be said that for the last ten years absolutely no progress has been made. We refer to the lighting of cars. Better lighting is needed on both city and interurban cars, but on the latter the lighting is most assuredly inadequate.

Interurban lines have developed to a point where they cater to the same class of patrons as do steam lines. Many of these passengers are traveling men who, when on steam cars where lighting facilities will permit them to do so, utilize the time on the train to write up their notes and reports. It is safe to say, however, that comparatively few interurban lines have their cars so lighted that reports and notes may be written with any degree of satisfaction. In fact, in many it is almost impossible to read a newspaper at night. It is reasonable to presume that when steam and interurban roads are run parallel the inferior lighting on the electric car is the cause of much loss in traffic and if interurban lines are to compete with steam roads certainly this handicap must be removed.

Attempts to better the lighting by increasing the number of lamps, while helping conditions somewhat, has not proven a satisfactory method. The variations in the intensity of light remain about as great as before. Of course at a low line voltage the car with the greater number of lamps gives more illumination. On the other hand, after the eye has adjusted itself to the intense light when the line voltage is high, it is able to read print very little better on low voltage when the car has a large number of lights than when it has a fewer number. At present it does not seem possible to secure proper lighting of electric cars without the installation of a gas system, a storage battery together with a regulator, or some other expensive apparatus. Managers are naturally unwilling to install such apparatus, however, because of its cost and the additional complications in the car equipment. But it is a serious question and one to which inventors might properly devote some attention. One Western road to our knowledge is having several cars equipped with storage batteries and a regulator.

Advertising on Large Urban Systems

Progressive, energetic advertising has been one of the most potent factors in the success of many small interurban and even city roads. The importance of calling the public's attention to the facilities offered is being realized to-day as perhaps never before in most of the fields of public service work. The telephone industry bears striking evidence of the influence of advertising upon growth of business, and central stations all over the country are vigorously pushing their output into new territory. Perhaps the most notable advertising campaigns in the street railway field have been carried on by roads situated in regions especially favorable to the development of summer resort traffic. The larger city systems have not always realized the powers of advertising, however, for the traffic of every great metropolitan center is to a large extent compulsory.

The problem of stimulating traffic should certainly be looked into, however, in any case where the earnings have fallen over noticeably in their rate of increase, during the past few years. The company's cars are always available for such uses, and the judicious if sparing use of daily newspaper space may prove to be quite as effective as the "carrying of ads." in the weeklies of adjacent towns. There is certainly room for a broader co-operation between connecting systems in the matter of advertising. It is almost as much to the advantage of a large city road to stimulate traffic over its lines to points outside the limits of its own system as it is to develop local business within its own borders. In other words, the attractions of points reached by foreign cars which traverse a given city system in going and returning, should not be neglected by the urban street railway advertiser.

On every large city system which serves suburban or residential districts beyond walking distance from the business center, a large number of extra cars are necessarily held idle at other periods than the rush hours. The utilization of some of these cars is a point worth attaining, in its influence upon the statement of gross and net earnings at the end of the year. It will not be many weeks before the open car will be in operation once more, and we believe that it will pay to stimulate pleasure riding as the summer season comes on, by a little extra advertising on the part of some of the larger systems. Whether a city is adjacent to a park resort or not, every system is capable of providing comfortable transportation on its

open cars during the warm evenings of the late spring and summer. There are many methods of attracting traffic. A number of these were discussed at the Elmira meeting, reported elsehere in this issue. We certainly believe that even the larger systems can do something to increase their profits by giving more thought to the subject than they have always done in the past.

Electric Railroading Abroad

Mr. Dawson's paper, which we are exceedingly glad to present to our readers in the current issue, is upon the whole by far the most complete discussion of the larger work of electric railroading which we have yet seen. It indicates very clearly that in the electrification of the larger railways our foreign confrères are well to the front, and are less hampered by conservatism than we are. In the growth of electric traction the same great problems have appeared both here and abroad. The coming of electric traction was welcomed by the tramway and, in so far as possible, repressed by the main line railroads. Everywhere the result has been the same. The tramways have been converted with great rapidity, and with almost universal success and the pressure of competition thereby brought to bear upon the main and suburban lines has been very keenly felt. The effect of real rapid transit upon the habits of the public, always a marked phenomenon, has been no less striking abroad than here. Just how it takes place and what are the various factors that produce it, is difficult to tell, but the facts are startling. As an example, study Mr. Dawson's figures for London, which we Americans are wont to look upon as a city less enterprising than a community of the first rank here. In 1895 it had just passed the 6,000,000 mark in population for the greater metropolis and the annual journeys per head amounted then to just over a hundred. Today it is nearing 7,000,000, an increase of only 12 per cent to 15 per cent, but if we judge Mr. Dawson's figures aright, the journeys per head, by railway, tramway and bus, must be close to 150.

How much of redistribution of population and amelioration of general conditions this increase implies it is hard to reckon, but the aggregate effect is certainly imposing, and may be taken as the indubitable effect of rapid transit introduced by electric traction. And London, like every large city, is even now hard pressed for more facilities. It has not piled city upon city skyward like New York, but the very hugeness of the place has compelled the growth of outlying districts, and forced the construction of at least partially adequate facilities for travel. And, as in American cities, the main railway lines centering in the metropolis have not kept up with the march of progress. With the competition of the tubes and tramways the railroad business has fallen off relatively, and at present the possession of termini far within the city has become almost a disadvantage, since the congestion at these points is terrific. It is to the betterment of these conditions that Mr. Dawson especially addresses himself. Only modern methods employed, not conservatively, but radically, seem able to cope with the situation. The report of the Royal Commission favoring electric traction has carried weight and it now looks as if electrification on a large scale was to be the order of the day. There is not the slightest doubt that the daily capacity of a terminal can be doubled by the complete adoption of electric service with its greater working speed and larger facility for running on short headway. But for the greatest gain the change must be complete, and the steam locomotive put definitely out of service for urban work.

From Mr. Dawson's account the sooner this is done the better, and the main question is not the necessity for the change, but the best method of making it. In reviewing the available methods it must not be forgotten that the drastic Board of Trade regulations on rail return make the third rail system relatively less desirable in England than here, yet we believe that Mr. Dawson's condemnation of a low voltage third rail on the ground of economy is fully justified in London or anywhere. It is interesting to note, too, that the consensus of opinion among European engineers is distinctly against this method of distribution. Of the alternating-current methods Mr. Dawson strongly favors the single phase, laying aside the three phase on the well-known grounds of complication of overhead wiring and inefficiency of speed control, noting incidentally that the recuperation of energy claimed often as an advantage of the system cannot be taken very seriously. We would go further, and express a grave doubt whether on ordinary roads the recuperation game with any motor is worth the candle. It inevitably leads to some, usually considerable, extra complication and unless there are specially favorable opportunities for it, seems of very dubious value. Certainly it is not important enough to justify the use of a motor system otherwise uneconomical. Of the single-phase motors Mr. Dawson has an evident liking for the Winter-Eichberg, or modified repulsion type, as against the plain series compensated type in increasing use here. Certainly the curves of the Winter-Eichberg motor which he gives are very encouraging and the facility with which it can be wound for high trolley voltage, so far as the stator is concerned, is most striking. In the general case, however, we are not inclined to attach great importance to this feature, since on long lines the trolley voltage is pretty certain to be carried to a point above that for which one would care to wind even a stator, and given a transformer, the secondary voltage is unimportant. On certain lines where moderate trolley voltage is required the Winter-Eichberg type might be advantageous. However, this case, like capacity for working on d. c. circuits, is not general, but only of limited, importance. The final type of a. c. motor for railway work will be determined by its properties as a motor rather than by accidental advantages. It is interesting to note that the a. c. motor in question makes a specially neat work of the acceleration, and shows substantially the same efficiency as the corresponding d. c. motor, with a very moderate increase in weight, considerably less than the 20 per cent put forth in the usual d. c. manifesto. The mean power factor in the test cited was 85 per cent, which is certainly not a bad showing. The acceleration question is, however, largely a matter of adaptation rather than capability and probably the result just noted merely indicated more skill in planning than anything else. It is certain that in the last resort, the new a. c. motor must suffer a little in weight, efficiency, or cost, the inherent difficulties being to a large extent transferable from one account to another at the will of the designer. Certainly Mr. Dawson makes out a very strong case for the immediate introduction of electric traction on main lines, and we hope that the work now in progress on this side of the water will be full of encouragement

ELECTRIC TRACTION ON MAIN LINE RAILWAYS IN EUROPE.

BY PHILIP DAWSON, M. Inst. C. E., Etc.

The subject of electric traction on main line railways has frequently been dealt with in these columns, and attention has been particularly called to it recently by the series of papers read at the International Railway Congress at Washington last summer.

The present position of main line railways is very similar to that of tramways some twenty years ago, with the only difference that in the case of tramways electricity was still in its infancy and its value had still to be proved; whereas, in the present instance no one can doubt that electricity is quite capable of hauling main line trains.

The principal cause of the electrification of tramways was the desire to increase their earning capacity, and it was the financial success of the wholesale electrification of American tramway lines which led to its general introduction in Europe some years later. Generally speaking, the favorable results which accompanied the transformation in America were experienced in Europe, although possibly on a somewhat smaller scale.

Electric tramways have been referred to, because as far as Great Britain is concerned it is the results of their electrification which, to a large extent, is forcing the railway companies to seriously consider the necessity of taking action to stop the loss of traffic resulting from tramway competition. The results of electrification of tramways in Great Britain are shown in Table 1, which is taken from the last Board of Trade returns.

TABLE I.—SHOWING RESULTS OBTAINED BY THE INTRODUCTION OF ELECTRICITY ON TRAMWAYS IN GREAT BRITAIN

	1878	1904-1905
Length of route	269	2,117
Capital expended	£4,207,350	£52,675,152
Number passengers carried	146,000,000	2,069,000,000
Ratio of operating expenses to receipts	83.81%	66.19%
Net receipts	£230,956	£3,351,977

Some years ago, in an article contributed by the author to the Street Railway Journal, the opinions expressed by representative officials of a number of British steam railway companies were quoted, showing the extent to which they considered the railway receipts had been affected by the electric tramways. The first step on the part of these railway companies, so far, has always been to oppose in Parliament and elsewhere every effort that was made either to electrify existing tramway lines or to build new ones, but the public demand for increased facilities of transportation prevented such retrograde policy being effective. The result is that so-called tramway competition has become much more serious, and has again been suggested this year by many railway companies as the cause for the decrease in their receipts from local passenger traffic.

In all countries large railway companies are probably among the most conservative bodies to be found, but particularly is this the case in Great Britain, and electric traction in their case will, in many instances, only be adopted when absolutely forced upon them. As a matter of fact, the same thing would appear to be the case in the United States, where the electrification of main line railways has generally only taken place because steam was inadmissible, and there is little doubt that railway men, if it had been possible, would have preferred to use steam instead of electricity.

Before dealing any further with the causes which are at work, and which will eventually result in the electrification of railways on a large scale on this side of the Atlantic, or with results which may be expected therefrom and the reasons which lead to anticipating such results, it may be advisable to consider the types of railway service for which electric traction is suitable and to explain the particular meaning which it attached in this article to "Electric Traction on Main Line Railways."

TRAMWAYS AND LIGHT RAILWAYS

Electric traction is applicable to either tramways and light railways or to railroads. A tramway and light railway in Europe may be defined as a system of which a large portion of the track is laid on the public thoroughfares and not on a private-owned right of way, or where, if the company has its own right of way, it is not required by Government regulation to protect level crossings or to be operated under the "block" system of signaling.

On such lines or public high roads the maximum speed permitted by Government regulations rarely exceeds 12 m. p. h. to 16 m. p. h., although in practice, even in Great Britain, this speed is greatly exceeded, as is shown by actual speeds which were taken by expert time-keepers of the Automobile Club of Great Britain and Ireland quite recently, and which indicate that on the London United Tramways, in Acton and Hanwell, the speed was generally considerably over 12 m. p. h., and frequently reached over 17 m. p. h. In Newport (Wales) the same results in timing were obtained, and in Leeds even higher speeds were found to exist. Notwithstanding these isolated cases, the congested condition of the streets of our large towns makes it impossible for light railways even on long routes to acquire a speed, including stoppages, which will give an average of 10 m. p. h. or more.

TABLE II.—INCREASE OF PASSENGER TRAFFIC IN GREATER LONDON

	Number of Passengers Carried by:				Estimated Population of Greater London	Number Journeys per Head
Year	Railway (Local Companies)	Tramway	Omnibus (Two Principal Companies)	Total		
1880...	133,877,485	64,817,361	57,722,231	256,417,077	4,670,243	54.8
1890...	167,299,200	191,041,904	148,531,099	506,872,203	5,540,430	91.5
1895...	184,411,600	249,996,979	191,076,010	625,484,589	6,021,433	103.9
1900...	214,537,095	340,203,066	264,503,868	819,244,029	6,484,516	126.3
1901...	236,506,162	340,772,414	269,933,759	847,212,335	6,581,402	128.7
1904...	242,170,120	401,108,033	288,965,214	931,243,367	.....	——

Note.—The railway companies included in the above table are the Metropolitan, Metropolitan District, North London, East London, City & South London, Waterloo & City, Great Northern & City and the Central London. The omnibus companies included are the London General and the London Road Car. The tramway column includes all tramway traffic.

METROPOLITAN OR RAPID TRANSIT RAILWAYS

For the purpose of this article, railways can be classed broadly as Metropolitan railways and as main line railways. Metropolitan lines generally either have no termini, or if they have, it is not necessarily the station where most passengers get out on arriving in town or get in when coming home at night. Such a railway does not usually have main line long distance steam trains running over its lines, nor is there usually much freight traffic handled over it. Such Metropolitan lines were till recently mostly worked by steam, although as the result of the enterprise of Mr. Yerkes and Sir Charles Maclaren, this is no longer the case in London.

Under the heading of Metropolitan lines which, in many instances, may be run through shallow subways, may also be included the tube, or deep level lines. In the latter case, electricity has been adopted from the commencement, but here again steam was inadmissible for reasons of ventilation, and electricity was necessarily adopted in the case of the City South London Railway, the first deep level line ever constructed.

The adoption of electric traction on Metropolitan lines inevitably means the suppression of all steam-hauled trains.

MAIN-LINE RAILWAYS

Main line railways are taken as being lines having termini in big towns, and over which a large number of different services are operated, such as long distance trains connecting up big towns which are far apart and which may be trains running long distances without a stop, or slow trains with frequent stops. Freight or goods traffic is generally one of the most important and remunerative branches, and is necessarily operated over the same system, and can, in its turn, be divided into slow and fast. The mere fact of long distance lines having termini in the big towns necessarily results in their lines being utilized to a varying extent, largely depending on the requirements of, and the facilities given to, the large crowds whose business requires them daily to go in and out of town to and from business.

TABLE III.

Passengers Carried In and Out of London in 1903 on Locomotive Lines	
Great Eastern Railway....	65,300,000
London & So. West'n Ry.	33,200,000
North London	26,700,000
Great Eastern & London & Tilbury Railway.....	24,000,000
London, Brighton & S. Coast Railway	42,300,000
South Eastern & Chatham Railway	59,900,000
Great Northern Railway...	15,340,000
Midland Railway	9,767,000
Great Western Railway...	9,174,000
London & North Western Railway	4,470,000
West London Railway....	4,100,000
Total	294,151,000

Passengers carried in London on Metropolitan Lines in 1904	
Metropolitan	74,482,689
District	50,697,936
North London	34,988,493
East London	6,621,190
North & South	447,792
Central London	44,875,547
City & South London.....	17,631,275
Great Northern & City....	7,939,488
Waterloo & City	4,485,713
Total	242,170,120

1904—Passengers Carried Into and Out of London by Various Means of Conveyance	
Main line and Metropolitan Railways	542,000,000
Tramways	401,000,000
Busses	289,000,000

Although in many Continental towns the termini of the main railways are situated at some distance from the business centers, in most large towns in England the railway terminis are in or near the heart of the city. The result of this arrangement is most satisfactory from the point of view of the suburbanite who wishes to go to town, but the result as far as railway companies are concerned is not so satisfactory. Most of our railways were built over half a century ago, and the spare amount of land owned by them is often so small that quite apart from the question of short distance traffic, they lack sufficient space to deal with the rapidly increasing long distance and goods traffic. Also any increased station accommodation, particularly that required for properly handling the ever increasing local services, entails a vast expenditure of money, which, although amounting to millions of pounds, is frequently insufficient to give the desired accommodation for handling short distance as well as long distance traffic. Matters are further complicated in the case of most railways by the fact that the greater part of local travelers get out and in at the termini, thus greatly increasing the congestion and the number of passengers to be handled in a given time.

Under the heading of suburban traffic for main lines may also be included interurban traffic, in which also termini are generally encountered, such as that which exists in England between Manchester and Liverpool, or Bradford and Leeds.

CAUSES TENDING TO THE ELECTRIFICATION OF MAIN-LINE RAILWAYS

Having broadly considered the main conditions and generally classified the different system of railways, the reasons will be investigated which make it probable that electric traction may shortly be introduced on a very considerable scale on the main line railways of Great Britain, at the same time considering what portion ot their system is likely to be electrified and the reasons which for the present militate against such a change of motive power.

Among the principal causes which may eventually force electrification to be adopted by railways is, as has been already mentioned, the very serious competition which they are suffering at the hands of electric tramways. The railway companies are slowly discovering that although costly opposition may, for a time, put off the evil day, they cannot stop the progress and prevent electric tramways and light railways being built. They appear to be at last realizing that the only way to compensate for losses caused by paralleling electric tramways is to improve the local service of their own lines, and this, as long as steam is the motive power, is practically impossible.

As has already been pointed out, the accommodation at the stations and the number of tracks available, are scarcely sufficient to cope with the present services. The great improvement in long distance services increases the demand on the resources of the railway companies and it thus becomes impossible to increase the number or speed of the trains which are purely serving suburban districts as long as these are operated by steam. Furthermore, the requirements of suburban districts are constantly increasing, owing to the very rapid growth of the population in the large manufacturing centers of Europe. This is clearly shown by Tables II to V, which show the increase in traffic population in London, Berlin and Liverpool. The existing methods of rapid transit, as far as Berlin and London are concerned, are shown in the two maps accompanying this article, and which have been specially prepared for it.

The congestion of local traffic services is further increased by the practice of making short spur or branch lines from existing railways to those districts needing further accommodation. This method is advantageous from many points of view, but the result of such a policy is greatly to overcrowd the approach on the final section to the London terminus.

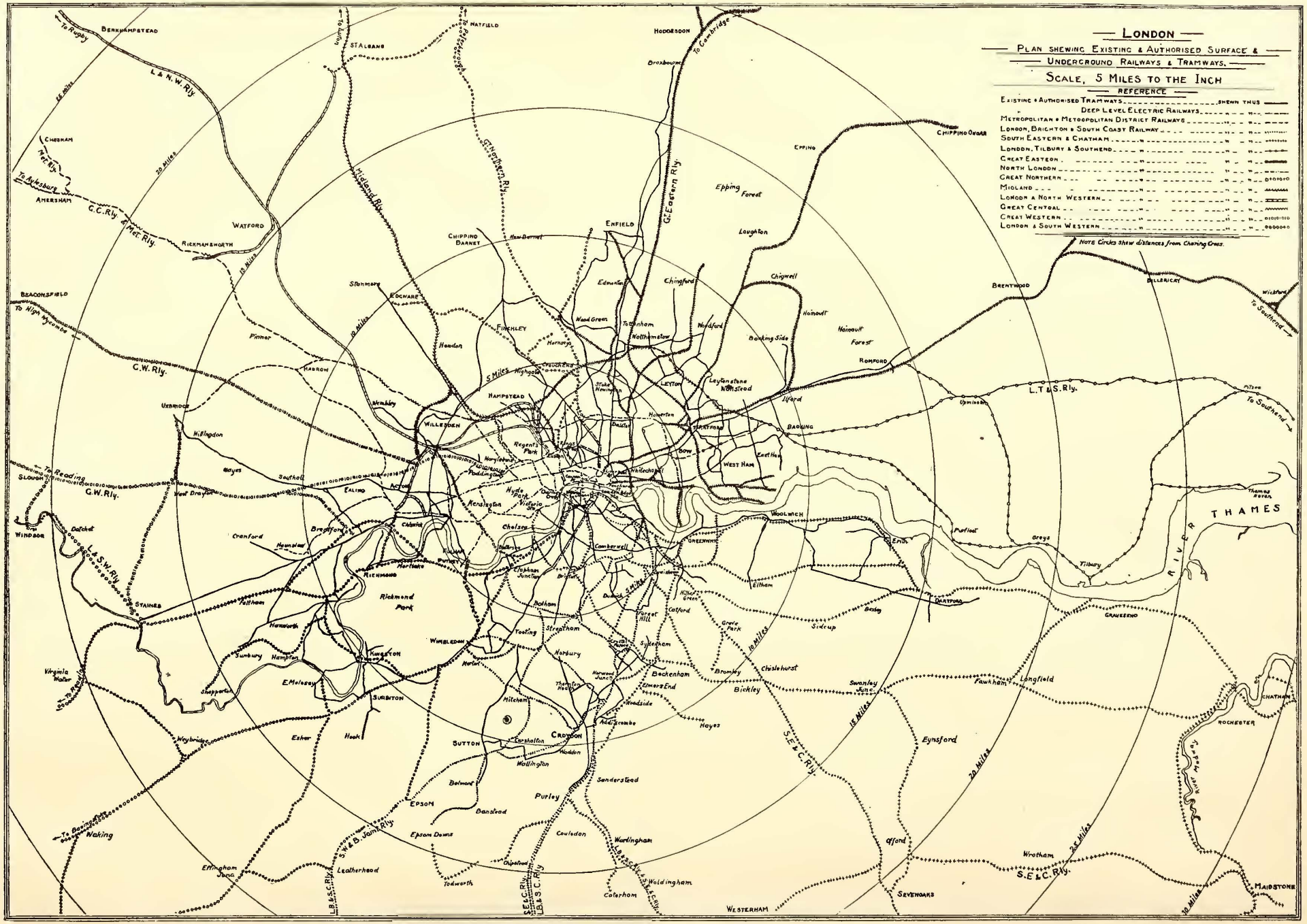
It is undoubtedly a fact that a great deal of the overcrowd-

TABLE IV.—INCREASE OF POPULATION AND TRAFFIC IN BERLIN

Year	Population of Greater Berlin	Passengers Carried, Tramways	Passengers Carried, Met. Rys.	Electric Railways	Passengers Carried, Omnibus	Total Passengers Carried	Times Pop. Carried Per Annum
1885	1,458,000	87,000,000	15,000,000	.....	16,000,000	119,000,000	82
1890	1,827,000	143,000,000	29,000,000	.....	29,000,000	209,000,000	114
1895	2,089,000	168,000,000	75,000,000	.....	44,000,000	287,000,000	137
1900	2,404,000	280,000,000	98,000,000	.....	80,000,000	458,000,000	191
1901	2,443,000	332,000,000	87,000,000	.....	80,000,000	499,000,000	204
1902	2,505,000	345,000,000	92,000,000	19,000,000	79,000,000	533,000,000	225
1903	2,585,000	368,000,000	86,000,000	30,000,000	86,000,000	581,000,000	225
1904	2,650,000	394,000,000	111,000,000	32,000,000	93,000,000	631,000,000	238

TABLE V.—LIVERPOOL TRAMWAYS

Passengers:	1897	1898	1899	1900	1901	1902	1903
Electric cars	.....	785,064	15,853,160	58,068,531	100,076,789	108,906,472	113,015,728
Horse cars	30,596,229	31,985,158	39,321,946	19,051,875	218,166	74,685	41,506
Omnibuses	7,812,855	9,001,812	8,596,344	5,247,552	813,825	354,428	.....
Totals	38,409,084	41,772,034	63,771,450	82,367,958	101,108,780	109,335,585	113,057,234



MAP OF LONDON, SHOWING EXISTING AND AUTHORIZED UNDERGROUND RAILWAYS AND TRAMWAYS

ing which exists in the large cities is due to the want of adequate rapid transit facilities and the Royal Commission on London Traffic rightly states that:

We look for the relief of overcrowding to the future adoption of electric traction for suburban trains, and to the increase in the number of trains run, which would probably follow the change in motive power. Trains of uniform, but not excessive size, run at very short intervals, afford the best way of meeting the evil of overcrowding.

The Royal Commission is greatly impressed by the possibilities of electric traction on railways, and clearly states this view as follows:—

So long as trains are hauled by steam engines we do not think that much improvement in the speed of suburban train service can be looked for. When electric traction is adopted the advantage of quicker acceleration will be secured, and the readier adaptability of electric trains to all requirements will, we hope, enable suburban train services to be greatly improved, and the journey time of trains to be reduced substantially.

It is, we think, evident that the introduction of electric traction will lead to a great improvement of suburban and urban railway facilities in London; the speed of all trains worked by electricity, especially those which stop at many stations, will show substantial increases over the speed of steam trains. It will, we believe, also be found that electric traction, apart from its other advantages, will enable railways companies to increase the number of trains working in and out of the terminal stations, and thereby add largely to the facilities afforded for suburban traffic.

We hope, therefore, that there may be no great delay before the railway companies serving London adopt electric traction for the working of their suburban train service.

MAIN-LINE RAILWAYS IN LONDON

In considering the problem of electric traction on railways and in order to show the necessity for action on the part of the railway companies as to the electrification of their suburban services, no better example can perhaps be taken than that of London, and in this connection attention is directed to its map already referred to.

Looking at this map of London the first broad feature which is apparent is the existence of 10 main lines of approach, each belonging to a separate and independent railway company. Seven of these main line systems are on the north of the Thames, two having their terminal on the east side of the central area within half a mile of each other and conveniently situated for access to the City of London. The remaining five have their termini almost in a straight line, extending from East to West for a distance of about 2½ miles from Kings Cross (G. N. R.) to Paddington (G. W. R.) Three of the main lines have their principal termini on the south of the central area.

These main routes along which long distance traffic is brought to London also afford the principal avenues of railway approach to London for the trains from all suburban branches, except those connected with the North London and the Metropolitan and Metropolitan District Railways. Hence again, subject to the same exceptions, the vast suburban traffic, although also served by many subsidary stations, is chiefly concentrated at the same terminal stations which serve the long distance passengers, who, thought large in the aggregate, form only a small fraction of the total number of passengers dealt with at the main termini.

It may be convenient here to set out a tabular statement of the main lines of railway into London and their principal terminal stations. (See Table VI.)

An examination of Table II will show that the traffic on these railways has not been seriously affected by the enormous increase in the number of passengers carried by tramways and which is due entirely to electrification. That is, the results obtained in London are very similar, if not perhaps quite as striking as those which were obtained by the electrification of the New York street railways. But notwithstanding the enormous increase in passengers carried by street railways in New York, the electrification of elevated lines resulted in a similar increase in their case, and the construction of the underground lines in New York has not, apparently, seriously damaged any of the above mentioned systems, in spite of the very large number of people carried by it. All of which shows that the increase of travelling facilities increases the

TABLE VI.—SHOWING THE MAIN-LINE RAILWAYS HAVING TERMINI IN LONDON

Railway	Main Termini in London	Route, Miles in Greater London	Number of Stations in Greater London
Great Eastern	Fenchurch Street	86.1	88
London, Tilbury & Southend		16.3	8
Great Eastern	Liverpool Street	....	..
Great Northern	King's Cross	32.7	28
Midland	St. Pancras	20.3	14
Lon. & North Western	Euston	24.2	19
Great Central	Marylebone	2.2	1
Great Western	Paddington	28.7	16
Lon., Brighton & South Coast	London Bridge and Victoria.	71.7	56
S. East'n & Chatham.	Victoria, Charing Cross, Holborn Viaduct, Cannon Street, St. Paul's.	124.7	101
Lon. & South Western	Waterloo	75.7	50
Total		482.6	..
Joint lines owned and authorized by the above companies:			
Total mileage		50.6	..
Total number of stations		....	50

Length of single road used by passenger trains in Greater London, 1604 miles. This figure includes Metropolitan and tube lines at present being operated.

demands on the part of the public, and that the increase in rapid transit facilities, once a public has been educated for travelling, has, up to date, never kept up with the demands.

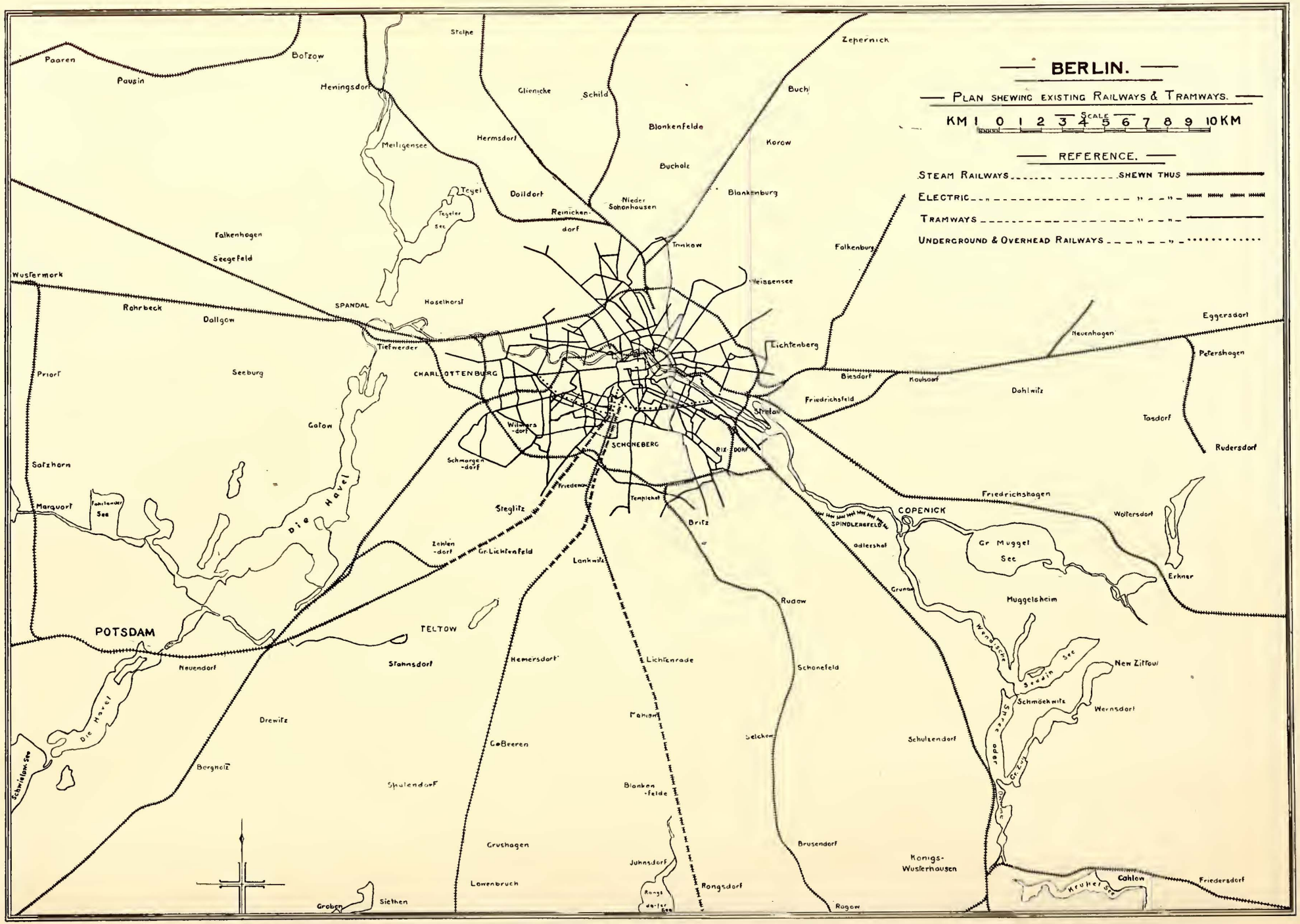
Applied to London, this means that the habit of travelling, which has been cultivated by the electrification of tramways, will, in the end, be beneficial to the railways, provided the latter amend their service and give the public rapid and frequent trains. At present only those people travel by railways, as far as suburban traffic is concerned, who are absolutely obliged to do so. If better facilities are granted the general public will avail themselves of the increased facilities as they get the chance. That the railways may do something in this direction is apparent from the fact that although the total annual traffic is constantly on the increase and, if anything, has been greater than in past years; the same cannot be said as regards the ratio of net receipts to capital expended, as is seen from Table VII.:

TABLE VII.—SHOWING NET PROFIT, IN PER CENT, OF CAPITAL EXPENDED ON MAIN RAILWAYS

	Per Cent
Average for five years from 1881 to 1885	4.22
Average from 1901 to 1905	3.80
Average for 1902	3.42
Average for 1903	3.4
Average for 1904	3.36

CONDITION OF ENGLISH MAIN-LINE RAILWAYS

Owing to the increase in population and consequent increase in the municipal and national expenditure, rates and taxes are constantly increasing, as will be seen from the fact that in 1904, the rates and taxes per train mile amounted to 3.1 pence, as against 2.9 pence in 1895. The total operating cost per train mile, including maintenance, locomotive power, traffic and general charges, compensation, legal and miscellaneous, has risen from 33.26 pence per train mile in 1895 to 41.27 pence per train mile in 1904. During the same period the total receipts from all sources per train mile has practi-



PLAN OF BERLIN, SHOWING EXISTING RAILWAYS AND TRAMWAYS

cally remained stationary, having been 49.47 pence per train mile in 1895 and 49.19 pence in 1904.

The chairman of the North London Railway Company, at the last annual meeting this February, reported a further decrease in receipts from passengers, due mainly to the competition of electric tramways and railways, and stated that it was practically impossible to attempt to meet the competition until the electrification of suburban lines could be carried out.

Contrary to this result are the statements made at the meetings of the Lancashire & Yorkshire and North Eastern Railway companies, where reference is made to the results obtained by the electrification of the Liverpool & Southport and Newcastle & Tyneside lines, respectively.

The chairman of the Lancashire & Yorkshire Railway Company—Sir George Armitage—expressed satisfaction at the results of the electrification, which has enabled them to do a much greater amount of work and give a much greater service to the public, which would have been absolutely impossible under old conditions, and he stated that they were contemplating further extensions.

The chairman of the North Eastern Railway Company—The Right Hon. John Lloyd Walton—stated that the further experience of electric traction of the suburban lines of the Newcastle district have been entirely favorable, both practically and financially. In the last half year of steam they had had 2,844,000 bookings, but with electric traction for the last half year of 1905 they had carried 3,000,548 passengers, an increase in round figures of 25 per cent. The gross earnings for the year of 1903, when operated by steam, were £129,000 and for the corresponding year, 1905, when run electrically, £151,000. The chairman further stated, that while the running costs in 1903 for the half year were £42,761, although their mileage had been doubled with electrification, the working costs for the corresponding half year, 1905, were only £47,779.

Sufficient has already been said to demonstrate the necessity of decisive action on the part of the railway companies. No simple alteration of type of rolling stock or locomotives, or length of trains, or even reduction in fares will be sufficient to meet the case.

Those who are thoroughly acquainted with the results of electrification, obtained not only on tramways but also on railways, are frequently of the opinion that all that is necessary, is to convince the railway authorities of the results which can be achieved by the substitution of electricity for steam on their railways, and to quote the decision of other companies as regards electrification and the results obtained by them.

It may, therefore, be not without interest to investigate shortly the reasons which have led to electrification and how far electrification has been adopted by main line railways, and then to see whether the conditions which have caused electrification in other cases, may be expected to produce the same result, say, in London, or other towns or districts in which similar conditions obtain.

It is recognized that, as regards main line traction, electricity has not as yet been largely adopted, and that America is no exception to this rule. Indeed, until such times as the services of the New York Central, New York, New Haven & Hartford and Pennsylvania are electrified, America will be behind Europe in this particular branch.

EXISTING MAIN-LINE ELECTRIFIED ROADS

In England, there are two railway companies, namely, the Lancashire & Yorkshire, and the North Eastern, which have electrified portions of their systems. In both these cases, the electrified lines are branches which are used for local traffic only, and over which there are few or no main line trains and very few goods trains. Both these cases are therefore very different from the conditions which would have to be met in the case of any main line London railway desiring to electrify a portion or the whole of its suburban system. The principal reasons which led to the electrification in the two cases mentioned were, probably, tramway competition, and the desire on the part of these companies to increase their traffic.

If we look to France, we again find only one case in which what we may call a main line has been electrified, namely, the Orleans line. Electrification in this case was brought about by the building of the new station at the Quay d' Orsay, which enabled the railway company to come nearer the center of Paris, and which is connected with older stations in the outskirts, by means of a practically continuous tunnel. Here electric traction had to be installed, as steam trains could not have been run, and so all trains on their approach to Paris are hitched to an electric locomotive, which brings them into the terminus; it is only recently that the lines have been prolonged so that suburban electric service can be operated over it. The only other line in Paris which has been electrified is a suburban branch line of the Western Railway of France going to Versailles. It has very little traffic.

As regards Berlin the case is different, as here the railways are owned by the Government, which has long been investigating the problem of haulage, not only in connection with suburban lines but also with main lines. All readers of the Street Railway Journal know of the very progressive series of tests of high-speed railways carried out between Berlin and Zossen.

If we look to Italy we have the two comparatively long lines between Milan and Varese over a portion of which main line services have to run, but the majority of which is practically purely suburban system with no main line traffic. The well-known Valtelina line is a line entirely operated by water power and is a mountain railway, and in both these cases electrification was the result of the Italian Government engineers deciding to investigate electric traction.

If we go to America, the reasons of the electrification of the New York Central are too well known to need much explanation. Here again, the company was practically forced to electrify in consequence of the long tunnel leading to the terminus. The same applies to the New York, New Haven & Hartford and to the Pennsylvania lines into New York. In other words, in all the chief cases of electrification of main line railways, it will be found that the railways were either forced to electrify because of special local conditions, or that electrification was due to Government initiative and carried out at Government expense. It will be easily realized that Governments are far more likely to enter into large expenditure for experimental purposes than private companies who have to earn a dividend and to satisfy their shareholders, but besides this there is the fact that railway companies are, as already stated, probably the most conservative bodies in the world and that it takes a great deal to convince and to prove to general managers, locomotive superintendents, or railway engineers who have not been educated in electricity, that electricity is capable of doing the work required of it.

The reasons which have hitherto been the main cause for, and in many cases compelled, the adoption of electric traction on railways will probably not be those which will chiefly weigh in the future with railway companies when considering the electrification of their suburban services. Our main line railways are not under any obligation to use electricity on their suburban systems, and the disadvantages, whether real or imaginary, possessed by any one system of electric traction, may seriously militate against its introduction on rail-

ways. It is therefore of interest to compare the three systems which are at present available for operating railways electrically, and the peculiar features which may render each suitable or objectionable from the railway manager's or railway engineer's point of view.

DIRECT CURRENT

As regards the direct current system, very little need be said, as it is well known to all readers of the Street Railway Journal. There can be no doubt as to its reliability and suitability for all purposes, no matter what the maximum speed to be obtained, or how high the desired rate of acceleration, or how heavy the weight of train to be hauled may be. But from a financial, and from the ordinary railway man's point of view, it possesses serious disadvantages when compared to the two other systems. It necessitates, in order to comply with the Board of Trade's regulations, not only a third rail, but in most cases a fourth rail as well, and if it is to be used on an extended system, all current has to be generated in the shape of high-tension polyphase currents, which have then to be transformed first to low-tension alternating currents, then to direct currents and finally distributed by means of low-tension conductors.

The capital cost of a complete direct current third rail system with high-tension three-phase transmission and rotary converter sub-stations is much greater than that of an equivalent single phase system and the operating costs are larger than in the case of a three-phase one. Some of the main items of the former are the cost of the additional current which has to be generated in the station, owing to the loss in transformation, as well as additional costs involved in operating and maintaining rotary sub-stations and interest on the greater capital involved.

It has been held by some that the cost of overhead construction used with single-phase high-tension railways is greater than the cost of installing the third and fourth rail, but such statements do not bear careful examination and, as far as Great Britain is concerned, where a fourth, as well as a third rail, is in most cases practically a necessity. It will be found that the cost involved by such a construction and by the necessary inter-connection between the different rails which must be effected, is, if anything, larger than the very best and most solidly designed overhead construction.

Even if the expense of construction and operation were of little importance there is another reason which militates seriously against the adoption of direct current and third rail by the main line railways of Europe for long distance service. The bulk of European railway engineers are opposed to the introduction of the third rail and, without going into the merits of this opposition, it will suffice to state that if a third rail were essential to the use of electricity on the majority of British railways, it is very problematical whether electricity would ever be introduced on a serious scale by most of our railways.

As long as there is a system which, while obviating the use of a third rail, possesses the following principal characteristics, it will be adopted by the railways in preference to the direct current one necessitating a third or fourth rail. The characteristics are:

Rapid acceleration from starting to maximum speed.

Reserve power and speed for making up lost time.

Simplicity and efficiency of equipment and economy in power consumption.

Ease of extension and adaptability to run over existing systems.

THE THREE-PHASE SYSTEM

The use of the three-phase system necessitates at least two overhead conductors which have to be insulated from each other, and which considerably increases the complications and cost of overhead work at crossings and turnovers. This disadvantage is comparatively unimportant on such a line as the Valtelina railway, which has no complicated junctions, but in cases such as would be met in some of the London stations, and on some of the London suburban lines, the disadvantages of such complications will at once become apparent. On account of the wires having to be insulated at crossings, it is not wise to exceed the pressure of 3000 volts, whereas, there are single-phase lines running to-day with a pressure on the trolley wire of 15,000 volts and no trouble has been caused thereby. It is quite possible that had no efficient and really satisfactory single-phase motor been evolved, railway companies in England might have been led seriously to consider, is not to adopt, the Ganz system instead of the direct current one. It is true that at the arbitration which was held to decide whether the Ganz three-phase concatenated system was to be adopted by the Metropolitan and District, or whether direct current and third rail were preferable, the decision was given in favor of the latter, but it is not to be forgotten that in this case all of the lines were practically in tunnel, which is not the case with the majority of suburban lines now considering electrification.

It is not proposed in this article to go into the technical merits or demerits of the three-phase system, the system itself being already sufficiently well known to the readers of the Street Railway Journal. Those, however, who wish to get further details and a more scientific comparison of the various systems of traction, should refer to the London "Engineering," of May 26, 1905, page 663 and 664. It may be mentioned in passing that one of the great claims made in favor of the concatenated three-phase system is based on the recuperation of energy, but, on careful examination of actual figures obtained, the claim does not seem to warrant very serious importance being attached to it. Furthermore, it may be mentioned that recuperation can be obtained quite as well with direct current motors, and that certain forms of single-phase motors also lend themselves to recuperation, should such be desired and found in practice to be satisfactory or advantageous.

In connection with this point it should not be forgotten that recuperation is essential to the Ganz system as, owing to the properties of the three-phase motors, their rheostatic losses at starting are so very great that, unless recuperation of energy were effected, the energy consumption per ton mile with this system would be so heavy as practically to put it out of consideration, as far as suburban traffic is concerned. This point leads us to another classification of alternating current motors as follows:—

(1). Motors which can recuperate during braking or when going down hill, but which are economical without recuperation.

(2). Motors which cannot recuperate except by the introduction of very considerable complications.

(3). Motors which must recuperate if they are to be operated economically.

The first of the above three types is represented by a compensated repulsion motor of the Winter-Eichberg type, as manufactured by the Allgemeine Elektricitäts Gesellschaft and Messrs. Lahmeyer. The second type is represented by what may be called, a "plain" series motor, as manufactured by the Westinghouse Company, Siemens-Schuckert, Dr. Finzi, the Oerlikon Company and the General Electric Company of America. The third type is represented by three-phase motors, and the arrangement adopted by Ganz & Company in the concatenated or cascade system of control.

It is not intended in this article to refer to the theory of the

different types of motors mentioned above; those who are interested in this particular branch should refer to the "Elektrotechnische Zeitschrift," No. 22, June 2, 1904, to a paper read by Mr. Karl Pichelmayer, of Berlin, and to an article by Dr. Eichberg in the same paper of Jan. 28, 1904, page 75, and to the many other theoretical papers on the same subject, which have appeared from time to time in the technical press, or to the papers read before the scientific societies. The two particular articles are only referred to as they treat particularly, clearly and completely the mathematical side of single-phase motors. Suffice it here to say, that as regards watt-hour consumption per ton mile under equal conditions of acceleration and load, such as are met with on ordinary suburban service on heavy railways, the single-phase motor, whether recuperating or not recuperating, compares more than favorable with the three-phase motor.

In this connection it must be distinctly understood that the whole discussion is one as regards the most advantageous motor to be used for handling suburban traffic, that is to say traffic which requires rapid acceleration and where running distances are short and stoppages numerous. In long distance traffic which, for the present at least, as far as Great Britain is concerned, does not seem likely soon to be operated electrically, different as well as additional factors will have to be taken into consideration, and the remarks which have been made as regards the three-phase system should in no way detract from the great credit due to the enterprising firm of Ganz & Company in installing the Valtelina line, and to the success which has crowned this enterprise.

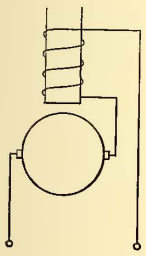


FIG. 1.—SIMPLE SERIES MOTOR

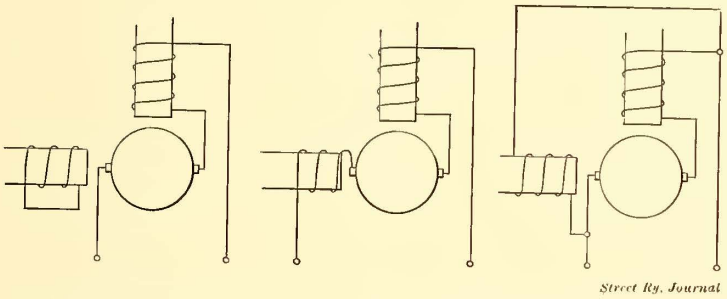


FIG. 2.—THREE FORMS OF COMPENSATED SERIES MOTOR

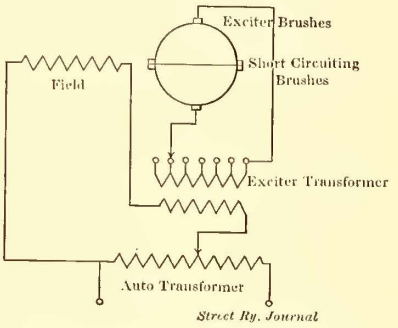


FIG. 3.—WINTER-EICHBERG COMPENSATED REPULSION MOTOR

SINGLE-PHASE MOTORS

Broadly speaking, there are at the present moment on the market, two definite types of single-phase motors, one designed, built and advocated by the Westinghouse, Siemens-Schuckert and General Electric companies, which may be called for the sake of briefness, the "plain series motor." This motor has been brought to a great state of perfection by the Westinghouse Company, and the general results obtained by its use seem to be excellent and appear to be in every way satisfactory.

The other type of single-phase motor may be broadly called the compensated repulsion type. The most satisfactory example of this type, up to the present, is the Winter-Eichberg motor, manufactured by the Allgemeine Elektricitäts Gesellschaft, the rights for which, in Great Britain, are owned by the British Thomson-Houston Company, who are the joint contractors with the A. E. G. for the electrification of the first portion of London, Brighton & South Coast Railway. A motor, much on the same lines, has also been put on the market recently by Messrs. Lahmeyer.

THE PLAIN SERIES MOTOR

This motor, as its name implies, is an alteration of the direct-current series motor, the alterations and additions being of a nature to reduce sparking at the commutator. As is well known, any ordinary series motor can be operated with single-phase current, and it is on this principle that Messrs. Deri and Lamme and Dr. Finzi started, having been followed by the General Electric Company of America and by Messrs. Siemens-Schuckert. The various devices which have been adopted for decreasing the sparking may be roughly divided into two categories, namely, the compensated coils method and the use of resistance in the armature circuit between the armature coils and the commutator.

The compensated coils may consist of short circuited windings on the stator, which was the arrangement first adopted by Deri some seven years ago, or an additional shunt coil on the stator, which in combination with the resistances between the armature windings and the commutator bars, is that which has been successfully adopted by Siemens-Schuckert. The Westinghouse Company improved the resistances by dividing them in such a way that each resistance only remains in circuit during the time that the commutator bar to which it is attached is covered by the brush. The Westinghouse Company has further introduced a compensated or neutralizing winding, which is in series with the armature and is reversed when the armature is reversed. In the case of the compensating shunt winding mentioned, it would appear that to make it in any way satisfactory, some regulation of this winding is necessary so as to insure the compensating field remaining always at right angles to the main field at all loads and speeds. Diagrammatically these arrangements as regards compensating are shown in Fig. 2.

THE COMPENSATED REPULSION MOTOR

Having briefly examined the connection and construction of the series motor, we will now as briefly investigate the compensated repulsion motor ; a diagram of the connections are shown in Fig. 3.

It will be seen from this diagram that the construction and connections of this motor are totally different from the plain series motor. The field winding can be entirely separated from the armature winding, and it is, therefore, possible, if it is wished, to wind the field in such a way that high-tension currents can be directly employed to excite it. The only low-tension current required to be taken from the line would then be that supplied to the exciting brushes on the armature.

In many cases it is preferable to use low-tension motors, in which case all the current required by the motors has to be transformed from the high pressure to the maximum low pressure usable just as in the case of the plain series motor. If high-pressure windings to the stator or field are adopted, only a comparatively small portion of the current, namely, that required for the exciter brushes, has to be transformed. In the case of low-tension motors series parallel controllers are used, the rotors being generally kept permanently in series, while the stators are first started in series and later on are put in parallel. The connections as proposed to be used

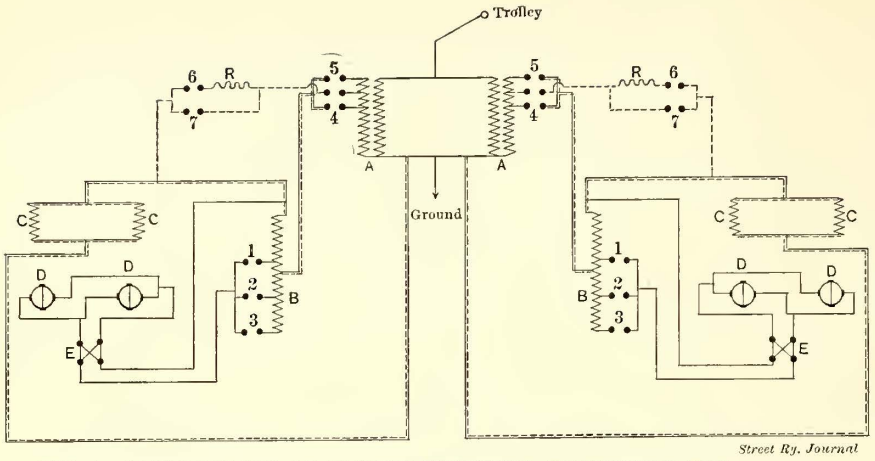


FIG. 4.—CONNECTIONS OF WINTER-EICHBERG EQUIPMENT FOR BRIGHTON & SOUTH COAST RAILWAY

A—Main transformer.
B—Exciting transformer.
C—Stator winding.
D—Rotor winding.
E—Reversing switch
1, 2, 3, 4, 5—Contactors.
R—Resistance.

Position of Controller	Contactors Closed
I.	4—2
II.	4—3
III.	5—1
IV.	5—2
V.	5—3

Motor equipment with regeneration shown thus —.—.—.
First braking position 6 is closed.
Second braking position 7 is closed.

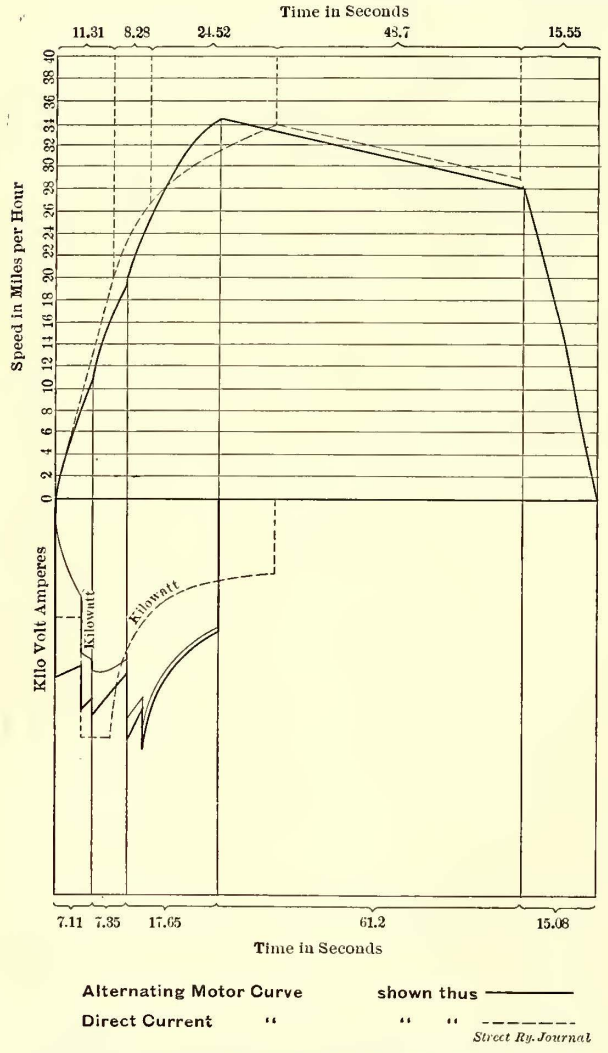


FIG. 5.—COMPARATIVE SPEED-TIME CURVES OF ALTERNATING AND DIRECT-CURRENT EQUIPMENTS

on the London, Brighton & South Coast Railway are shown in Fig. 4.*

* For diagram of the connections of the Winter-Eichberg equipment for the Swedish Railways, see Street Railway Journal for March 31, page 488.

CHARACTERISTICS OF THE SINGLE-PHASE EQUIPMENT

Before describing some of the single-phase motors which have been made on this side of the Atlantic, it may not be out of place to see how far the single-phase motor is suitable for operating suburban trains, as there still appear to be many engineers who are of the opinion that, while single-phase traction may with advantage be used for long interurban roads and over those lines where rapid acceleration is not of primary importance, it is not suitable for handling suburban traffic where rapid acceleration is of vital importance. In this connection the decision of the officers and directors of the Brighton Railway Company to adopt the single-phase system of haulage, after the most careful investigation, is of great importance, especially as the conditions which the railway company required to be fulfilled were probably among the most stringent that have ever been issued, and the guarantees which are required from the tenders were of the most far reaching character, and

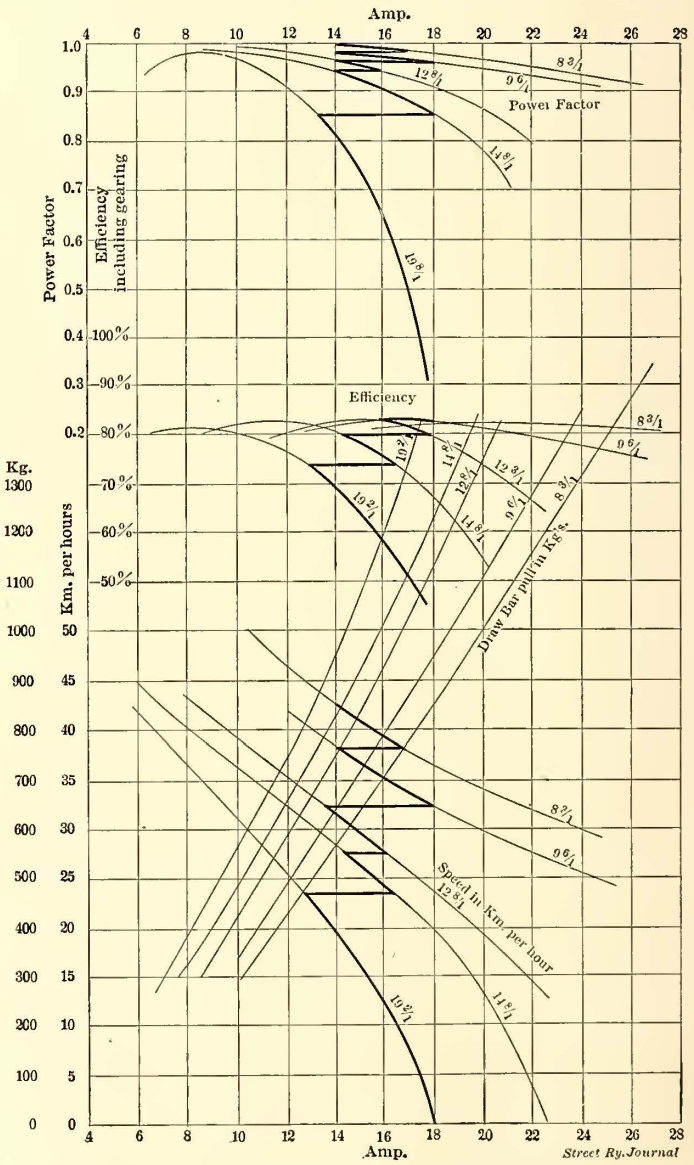


FIG. 6.—CURVES OF WINTER-EICHBERG 6000-VOLT, 25-CYCLE MOTOR

every guarantee given had to be based upon actual experimental results.

Figs. 5 and 6 show two diagrams which have been compiled from experimental data; both show the running of a three-car train through a distance of 1225 meters on a level and straight track. Each train was composed of two motor cars and one trailer car, and was propelled by eight motors. The only difference was that one train was operated by direct current and the other by single-phase current. The comparative weight and the result obtained are given below:

	Direct Current	Single-Phase
Weight of three-car train including 220 passengers	110 tons	117 tons.
Add for revolving motors	9 per cent.	11 per cent.
Gear ratio	1 to 3.5	1 to 3.7
Average power factor		0.85
Watt hours per ton kilometer	44.6	45.2 (41.3) if regenerating
Efficiency	72.8 per cent.	72 per cent.

But the curves of the performance of the two trains show far more than would be apparent from the above table, and clearly demonstrate the advantage of the use of a properly designed single-phase motor as regards acceleration. From them it will be seen that whereas with a direct-current motor it took 44.11 seconds to reach a speed of 34 m. p. h., with a single-phase motor equipment 34½ m. p. h. were reached in 32.11 seconds. The curves also show that in the case of a direct-current motor the acceleration is only fairly constant for about half the total period of acceleration, after which it rapidy falls off, whereas, in the case of the single-phase motor the acceleration is practically constant throughout the whole period of acceleration. Fig 6 gives efficiency, speed and power factor curves of the W. E. I. single-phase motor used in this test. The dark lines indicate the different transformer ratios employed to obtain the different speeds. The diagram given for the direct-current train were calculated for

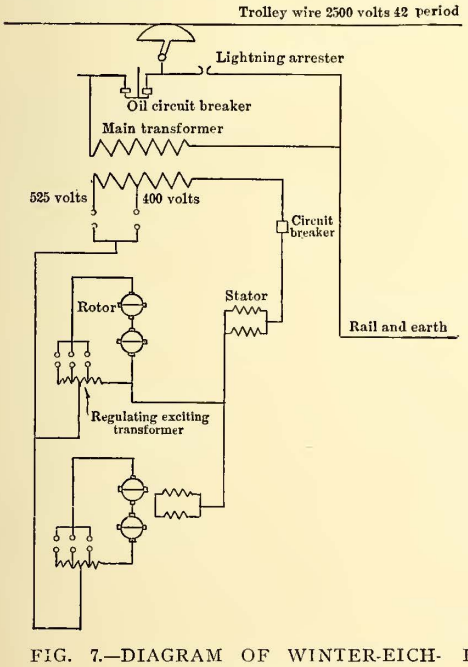


FIG. 7.—DIAGRAM OF WINTER-EICHBERG MOTOR CONNECTIONS ON STUBAITHAL BAHN

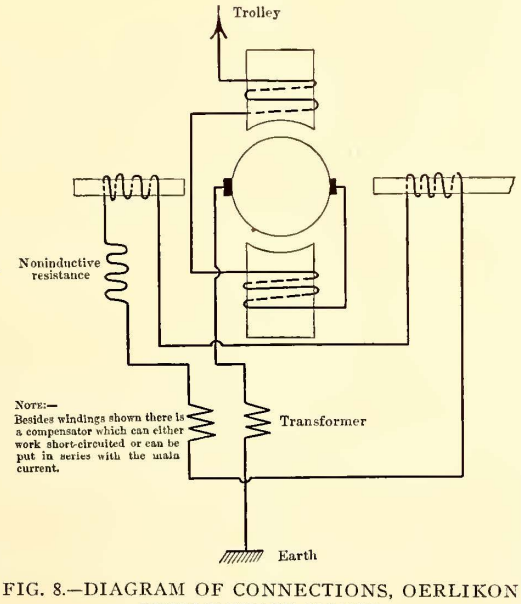


FIG. 8.—DIAGRAM OF CONNECTIONS, OERLIKON SINGLE-PHASE MOTOR

eight GE 66 motors, manufactured by the Allgemeine Elektricitäts Gesellschaft. The single-phase diagram includes eight W. E. I. Winter-Eichberg motors.

It will be seen that the maximum kw is somewhat greater in the case of a single phase than in direct current, but it will be observed that this maximum comes at a later stage than in the case of the direct current and that the result of it is a higher rate of acceleration during the final period of acceleration. The diagram clearly proves that the single-phase motor is eminently suitable for heavy traffic and rapid acceleration, or, in other words, for handling suburban trains.

Having considered both the general question of electric traction on railways, and also what particular type of motor, at any rate as far as Great Britain is concerned, may be expected to be the one which will be most generally adopted, a summary of the heavy traction work which has so far been carried out in Europe may not be out of place.

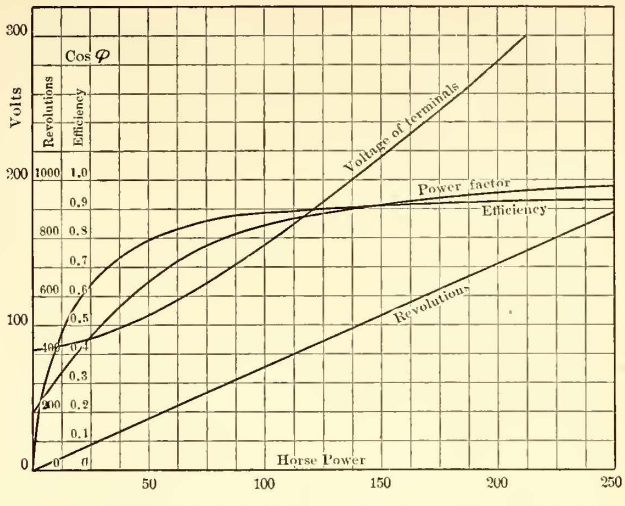


FIG. 9.—CHARACTERISTIC CURVES, OERLIKON 200-HP SINGLE-PHASE MOTOR

Apparently, with the exception of Mr. Westinghouse and the New York, New Haven & Hartford Railway, the majority of American engineers seem still to be greatly in favor of continuous current for traction work on suburban railway lines, and considering the results this motor has yielded in America, it is, perhaps, not to be wondered at. Single-phase traction in America has certainly advanced, as the length of the lines carried out on this system by the Westinghouse and the General Electric Company show, but, unfortunately, most of these lines would appear to be long distance or interurban lines, or light railways, and, therefore, do not attract the attention of many of the well-known engineers. The case of the New York, New Haven & Hartford Railway is also different, as this railway company has decided upon the use of locomotives, and, as far as the writer can gather, is thus quite different from the electrification of heavy suburban lines running motor car trains at frequent intervals on this side of the water. No doubt American engineers and railway men will now watch the results which will be obtained in London and Hamburg with as keen an interest as European engineers have, in the past, anxiously awaited results of the electrification of lines, such as the Manhattan Elevated and others.

LIST OF EUROPEAN ELECTRIFIED MAIN LINES

The following is a list of practically all of the main railways in Europe which have been electrified. This list gives the subway lines in London but does not include mountain

railways, the London tube railways, or the elevated and underground railways of Paris, Berlin or Budapest.

ENGLAND

Lancashire & Yorkshire, Liverpool & Southport division; length of route, 23.5 miles.[1]

SINGLE-PHASE CAR OF MURNAU-OBERAMMERGAU RAILWAY

Northeastern Railway, Newcastle branch; length of route, 82 miles.[2]

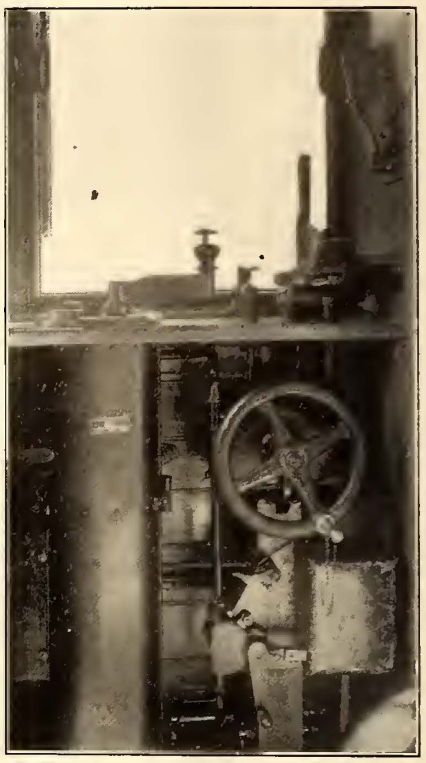
Mersey Tunnel, length of route, 4.6 miles.[3]

Metropolitan District of London, length of route, 24 miles.[4]

Metropolitan Railway of London, length of route, 79 miles.[4]

ITALY

Italian Government Railway, Milan-Gallarate-Varese, length of route, 45 miles.[9]



SINGLE-PHASE MASTER CONTROLLER IN CAB OF HAMBURG CAR

Italian Government Railway, Lecco-Colico-Chiavenna, length of route, 67 miles.[10]

Of the above the last is equipped with three-phase apparatus and the Hamburg railway with single-phase apparatus. The others are all direct-current roads.

SPINDLERSFELD EXPERIMENTAL SINGLE-PHASE MOTOR CAR

FRANCE

Western Railway of France, Paris-Versailles, length of route, 11 miles.[5]

Orleans Railway, Paris-Juvisy, length of route, 12 miles.[6]

GERMANY

Berlin-Grosslichterfelde, length of route, 5¾ miles.[7]

Prussian State Railway, Hamburg, length of route, 15 miles.[8]

The following is a list of the principal single-phase roads in Europe, in operation or course of construction:

[1] See Street Railway Journal for Jan. 30 and April 2, 1904

[2] See Street Railway Journal for June 20, 1903.

[3] See Street Railway Journal for April 4, 1903.

[4] See Street Railway Journal for March 4, 1905.

[5] See Street Railway Journal for Nov. 15, 1902, and May 20, 1905.

[6] See Street Railway Journal for Nov. 15, 1902; Feb. 28, 1903; Aug. 6, 1904, and May 20, 1905.

[7] See Street Railway Journal for Sept. 7, 1901, and June 7, 1902.

[8] See Street Railway Journal for March 17, 1906.

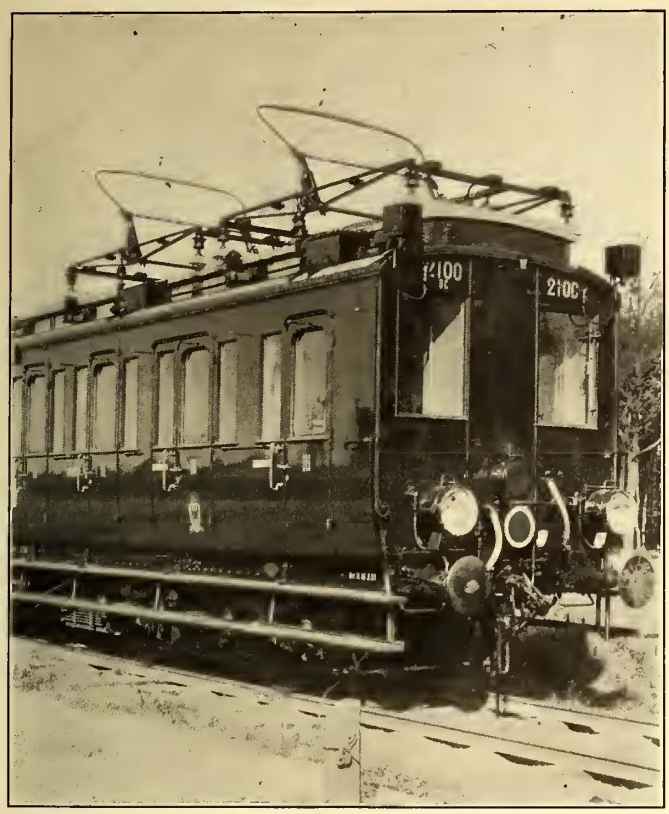
[9] See Street Railway Journal for Nov. 24, 1900; Aug. 3, 1901; Dec. 6, 1902, and May 13, 1905.

[10] See Street Railway Journal for May 2, 1903; April 1, Aug. 5, and Aug. 26, 1905.

Belgium.—Société Nationale des Chemins de Fer Vicinaux, Borinage division.[11]

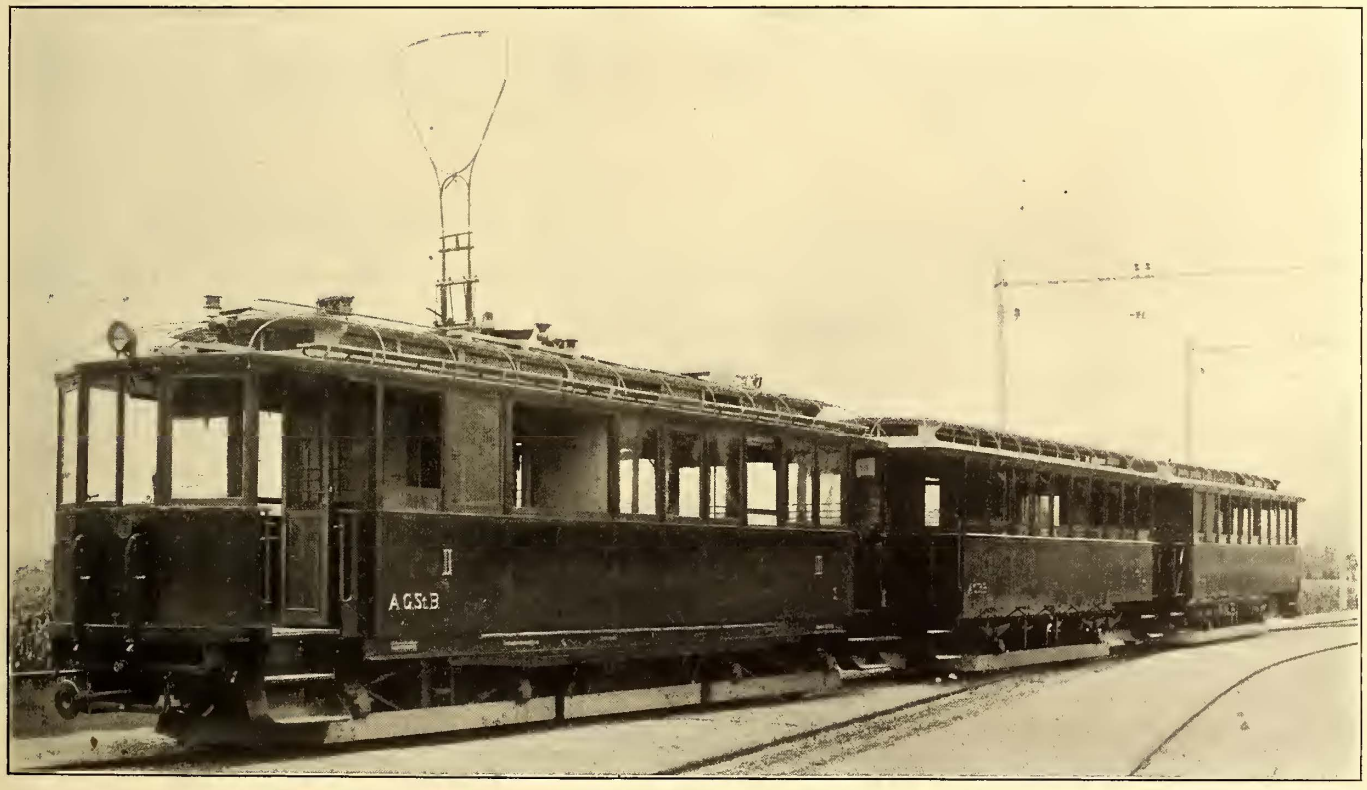
Germany. — Spindlersfeld - Oberschoenweide.[2] Oberammergau.[13] Hamburg.[8]

Italy. — Bergama-Valle Brembana. Rome-Civita Castellana.



END VIEW OF HAMBURG SINGLE-PHASE CAR, SHOWING ARRANGEMENT OF CURRENT COLLECTORS

CHEAP FORM OF BRIDGE OVERHEAD CONSTRUCTION, STATION OF STUBAITHAL SINGLE-PHASE RAILWAY



SINGLE-PHASE TRAIN ON STUBAITHAL BAHN, SHOWING PROTECTIVE STRIPS ON ROOF

Switzerland. — Seebach-Wettingen.[14] Simplon tunnel.[15]

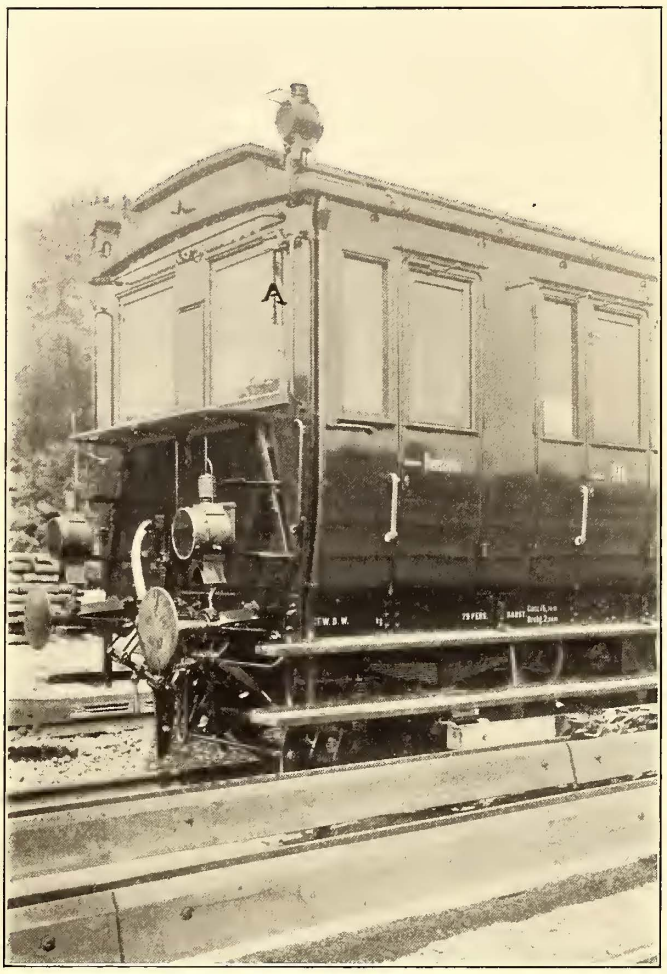
Austria.—Stubaithal.[12]

Sweden.—Government Railways.[16]

[11] See Street Railway Journal for Sept. 16, 1905.
[12] See Street Railway Journal for Nov. 26, 1904.
[13] See Street Railway Journal for April 1, 1905.
[14] See Street Railway Journal for Nov. 26, 1904; April 8, 1905, and Feb. 24, 1906.
[15] See Street Railway Journal for Jan. 6 and Feb. 24, 1906.
[16] See Street Railway Journal for March 31, 1906.

DETAILS OF EQUIPMENT

Views of several of these recent installations are presented herewith. Attention might be called to one or two features in connection with these cars, which has, perhaps, escaped mention in the descriptions which have been published of



FRONT END OF GROSS LICHTERFELDE CAR, SHOWING WINDOW CLEANER AT *A*

their electrical equipment. One is the metallic hoops and guards on the top of the cars, all properly earthed, to provide against any possibility of the wiring coming down and injuring the passengers. This is particularly noticeable in the Stubaithal, Oberammergau and Spindlersfeld cars. Another illustration shows the motorman's compartment in the Hamburg-Blankenese car. This compartment is fitted with a seat accommodating three passengers, and when this compartment is not being used for driving purposes, the controller is shut off by means of a door. Electric head lights are fitted to the car and a very neat arrangement is used for keeping the window clean in case of wet weather. This is an arrangement which is used in Germany and it is more clearly seen on the photograph of the Lichterfelde car, which is operated by direct current and which was equipped by the Union Company some time ago. The letter "A" indicates the squegee, which is a lever operated from within the cab and which cleans off any moisture which may have accumulated on the sash.

CAR DESIGN

Having now considered the general condition in connection with the introduction of electric traction on main line railways, and also considered what the conditions are which will effect the use of electricity under different conditions of railway traffic, a brief consideration may perhaps be given as to what type of carriage, at least as far as Great Britain is concerned, will probably be found to be the most useful for handling the suburban traffic of our main line railways. The following classification may be of assistance in considering this question:

Main Classification	Sub-Classification
(1) Carriages with end doors only, being originally American and Swiss Standard practice.	(a) Side seats only, with large space between seats for standing room. (b) Transverse seats with passages down center. (c) Combination of the two types, side seats at end of car, allowing standing room at either end. Transverse seats in middle of car with narrow passage between them.
(2) Side doors along the whole of the coach.	(a) Transverse seats with passage through middle. (b) Transverse seats in the middle of the carriage with passage at either side. (c) Transverse seats at one side of the carriage with narrow passage at other side.
(3) Combination of above two, with end doors and center doors.	(a) Side seats with big standing room between seats as well as standing room at end doors and central doors. (b) Transverse seats or combination transverse and side seats with standing room in middle.

The diagram, Figs. 10 and 11, gives a good idea of the above-named arrangements.

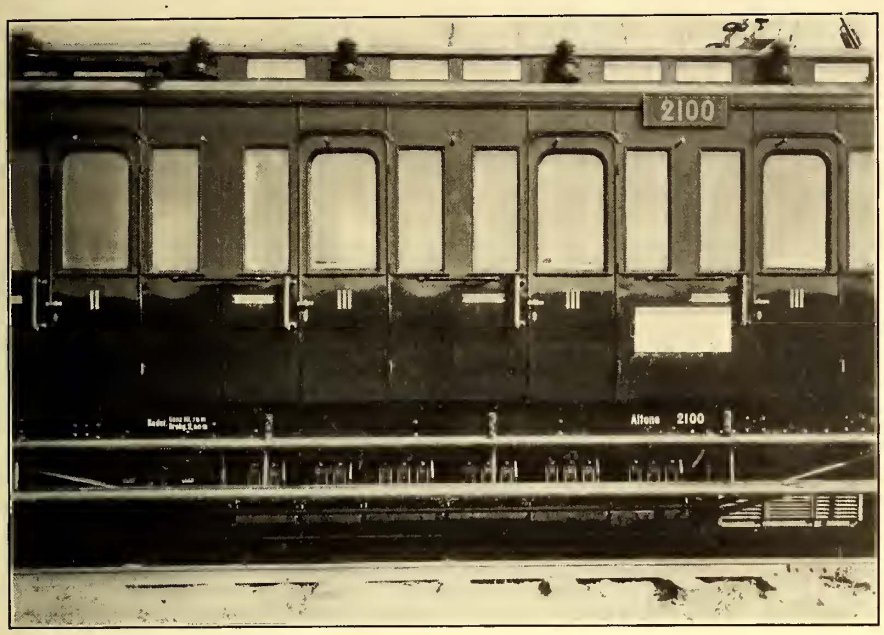
The first class is that which so far has been generally adopted in America, and which has also been employed on a great many of the London tube lines. The second class is one which is known in America as the "Illinois Central," and

MOTORMAN'S CAB ON GROSS LICHTERFELDE CAR, SHOWING WINDOW CLEANER AT *A*

which also finds favor on the Continent of Europe. The third class has been adopted by both countries.

In ascertaining what type of car is most suitable for su-

burban lines, the conditions which obtain must not be lost sight of. The principal one is that the main stations in London are practically all terminal stations, and that during the rush hours of the day at these termini, the train has to be practically completely emptied and filled in the shortest possible time. These conditions are totally different from those

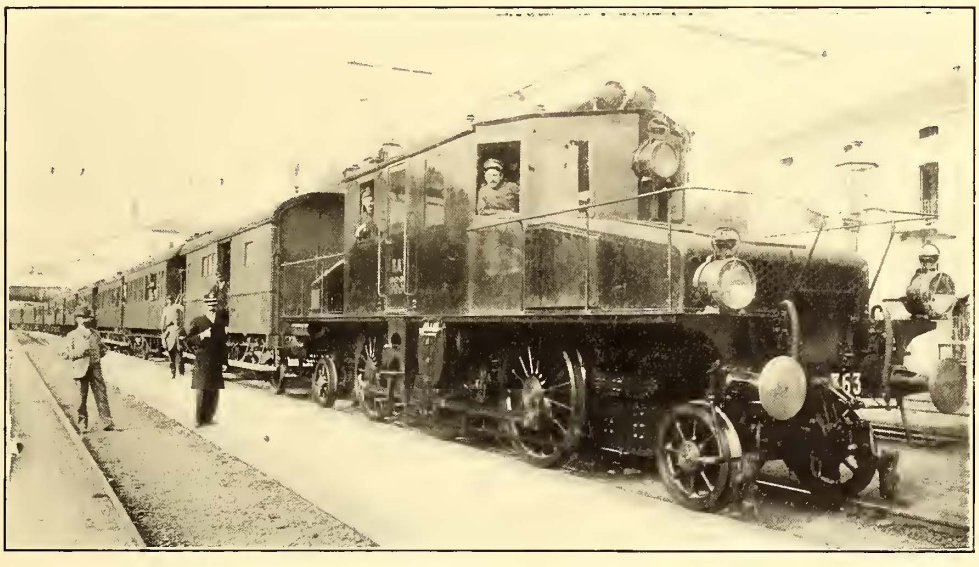


SIDE VIEW OF HAMBURG SINGLE-PHASE CAR, SHOWING CONTACTORS

met on the London tube lines and elevated roads in New York, where there are several stations at which passengers get in and out. The addition of a central sliding door has been made to assist the rapid unloading, the arrangement generally adopted being that passengers get out at the central side door and new passengers enter the car by the end doors. This is the system adopted by the Metropolitan District Railway in London, but it does not appear to be very favorably viewed by the English traveling public. Undoubtedly, in the conditions mentioned above, which exist with suburban traffic on main lines, side doors the whole length of the coach, as in the Illinois Central, are desirable. This system, however, presents certain disadvantages, in that side doors are more difficult to keep air tight and cause draught, also that in order to be satisfactory they should be worked by compressed air, which calls for a considerable amount of extra capacity of the compressors. It has been found in practice that the amount of air to work the side doors in some cases has to be even greater than the amount required for braking purposes.

The necessity of using sliding doors instead of swinging doors is in consequence of the very rapid acceleration which is rendered possible by the adoption of electric traction, otherwise the ordinary swinging doors would certainly appear to be preferable. In this connection there is a great advantage resulting from the use of single-phase motors, as by this system the acceleration can be so graduated that for the first few hundred feet it can be kept low enough to allow the doors to be closed by a person standing on the platform. The rate is then rapidly increased and kept practically constant until the end of the period of acceleration. Experiments which the writer has recently been able to conduct on d. c. and single-phase railways shows this very clearly. Thus, while the average acceleration for single phase during the whole period of acceleration is 1 mile per hour per second, the acceleration for the first couple of hundred feet or so, is under 1 ft. per second per second, rising rapidly after that till it reaches the neighborhood of 2 ft. per second per second. This latter rate is kept up till the end of the period of acceleration. On the other hand, with d. c. motors acceleration at the commencement is between 2 ft. and 3 ft. per second per second, rapidly falling afterward to under 1 ft. per second per second. The use of the single-phase motor, therefore, enables railway managers simply to consider the convenience of their passengers and to utilize that acceleration which, from the passengers' point of view, is the most suitable.

Under these circumstances there seems little doubt but that the type of suburban carriage finally adopted by the Prussian State railways will best meet the requirements. This type is shown in one of the plans accompanying this article, from which it will be seen that the train will consist of two classes, each class being again sub-divided into smokers and non-smokers. The carriages are arranged similarly to the ordinary type of English carriage, with side seats a narrow passage being provided at one end, so that any passenger getting into the compartment and finding it full can pass through this narrow passage and find a seat in another compartment.

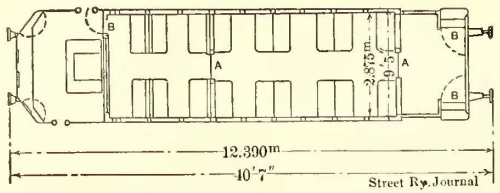


EXPRESS PASSENGER TRAIN ON VALTELLINA RAILWAY, WITH NEW LOCOMOTIVE

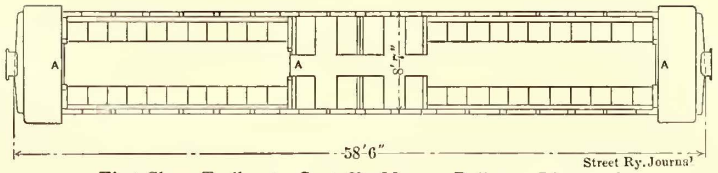
It may be contended by some that this takes away from the carrying capacity of the car, owing to the fact that one seat is taken away, but, as a matter of fact, the real carrying capacity is increased because three passengers are able to stand in the room which would otherwise be occupied by two seats.

CONCLUSIONS

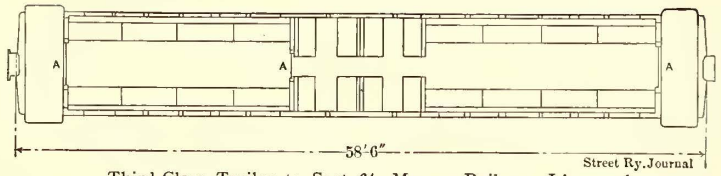
A careful survey of the present traffic conditions existing



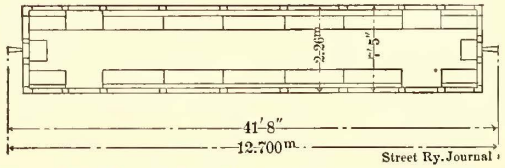
Motor Car to Seat 36, Paris-Lyon-Mediterranean Ry.



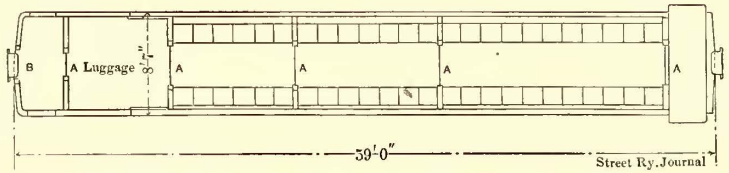
First-Class Trailer to Seat 60, Mersey Railway, Liverpool



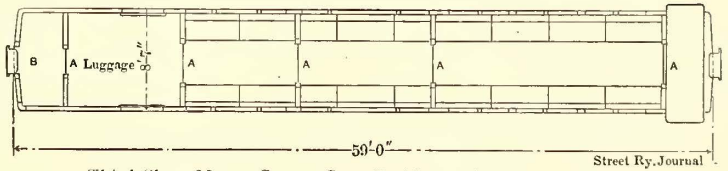
Third-Class Trailer to Seat 64, Mersey Railway, Liverpool



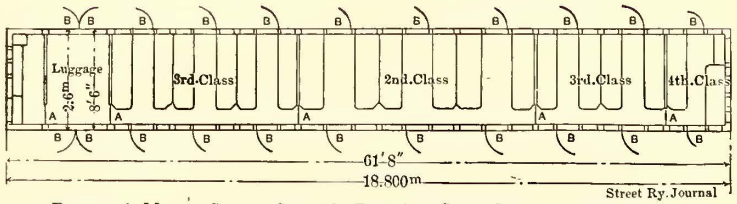
Trail Car to Seat 44, Berlin Elevated Railway



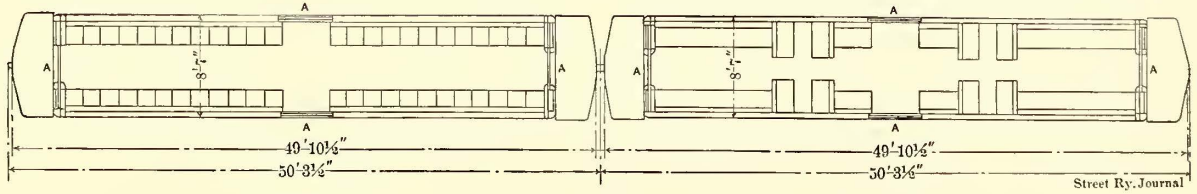
First-Class Motor Car to Seat 48, Mersey Railway, Liverpool



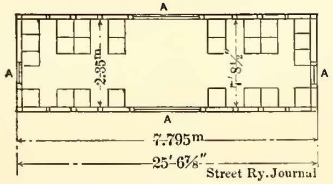
Third-Class Motor Car to Seat 50, Mersey Railway, Liverpool



Proposed Motor Car to Seat 73, Prussian State Railways, Hamburg

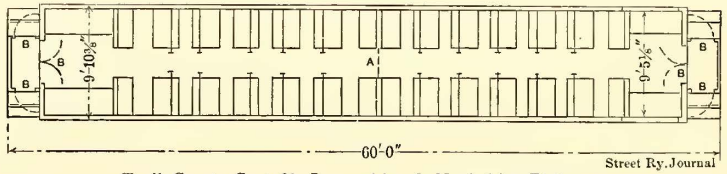


Motor Car to Seat 48, and Trail Car to Seat 52, London Underground Electric Railway

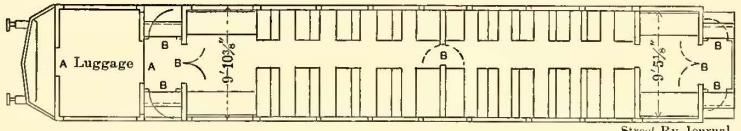


Trail Car to Seat 26, Paris-Metropolitan Electric Railway

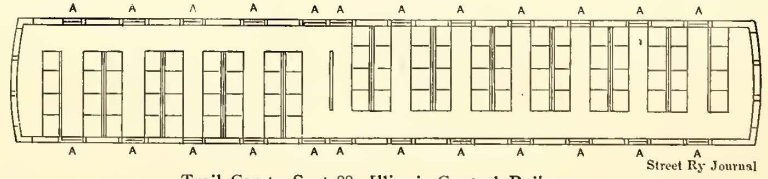
Note.—*A* indicates sliding door.
B indicates swing door.



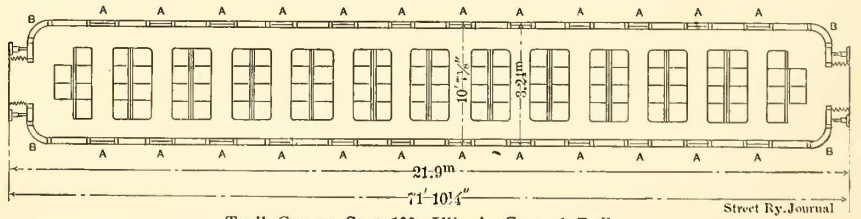
Trail Car to Seat 66, Lancashire & Yorkshire Railway



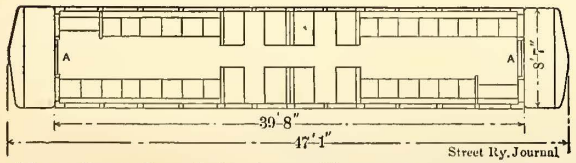
Motor Car to Seat 69, Lancashire & Yorkshire Railway



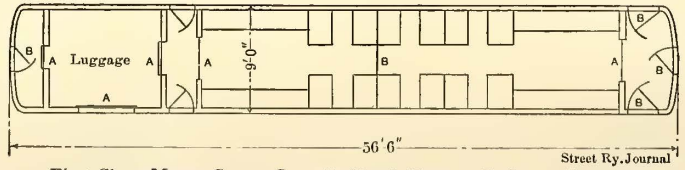
Trail Car to Seat 88, Illinois Central Railway



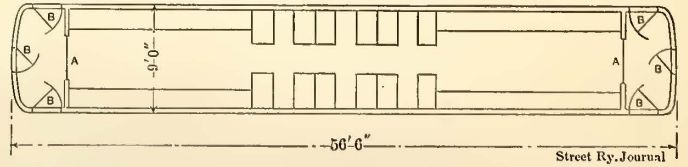
Trail Car to Seat 100, Illinois Central Railway



Motor Car to Seat 48, Manhattan Elevated Railway, New York



First-Class Motor Car to Seat 48, North Eastern Railway, England



Third-Class Trail Car to Seat 70, North Eastern Railway, England

FIG. 10.—DIAGRAMS COVERING THE DIFFERENT CLASSIFICATIONS OF MOTOR AND TRAIL CARS USED ON AMERICAN AND EUROPEAN STEAM AND ELECTRIC RAILWAYS IN CITY AND SUBURBAN SERVICE

in and round our large towns clearly shows that the suburban railway systems must be operated electrically within the next few years and the fact that one of the principal English railways, having termini in London, after most careful consideration, has finally decided to electrify its suburban system, upholds this view.

Besides the disadvantages of the third rail and the greater

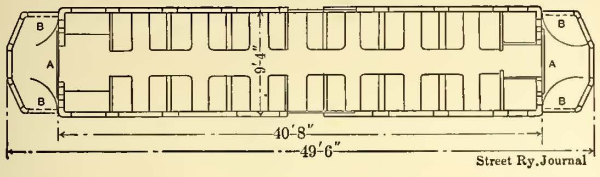
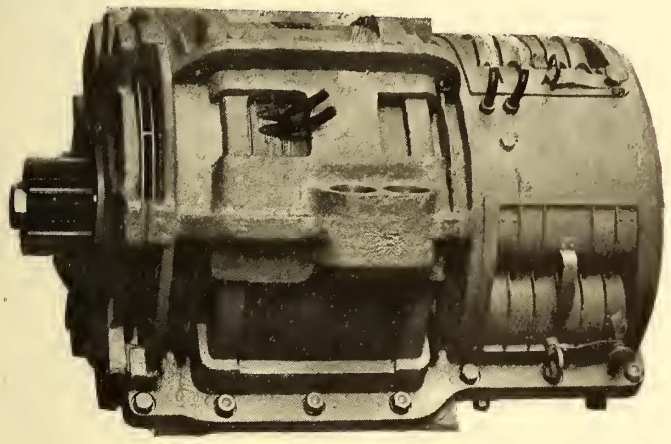


FIG. 11.—MOTOR CAR TO SEAT 58, GREAT NORTHERN & CITY RAILWAY, LONDON

costliness of direct current, as compared to single-phase current, this latter presents so many advantages that it would appear to be the only system which with our present knowledge will fill nearly all the requirements of railway men, and



HAMBURG SINGLE-PHASE MOTOR

is, therefore, the most suitable for handling the suburban traffic of our main line railways.

Electrification of main lines, as far as long distance and goods traffic is concerned, may be made under special circumstances but does not appear to be likely to be adopted in the near future, as far as Great Britain is concerned.

THE FIRST ELECTRIC RAILWAY IN BOLIVIA

A few months ago there was inaugurated by the Bolivian Government, at La Paz, Bolivia, the Bajada Extension of the Ferro-Carril de Guaqui á La Paz (Guaqui-La Paz Railroad), a meter-gage road operating between these two towns. This road is the first electric railway in Bolivia, and probably is the highest in the world. The extension completes the chain of communication by railroad and steamship between La Paz and the port of Mollendo on the Pacific Coast, and has already proved itself to be an important link in this chain. Almost all of the Bolivian importations enter at Mollendo and are shipped over the Southern Railway of Peru to Puno, on the Peruvian side of Lake Titicaca, the highest lake in the world, (12,500 ft. elevation). Transhipment is made across the lake to Guaqui, Bolivia, and from here over the Guaqui-La Paz Railroad to the "altos" (13,400 ft. elevation) overlooking the city of La Paz, the central plaza of which is 1500 ft. below. The only approach to the city is from above, and formerly all goods were carried from the railway terminus to the city by mule teams, and passengers traveled by coach, a distance of some eight kilometers, over a bad road.

The lower terminus of the Bajada Extension is located about one kilometer from the center of the city, and the power house and car house about 1½ kilometers along the road. The present equipment consists of two 150-kw General Electric railway generators, belted to Premier gas engines furnished by the Power Gas Corporation, of England. The mond gas producer is used. The generators are provided with collector rings to give a three-wire 250-volt distribution for lighting purposes during the night.

The rolling stock consists of two Brill cars for first-class passengers, two Brill cars for second-class passengers, each of which is mounted on Brill 21-E trucks and fitted with double motor GE-53 equipments; and one Brill 25-ft. vestibule baggage and express car, mounted on Brill 27-G trucks and fitted with four-motor GE-53 equipments.

The service required of the cars, when not carrying passengers or baggage, is that of taking up and down the "bajada" the freight cars of the steam road. For this purpose the platforms and bumpers were made stronger than usual. As practically all the goods traffic of La Paz is inward, the work resolves itself into holding back loaded cars on the down grade and drawing empty cars on the up grade. Each passenger car can draw one trailer up the hill and the baggage car two trailers. The downward journey is a question of brakes, and to hold back the trailers, the electric cars are equipped with Stirling power brakes, and air compressors, the latter operating Westinghouse air brakes on the freight cars. It was also desired to have track brakes, but the crowded condition of the bottom of the car, due to the narrow gage, made this difficult.

The road itself, throughout the entire length, is a series of curves. In fact, the longest piece of straight track is only about 1000 ft. Added to this, there is an almost continuous grade of 6 per cent from the lower end of the line to the railroad station on the "alto." The road is single track, overhead trolley construction, and although the station on the "alto" is only about 2 kms from the lower station, the 1500 feet difference in level necessitates a tortuous route almost 9 kms in length.

The entire full load capacity of one generator is taken in sending the baggage car with two empty trailers up the hill. The line is divided into two sections, a 300,000-C. M. feeder from the power station being tapped in the middle of the upper section.

The successful culmination of the Bajada Extension is due to the initiative and untiring efforts of T. Clive Sheppard, who, as Director General of Public Works, gave much of his personal attention to the matter. The electrical equipment and cars were furnished through W. R. Grace & Company, Lima, Peru, agents for the General Electric Company, on the West Coast of South America. The plant was installed by N. Coe Stewart.

Conspicuous signs in St. Louis cars will soon inform all passengers that the city ordinances provide "Ten Dollars Fine for Spitting on the Floor of This Car." The politely worded signs now displayed, stating that "The Ordinances and Decency Prohibit Spitting on the Floor of This Car," have not had the desired effect and the Board of Health has decided to lay down the law in more direct and vigorous fashion. A letter to the board from the Suburban Railroad Company, signed by Julius S. Walsh, president, says the company will do anything asked to aid in carrying out the order. This, it is expected, will take the form of an order to conductors to cause the arrest of passengers who violate the rule.

THE PENNSYLVANIA RAILROAD'S EXTENSION TO NEW YORK AND LONG ISLAND—THE LONG ISLAND CITY POWER STATION

A short account was published in the Street Railway Journal for Nov. 4, 1905, of the electrified section of the Long Island Railroad. Current for the operation of this line is obtained from a large power station now being erected by the Pennsylvania Railroad Company. This station will also supply part of the power for the New York terminal, and will have capacity for emergency operation of the entire tunnel system and the electrified system of the Long Island Railroad.

Two companies have been incorporated through which the Pennsylvania Railroad Company is carrying on its New York extension work. One of these, the Pennsylvania, New Jersey & New York Railroad Company, will build all of that portion of the tunnel and approaches in the State of New Jersey and extending under the Hudson River to the boundary line of the States of New Jersey and New York; from this boundary the other, the Pennsylvania, New York & Long Island Railroad Company, will construct the tunnels, terminal station and yards on Manhattan Island, under the East River and in Long Island City. The officers of these companies are the officers of the Pennsylvania Railroad Company, the president being A. J. Cassatt. The engineering and architectural features are sub-divided in accordance with the character of the work, the whole project being under the general direction of the management of the Pennsylvania Railroad Company.

The tunnel work proper is divided into two parts; the East River Division being under the direct charge of Alfred Noble, chief engineer, and the North River Division under the direct charge of Charles M. Jacobs, chief engineer; the general railroad facilities and the electrical and mechanical features of the railroad and terminal are under the charge of George Gibbs, chief engineer of electric traction. These three officials, together with Brigadier General Charles W. Raymond, chairman, constitute a board of engineers to whom the general engineering features of the whole plan are confided.

Westinghouse, Church, Kerr & Company have been selected as engineers and contractors for the electrical and mechanical engineering, acting under the supervision of the chief engineer of electrical traction.

LOCATION AND CAPACITY

The Long Island City power station, already mentioned, adjoins the Long Island Railroad passenger and freight stations and is close to the East River. It contains at present three 5500-kw steam turbines and generators, a size which has been adopted as standard for future work. The station is designed so that it can accommodate within its present walls six generating units of this size and two of 2500 kw for lighting the tunnels. The ultimate capacity when extended will be about 105,000 kw in electrical machinery.

FOUNDATIONS

The site was formerly under water and had only been filled in to an extent that brought the surface about 1½ ft. above the extreme high water. A series of borings showed that the soil consisted of from 10 ft. to 15 ft. of loose fill and river mud overlying successive strata of clay, sand and gravel, with rock being struck at a depth of 35 ft. to 60 ft. below the level of the street. In the design of the foundation due consideration was given to several different methods and it was finally decided to use a comparatively uniform spacing of piles overlaid by a monolithic concrete mass of a thickness which should take up the distance between the point at which the piles could be safely cut off and extreme high water. Test piles indicated a safe carrying capacity for piles from 30 ft. to 35 ft. long, of 13 tons to 20 tons, varying on different parts of the site. The foundation was designed to carry a load of 12 tons per pile, and the spacing of the piles is on an average, 2 ft. 4 ins. between centers over the entire area. The total number of piles required for the foundation was 9115. Underneath the stacks the concrete cap is 8 ft. 6 ins. deep, the piles being cut off 2 ft. lower down. The stack

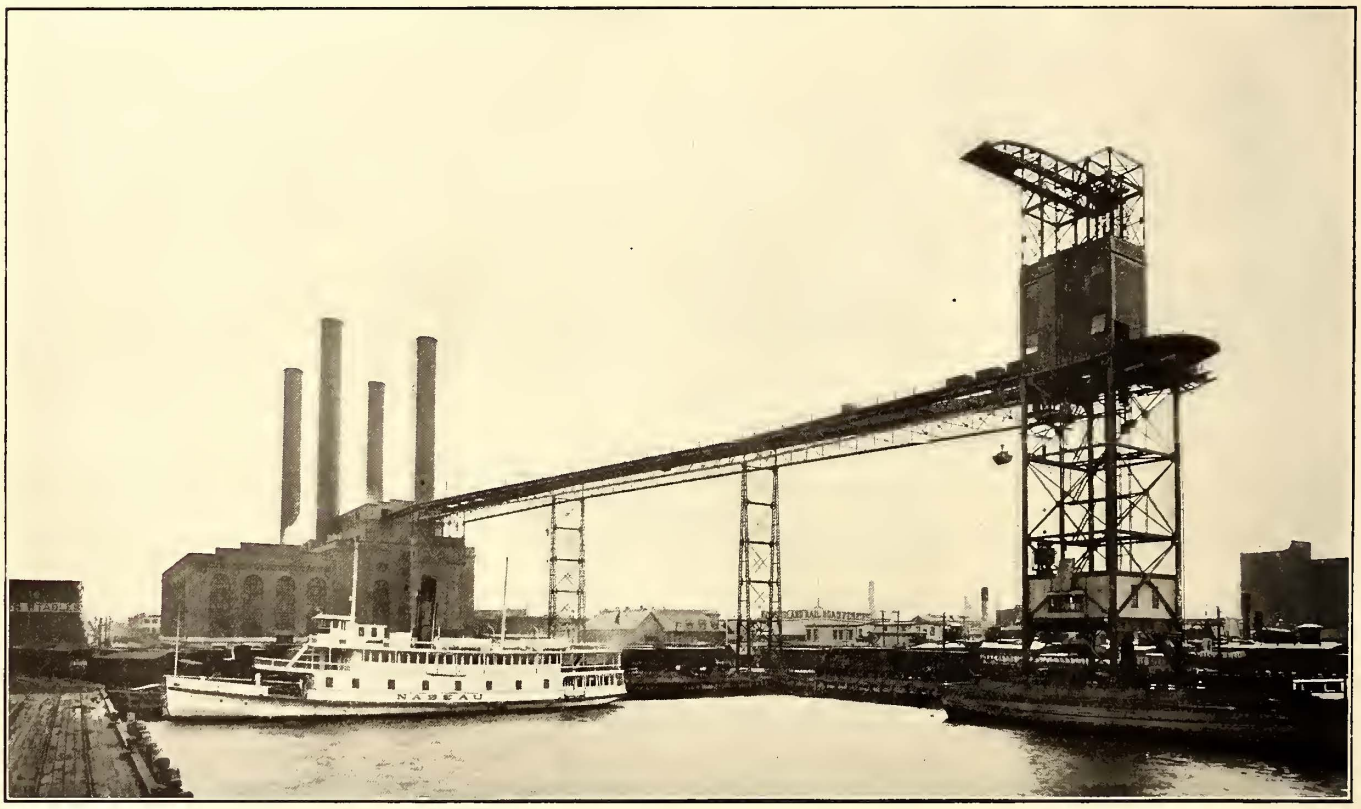


FIG. 1.—POWER STATION FROM RIVER, SHOWING COAL TOWER IN OPERATION

anchor bolts pass through a grillage of steel T-rails, embedded in the bottom of the concrete.

INTAKE FLUME

The flume for the condenser intake, and the overflow flume directly above it, traverse the building foundations completely from west to east, and are integral with it, as is shown by the cross section given in Fig. 4. Both the intake and the overflow flumes are nominally 10 ft. in diameter, this large sectional area being required to provide sufficient condensing water with a low velocity of flow when the power station is extended to its maximum future length of 500 ft. and filled with generating machinery. The elevation of the intake flume is such that it is always submerged.

At the bulkhead line, the intake is provided with an ice fender, extending to a point below the extreme low water, to prevent a boat that may be lying against the face of the timber rack from packing ice against it and stopping the water supply. This timber rack extends from the bottom to the top of the intake opening, and it is built of 3-in. x 10-in. yellow pine timbers spaced 4 ins. apart in the clear. The face of the rack is inclined, so that floating objects drawn in by the current can be easily removed. Behind the rack is a screen chamber or well, with two sets of screens fitted in vertical cast iron guides. Each set of screens is built in three parts, placed one above the other in the same groove, made up of oak frames and brass fittings, and on the front of the bottom rail of each section is a catch basket to retain falling objects when the screen is drawn up for cleaning or inspection. The outside screen is of iron wire, 1 in. mesh, and the inside screen is of No. 10 gage copper wire, ½-in. mesh. A trolley beam and chain block are provided over the screen well to facilitate lifting out the screens and removing debris from the baskets. It was also decided to place a 30-in. connection from the overflow into the screen chamber, so that under severest winter conditions warm water might be run through on to the screen to prevent an accumulation of ice within the intake chambers. It is not probable that it will be necessary to use this connection a great deal, but it is so placed that, even with a moderate load on the power plant, there will be sufficient warm water to cut out this ice. The valve controlling this by-pass is placed in a watertight compartment accessible from the top.

PILING

Spruce piles were used, varying in length from 25 ft. to 40 ft. They were driven practically to refusal with a 2000 lb. hammer, falling 18 ft. to 20 ft. The first pile was driven on Nov. 16, 1903, and the last one on March 5, 1904. There were at one time eight pile drivers on the ground, four of which were generally used for driving foundation piles, and the other four being used for sheet piling and for the piling needed for the temporary concrete plant. The greatest number of piles driven in one day was 232, using four pile drivers, and the greatest number of piles driven by one driver in one day was eighty-three.

CONCRETING

The concrete was mixed by machine, and a special plant was installed for this purpose, with a view to securing the most economical and rapid production of concrete. The plant had a capacity for storing about 2000 cubic yards each of stone and sand, and 2500 barrels of cement.

The concrete was mixed in proportions of 1, 2½ and 5, very wet, and required very little ramming. Although the work was done during an unusually cold winter, the precautions taken sufficed to prevent trouble from freezing. The entire block of concrete required for the monolithic cap and the flumes was about 18,000 cubic yards. The first concrete was placed on Jan. 24, 1904. Under favorable conditions the mixing capacity of the plant was as high as 100 cubic yards of concrete per hour. On one occasion fifty-seven men, working eight hours, placed 716 cubic yards of concrete, or about 90 yards per hour for a whole day.

FIG. 2.—GENERAL VIEW OF POWER STATION AND ASH TOWER

DIMENSIONS

The over-all dimensions of the present building are: 200 ft. x 262 ft., outside measurement. The boiler house is 103 ft. wide inside, the engine room 66 ft., and the electrical galleries 25 ft. wide. The boiler house proper is 82 ft. high to the top of the parapet. The coal pocket enclosure, superimposed on the boiler house, is 60 ft. wide, and its parapet is 118 ft. high. The engine room is 70 ft. high, to the top of the parapet.

The first floor of the boiler house is 16 ft. above the basement, and the second floor of the boiler room is 35 ft. above the first floor. In the engine house, the engine room floor is 23 ft. 6 ins. above the basement, and thence to the roof trusses the height is about 40 ft. in the clear. This is a much lower engine room than is commonly met with in power stations of this size, the saving in head room being due to the adoption

of the horizontal type of steam turbine, which enables economy in vertical space required as well as in the floor area.

STEEL CONSTRUCTION

Like all large power stations of modern construction, the superstructure of the building consists of steel framework which carries the weight of the room and the entire contents of the building, excepting such portions of the machinery as may be more conveniently carried on separate foundations. The south wall of the boiler house supports the outer ends of the boiler room roof trusses on that side of the building, but in other respects the steel superstructure is independent of the building walls.

The steel framing of the boiler house and engine room are necessarily different in type, as the former has to carry a double tier of boilers with flues, economizers, etc., and a coal pocket of 5200 tons capacity on top of everything, while the engine room consists of simply a large open space which makes the roof truss construction the most conspicuous feature, but aside from this does not involve difficult construction. Conditions in the boiler house, are, however, more complex, chiefly by reason of the imposition of the coal pocket, which runs the entire length of the building.

The steel stacks are independent of the boiler house, excepting where they pass through the lower fire room floor, at which point the floor is built against the stacks. At other points they pass through circular openings in the floors and roofs, so that there is no stress induced upon the structure by deflection of the stacks under stress of wind.

A cross section of the coal pocket closely resembles the letter "W," this form being the necessary consequent of having a double line of boilers with an alley between them, requiring a down flow of coal by gravity at points directly over the boiler fronts. Every portion of the bottom of the bunker is so arranged as to induce constant movement of coal in the bunker to the fire rooms, thus tending to prevent fires in the bunkers. No fire has yet been detected within the bunker.

COAL-HANDLING PLANT

The location of the power station is such that it can receive coal either by water or by rail, but as some water transportation is necessary in order to reach the power station site from the New Jersey terminals of coal carrying railroad lines, it becomes cheaper to carry it in barges to the power station site. The plant was, therefore, designed more particularly to deal with water coal, though certain provisions were made in the design of the tower that will admit of the development of the power station for handling railroad coal directly from the cars should it ever be required in the future.

FIG. 3.—COAL BRIDGE, VIEWED FROM TOWER

The complete coal and ash conveying plant, which is shown in one of the half-tone engravings, may be said to consist of three parts, the coal hoisting tower, the cable railroad, which carries the coal from the tower to the coal pocket and its supporting bridge, and the ash bin structure, which is so arranged that it forms a part of one of the piers of the cable railway bridge. This level bridge is 107 ft. above the dock, and is at about two-thirds the entire height of the tower, whose top is 170 ft. above the dock.

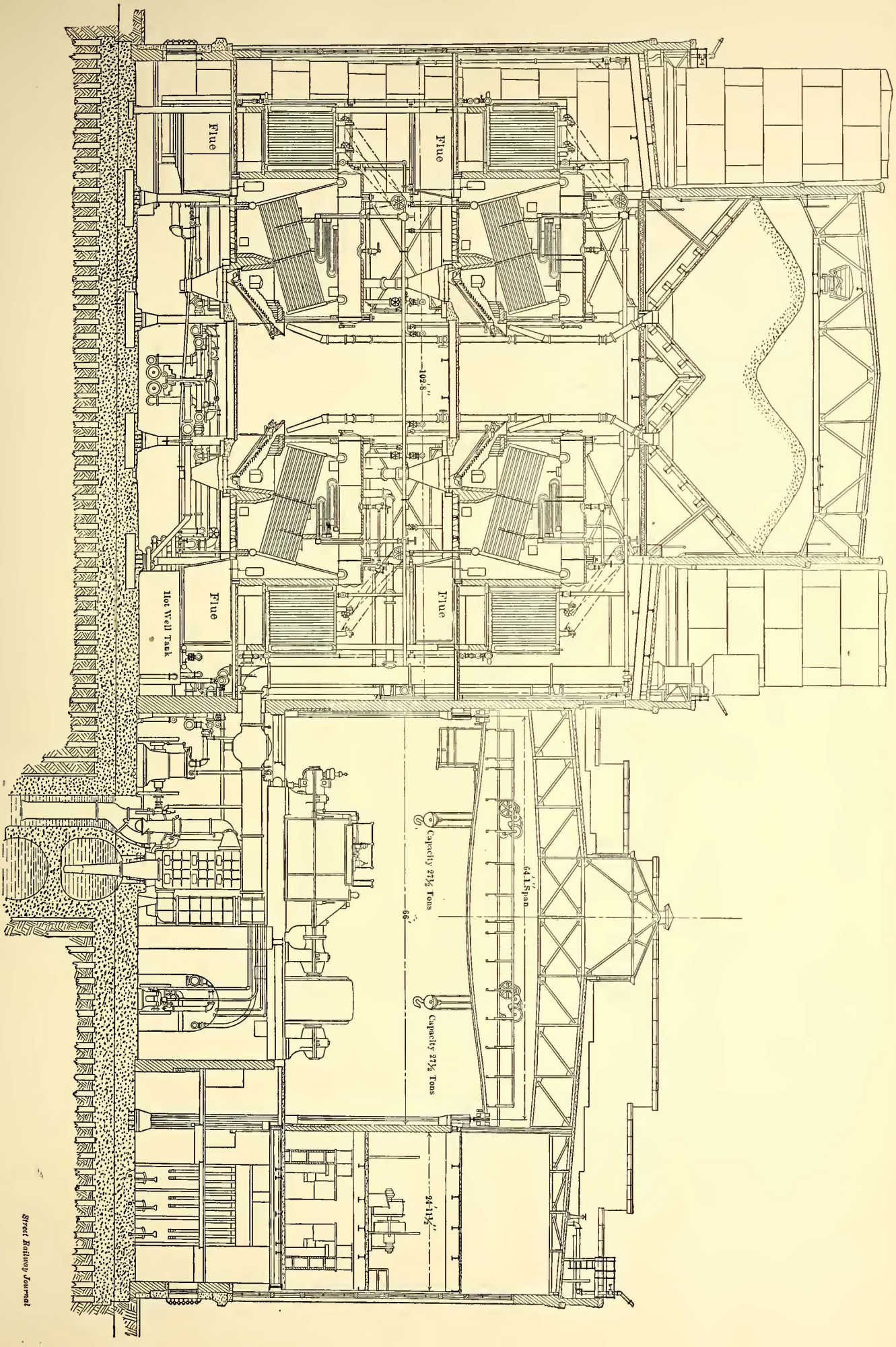


FIG. 4.—SECTIONAL ELEVATION THROUGH STATION

The hoisting engine and apparatus is located within the four-corner columns of the hoisting tower in an enclosure 25 ft. above the dock and having a height of 14 ft. The tower is of the "one man" type, and has a capacity for 400 long tons of run-of-mine bituminous coal in five working hours. Hitherto, the single operator of a one-man tower has generally been stationed directly under the trolley boom, which, at the height adopted in this case, would necessitate shutting down during foggy weather. To avoid this contingency the mechanism controlling the operation of the bucket was designed to stand the operator at an elevation only a short distance above the barge then being unloaded. Another new element in the design partly introduced to facilitate this, is a third hoisting engine for opening and closing the bucket, in addition to the two engines ordinarily used, one for hoisting it, and the other for trolleying it along the boom.

The coal is hoisted in a 2-ton Haywood bucket of the "clam-shell" type, which is raised and lowered by a 2-cylinder 15 ins. x 24 ins. Lidgerwood type of hoisting engine, with a Stephenson link motion. The bucket is so counterweighted that when lowered its speed cannot exceed 1000 ft. per minute. It is suspended from a substantial trolley, carried on a rigid boom built of steel trusses in parabolic form, and projecting 43½ ft. beyond the tower, at a height of about 163 ft. above the dock. The opening and closing of the bucket is done by a "biter" engine, which is of the 8-in. x 10-in. Lidgerwood type. This engine can also be used to drive the winch head for warping barges along the dock, at which time it is disconnected from the biter mechanism. The trolley motion for running the bucket in or out along the boom is operated by a 6-in. x 8-in. Lidgerwood engine. All of these engines work at 160-lbs. steam pressure supplied from the main boiler house and are located in the engine room in the base of the tower. The bucket can complete a round trip, i. e., load, hoist, trolley it over the hopper, dump, trolley out, and descend again to the barge, in 45 seconds. The machinery for hoisting and trolleying the operation of the bucket was designed and built by the Robins Conveying Belt Company.

For about 34 ft. above the level of the cable railway, the upper third of the hoisting tower is completely enclosed with corrugated copper sheathing, forming a house with two stories, the lower one of which contains the weighing mechanism, and the engines driving the crushing machinery, and the cable railway, and the upper story containing the crusher. The roof of the crusher room is formed by the receiving hopper.

Between the coal tower proper and the boiler house structure, a distance of about 500 ft., there are four spans of bridge construction supporting the cable railway. The two outermost spans of this bridge are 140 ft. 6 ins. in length, the third about 149 ft., and the span from the ash tower to the boiler house is 70 ft. The long spans were justified, both on account of the height of the foundations and because they offered the minimum amount of obstruction in the freight yard. The combination of the high level cable railway bridge and the hoisting tower of corresponding height, enables all the hoisting to be done at one operation, without the pulverizing of the fuel incident to passage through a succession of conveyors or elevator devices.

The cable railway itself is designed for a capacity in excess of the other portions of the mechanism above described. That is, it is capable of handling 150 tons per hour, when operating twenty-nine 2-ton cars at a speed of 180 ft. per minute around a track loop approximately 2500 ft. long. There are at present installed ten cars, each of about 2 tons capacity. The cable is ¾-in. six strand wire rope, laid on hemp centers. It is driven by 7½-in. x 7-in. Westinghouse standard engine, and is kept taut by a heavy counterweight. The track is laid with 16-lb. T-rails, and the gage is 24 ins. A single guard rail is provided at curves. The minimum radius of curvature is 14 ft. 6 ins. The coal cars are of the side dump type, whose sides are designed to swing outward and whose bottoms are inclined outward so that the coal, when released by the swinging out of the sides, drops out of the car. The car dumps its load without letting go of the cable, proceeds around the loop and returns to the loading hopper automatically.

It is estimated that the actual cost, including labor, supplies, and fixed charges, per ton of coal, from the time it leaves the barge until it arrives in the bin, on the basis of 480 tons per day, is 9 1-3 cents per ton, which is believed to represent the greatest economy yet obtained by any plant intended to accomplish the same purpose under similar general conditions.

The striking feature of the installation is the unusual height, both of the lift and of the conveying cable railway for carrying coal into the pocket.

The ash bin is directly across Front Street from the boiler room, and ashes are delivered to it through a bridge, at an elevation of 69 ft. above the street, by means of a telpherage system which hoists and transports the ash cars from the boiler room basement up to the level of this bridge, and thence over into the tower where the contents are dumped into the bin. The bottom of the bin is 20 ft. above a railroad track that runs through the base of the tower, and the ashes are handled through dumping gates into gondola cars standing on this track. The capacity of the bin untrimmed is 300 tons.

WATER SUPPLY SYSTEM

Water is taken from the mains of the Montauk Water Company, two of whose service mains are connected to an 18-in. main supplying the power house. To be sure of having a reserve on this supply, there was built adjacent to the Long Island Railroad yard, at a distance of about 2700 ft. from the power station, the nearest available site, a standpipe 40 ft. in diameter, 80 ft. high, which is connected into this 18-in. main and under ordinary circumstances kept full. From the 18-in. main which runs along Front Street, parallel to the south wall of the building, two 14-in. branches are carried into the building, each branch having two 10-in. meters in multiple, with suitable by-pass connections. A third water connection of the same size is provided from the same main at the southeast corner of the power station. There are also two independent cross connections between this 18-in. supply line and the city water system, for use in case of accident to the Montauk Water Company's pipe line. Under normal conditions this water is only used as needed for "make-up" water to be added to the water of condensation which is returned from the surface condensers.

Owing to the employment of surface condensers the major part of the boiler supply is, of course, derived from the hot wells receiving the discharge from the surface condensers. For each generator unit two hot wells are provided in the form of steel tanks, 18 ft. 4 ins. x 18 ft. 5 ins., and 6 ft. 6 ins. deep, to which the water of condensation is pumped. Although each unit has its own pair of hot wells, they may all be connected together. The pipe connections are so arranged that the make-up water from the outside supply mains may first be used, if desired, for cooling purposes around the building, such as in jacketed bearings, whence it passes to the open heater. Otherwise, it goes directly from the mains to the open heater, which is a cylindrical Cochrane feed-water heater and purifier, made by the Harrison Safety Boiler Works. This heater is 8 ft. in diameter and 15 ft. long, and utilizes exhaust steam from the double-acting aux-

iliary engines and reciprocating pumps in various parts of the building. It has sufficient capacity to heat feed water for 15,000 hp of boilers from 40 degs. to 205 degs. F.

It was made purposely large in order to insure a comparatively slow circulation of the make-up water through it, so that it would have ample time to throw off the carbon dioxide and other injurious substances in solution, which would attack the valve seats and the tubes in economizers and condensers. The make-up water is likely to run from 10 per cent to 15 per cent of the entire water consumption of the plant. The heater is really more of a purifier than a heater. The arrangement was designed with this particular object in view. The Westinghouse single-acting engines driving auxiliary machinery do not send their exhaust steam to this heater on account of particles of crank case oil that may work into the exhaust, but the ordinary cyclinder oil in the exhaust of the pumps and double-acting engines is extracted by allowing the steam to run at a very low velocity through a comparatively large pipe before reaching the heater, and thence into a 26-inch Cochrane oil separator, by which means it is effectually extracted.

By the course of treatment above outlined, the purity of the water in the steam in all parts of the system is insured, resulting in a marked decrease in corrosion and leakage in all parts of the plant with a corresponding reduction in operating expense and depreciation. For instance, the wear and tear on both water and vacuum pumps is appreciably reduced by reason of the lower speed made possible by the absence of leakage. The seats of the high pressure steam valves, being integral with the bodies, the corrosion of them would be a serious matter. But it is believed that corrosion can be absolutely prevented by eliminating from the feed water the gaseous as well as the solid impurities in the above manner.

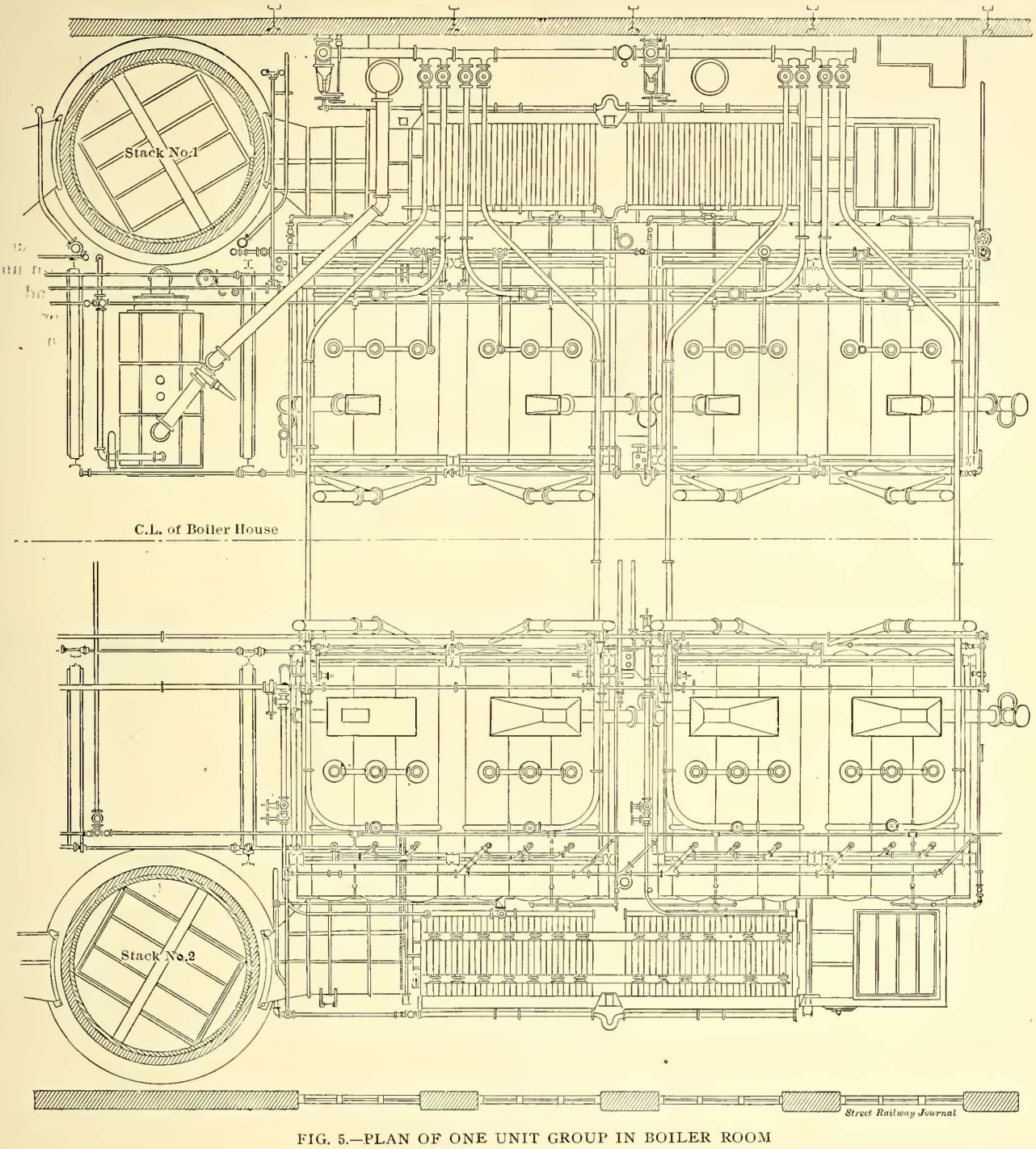


FIG. 5.—PLAN OF ONE UNIT GROUP IN BOILER ROOM

BOILERS

The boiler plant for the Long Island City power station

consists of thirty-two Babcock & Wilcox water-tube boilers set in batteries of two boilers each, eight batteries on the first floor and eight on the second floor immediately over the former; these batteries are equally distributed on each side of

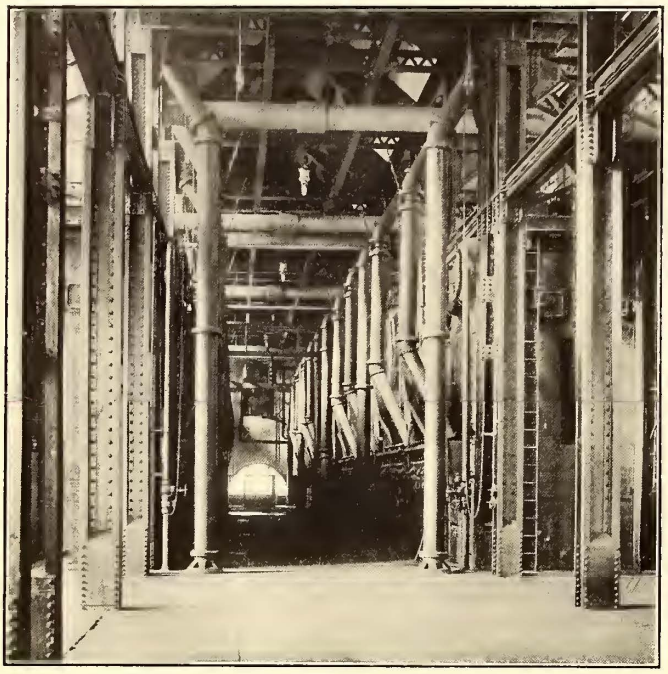


FIG. 6.—BOILER ROOM, SECOND FLOOR

the boiler plant, with a firing space between boiler fronts of about 18 ft. in width.

The boilers are designed for a working pressure of 200 lbs. per sq. in., and each boiler has a total effective water heating surface of 5243 sq. ft., comprised in three steam drums, 42 ins. in diameter and 23 ft. 10⅝ ins. long, and twenty-one sections of 4-in. tubes 18 ft. long, with twelve tubes in each section. Each boiler is supplied with a superheater capable of superheating the output of the boiler 200 degs. F. when operating at 200-lbs. pressure, and comprises about 1116 sq. ft. of superheating surface. Each boiler has two steam openings, the main nozzle receiving steam from the superheater, and the auxiliary nozzle taking its saturated steam directly out of the tops of the boiler drums for use in the auxiliary mains that supply the small engines in various parts of the house

The thirty-two boilers now installed are arranged in four groups with eight boilers in each group, the eight boilers being those on the first and second floors directly over one another. The group nearest the west end of the plant is intended ultimately to take care of the two 2500-kw lighting units there to be installed. The other three groups are each capable of supplying one 5500-kw turbine unit. The ultimate capacity of the boiler house, when finally extended, will be 96 boilers of the type now installed.

Each boiler is fitted with a Roney stoker. Each stoker is 150 ins. wide and has twenty-four grate bars, with a dumping grate at the bottom to drop the ashes into the ash pit. The bars are rocked by a small Westinghouse engine, there being one engine to eight stokers.

The contents of the ash pit are disposed of by gravity down a chute terminating over the narrow gage railway track in the basement. At the bottom of each chute is a dumping gate for loading the cars provided for the removal of the ashes.

FLUES AND ECONOMIZERS

The arrangement of flues, economizers, and dampers has been made so as to permit the operation of the plant on the unit system (that is, by working each set of eight boilers on one turbine) but the flues and economizers can be interchanged and cross connected to insure the greatest capacity and highest efficiency under all conditions of operation, even though some portions of the boiler and economizer plant may be out of service. One economizer utilizes the waste heat from two batteries of boilers.

Under normal conditions the gases from the four boilers discharge into their respective sections of the main flue, then pass through the economizer directly above, and into the stack, but dampers on the first and second floor permit inequalities of quantity and pressure to divide under the different economizers irrespective of the boilers in service. In case it is found necessary to isolate any economizer for cleaning and repairs, the gases can be by-passed directly into the stack or divided up through the other economizers.

Each economizer consists of fifty-six sections of ten tubes each, designed for 250-lbs. pressure. The rear wall of the economizer chamber is made of vitrified asbestos air cell board, laid on in sections, so that in the event of a broken economizer tube it is not necessary to tear down any of the brick work in order to replace the section. By the use of these economizers the hot gases are so reduced in temperature that they enter the base of the stack at about 350 degs.

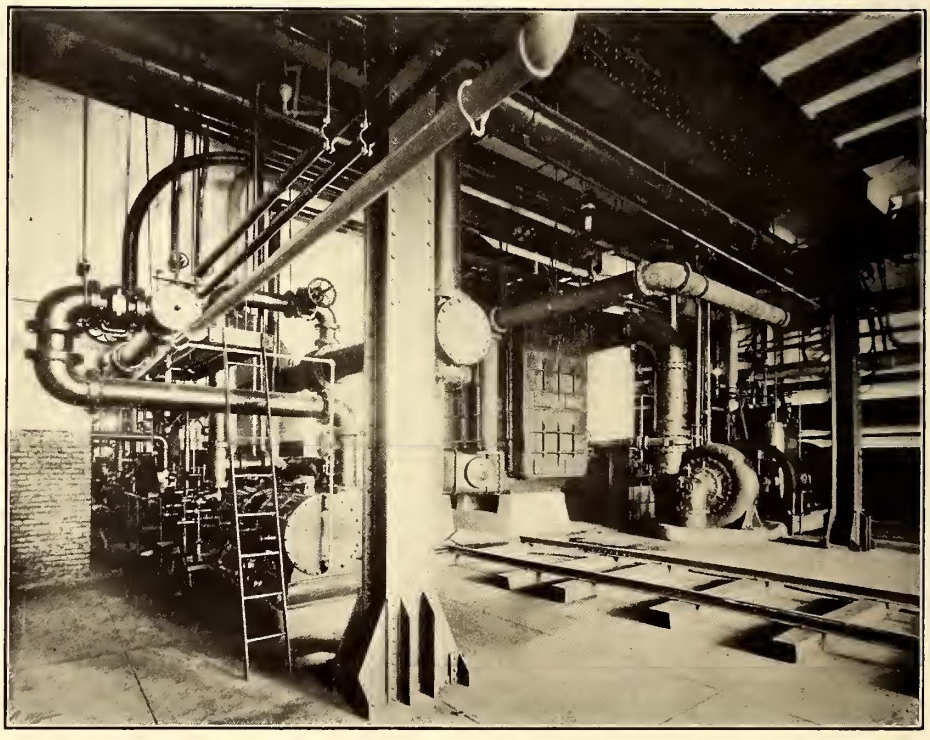


FIG. 7.—CONDENSER, CIRCULATING AND DRY VACUUM PUMPS

STACKS

There are four stacks in the power station, of which, however, only two are required for the operation of the present

installed apparatus, but it was deemed advantageous to erect all four. When the station is extended, the number of stacks will ultimately be six. They are of steel, are entirely self-supporting, and are 275 ft. in height above the base. The inside diameter of the straight portion is 17 ft. 10 ins. at the bottom and 16 ft. at the top. The bottom courses are flared out to a diameter of 23 ft. They are lined throughout with brick, which is supported at intervals of 20 ft. with Z bar rings riveted around the interior of the stack. Each stack has six openings, two in the basement for the main flues, two for the boiler flues on the first floor and two for those on the second floor. These openings are all heavily reinforced with plate and angles. The concrete base of the stack is formed solid with the monolithic building foundation, and is run up 3 ft. above the basement floor, which gives an average height of 245 ft. above the furnaces. The plates composing the stack are of open hearth steel, and are larger than usual, to reduce the number of joints. Above the second opening, no ring is composed of more than four plates, the largest of which are about 6½ ft. x 15 ft. The time consumed in the erection of the four stacks was about three and one-half months.

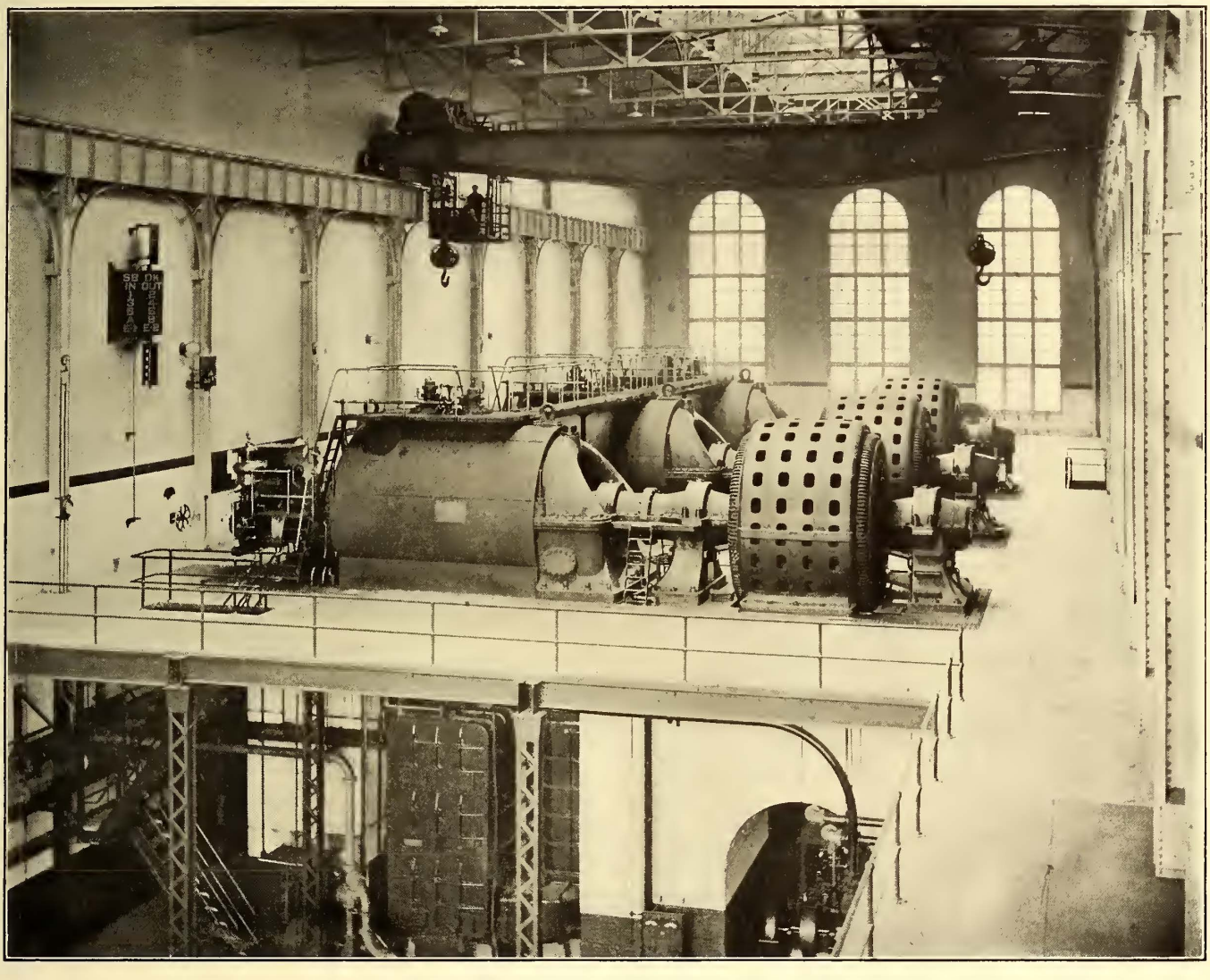


FIG. 8.—INTERIOR OF ENGINE ROOM

STEAM TURBINES

For the initial equipment three main-generating units have been installed, consisting of steam turbines direct connected to three-phase, 11,000-volt generators of the revolving-field type. The turbines are of the Westinghouse-Parsons single-flow type, rated to develop 5500 kw at 175-lbs. steam pressure, and 27½ ins. vacuum, running at 750 r. p. m. The bearings of the turbine are supplied with a forced circulation of oil and are also water jacketed. At each end of the cylinder where the shaft passes through, a water-seal gland is provided which effectively prevents leakage of steam along the shaft. There is a large air space surrounding the cylinder for its entire length. It is lagged with asbestos, and fitted with an outside jacket of sheet steel, giving a smooth cylindrical exterior. The entire structure of the turbine and generator rests on a heavy rectangular bedplate, which in turn rests on the foundation, but it is not fastened with anchor bolts.

The length of the turbo-generator unit is 47 ft., width 13 ft., and height 14 ft. to the top of gallery railing. By way of contrast it may be stated that a four-cylinder piston engine of equal capacity, with its generator, occupies a floor space about 55 ft. long, by about 35 ft. wide, and 39 ft. in height.

The steam consumption of the turbine is guaranteed by the builders not to exceed the following rates when operating at 750 r. p. m., with dry saturated steam at the throttle of 175-lbs. gage pressure, with a vacuum of 27½ ins. mercury (referred to a 30-in. barometer) in the exhaust pipe:

Rated load, 5500 kw, 15.3 lbs. steam per ehp-hour.
Three-quarter load, 4126-kw, 16.1 lbs. steam per ehp-hour.
One-half load, 2750 kw, 18.1 lbs. steam per ehp-hour.

These results will be improved by the following percentages, by the use of superheated steam, temperature being measured at the throttle:

100 degs. superheat, 10 per cent.

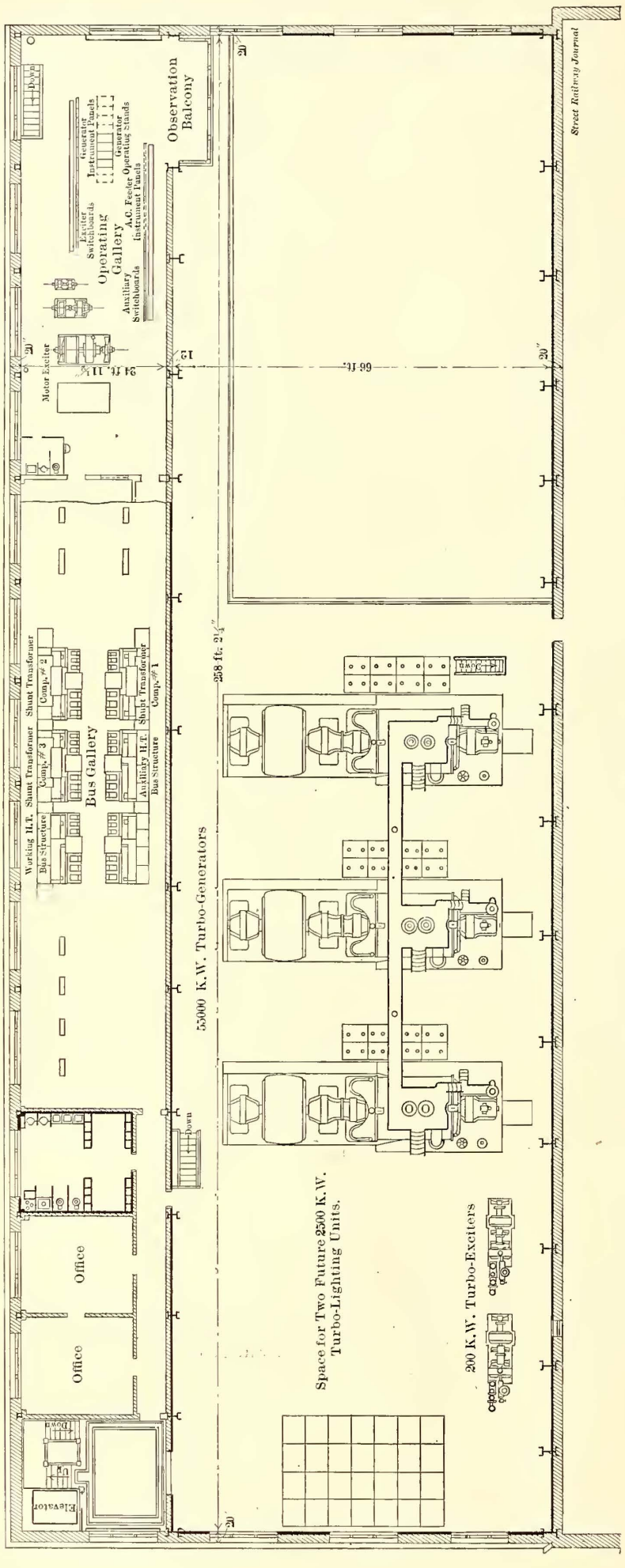


FIG. 9.—PLAN OF ENGINE ROOM AND SWITCHBOARD GALLERIES

150 degs. superheat, 12½ per cent.
175 degs. superheat, 13¼ per cent.

The turbine is also fitted with an automatic safety stop arrangement which shuts off the steam supply automatically in case the speed exceeds the predetermined limit. A device is also provided for controlling the action of the relief valve in the outboard exhaust connection.

To maintain perfect alignment of the revolving part of the turbine, there is provided a special bearing, resembling a thrust bearing in construction, but much lighter because of the absence of thrust. This is capable of very close adjustment.

Convenient to each turbine there is a bracket on the boiler room wall carrying a stop valve by which steam supply to each turbine unit can be cut off in the boiler room without leaving the engine room floor. An iron gallery, fitted with the usual iron ladders and polished hand rails, extends across the tops of the three turbine units, affording ready access to the admission and by-pass valve.

The turbines were built at the East Pittsburg works of the Westinghouse Machine Company.

CONDENSERS

A separate condenser is provided for each turbine. It is of the counter-current surface type, built by the Alberger Condenser Company, and has 20,000 sq. ft. of cooling surface, consisting of seamless drawn brass tubes of No. 18 S. W. G., and 1-in. outside diameter. The condenser is placed in a large arched opening made in the turbine foundation. In fact, the entire condensing plant, consisting of condenser, circulating pump, dry air pump and hot well pump, is compactly grouped within and about the base of the foundation.

The exhaust trunk is of cast iron, rectangular in section, well ribbed up on the outside. The outboard exhaust passes over the top of the condenser, through a 36-in. relief valve, to an independent vertical 36-in. exhaust pipe passing up through the roof behind the boilers. The exhaust steam enters the condenser at the bottom. The dry air pump exhausts the vapor from the top and the water of condensation is collected from the bottom by the hot well pump. The circulating water enters the tubes at the top, making three passes, and is discharged from the bottom of the condenser into the overflow flume directly underneath.

The intake flume is underneath the overflow, and access to its contents is made possible by a well extending past the outflow flume down to the intake flume, this being shown in sectional elevator in Fig. 4. Condensing water is lifted from this well by a 24-in. double suction centrifugal pump made by the Morris Machine Works, capable of pumping 20,000 gals. of salt water per minute against a head of 20 ft. Each

pump is driven by a 12 x 24 x 12 Westinghouse compound engine direct connected to it. The engines are able to develop 175 hp at 175-lbs. steam pressure at 225 r. p. m., running non-condensing.

The condensed steam is drawn from the bottom of each condenser and discharged to the hot well tanks in the boiler-room basement by a 4-in. centrifugal pump direct connected to a 15-hp, 220-volt, direct-current motor, running at 560 r. p. m. A by-pass arrangement to the overflow flume is provided for discharging the condensed steam directly into the flume if desired. The wet pump and its motor, together with the condenser and exhaust trunk above described, is shown in Fig. 13. The relation of the hot well tanks to the boiler feeding system has already been outlined.

Vacuum is maintained in each surface condenser by means of a horizontal steam-driven two-stage dry vacuum pump, with Corliss valves and automatic governor on the steam end, and positive valve motion on the vacuum end. The vacuum cylinders and heads are water jacketed. The steam cylinders are 10 ins. and 24 ins. in diameter, and the pump cylinders 24 ins. in diameter, with a 24-in. stroke, and its normal speed is 100 r. p. m. They are built by the Alberger Condenser Company. Fig. 7 is a view of the centrifugal circulating pump and its engine, and also of the dry air pump, which, like the condenser, is placed in an arched opening in the engine foundation.

CONDENSER TUBE PROTECTION

A somewhat unusual feature has been introduced into this station to prevent the serious deterioration usually occurring where salt water is used for circulation of surface condensers. It is the universal experience that more or less galvanic action takes place in any event at the expense of condenser tubes, but this is often aggravated in large and important

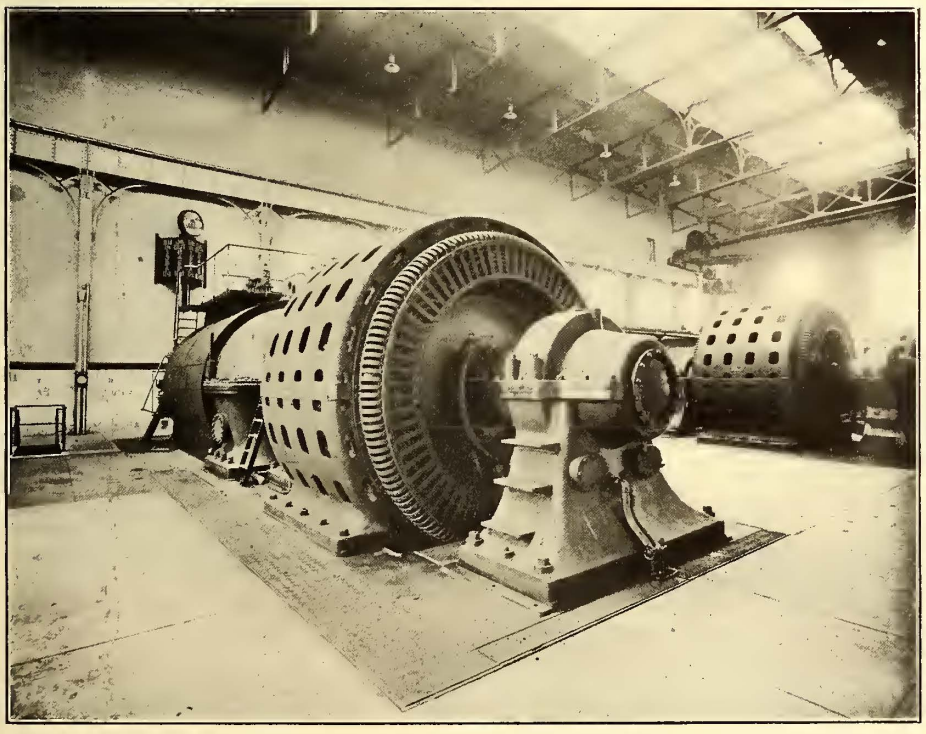


FIG. 10.—GENERATOR END OF 5500-KW TURBO-GENERATOR

plants by the fact that the water and the body of the condenser have formed a convenient path for stray electric railway return currents getting back to their own power station some distance away, through the condenser intake and the water of the harbor.

A sufficient number of voltmeter readings were taken between the river, the flume, and various parts of the piping about the building and in the streets, to indicate that there was at all times a difference of potential enough to make trouble, although its polarity was not always the same.

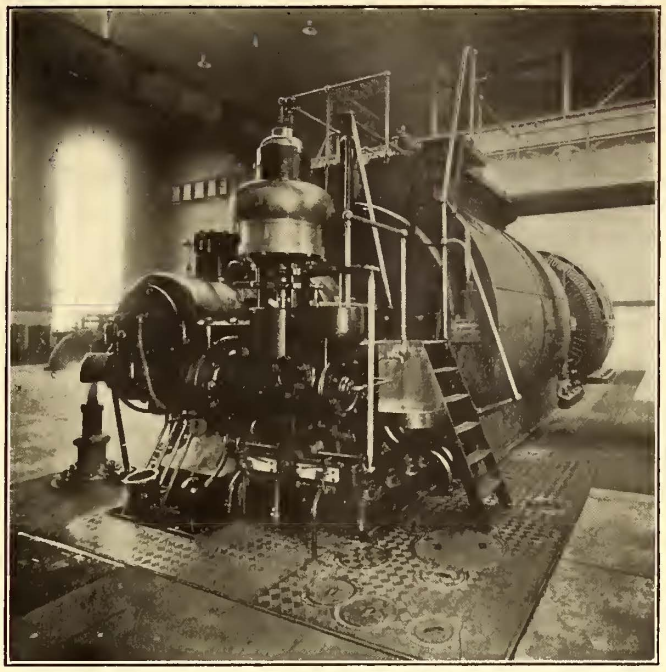


FIG. 11.—STEAM END OF 5500-KW TURBO-GENERATOR

The metallic connections of the power station equipment to the city piping station are through two 14-in. connections to the water mains and on account of the proximity of water mains to the trolley tracks all over the city, there is a tendency for stray currents to flow into the piping of the building, and then to the condenser intake, returning through the river to the negative bus-bars of some neighboring street railway power plant. Currents flowing in this direction are certain to cause electrolytic corrosion in the condenser tubes.

The method adopted to prevent this corrosion consists first in providing a shunt circuit between the incoming water pipes and the condenser flume, in order to divert as large a proportion as possible of the current from the condensers. This was done by the insertion in each water main connection of a short piece of pipe with an insulating joint on each end of it. These short pieces of pipe were then connected to a 750,000 circ. mil cable, which was carried to the outer end of the condenser intake. Such current as may leak from the pipes to the water contained in them thus has an opportunity to get back into the harbor without going through the piping system and the condensers. To neutralize the effect of such current as might still leak past the insulating joints, a small booster generator was provided, driven by a 220-volt motor. The positive pole of the booster was connected to the heavy grounded shunt cable above mentioned and the negative pole was connected to seven different points on each condenser,

and there was an adjustable rheostat in each of these branches of the negative circuit. This superimposed voltage can be adjusted by means of the rheostats exactly to counterbalance the natural galvanic electromotive forces due to the brass tubes, the iron shell and the circulating water, together with the stray electromotive forces from outside. With the destructive potentials so counterbalanced, the condenser is in a

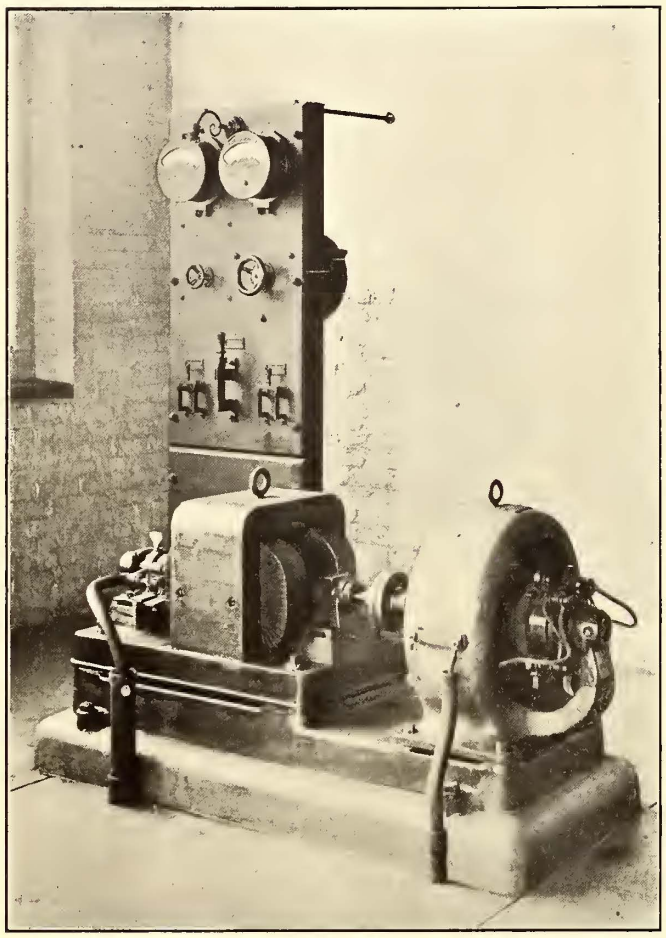


FIG. 12.—BOOSTER FOR PREVENTING CONDENSER ELECTROLYSIS

neutral electric state, which effectively prevents the corrosion and pitting of condenser tubes and sheets, and secures a far longer life than has hitherto been possible for this very important and highly vulnerable section of the steam equipment. A little switchboard panel is provided for each condenser, with seven rheostats mounted on it, each of which is connected by a separate negative lead to a different section of each of the three condensers.

A differential voltmeter is provided which can be plugged to each of these sections of the negative circuit, there being a separate rheostat in each circuit. By adjusting the rheostats for each section it is possible to keep the potential at zero in all of them. The booster apparatus shown in Fig. 12 is conveniently situated in the electrical bus gallery directly under the operating gallery. The rheostat panel for each condenser is situated conveniently to it in the engine room basement, and observations at suitable intervals enable the operating force to maintain the condensers absolutely neutral.

SYSTEM OF PIPING

In general, the piping for the main power units in the plant was laid out to conform with the general design of the station on the lines of the unit system already referred to. In other words, the piping was so arranged that under normal conditions a given group of boilers and auxiliaries serves a single main-power unit, which is provided with suitable cross and equalizing connections between itself and the similar system of piping of the adjacent power units.

MAIN OR SUPERHEATED STEAM

The general arrangement of the main steam piping is shown diagrammatically in Fig. 5 (drawn for a completed quarter of the station), and is such that four boilers on each floor, or eight altogether, feed directly to a separate main steam header, located back of the first floor boilers, joining these separate feeders, and fitted with suitable stop valves. It is then carried down to the point where it passes through the engine room wall under the turbine operating floor, having on the way a connection from a similar manifold with the corresponding group of boilers on the first floor. The two boilers on the south side of the boiler room are run into the same manifold as the two boilers directly opposite them on the north side, and the same arrangement is carried out on the lower tier of boilers.

As it is planned to use steam up to 200-lbs. pressure, with 200 degs. superheat, special care had to be taken to design the steam piping so as to allow ample flexibility for the excessive expansions due to these high temperatures. Long radius pipe bends were used throughout, and this arrangement has been found to furnish ample flexibility under the most exact-

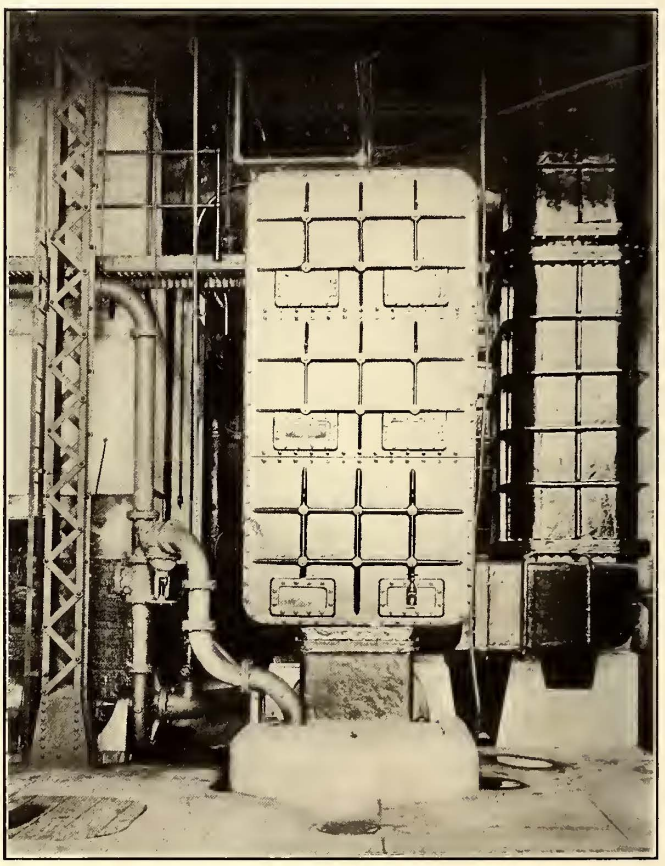


FIG. 13.—CONDENSER, EXHAUST TRUNK AND WET PUMP

ing conditions. Full weight steam pipe, with extra heavy welded steel flanges, was used throughout on the main steam piping. The fittings are of special design and made of open hearth cast steel. The valves are constructed of semi-steel throughout, with integral seats and specially designed stuffing boxes. Gate valves were used throughout except at the boiler nozzles, where automatic reverse current stop and check valves were provided.

The joints were made up with particular care, steel bolts and corrugated copper gaskets being used throughout. The faces of the flanges on the piping, valves and fittings inside of

the bolt holes, and the raised faces given a smooth machine finish so as to insure perfection in obtaining tight joints.

The supports for the main steam piping as it crosses the boiler house to the large mains that lead to the engine room, consist simply of turnbuckle rods suspended from steel work of the roof, the arrangement being such as to afford opportunity of expansion in any direction. The large vertical feeders that lead to the engine room are supported by special bracket elbow fittings at the point where they turn from the boiler room into the engine room basement, the turbines being fed from below. The heavy manifolds above mentioned are supported from the roof beams, the springs being introduced to insure support from the pipe when it expands upward, these large risers being supported from the bottom. By these means the pipes are firmly supported, and at the same time given all needed opportunity for expansion without setting up an unnecessary strain.

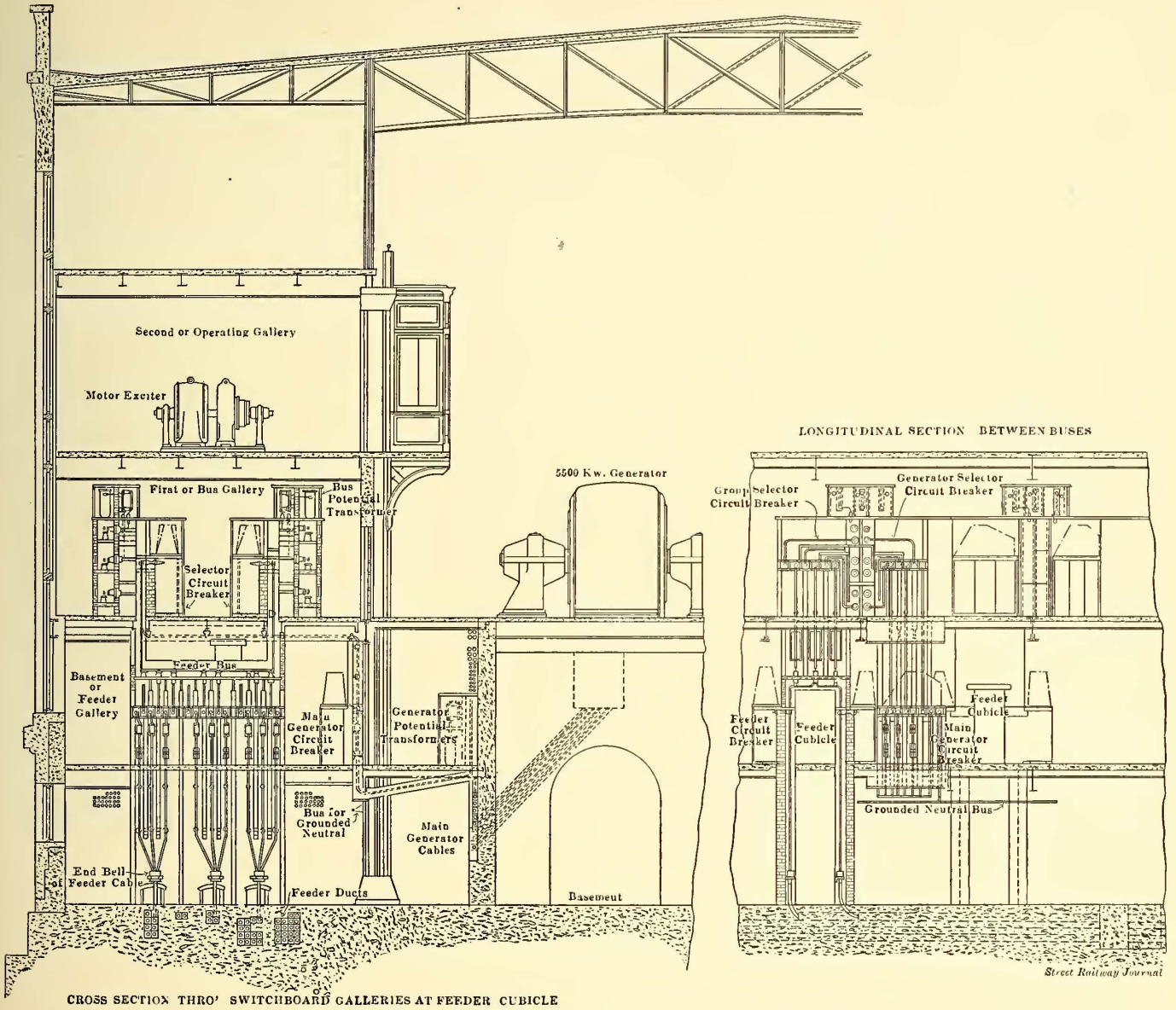


FIG. 14.—SECTIONAL ELEVATION OF SWITCHBOARD GALLERIES

BOILER-FEEDING SYSTEM

The normal feed water supply to the boilers comes from the "hot well" or storage tanks which receive their water from the main surface condensers. The water is taken from the tanks by four boiler feed pumps, installed in a pump room in the center of the basement. These pumps are of the outside packed plunger, pressure type, of Epping-Carpenter make, with compound steam ends, steam cylinders 14 ins. and 22 ins. in diameter, water cylinder 12 ins. in diameter, and 24-in. stroke. In case of emergency, the pumps suck directly from the water supply mains. They discharge into a 12-in. pipe, running around the ceiling of the pump room, making a loop which carries the discharge of the closed heaters. Each pump can discharge into either side of the loop, thus enabling the other side to be temporarily cut out for repairs if necessary.

There are two vertical coil pipe feed water heaters, each containing 1000 sq. ft. of seamless copper tube heating surface, having 5-16-in. steel shells 60 ins. in diameter by 12 ft. long, and designed for 300-lbs. working pressure. These heaters are supplied with exhaust steam from the auxiliary Westinghouse engines. The exhaust from the reciprocating pumps at various parts of the basement goes to the open heater above mentioned. The heaters are situated at the west end of the pump room and are so connected to the pumps and main feed lines that they can readily be by-passed. The discharge pipes through the heaters are 12 ins. in diameter.

From the closed heaters the feed water passes through risers to a loop over the first floor boilers, thence to the economizers, which have been described in connection with the boilers behind which they are located. From the economizers

the feed water passes into another loop, above the first floor boilers, whence it is distributed to the individual boilers.

LUBRICATING OIL CIRCULATION

There are three systems of distribution of lubricating oil. First of all, is that which distributes the oil to the turbine bearings and includes a storage tank 8 ft. in diameter by 14 ft. 8 ins. deep, situated in the boiler house at about the level of the coal bunker, from which oil is distributed by gravity to the turbine bearings. From the bearings it is carried to a filter tank from which it is pumped automatically to the storage tank again by two 6-in. x 10-in. x 8½-in. x 12-in. compound duplex piston pumps, each having a capacity of 200 gallons per minute under 60-lbs. pressure. The filtering plant is located in a two-story closed chamber. The upper story of this chamber contains several tiers of filter pans which carry the bags through which the oil runs. The lower story contains the tank and pipe discharge connections to the oil pumps, which are situated on the top of the structure. There are about 5000 gallons of oil in this system and about 90 gallons per minute is circulated through each turbine when in operation. About 20 gallons per day are drawn off for various purposes, this including a very small loss by evaporation. Separate oiling systems are provided for the crank cases and for the cylinders of the reciprocating engines used for the auxiliaries.

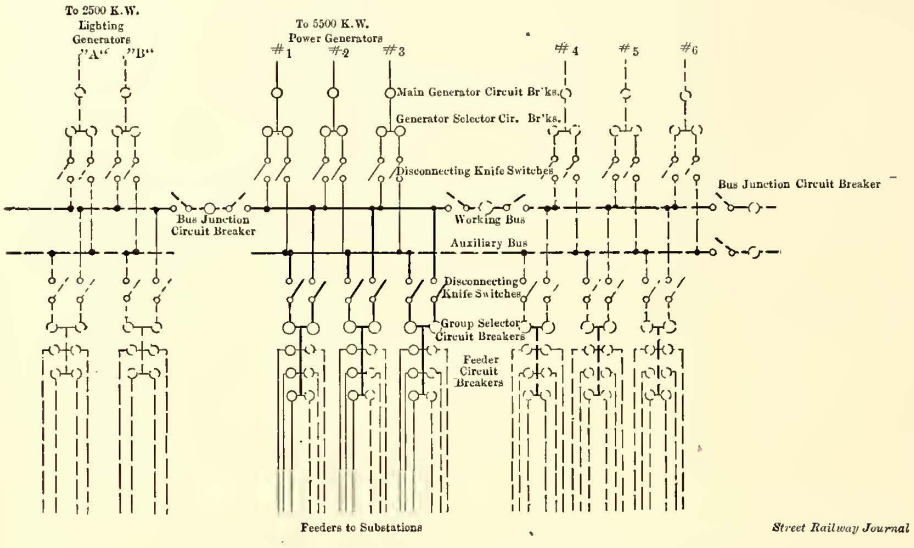


FIG. 15.—DIAGRAM SHOWING HIGH-TENSION WIRING

COMPRESSED-AIR CLEANING SYSTEM

The station is equipped with a compressed air system for cleaning and other purposes. Air is supplied to this system by two motor-driven compressors of the Westinghouse Traction Brake Company's D-4 type of water-cooled compressors, operating from the 220-volt supply circuit. Each compressor has a capacity of 50 cu. ft. of free air per minute, at 100-lbs. pressure, and is controlled automatically by a pump governor.

PIPE COVERING

The non-conducting covering applied to the pipes and other heated surfaces throughout the building was furnished and put on by Keasbey & Mattison, in accordance with specifications. The saturated steam pipes consists of a layer of 1-in. asbestos cement and then a layer of 1-in. 85 per cent magnesia blocks, covered again with ¾-in. cement enclosed in a heavy canvas jacket. The saturated steam pipes are covered with 1½-in. 85 per cent magnesia jacketed with heavy canvas. Boiler feed lines and high pressure drips and all other auxiliary piping and heaters are also covered with 85 per cent magnesia in varying thicknesses. The smoke flues are jacketed first by 1-in. air space and then with 1-in. 40 per cent magnesia overlaid with ½-in. coat of hard finishing asbestos cement. These non-conducting coverings are held by galvanized iron netting and tie wires underneath the canvas.

The covering of the flanges and fittings on the superheated steam lines was of the special sectional design so as to be readily removable. Canvas covering on pipes and other surfaces were given two coats of paint, and a general color scheme, in which the different classes of pipes have different colors, was devised for the purpose of indicating at a glance the various systems of piping. As may well be imagined, it has been found of great convenience to the operating force.

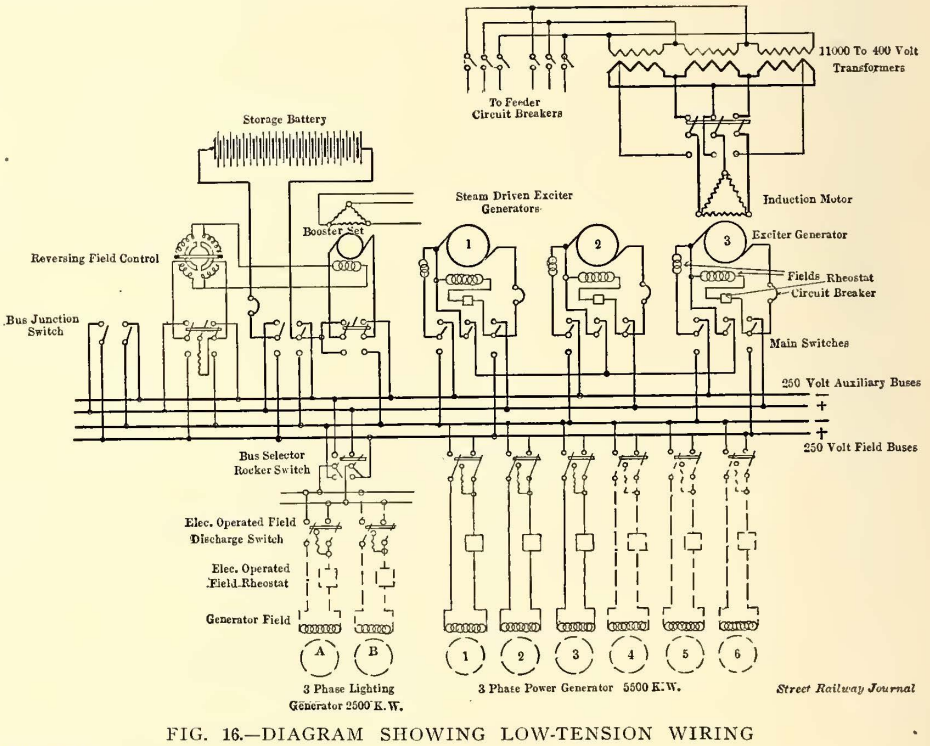


FIG. 16.—DIAGRAM SHOWING LOW-TENSION WIRING

GENERATORS

The main turbo generators, as stated, are of 5500 kw each and run at 750 r. p. m. The stator coils are wound with copper wire, and as is usual with very large generators, were built into slots after the armature frames and cores were permanently in position on the bedplates. They are "star-wound," i. e., the three sets of armature coils, needed for the generation of three-phase alternating current, are all connected to one point, called the "neutral," and the neutral points of the three machines are connected to one neutral bus, which is permanently grounded through a resistance.

The revolving field consists of a four-pole structure formed out of solid steel disks, milled to receive the winding. It is 6 ft. 8¼ ins. in diameter, and about 6 ft. long. The field coils are wound with heavy copper straps embedded in slots and retained by heavy bronze wedges. Ventilating ducts are provided in the core, which enables the revolving field to draw an abundant supply of air through its interior by a sort of fanning motion, which also aids in reducing the temperature of the stationary armature. The core is pressed on and keyed to a shaft of nickel-steel, 19¾ ins. in diameter, which runs in bearings 15 ins. in diameter, through which there is a forced circulation of oil. The field is separately excited at 220 volts, the exciting current being delivered to the winding through a two-ring collector by means of sliding carbon brushes.

These generators are each guaranteed to deliver 289 amps. per terminal at 11,000 volts, and 80 per cent to 100 per cent power factor for a space of 24 hours continuously, with a rise in temperature not to exceed 35 degs. C., and a 50 per cent greater current for two hours with a rise not to exceed 55 degs. C.

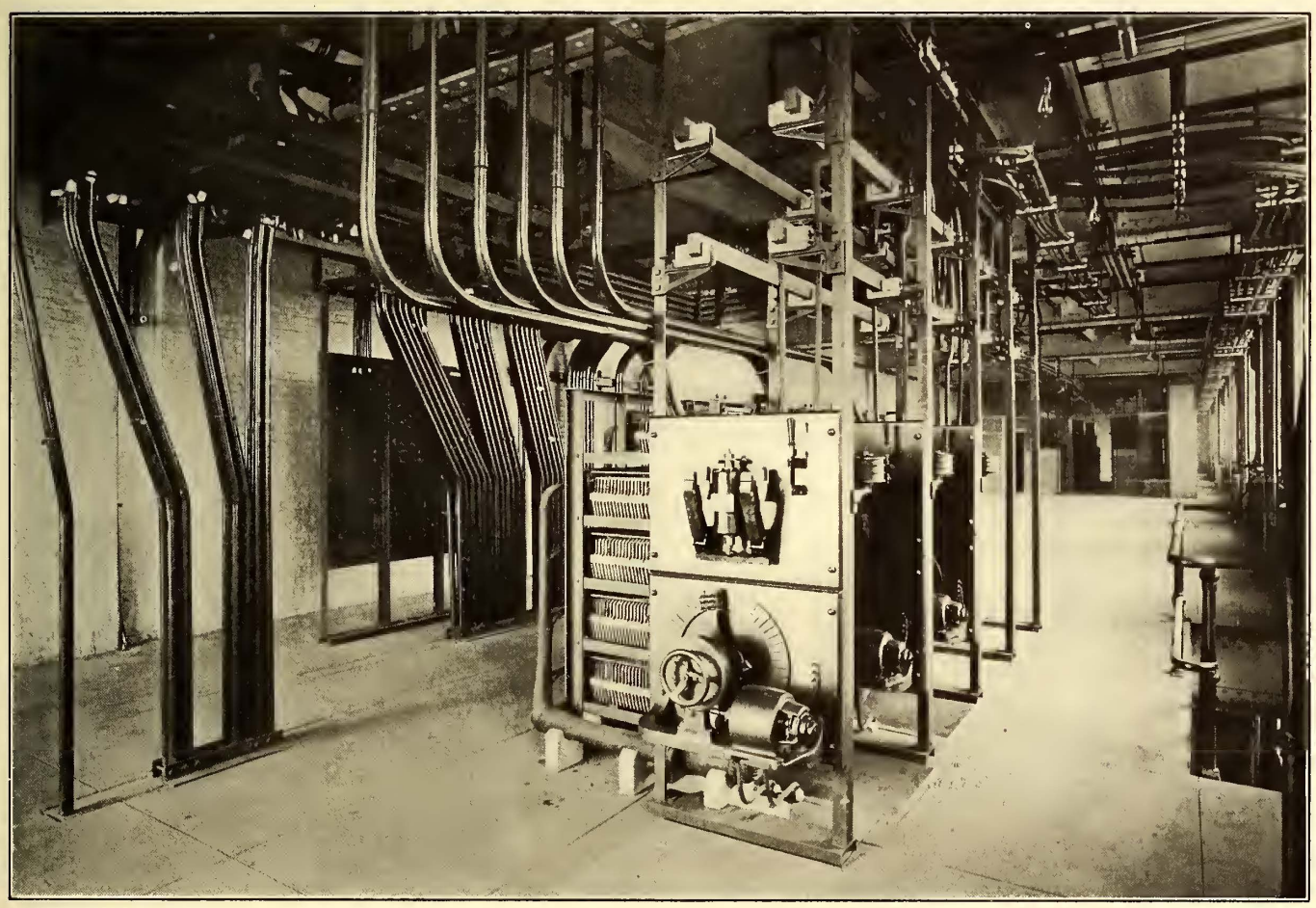


FIG. 17.—GENERAL VIEW OF BUS GALLERY, SHOWING MAIN GENERATOR, RHEOSTAT AND AUXILIARY WIRING

EXCITERS

Three separate sources are provided for exciting the fields of the main generators, viz., the two steam-driven exciters, one motor-driven exciter, and a storage battery. These are designed to give direct current at from 180 volts to 220 volts. The steam-driven units each consist of a Westinghouse-Parsons steam turbine directly coupled to a 200-kw direct-current turbo-generator, designed to run at 1800 r. p. m. These turbines are designed to run either condensing or non-condensing with 175-lbs. steam pressure and superheat up to 200 degs. These exciters are located near the southwest corner of the main floor. The motor-driven exciter, also of 200-kw capacity, is driven by a 290-hp, three-phase, 440-volt induction motor, both motor and generator being mounted on the same shaft, bearings and bedplate. This motor-driven exciter is located in the operating gallery. The three-phase motor derives its current from three 175-kw oil-insulated self-cooling transformers located in the basement of the electrical gallery.

STORAGE BATTERY

The storage battery is intended mainly as an absolutely reliable source of supply of the exciter-bus system and the other more important auxiliaries. It is installed in a specially arranged room in the engine room basement, and consists of 110 cells, each containing seven plates of the type "R" chloride accumulator, manufactured by the Electric Storage Battery Company. The tanks are built large enough to ultimately contain eleven plates. This battery has a discharge rate of 366 amps. for one hour, and is controlled from the operating gallery. It is normally kept floating across the excitation bus. In order to charge the battery a 12.5-kw booster, driven by a 15-hp induction motor, is located in the operating gallery next to the motor-driven exciter above mentioned.

SWITCHBOARD APPARATUS

The generators are designed to run in parallel on either of two sets of main bus-bars, called the "working" and the "auxiliary" bus, only one set of which is generally in use. The general plan of the main wiring is quite simple and is shown in Fig. 15. For the sake of simplicity, the three conductors forming a three-phase circuit or connection are shown in the diagram as one conductor.

The switches for the outgoing feeders are arranged in groups of six (three only of each group being installed at

present), these feeders being tapped from an intermediate or "group" bus. To distribute current to the feeders, therefore, it is first necessary to connect a group bus to either the working or the auxiliary bus, and this is done by providing each group with two selector circuit breakers, one for each of the two sets of main bus bars. Thus, any generator, or any group of feeders, can be connected at will to either set of main bus bars.

The course of the current from the generators through various switches and bus bars to the outgoing feeders can be readily traced from Figs. 14 and 19, which show a sectional elevation of the four electrical galleries. The cables are run through the turbine foundations into the basement (where taps are taken off for the generator potential transformers, whence small wire leads run in conduits to the instrument board in the operating gallery), then to main generator circuit-breakers which are placed on the feeder gallery next above the basement, with their backs to the engine room columns. The main generator circuit-breakers are shown on the right hand side of Fig. 18, which also shows the potential transformers directly in the rear of them along the engine room wall.

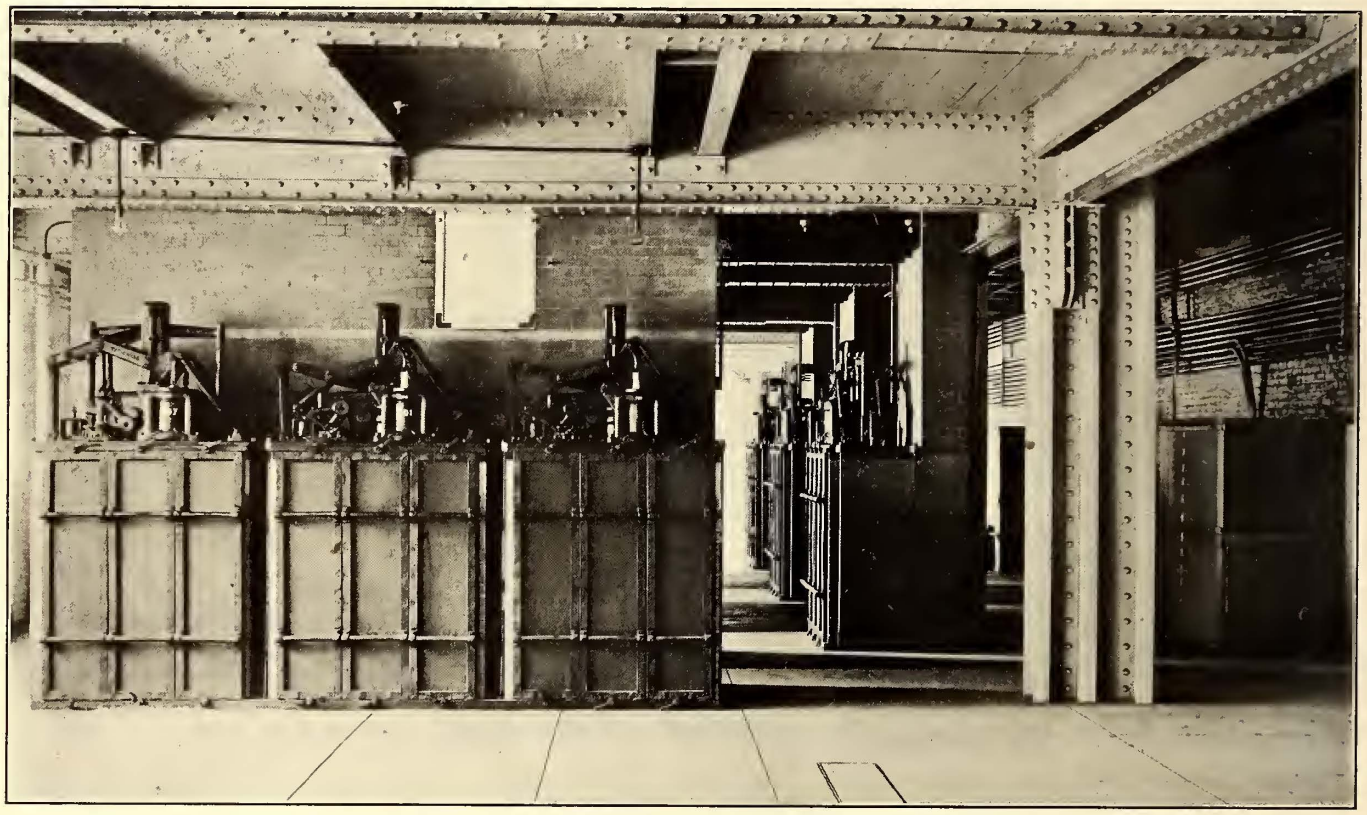


FIG. 18.—FEEDER GALLERY, SHOWING TYPE COIL CIRCUIT-BREAKERS FOR FEEDERS AND GENERATORS

The three bus-bars of the working bus are disposed in the three-story bus structure of brick and alberene stone along the north side of the gallery, the auxiliary bus being disposed in a similar structure along the south side and directly opposite the main bus. Ranged along the inner sides of these bus structures, and facing each other, are two lines of type "C" oil circuit breakers. The two smaller breakers on either line directly opposite to each other are the generator selector circuit breakers, and the two larger ones are the feeder group selector breakers. These successive pairs of feeder selector switches are joined underneath the floor by group bus-bars, and there being a selector switch at each end of this group bus-bar, the group bus can be joined to either the main or auxiliary station bus. The main generator switches are connected to similar sets of cross-connecting bus-bars joining the generator-selector switches, thus enabling any generator to be thrown in on either set of bus-bars by closing the proper selector switch. The feeders are tapped from the group bus joining two opposite feeder-selector switches, six feeders being tapped on to each auxiliary group bus, and each feeder having its separate circuit breaker. The feeder circuit breakers are, therefore, installed in groups of six, three of each group being now installed, the remaining three being omitted until future completion of the equipment. The middle section of Figs. 14 and 19 is a cross section through the switchboard galleries at the feeder cubicle, and shows how the feeder selector circuit breakers, attached to either the main or the auxiliary bus, can connect either bus to the feeder bus directly underneath. To the latter are attached the feed switches, from which the outgoing cables are seen descending through the basement to the three-conductor cables entering the conduits. In the same sectional view may be traced the main generator cables which, on leaving the main breakers, run in septums directly under the bus gallery floor with connections reaching up to the generator selector switches by means of which the generator can be thrown at will on either set of bus bars.

All of the circuit breakers have remote electrical control and are worked from the main operating gallery on the upper floor. The main generator circuit breakers are of 600 amps. each, the generator selector breakers of 600 amps. capacity, the feeder-group selectors of 1200 amps. capacity, and the feeder switches of 600 amps. capacity. The generator switches are four-pole, to accommodate an extra connection to the neutral point of the generator winding and a neutral bus which is grounded. All the other oil switches are three-pole.

Each pole of the circuit breaker is enclosed in a separate fireproof chamber of brick, capped with a slab of alberene stone upon which the operating gear is mounted. The contact piece is carried upon a substantial wooden rod, and the contacts are located near the surface of the oil instead of near the bottom of the receptacle, thus insuring freedom of deposits of carbonized particles at the points of contact. The

oil tanks are of sheet metal, and are insulated from the circuit. As is usual in this type of switch, the compartments are closed at the rear by the brick structure, while the front of each compartment is enclosed by a cover of asbestos lumber, held in place by eccentric clamps, thus facilitating quick and easy access to the parts. These switches are all electrically operated through solenoids actuated by current received from the auxiliary bus through controllers on the switchboard panels, as will be described later. The brick work of the oil switch structures is uniform with that of the bus structure, all being built of pressed yellow brick with caps of alberene stone.

Besides the oil switches there are also installed disconnecting hook type switches, to be opened and closed by hand, for isolating various parts of the system of connections when not in use, or while being inspected. These are mounted on heavy porcelain pillars placed in small compartments built into the brick bus structure. To get indications of the voltage across the main bus-bars, bus potential transformers are mounted in brick and alberene stone compartments on top of the bus structure. Leads from these transformers are carried to the instrument switch board.

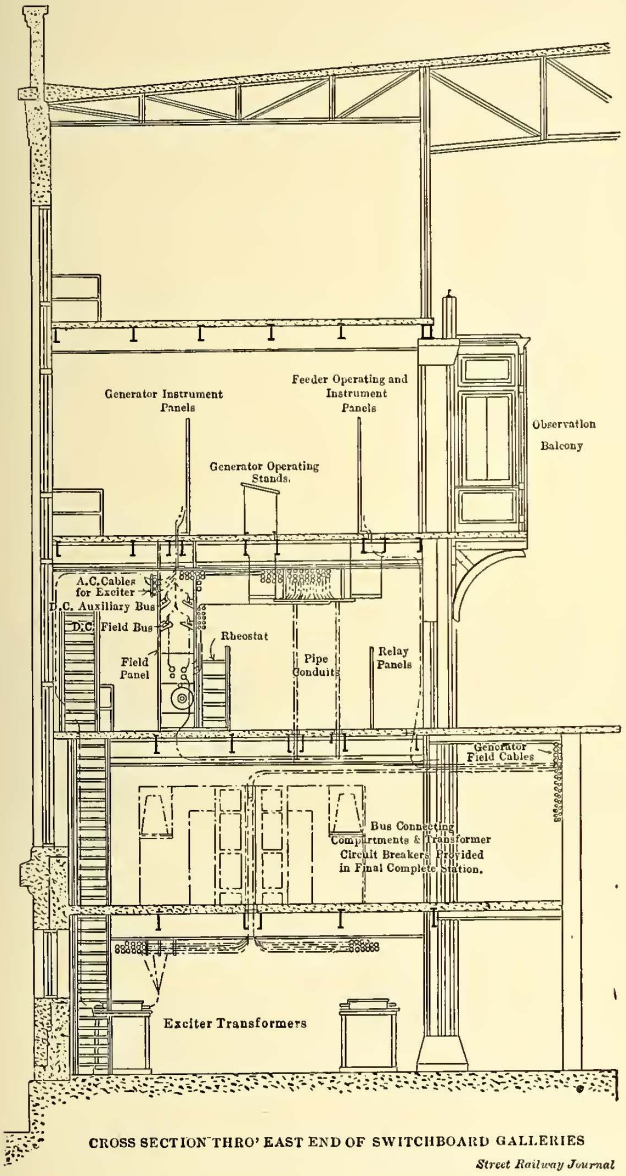


FIG. 19.—CROSS SECTION OF EAST END OF SWITCHBOARD GALLERY

The buses themselves are composed of copper bars, 3 ins. x ¼ in., resting on heavy porcelain pillars, each in its own compartment of the bus structure, and entirely isolated from the other two. The main connections between the bus-bars and all the main, generator, selector, and feeder switches are of heavy copper rods carried on porcelain insulators within brick compartments or "septums," to secure complete isolation of each conductor from all the others. These septums

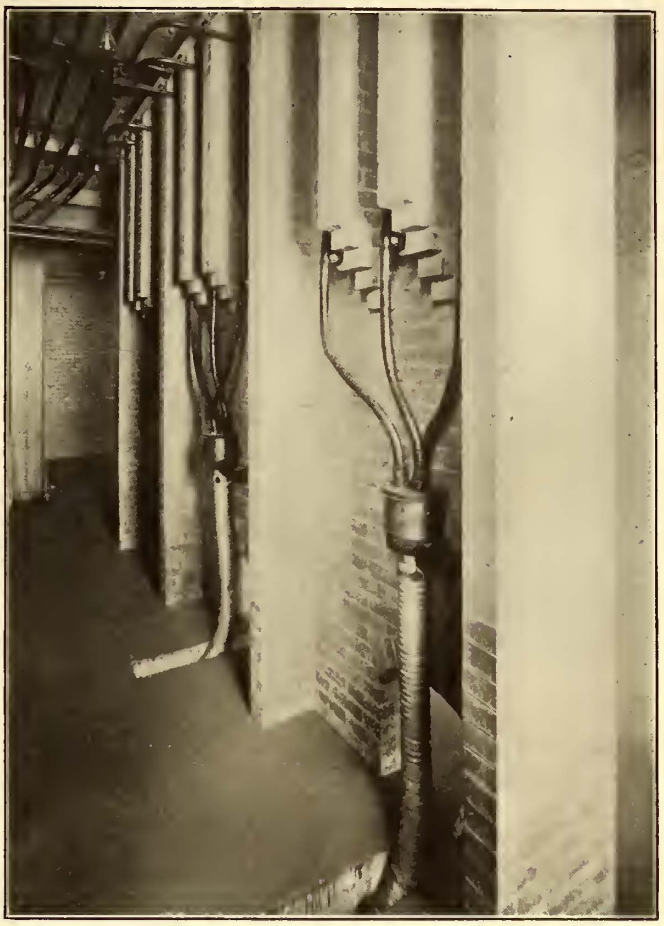


FIG. 20.—HIGH-TENSION FEEDER CABLES IN BASEMENT, ENTERING CONDUITS

are at the back of each of the feeder and generator switch structures.

From the feeder circuit breakers on the feeder gallery, the separate cables pass down through the floor, still in brick septums, to a few feet below the basement floor level, where they are spliced to the conductors of the three-phase cables, which are properly insulated and lead covered, and pass into the outgoing ducts which are laid in the floor of the basement gallery. Thence they are conducted to the distributing manhole at the commencement of the conduit line leading toward the sub-stations.

The connections between the main generator switches, the bus-bars and selector switches and feeder circuit breakers, are all of heavy copper bars or rods, mounted upon porcelain pillars. Bars and connectors of opposite polarity are separated by barriers or partitions of alberene stone, insuring absolute freedom from short circuit in this extremely important part of the installation. The enormous amounts of energy developed in the power house of this size are such as to make an absolute isolation of all main and bus connections a matter of paramount importance. The main conductors, separated as they are by partitions and carried on heavy porcelain insulators, need no other insulating covering.

ELECTRICAL CONTROL APPARATUS

The above described system of switches, bus-bars, and regulating or other auxiliary appliances is all controlled from the operating room at the east end of the third or operating gal-

lery. This location at the east end of the present engine room will be opposite the center of the completed engine room when the building is extended to accommodate the final installation. This gallery is about 13 ft. above the main engine room floor, and projecting from the generating room is an overhanging observation balcony that gives a good view of the whole engine room. Mutual intelligence for the proper operation of the turbines and the controlling switches is commonly interchanged between the engine room floor and the operating gallery by means of a system of visual signals.

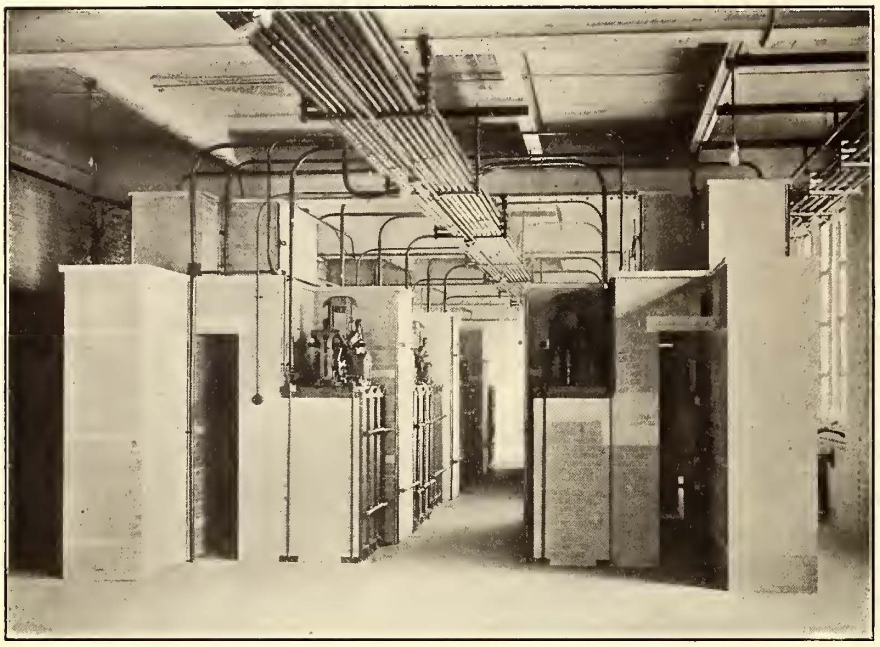


FIG. 21.—BUS STRUCTURES AND SELECTOR SWITCHES

The control apparatus consists of the following:

(a) Generator control bench.

(b) Greater instrument board, directly in front of the bench.

(c) Feeder control board.

(d) Exciter switchboard.

(e) Auxiliary switchboard.

The panels of these boards are of marble, and all panels and the metal fittings, switches and instrument cases have a dead black finish. The generator control bench resembles a low desk with an inclined top, and accommodates three sets of operating handles for the generator main switches, one set for each unit, and two sets for bus junction switches, which divide the main bus into sections. Directly opposite each generator panel on the desk is a vertical panel in the generator instrument board. The instruments on this panel are all operated from current derived from shunt potential transformers and series transformers, suitably located in the leads from each machine. On the narrow panel, to the left of the three-generator instrument panels now installed, are mounted three a. c. voltmeters, giving bus potential on each leg of the circuit, and a frequency meter. There are also two synchronizing lamps on this panel, one for each bus. On the bus junction panel at the right hand end of the instrument board, are mounted a differential a. c. voltmeter, two synchroscopes with plug receptacles, two synchronizing lamps, and an a. c. ammeter to indicate the current in the grounded neutral bus from the generators.

The feeder switchboard consists of three vertical panels, each containing apparatus for the control of six feeders and two feeder group selector switches, one of the latter running to each bus, end enabling the group of feeders on that panel to be put on either bus at will. Each of the three panels is at present equipped, however, with only three sets of feeder control apparatus, space being left for the remaining three when the installation is completed. The exciter switchboard is placed to the left of the generator instrument board with several blank panels intervening. A separate auxiliary switchboard controls the supply to all the various direct-current motors and the lighting system thrughout the station, and from it is also supplied the current required for electrically operating the generator selector and feeder oil switches, whether automatic or not.

All the outgoing feeder and main generator switches are fitted with both kinds of control, but all the selector switches have manual control only.

CABLES AND WIRES

The main generator cables are of the single conductor type, with four leads to each machine, each of 600,000 circ. mil, insulated with varnished cambric, 10-32 in. thick, protected on the outside with double braiding. Between the group selector switches and the outgoing feeder buses, each lead is of 1,318,000 circ. mil cable. Between the feeder switches and the end bells of the three-conductor cables that lead to the outgoing circuits, the cables are of 250,000 circ. mils. Between the feeder switches and the transformers that supply the

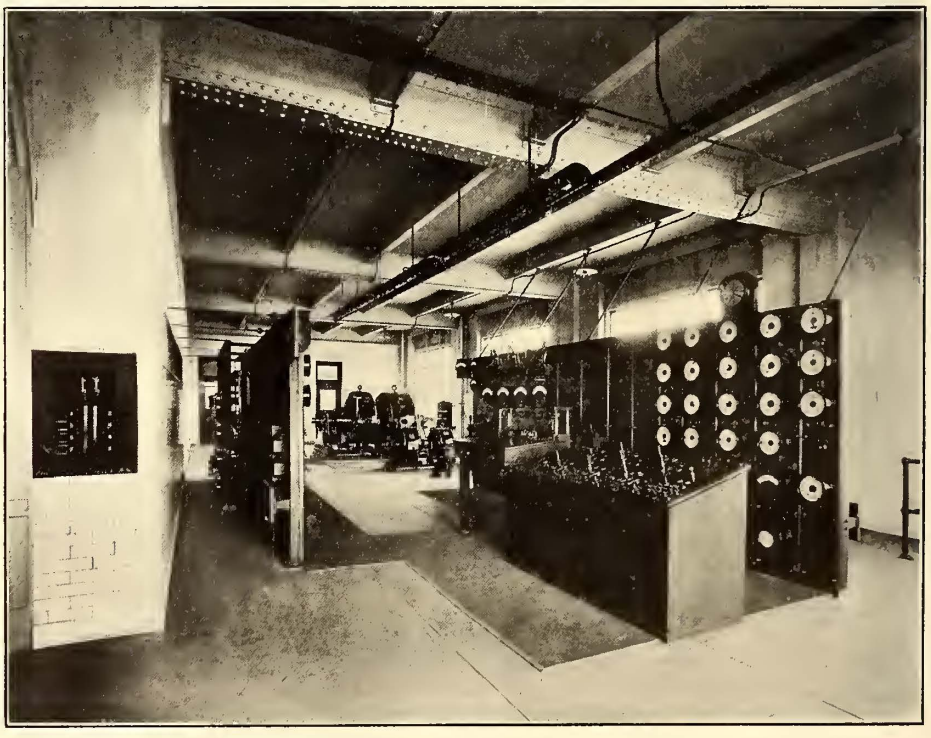


FIG. 22.—ELECTRICAL OPERATING GALLERY

motor generator exciter set, leads are 73,000 circ. mils. The main ground neutral lead connecting all the generators to the neutral resistance is of 600,000 circ. mils. All these cables are provided with 10-32 in. of varnished cambric insulation with a double protective braiding.

None of the power house cables, either high or low tension, is lead covered. The varnished cambric insulation of the cables, which was manufactured by the General Electric Company, is guaranteed to be sufficient for the working pressure adopted without the necessity of sheathing it with a continuous waterproof covering of lead, under the conditions that prevail in this power station, the ducts being so constructed that there is no possibility of moisture collecting in any point of the duct system.

The feeder cables leading to the high-tension transmission system are of the three-conductor type. Each conductor is of 250,000 circ. mils, and is wrapped with a layer of paper insulation, 7-32 in. thick. The three insulating strands when twisted into one cable are then surrounded with an additional insulating wrapping, 7-32 in. thick, and the interstices filled with jute. The whole is enclosed in lead sheath, 9-64 in. thick. These cables leave the power station through ducts laid in the floor of the basement gallery, which lead to a manhole directly outside of the building .

Each high-tension cable is provided with end balls of spun brass, 7¾ ins. in diameter and about 5 ins. deep, sweated to the end of the lead sheath of the cable and filled with insulating compound.

ENGINE-ROOM SIGNALS

A very complete system of signals for intercommunication between engine man and electrical operator has, therefore, been installed, which consists of a number of illuminated signals grouped together and located at a point visible from all parts of the engine room. These are worked from the operating gallery after the engine man's attention has been obtained by means of a whistle signal. A system of returning signals operated from the engine room floor, and showing in the operating gallery, enables the engine man to show the electrical operator that his signals have been understood, and the two systems together supply all necessary communication between the two operating floors. A large synchroscope visible from all parts of the engine room has been installed, so that by watching it the engine man is informed as the generator approaches synchronism and is switched into service. Figs. 8 and 10 show the signal board mounted conspicuously on the south wall of the engine room with the synchroscope on top of it. The large letters and figures are illuminated from behind by incandescent lamps, which are lighted when the proper contact keys are pressed by the electrical operator. A corresponding set of keys at each turbine enable the engine man to light the answering signals on the instrument panel in the operating gallery.

Suspended from the large signal board is a load indicator, by means of which the engine room forces are notified regarding the condition and tendency of the station load. This is actuated by an electric circuit manually operated by the main switchboard attendant. Other load indicators of the same type are also located in the upper and lower boiler rooms for the same purpose.

LIGHTING AND HEATING

The lighting for the station is done by arc lamps for general illumination, and incandescents for detail illumination. The arc lamps are run from a 110-volt d. c. circuit. The incandescent lamps are 220 volt and of 16 candle power.

The heating of the electrical galleries and offices is accomplished by means of a direct system of low-pressure direct steam pipe coils, amounting altogether to aobut 3300 sq. ft. of radiating surface. It is supplied by live steam, working through a reducing valve.

HOISTING MACHINERY

The traveling crane spanning the engine room has a capacity of 55 tons, and a span of 64 ft. It is of the double-trolley type, with a hoisting and a trolley motor on each trolley, besides the main motor which propels the entire crane. These motors are all operated from the 220-volt circuit. The crane was built by the Morgan Engineering Company. The hoisting trolleys are geared for both slow and rapid hoisting. Steel wire hoisting ropes are used throughout.

Two elevators have been installed, one a passenger elevator for serving the offices and electrical galleries, and the other a combination freight and passenger elevator in the boiler house, running from the basement to the top of the coal bin. These elevators were made by the Marine Engine & Machine Company, and all are of the electrically-controlled type operated from a 220-volt circuit. They are driven by motors capable of handling live load of 1800 lbs. at 200 ft. per minute and are fully equipped with safety devices. The elevator in the boiler house is arranged for automatic button control.

CONCLUSION

The first work of clearing the site began on Sept. 15, 1903, and the excavation on Oct. 20. The first turbine was started Jan. 16, 1905; high-tension current first turned into the transmission lines April 27, 1905. Current was furnished for testing cars on May 13, and on July 26, 1905, the line between Flatbush Terminal and Rockaway Park, the first section of the Long Island Railroad to use the new motive power, was permanently changed from steam to electrical operation.

The station was planned and built by Westinghouse, Church, Kerr & Company, engineers, for the Pennsylvania, New York & Long Island Railroad Company, which is the organization through which the Pennsylvania Railroad is carrying on its New York extension work. The design and construction were under the charge of George Gibbs, chief engineer of electric traction of the road, and under the general supervision of the Mechanical & Electrical Advisory Committee, New York Extension; a committee composed of officers of the Pennsylvania Railroad Company.

GETTING A NEW NAME FOR A NEW PARK

Big Island Park is the name the Twin City Rapid Transit Company has selected for its new amusement park on Big Island, at Lake Minnetonka, out of more than 2000 names suggested. In response to the company's invitation for a name, replies came from all over the United States. Suggestions even came by wire. A deluge of poetry was offered and the dictionaries seem to have been ransacked for words denoting pleasure. The name selected commends itself because it is historic, the island having been known as Big Island for 25 years or more, and is known prominently as part of Minnetonka. It also conveys the meaning of an island park. The keen interest which was manifested indicates how the Twin City's new amusement island at the lake has aroused the public, and with all the suggestions came pleasant words of good luck and well wishing for the island. Dana Todd, of Minneapolis, was awarded the prize of a chartered car party to the lake and island, as the guest of the company, on some day in the early summer, when the island is ready to be seen in all its beauty.

BAKER STREET & WATERLOO RAILWAY OF LONDON

The first of the underground tube railways in London, which belong to what is commonly known as the "Yerkes Group," was put in operation March 10, and is now in daily use. So much has already been published regarding the complete scheme of work which the late Mr. Yerkes laid out that it is hardly necessary to refer to it at this point. As has been frequently stated in these columns, the first of the processes of electrification which took place was the electrification of the Metropolitan District Railway, which is now a completed fact. In addition to this scheme, there have been under construction for the past few years three entirely separate tube or deep underground schemes, and the first of these to be completed, the Baker Street & Waterloo Railway, is the one now shown in the accompanying illustrations. To anyone studying the map of London, it will be seen that the east and west has been fairly well provided for with means of transportation. The north and south has had, however, little done to enable one to be transported comfortably from the northern limits of the city to the southern portions. The City and South London tube was the first to make some effort in that direction, but as it is confined to the "City" and has no connection with the West End, it could only do a portion of the work. The Baker Street & Waterloo Railway will undoubtedly fill a long felt want, as hitherto there have been almost no methods of communication between Charing Cross and the West End of London and the north-western suburbs. This railway will now connect Waterloo Station, the great terminus of the London & South Western Railway, with the West End at Trafalgar Square, Piccadilly Circus, Oxford Circus, and so on to Baker Street, where it will connect with the Metropolitan Railway system running further into the north-westerly suburbs. Later on when the scheme is completed it will also touch the Great Central Railway and the Great Western Railway at Paddington. The engineers for the construction of the line are Sir Benjamin Baker, Galbraith & Church and Dalrymple Hay, while the whole of the electrical equipment has been ably superintended by J. R. Chapman, chief engineer of the Underground Electric Railways Company of London.

The tube has been constructed practically in the same manner as other London tubes, and has been bored by means of the well-known Greathead cutting shields into the London clay, at an average depth of 60 ft. to 70 ft. below the surface. Previous articles in this paper have described this method of construction, so that it is not necessary to refer to it here, but the view on this page will give an idea of the shape of the cast-iron sections which are put in to make the tube after the clay has been cut away by means of the workmen in the shield. One of the interesting features of this tube has been that a large portion of the work has been conducted from a temporary staging in the river Thames, by means of which all of the clay dug out was taken away by means of scows and all of the necessary material for the tube was brought in the same manner, two vertical shafts being sunk into the bed of the river for that purpose.

TRAFALGAR SQUARE STATION OF THE BAKER STREET & WATERLOO SUBWAY

It will be remembered that the opening of the Central London Railway, popularly known as the "Twopenny Tube," was the commencement of a series of complaints from house-

holders on the route of great annoyance from vibration, and so considerable sums of money in the way of compensation had to be paid. This railway, it will be remembered also, was operated by locomotives, but these were ultimately dispensed with and the multiple-unit system adopted, which eliminated to a very large extent the troubles of vibration. The subject of vibration, however, was considered a very important one, and every endeavor has been made in the Baker Street & Waterloo tube to prevent any trouble of this kind. Cross ties of non-inflammable Jarrah wood have been embedded in a bed of concrete, and the rail is of the regular British railway type, 90 lbs. bull-headed. Suspended joints are used and ballast is used between the tracks. The contact rails are rectangular in section and notched at the sides, so as to allow them to be clamped in chairs. The chemical composition is as follows:

	Per cent
Carbon	.05
Manganese	.19
Sulphur	.05
Phosphorus	.05
Silica	.03

The insulators are of vitrified earthen ware, made by Doulton & Company.

Everything has been done to make the risk of fire a practically negligible quantity. The station platforms are constructed of concrete and iron, and the ties, as stated, are non-inflammable. The rolling stock, referred to later, is built almost entirely of steel, and the small quantity of wood used for decorative purposes inside the cars is rendered non-inflammable. The whole tube also has been fitted with a system of electric lighting, electric lamps being placed at intervals of 40 ft., these lamps being supplied by an entirely different source of current from the cables which supply the power for operating the trains.

The signalling system is that known as the Westinghouse electro-pneumatic automatic, and is similar to that which is installed on the Metropolitan District Railway, which was described on page 417 of the STREET RAILWAY JOURNAL for March 4, 1905. The system differs from that used in Boston and New York, in that besides the two running rails there is a fourth or return rail and a negative signal main. One of the running rails is continuous throughout the entire length of the road and constitutes the positive feeder to, or pole of, the signal system. The other running rail is divided into block sections by insulated joints and is connected to the negative main through a resistance at one end of the section, and a pressure of from 2 volts to 4 volts is maintained between the two running rails. Power is supplied from the motor generator sets installed in each sub-station at 60 volts pressure. The negative terminals of these machines are connected to the insulated conductor or negative signal main, running the entire length of the system.

THE YARD AT KENNINGTON FOR STORAGE OF CARS, REPAIR SHOPS, ETC.

At each end of the block section a polarized relay is connected by one terminal to the block rail, and by the other terminal to the continuously bonded running rail. The local signal circuit is controlled by both relays, and unless they are both suitably energized by a current in the normal direction, the signal cannot drop to clear. The entrance of a vehicle into the block section short circuits one or both of the relays,

and the signal is placed at danger and remains so as long as the vehicle is in the section. The main feature of this installation is that currents extraneous to the signal system cannot affect the apparatus so as to cause a false indication of safety. When a train is in the section, one or other of the relays is always reversely energized or shunted, thus opening the local signal circuit at one or two points. Each train works the signals automatically, the signal of the section of the train which has just left being automatically set to "danger" by the passage of the train. When the train reaches the end of the block, this signal is released and is set at "clear." There is also an automatic stop, which consists of an iron arm outside the track rail, so that should a motorman at any time take his train past the danger signal, the current will be automatically shut off by means of this iron arm actuating on the mechanism of the car itself, which engages with the air brake system on the train.

STANDARD CAR FOR BAKER STREET & WATERLOO RAILWAY

An emergency telephone system has also been provided for the use of motormen which can be made use of at any time, a pair of bare copper wires being installed in the tunnel which are within the reach of the motorman's cab at all times.

A great deal of thought has also been given to the subject of ventilation. Six exhaust fans have been installed at intervals, capable of withdrawing 18,500 cu. ft. of air per minute from the tunnels, which is sufficient to change the whole atmosphere of the tunnels about once every hour, allowing for the fact that some fresh air must of necessity be also extracted.

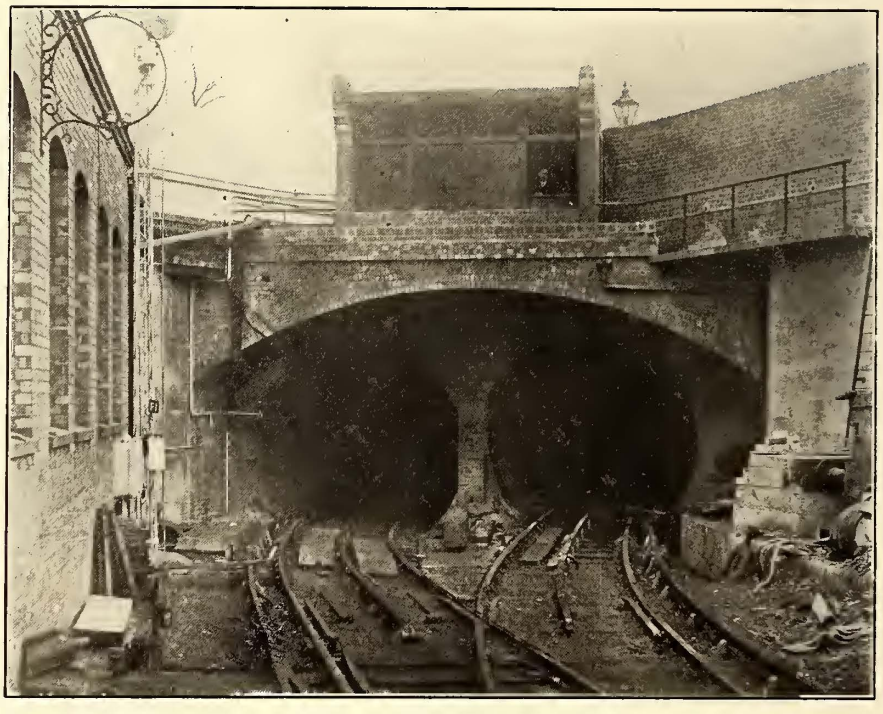
The stations themselves on this tube railway are the most attractive of any of the stations on the London railways. Each of the stations, as in the New York Subway, has a distinctive coloring or design. Each station is lined with glazed tile. The names of the stations appear in bold letters on the tiles and are permanently fired on.

Electric elevators are, of course, provided at every station. These elevators have an area of 150 sq. ft. The winding apparatus is above, and is operated by electric motors. In addition to the standard "Otis" safety device the motors are so wound that they will become self-exciting and act as powerful brakes themselves. Two powerful electro mechanical brakes are also fitted on each worm-shaft. The motors are connected to the drum shaft by worm wheel and spur gears. Each motor is of 35 hp, with a speed of 625 r. p. m.

The total length of the line (double track) is about 5 miles. There are eleven passenger stations and the average schedule speed is 14 m. p. h. The motors were supplied by the British Thomson-Houston Company, Ltd., of Rugby, and consist of GE-69s, 200 hp, with Sprague Thomson-Houston control. There are thirty-six motor cars, each equipped with two motors, and seventy-two trailer cars. The trains will be made up of six cars, a motor car at either end and four trailers in the middle.

All the control apparatus, as well as the air compressors, is carried in a steel cab at the driving end of the car. Here the contactors and circuit breakers are hung from horizontal slate panels supported by rigid steel framework. This form of construction was adopted because the small diameter of the tunnel does not allow sufficient room for the apparatus to be carried under the car, as in the case of the District Railway. It is also considered safer on the "tube" lines to have the apparatus enclosed in a steel cab in case of any fault developing in the equipment while a train is running in the tunnel.

Current for the Baker Street & Waterloo Railway is, of course, derived from the large station at Lots Road, Chelsea, which has been described in this paper, and the road will have physical connections with the Metropolitan District Railway and the Charing Cross, Euston & Hampstead Railway at Charing Cross station, and the Great Northern, Brompton & Picadilly tube at Picadilly Circus.



ENTRANCE TO TUBE FROM KENNINGTON YARDS

There are two sub-stations which feed the Baker Street & Waterloo Railway exclusively, both of which were completely equipped by the British Westinghouse Electric & Manufacturing Company., Ltd. They are situated at Baker Street and London Road, respectively, and their design, and that of the electrical machinery installed in them, are identical with those of the Charing Cross sub-station of the Metropolitan District Railway, a description of which was published in the Street Railway Journal of March 4, 1905. The only dif-

ference is in the number and capacity of the rotaries, transformers, feeders, etc., which are as follows:—

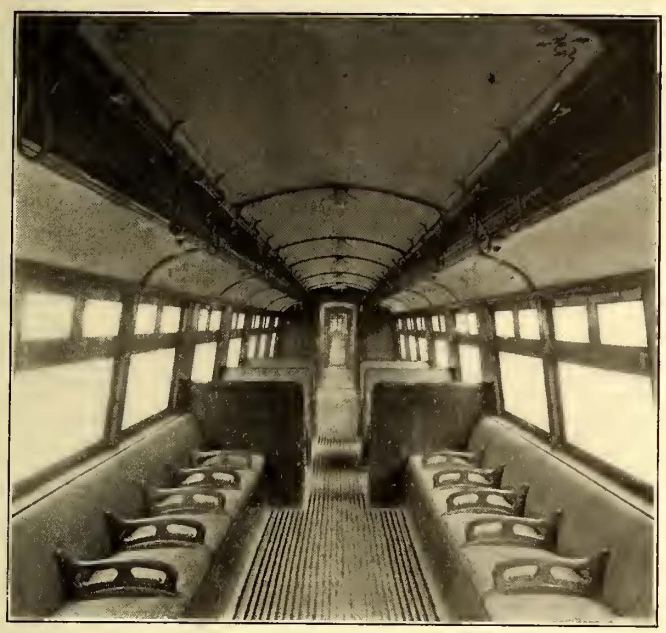
Two 800-kw rotary converters. (Space provided for one extra.)

Six 300-kw air-blast transformers supplying current to the rotaries.

Two lightning transformers supplying current for lighting the stations and tunnels.

Two motor generator sets for signaling apparatus.

There are two in-coming, high-tension, three-phase feeders at each sub-station, and five out-going feeders to the conductor rails at Baker Street and six at the London Road sub-station. All other details are covered by the Charing Cross description.



INTERIOR OF SUBWAY CAR FOR BAKER STREET & WATERLOO RAILWAY

The rolling stock, which is illustrated in this connection, was manufactured by the American Car & Foundry Company in America and put together at the company's Trafford Park works at Manchester. The cars are built almost entirely of steel, and the few internal fittings of wood have been treated so as to render them non-combustible; 108 cars have been ordered and 95 are completed. Six cars makes a standard train, of which the two end cars only are motor cars. All the cars are 50 ft. over all, 33 ft. between truck centers, 8 ft. 8 ins. in width and 9 ft. 5⅜ ins. high from rail level. The trailer car seats 52 passengers. The motor car has seats for 46 passengers, the remainder of the space being taken up by the motorman's cab and electric control apparatus. The motor trucks have wheels 36 ins. in diameter; all other wheels are 30 ins. in diameter. The floor of the car, except in the motorman's cab, is only 22 ins. above the rails.

The fare for any distance is 2d. and books of 25 tickets can be bought for 4s. In addition, workmen's return trip tickets, good on week days up to 7:58 a. m., can be bought for 2d.

INSTRUCTIONS TO INSURANCE INSPECTORS IN CLEVELAND

During the past two years the Cleveland Electric Railway Company has devoted considerable study to the subject of the insurance of its property against loss by fire, and especially to the subject of protecting its buildings and rolling stock against damage by fire. Among the precautions it has adopted has been the appointment of an employee of intelligence and ability at each shop and car-house to make daily inspections of the property, with a view to the prevention of fires. To assist these men in the performance of their duties the company has issued a series of printed instructions. These instructions are reproduced below.

INSTRUCTIONS TO INSPECTORS OF BUILDINGS

An ounce of prevention is worth a pound of insurance. This company cannot afford to have a fire in any of its power stations or car houses, or elsewhere. An extensive fire would not only destroy property of great value, but would cripple the company's business and cause a large loss in earnings. More than this, it would result in seriously inconveniencing its patrons, who are all the people of Cleveland and vicinity. The company has recently expended more than $100,000 for equipping its car houses with automatic sprinklers, and other large sums for fire-hydrants, for bricking up windows in car houses and for other purposes, in order to protect its property and business against loss or damage by fire. It is willing to spend more, if necessary, to make its buildings as nearly fire-proof as practicable, and it desires the co-operation of every employee in its efforts to prevent fires.

Observe carefully, therefore, the following instructions:

AS TO SPRINKLER EQUIPMENTS

See that all sprinkler lines are rigid and unobstructed at all times, and that proper water and air pressure are maintained.

See that no electric wire is in contact with the piping or hangers.

See that the gravity tanks are full of water.

See that all valves are sealed in proper position, either open or closed.

See that all indicator-posts register "Open."

See that tank risers and valve houses are properly heated, so that water in them will not freeze.

See that all drain valves are in working order.

See that all water connections and air pumps are operative.

See that alarms are in working order.

See that at least six sprinkler heads are on hand in each building.

Report, on the blank furnished for that purpose (form 150), the air and water pressures, in pounds, at valves, each day, and send the report, at the end of each week, to the master mechanic.

Study the sprinkler system, and suggest any modification that will, in your judgment, increase its efficiency.

AS TO GENERAL CARE AND CLEANLINESS

Inspections should be made daily of all buildings.

If any building is out of repair, report what repairs are needed.

Floors should be swept once a day, and all dirt and refuse placed in proper receptacles.

Smoking is not permitted in any building (except in club rooms, motormen's and conductors' waiting rooms, and other places designated for that purpose).

All buildings and cars should be kept constantly clean and free from litter.

Oil should be kept in the oil-storage houses.

If a fire is started in a car stove while the car is in any building, or if kindling is saturated with oil in any building, or within 20 ft. of any building, or if ashes are taken from any car stove while the car is in a building, report the fact.

If a car stove or chimney is broken or in bad condition, report it at once for repair.

See that the apparatus for heating the building is safely arranged.

See that all chemical fire extinguishers are charged, free from frost, and in good order.

See that fire pails are full of water in summer or sand in winter.

See that fire-hose is in place and in good condition, and that employees know where to find it and how to use it.

See that hydrant houses are in good order, with lanterns, axes, spanners, wrenches and hose ready for use.

See that all pits, closets, floors, benches, shelves and corners are free from dirt and grease.

See that oily waste not in immediate use is placed in standard waste cans, with self-closing lids, and that all waste cans are in order.

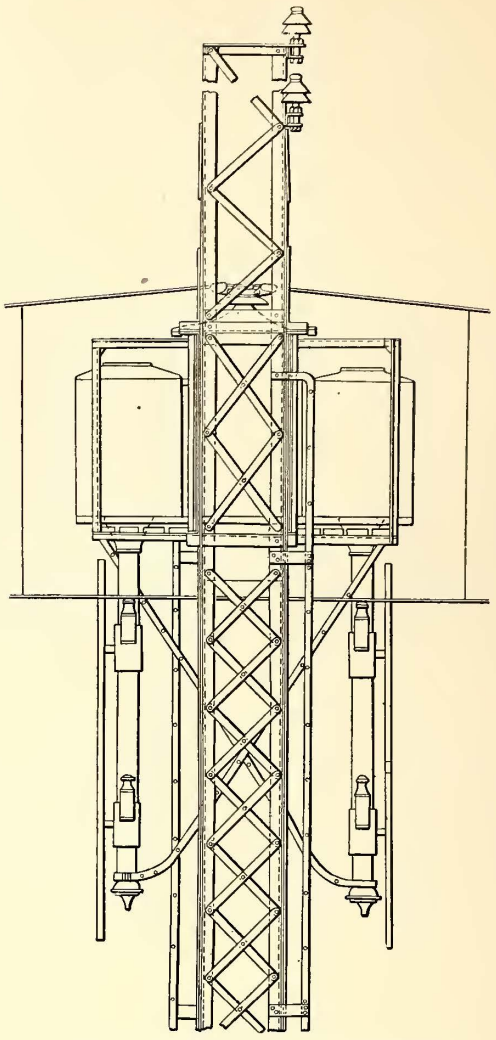
Suggest any improvement or change in construction or operation that will, in your opinion, lessen the hazard of fire.

All reports and suggestions should be sent to the master mechanic.

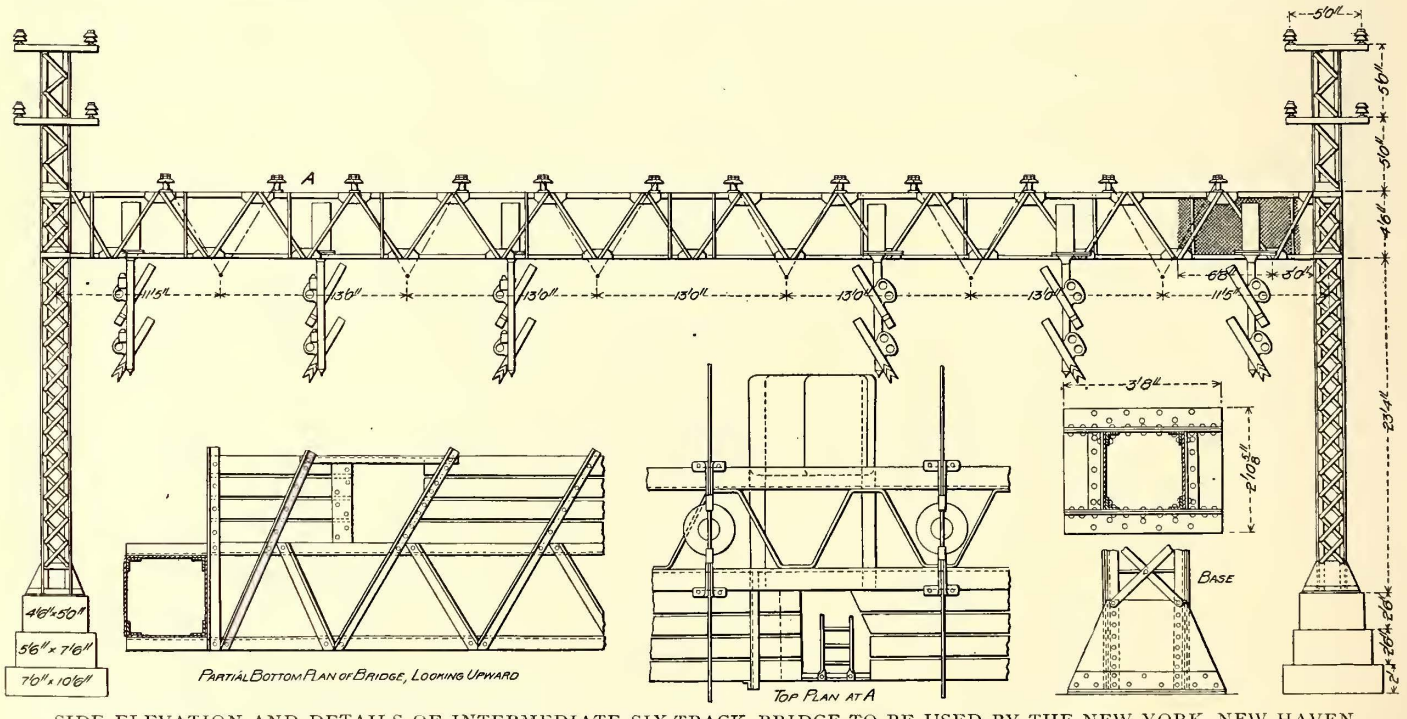
OVERHEAD CATENARY CONSTRUCTION FOR THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD

An account was published in the Street Railway Journal of Feb. 17 and March 24 of the overhead catenary construction proposed by the New York, New Haven & Hartford Railroad on its electrified section from Woodlawn to Stamford. As will be remembered, each trolley wire will be carried on two 5/8-in. steel catenary cables and that these catenary cables are carried on steel structural bridges which span four, and in some cases six, tracks. These bridges will be located every 300 ft. The trolley wires will be divided into sections, about 2 miles in length, by oil circuit breakers, which will be carried at these points on a bridge of heavier construction, known as an anchor bridge.

The accompanying engravings illustrate one of the intermediate bridges of the company, designed by the Westinghouse Electric & Manufacturing Company, and intended for spanning six tracks. As will be seen, the posts are 87 ft. 10 ins. apart on centers, 22 5/8 ins. square, and are made up of four 4-in. x 4-in. x 9-16-in. angles with 2¼-in. x 7-16-in. double lattice bars on each side. The angles of the column are riveted at the bottom to a built-up base of plates and angles, which has a bearing surface 3 ft. 3 in. long and 2 ft. 10 5/8 ins. wide on the concrete pedestal, to which it is attached by four anchor bolts per column. The pedestal is 4½ ft. x 5 ft. at the top, 7 ft. x 10½ ft. at the bottom, and 7 ft. deep. The anchor bolts are carried through the entire mass of concrete to 15-in. anchor plates on its bottom surface. The columns are connected by a pair of light Warren trusses, each having a 6-in. x 4-in x ¾-in. angle for a top chord, and a 4-in. x 3½-in. x 11-16-in. angle for a bottom chord, with angle-bar diagonals ranging in size from 3½ in. x 2½ in. x 3-8 in. at the ends to 2½ in. x 2 in. x 5-16 in. at the center. These chord and diagonal angles are connected by gusset plates with six rivets each. The top chords of the two trusses are connected by 2¼-in. x 5/8-in. diagonal straps, which are riveted to the



END ELEVATION OF INTERMEDIATE BRIDGE, NEW YORK, NEW HAVEN & HARTFORD RAILROAD



SIDE ELEVATION AND DETAILS OF INTERMEDIATE SIX-TRACK BRIDGE TO BE USED BY THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD FOR SUPPORTING TROLLEY WIRES & SEMAPHORES

vertical faces of the angles instead of being arranged like ordinary lattice bars. The lower chords are connected by a single system of latticing, consisting of 2¼-in. x 2-in. x 5-16-in. angles.

Each alternate angle projects beyond the lower chord of the truss so as to carry a plank platform about 2 ft. 10 ins. wide. This platform is on the opposite side of the bridge from the signals and, as the latter are on the side of the bridge

facing the trains, it follows that the platform is on one side of the bridge for half the length of the latter and on the other side for the remaining distance. This platform is covered with expanded metal to protect the inspector from the high-tension lines while handling the signals. Protection against accidental contact with the catenary cables overhead is provided by a covering also of expanded metal on planking, which is carried on 2½-in. x 2-in. x 5-16-in. angles, spaced every 7 ft., and riveted to the top chord of the truss. These angles are supported by the outer ends by uprights, which are of the same size, and 4 ft. 8 ins. long, and which are riveted at their base to the platform angles.

The triangular hangers, which support the No. 0000 trolley wire from the catenaries, are spaced 10 ft. apart. They are sections of pipe and consequently hold the trolley wire rigidly to the supporting cables, but the whole structure has a spring motion on account of the flexibility of the stranded cables. All the pipe hangers are in a vertical plane at right angles to the track. The weight of the intermediate bridge is approximately 13,000 lbs.; that of the anchor bridge, approximately 23,000 lbs.

THE SECOND QUARTERLY MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK

The second quarterly meeting of the Street Railway Association of the State of New York was held on March 29, in the Rathbun Hotel, Elmira, N. Y. The morning session convened at 10:30 o'clock, with about thirty-five members present and President R. E. Danforth in the chair.

MORNING SESSION

President Danforth opened the morning session by introducing to the members B. V. Swenson, secretary of the American Street & Interurban Railway Association, and asked him to outline the plans of the reorganized associations.

Mr. Swenson first referred to the advantages secured in association work, and a discussion of engineering, managing and auditing methods. He believed that a frank, open discussion and interchange of ideas, such as occurred at the last quarterly meeting of the New York association could not but be mutually beneficial. The American Street Railway Association was formed at a time when all of the smaller systems were operated by horses. Between 1884 and 1888 attention began to be directed to electricity and in 1895 the interurban railway made its appearance. The national association has thus kept in touch with the entire development of the street railway industry. In 1897 the Accountants' Association was formed, and the Mechanical and Electrical Association in 1902. Probably the most important subject upon which the latter association is now working is the standardization of equipment. The present committee is engaged upon the standardization of such items as journal boxes, wheel treads, brake shoes, and of track between city and interurban railways. This is of great importance when it is considered that it will not be long (and, in some cases, it is already being done) before cars will be interchanged between roads. The Claim Agents' Association was organized at St. Louis in 1904, and has already accomplished a great deal of good in compiling statistical information relating to fradulent accident claims. Attention has also been given to the knocking-down of fares by men who make a practice of going from one road to another.

After outlining the system of dues adopted by the new association, Mr. Swenson referred to the work now being done by several of the standing committees. The insurance committee, of which Henry J. Davies, secretary of the Cleveland Electric Railway Company, is chairman, has conducted a series of investigations and negotiations, as a result of which it is expected that the companies will be able to secure an average rate of 25 cents per $100 on protected property and 75 cents for unprotected property. The committee on compensation for carrying mail has secured information on rates paid for carrying mail from between 150 companies and 200 companies. The postal authorities at Washington do not seem inclined to afford very much assistance, but the committee's work has been presented to the postal authorities and to the members of the congressional committee. At present the rates are 3 cents for pouch mail and 15 cents per car mile. It is hoped that this will be advanced in a short time to 5 cents or 6 cents for pouch mail and 25 cents per car mile for mail cars.

There are additional committees on promotion of traffic, heavy electric railroads, municipal ownership, welfare work, public relations, etc. The committee on topics and papers is also at work on papers for the next convention, which will be held at Columbus, Ohio, from Oct. 15 to Oct. 19.

The president then announced that the first topic for discussion would be methods of increasing traffic by advertising, and in the absence of the author requested the secretary to read the paper on "Advertising" prepared by H. E. Smith, general passenger agent of the Hudson Valley Railway Company, of Glens Falls, N. Y. This paper was as follows:

ADVERTISING

The conditions under which urban and interurban roads throughout the country operate vary so much and the diversity of business served in different localities is so great, that it is almost impossible to give any one or more ways which will best bring what a road has to offer before the public in an attractive way, and gain the best results from the publicity department. Each manager should make a careful study of the interests which his road serves. He must study the people and ascertain what induced riding can be created. The people in some communities can and will afford to take advantage of frequent attractions, while in other places the people cannot spend their money quite so freely. The careful and conservative management will take these things into consideration and not endeavor to force attraction riding where there can be no results.

There is hardly a trolley road of any importance to-day but has its park or parks and on whose park lines riding must be stimulated by some means. It should be the aim of every manager before the opening of the park season to cast about his territory and ascertain what chartered car business can be worked up for his park, not only because there is good money in business of this kind, but because the chances are that a large number of people who make the trip in this way will enjoy themselves so much that they will want to go often, either individually or in small parties. Get the people to talking about your resort and others will follow. In order to interest Sunday schools, lodges, societies, etc., in your road or park, a complete list of such organizations with the names of officers should be at all times available, and to the names on this list the literature of the road and park should be sent early in the season, together with a short personal letter. The letter should be brief, but enough can be said to attract the attention of the person to whom it is sent so that it will not be thrown aside. Get the attention of the people in charge of these organizations and set them to thinking of the varied amusements to be had at your resort. After a short time, if nothing is heard from the letter, a personal call should be made, and the trip explained more in detail in such a way as

to leave no doubt in their minds as to the advisability of running an excursion to your park. Personal interviews will go farther than the best advertising. On excursions of this kind it is well to have a representative of the company accompany the party, to look after details.

In order to get your park before the public generally a number of methods can be adopted, all of which have been found more or less beneficial. Cars can be equipped with announcement boards to be hung on the dash on open cars and on the side or front vestibule of the closed cars. These boards should be about 22 ins. x 28 ins., in order to take a fair-sized sheet and give a good display. Care should be taken not to get too much matter on a sheet, as this kind of advertising must necessarily be read hastily and in some cases from considerable distances. Therefore, the main features only should be brought out with the best type obtainable. These same boards may be used during the winter to advertise skating rinks, theaters, etc., along the line. Our experience has been that theaters are only too glad to furnish paper and labor for this kind of publicity. In connection with this outside display it is well to follow it up with hangers inside the cars or permanent cards placed in either the side or end spaces, so that whatever fact you are trying to bring out is not lost sight of at any time. Hangers for the inside work make a very effective display and can be used at your different stations or hotels and stores, but unless a great deal of attention is given this method it is not permanent.

In the matter of literature each manager will have to govern himself according to the conditions. As far as possible, a standard size should be adopted and followed. The most important form to have at all times is a good supply of detail time tables adapted to the needs of the public. If it seems desirable, pages may be added with descriptive matter, but so far as possible the two should be kept separate. In placing time tables especially, or literature in general, before the public, great care should always be used to make the matter as simple as possible. Get the literature up in such a way as to make it easily understood, for the majority of people do not fully understand how to get at anything but the simplest kind of a time card. Some roads solicit advertising enough for their literature to offset the cost of printing, but for anything outside of time table literature this does not pay in the end for it cheapens descriptive literature so much that it is less effective.

If your roads run through a historic country a study of the historical points can be made and literature pertaining to them can be put out. Or if you are obliged to depend upon picturesque scenery, manufacturing towns or mining regions, a little study will soon bring out points that will be interesting if put before the public in the proper way. Summer or winter resorts along your line should receive attention and oftentimes one resort will call for a whole booklet telling of the best way to reach it, the beauties of the place or the trips to be taken by your line after people have arrived. In getting out booklets describing special trips from resorts it should always be your aim to bring out your points in the simplest manner possible. Try to make the public see on paper just what you yourself have seen a thousand times with the eye in a clear, concise way, and the chances are the people will make the trip your literature suggests. Only the largest roads would probably be able to issue a weekly or monthly paper for distribution, though even the smaller roads might be in a position to run during the summer months a small pamphlet weekly which, with the proper distribution, would get into the hands of a large number of trolley riders. Enough advertising can generally be solicited to defray a large part of the expense. Special articles can be called for from the public to be used in the pamphlet for which prizes can be offered, which will create interest in the publication. There are innumerable prize schemes which can be worked out not only in a literary way but for park features as well.

In the matter of distribution of literature, we find that small tin racks placed in one end of the cars for time tables and literature prove one of the best ways to get this matter into the hands of the public. These same style of racks may also be used for hotels, stores and other public places. Nearly every one will gladly allow the racks to be put in their places of business. Of course, all stations along the line should be kept supplied with these racks and time tables. We also send literature to all bureaus of information, such as those established by the larger metropolitan papers. At the resorts along our line we put our advertising in the hotels and boarding houses, and then follow it up with a man of good address who is something of a reader of human nature. When he sees people reading or looking over literature, he can step up and introduce himself and explain details of some of the trips, and he usually secures the party for a trip.

In announcing special excursions or features which are only for a day or evening, we find that it is not wise to advertise too far in advance. Excursions advertised by steam roads are generally of longer duration than those on the trolley, and for this reason the public must have a longer time to think and plan over the trip. People usually take a trolley excursion on the impulse of the moment and, therefore, it is well to get out bills, dodgers and newspaper display only a few hours before your attraction. Spring it on the public in the best and most complete way possible under the existing conditions.

With the exception of the time table advertising, the foregoing has been along the lines of forced pleasure riding, and the writer now desires to say a word relative to what will be called, for want of a better name, the real or permanent business of a railroad. It is granted that we must strive in every way possible to build up the pleasure riding, but business that is going on each day, rain or shine, throughout the year is what, in the writer's opinion, should be gone after strong, for that shows permanent returns. Take for example the drummer trade, which is a large item to any road. To bring your service before this trade, comprehensive maps and time tables, showing all possible connections, should be in hotels and stores. Small pamphlets relating to towns or cities through which you operate can always be used. Merchants are glad to use them on their show cases or enclose them in all their correspondence. Such things keep your name before the people and bring business. Hangers and window cards announcing the convenient service, low rates and baggage regulations should be displayed where they will do the most good. Get on friendly terms with hotel employees and hackmen, giving them information which they can use to your advantage, and you will soon see many a knight of the grip enjoying his cigar in your smoking compartment rather than in the coaches of your rival, the steam road. Go after the permanent business by making close connections and operating clean cars, with polite and well-uniformed men who show as high a degree of intelligence as it is possible to get.

Now, as to bringing the freight and express service before the people, providing your road operates that branch. First of all a personal canvass should be made, giving rates, explaining the service and the benefits derived from the "electric way." Ask people to make a trial shipment, and if they agree, give it personal attention. Follow it up with an inquiry as to whether the trial was satisfactory or not, though you may know it could not have been otherwise. Make yourself a good fellow with your customers—it pays. Let your canvasser call frequently on shippers, as now and then slight dissatisfaction

may arise which may be easily explained by personal interviews. Let your shippers and customers see that you have their interests in mind. Don't be afraid to let them understand that their business is important, no matter how small. It may grow or they may have friends.

A "sticker" with some attractive design may be adopted, and then give instructions to the whole office force to place one on every letter sent out. Give all merchants along your line a supply and ask them to use them when sending in orders to the wholesaler. It may be that you have only a half enthusiastic customer, and he will not state how he wants his goods shipped; the poster will be a reminder to the wholesale house. Hangers announcing special cars for perishable goods, schedules, etc., may be placed in stores, shops and public places. Cards with the same information can be placed in the advertising spaces of passenger cars.

The president then called upon B. E. Wilson, general passenger agent of the Rochester Railway Company, to open the discussion. Mr. Wilson said that although advertising by a traction company is a very important factor, and if handled properly has a surprising influence in increasing the company's revenues, still if the cars are not available and the crews are not courteous, no amount of advertising will get the business. The duties of the advertising man do not consist entirely in preparing press notices and attractive signs to place before the public but he must also learn how, by a little "boosting," to get people to ride. It is often necessary to originate and create attractions and not depend entirely upon the regular run of entertainments. The Rochester Railway two years ago arranged for a Masonic fair and carnival at Grand Haven along the latter part of the season, when the park travel had begun to fall off to some extent. The company gave the resort for two weeks without charge and the lodge furnished the attractions and did the advertising. The event was mutually successful, as the Masons cleared between $5000 to $6000, and the company carried a very heavy traffic. The Rochester company has also worked out several original schemes for city parks. The event known as "Toy Day" has been particularly effective. In the latter case the company gets out a lot of numbered tickets, which are hidden in out-of-the-way places in the park. It is then advertised that the children finding the tickets with certain numbers will be given toys or other prizes. Such an event creates considerable interest. The Rochester company is now working up a proposition to run a military carnival at Grand Haven for the last two weeks of the coming season, the military companies of the city to run the affair as did the Masons. Sham battles, drills, etc., will be put on, and a good business is expected. Two years ago a sham battle was given at the park for which the company carried 15,000 to 17,000 people between the hours of 5:30 o'clock and 7 o'clock p. m. The cost of that entertainment to the company was about $140. The same idea can be extended to interesting the Sunday schools and churches in the parks, as places for holding excursions and picnics.

All companies have about the same number of mediums with which to advertise, such as dash signs, cards, folders, billboards, the press, etc. Rochester is getting excellent returns from dash signs. The best results are obtained, however, from the company's own publication, which is a weekly folder known as "Trolley Topics." The booklet contains 32 pages, and the front and back covers are the same. Half of the pages in the book are bound in upside down, so that, in picking up the book, the passenger's attention is attracted by the arrangement, and almost before he knows it he is reading the notices and the advertisements. This is used as an argument in soliciting advertising. Last year the company secured about $1000 in advertising, and the expense of issuing the folders was $1200, which covered also the cost of two different cuts each week. The only other expense was that of distribution to hotels and other places. This year the publication will be issued by private parties, who will deliver the edition to the company free of cost for the advertising they can obtain in the books. These same parties are working up a proposition to get a number of electric railways interested in this, the private parties to get up the books at very little cost to the different companies and the companies to prepare their own local matter.

Mr. Danforth, in further explanation concerning the resort business in Rochester, said that the Rochester Railway Company operates four lines to resorts on Lake Ontario, which is eight miles from the city. There are also two popular city parks, so that for a place of 180,000 the city has almost too many places of amusement. Each resort on the lake has its own peculiar characteristics and the intention in all the advertising is to promote the peculiar advantages of each park without interfering with the others. One is a modern amusement park like Dreamland or Luna Park, Coney Island; another is a park of the old-fashioned picnic kind; Ontario Beach is more of a cottage resort, having in connection with it what is known as the "White City," where at times there are 3000 people to 5000 people living under tents. The only amusement in the last named park is dancing. There are two dancing pavilions, which last year were open almost every night from April to October. The business did not cost the railway company anything, as those who run the pavilions induce dancing clubs and classes from the towns to hire the dancing pavilions for certain nights.

W. W. Cole, of Elmira, believed that the value of advertising literature was greatly increased by having the reading matter illustrated with good cuts. A plain dodger without illustrations will either go unnoticed or be thrown away, while an illustrated pamphlet attracts attention and is read and kept. He referred to the scheme introduced by Mr. Wheatly in the City of Mexico, whereby the street railway tickets are numbered and cash prizes are given to the holders of tickets bearing certain numbers. Some of the delegates, however, thought this scheme would not be feasible in New York State, as it might conflict with the anti-lottery laws.

E. S. Fassett, of Albany, stated that his company has no advertising at all, except that done by the advertising company in the cars. So far as his company is concerned, it has no parks, and no special place of amusement to advertise. The company makes a contract for the car advertising, which relieves it entirely of all the responsibility of advertising anything. So far as folders and hangers are concerned the city ordinances both of Albany and Troy prohibit anything of the kind. The railway company is prevented by its contract with the advertising company from putting in the cars anything more than announcements regarding car movements. The United Traction Company of Albany believes this arrangement is to its advantage.

Mr. Wilson, of Rochester, said he had a scheme to provide a resort which could be reached for a 15-cent half-fare and a 25-cent adult fare. For this proposition he would go to the school principals of the city or town and offer a free ticket to the park or resort to every child in the school, with the understanding that the principal would sell an adult ticket for some one to accompany every child. There would be no question that in a city with 20,000 school children at least 10,000 would take advantage of this occasion, and the parents would be more than willing to spend 25 cents to go along with them.

Mr. Fassett wanted to know what would be done in cases where there were several children in charge of one adult.

Mr. Wilson, of Rochester, replied that it was understood there would be only one child for each adult fare.

Mr. Fassett remarked that he had a case where twenty-two children got on for one five-cent fare, and the conductor had to ask for instructions.

Mr. Beardsley, of Elmira, thought Mr. Wilson would find some difficulty, because the rules of various boards of education forbid the selling of tickets to school children through the school officials, but Mr. Wilson said he had spoken to several principals who expressed themselves as very much in favor of the idea and willing to aid in carrying it out.

Mr. Cole thought well of efforts tending to promote afternoon riding. With the exception of one or two afternoons throughout the week, the afternoon travel is fairly light unless the company can arrange a number of excursions. Every effort should be made to promote general party and excursion riding on lines where the income would go up by encouraging park business. Elmira has one park in the city where vaudeville attractions for the masses are given and another park of higher order where operas are given. The instant the performance is over the entire crowd wants to get on the cars at once and go home. The speaker wanted to know what attractions will tend to spread out the traffic, instead of having all the passengers leave at once.

Mr. Wilson, of Rochester, mentioned his experience last year in Glen Haven. They had an open-air theater or "circus maximus," with electric tower effects, and tried the scheme of continuing the entertainments over a longer period. They put on various acts for 15 minutes with intervals between, but the other concessions at the resort did not do very well, as the people were afraid of not getting close to the stage and, therefore, would spend the intervals between the acts waiting in the theater instead of walking around the park. This year the entertainment will be run off continuously without long intervals between the acts.

Mr. Cole remarked that he had found it a great advantage to have the sale of seats in the theater begin three days in advance, so that on rainy nights a larger crowd is carried to the park than would otherwise be the case, because those who have purchased tickets in advance go in spite of the rain. Seats in the theater cost 10 cents, 15 cents and 25 cents, and there are 600 free seats. The theater is enclosed and protected from the weather. Last year this park more than paid for the entertainment, and the company had a net profit of several thousand dollars.

A delegate remarked that he knew of a prominent manager who had been studying some of the statistics on his park travel, and was beginning to feel that the excursion business had to be examined from two standpoints. The great risk of accidents enters very materially on a number of lines he was operating in handling large excursions. For instance, his passenger agent would advertise some special attraction and every effort be made to get a big crowd out for an evening. The result was that the cars came and went jammed more than full and, in fact, it was almost impossible to keep the passengers off the roof. He kept some records and found that, while the receipts for the day showed up heavier, when he got his report from the accident department, the accident account had run up alarmingly. In fact, he decided that one or two of the special excursions had been run at a loss because what had been taken in as extra fares had to be paid out through the accident department. The delegate asked if it had been the experience of others that excursions materially increase the chance of accident.

Mr. Cole said that taking care of crowds is largely a matter of schedule. The fact whether or not liquor is sold also makes a difference, as there are less accidents in bringing down a quiet crowd, but, in any event, if the people cannot get away soon without considerable crowding the accident account is materially increased.

C. Loomis Allen, of Utica, referred to the question of temperance and non-temperance parks. His company has two parks whose history has been about as follows: In 1902, one park, located about three miles from the business center of Utica, ran with a license and produced a net revenue of about $9800; the other park, located about seven miles from the business center and reached on a 10-cent fare, was run as a temperance park and produced a net deficit of $15,000. The year following that the company leased the parks to two different parties at a nominal rental. The park where liquor is sold is making money and the other, which is still run as a temperance park, is barely making expenses. From his own experience and observation of results elsewhere, the majority of railway companies in providing attractions are putting in one dollar and taking out ninety cents, if all the items of expense that go into the operation of a park system are considered. To his mind the railway company has not much excuse to be in the park business. He said that he was a firm believer in advertising and had peculiar notions, perhaps, along that line. In the territory served by the Utica & Mohawk Valley Railway are some twenty-one papers, of which five are dailies and the rest semi-weekly or weekly. The company's advertising is confined wholly to the publication in these papers of time tables and "readers," consisting of slight references to whatever attractions may be offered at either of the two parks, but more especially to the different points of interest outside of the two parks. His reason for choosing this kind of advertising was, first of all, to secure the advantage of all the circulation possible without any effort on the company's part. The circulation of the daily papers used is upwards of 30,000, and as it is estimated that there are four persons per family he assumed that practically everybody served by this road reads one of these papers some time each day. In this way, he thought, prospective passengers were reached better than by any other system the company might adopt. The cost of this advertising is made up as follows:

The company issues to each daily paper published in its territory six local pass books, each containing fifty five-cent coupons, and to each of the owners of the semi-weekly and weekly country papers is issued one city book of fifty tickets, renewable when used up, and one interurban pass book, also renewable when exhausted. An accurate record is kept of the value of the coupons turned in; the total last year proving to be about $4000. This complimentary traffic is treated as a thing of no value except as a matter of information, and, therefore, is not passed into the company's accounts. He was sure that the custom of issuing complimentary transportation is a good thing and is productive of good feeling on the part of the press. No restriction is placed on the amount of transportation the newspapers have, but its use is confined to the persons to whom it is given. He had considered at different times the issuing of a trolley folder in his territory, but found that to get out 10,000 trolley folders, free from advertising except that referring to the company's business, would cost upward of $1500, and after getting the folders he would not have known where, nor how to distribute them.

Mr. Fairchild asked Mr. Allen if, after issuing the pass books, he paid cash for advertising and how the newspapers regulated the space allowed. Mr. Allen said he paid no cash whatever. The only restrictions that are made are made by three of the dailies, which restrict the space occupied by the time tables to 4 ins., but do not restrict the space given to

"readers." His company does not try to take up too much space in writing a description of the subject to which it desires to attract attention, averaging not more than 1½ ins. to each notice. Sometimes in writing up some important event of local interest, as a reference to a battle field nearby, 3½ ins. to 4 ins. might be taken.

In reply to a question from Mr. Cole, as to keeping parks open on Sunday, Mr. Allen said that the two parks already mentioned are opened on Decoration Day and are kept open every Sunday until the Monday before the Fourth of July, and then are open every day of the week until Labor Day. The season runs practically from the first of July to Labor Day. The man who operates the licensed park has an orchestra for dancing every afternoon, and this orchestra is augmented on Saturday afternoons and Sundays.

C. F. Seixas, of St. Catharines, Ont., asked whether the operating department received any credit for transportation issued to newspapers. His company had an advertising account, but treated such transportation in the same way as other complimentary tickets, except that press tickets are printed on a different color, so that the cashier can distinguish press tickets from other tickets. He credits the operating department and charges to the advertising department the amount of this newspaper transportation.

Mr. Allen thought it unwise to put a restriction or a cash value upon the advertising given to the papers, or upon the transportation issued to the newspapers.

Mr. Seixas realized the force of Mr. Allen's argument, but said that every ticket issued by his company is charged to the account of some department. For instance, some free transportation is given when getting freight business, but that transportation is charged against the freight department and credited to the operating department.

J. H. Pardee, of Canandaigua, said that he had an arrangement with the Rochester papers to give them two annual passes, besides giving them mileage books for unlimited use by one or more people. These mileage books are charged to newspapers at face value and whatever advertising his company uses is charged back. The papers use all the transportation they want and credit the railway with the mileage books against the charge for advertising. If the balance is in their favor, they get more transportation and if in the railway's favor the latter does more advertising.

In connection with this question, Mr. Allen made a comparison between the value of the dead-head business issued to the account of advertising contracts to that of the total dead-head business. The latter averages $30 a day, including employees' tickets and other complimentary transportation, making a yearly total of about $12,000, while the advertising transportation is only $4000 a year.

F. W. Bacon, of Fort Lee, N. J., said that his company issued a monthly card in the form of a handsomely gotten up calendar, which has been found a valuable source of advertising. People who do not get this card month after month will call for it at the office or write in large numbers. In addition to this feature, as his line is an interurban road, large schedule boards are placed at prominent traffic points in the different towns. The company has also bill-posting boards, about 30 ins. x 30 ins., on which it advertises its business during the summer and in the winter leases the boards to the New York theaters.

Referring to the question of sale of liquors at parks, Mr. Fairchild said the matter depended very largely on the class of people served. One large company has solved the question nicely. Its park is probably one of the most elaborate and best conducted pleasure resorts of its kind in the country, and a strong point is made of the fact that no liquors are sold, so that women and children are free to go there at any time. However, private parties have put up, outside the limits of the park, a well-conducted hotel where a full line of liquors are sold, so that any visitor to the park who wants something stronger than the park water can very easily get what he wants. This keeps liquor out of the park. Mr. Danforth said that this solution of the question seemed to him like beating the devil around a stump.

Mr. Fassett agreed with Mr. Allen on parks, saying he did not believe that the park business is a healthy one for street railways. In the five cities reached by his company it was the policy to rather discourage picnics and excursions and try to turn them over to the steam roads, which can handle them by putting on longer trains, but as far as concentrating many trolley cars at one point and interfering with regular travel is concerned, he did not believe that to be good railway business. It seems to him to be very much better to get a factory established at some outlying point or promote a building boom, which would result in constant business. So far as passes are concerned, his company has none except for employees. He saw no reason why passes should be given to city officials or policemen and firemen. The latter are better paid than many other citizens, but while his company would have no particular objection to policemen and firemen riding while on duty, it refused this privilege for fear of its being abused.

Mr. Wilcoxen asked Mr. Fairchild whether the accidents he referred to occured at the terminals or between them, and was told that they usually occur at the loading and unloading points, both at the park and in the center of the city, where the crowds make a rush when getting on or off, especially on open cars with running board.

Mr. Pardee opened the discussion on interchangeable coupon books by reading the following paper on "Interchangeable Coupon Books." Mr. Pardee had a number of sample books used in the Central West which he passed around for inspection.

INTERCHANGEABLE COUPON BOOKS

During the past few years many of the principal cities and villages in New York State have been connected by interurban electric railroads, and in a few years more the present gaps will be closed, and through electric train service will be possible from New York to Buffalo, as well as along the through lines of travel in the southern part of the State. Commercial travelers find electric roads quicker and more convenient than steam roads, and as the electric lines are extended they will be patronized by commercial men more and more. Each electric railroad has its own basis and system of fares, and while the basis and system are not the same on all roads, yet there is a considerable uniformity and practically all of the electric lines are approximately on the same basis and system. A few of the electric lines are issuing and selling to their patrons books which correspond in theory to the mileage books of the steam roads. Some of the lines are issuing straight mileage books which are identical with the steam mileage books, and others are selling coupon books which contain certain numbers of five-cent coupons entitling the holder to five cents' worth of transportation for each coupon contained in the book. It would seem that if an interchangeable coupon book, good on all of the interurban lines of the State could be issued, such a book would be appreciated by the traveling public generally and particularly by commercial travelers, and that increased business would naturally result.

Several of the interurban lines of Illinois last year formed an association called the Interstate Electric Railway Association for the express purpose of issuing interchangeable cou-

pon books good on all of the roads joining the association. The roads joining signed a contract covering all of the details of the issuance and use of a book which contains 120 five-cent coupons and which is sold at a price of $5. The settlement of the revenue derived from the sale of the coupon book tickets is taken care of as follows:

All foreign coupons collected by companies parties to the contract shall be mailed to the company issuing same, not later than the fifth day of the calendar month following the month in which they are honored. A statement shall be rendered for the coupons so sent on a basis of 83 1-3 per cent. of their face value, duplicate of which statement shall be forwarded by the same mail to the chairman of the association, and a remittance for said statement, if correct, shall be made by the issuing company not later than the 10th of the same month. Provided, however, that the settlement between two companies, each of which has mailed a statement to the other for the same month, shall be made by a payment of the balance.

The conditions attached to the coupon books and made a part of the contract for selling provides substantially as follows:

First—The holder of the book is entitled to receive an aggregate of $6 worth of transportation.

Second—The company acts only as agent for the sale of such transportation as may be used over the lines of any other company.

Third—Coupons must be detached by conductor.

Fourth—Sufficient coupons at their face value shall be detached to cover the local cash fare and not less than two coupons shall be accepted for any distance.

Fifth—Baggage can be checked only under the rules of the company over which the ticket is used.

Sixth—The book expires one year from date of purchase.

Seventh—The ticket is a bearer ticket, and is good for the use of any one person, and the person presenting the book shall be considered as the owner thereof.

Other usual conditions are attached, but are not important.

Fifteen of the interurban lines of Ohio and Indiana formed a similar association, called the Ohio-Indiana Railway Association, for the issuance and sale of interchangeable coupon tickets. The books issued by this association and sold by the subscribing companies are on the same plan as the Interstate Electric Railway Association, except that the books contain 240 coupons, or $12 worth of transportation, and are sold for $10. The conditions attached to these books are more severe than those attached to the books of the Interstate Electric Railway Association in the particulars that the book is good only for the transportation of the purchaser and that the purchaser must identify himself or herself by writing his or her name on the back of the coupon strip detached. The roads comprising the Ohio-Indiana Railway Association, as I am informed, make monthly settlements for tickets sold and redeemed through the equivalent of a clearing house.

It will be noticed that the reduction of the rate of transportation is equivalent to 16 2-3 per cent, and the writer has had the rate sheets of several of the New York State interurban lines analyzed and finds that this reduced rate nets approximately the rate of round trip tickets. In other words, the holder of one of these books will be enabled to receive one-way transportation at approximately the same rate as the round trip transportation. The recommendations of the writer are that the interurban lines of the State of New York join in the issuance and selling of an interchangeable coupon-ticket book which will contain 240 five-cent coupons at the rate of $10, subject to the following conditions:

First—That the book is good for one year.

Second—That the book is good in the hands of any person and for any number of persons.

Third—That there shall be detached sufficient coupons at their face value to equal the one-way ticket rate.

Fourth—That not less than two coupons shall be detached for any distance, however short.

Fifth—That tickets shall not be good for the transportation of baggage unless permitted by the regulations of the company over whose lines it may be used.

Sixth—That expired or unused coupons may be redeemed only by the company issuing same is presented within eighteen months from the date of issue but only on the following basis:

Full fare or face value shall be computed on all of the coupons which shall have been used. The balance of the original purchase cost shall be the value of the redemption.

The writer would recommend that the system of monthly settlement by the different companies be the same as pursued by the Interstate Electric Railway Association, that is, that each road receives or remits balances with every other road. These coupon-ticket books, as issued by the associations named, are in the same general form as the steam road mileage books, and cost to manufacture from six cents to seven cents, in lots of one thousand.

Mr. Shannahan expressed his appreciation of Mr. Pardee's paper and said it seemed to him that the interurban lines are bound to meet in the future and adopt some common form of mileage transportation. He wanted to ask Mr. Pardee what he meant by the tickets being good for only one year. Would that be held constitutional? For instance, his company sells a ticket which is good until used and why should this not apply to a book of coupons?

Mr. Pardee thought that because a coupon book is sold at a reduced rate some limitation can be placed on it. Personally, he was not especially in favor of the one-year limitation. On his road straight mileage tickets are sold at the rate of 1000 miles for $12, without any limitation as to the number of persons, except that not less than four coupons (5 cents) be taken as a minimum fare, and that if a book is redeemed the part used is figured at the rate of 1½ cents a mile, the holder getting the balance. He believed that the fewer restrictions placed on a coupon book the more successful it will be.

Mr. Shannahan thought that the use of round trip tickets and other forms of transportation for which the cash goes through the ticket office will be a very decided advantage.

Mr. Sheehan, of the Buffalo & Lockport division of the International Railway Company, said his company had a commutation book good only for the holder, but found that two or more persons tried to use one book, and that transportation would be sold at reduced rates by cigar dealers and other storekeepers who bought the books and sold them to their customers. It was, therefore, necessary to put in force very severe restrictions to confine the use of these books to the parties to whom they were issued.

Mr. Pardee said that a distinction should be made between commutation and mileage books, as they are not supposed to be the same. His company has commutation books and the rate of fare decreases with the distance. On a 28-mile ride a fifty-four trip book averages 23 cents. He had learned from J. H. Merrill, secretary of the Central Electric Railway Association, that the mileage book used by members of that association had worked out for the great benefit of the companies. He knew that on his own road a great deal of travel is obtained through the mileage books, which are good for any

number of persons. If an interchangeable coupon book can be put into the hands of commercial travelers which they need not sign and can use on any convenient electric railway, they will not ride on the steam roads when they can go by trolley.

As an example of steam railroad practice, Mr. Shannahan mentioned the New York Central. The latter issues a mileage book which it sells for the straight rate of two cents, and good for any number of persons. It also gives commutation rates very much below the mileage rate. Tne rate of less than one cent a mile is based on one person riding every working day or school day of each month, but the theory of the mileage book is entirely different.

Mr. Stevens, of the Albany & Syracuse Railroad, said that his company has been using some form of mileage book for some time. It has been so successful that it is thinking of adopting a book with different kinds of tickets. The company issues a $10 book for $8, and is thinking now of issuing a $5 book for $4.50, in order that the people who do not live near the ticket stations may have the advantage of the mileage rate, and that the ticket sales may make up the greatest portion of the receipts. There was only one thing in Mr. Pardee's recommendations to which he took exception, namely, in regard to using the book for any number of people.

Mr. Allen expressed himself as a firm believer in a form of joint coupon book which will accomplish what Mr. Pardee had outlined in his valuable paper. He did not think it should be confounded with commutation rates. He did not believe in commutation rates on trolley roads, thinking that if the whole public is offered the lowest fare possible, and with as few restrictions as possible, the company will be giving the public the most it can for its money and the public will purchase the most transportation it can use. The book coupon should have such a value that it would meet the rates of fare that are practically uniform in New York State. There should be no restrictions as to when, where or by whom used, or on what class of trains the book will be accepted. With a mileage or round-trip ticket, the operation of fare collection is comparatively simple and certainly is a great convenience to the passenger, conductor and railway. He hoped that not only the interurban roads, but the city roads of New York State, would join in issuing a joint interchangeable coupon book.

C. L. Wilson, of Toronto, said that on the interurban roads out of Toronto his company sells a family commutation book and has found that the conductors have a way of accommodating their friends with these tickets. He has recommended to the management that they be done away with; that the regular fare could be reduced somewhat and a 10-fare ticket sold in lieu of commutation books. He liked the coupon book idea and believed many interurban roads could use it to advantage. His company is seriously considering doing away with commutation books on account of their abuse.

Mr. Shannahan then moved that a committee of three be appointed to take up with all the companies in New York State the question of adopting an interchangeable coupon book; to draft a form of contract; and to report at the annual convention in June. The motion was carried.

The meeting then adjourned for luncheon.

It is stated that a syndicate of Chicago capitalists, represented by R. H. Springer, are having a survey made for an electric railway from the Cuernavaca line of the Mexican Central to the city of Chilpancingo. The syndicate has options on more than two million acres in the valley of the Rio Balsas. If these lands are purchased, they will be colonized with American farmers. The electric power for operating the railway will be furnished from waterfalls.

CORRESPONDENCE

THE WARD LEONARD SINGLE-PHASE SYSTEM

Bronxville, N. Y., March 30, 1906.

Editors Street Railway Journal:

In your issue of March 24, you published an abstract of the paper by Mr. Lamme on "Alternating Current Electric Systems for Heavy Railway Service," with discussion. In his paper, Mr. Lamme first took up my system and with great particularity of figures has given the weight, losses, etc., of the motor generator required for a locomotive on my system which would be equivalent to the Westinghouse-New Haven locomotive. It will probably be unnecessary to say that Mr. Lamme has presented my system in the most unfavorable light possible, and as my silence under the circumstances might be misinterpreted as an admission that his presentation of my system was a fair one, I request the opportunity of using your columns to direct attention to a few pertinent facts.

Any fair comparison between my system and the commutated single-phase alternating system demands not merely exaggerated figures as to the weight, cost and efficiency of my motor generator, but complete data as to both systems, including figures showing the weight, cost and inefficiency of the alternating-current motor. Upon this subject Mr. Lamme is significantly silent, although it is the vital part of the Westinghouse locomotive, and one upon which he is no doubt able to give exact information. My present belief is that at the same speed, ventilation, horse power and other determining conditions, the losses would be 100 per cent greater in the commutated single-phase motor than in the direct-current series motor and that its weight would be about 50 per cent greater. As to the equivalent propelling motors in my type of locomotive, these motors are more efficient than even the best forms of direct-current series motors.

Had Mr. Lamme directed attention to the light weight, high efficiency and small size of his motors, upon which he had exact information, it would have been more convincing as to the superiority of the Westinghouse locomotive, than to magnify the alleged defects of a certain portion of my system, while leaving its best points unnoticed.

The figures Mr. Lamme gave as to my system might have applied to it about 16 years ago, when I invented it, but they are completely out of date to-day. It seems evident that progress is possible during 16 years along the lines of my system, as well as along the lines of commutating series alternating motors. On account of unpublished inventions which are involved, I cannot give full details on this subject. For the present, it may suffice for me to say that instead of 54,000 lbs. 25,000 lbs. would be a fairer figure at which, at present, to estimate the weight of the apparatus needed to convert the alternating current into direct current, and that there is a corresponding reduction in the losses stated by him.

Having recently received full and accurate engineering data regarding the Ward Leonard-Oerlikon locomotive, which has been in successful operation for more than a year, I can confidently say that even basing the figures on this locomotive and its performances, it will compare favorably with the Westinghouse locomotive, as far as the published facts enables one to judge. This Ward Leonard-Oerlikon locomotive was designed for freight haulage, a type much more difficult to design and somewhat heavier per horse-power than the passenger locomotive type, on account of the gear reduction.

A Ward Leonard-Oerlikon locomotive capable of exerting 800-hp maximum output, measured at the rails, has a total weight of 97,000 lbs., all on drivers. There are 121 lbs. on

drivers per horse-power at the rails, based upon the maximum output, which compares favorably with the best modern freight locomotive practiee, in which there are about 125 lbs. on drivers per indicated maximum horse-power in the cylinders. The present selling price of a Ward Leonard-Oerlikon locomotive F. O. B. works is about 20 cents per pound, if only one is ordered.

I estimate that if locomotives of the Ward Leonard type should be manufactured in large enough quantities to make comparisons with steam locomotives fair, the price per pound would be 9½ cents, which I arrive at as follows:

	Cents Per Pound
Motor generator	10.0
Propelling motors	12.0
Average of total electric equipment	11.6
Mechanical equipment, including trucks, driving axles, etc.	7.0
Average price of total locomotive when manufactured in large quantities	9½

The importance of the multiple control of several locomotives acting on one train can hardly be overestimated. Mr. Lamme's silence as to the multiple control of locomotives of the Westinghouse type is certainly significant. My system of multiple locomotive eontrol, which I described and patented some five years ago, consists essentially of four small wires along the train and a field rheostat on each locomotive. Here is an advantage in weight, reliability, simplicity, first cost and efficiency in my system for heavy traction which more than compensates for all objections that can be raised against the motor generator.

In speaking of the great importance of increasing the train power by multiple locomotive control, Mr. Townley said, in discussing Mr. Lamme's paper, "The result is to secure an increase of track capacity, which is of even more importance in congested districts than the question of train or engine mile costs." For evident reasons Mr. Lamme does not compare my system of multiple locomotive control with that of the Westinghouse Company.

As to frequency, it is possible to use any frequency with my system up to 50 cycles with perfect results. This may be of great importance when electric lighting is to be supplied from the same source, which will certainly be desirable. As to the propelling motors, which of necessity are subjected to the worst treatment and must operate with the minimum of attention, my motors are better in this respect than any other form of commutator motors, as the type is the best possible for sparkless commutation and the voltage can be selected at any desired amount to suit the best design, and since the armatures and field circuits are never necessarily opened there is a complete absence of the destructive sparking which is met with in larger motors, and which is due to the usual barbarous opening of these circuits in the use of the usual series parallel control.

The perfect division of the load between all of the motors, especially during starting and acceleration, is also a matter of great importance, and in this feature my system has great superiority over any system employing series motors, especially when such motors are in series with each other. This latter arrangement is the worst engineering possible for locomotive practice, and leads inevitably to the power-equalizing parallel rod and the rigid wheel base, which is one of the most objectionable features of the steam locomotive, and should be, and can be, eliminated from the electric locomotive.

The importance of being able to restore energy at any and all speeds while upon down grades and for braking, is now no longer questioned. As to such energy restoration, Mr. Lamme, speaking of the Westinghouse locomotive system, says: "A number of ways of doing this in a more or less suecessful manner have been tried."

This feature is inherently and automatieally present in my system without any additional apparatus and by the simplest methods. This feature inereases the effieieney, reduces the cost of the generating and transmitting plant, inereases the load factor of the generating plant and effects an important saving of brake shoes, tires and rails. My single-phase system is the only one which has this important advantage. In other words, that feature is essentially mine, as the patent records show.

A matter of great importance in all locomotives, and especially freight locomotives, is the ability to seeure the maximum tractive effort for starting the load with a certain weight on drivers. That is, it is of great importanee to seeure the highest possible coefficient of traction. The torque should be absolutely smooth and under perfeet eontrol by the most gradual increase and decrease and the torque and speed should be practically independent of each other. By my system, with the train at rest, the torque ean be gradually and smoothly raised until the load starts, or the wheels slip. If a eertain pair of wheels slip they do not run away in speed, and they have no effect in reducing the torque of others, as in the ease with two motors in series. The slipping pair of wheels grind slowly around, exerting their maximum torque and a slight adjustment of the controller reduces the torque to a statie pull once more. No series motor can have this important property and two series motors in series with each other make the worst combination imaginable, for maximum traction.

Notwithstanding Mr. Lamme's statement that there is no essential difference between the single-phase and the continuous current as to maximum traction for a certain weight on drivers, this still remains unproven and apparently unreasonable.

Mr. Lamme states that the employment of my system necessitates a complete and separate complement of d. c. eontrolling apparatus. I grant that the Westinghouse locomotive requires this, but I deny that my locomotive does, but as unpublished inventions of mine are involved in my denial, I cannot explain my position fully at present.

Recalling the high speed of the single-phase motors and the air blast needed to carry away the unusually large amount of energy wasted in heat, it seems appropriate to point out that the weight per horse-power of continuous current motors can be reduced in the same way, and to the same degree, and that, therefore, speeds and ventilation must be equalized before fair comparisons can be drawn.

I presume that the two static transformers, which the Westinghouse locomotive has and which mine has not, can fairly be assumed to weigh something and cost something at 25 cycles, and I do not suppose that any one will contend that "six operative voltages" are as good for locomotive practice as a practically unlimited number.

I trust that I have made it clear that a comprehensive eleetric railway system cannot be fairly judged merely from exaggerated figures as to the weight, cost and ineffieiency of one element, such as my motor generator, and that especially is it unfair to attack one element of a competing system by specific hypothetical figures and withhold all information of real importance as to the system advocated by the writer. Mr. Lamme is no doubt able to give convincing figures on the weight, cost and efficiency of the single-phase motors he has designed and tested, but he is discreetly silent on this subject. But he gives with exact definiteness such figures as to my system, which he has never designed, built or tested

During the past fifteen years, this system of mine has been struggling for existence in the survival of the fittest. About 1893 three of the leading engineers of the General Eleetric Company reported upon it in writing. The first said that no generator could be made for use on the system, although a

large number of Edison generators were in fact then operating perfectly on the system. The second engineer said it would be impossible to restore energy from full speed to rest, or to reverse, by reversing the field of the generator. The third said that the conversion of energy on the train in order to secure voltage control of the speed was undersirable, unnecessary and uncommercial. A few years later my system was completely exterminated on the floor of the A. I. E. E. by exactly such figures as Mr. Lamme now presents. But after being apparently successfully killed in this country, it was born again in England, Switzerland and Sweden, where leading engineers, about 1902, pronounced the Ward Leonard system the best then available for comprehensive railway electrification.

For many years past the Ward Leonard system, which consists essentially in the conversion of the high-tension energy on the locomotive instead of in sub-stations, and voltage-speed control instead of series-parallel and rheostatic control, has been ignorantly ignored by those who have so successfully obstructed progress in electric railway matters by forcing the sale exclusively of their standard, obsolete, patented, series parallel, low-tension system. I merely direct attention to this, but can not complain of it, for I very much appreciate the open field I have enjoyed in the patent office and expect to profit from it in many ways.

Fortunately there are at present unmistakable signs of the dawn of a brilliant day in electric railway engineering, for the steam railways are beginning to employ electrical engineers, who owe nothing to, and care nothing for, the electrical engineering and patent trust.

Mere manufacturers will not, much longer, control the electric railway engineering in this country, for trunk line electric traction involves interests so large and so varied as to insure, in the immediate future, competent engineers who will tell manufacturers what they shall make for them and will not say "what have you in stock?"

The United States Navy electrical engineers have thus far been the only ones in this country who have intelligently specified their wants, and insisted upon the best, and wherever they have operated they have raised the standard to the highest in the world. It is significant in this connection that, notwithstanding the cost, weight and inefficiency of the motor generator, the Ward Leonard system was specified some ten years ago by the Navy officials against the strenuous efforts of the manufacturers and after annual assaults by unsuccessful experiments, the turrets, some of which weigh 600 tons, are still operated by my system.

In conclusion, in order to test Mr. Lamme's willingness that a fair comparison should be made, I now offer to supply to your paper, for immediate publication, complete data and curves showing the actual performance, efficiency, etc., of the Ward Leonard-Oerlikon locomotive if he will publish equivalent data in the same issue as to the Westinghouse-New Haven locomotive, which has been tested.

H. Ward Leonard.

TESTING ARMATURES IN THE WINDING ROOM

March 23, 1906.

Editors Street Railway Journal:

I was amused at an article headed: "Testing Armatures in the Winding Room," in your issue of Feb. 10. The incident quoted was the result of gross carlessness or incompetency of the armature winder; no one can deny that. The company by whom I am employed has on its system about 1600 armatures. Two men, who are competent, rewind these armatures, and are assisted by two apprentices. We have no need for any testing apparatus other than a lamp bank of 1 amp. at 550 volts, and never have had any such trouble as that quoted.

The writer has wound armatures of all descriptions for the last ten years and has never tested out the coils of single coil armatures, but when there are two or three coils in a slot, those in each slot are tested for shorts.

The practice of some railway companies and manufacturers of giving their machines a ground test of from 2800 volts to 3500 volts a. c. is injurious in my opinion. In several cases factory armatures have grounded with us before they turned a wheel, having probably been weakened by the factory test.

A joke was recently played in this shop on a car house foreman, who returned an armature to the winding-room because he said it would only run one way. We disconnected a few leads on opposite sides of commutator and tested them for proper connection and found them to be O. K. We then resoldered the leads which we had removed, and returned the armature to the car house. The next day it was returned and the foreman reported the same trouble, although the armature was tried in another car. We then defaced the number on the end of the armature shaft and stamped on another number. The armature was then put in a car, and has done service for the last six months. The foreman, knowing the number, which was 1009, inquired what we had done with it. He does not know yet.

Armature Winder.

PILOTS OR FENDERS FOR INTERURBAN CARS

Boston, March 26, 1906.

Editors Street Railway Journal:

In regard to the question as to whether or not pilots are desirable on interurban cars, as discussed by Mr. Boynton in your issue of March 3, the writer wonders why some one has not mentioned fenders as possible alternatives. The fender is usually considered applicable only to city cars, but many interurbans in the Central West, particularly those radiating from Toledo, Ohio, use them almost exclusively. There is, of course, considerable difference between the horizontal, flat fender, largely used in the East, and the modern interurban fender. The latter is capable of picking up a horse or cow from the track when the car is going at full speed, and carrying it until the car can be brought to a stop, thus proving a better "cow-cather" than a pilot.

As far as appearance is concerned, the pilot has the advantage. It is also of more use than a fender in pushing inanimate objects from the track, thus preventing derailment. Its first cost is also less, though, when one considers damage claims likely to arise, the fender should prove more satisfactory in the end, for when a pilot would injure or kill a man, a fender would pick him up uninjured. A pilot requires none of the attention which must be bestowed on a fender, but many objections to pilots, such as snow piling up under the rear pilot of a double-end car, do not apply to a fender.

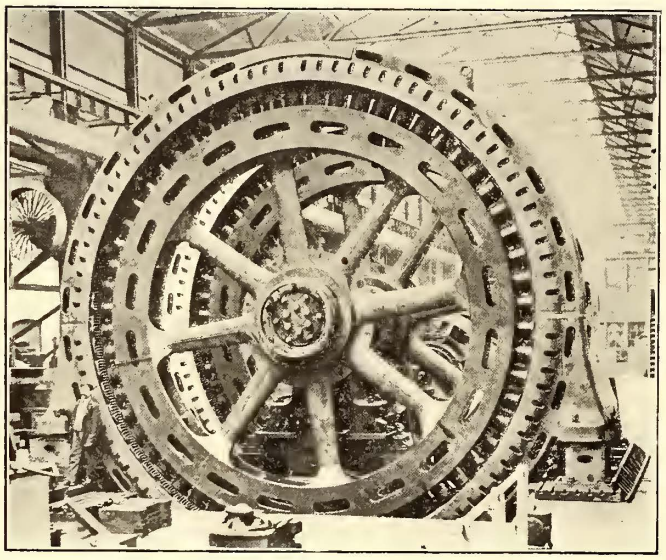
The writer does not know of any laws requiring pilots on interurban cars. If any exist, they probably specify fenders; in fact, there are several Ohio towns which have forced, or are trying to force, interurbans to exchange pilots for fenders. An interurban road of heavy enough construction to use multiple-unit trains, ought to leave fenders alone and use pilots, if anything. But, for light railways running partly upon highways, and with numerous grade crossings,—such as are still quite numerous in spite of the remarkable advance in heavy construction and reconstruction in the last few years,—the fender is the best suited, as a protection to the public, and a means of avoiding unnecessary damage suits.

K. P. Armstrong.

LARGE ALTERNATORS FOR JOHANNESBURG

Siemens Bros., Ltd., of Stafford, England, have just completed four two-phase 50-cycle alternators for the Johannesburg municipality. Two of these are for 1350 kw 3300 volts, and run at 100 r. p. m., and two are for 675 kw 3300 volts, and run at 125 r. p. m. The company recently invited a number of technical journalists to inspect the new machines at the company's works at Stafford, and during the visit the accompanying notes were obtained:

These alternators are designed for direct coupling to gas engines, to the specification of Messrs. Mordey & Dawbarn, and had to fulfill the most stringent guarantees. The temperature rise was guaranteed not to exceed 50 degrees F. in any part, after running for 12 hours at full load, and this temperature rise was not exceeded on test. The size of the machines was determined principally by the low excitation loss and the small rise of voltage on throwing off the load required by the specification. The 675-kw sets, which are not shown, have an excitation loss of only 1.1 per cent of the output. When running at full load on a .75 power factor the



1350-KW TWO-PHASE ALTERNATOR FOR JOHANNESBURG, SOUTH AFRICA

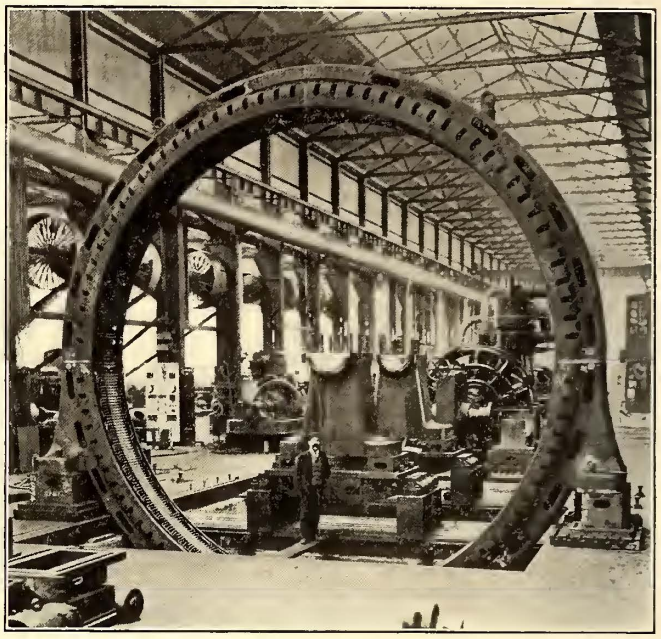
rise of voltage on throwing off the full non-inductive load is only 4½ per cent. Similar results have been obtained on the 1350-kw sets.

The stator frame is of cast iron and combines great stiffness with minimum weight. It is efficiently cooled by the current of air set up by the rotor, which escapes through the holes in the side protecting flanges and the shell of the frame. The frame is cast in four pieces, which are held together by concealed bolts. The stator plates are firmly clamped by means of insulated bolts between two cast steel angle plates, which are fixed to the stator frame by means of bolts and adjustable sleeve nuts, making it unnecessary to machine the inside of the stator frame. The core is built up of laminated stampings, insulated on both sides; the slots are open with grooves to receive wooden keys to hold the former wound stator coils firmly in place. This construction allows the coils to be thoroughly insulated before they are slipped into position, and also provides for repairs or renewals being easily made. The coils are insulated with mica moulded on to the straight part. This tube of mica, when the coil is in position projects a sufficient distance beyond the stator core to ensure a leakage distance sufficient for the voltage of the machine.

The ends of the coils are taped with special oiled tape, and, being very rigid, they are kept well away from all parts of the frame or core and thus have an ample air insulation. They are thoroughly protected by the shields on the frame without interfering with ventilation.

The rotor consists of poles attached to a cast steel wheel, the rim of which is of U section. The wheel is cast in four pieces. It is provided with spokes and is strongly ribbed inside. The divisions are made through the spokes in order to avoid the large bending moments due to unsupported lengths of rim and the segments are held together by shrunk keys inside the rim. Lateral movement is prevented by round keys fixed in the rim. The hub is held together by shrunk rings.

All poles are round and mounted on flat circular facings on the periphery of the fly wheel. They are held to the wheels by screws passing through the fly wheel from the inside, the screws being provided with lock washers to ensure their not working loose. The pole itself is prevented from turning by a steady pin. The pole shoes are of thin stampings, securely



STATOR FOR 1350-KW TWO-PHASE ALTERNATOR FOR JOHANNESBURG, SOUTH AFRICA

riveted together, and are attached to the pole by means of four countersunk screws which are locked into position after being tightened. The rotor coils are wound on metal formers which fit the poles, a flange on the pole itself holding them in position against centrifugal force. The construction is of great mechanical strength and suited to high peripheral speeds. Should a rotor coil be damaged, it can easily be replaced by taking off the pole, and the stator windings can also be easily removed.

From the stator coils, leads are taken to porcelain terminals mounted on the underside of the stator frame. They are readily accessible and yet out of all danger from casual or accidental contact. The stator coils are also so placed that should moisture collect on the machine from any cause, they are thoroughly protected. From the rotor coils, leads are taken to the slip-rings.

The slip-rings are of brass and are supported on insulated pins which are screwed into the boss of the rope wheel that drives the exciter. The current is collected from these by means of two carbon brushes on each ring, so that one can always be lifted off or replaced without in any way interfering with the operation of the machine. The current flowing through the carbons is kept at a low density, thus insuring small wear and absence of glowing and pitting.

WHEEL-TURNING LATHE FOR LONDON

The lathe shown in the accompanying cut is made by the Tangye Tool & Electric Co., of Birmingham, England, for turning worn tires of hard steel, and will take two cuts at the same time, one on each tire, ⅜ ins. deep x ⅛ in., traverse at speeds which vary from 15 ft. to 30 ft. per minute, depending upon the hardness of the tires.

The bed is 3 ft. 5 ins. wide x 20 ft. deep, and 15 ft. 4 ins. long, and has the pockets carrying the slide rests cast with it. The left-hand headstock is fixed, but the right-hand one is adjustable along the bed to suit the different lengths of axles.

The spindles are 14 ins. diameter x 14 ins. long in the front bearings, and 8½ ins. diameter x 10 ins. long in the back bearings, and have the driving plates cast with them. The bearings are of special hard gun-metal, and adjustable. Steel tail pins are provided to take the end thrust. Each of the spindles is bored out and has sliding inside it a steel barrel 9 ins. in diameter, which is moved in or out by large hand wheel, and carries a special split cone for carrying the axle from the bearing seats, thus ensuring rigidity under heavy cuts, and avoiding the use of centers, which would not be suitable for the heavy cutting. The drivers are of cast steel with large pins, and the wheels are close to the face plate; in the small wheels, which have solid bodies, special holes and suitable drivers are provided to ensure steady driving, and in all parts great care has been taken to ensure the steady running and absence of all vibration.

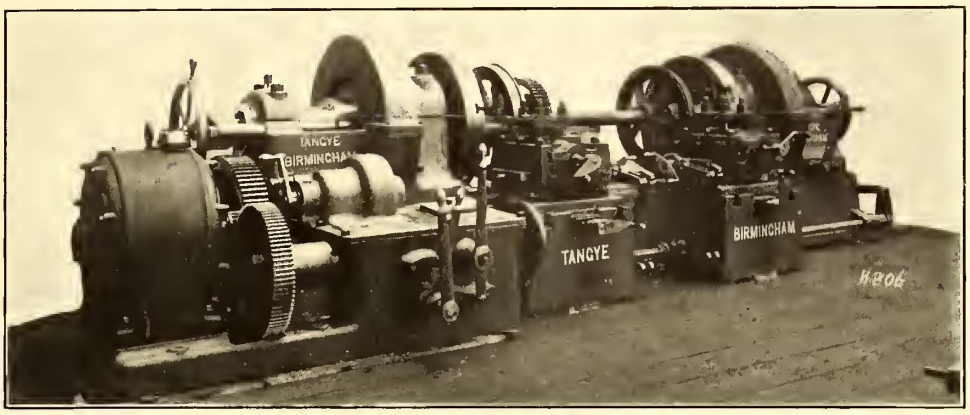
The driving of the lathe is from a 36-hp E. C. C. alternating-current motor by means of a rawhide pinion and spur wheel, to a variable speed gear box, which also carries the motor, so that they are self-contained. The gear box has all its gear wheels enclosed, and the changes of speed are made by levers in the front. From the gear box the drive is by spur gear to a 6-in. diameter forged steel shaft carried in adjustable gun-metal bearings in the bed, on which are forged steel pinions working into forged steel rings on the spindles. The whole of the gear is machine cut from the solid, all the pinions and most of the wheels being of steel, and suitable gear covers are provided. The maximum purchase of the gear is 720 to 1, and six changes of speed are provided, ranging in regular order from 1 to 6 r. p. m. of the spindle.

The slide rests are arranged to carry 1¾-in. square tools; they have large square slides throughout, the number of joints has been reduced to a minimum, and the rests can be adjusted by screw on the bed to support the tools close to the cutting edge even when turning small wheels. Each rest has an indexed swivel for turning the correct cone on the wheel treads. The feed motion gives traverses of 1-16 in., ⅛ in. or 3-16 in. per revolution. The levers and connecting rods are of exceptional strength and each rest can be separately adjusted to give any of these traverses.

The illustration shows the lathe standing on the shop floor, but when in use it is sunk in a pit so that the top of the bed at the back is on a level with the ground, thus permitting the wheels to be rolled into the lathe, and raised to the center of the lathe by means of an elevator in the bed.

When tested on the shop floor, without any foundation, the lathe took cuts on hard steel tires of 7-16 in. deep x ⅛ in. traverse at 25 ft. per minute, and on the wheels shown in the view of the lathe, which were 28 ins. in diameter on tread, it reduced the thread to 27¼ ins. diameter, and rounded the flange on both wheels in about 15 minutes, which is an exceptional result on such hard material.

The lathe weighs nearly 18 tons, and was supplied to the tramway department of the London County Council for use in the repair shop at New Cross Tramway Depot.



WHEEL TURNING LATHE FOR LONDON TRAMWAYS

A NEW ONE-FARE RECORDING REGISTER

The Ohmer Fare Register Company, of Dayton, Ohio, complying with the request of a number of managers of street railways in the larger cities, is now manufacturing a recording register for one fare. It is operated with the ordinary rod or cord, prints the number of fares by the trip, the day, the month, the direction, the number of the machine and the conductor's number. This invention is being built under the original Ohmer patents for recording machines, and along the lines of the several larger types of registers, for recording a plurality of fares, which the company has been building with so much success during the past ten years. The record sheets in this new machine are clearly printed and easily removed. It is a strong and complete register for recording one fare.

It resembles, somewhat, the new two-fare recording register built by the Ohmer Company and which was described in the Street Railway Journal of March 3, 1906.

BLOCK-SIGNAL AT COMPLICATED CROSSING

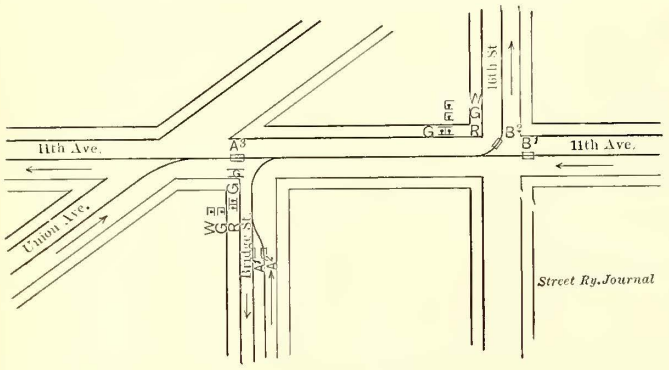
A very interesting installation of the Eureka automatic electric signals has been in operation for some time at a complicated wiring on the Altoona & Logan Valley Electric Railway, at Altoona, Pa. This particular set is located on Eleventh Avenue, between Sixteenth Street and Bridge Street, Altoona, at a point where service is complicated and very frequent, and where buildings shut off the entire view around the corners, as shown by the accompanying diagram.

The Broad Avenue cars and the Hollidaysburg cars, on eight and fifteen-minute schedule, respectively, come in Union Avenue, up Sixteenth Street, and after passing around a loop, go back over Eleventh Avenue. The Seventh Avenue cars, on eight-minute schedule, come in on Bridge Street at the end of the double track, pass up Sixteenth Street and similarly return down Eleventh Avenue and out Bridge Street. The Eighth Avenue and Juniata cars, each on eight-minute schedule, also pass over this section in opposite directions on a belt line; the former coming in on Bridge Street and up Six-

teenth Street, while the latter go out Eleventh Avenue and Bridge Street. Besides this regular service, three or four extra cars may pass over this block at various times during the day. Under such service three or four cars are often in the block at the same time, while as many may be waiting to pass in the opposite direction.

The circuit makers are located as shown in the diagram. At the end of the double track on Bridge Street, and on the corner of Sixteenth Street and Eleventh Avenue are the governing colored lights, white, green, and red, facing outward from the block, and on the corner of Eleventh Avenue and Bridge Street is an intermediate green light that can be seen from each direction on Eleventh Avenue.

A car, for instance, entering the block at either Bridge Street or Union Avenue, gets a white light at the Bridge Street end as it crosses A2 or A3. In series with this white light, are four others, the intermediate light, a green light facing inward at Sixteenth Street, and red and green lights facing outward against cars going out Eleventh Avenue. Successive cars entering in the same direction simply alternate



COMPLICATED LAYOUT OF INTERSECTIONS AT ALTOONA, PA., PROTECTED BY AUTOMATIC SIGNALS

the white and green lights at the entering end, while all the other lights remain burning, and remain so until the last car has passed out under B2, or out of the block under any of the circuit makers.

Similarly, cars entering at Eleventh Avenue and Sixteenth Street under B1 get white or green at that end, the intermediate light, the green facing inward, and the red and green facing outward against cars coming in Bridge Street. A car coming in Union Avenue cannot see the red at this end of the block but sees the intermediate light burning. It can cautiously proceed to the corner far enough to see along Eleventh Avenue and Bridge Street before touching A3 and cars in the block can be located. In a like manner the lights remain burning until all cars have passed out under A1 or A3, or any other circuit maker.

This set was installed nearly a year ago and has given invaluable service ever since. Previously it was necessary for conductors to leave their cars and flag their motormen around the corner. As the service is very frequent here and street traffic heavy, much time and annoyance has been saved.

The Altoona & Logan Valley Electric Railway Company has sixteen other similar sets distributed throughout the system between turnouts on single track, all having the capacity of recording twenty-four cars in the block. This system of signaling is controlled by the Eureka Automatic Electric Signal Company, of Lansford, Pa.

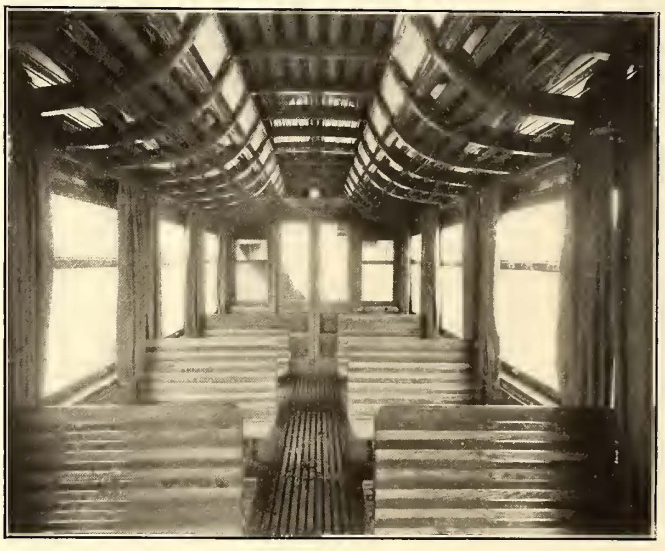
Reports from Schenectady state that the gasoline electric car which was built by the General Electric Company for the Delaware & Hudson Railroad recently, gave excellent service in a heavy snowstorm.

TOP-SEAT CARS FOR SANTIAGO, CHILI

Ten top-seat cars like the one illustrated were recently shipped to the Chilian Electric Tramway & Light Company, Ltd., of Santiago, Chili, by the J. G. Brill Company, of Philadelphia. When these cars are placed on the lines, the company will have nearly 200 motor cars and 150 trail cars in commission. The new cars measure 17 ft. 6⅝ ins. over the bodies, 29 ft. 4 ins. over the platform crown pieces and 30 ft. 11¾ ins. over the buffers; width over the side posts, 7 ft. 10

DOUBLE-DECK CAR FOR THE CHILIAN ELECTRIC TRAMWAY & LIGHT COMPANY, LTD.

ins. The interiors are finished in cherry of natural color with stationary transverse vis-a-vis seats composed of cherry and ash slats. The seats are 34¼ ins. long and the aisle 18 ins. wide. Curtains at each side of the windows slide on rods at top and bottom. The window sashes are double with the upper stationary and the lower arranged to drop into pockets in the side walls. The ceilings are of carline finish with steel rafters sandwiched between each pair of wooden rafters. The deck seats are the full length of the car body and are removable. Over the portion of the platform occupied by the motorman



INTERIOR OF CHILIAN CAR

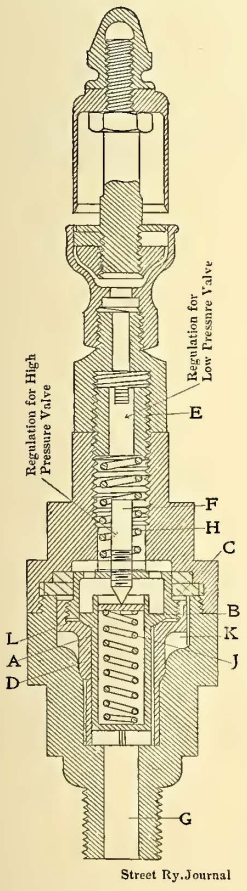
the hood is extended to form a protection for the motorman and for passengers entering and leaving the car, and is also used to support the electric headlight. Entrances are provided at both sides of the platforms. The platform step facing the deck stairs is twice the width of that on the opposite side. The sand boxes, angle iron buffers, radial draw bars, ratchet brake handles, alarm gongs and other specialties are of the builder's manufacture. The trucks have a wheel base of 6 ft. and 33-in. steel-tired wheels. Two motors of 37 hp each are used per car.

Santiago, the capital of Chili, is the third largest city in

South America, and is noted for its picturesque and healthful situation. It lies on a level highly cultivated plain, 1700 ft. above the sea, with the curving line of the Andes ten miles distant, showing a succession of magnificent snow covered peaks. The city covers an area of about eight square miles and the streets and avenues are wide and mostly paved with Belgian blocks and lighted by gas, which is supplied by the tramway company. The principal avenue is two miles long and 350 ft. wide. Besides the two driveways, each 100 ft. wide, there are promenades for pedestrians, and the space between the driveways is used by tramway tracks. Facing this avenue are some of the finest private residences in the city. Santiago is well provided with parks and squares, the number being twenty-five, and the largest having an area of over 200 acres. The public and business buildings are handsome structures, and the homes of the lower as well as the better classes are well built. There is telephone and telegraph communication with the nearby cities and towns. A belt railway surrounds Santiago and railways connect the city with the port of Valpairiso, 114 miles distant, and other cities in every direction. The Transandine Railway gives direct communication between Santiago and Buenos Aires, Argentine Republic. The population of over 300,000 is exceeded in South America only by that of Buenos Aires and Rio de Janeiro.

AN AUTOMATIC LOW-PRESSURE SIGNAL

While such accidents are not of very frequent occurrence, it must be admitted that on electric railway lines many are due to the air pressure in the air reservoir of the brake system falling below that at which the car can be stopped in a reasonable short distance. Very few of the cars now in operation are provided with any device that will warn the motorman when the reservoir pressure falls below that required for an emergency stop. If pump governors and pumps were infallible there would, of course, be no necessity for such a device. But as they are not absolutely infallible a device to indicate a falling of the pressure would at times add considerably to the safety of all those aboard the car equipped with it.



SECTION OF PRESSURE ANNUNCIATOR

A device which not only indicates low pressure but in addition acts as a high-pressure indicator and a safety valve, has been recently invented by Bert Aikman, of Chicago. It is now being put on the market by the Ohio Brass Company and several have been installed on cars throughout the country. The contrivance is largely of brass, measuring 7 ins. in length and 2 ins. in diameter. The working of its valves may be understood by reference to the accompanying cross section. Reservoir pressure is admitted through passage G. The outer of the two concentric valves, A, is held to its ground seat, D, by the coil spring, H. The inner valve, B, is held against seat, L, by the lower coil spring, J. With no pressure in the reservoir both valves are seated. When air is pumped up to that at which the low pressure alarm is to be given both valves are raised until the outer one seats on a rubber gasket at C. The outer valve has about ⅛-in. travel and while it is moving upward, there is a slight passage of air past the seats D and C and to the atmosphere through the whistle at the top. This passage of air is only momentary, for when the valve raises enough to let reservoir pressure into cavity K, the area upon which the pressure acts is increased and the valve moves upward suddenly. When the high pressure limit is reached, valve B is raised from its seat, L, and air escaping over the seat passes upwards through the middle of the stem and sounds the whistle. As long as the pump continues in operation the whistle will blow. On stopping the pump, however, the pressure drops, due to the escaping air and valve B seats itself. If for any reason the pressure falls below that at which the low-pressure spring is set valve A drops slightly and is unseated at C and air passing over seats D and C blows the alarm whistle. The whistle continues to sound until the pressure falls sufficiently to seat valve A on seat D. When the valve does come to a seat the pressure in cavity D is relieved and reservoir pressure considerably above that at which it seats is required to raise the valve. The low-pressure limit is regulated by means of screw E, which acts on spring H. Adjustment of high-pressure valve B is made by applying a screw driver to screw F. The use of the device tends to break careless motormen of the habit of allowing the pump to continue to run after the safety valve begins to blow off. The piercing tone of the whistle is so annoying that the motorman is forcibly reminded of the necessity of cutting the pump out. When the ordinary safety valve is employed, the motorman must keep close watch on the gage after the pump is cut out, to see that the pressure does not fall too low. The use of the annunciator described, however, obviates the necessity of doing so, as the motorman is forcibly reminded of low pressure by the alarm. For this reason the annunciator should be placed in the cab near the controller. It is better, however, to make the connection with the reservoir through a separate pipe leading from the reservoir, for if the connection is made direct with the pipes leading to the brake valve or whistle false variations of pressure are likely to cause annoyance.

FIRE DEPARTMENT AND TRANSIT COMPANIES CO-OPERATE IN BROOKLYN

The Brooklyn Rapid Transit Company is making preparations to install at once signal red lights in front of each fire apparatus house which faces upon its surface tracks. There are twenty such houses, and the contrivance is to be so rigged that the trap lever which drops at the first tap of the alarm in the house, will light a cluster of red lamps suspended out over the trolley wires. This will serve as a warning to motormen to halt their cars and give the apparatus an opportunity to make a quick start. Similar action has been taken by the Coney Island & Brooklyn Road, which is also installing the same sort of warning lights.

The Interurban "Enterprise," dated Winterset, Iowa, a four-page paper published by the Des Moines, Winterset & Creston Electric Railway Company, was gotten out under peculiar circumstances. The company applied for a franchise at Winterset and asked for only such a franchise as was necessary. The application was bitterly opposed by various interests which believed that the road would not be to their advantage. The result of such opposition was to secure the assistance of all the newspapers in Winterset against the franchise. The hostile attitude of the newspapers compelled the company to edit and publish the "Enterprise," which was used to set forth the company's side of the application.

SOME NEW DIRECT-CURRENT SWITCHBOARD INSTRUMENTS

Movable coil permanent magnet type instruments have been in general use for years, and the principle employed in their construction is universally considered to be the most satisfactory for measurements on direct-current circuits. It is, however, generally known that these instruments do not remain equally reliable on switchboards as when used in laboratory work. This is due to the fact that the instruments have been constructed too delicately and fragilely to withstand handling by inexperienced men and the trying working conditions existing in stations.

The large majority of cases in which instruments fail to indicate properly is caused by friction, due either to damaged pivots or jewels or to an accumulation of dust or other small particles between the movable and stationary parts of the instruments. It seems to be self-evident that the cases protecting the instruments proper should be dust-proof, but a close inspection shows that very few of the so-called dust-proof cases really deserve this name.

The peculiar form of pivots and jewels generally employed in electrical measuring instruments cannot withstand the jarring in transportation or the vibrations found in central stations. Instruments with conical pivots will seldom show any friction under the first laboratory tests, and the manufacturer seems to be satisfied that this way of pivoting the movable coil is the easiest, and has, therefore, adhered to it. The mechanical difficulties to be overcome in producing instruments with cylindrical pivots and journaled in watch jewels are undoubtedly greater, but when once accomplished an instrument of this kind will remain practically frictionless forever. There is no possibility of the pivots or jewels becoming damaged under ordinary conditions. Another defect found in instruments is the insufficient insulation of the current-carrying parts. Connections are often made by thin wires not properly supported, which can easily come in contact with each other or the case, causing not only inaccurate indications but frequently the complete burning out of the instruments.

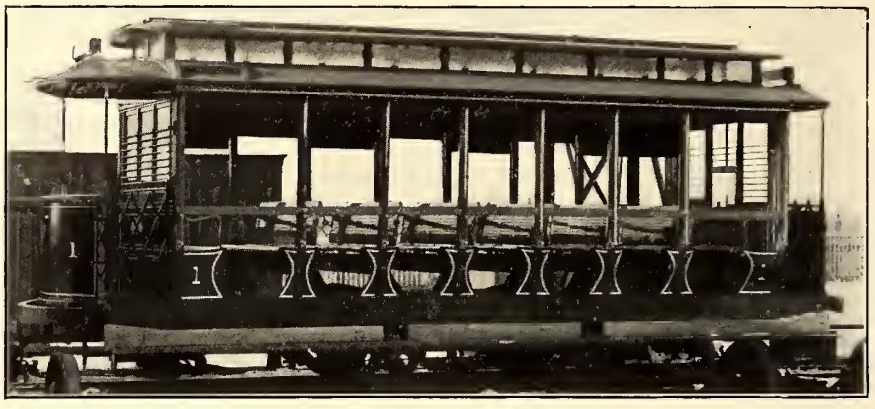
The American Instrument Company, of Newark, N. J., in bringing out its new line of direct-current switchboard instruments, has taken special care to insulate all parts of the instruments from their enclosing cases, to make these cases absolutely dust-proof by providing large contact surfaces where detachable parts are joined, and to employ highly polished cylindrical steel pivots and perforated jewels. Besides these vital points other minor ones have been carefully considered. By the selection of a proper winding for the movable coils the instruments have a somewhat larger torque, which permits the use of stronger controlling springs. Zero errors so often noticeable in other instruments, are completely avoided. All voltmeters are adjusted to the same resistance per volt and, therefore, multipliers can be interchanged. The same plan has been adopted for the shunts of ammeters. The scale opening in the front of the case is somewhat larger than usual, thus more light is admitted to the scale and it can be read more clearly.

Scales for the different ranges are divided in such a manner that the indications of the instruments are easily read without any mental calculations. The instruments are regularly provided with back connections, but can be converted into instruments with front connections if preferred. All instruments can be mounted flush with the switchboard by the mere addition of a special guard ring.

OPEN CARS FOR PERU

The John Stephenson Company, of Elizabeth, N. J., has recently shipped to the Lima City Tramways, of which W. R. Grace & Company, of New York, are the managers, forty open cars. Lima is the chief city of Peru, with a population of 113,000. So very fine and costly are the buildings, so picturesque the dwellings and beautiful the parks, that the city has earned for itself the name of the "Paris of America." It is also a great industrial and manufacturing center, and has an extensive local street car service connected with neighboring towns by interurban roads, among them being the Lima-Callao; this line connects Lima with Callao, the chief port of Peru, about 9 miles distant from the capital.

The new cars are of the standard open character. The economy in their length is at once apparent, this being accomplished by the omission of the two seats outside of the bulkheads, permitting of shorter platforms. The absence should be noted of any space between the side sill and the tow piece (as is usual in standard open cars). The length of the body is 20 ft., and over the vestibules 26 ft. 3 ins.; width over the sills and panels, 6 ft. 6¼ ins., and over the posts at the belt, 7 ft. 5¼ ins.; distance between the centers of the side posts, 2 ft. 6 ins.; distance between the center of the post to the corner post at bulkhead, 3 ft. 7⅜ ins.; height from floor to the ceiling, 7 ft. 10¾ ins.; height from the rail to the side sills, 2 ft.; height from the sills over the trolley board, 8 ft. 10¼ ins.; the platform steps are 1 ft. 3 ins. from the rails. The interiors are finished in white ash, with ceilings of bird's eye maple, three-ply. The transverse seats are made of ash slats. The three sash at each end of the car drop into pockets in the ordinary manner, this portion of the car being well protected with window-guards. The Brill folding gate is used in the platforms. The car is equipped with two motors of 25 hp each.



PERUVIAN OPEN CAR, WITH BULKHEAD SEATS OMITTED

The passenger officials of Ohio steam roads have decided to put into effect the 2-cents-a-mile passenger tariff to the exclusion of all other rates within that State. The 1000 mile books of the Central Passenger Association will be accepted on Ohio roads but will not be sold. The reduction of all fares to a 2-cent basis will do away with convention rates, excursion rates, commuters' rates, charity tickets, clergymen's permits, etc., on Ohio steam roads.

SEMI-CONVERTIBLE CARS FOR MOBILE

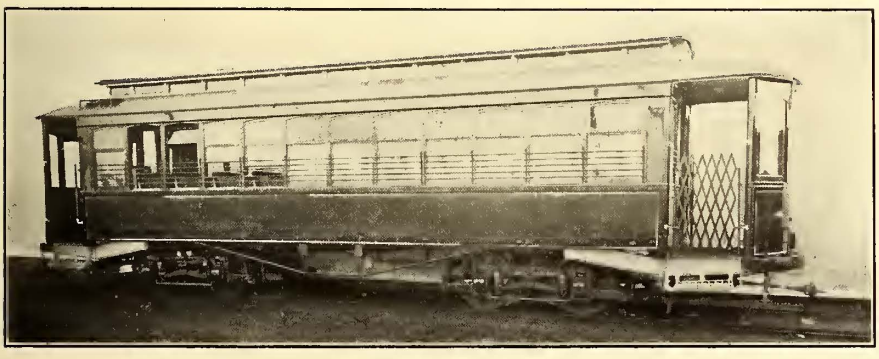
An article in the Street Railway Journal of Feb. 4th, 1905, described four semi-convertible cars built by the American Car Company for the Mobile Light & Railroad Company. These cars have given such satisfaction that the company has ordered fourteen cars of the same dimensions and details, with the exception that the new grooveless post feature is included. These cars measure 18 ft. 10 ins. over the bodies, and 27 ft. 10 ins. over the vestibules; and in addition there are six cars of the grooveless post semi-convertible type, 30 ft. 10 ins. long over the bodies and 39 ft. 10 ins. over the vestibules. The short cars are mounted on Brill No. 21-E trucks and the long cars on No. 27-G-1 trucks of the same manufacture. The new cars have just been placed on the company's lines at Mobile which, with the cars in service, brings the equipment up to nearly 100 motor cars and 25 trailers.

The dimensions of the smaller cars are as follows: Length over the end panels, 18 ft. 10 ins., and over the vestibules, 27 ft. 10 ins.; width over the sills and side sheathing, 8 ft. 2 ins.; centers of posts, 2 ft. 5 ins.; height from the floor to the ceiling, 8 ft. ¼ in.; from the track to the under side of the sills, 2 ft. 6⅜ ins., and from the under side of the sills over the trolley-board, 10 ft. 7 ins.; from the track to the platform step, 15¼ ins., and from the step to the platform, 12 ins. The side sills are 4½ ins. x 7¾ ins., and the end sills, 4½ ins. x 6⅞ ins.; inside sill plates, 12 ins. x ⅜ ins.; wheel base of the No. 21-E trucks, 7 ft. 6 ins., wheel diameter, 33 ins., and axle diameter, 4 ins. Two motors are used per car of 400 hp each. The weight of a car and truck without the motors is 13,000 lbs., and weight with motors and complete equipment, 19.400 lbs.

These cars have several unusual features. The trolley-board, as will be seen in the illustration, is of a long truss type, which brings the weight of the trolley stand and pole upon the car ends instead of upon the roof at the center. These are the only single-truck cars of this type ever built to have inside truss rods in addition to the regular 12-in. x ⅜-in. steel sill plates. The vestibules it will be seen are enclosed at one side and five-bar window guards are continued to the vestibule corner posts.

The double-truck cars measure 30 ft. 10 ins. over the end panels, and 39 ft. 10 ins. over the vestibules; width over the sills, including the sheathing, 8 ft. 2 ins.; centers of the posts, 2 ft. 5 ins.; height from the floor to the ceiling, 8 ft. ¼ in.; from the track to the under side of the sills, 2 ft. 10 ins., and from the under side of the sills over the trolley-board, 9 ft. ½ in.; from the track to the platform step, 16¾ ins., and from the step to the platform, 14 ins.; length of the seats, 36 ins., and width of the aisle, 22 ins. The side sills are 4¾ ins. x 7¾ ins.; intermediate sills, 4 ins. x 6 ins.; end sills, 5¼ ins. x 6 ¾ ins., and 12-in x ⅜-in. sill plates. Inside and under trusses are also used. The wheel base of the No. 27-G truck is 4 ft. 6 ins., wheel diameter, 33 ins., axle diameter, 4 ins., and four 40-hp motors are used per car. The weight of a car and trucks without the motors is 26,500 lbs., and with the motors and complete equipment, 38,200 lbs. These cars have entrances at both sides of the platforms with folding gates. Both the small and large cars are finished in cherry with bird's-eye maple ceilings. The seats are of Brill manufacture and composed of cherry slats with spindle backs. The backs are of the pushover type and the seats tilt.

SINGLE-TRUCK CAR FOR MOBILE



DOUBLE-TRUCK CAR FOR MOBILE

The tracks throughout the business part of the city and on the principal residence streets, are laid with 90-lb semi-grooved rails, placed on concrete stringers. The company owns Monroe Park on Mobile Bay, where summer opera is given for a season of four months, which is said to be the longest consecutive engagement of any opera company in the United States. The Park is very popular and is unsurpassed in its equipment and the fine views which may be had from all points. The Mardi Gras, which is held each year in Mobile, is second only to that of New Orleans.

SCHEDULES ON THE NEW YORK SUBWAY

George S. Rice, chief engineer of the Rapid Transit Railroad Commission, has just rendered a report to President Orr submitting the results of an investigation made by him and his assistants into the subject of headways and efficiency of service in the subway. This investigation was conducted March 3 to March 7, on which days the total ticket sales at all stations were as follows:

Saturday, March 3	446,884
Sunday, March 4	280,081
Monday, March 5	539,248
Tuesday, March 6	478,605

Those on Monday were among the largest day's sales since the operation of the road.

A subway car seats 52 passengers, and records were taken as to the number of sitting and standing passengers, on both local and express trains, during the 24 hours of each day. It was found that passengers distribute themselves through the trains very irregularly and that the end cars were less crowded than those in the center. In many cases the central cars are crowded with standing passengers, while there are seats vacant in the end cars. As a result of the investigation the engineers recommended that seven-car or eight-car express trains should be run during the entire Sunday schedule instead of five cars for part of the day as at present, and that the Sunday express schedule should be begun earlier.

In respect to the week-day express service, the engineers found that trains are run between 7 a. m. and 9 a. m., and 5 p. m. and 7 p. m. at the smallest interval practicable, and although these trains are very crowded it does not seem possible to increase the service. The present express train headway at other hours is 6 minutes between 6 a. m. and 7 a. m. and betewen 7 a. m. and 8 p. m., three minutes between 9 a. m. and 10 a. m. and between 4 p. m. and 5 p. m. for eight-car trains. After 8 p. m. approximately all express trains are reduced to five cars. The engineers recommend that eight-car trains should be maintained from 6 a. m. to 9 p. m. and that more express trains should be run throughout the day until 1 a. m. than the schedule now provides. They also think that more local trains should be run during the rush hours; at other hours the service seems adequate. They also recommend that notices should be posted at the stations at night regarding the hour at which the express service is discontinued.

CIRCLE TIME-LIMIT TRANSFERS

The Globe Ticket Company, of Philadelphia, has added to its extensive line of tickets a new form of transfer invented by W. C. Pope, vice-president of the company, and named the "circle time-limit transfer." Owing to its clearness and the ease of indicating the time limit with one punch this type has created a good impression on the traction men who have

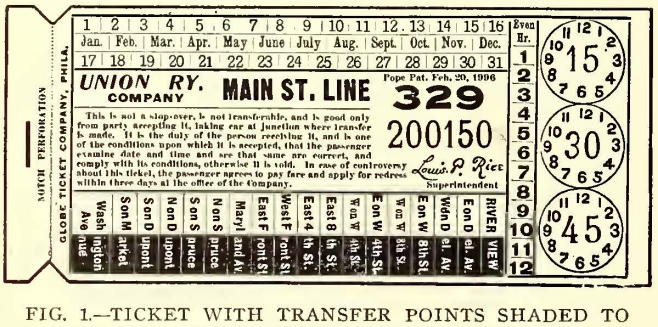


FIG. 1.—TICKET WITH TRANSFER POINTS SHADED TO DENOTE A. M. AND P. M.

already seen it. The accompanying illustrations are reproductions of four specimen tickets.

Fig. 1 shows a transfer on which the month and days are punched in the regulation way and the transfer points are shaded to denote a. m. or p. m. For the time-limit one column is shown for even hours, and for fractions a series of even hours arranged in a circle around each fraction needed, according to the time-limit required. In this case a 15-minute time-limit is indicated.

Fig. 2 shows a transfer to be issued for a. m. use only, therefore the transfer points are not shaded.

Fig. 3 shows a transfer for p. m. use only, the time-limit being shaded. In this way an a. m. transfer can be told at a glance from one good only for p. m. use. This, it is believed, will prevent many of the present abuses which are a source of loss and annoyance to street railway management, and there is absolutely no more waste, or trouble in issuing. It can only mean at most that a few conductors on their noon trip must carry two pads of transfers.

Fig. 4 shows a dated transfer with the day of the week, month and date of month printed on it in a contrasting colored ink, and the time-limit is the same general arrangement, except it shows at one punch not only the hour and fraction but as well whether that hour and fraction are a. m. or p. m., there being two series of hour figures arranged in a circle

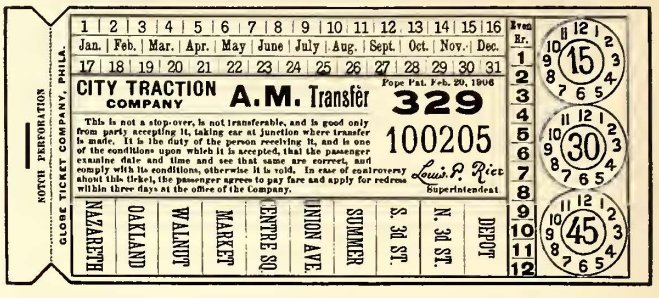


FIG. 2.—TRANSFER DEVISED FOR A. M. USE ONLY

around each fraction, one dark and one light. The even hour column is shaded half light and half dark.

IMPROVEMENTS IN TACOMA

On his return to Tacoma from the East, W. S. Dimmock, general manager of the Tacoma Railway & Power Company, announced in detail the plans for improving the company's property, which he outlined in general for the STREET RAILWAY JOURNAL when in New York en route to the coast. Part of the interurban line to Seattle is to be double-tracked, the Sixth Avenue line is to be double-tracked, 4 miles of the Jefferson line are to be relaid with heavier rails, a sub-station is to be built at Puyallup, a car house is to be erected on Puyallup Avenue, a branch is to be built to Bismarck, and street pavingexpenditures are to be made that will aggregate $75,000. In addition, twenty-six new cars are to be placed in service on the local lines in Tacoma, and four new coaches on the interurban line. Included in the new rolling stock equipment will also be a freight locomotive and flat, box and gondola freight cars. The new track to be laid on the Tacoma-Seattle line will aggregate 10 miles. It will of course increase the safety of operation and permit the cutting down of the running time between centers. The new cars are mostly single enders and are being constructed by the St. Louis Car Company.

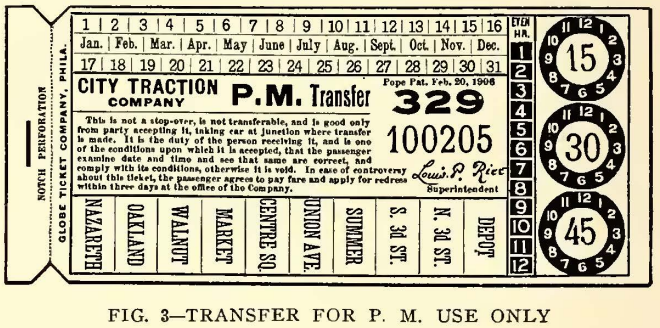


FIG. 3—TRANSFER FOR P. M. USE ONLY

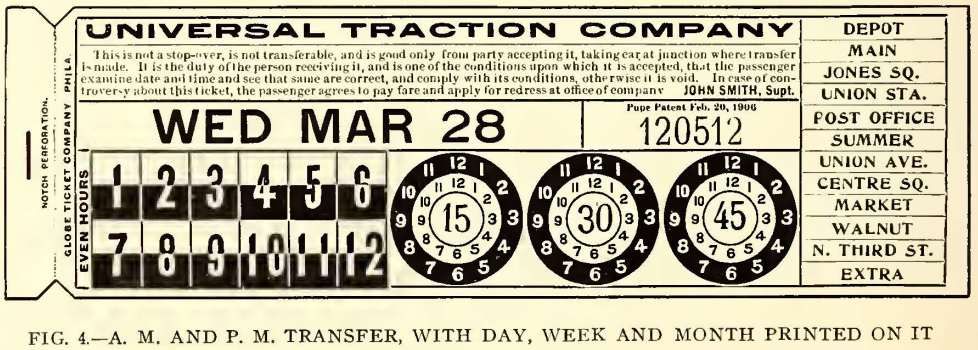


FIG. 4.—A. M. AND P. M. TRANSFER, WITH DAY, WEEK AND MONTH PRINTED ON IT

AUTOMATIC TRACK SWITCH

The St. Louis & Suburban Railway Company has been using successfully for two years an automatic track switch made by the Woolley Electric Company, of Clayton, Mo.

This device may be said to consist of three distinct parts—the trolley contacts, the relay magnets and contacts, in a box usually mounted on a pole near the switch, and the magnets and lever mechanism, housed in a heavy cast-iron box, between the rails near the switch tongue to be operated.

The overhead contact is illustrated in Fig. 2. It consists of a piece of galvanized sheet iron bolted around the trolley and insulated from it. The two contacts are placed on the wire, 20 ft. or 30 ft. apart. The box containing the relay magnets is of such a shape that these magnets, with their respective contacts and blow out coils, are carried one above another, so that the box is but a few inches wide.

Inside the cast-iron box placed in the street is a second box containing two magnet coils. A common plunger for the two coils is so connected to the switch tongue that current through one of the coils throws the switch one way, while current through the other throws it in the opposite direction.

The instructions to motormen regarding the operation of

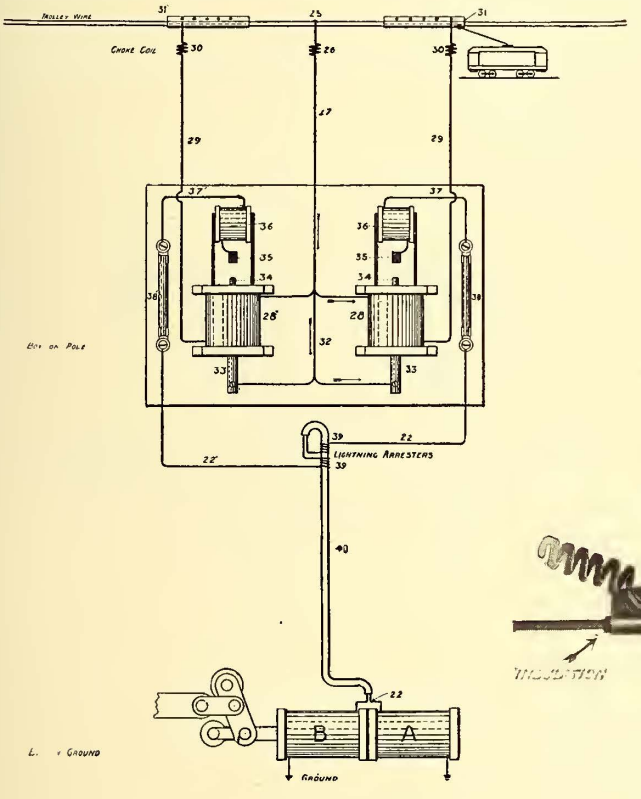


FIG. 1.—DIAGRAM OF CONNECTIONS

the switch are very brief. To throw the switch for the curve track, the first of the two overhead contacts is run over with the power on, and the car is allowed to coast over the second. If the switch is to be thrown for the straight track the first contact is run over with power off, while power is applied in passing the second one. Should the switch tongue be in the desired position, the car is allowed to coast until beyond both of the contacts.

All of the parts of the automatic device, as well as the electrical connections between them, are shown in Fig. 1. A tap from the trolley at 25 leads through a choke coil, 26, and wire, 27, to two relay magnets, 28^1 and 28, and to the plungers of these magnets as well. The paths through the relay magnets continue by way of wires 29^1 and 29 to the two sleeves or contacts on the trolley wire. It is evident that while the trolley wheel of a car rests on one of the overhead sleeves, as is indicated in the drawing, any current used by the car must pass through one or the other of the relay magnets. Assume that the controller is turned on when the trolley wheel is bearing on contact 31. Current through magnet 28 lifts plunger 33, causing its upper end, 34, to make contact with lug 35. When this contact is made, current from the trolley flows successively through wire 32, and plunger 33, blow-out coil 36, wire 37, fuse 38, choke coil 39, and through a rubber-covered wire into an iron pipe, extending between the box on the pole and the cast-iron box placed between the rails near the switch tongue. Wire 29 entering the pipe emerges in the box previously referred to, and as wire 22 continues through the winding of coil A and to ground on the magnet frame. When magnet A is excited the switch tongue, if not already thrown in the desired position, is pulled over. The path from the trolley to magnet B is closed in a manner similar to that already described for magnet A.

The employment of two separate circuits eliminates many serious objections. The circuit through the relay magnets is of very heavy wire and is intended to carry several hundred amps., which amount of current would flow through it were a heavy car started when the trolley was on one of the overhead contacts. The circuits through the blow-out coils and the operating coils are of small wire and high resistance.

The fact that the circuits through the relay magnets are of large wire, and consequently of low resistance, eliminates any tendency for the trolley to draw an arc in passing from the trolley wire to one of the contacts. The drop in the circuit is only about two volts, and it is readily seen that no destructive arcing can take place at this difference in pressure.

When the armature of a relay magnet drops, current at the full line voltage is broken at contacts 34 and 35. To prevent arcing at this terminal the choke coil, 36, is placed in the circuit. This causes the arc to snap at about a 1-16-in. opening between the terminals. Any danger of arcing at this point is further removed by the fact that the armature drops 1 inch.

No danger can result if a car is stopped with the trolley on a contact, as in such an instance current ceases to flow through all the circuits as soon as the power is thrown off the car. The relay magnets are constructed to operate at any set current desired, but usually are adjusted to work at about 35 amps.,

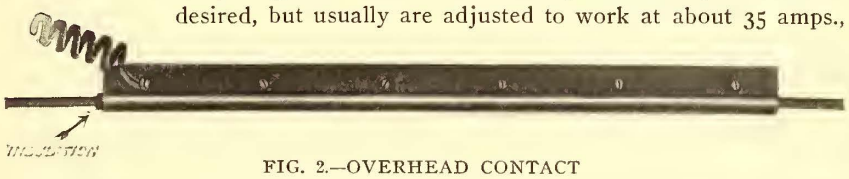


FIG. 2.—OVERHEAD CONTACT

as this avoids any danger of them being operated by the heater or auxiliary circuits of the car. Where heaters are employed it is customary to adjust the relay magnets, so that they will operate on the first notch of the controller when the heaters are on and on the second notch when the heaters are off.

The box containing the operating magnets has a cast-iron cover made in two parts to facilitate inspection and cleaning. Since such a box is impervious to mud and water, the mechanical parts inside are so constructed that the presence of water will not affect their operation. As it is highly essential that the magnets be protected from all moisture, they are housed in a second cast-iron box having cast-iron heads, which are screwed in position. A combination of right-hand and left-hand threads, on the heads of the box and on the ends of the brass tubing around which the coils are placed, make it possible to screw the heads and the tubing in place as tight as may be desired, and make the box waterproof. After the magnets are placed in position in the inner box, this is filled with paraffin, to guard further against the entrance of water.

IMPROVED STORAGE AIR BRAKE SYSTEM

One of the main advantages of the storage air brake system over other air brake systems is that instead of using compressors for each car the air is compressed at stations suitably located over the city, and stored for transmission from time to time to the receivers on the cars. In the system devised by the Magann Air Brake Company, Ltd., of Detroit, Mich., the air is stored at a pressure of 300 lbs. On the cars are air reservoirs into which the air is passed from the station storage tanks and held at the same pressure. From these reservoirs the air passes by a pipe through a reducing valve into a small receiving tank at a pressure of 50 lbs., more or less, according to the size of the car and the consequent power required for operating the brake. In some cases a pressure of 25 lbs. is amply sufficient. From this receiver the air passes through piping to the motorman's valve, where it is under the control of the motorman and can be used to put the brake in operation and to release the brake to its normal position.

From the motorman's valve the air passes into piping which connects with the brake cylinder. To operate the brake

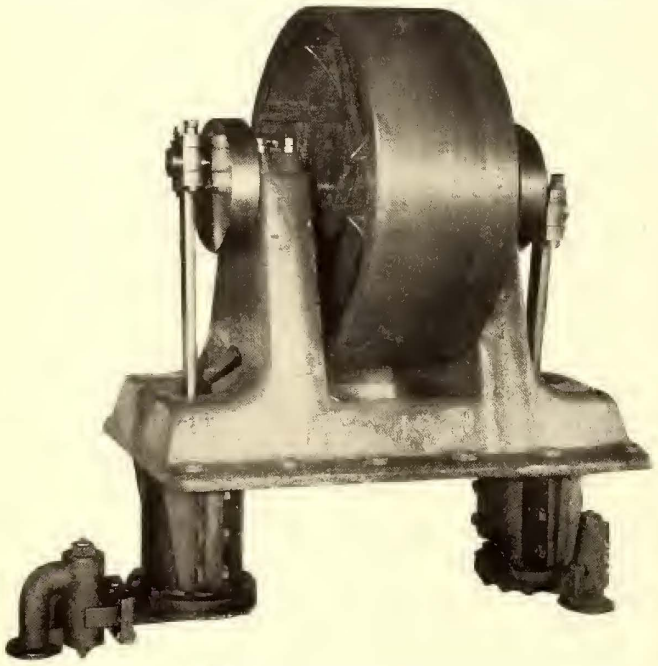


FIG. 1.—NEW COMPRESSOR FOR AIR-STORAGE SYSTEM

the motorman, by a slight turn of the valve handle, allows the air to pass into the brake cylinder between two piston heads, which are thus forced apart, driving the pistons out on either end of the cylinder. By means of levers attached to these pistons the brake is put into operation.

In ordinary circumstances the motorman allows sufficient air to enter into the cylinders to check the speed of the car and gradually allows more and more air in till the car is brought to a complete standstill. In case of emergency, by allowing the whole pressure of air into the cylinder more rapidly than in ordinary cases, the car can be brought to a standstill practically as speedily as circumstances require.

To release the brake another slight turn of the valve handle is required; this allows the air, which was driven in between the piston heads when applying the brake, to pass out into the atmosphere, thus permitting springs inside the brake cylinder to return the piston heads to their normal position and release the brake.

The reservoirs used are of such strength as to avoid all possibility of accident from explosion; each reservoir being thoroughly tested before use. The ultimate rupture point of these reservoirs is five times the working pressure.

The installation of the Magann air brake does not in any way interfere with the operation, in case of need, of the ordinary hand brake, and the cars can still be equipped with a hand brake, though experience shows that there is practically no necessity for this, owing to the simplicity of the apparatus used, which reduces to a minimum the likelihood of its getting out of order. A duplex gage, placed in front of the motorman, shows the pressure of air, both in the reservoir and the receiver, so that he is fully advised as to the amount of air still available for use on his car before the reservoirs require recharging.

Of the accompanying illustrations, Fig. 1 shows the new compressor designed and built by the company, and Fig. 2 a specially large cylinder made for use on the Toronto & York Radial Railway for the new 60 ft. combined passenger and freight cars running on its Mimico Divisions. These are specially heavy cars and an unusually large cylinder was required to operate them. The body of the car weighs 18 tons, and the total weight, with load, is 35 tons. The motors aggregate 220 hp.

Among the recent improvements made in this system are the following. A special check valve which it attached to the charging tanks on the cars and automatically admits air from the charging station, but does not let air out when the tank has been charged; a special form of coupler designed for compressed air, which greatly facilitates the charging of the tanks on the cars and reduces the charging time to a very few seconds; and an automatic charging valve. Under the present system the charging hose between the charging box and the car tank has to be emptied of air before it can be uncoupled,

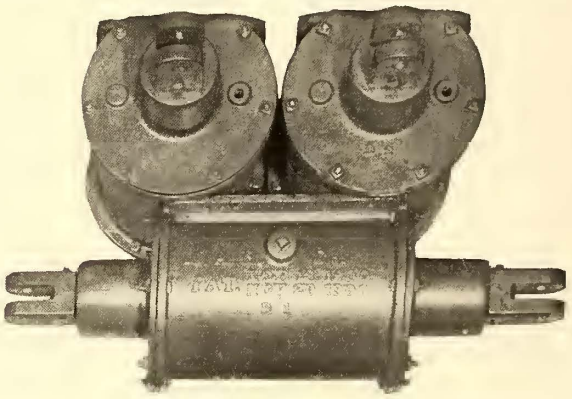


FIG. 2.—DOUBLE-ACTING JAM CYLINDERS FOR 60-FT. CARS

so as to prevent damage by the escape of the compressed air. This requires a special valve in addition to the valve which lets the air into the hose, and the turning on and off of these two valves requires four different motions. The new charging valve mentioned does the work of both valves, is opened by a single foot pressure and immediately closed on the foot pressure being taken off.

All of the double truck cars of the Toronto Railway in service have now been equipped with air brakes, and a large number of new cars in course of construction will be equipped this year. There are at present five compressor stations in Toronto, with from one to three large 15-ft. x 3-ft. tanks for storing air. This installation was described on page 236 of the Street Railway Journal of Feb. 10.

General Superintendent Dicke of the Fort Wayne, Van Wert & Lima Traction Company recently ran a special theater car from Lima to Fort Wayne, 65 miles, to enable Lima people to witness a production of "Ben Hur." The car made the run each way in less than two hours. A special low rate was made and the theater seats were sold through the Lima office of the company.

LONDON LETTER

(From Our Regular Correspondent.)

We have frequently referred in these columns to the great enterprise which the late Mr. Yerkes inaugurated in London some six or seven years ago, and we are pleased to be able to record this month the opening to traffic of the Baker Street & Waterloo Railway, which is the first of the tube railways with which he was connected and which is under the control of the Underground Electric Railways Company of London. This railway was not, however, inaugurated by Mr. Yerkes, as the work had already been commenced before his connection with London, but had been brought to a standstill for lack of funds and imperfect organization. It is just about eight years since the work was commenced by the erection of a huge staging in the river Thames, close to the Hungerford Bridge, which is the bridge from Charing Cross Railway Station. From this staging two shafts led down into the London blue clay underneath the bed of the river, and chiefly from this point the boring operations for the tube were commenced southwards and northwards. In another column will be found a fuller description of the tube, and it will suffice to say here that the press were afforded an excellent opportunity to inspect the tube, various railway stations and sub-stations, the terminus at the Kennington Road end, where a branch from the underground tube comes to the surface, and where there is a large area for the storage of the necessary rolling stock, large repair shops, offices, etc., etc. The formal opening took place a day or two afterwards, Sir Edwin Cornwall, M. P., chairman of the London County Council, performing the necessary function. At the luncheon which followed the opening ceremony, Mr. Edgar Speyer, chairman of the Underground Electric Railways Company, presided. After reading a letter from Mr. George Lloyd, the president of the Board of Trade, wishing success to such an important enterprise, Mr. Speyer stated that he considered it an especially happy augury for the success of the line that it should have been opened that day by Sir Edwin Cornwall, who was himself intensely interested in the transportation problem of London, by means of his connection with the London County Council's vast system of tramways. Sir George Gibb, the general manager of the company, made special reference to the fact that the various tube systems which were now under construction would, when completed, be all connected together at various points, so that the question of transportation from one point of the metropolis to another would be made much more easy than at present. The new tube is naturally the best of the tube railways in London, as many lessons had been learned from the experience of the other tubes. One very striking feature of the tube is that it is lighted by incandescent lamps from end to end, and it is intended, at least for some time, to keep the tube lighted, as it is expected it will give considerable confidence to the traveling public.

We have referred in these columns previously to the opening of the new tramway from the Strand to Islington by means of the subway which starts at the bottom of Kingsway and continues along the whole of the length of that new thoroughfare underneath Holborn, coming to the surface at the corner of Southampton Row and Theobalds Road. The opening was, unfortunately, delayed, but the opening ceremony has now taken place, and the new route has been in use by the public for the past few weeks and has proved most popular. It has, of course, long been known that there is an immense population around the Strand district which wants to get to the north, the only method of transportation having hitherto been the slow horse omnibuses. This is the first electrification of tramways in the north portion of London by the London County Council, and the fact that this first northern section made use of the new thoroughfare and was in a subway added interest to it, and has perhaps made the lines even more popular than they would have been on the surface. The subway under Kingsway is a shallow subway, constructed much in the same manner as that in Boston; the chief difference is that the cars are operated on the conduit system instead of on the overhead wire system. Under Holborn, however, the subway takes a sudden dip, so as to escape all sewers and pipes under that thoroughfare. The construction at this point changes from the ordinary subway construction to that of cast-iron tube so familiar to the Londoner in connection with the tube railways. This tube construction is only used under Holborn, however, where the tramway has to dip some 30 ft. This is a little unfortunate, as it makes a very severe grade from the lowest point of Holborn up to the corner of Theobalds Road, where the tramways emerge from the approach to the subway. At present the subway terminates, so far as traffic is concerned, at the corner of Aldwych and Kingsway, though the subway itself is actually constructed down the western branch of Aldwych as far as the Strand. It is intended later on to cross the Strand in much the same way as Holborn has been crossed, and the tube will then continue underneath Wellington Street south to the Embankment, where the exit will be made on to this thoroughfare at road level. The present width of the tramway subway is 20 ft. and the height 13 ft. 6 ins., so that a different type of car to those with which Londoners are familiar has had to be used. All of the cars are of the single-deck pattern, and are constructed of steel and other non-inflammable material. They are the first tramway cars of this type constructed in this country, and were supplied by Messrs. Dick, Kerr & Company, who made them to the design of Mr. A. L. C. Fell, the chief officer of the tramways. Sixteen cars have been supplied for the present, though when the northern system of tramways is electrified a much larger number will be used. As has been said, this route has attained instant popularity, and augurs well for the success of the electrification of the northern tramways when they become electrified. This work is now being put in hand, both Dick, Kerr & Company and J. G. White & Company having recently received very large contracts for electrifying the trams from Bloomsburg to Poplar, and from Shoreditch and Stamford Hill.

The Folkstone Town Council has decided to hand over its powers for the introduction of trams to the National Electric Construction Company, on the payment of £15,000, after the Royal assent is given to the bill now being promoted in Parliament. It has been arranged that the trams will not run on Sundays between 11 and 1 o'clock. The cars are to be worked on the Dolter surface contact system.

Mr. D. Boyle, who has been chairman of the Manchester Corporation Tramways committee since it was first formed on the municipalization of the tramways, has resigned his position both as chairman and also as a member of the committee. He has accepted the managing directorship of the Manchester District Omnibus Company, Ltd., just formed, with the object of providing a service of motor omnibuses on the south and west suburbs of the city, and other districts beyond, not now provided with a tram service, or, where a tram service exists, to act as a feeder thereto and receive traffic therefrom. The new company has declared its intention not to enter into competition with the Manchester tramways, and it was after receiving definite assurances on that point that he agreed to accept a position on the directorate.

Mr. R. Stuart Pilcher, traffic manager of Corporation Tramways, Burton-Upon-Trent, was appointed general manager of the Aberdeen Corporation Electric Tramways. The salary is £300 per annum. The new manager will not have control of the electrical equipment of the tramways, his duties being practically confined to the management of the traffic. Mr. Pilcher is a native of Liverpool, and has been in Burton for two years.

The Mayor of Kingston recently opened an important Surrey extension of the London United Electric Tramways. The lines have been carried across Kingston Bridge from the former terminus at Hampton Wick, and extended through Kingston to Talworth in one direction and to Long Ditton in another. The lines now opened link up Kingston, Surbiton, Malden and Long Ditton, but they are only an installment of the ring of electric trams which will soon encircle the metropolis. A little later the line will be continued from Raynes Park through Wimbledon to Tooting, where it will join with the County Council system, and it will then be possible to reach almost any part of the Surrey shore of the Thames by tram from the center of London. In the other direction, the Long Ditton line will be continued through Thames Ditton and Molesey to Hampton Court, across the river to join the Middlesex system of the same company there, as well as across Kingston Bridge, while the Surbiton line will be carried on to Hook.

THE NORFOLK SITUATION

R. Lancaster Williams, who, with the Middendorf interests of Baltimore, dominates the street railway and lighting business of Norfolk, is quoted as stating that he and his associates will not part with the control of the Norfolk Railway & Light Company, but that at the stockholders' meeting April 19, additional capital will be accepted from new interests who wish to join with those now in control. Mr. Williams said that $2,000,000 will be added to the capital stock to build a new power house, to cost $1,000,000, and to buy rolling stock in order to handle the passenger traffic during the Jamestown Exposition.

NEW HAVEN TO BE ELECTRIFIED BETWEEN BOSTON AND PROVIDENCE

Another important announcement has been made regarding the plans of the New York, New Haven & Hartford Railroad. This is to the effect that electric trains will be run on the Providence division, which is to be four-tracked for its entire length between Boston and Providence. This plan of the company was made public in an address delivered by President Mellen before the Art Club, of Boston, Saturday evening, March 24. In his speech Mr. Mellen reviewed the general situation confronting the company, and then detailed briefly the plans made for meeting existing conditions. In addition to this he expressed himself freely on the rate question. Much that he said about the general situation in railroad circles in New England necessarily was foreign to his reference to electrification. Still his remarks along these lines are valuable as throwing light upon the general situation that confronted him when he assumed the management of the road, and are particularly pertinent as showing the aggressive campaign in hand for bettering conditions. He said the mistake had been made of not standardizing the equipment as acquisition had been made of new lines, with the result that in many cases serious consequences followed. In locomotive equipment and bridges he said conditions were very bad. The gist of his remarks in this respect are contained in the following statement:

"The lack of equipment is remedied so far as numbers is concerned, but the character is yet far from satisfactory, and will continue to be until the bridges are rebuilt to carry the heavier class for which they are designed. The past winter has been the first in many years where there was power in reserve for emergencies which fortunately did not arise, but before another winter the present increase in business will absorb all of that reserve even, without additional provision is made.

"In this vicinity at the present time we are building additional shops at Hyde Park and Readville at an aggregate expense of about $1,500,000, which, with the facilities already there, will make one of the most complete plants for its purposes that exists east of Altoona, Pa., a plant of greater capacity than all the scattered, obsolete and uneconomical ones inherited from the various lines of road now making up the New Haven system, and with a similar plant to be erected at or near New Haven we shall then be able for the first time in the history of the property to maintain the equipment as it should be, instead of witnessing that constant deterioration of which complaint has so justly been made.

"The four tracks upon the Providence line will be extended from Readville to East Junction, with revision of alignment and grades, and with the elimination of all crossings, there meeting a double-track line to Providence by way of Pawtucket, and another double-track line by way of the new tunnel now building in Providence, the two connecting at the Union station, completing by the two routes a four-track line between the two cities, one of them without crossings at grade, and so constructed to be a high-speed line, than which there can be no faster or better, completed with a view of using electric traction, which we anticipate the results of the work upon our New York end will demonstrate to be economical and practical."

STREET RAILWAY SITUATION IN SAN FRANCISCO

The advocates of an electric conduit railway system in San Francisco were considerably encouraged recently by a compromise said to have been reached by President Calhoun of the United Railroads and representatives of the Society for the Adornment of San Francisco and the Sutter Street Improvement Club whereby Calhoun agreed to provide an underground electric conduit system on Market Street as far as Valencia Street, and on Sutter Street as far as Polk Street, and would be permitted to replace the cable system with the overhead trolley in other portions of the city without opposition on the part of the associations named.

This announcement drew forth considerable discussion and elicited a further statement from President Calhoun in which he declared that the United Railroads was not moved by motives of economy in favoring the overhead trolley as against the conduit system, and that the company would donate to the city, for the improvement of the Golden Gate Park Panhandle the difference in cost of the two systems should the people decide in favor of poles and wires on Market Street. He figured that the difference in cost would be somewhere in the neighborhood of $200,000. He has agreed to supplant the cable system on Market Street with an up-to-date conduit system, provided the people of San Francisco do not rise up and object to the improvement. He maintained, however, that what the city needs, and what he believed the people will favor, is a uniform system of overhead trolley lines.

The next development was threatened litigation against the United Railroads by the city for the annulment of its franchise, on the ground that the merger of the eighteen companies and their absorption by the present corporation was an illegal act. In answer to several inquiries President Calhoun finally sent a letter addressed to Jas. D. Phelan and others, in which he said: "In view of the development of the last few days, the threatened litigation against my company, and the action of the Sutter Street Improvement Club, I desire to inform you that the United Railroads will proceed to prepare a plan for the improvement of the transportation of San Francisco, the essential feature of which plan will be a modern up-to-date, efficient and uniform system of electric propulsion, through the introduction of the overhead trolley system wherever the grades of the streets of the city will permit. When this plan is perfected it will be presented to the proper authorities of the city for their consideration. We will be very glad to go over it with you. Under the circumstances, it will be useless for me now to furnish the preliminary plan of which we spoke."

The apparent abandonment of the conduit system by the United Railroads drew forth an emphatic statement from Claus Spreckles, who says if he can do anything to prevent it there will be no overhead trolley system in San Francisco. He is said to be ready to organize a company to give San Francisco an up-to-date conduit system and already has engineers working on the plans. He proposes to make use of the tracks of the United Railroads wherever advantageous under the law which allows one road to run for a distance not exceeding ten blocks over the tracks of another one on the payment of a sum fixed by law. Mr. Spreckels states that his attorney informs him that the new road can use the tracks of the existing company by paying interest on half of the original cost of the tracks and maintenance charges.

The final development is the announcement by the city administration that it has formulated a plan for a municipal street railroad system so attractive that private capital will readily take hold of it and construct the road under conditions that will permit the city to assume ownership after a stated period. The details of this plan for interesting capital are not made public, but the administration states that it will be eagerly taken up and that there will be no difficulty in getting all the capital necessary. New tracks are to be laid on Market Street, but in the main, franchises will be awarded on streets not now occupied. The conduit system will be used throughout.

FRANCHISE AWARDS IN LOS ANGELES

The reported sale of the Los Angeles-Pacific Company's electric railway system to E. H. Harriman for $6,000,000 has brought forth many stories concerning the preparations that are being made by Henry E. Huntington to meet the competition promised by the new interests. Whatever Mr. Huntington's plans are, however, he has kept them to himself. Still, an interesting development came to light on March 27, when E. W. Gilmore, acting presumably for Mr. Huntington, was granted by the City Council of Los Angeles a twenty-one-year franchise for a steam or electric railway to be used as "a part and extension of a railroad to be constructed and maintained between the city of Los Angeles and other cities and towns," to be single or double track, at the option of the grantee, over a certain strip of land having a uniform width of 40 ft., and paralleling the Los Angeles River for a distance of more than 3 miles. This franchise would give Mr. Huntington a new line through Los Angeles that would connect the vast country north of the city directly with the mile-long mole he is now building into deep water at San Pedro. The franchise begins just where the old San Gabriel Rapid Transit Railway ends, on the east bank of the Los Angeles River at Aliso Street. This old line Mr. Huntington owns from the city to Sherb, and its roadbed is now being regraded with the intention of putting an electric road upon it, and extending it to Pasadena. The route lies entirely over a private right of way from Aliso Street south along the river bed. Mr. Huntington can build an electric railway which will afford all of his lines to the north a short-cut to San Pedro and other seaside points. This route does not comprise a public thoroughfare, and for that reason would be especially desirable for fast freight and passenger traffic. Moreover, it would provide a through line that would avoid the restricted speed required on city streets.

THE TRI-CITY CONSOLIDATION

In connection with the plan to consolidate the public service utilities of Davenport, Ia., and Rock Island, Moline and East Moline, Ill., to which reference has been made before in the Street Railway Journal, it is announced that it is proposed to organize the Tri-City Railway & Light Company under the laws of Connecticut, in which will be vested the ownership of substantially all of the outstanding stocks and all except $464,000 of the bonds of the following companies:

(a) People's Power Company (gas and electric lighting, Moline & Rock Island).

(b) People's Light Company (gas and electric lighting, Davenport).

(c) Davenport Gas & Electric Company (gas and electric lighting, Davenport).

(d)Tri-City Railway Company (electric transportation, Davenport, Rock Island and Moline).

(e) Davenport Suburban Railway Company (electric transportation, Davenport and vicinity.)

(f) Moline, East Moline & Watertown Railway Company (electric transportation, Moline to East Moline and Watertown).

Of the 34,080 outstanding shares of the capital stocks of above companies 33,530 shares, or 98 4-10 per cent, and in no case less than 96 per cent have already been acquired. It is confidently expected that all of the stock will soon be secured. Of a total of $2,913,000 bonds outstanding, all but $464,000 have been or will be acquired.

The capitalization of the new company is to be as follows:

Five per cent collateral trust first lien sinking fund gold bonds, dated April 1, 1906, due April 1, 1923, but subject to redemption at option of company on any interest date at 105 and interest; with a sinking fund sufficient to retire $2,250,000 of the bonds by maturity; total authorized issue		$9,000,000
To be presently issued		6,000,000
Reserved to refund at maturity $464,000 6 per cent bonds, due $33,000 annually, and balance in 1911	$464,000	
Reserved for additions and improvements	1,500,000	
Reserved for additions and improvements at 85 per cent of cost	1,036,000	3,000,000
Common stock, total authorized, all to be issued forthwith		$9,000,000
Preferred stock, 6 per cent cumulative total authorized		3,000,000
To be issued forthwith		2,600,000
Reserved		400,000

The engineering firm of J. G. White & Company is associated with the banking houses of Mackay & Company and Halsey & Company in plans involving the institution of a thoroughly modern service in connection with the consolidation. The report of the physical condition of the properties of these companies was made for the bankers by J. G. White & Company, and it is probable that the operating department of the same company will be charged with the work of operating the consolidated system in accordance with the best modern practice, one of the foremost operating experts of the country being made general manager of the holding company. In the traction system there are 100 miles of track, and one phase of the general improvement contemplated is the renovation of the service of the street railways, involving more frequent and regular service and an increase of speed. Another step in the direction of increased efficiency will be the manufacture of a single variety of gas in one plant instead of the manufacture of six varieties in three different plants as now obtains. Finally, the water-power rights of the Moline Water-Power Company will be made the most of, and so developed as to permit the abandonment of a large percentage of power generation by steam.

INSURANCE COMPANY TO START MAY 1.

The American Railways Insurance Company, of Cleveland, will commence writing policies on street railway risks on May 1. This company is allied with the Traction Mutual Insurance Company, which is being formed to carry out a plan whereby traction companies may carry their own insurance. This company will not become operative until $20,000,000 of protected risks have been secured. The American Railways Insurance Company has been formed to furnish immediate protection for those companies that desire to become associated with this movement. It is a stock company with $200,000 capital stock and $300,000 reserve, and while it will be operated as a stock company and will enter into active competition with the old-line companies, taking unprotected as well as protected risks, it will be a mutual company in that the profits, after paying losses, operating expenses, and a small percentage for a reserve fund, will be divided among the companies insured. The company will limit its operations to $25,000 on any one risk. It is estimated that on sprinkled risks the net cost will not exceed ½ per cent. Henry N. Staats, manager of the various companies, states that more than fifty leading city and interburban companies have agreed to give part of their insurance to the new company this year.

It is stated that since these mutual companies commenced their activities about a year ago the old-line insurance companies have reduced rates on both protected and unprotected risks. Within the past few weeks old-line insurance companies are said to have rewritten insurance with reductions in rates as follows: Cincinnati Traction Company, from $1.55 to $1.25; Rochester Railways & Light Company, $1.05 to $0.75; Utica & Mohawk Valley, $1.20 to $0.75; Chicago City Railway, $1.85 to $1.00; Eastern Ohio Traction Company, Cleveland, $1.45 to $1.12. The Cleveland & Southwestern Traction Company, the Kansas City Railway & Light Company and the Twin City Rapid Transit Company are also said to have secured large reductions in rates.

MUNICIPAL OWNERSHIP, BUT NOT OPERATION, DECLARES CHICAGO

Chicago has declared for municipal ownership of street railways, but not for municipal operation. The decision was made at the election held April 3, at which a majority of 3837 was recorded for municipal ownership. The vote for municipal operation was defeated by 10,651. The vote on the proposition, "Shall the city of Chicago proceed to operate street railways?" was: For the proposition, 120,911. Against, 110,260.

On the question of public policy submitted to the people, which was: "Shall the City Council proceed without delay to secure municipal ownership of all street railways in Chicago under the Mueller law, instead of passing the pending franchise ordinances or any other ordinances granting franchises to private companies?" the vote was 111,662 for, to 108,025 against, a majority of 3837 for the proposition. The question of issuing $75,000,000 worth of Mueller law certificates was also answered in the affirmative, the majority being 3339. The vote in detail was: For, 110,008; against, 106,669.

The Mueller law, which lacks the authority of the Supreme Court and the validity of which is open to some doubt, is a legislative act passed several years ago, authorizing the issuance of "certificates," a sort of bonds to be used for the purchase of public utilities by any city wishing to go into the business. This is the first time any municipality has had a chance to vote on the subject, and Mayor Dunne and his immediate municipal ownership friends are deeply disappointed at the people's declaration against the idea of the city operating the street car lines. After the return had been received, Mayor Dunne said:

"The election, so far as municipal ownership is concerned, leaves us practically nowhere. It would have been all plain sailing if the operation clause had carried. Now it is up to the street car companies to say on what terms they will sell out to the city. Then we will have to test the Mueller law in the courts.

"If they decide in our favor, and I think they will, I propose that we go to the people again. We will have possession of the street car lines, and our possession will have been confirmed by the courts. I propose then to submit the operation proposition to another vote. I don't believe that we could get the full approval of the people to operate unless we had possession. When we have that I am assured that the vote will be overwhelmingly for operation."

The "I. M. O." movement was fought vigorously in every journal published in Chicago. The Republican party was dead against it, and ex-Mayor Harrison and a large body of conservative Democrats also deprecated it. The Council opposed it, and Mayor Dunne had been blocked in every move he made in its favor. The corporations, and this means not only the street railway companies, but every corporation and firm of any description in the city, was strongly against it.

STRIKE AT WINNIPEG

Winnipeg is in the throes of a strike that has assumed a very serious aspect. The trouble culminated March 29, when the conductors and motormen in the employ of the Winnipeg Street Railway Company quit work in an effort to enforce their demands for higher wages. Violence attended the situation almost immediately. Wires were cut and switches opened, and finally the attempt was abandoned that had been made to run cars. A proclamation was issued at once by Mayor Sharpe asking the co-operation of all citizens in maintaining order. The following day a detachment of Royal Canadian Mounted Rifles was placed on duty in Main Street, and the regulars were called into service to preserve order. Regulars, drawn up at Higgins and Main Streets, with fixed bayonets, did not awe the crowd, which attached a car and attempted to drag away the crew. Mayor Sharpe then read the riot act, and was greeted with hoots and jeers. The soldiers then loaded with ball cartridge. The mob still failed to disperse, and a charge with fixed bayonets was ordered. This drove back the excited men. Six cars were operated, but none was sent out after dark.

BROOKLYN EMPLOYEES' ISSUE THEIR MAGAZINE

The Brooklyn Rapid Transit Employees' Benefit Association last week issued the first number of their new magazine "The Third Rail." They have secured the consent of the company to publish this in the interests of their association and to further advance the objects for which the association was organized. The paper has thirty-six pages, and cover, of which twenty-four are devoted to reading matter. The contents includes fiction and feature articles with illustrations. Any profits that may be derived from the publication will be devoted to furthering the educational work of the members of the Employees' Benefit Association. The committee from the Benefit Association will have the immediate work of editing and publishing the new monthly. The general plan for distributing the paper and placing it on sale was referred to in the Street Railway Journal of Jan. 26, 1906.

FREIGHT SERVICE BEGUN ON THE OLD COLONY

A beginning was made April 2 in the operation of freight cars by the Old Colony Street Railway Company, of Boston, under the Brockton-Taunton-Providence permit, granted several weeks ago by the Massachusetts Railroad Commission. The first cars were started from Taunton, through the towns of Rehoboth and Seekonk to the State line, whence they were taken into Providence over the tracks of the Rhode Island Company. This development is practically the first move in the freight business by the large companies operating into Boston.

The Old Colony trackage gives access direct to a new freight station just established in Taunton, and within a few days the route for this car will be extended toward Boston as far as Brockton. It was expected that the Brockton arrangements would be all completed this week; but two stores which are to serve as a temporary freight station and for offices of the division freight agents have yet to be remodeled to fit them for their new uses, and a short section of tracks connecting this station with the company's existing tracks in Brockton has yet to be put down. When that is done service will be established between Taunton and Fall River.

So far as the Brockton-Boston link of this contemplated system is concerned, the company has not yet finished with the town of Milton with reference to securing the necessary franchise from the local authorities. It will be some time yet before the petition for approval of this northerly link can be placed before the Railroad Commissioners. The Fall River branch was petitioned for some time ago, but the Fall River Aldermen imposed so many unusual restrictions that the Railroad Commission sent the matter back to the local authorities. The Commission has stated that it will grant its approval to the proposition when the local authorities give their permission without imposing conditions foreign to the business of carrying freight. The Commission holds that the only conditions pertinent are those which relate to the manner in which freight business shall be conducted, and not conditions carrying provisions for snow removal, waiting rooms, and other items associated wholly with passenger service.

NEW ELGIN, AURORA & SOUTHERN COMPANY ORGANIZES—MOOTED PLANS FOR EXTENDING THE INFLUENCE OF THE COMPANY

At a meeting of the stockholders of the newly organized Aurora, Elgin & Chicago Railroad Company, the consolidation of the Aurora, Elgin & Chicago Company, the Elgin, Aurora & Southern Traction Company and the Cook County & Southern Railraod Company, officers and directors for the ensuing year were chosen as follows:

L. J. Wolf, president; D. J. Peffers, vice-president; H. C. Lang, secretary and treasurer. L. J. Wolf, D. J. Peffers, H. C. Lang, F. E. Meyers, James Hopkins, Harry Greenebaum, E. C. Faber, directors. Later, Mr. Faber's appointment to the position of manager of the company was announced.

On March 31, a call was issued from the offices of the Mandelbaum Syndicate in Cleveland for a meeting of the shareholders of the company at Chicago, June 30 next, to vote on a proposition to issue bonds to the amount of $25,000,000. Coupled with the notice is another calling upon shareholders to pass upon a proposition to enlarge the scope of the present charter so as to enable the company to acquire a network of lines covering practically all of Northern Illinois and Southern Wisconsin. Among the lines it is proposed to include in the merger, aside from the three embraced in the reorganized Aurora, Elgin & Chicago Company, are: Elgin & Belvidere, Belvidere, Rockford & Freeport, Rockford, Beloit & Janesville, Janesville & Madison, Geneva & Freeport, Aurora & DeKalb, Aurora, Plainfield & Joliet, Yorkville & Plano, Carpentersville & Crystal Lake, Freeport & Dubuque.

THE PUBLIC SERVICE CORPORATION'S MEETING

United States Senator John F. Dryden's resignation as a director of Public Service Corporation of New Jersey was announced to stockholders at the annual meeting held April 2. His letter stated that his Senatorial duties prevented him from giving attention to the business of the corporation. At the election James P. Dusenberry was elected in his stead, and A. B. Carleton, Thomas Dolan George R. Gray, A. R. Kuzer, T. N. McCarty, R. Morgan and J. I. Waterbury, the retiring members, were reelected. At the close of the meeting Secretary Frederick Evans said no action had been taken on the merger plan with J. P. Morgan and United Gas interests. Considerable interest attached to the meeting because of the statements to the effect that new interests would be admitted to the management of the company.

THE ELSBERG BILL IN NEW YORK

The Elsberg Rapid Transit bill has passed the State Senate. Its essential object is to give the New York Rapid Transit Commission greater freedom of action. Now it can let contracts for constructing rapid transit lines only on condition that the contracting party be bound to equip and operate them. The original Elsberg bill precluded the further use of that plan and required separate contracts for construction, and for equipment and operation. As passed by the Senate, it leaves the option of either plan to the Commission. Franchises are limited by the bill to twenty years, with renewals not to exceed the same period.

THE MONTGOMERY SITUATION ADJUSTED

The City Council of Montgomery, Ala., and the Montgomery Traction Company have at last reached an agreement under which the Traction Company will immediately begin the work of connecting its tracks with those of the recently acquired Montgomery Street Railway. An ordinance has been passed granting the franchise, and the representatives of the Traction Company have signified the intention of that company to accept the terms. With one exception, the ordinance is identical with the one passed by the Council and approved by Mayor Teague several weeks ago. This exception was in reference to the provision as to the issuing of books of twenty-four tickets to be sold for $1. The ordinance has been before the City Council since December. The controversy has been referred to from time to time in the Street Railway Journal, and recently was the subject of an editorial, in which were set forth the peculiar conditions sought to be imposed upon the company for the simple privileges it desired looking to the improvement of property.

THE DEATH OF G. MARTIN BRILL

George Martin Brill, president of the J. G. Brill Company, died suddenly of apoplexy on March 31, at his home in Marion, a suburb of Philadelphia. The stroke came without warning, for he was apparently in his usual good health and had only returned the previous evening from New York, and intended to go to St. Louis the following day. The funeral was held on the afternoon of April 4, at his home, and the pall bearers were the heads of the different departments of the Brill Company.

The story of Mr. Brill's life is easily read by what he has left—a happy home, an honored name, and a successful business. He was born in Hesse Cassel, Germany, in 1846, and was the eldest son of John George Brill. The father came to this country in 1847 and settled in Philadelphia, where he was employed in the car building concern of Murphy & Allison. After his graduation from the public school, G. Martin Brill obtained a position with Murphy & Allison and was foreman of the woodworking department for several years. In 1868 the plant was destroyed by fire, and as the firm decided to discontinue street car building, Mr. Brill and his father took up this branch of the business. A small shop was rented at Thirty-First and Chestnut Streets, and the new firm of J. G. Brill & Son commenced in a very modest manner. The quality of workmanship of the productions was quickly recognized, and year after year it was necessary to purchase additional ground and erect buildings, until all the available land in the vicinity (four and a half acres in extent) was covered. In 1890 the present plant—comprising eighteen and a half acres, covered with modern buildings, was occupied. Since the death of his father in 1888, Mr. Brill has been the president of the company, and until recently was also its general manager. The company's first foreign order was obtained in 1872 for a large number of cars for the City of Mexico, and after that the foreign business grew rapidly and to-day constitutes a large percentage of the output. Highest awards have been received by the company for its cars and trucks at nearly all the principal expositions at home and abroad, the last being the Lewis and Clark Exposition of 1905. Finding it necessary to take care of an increasing volume of business, the Brill Company has purchased within the last few years the American Car Company, of St. Louis, the Kuhlman Car Company, of Cleveland, and the John Stephenson Company, of Elizabeth, although each of these plants is operated separately. The Philadelphia plant has received important additions nearly each year of its history, and another large erecting shop is about to be built.

G. MARTIN BRILL

As an inventor Mr. Brill has issued to him nearly one hundred patents, for the most part on cars, trucks and parts of their equipment. As a manufacturer his work is well known to readers of this paper, but it might also be said that the management of the Brill works was directly in his charge. He possessed a marvelous faculty for detecting faulty work of any kind, whether of material, design or workmanship, and he trained his men to exercise the same degree of watchfulness. In the business world he was regarded as an unusually able organizer and director of affairs. His business associates knew the man they were dealing with, for he spoke plainly, and his methods were always governed by high principles.

Besides being president of the J. G. Brill Company, Mr. Brill was a director in the American Car Company, the G. C. Kuhlman Car Company, the John Stephenson Company, the Merchants' National Bank, of Philadelphia, and the Inter-State Railway Company. He was a member of the Manufacturers' Club, in Philadelphia, the New York Club, the Union Club, of Cleveland, and the St. Louis Club.

IMPROVEMENTS IN HELENA

A contract has been made between J. G. White & Company and the Helena Light & Railway Company, of Helena, Mont., whereby the former company will undertake the reconstruction of properties of the latter for $140,000.

On Sept. 11, 1905, the public service utilities of Helena were bought, reorganized and consolidated under the holding corporation known as the Helena Electric Light & Railway Company. The amount of the transaction was $2,350,000, which covered electric railway, electric light and gas lighting properties. Responsibility for operation was delegated by the corporation to the operating department of J. G. White & Company. During the month of February, 1906, the traffic on the railway was nearly quadruple that of the corresponding month of 1905, and the proceeds from the lighting service were also very materially augmented.

Electric power is supplied the Helena Light & Railway Company by the Missouri River Power Company, and the organizations are united in the ownership of the central sub-station, from which power is distributed for the public service. The agreement for power supply calls for a rate at maximum of utilization of $25.00 per horse-power-year. Owing to the fact that the maximum is not at present utilized, there is a large margin for increase of consumption by the light and railway company without increase of operating expense.

There are about 18 miles of track in the railway system, a great deal of which will be reconstructed under the provisions of the contract just signed. Before the reorganization the annual income from the railway property was about $62,000, and from the lighting property, both gas and electric, about $151,000. The combined operating expenses were about $143,000, making the ratio of operating expenses to gross receipts 67 per cent. A careful estimate of operating conditions after the contemplated improvement places the gross receipts at $255,000, and the operating expenses at $147,000, thus reducing the ratio to 57 per cent. The estimate for improvement includes $115,000, to be devoted to reconstruction and extension in general, and $25,000 for the relaying of tracks and replacement of overhead construction on Main Street in Helena.

THE STANDARDIZATION COMMITTEES

It will be recalled that shortly after the plans for reorganizing the various national street railway associations had been consummated, announcement was made that an important function of the new parent association and its allied bodies would be the instituting of active work looking to the securing of more uniform standards and practice along certain lines. To this end two committees on standards have been appointed, one representing the American Street & Interurban Railway Association, and one representing the American Street & Interurban Railway Engineering Association. The plan is for the committee of the engineering association to make the active investigations and prepare the reports. The reports will then be reviewed by the committee of the parent body, and the latter committee will make the recommendations to the main association, based upon the reports. The office of the secretary of the parent association will be placed at the disposal of the engineering standardization committee, and the general notices and information blanks will be sent out from that office. By co-operating in this way it is expected that the two committees and the association headquarters will keep thoroughly in touch one with the other on this work. A considerable amount of preliminary work has been done and it has been decided to take up first, investigations looking to the standardizing of tread of wheels, brake shoes, journals, journal-boxes, and tanks for street and interurban railways. Data blanks requesting information on these items will be sent out in the near future to all electric roads in America, and the committee bespeak the co-operation and assistance of everyone interested in this important work.

Secretary Swenson announces the appointment of the two standardization committees as follows:

For the American Street & Interurban Railway Association:

Chairman, H. C. Page, general manager, Springfield Street Railway Company, Springfield, Mass.; John Murphy, general manager, Pittsburg Railways Company, Pittsburg, Pa.; H. A. Nicholl, general manager, Indiana Union Traction Company, Anderson, Ind.; T. W. Wilson, general manager, International Railway Company, Buffalo, N. Y.; H. Wallerstedt, engineer car equipment, Interborough Rapid Transit Company, New York, N. Y.

In the American Street & Interurban Railway Engineering Association:

Chairman, H. Wallerstedt, engineer car equipment, Interborough Rapid Transit Company, New York; Herschel A. Bene-

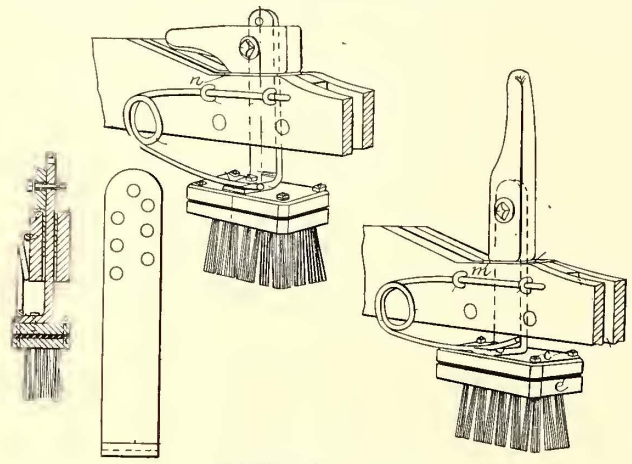
dict, mechanical and electrical engineer, United Traction Company, Albany, N. Y.; F. H. Lincoln, assistant general manager, Philadelphia Rapid Transit Company, Philadelphia, Pa.; Paul Winsor, chief engineer of motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.; W. H. Evans, master mechanic, Indianapolis Traction & Terminal Company, Indianapolis, Ind.; H. B. Fleming, superintendent of maintenance of way and structure, Chicago City Railway Company, Chicago, Ill.; J. M. Larned, engineer, maintenance of way, Pittsburg Railway Company, Pittsburg, Pa.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED MARCH 27, 1906

815,986. Pleasure Railway; William P. Taylor and James L. Hoard, of McKeesport, Pa. App. filed Dec. 28, 1905. A gravity railway comprising a main track on which cars are adapted to travel in forward direction, a track section on which the cars are

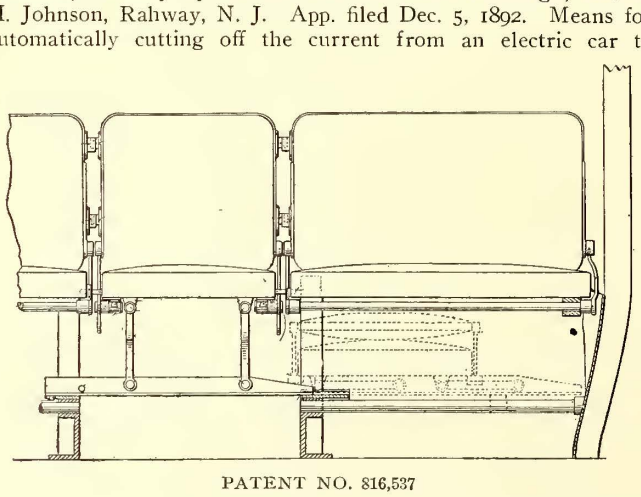


PATENT NO. 816,485

adapted to travel in a rearward direction, movable track sections for switching the cars, and braking means carried by the first mentioned track section to prevent passage of the cars thereon during the operation of the switch sections, said braking means being automatically operated in the movement of the switch sections.

815,991. Trolley Pole; Andrus S. Weaver, Sodus, N. Y. App. filed Jan. 7, 1905. The upper end of the trolley pole is hinged to the body thereof and the relative movement causes the pole to drop when the wheel leaves the conductor.

816,014. Safety System for Electric Road Crossings; Arthur H. Johnson, Rahway, N. J. App. filed Dec. 5, 1892. Means for automatically cutting off the current from an electric car to



PATENT NO. 816,537

thereby prevent its approach to a track on which a steam or other train is approaching.

816,148. Trolley Shield; John W. Brown and Charles W. Jenkins, Washington, D. C. App. filed April 29, 1905. The lower half of the trolley wheel runs in a curved guard which prevents the wheel from catching over the wire when it slips off and is being repositioned by the retriever or other means.

816,239. Trolley Harp; Isaac H. Lunt, Barre, Va. App. filed Sept. 6, 1905. The trolley is hinged at the upper end of the pole to have an independent transverse movement, the purpose of which is to facilitate rounding curves.

816,293. Brake Hanger; George M. Brill, Philadelphia, Pa. App. filed June 27, 1905. An adjustable and universal joint for each end of the hanger consisting of bearing blocks adapted to turn in pockets and hangers free to turn in said blocks.

816,294. Car Truck; John A. Brill and Samuel M. Curwen, Philadelphia, Pa. App. filed March 31, 1904. Details of construction.

816,308. Switch; Matthew S. Farmer, Washington, D. C. App. filed July 21, 1905. Levers in the tread of the rails are depressed by the wheel flange thereby elevating a switch-throwing pin adapted to be engaged by suitable means on the car.

816,373. Brake Shoe; James F. Powers, Elkton, Md. App. filed Dec. 16, 1905. Comprises a cast-metal body portion having a hard metal strengthening member applied to the rear face thereof, said member being provided with a plurality of dovetailed openings, and with an intermediate bearing head, having a dovetailed recess formed therein, said recess and openings being designed to receive material of the body for uniting the strengthening member thereto and the body having enlargements in which the member is terminally embedded.

816,377. Switch; Hugh Richardson, Atlanta, Ga. App. filed Aug. 16, 1905. Switch operating mechanism involving two springs of different strength, one of which controls the other.

816,415. Trolley; Henry Zancer and Gustav Hahn, Wilmerding, Pa. App. filed Sept. 25, 1905. A pair of guard arms adapted to normally close over the wheel and hinged upon the sides of the harp, for preventing the escape of the wire. The arms can be separated when desired by a cord connection.

816,467. System of Trolley Wire Suspension; Paul E. Herkner, Berlin, Germany. App. filed Sept. 10, 1904. A trolley system for high-speed trains in which the hangers at the curves have short arms or rods connected with the trolley wire which permit a slight upward yielding thereof when the train passes.

816,485. Rail Cleaning Apparatus; John Lindall, Boston, and Paul Winsor, Weston, Mass. App. filed Jan. 23, 1904. Spring-pressed wire brushes attached to the truck frame.

816,537. Disappearing Seat; Samuel M. Curwen, Haverfort, Pa. App. filed Feb. 9, 1905. An aisle seat adapted to be folded and stored under one of the adjacent seats.

PERSONAL MENTION

MR. CHARLES R. VAN ETTEN, general freight agent of the Brooklyn Rapid Transit Company, has resigned, effective April 1. Mr. James B. McQueeney is appointed acting general freight agent.

MR. F. H. RAPLEY, who held the position of assistant to the president of the Pressed Steel Car Company, has resigned and returned to England to accept a position with a manufacturing company.

MR. ALBERT SPIES, who, in addition to his duties as editor of "Cassier's Magazine," has had charge of the editorial management of the "Electrical Age," of New York, since it has been in the possession of its present owners, has resigned from the editorship of this latter property.

MR. JOHN N. SPELLMAN has been appointed master mechanic of the Indianapolis, Columbus & Southern Traction Company, with headquarters at Greenwood, Ind. Mr. Spellman came from the Indiana Union Traction Company, with which he was connected for six years.

MR. C. N. WILCOXSON, general superintendent of the Cleveland & Southwestern Traction Company, of Cleveland, has been appointed general manager of the company, President F. T. Pomeroy having relinquished the active management. Mr. Wilcoxson was formerly general superintendent of the Western Ohio Railway.

MR. WILLIAM E. ROLSTON, for several years superintendent and chief engineer of the Dayton & Troy Electric Railway, of Dayton, Ohio, has resigned to accept a similar position with the Canton-Akron system, of Canton, Ohio. Mr. Rolston was responsible for many of the innovations which gave the Dayton & Troy the reputation of being one of the best constructed and best operated interurban lines in the Central West.

MR. AXEL H. ENGSTROM, of Philadelphia, consulting engineer in electric railway work, is dead. Mr. Engstrom was born in Sweden and was forty-nine years old. He has lived in America twenty-five years. Mr. Engstrom resigned as chief en-

gineer of the Electric Traction Company, of Philadelphia, in December, 1895, and started in business as consulting engineer. Since then he has been retained as consulting engineer for a number of electric railways and electric power plants, and has also had charge of the complete construction of a number of electric railways, besides the construction of machine shops. Among properties built by Mr. Engstrom are the Fairmount Park Transportation Company's line in Fairmount Park, Philadelphia, and the Philadelphia, Morton & Swarthmore Street Railway Company's lines, adjacent to Philadelphia. Mr. Engstrom's estate will complete the unfinished work that he had on hand under charge of Mr. Chas. R. Peddle, who for a number of years has been associated with Mr. Engstrom.

MR. EDWARD G. WATERS has just been appointed assistant to the first vice-president of the General Electric Company, with headquarters at Schenectady, N. Y. Mr. Waters has been connected with the General Electric interests for a long time, and for the past three years has made his headquarters at Rugby, where he has been associated with the British Thomson-Houston Company, in a managerial capacity. Previous to going to England he was private secretary to Vice-President General Griffin, in the New York office of the company, and before that time represented the General Electric Company at Pittsburg.

MR. B. A. CONOLLY, for the past four years auditor of the Lima Electric Railway & Light Company, of Lima, Ohio, has resigned to become associated with Mr. Joseph B. Mayer, of Buffalo, who recently organized the Traction, Gas & Electric Finance Company, and has acquired a number of properties between Buffalo and Erie. Mr. Conolly will be auditor of the street railway lines of Erie, the Jamestown & Chautauqua Lake Railway, the Chautauqua Lake Steamship Company, the Buffalo, Dunkirk & Western Railway, the Dunkirk & Fredonia, and the Hamburg Railway, which are included in the deal. Mr. Conolly was given a farewell banquet by his associates at Lima a few evenings ago.

MR. WALLACE D. LOVELL, of Newton, Mass., well known as a business man and a street railway promoter, is dead. Mr. Lovell was born in Weymouth, Feb. 3, 1854, and received his education in the public schools, and later engaged in the banking business in Boston. Eventually he became a partner in the firm of Potter, Lovell & Company, bankers and brokers. After the firm retired from business Mr. Lovell passed some time in Mexico. On returning to Massachusetts he became interested in street railways. Foreseeing their development Mr. Lovell planned a system which would connect Boston with Manchester and Concord, N. H. The start in this plan was made with the electric railway running from Exeter, N. H., to Hampton Beach. Later the latter resort was connected with Amesbury. After the construction of the lines running to the beach, to Exeter and Amesbury they were continued to Haverhill, and the purchase of the franchise that had been obtained for a road between Haverhill and Salem, N. H., was the nucleus for the construction of the lines in Southern New Hampshire that have connected Nashua, N. H., with Haverhill, Lowell and Lawrence. Haverhill thus became the center of this system of street railways, and Canobie Lake Park one of the most important pleasure resorts. It was after this that Mr. Lovell secured franchises for the road between Haverhill and Manchester, N. H. The proposed new line to Boston from Haverhill was next planned, the object being to secure a through line from Boston to Manchester, N. H.

MR. W. BOARDMAN REED, whose resignation as engineer of maintenance of way and buildings of the New York City Railway Company was announced in the March 24 issue of this paper, was tendered a farewell dinner March 31 by his late associates. The banquet was held at the Hotel Astor, and was attended by about seventy-five gentlemen, including the officers and heads of departments of the New York City Railway Company, with the members of Mr. Reed's immediate staff and a few of his outside personal friends. The principal address of the evening was that of Mr. Vreeland, who spoke of the deep regret which he and the other representatives of the company present felt at the resignation of Mr. Reed. He also referred in the highest terms to the work carried on by Mr. Reed while with the company, to his engineering ability and skill and to his personal popularity with all with whom he was brought in contact. In conclusion, Mr. Vreeland, in behalf of the members of Mr. Reed's staff, presented him a diamond ring and a series of resolutions which are published below. Mr. H. A. Robinson, of the company's legal staff, in behalf of the heads of departments of the company, also presented Mr. Reed a gold watch. In replying to these speeches and gifts, Mr. Reed referred to the loyalty, harmony and esprit de corps which are characteristic in a marked degree of the organization of the New York City Railway, and which had been an important factor in the success and daily work of the maintenance of the way department. The toastmaster at the dinner was A. E. Aeby, New York agent of the Pennsylvania Steel Company, and addresses were also made by a number of others present. The resolutions to Mr. Reed follow: "Whereas, William Boardman Reed has for twelve years acted in the capacity of engineer of maintenance of way and buildings of this company; and, Whereas, during that period he has, by his uniform courtesy and eminent fairness toward the employees of this department, won their esteem and sincere good will; therefore, be it Resolved, that we adopt this method of conveying to him our grateful appreciation of those qualities which have endeared him to us. Committee, W. T. Dougan, M. H. Lynch, T. H. Gorey, F. Cooley, H. W. Webb, H. Bendfeldt."

AS STATED in the Street Railway Journal of March 31, Mr. J. V. E. Titus, whose energetic methods have made Garton-Daniels products known to electric railways far and wide, has been elected second vice-president of the new Electric Service Supplies Company. Mr. Titus was born in Lambertville, N. J., April 15, 1874, moved to Grenada, Miss., in 1885, but a year later wandered north to Keokuk, Ia., where he received a public school education. In 1892 the Garton-Daniels Electric Company was formed in that city, and Mr. Titus entered its employ as stenographer and bookkeeper. Within another year he was on the road selling lightning arresters with such success that 1894 saw him elected secretary of the company. He was the active manager of the business until 1899, when the present Garton-Daniels Company was formed with Mr. Titus as vice-president and treasurer. Upon the death of President John C. Daniels, in 1903, he was elected president and treasurer.

J. V. E. TITUS

MR. W. T. DOUGAN, assistant engineer of maintenance of way of the New York City Railway Company, has been appointed engineer of maintenance of way of the company, to succeed Mr. W. Boardman Reed, whose resignation from the company, to take an active interest in the management of the Bishop Gutta Percha Company, was noted in the Street Railway Journal of March 24, and to whom, as noted elsewhere in this issue, a farewell banquet was tendered at the Hotel Astor (New York) Saturday evening, March 31, by his associates in the New York City Company. Mr. Dougan accepts the added responsibilities of the new position well fitted by previous experience to perform them, for he has been with the company two years as assistant to Mr. Reed, and six years as engineer of construction in changing from horses to underground conduit. In addition to this he has as an asset engineering experience dating from his graduation from Union College in 1892, which has extended to many branches of railroad work. For two years Mr. Dougan was assistant engineer of construction of the electric railway from Fonda to Gloversville, N. Y. Later he had charge of the construction of the electric railway from Herkimer to Frankfort, through Mohawk and Ilion, N. Y. This work included the building of the power house at Mohawk. For a year he was assistant engineer at the iron ore mines owned by Witherbee, Sherman & Company in Essex County. He also made the preliminary surveys and located the Mountain Lake Railway, which extends from Gloversville to Mountain Lake, a summer resort in the Adirondacks. Mr. Dougan also had charge of the preliminary surveys for the New York & Ottawa Railway from Moira, N. Y., to Ottawa, Canada, across the St. Lawrence River. Following this began his connection with the New York City Railway Company.

W. T. DOUGAN

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.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O.						
Northern Ohio Tr. & Light Co	1 m., Feb. '06	66,420	37,839	28,581	22,667	5,914
	1 " " '05	60,312	35,462	24,850	22,917	1,934
	2 " " '06	139,655	79,458	60,197	45,334	14,863
	2 " " '05	125,777	72,554	53,223	45,834	7,390
AURORA, ILL.						
Elgin, Aurora & Southern Tr. Co	1 m., Jan. '06	40,714	23,790	16,924	9,333	7,591
	1 " '05	33,906	22,297	11,609	9,333	2,276
	7 " " '06	307,741	164,735	143,006	65,173	77,833
	7 " " '05	273,996	153,064	120,932	65,173	55,760
BINGHAMTON, N. Y.						
Binghamton Ry. Co.	1 m., Feb. '06	19,364	11,881	7,483	7,372	111
	1 " " '05	17,134	10,696	6,438	7,844	†1,406
	8 " " '06	193,371	100,090	94,281	58,137	35,144
	8 " " '05	173,001	91,905	81,096	56 866	24,229
CHAMPAIGN, ILL.						
Illinois Traction Co.	1 m., Feb. '06	209,064	*115,313	93,751	------	------
	1 " " '05	170,380	*94,366	76,014	------	------
	2 " " '06	442,816	*240,755	202,061	------	------
	2 " " '05	361,740	*197,345	164,395	------	------
CHICAGO, ILL.						
Aurora, Elgin & Chicago Ry. Co	1 m., Jan. '06	39,545	27,480	12,065	------	------
	1 " " '05	26,259	19,831	6,428	-----	------
	7 " " '06	404,711	211,326	193,384	------	------
	7 " " '05	293,799	156,326	137,473	------	------
Chicago & Milwaukee Elec. R. R. Co	1 m., Feb. '06	36,593	21,050	15,543	------	------
	1 " " '05	23,599	14,888	8,710	------	------
	2 " " '06	80,037	43,744	36,293	------	------
	2 " " 05	48,425	29,542	18,883	------	------
CLEVELAND, O.						
Cleveland, Painesville & Eastern R.R. Co	1 m., Feb. '06	13,930	*8 599	5,331	6,678	†1,347
	1 " " '05	11,209	*8,971	2,238	6,673	†4,435
	2 " " '06	29,788	*17,717	12,072	13,357	†1,285
	2 " " '05	24,555	*18,708	5,846	13,337	†7,490
Cleveland & Southwestern Traction Co.	1 m., Feb. '06	39,718	26,981	12,737	------	------
	1 " " '05	30,406	22,923	7,483	------	------
	2 " " '06	86,285	54,531	31,754	------	------
	2 " " '05	65,166	45,700	19,466	------	------
Lake Shore Electric	1 m., Feb. '06	52,128	*31,714	20,414	20,404	10
	1 " " '05	41,043	*28,463	12,580	20,404	†7,824
	2 " " '06	111,756	*70,370	41,386	40,808	578
	2 " " '05	88,877	*60,321	28,556	40,808	†12,252
DETROIT, MICH.						
Detroit United Ry	1 m., Feb. '06	379,334	*234,319	145,015	92,296	52,719
	1 " " '05	321,177	*211,070	110,107	92,970	17.137
	2 " " '06	797,167	*484,554	312,613	184,538	128,075
	2 " " '05	677,373	*440,275	237,098	186,407	50,691
DULUTH, MINN.						
Duluth St. Ry. Co	1 m., Jan. '06	54,424	33,722	20,702	17,536	3,166
	1 " " '05	47,593	27,908	19,685	16,729	2,956
EAST ST. LOUIS, ILL.						
East St. Louis & Suburban Co	1 m., Feb. '06	107,655	56,592	51,063	------	------
	1 " " 05	95,425	45,914	49,511	------	------
	2 " " '06	221,870	112,593	109,277	------	------
	2 " " '05	201,252	93,899	107,353	------	------
FT. WAYNE, IND.						
Ft. Wayne & Wabash Valley Tr. Co	1 m., Jan. '06	80,145	47,531	32,614	------	------
	1 " " '05	68,506	43,107	25,459	------	------
	12 " Dec. '05	949,498	580,832	363,665	------	------
	12 " " '04	83 ,231	534,295	301,937	------	------
FT. WORTH, TEX.						
Northern Texas Tr. Co	1 m., Dec. '05	57,296	35,758	21,538	9,938	11.601
	1 " " '04	55,165	30,972	24,193	9,182	15,011
	12 " " '05	661,037	391,863	269,174	118,127	151,047
	12 " " '04	564,711	328,813	235,898	108,760	127,138
HANCOCK, MICH.						
Houghton County St. Ry. Co	1 m., Jan. '06	14,832	13,347	1,485	3,899	†2,414
	1 " " '05	15,675	14,854	821	3,408	†2,587
	12 " " '06	166,224	167,136	912	44,149	†45,060
	12 " " '05	200,758	137,347	63,411	40,772	22,639
HOUSTON, TEX.						
Houston Electric Co.	1 m., Jan. '06	43,077	30,137	12,940	8,174	4,766
	1 " " '05	34,572	22,123	12 449	8,389	4,061
	12 " " '06	525,820	321,539	204,281	105,289	98,992
	12 " " '05	364,318	316,042	48,277	97,571	†49,294
HUDSON, N. Y.						
Albany & Hudson R. R. Co	1 m., Feb. '06	19,863	*17,880	1,983	5,000	†3.017
	1 " " '05	19,537	*18,051	1,486	5,000	†3,514
	8 " " '06	236,460	*178,585	57,875	40,000	17,875
	8 " " '05	207,758	*159,826	47,932	40,000	7,932
MANILA, P. I.						
Manila Elec. Ry. & Lt. Co.	1 m., Feb. '0.	70,600	34,845	35,755	------	------
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co.	1 m., Feb. '06	257,206	126,301	130,905	86,095	44,811
	1 " " '05	236,025	128,378	107,647	71,193	36,455
	2 " " '06	535,358	265,918	269,440	170,311	99,128
	2 " " '05	492.483	258,606	233,877	145,543	88,334
Milwaukee Lt., Ht. & Tr. Co	1 m., Feb. '06	40,872	17,807	23,066	21,953	1,113
	1 " " '05	33,856	19,287	14,568	18,373	†3,804
	2 " " '06	85.787	37,648	48,139	43,691	4,448
	2 " " '05	72,379	39,069	33,310	37,316	†4,005
MINNEAPOLIS, MINN.						
Twin City R. T. Co	1 m., Feb. '06	380,385	188,843	191,542	109,708	81,834
	1 " " '05	321,451	170,281	151,170	97,325	53,845
	2 " " '06	788,251	394,362	393,888	219,417	174,472
	2 " " 05	672,571	345,595	326,976	194,650	132,326
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., Feb. '06	213,416	156,039	57,377	36,124	21,253
	1 " " '05	185,864	147,896	37,968	20,478	17,491
	5 " " '06	1,171,016	772,173	398,843	138,962	259,881
	5 " " '05	1,027,214	701,878	325,336	95,805	229,530
OAKLAND, CAL.						
Oakland Traction Consolidated	1 m., Jan. '06	121,623	68,524	53,099	35,679	17,420
	1 " " '05	104,673	61,521	43,152	30,485	12,668
	12 " Dec. '05	1,441,471	740,367	701,103	392,955	308,149
	12 " " '04	1,258,136	659,261	598,875	318,550	280,335
San Francisco, Oakland & San Jose Ry. Co.	1 m., Jan. '06	48,309	22,801	25,508	16,497	9,011
	1 " " '05	40,381	16,405	23,976	12 578	11,398
	12 " Dec. '05	535,134	234,998	300,136	159,840	140,295
	12 " " '04	419,350	180,409	238,940	111,000	127,940
OLEAN, N. Y.						
Olean St. Ry. Co	1 m., Jan. '06	8,939	4,531	4,408	2,744	1,664
	1 " " '05	8,788	3,890	4,898	2,693	2,205
	7 " " '06	77,727	38,671	39,057	18,576	20,481
	7 " " '05	69,166	33,509	35,657	18,513	17,144
PEEKSKILL, N. Y.						
Peekskill Lighting & R R. Co	1 m., Jan. '06	10,210	*5,844	4,366	------	------
	1 " " '05	9.116	*5,987	3,129	------	------
	7 " " '06	78,772	*10,912	37,861	------	------
	7 " " '05	71,804	*40,188	31,616	------	------
PHILADELPHIA, PA.						
American Rys. Co	1 m., Feb. '06	177,037	------	------	------	------
	1 " " '05	153,347	------	------	------	------
	8 " " '06	1,225,696	------	------	------	------
	8 " " '05	1,006,770	------	------	------	------
ROCHESTER, N. Y.						
Rochester Ry. Co	1 m., Feb. '06	147,409	82,908	64,501	27,776	36,725
	1 " " '05	124,452	74,442	50,010	26,776	23,234
	2 " " 06	305,170	175,333	129,837	55,761	74,076
	2 " " '05	259,403	152,032	107,371	53,762	53,609
ST. LOUIS, MO.						
United Railways Co. of St. Louis	1 m., Feb. '06	638,076	*401,457	236,619	198,609	38,010
	1 " " '05	553,337	*398,043	155,294	199,657	†44,363
	2 " " '06	1,336,003	*825,748	510,255	397,218	113,037
	2 " " '05	1,159,833	*840,539	319,294	399,344	†80,050
SAN FRANCISCO, CAL.						
United Railroads of San Francisco	1 m., Jan. '06	600,210	------	------	------	------
	1 " " '05	543,371	------	------	------	------
	12 " Dec. '05	7,061,352	------	------	------	------
	12 " " '04	6,647,612	------	------	------	------
SAVANNAH, GA.						
Savannah Electric Co.	1 m., Jan. '06	49,618	31,863	17,755	10,904	6 851
	1 " " '05	41,340	25,607	15,733	10,553	5,180
	12 " " '06	594,514	354,283	240,231	128,045	112,185
	12 " " '05	545,750	317,445	228,306	126,111	102,195
SEATTLE, WASH.						
Seattle Electric Co	1 m., Jan. '06	235,396	155,893	79,503	23,230	56,273
	1 " " '05	201,760	142,636	59,124	25,135	33,989
	12 " " '06	2,599,550	1,687,269	912,281	289,744	622,537
	12 " " '05	2,333,181	1,614,395	718,786	297,420	421,366
SYRACUSE, N. Y.						
Syracuse R. T. Co	1 m., Jan. '06	86,061	49,591	36,470	21,759	14,711
	1 " " '05	74,254	44,251	30,003	20,334	9,669
	1 " Feb. '06	79,351	44,349	35,002	22,092	12,910
	1 " " '05	68 479	41,246	27,233	20,312	6,921
	2 " " '06	165,412	93,940	71,472	43,851	27,621
	2 " " '05	142,733	85,497	57,236	40,646	16,590
TERRE HAUTE, IND.						
Terre Haute Tr. & Lt. Co	1 m., Jan. '06	59,831	39,150	20,681	10,417	10,264
	1 " " '05	46,248	30,187	16,060	8,962	7,093
	12 " " '06	643,344	423,480	219,863	123,873	95,990
	12 " " '05	574,489	369,326	205,163	113,306	91,857
TOLEDO, O.						
Toledo Rys. & Lt. Co.	1 m., Jan. '06	159,053	*83,148	75,905	42,290	33,615
	1 " " '05	150,944	*76,090	74,854	42,701	32,153
	12 " Dec. '05	1,913,456	*972,994	940,462	510,307	430,155
	12 " " '04	1,752,833	*923,208	829,625	499,874	329,751