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Of this issue of the Street Railway Journal, 8200 copies are printed. Total circulation for 1906 to date, 302,300 copies, an average of 8170 copies per week.

Drafting in Repair Shops

The practice of street railways in locating drafting departments varies widely, particularly with reference to the drawing required for the execution of shop work. On some systems the drafting force is established in the general offices of the company in the business district; on others drawing is performed wherever it may be needed at the time, and generally on a table in the office of the shop superintendent or foreman. The latter course usually results in direct personal contact between the draftsman and the shop, and it often saves time; but unless all the drafting is ultimately brought under the control of a centralized department there is great danger of sketches and prints going astray when they are most badly needed.

It is a poor plan to lay down a hard and fast rule that all drawings for shop service should be turned out in the general offices of the company, for there are many occasions where a rough pencil sketch on an old piece of board is all that is needed to enable a piece of work to be pushed at once to completion. Then, too, a small blue-printing outfit is often a great convenience in the repair shop, and a layout of this kind with a couple of braced channel irons extending from the shop window to enable a carriage to be run in and out is the means of saving no little time in emergency work. It is doubtful if it really pays to do much general drafting at the shops unless the engineering and drafting departments as a whole are located there, but special odds and ends may be very nicely handled by a shop assistant if the requisite designing ability is present. Too great insistence cannot be laid, however, on the preservation of all actual construction drawings in the main drafting department or sub-department on standard sheets well indexed and properly filed.

Brakes and Skidding

One article and one communication in this issue are devoted to the subject of braking. The letter from Mr. Hunter first calls attention to the fact that any of the older brakes, even the old-fashioned spindle hand brake, can be so arranged as to apply the same pressure to the brake-shoes as any of the more improved forms of brakes. From this the author forms the deduction that the principal difference between the two classes of brakes, so far as their action is concerned, is in the time required to bring the shoes into contact with the wheels and to stop the car. Hence the chief difference lies in the length of the so-called "danger space" in front of the car. The letter then brings out the interesting condition that a shorter danger space does not necessarily, or in fact usually, result in a reduction in the number of accidents, because both motormen and the public soon learn to apply to the shorter distance the precautions which they formerly took with the greater space when the cars could not be stopped so promptly. The use of power brakes is, of course, to be recommended, whether they are operated by air, momentum or electricity or by the device of multiplying the strength of the motorman by gearing or cams as adopted on a number of roads, but according to Mr. Hunter, the advantage of these power brakes lies in the higher running speeds thereby made possible, rather than in any probable reduction in the number of accidents.

The article by Mr. Fox takes up another phase of the subject and describes the relation of braking to skidding. The progress in braking in this country so far has been largely to quicken the application of the brake-shoes to the wheels, and hence to install powerful and easily controlled braking apparatus. This policy is based upon the fact that in this country the rails are generally in a dry and clean condition. English roads, however, have a different condition to face, and, as Mr. Fox says, it seems strange to us to hear of engineering authorities abroad looking upon hand brakes as too powerful and upon air brakes as positively dangerous. The result has been the application and development in Europe, particularly in England, of a method of braking initiated in this country but not subsequently followed up here to any great extent.

Undoubtedly the track brake in its various forms, but particularly when the adhesion can be increased by magnetic means, is most useful on steep grades with slippery or greasy rails. In ordinary braking it is tacitly assumed that the wheels will not skid, since practically all braking devices are arranged to act directly or indirectly upon them. The tests given in Mr. Fox's paper are ostensibly upon electric brakes, but really their importance is not in showing the virtues of any particular means of applying power, but in putting upon record the difference between wheel braking and wheel braking plus track braking. It quite goes without saying that a powerful track brake is capable of slowing down a car rapidly, and experience seems to show that it also works fairly smoothly, a condition of great importance to the safety of the passengers. In some of the tests with the type B brake the retardation reached nearly 7 miles per hour per second. This is a figure so high as to be positively dangerous to the live load, and of course never to be used save to avoid a worse danger. The fact that with a proper track brake the retardation can be pushed up to the limit of safety is certainly important. Under favorable conditions air brakes on the wheels can produce all the retardation that is safe. If, however, the track is in bad condition, even the hand brake will skid the wheels, while the track brake can still get its grip.

The regenerative feature in some electric brakes seems to be regarded abroad as a feature of importance. Here it has never appealed to the street railway managers, and although the electric brake has been put out in several forms it has never fairly caught public attention. These foreign tests should bring it to the front again with the track brake attachment, although on account of our drier climate the need for braking other than on the wheels is probably not as great as an average condition of American practice as it is abroad. Nevertheless we believe that the tentative trials of these brakes outlined in the article referred to have been encouraging, and further work in this line will certainly come. The real significance of the whole matter is in the track brake as an additional safety device at certain times and under certain conditions. Even then there is no royal road to safety in electric railroading. With a slippery rail and a steep grade, only persistent inspection and attention to the details of equipment and discipline can keep down the accident list. The test brakes cannot promise immunity when motormen take long chances. They can, however, materially lessen the dangerous space on unfavorable track, and this we believe to be very advisable, in spite of the experience of the claim agents mentioned in Mr. Hunter's letter.

The Use of Poor Fuel

The final test of economy in station operation is the cost of fuel and firing per unit of energy. It is easy to find steam and electric plants of the latest type, laid out by the most sacred canons of efficient design, which yet fail to show any conspicuous economy when one takes account of the inroads on the coal pile. With the increasing cost of fuel it is necessary not only to use steam economically, but to generate it at the lowest possible cost for fuel. The day of burning high-grade coal in manufacturing establishments has well-nigh passed, and it is time to investigate the economics of poor bituminous coal and of low-priced anthracite tailings and refuse. Anything that contains a reasonable proportion of carbon can be made to burn on sufficient provocation, and while the labor of stoking and providing draft is greater with poor fuel than with good, it by no means offsets the considerable difference in price. The fact is that the thermal values of fuels differ very much less than their prices, and a proper degree of skill can effect large economies. The change from high-grade to low-grade fuel may involve considerable cost in change of furnace equipment, indeed the conditions must be radically altered, yet in the long run the change will often pay very handsomely.

To put the matter in concrete form, one gets from the best bituminous or anthracite coal about 13,000 to 15,000 B. T. U. per lb. From low-grade bituminous coal or cheap buckwheat anthracite one gets say 9000 to 10,000 B. T. U. per lb., these fuels containing more slate or other mechanical refuse and giving more ash. The present prices of such fuels vary not in the implied ratio of about 2 to 3, but more nearly as 1 to 2, so that the cheap fuel actually contains 30 to 40 per cent more thermal capacity per dollar of cost. Even culm is a fuel not to be despised where it can be had without the payment of extortionate freight charges. Many plants use slack and slack mixtures to advantage now, and if more attention was paid to the subject of furnaces, plants could profitably change to the supposed lowest grades of marketable fuel with good effect on the balance sheet. The secret of burning cheap fuel is of course in the design and management of the furnace. Poor coal, whether bituminous or anthracite, carries many impurities and gives much ash compared with high-grade coal, so that it is more difficult to burn cleanly and requires altogether more careful treatment. If finely comminuted like buckwheat coal or some of the bituminous waste it also requires a very special class of grate, much smaller in its apertures and more liberal in its available surface than those more commonly in use. There being smaller natural interstices in the burning pile of fuel, more draft is required, and particularly with the small anthracite coal a steam draft seems to work better than a dry blast. Dumping and shaking grates are also extremely useful in keeping up a uniform fire and facilitating cleaning, indeed the chief requisite in firing such fuel seems to be a thin and even fire forced to high temperature with plenty of well-distributed air. Mechanical stokers would seem to be particularly appropriate for handling poor coal, although most of the forms in use have not been specialized to the degree requisite for working the poorest grades.

There is a great opportunity for making judicious fuel mixtures of cheap materials. A low grade bituminous slack uncomfortably rich in volatile matter may be blended with buckwheat anthracite to make a mixture of well-balanced composition for easy burning, having almost as great thermal value as high-grade steam coal at far less cost. Such a mixture can be made, save for rather higher ash, to approximate very closely to the composition of the best steam coals, and if one works with large supplies can be kept exceedingly uniform in performance. The day has come when these so-called low-grade fuels should be utilized on a large scale. A mixture costing perhaps $2 to $2.50 per ton can be made to do the work of market coals costing half as much again, provided the fireroom is planned for the purpose. In building new plants it is certainly the part of wisdom to prepare for this instead of working on the tacit assumption that fairly high-grade fuel is to be used. We have very seldom seen a specification drawn in which due stress was laid on the adaptation of the boilers and furnaces to economical fuel. A boiler guarantee based on picked New River coal is very pretty to look at, but it is not business. In fact, a boiler and furnace showing high evaporation with such fuel is likely to give a disappointment in capacity and economy when used with cheap coal. It would not be a bad plan in laying down a specification for a power plant to call not for solemn guarantees in details, but for consumption of a specified grade of fuel per kilowatt-hour. Few power plants show up as they should on this basis. They may give all kinds of economy in the generating units and yet do badly upon the whole. Given a good load factor such as can be reached in most large stations and one must look for savings quite outside of the generating units. Keep an eye on the fireroom and the piping and the auxiliaries and the bills will be smaller.

Construction Work in Established Power Plants

Sooner or later the power plant on every growing electric railway system comes face to face with the problem of enlarging its capacity. In a good many installations the physical limits of the land occupied precludes any extension of equipment beyond the original layout, and increased capacity can be had only at the expense of tearing out a great deal of old machinery and setting up new apparatus in its place. This is always a relatively costly proceeding, for it rarely happens in these days that the foundations of the original equipment are at all suited to the design of the later styles of machinery. A greater or less obstruction of the regular work of the power plant is part of the price which has to be paid for remodeling, and it is important that when alterations are under way the regular service shall be interfered with as little as is possible.

Strictly speaking, the time to insure a minimum interruption of service in a plant during extensions is when the original design is made. Of course, this is as much out of the question in a good many plants as it is for a man to select his own grandparents, but in newly planned installations, it ought not to be such a difficult proposition to bear in mind the question of facility of extension before the hodcarriers begin to travel up and down the ladders or the concrete mixing gang begins to turn up its batches and put together the forms. Plants constructed on the so-called unit principle—where each group of boilers and engines, turbines, pumps or producers constitute in reality a separate operating station focussed upon a common set of bus-bars—offer many advantages both in economy of first cost and convenience of enlargement when increased capacity is needed. It is only the story of the sectional bookcase over again on a much larger and different scale. A station filled with heterogeneous machinery is a much harder field for expansion than a duplicated unit or similarly equipped installation. Therefore if the probable line of extension of a plant is known at the time when it is built, it is wise to provide for the future in such a way that tearing out will not be necessary unless some compensating advance in the science of motive power production relegates all the established equipment to the scrap heap.

Certainly no plant should undertake elaborate extensions without separating, as far as possible, the operating and the construction work. It is better to bring all the materials and machine parts into the plant at the opposite side from the working portion, even if this in some cases demands knocking a hole in the wall for a new doorway. We have seen plants all torn up with parts of machines and construction litter, tools and debris, which might have been largely avoided if the work had not all been carried through the engine room past operating apparatus to temporary resting places in aisles or other places on the wrong side of the building. A traveling crane or hoist of some description is almost invaluable in the work of adding to a power plant, and yet this useful device is often employed to the serious interference of the regular operating shifts. A great deal of such work is performed by outside contractors, but with a proper supervisory clause in behalf of the railway company, it should not be difficult to secure the adoption of the best methods of handling material, with respect to the good of the existing installation. At such times the equipment which is in operation is subjected to unfavorable conditions in regard to stone or metal dust, leakage of water, dirt, accident by collision with tools, materials or moving pieces of machinery being handled by the crane. Then again, the extension of a plant often means that the old equipment has to be considerably overloaded pending the establishment of the new machinery in regular operation, so that interruptions are more than ordinarily serious.

As far as possible, materials should be kept outside the immediate operating rooms, even if it is necessary in some cases to hire space on adjoining property for a short time. The men on duty should be free to move about quickly, and in case it becomes necessary to obstruct the vision of the switchboard attendants by the erection of staging or other false work, temporary telephones can be installed at various points, or at least electric push-button signals inaugurated. Sometimes a great deal of annoyance is saved by the suspension of a thick series of canvas curtains from the roof trusses so as to create a temporary partition between the operating room and the power plant extension. Sufficient care is not always observed in regard to covering up small machinery which is standing idle, to protect it from the dirt and dust of construction. An extra use of the air blast cleaner should be encouraged at such times, and it is a question if the use of a vacuum cleaning system is not desirable when so much dirt and dust is flying about in the air. Unless careful precautions along these general lines are taken when a plant is extended, it is by no means impossible that the cost of making alterations and improvements may be much increased, although the immediate expense of this sort of depreciation is hidden. Sometimes an extension can be made on the outward side of a wall, the latter remaining in place until the bulk of the work is done. A minimum of interference is then probable, and if the unit principle of construction is employed, the regular force in the plant may be almost as little hindered by the work as are passers-by on the adjoining streets.

BRIDGES FOR ELECTRIC RAILWAYS—I

By C. C. SCHNEIDER, Consulting Engineer

The recent development of electric railways has made them a very important factor in our modern systems of transportation, and created a demand for structures expressly designed to carry electric railway traffic only. This is the class of bridges which will be considered in this article, confining ourselves to steel structures only.

Bridges for electric railways do not differ much in their essential features from regular railroad bridges, except that the live loads to be carried by them are smaller and, therefore, do not require such heavy structures, and, on account of this difference, they require special treatment. Rigidity is one of the most essential requirements of a well-designed structure. A railroad bridge, owing to the nature of the traffic it has to carry, requires heavy members and connections, and this massiveness alone imparts considerable rigidity to the structure. On the other hand, a bridge carrying an electric railway is generally a much lighter structure and has not the natural advantage of that rigidity produced by its own weight; the same must, therefore, be obtained by the design.

The designing and building of a bridge or any other structure on the strength of which human life depends cannot be too well or carefully done. In accordance with the writer's experience and observations, electric railway bridges generally are not designed with the same care as railroad bridges. They are, as a rule, treated like county highway bridges, carelessly designed, sometimes by incompetent men, and built in shops fitted up to do only the ordinary class of highway bridge work. All over the country may be observed a number of flimsy structures of this kind, which will soon be worn out and will have to be replaced by more substantial ones in the near future. True economy, therefore, demands carefully prepared designs, good workmanship and good material.

SCHUYLKILL RIVER BRIDGE AT FALLS OF SCHUYLKILL, PHILADELPHIA, PA.

SELECTION OF A DESIGN

The kind of structure which is best adapted for a particular crossing depends upon local conditions, such as the shape of the profile, the width and nature of the stream, river bottom, and the material of the approaches. If a structure is to span a valley with only a small creek, a viaduct consisting of braced steel towers and plate girder spans is generally the most suitable structure. If the viaduct, instead of crossing the valley, is located in the streets of a city where the tower bracing would interfere with the traffic in the street, this bracing has to be omitted and the spans supported on columns in which brackets take the place of the bracing to insure lateral stability. Structures of this kind are known as elevated railroads.

Structures crossing a river may consist of one span, the ends being supported by abutments on the shores, if the stream is small, or a number of spans, with piers in the river, if the width of the river is greater and the nature of the stream will admit building such piers. The lengths and number of spans which give the best results for any particular crossing depend upon the cost of the sub-structure, and will be considered later in this article.

In all cases where it is practicable to put temporary supports or falsework in the river on which to erect the superstructure of a bridge, or where conditions are favorable for erecting the spans on scows near the shore and float them in place, bridges up to at least 700 ft. length should consist of simple spans of plain, substantial plate girders, lattice or pin-connected trusses. Where the nature of the stream or requirements of navigation make it impracticable to erect the superstructure on temporary falsework, and the conditions are unfavorable for floating the spans in place, some type of structure must be selected which can be erected without such temporary supports. The structures which can be erected without the use of falsework are: Cantilever bridges, suspension bridges, and such other types as can be erected on the cantilever principle.

CANTILEVER BRIDGES

For moderate spans, cantilever bridges are, under ordinary conditions, uneconomical and inferior in rigidity as compared with simple spans. They should be generally used for long spans only, or in cases where the conditions are such as to make any other type of bridge impracticable. Cantilever bridges have been built in many places, where simple trusses could have been erected more economically, and therefore the latter would have been more appropriate in their places. In some cases it is possible to design simple truss spans so that they can be erected on the cantilever principle, which should be done where the conditions make it practicable. For instance, in the case of the double-track cantilever bridge over the Monongahela River, with a clear span of 800 ft., the cantilever type was the most appropriate, in fact the only practical design which could have been selected in order to comply with the requirements and local conditions and also for economy.

SUSPENSION BRIDGES

Suspension bridges of the usual type are generally not to be recommended, as they lack that rigidity which is essential in a first-class bridge for railway traffic. Special types of suspension bridges with eye-bar chains and spandrel braced stiffening trusses can be designed so as to produce a structure rigid enough for railway traffic.

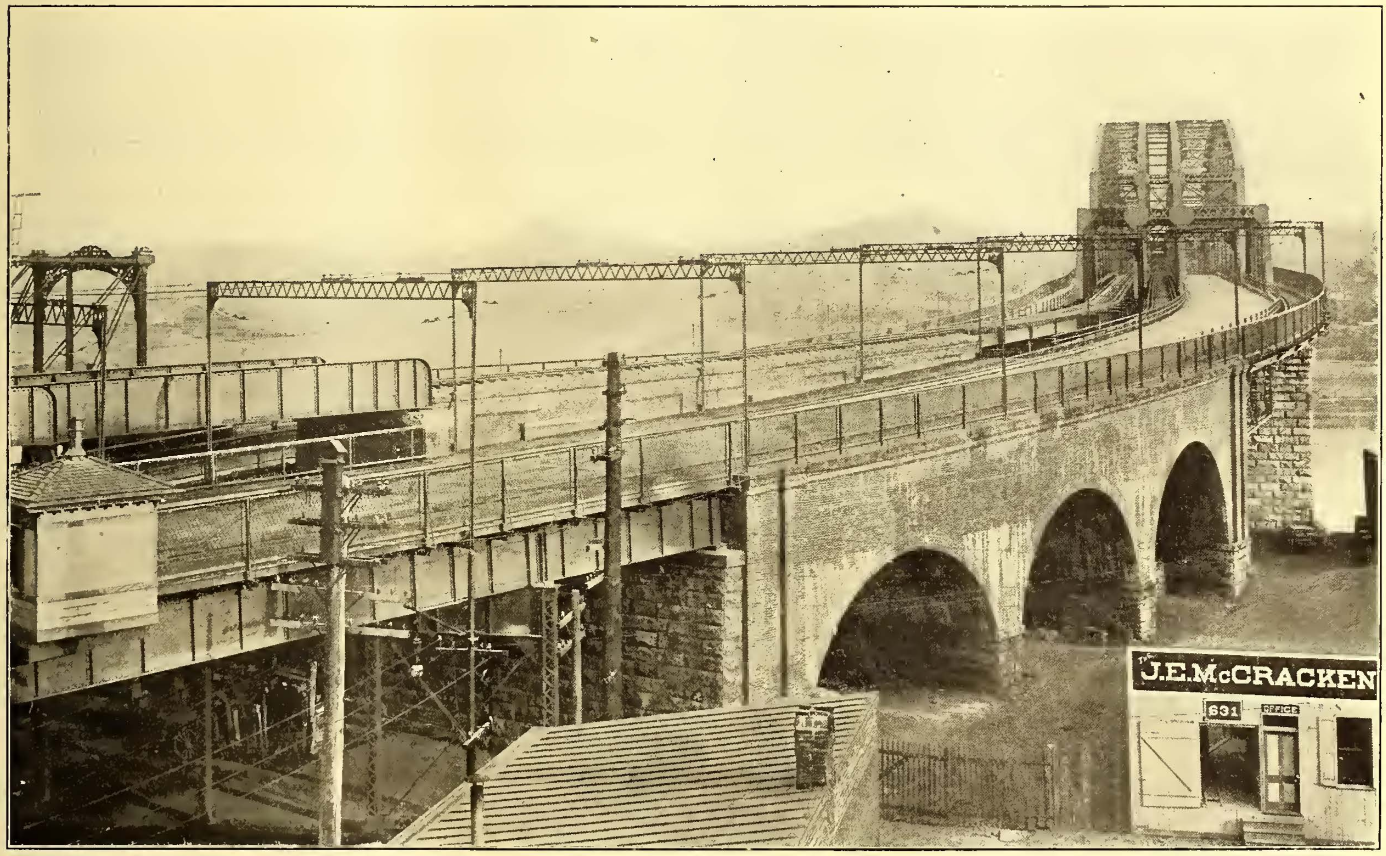
THE ARCH BRIDGE

The arch bridge is also one of those types which can be erected without falsework in certain locations. The steel arch is to be recommended in all cases where conditions are favorable as being economical as well as on account of the graceful appearance. The locations favorable for such an arch are where nature has already provided the skewbacks for the same, viz.: where the shores on both sides of the river consist of solid rock and rise considerably above the surface of the water, as is the case of the site of the Niagara Falls and Clifton Bridge. This structure also had to be erected on the cantilever principle. This arch has a span of 840 ft. between centers of pins, and is therefore the largest span of its kind in the world.

MOVABLE BRIDGES

If a bridge crossing a navigable stream is not high enough above the water level to provide the necessary clearance for the requirements of navigation, it becomes necessary to construct a movable bridge. There are various types of movable bridges, but the two principal types which have proved satisfactory in practice, and therefore have come into general use, are swing bridges and lift bridges.

The swing bridge generally consists of a continuous span over two openings, the center of which rests on a turntable supported by a pier. The ends of the span are also supported by piers when the bridge is closed. To open the channel for navigation the end supports are removed and the bridge turned around its center by means of the turntable, thus providing generally two openings which will allow two vessels to pass in opposite directions at the same time. The turntables are either rim-bearing or center-bearing, and sometimes a combination of both. The swing bridge with center-bearing turntable for ordinary spans under ordinary conditions has proved more satisfactory and given less trouble in operating than the one with rim-bearing turntable. The former requires less power to operate, and when closed is more like a continuous span on three supports than the latter, as then the ends as well as the center rest on fixed supports. Many

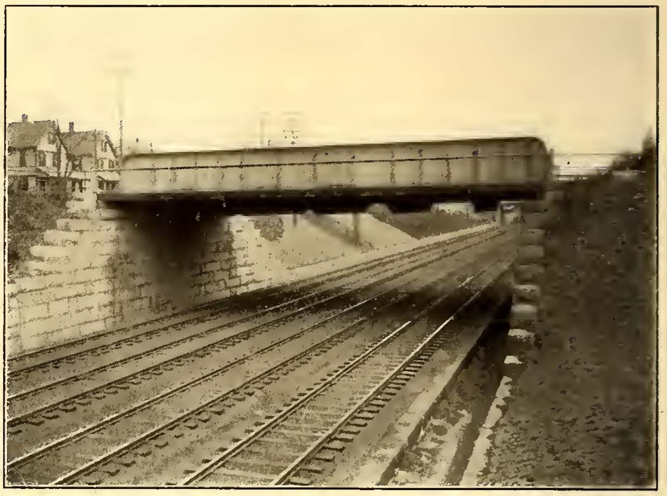


OHIO RIVER BRIDGE BETWEEN NEWPORT, KY., AND CINCINNATI, OHIO swing bridges with center-bearing turntables have been built and are in successful operation up to 350-ft. span for double and up to 500-ft. span for single-track bridges.

Lift bridges are generally used for small spans, where the local conditions are not favorable to a swing bridge. There are two types of lift bridges in general use, viz: the bascule bridge, which rotates in a vertical direction either around a pivot or rolls on a circular segment, and the ordinary lift bridge, which is lifted up bodily. Bascule bridges have proved very unsatisfactory for spans up to about 200 ft. For small spans one leaf is used, but for spans over 100 ft. they are generally composed of two leaves, the ends of which are locked together in the center when closed.

The ordinary lift bridge which is raised with chains or wire ropes from a tower at each end is sometimes used successfully for a crossing over a narrow canal, where it has to be raised only enough to let canal boats pass, but it is not to be recommended for long spans, or where a high lift is required.

BRIDGE OVER THE CONNECTICUT RIVER AT NORTHAMPTON, MASS.



RICHARDSON STREET BRIDGE, NEWTONVILLE, MASS.

NORFOLK & WESTERN RAILROAD COMPANY'S BRIDGE AT KENON, W. VA.

ECONOMICAL LENGTH OF SPAN

In many cases the location of piers and lengths of spans to be used in a crossing are determined by local conditions, but in cases where the local conditions admit of a choice, span lengths should be selected that are most economical. The total cost of a bridge at any particular crossing must include both the cost of the superstructure and the sub-structure. Generally the cost of sub-structure and superstructure should approximately balance each other. For steel viaducts consisting of braced towers and plate girder spans, the economical span length is obtained when the cost of the pedestals and towers are equal to the cost of the spans. It has proved economical to make the tower spans shorter than the intermediate spans, the usual practice being to make the latter approximately twice the length of the former. For low viaducts up to about 50 ft. or 60 ft. high, spans of 25 ft. and 50 ft. may be used; but for greater heights, 30-ft. and 60-ft. spans are to be recommended. For very high viaducts it is, on account of the stability of the towers, advisable to use longer spans. It is considered good practice to make the distance between the two bents forming a tower not less than one-fifth of the height of the tower.

In some cases there may be a small saving in weight if longer spans between the towers, than double the lengths of the tower spans, are used, but for practical reasons it is not advisable to do so. If the intermediate spans are not over twice the length of the tower spans, the same depth of girders can be used for both, which will simplify details, reduce the cost per pound of the steel work, and improve the appearance of the structure. It is also not advisable, excepting where conditions require it, to make intermediate spans over 80 ft. on account of the increased cost of erection. Therefore, 40 ft. and 80 ft. may be considered the practical maximum spans for viaducts under ordinary conditions.

In laying out the spans of a viaduct, it is not advisable to make every span conform to the theoretically economical length, but a uniform span length should be maintained throughout, as much as possible, more particularly in the tower spans, in order to reduce the cost per pound of the steel work. Duplications of parts always reduce the cost.

For low viaducts, where the floor is carried on single column bents without braced towers, such as elevated railroad structures, spans from 45 ft. to 50 ft. have proved the most economical. For bridges crossing a river, the spans of which are supported on masonry piers, the greatest economy will be obtained when the cost of the sub-structure is equal to the cost of the superstructure without the floor system; or in other words, the cost of one pier should equal the cost of the trusses and lateral system of the span. The cost of the floor system, which is approximately a constant quantity per lineal foot for a particular loading, has therefore no influence in determining the economical length of span. In doubtful cases, particularly with difficult and expensive foundations, it is always safer to make the spans longer, as the cost of the superstructure can be more closely estimated than that of uncertain foundations. In laying out the spans for a particular crossing, it should be borne in mind that what has been said in reference to viaducts also applies to bridges, viz: that uniformity and duplications of spans will reduce the cost of the superstructure.

Skew spans should be avoided wherever it is possible. If a skew span can be avoided by increasing the length of the same it will be in the line of economy as well as good practice, as the extra cost of the skew piers or abutments will generally balance the increased cost of the span. Skew spans, no matter how carefully they are designed, cannot be made as rigid nor have the same lateral stability as square spans.

The construction of masonry and foundations will not be considered in this article, being a subject generally well understood by all experienced engineers in charge of railway construction. However, to assist engineers in making approximate estimates of the cost of sub-structures, it was deemed desirable to give some data in reference to dimensions of masonry piers.

The top dimensions of a bridge pier and bridge seat of an abutment are generally determined by the size and position of the bed plates or pedestals. If there is sufficient room on top of the pier for the bridge seat, the pier may be considered safe for ordinary conditions. The usual practice is to have the masonry on top (under coping) project 3 ins. in the direction of the thickness of the pier and at least 6 ins. in the direction of the length of the pier beyond the edges of the bed-

APPROXIMATE DISTANCES BASE OF RAIL TO MASONRY.

Span in Feet C. C. Bearings	Deck Plate Girder Spans — Class A: Depth of Web	Class A: B of Rail to Msry.	Classes B and C: Depth of Web	Classes B and C: B of Rail to Msry.	Through Girder Spans — Base of Rail to Masonry: Class A	Classes B and C
	ft. in	ft. in.	ft. in.	ft. in.		
15	1 9	2 6	1 3	2 0	3′ 0″	2′ 6″
20	2 0	2 9	1 9	2 5		
25	2 9	3 6	2 0	2 9		
30	3 3	4 0	2 6	3 3		
35	3 9	4 6	3 0	3 9		
40	4 3	5 0	3 6	4 3		
45	4 9	5 6	3 9	4 6		
50	5 3	6 0	4 3	5 0		
55	5 6	6 3	4 9	5 6		
60	5 9	6 6	5 0	5 9		
65	6 0	6 9	5 6	6 3		
70	6 3	7 0	6 0	6 9		
75	6 6	7 3	6 3	7 0		
80	6 9	7 6	6 9	7 6		
85	7 3	9 6	7 3	9 3	4′ 4″	3′ 6″
90	7 6	9 9	7 6	9 6		
95	8 0	10 3	8 0	10 0		
100	8 3	10 6	8 3	10 3		

For through lattice and pin spans over 100 c. to c. the approximate distance base of rail to masonry will be 5′ 0″ for Class A and 4′ 0″ for Classes B and C

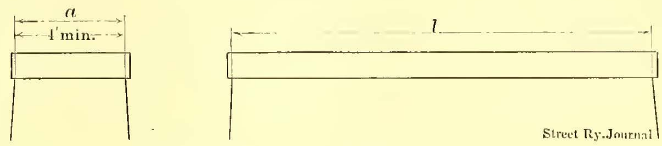
plates. The thickness of piers and abutments under coping should not be less than 4 ft., and the thickness of the parapet or back wall of abutments not less than 2 ft.

The following tables give the approximate minimum dimensions of piers and abutments for different spans and classes of bridges; the thicknesses of the piers are determined with the assumption that one pier supports two spans of approximately the same length. For piers supporting only one span, the dimensions given for the bridge seat of the abutment should be used. The dimensions given in the tables refer to three different classes of bridges designed for the different kinds of traffic designated in the specifications as:

Class "A" loading for heavy traffic.

Class "B" loading for medium traffic.

Class "C" loading for light traffic.



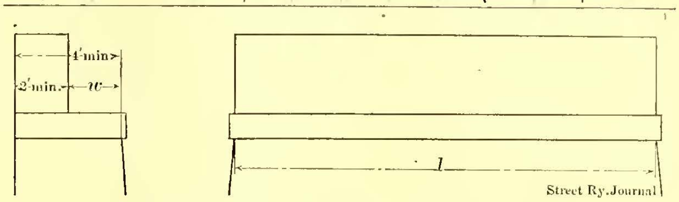
DIMENSIONS OF MASONRY PIERS

Thickness "a" Under Coping

Span	Class A S.T.	Class A D.T.	Class B S.T.	Class B D.T.	Class C S.T.	Class C D.T.
ft.	ft.in.	ft.in.	ft.in.	ft.in.	ft.in.	ft.in.
25	4 0	4 0	4 0	4 0	4 0	4 0
50	4 0	5 3	4 0	4 0	4 0	4 0
75	4 6	6 0	4 0	4 6	4 0	4 0
100	5 0	6 6	4 6	5 0	4 0	4 0
125	5 4	7 0	4 0	5 4	4 0	4 4
150	5 8	7 6	4 3	5 8	4 0	4 8
175	6 0	8 0	4 6	6 0	4 0	5 0
200	6 4	8 6	4 9	6 4	4 0	5 4
225	6 8	9 0	5 0	6 8	4 3	5 8
250	7 0	9 6	5 3	7 0	4 6	6 0
275	7 4	10 0	5 6	7 4	4 8	6 3
300	7 8	10 6	5 9	7 8	4 10	6 6
325	8 0	11 0	6 0	8 0	5 0	6 9
350	8 4	11 4	6 2	8 4	5 2	7 0
375	8 8	11 8	6 4	8 8	5 4	7 3
400	9 0	12 0	6 6	9 0	5 6	7 6

l = dist. c. c. trusses + figures in table

Span	Class A S.T.	Class A D.T.	Class B S.T.	Class B D.T.	Class C S.T.	Class C D.T.
ft.	ft.in.	ft.in.	ft.in	ft.in.	ft.in.	ft.in.
50	3 6	4 0	3 6	3 6	3 6	3 6
100	4 0	5 0	3 6	4 0	3 6	3 6
150	4 6	5 6	4 0	4 6	3 6	4 0
200	5 0	6 0	4 0	5 0	3 6	4 6
250	5 0	6 6	4 6	5 0	4 0	4 6
300	5 6	7 0	4 6	5 6	4 0	5 0
350	6 0	7 6	4 6	6 0	4 6	5 0
400	6 0	7 6	5 0	6 0	4 6	5 6



DIMENSIONS OF MASONRY ABUTMENTS

Thickness "w" of Abutments

Span	Class A S.T.	Class A D.T.	Class B S.T.	Class B D.T.	Class C S.T.	Class C D.T.
ft.	ft.in.	ft.in.	ft.in.	ft.in.	ft.in.	ft.in.
25	2 0	2 2	2 0	2 0	2 0	2 0
50	2 2	2 9	2 0	2 2	2 0	" "
75	2 6	3 3	2 0	2 6	2 0	2 0
100	2 8	3 6	2 0	2 8	2 0	2 2
125	2 10	3 9	2 2	2 10	2 0	2 4
150	3 0	4 0	2 4	3 0	2 0	2 6
175	3 2	4 3	2 6	3 2	2 0	2 8
200	3 4	4 6	2 8	3 4	2 2	2 10
225	3 6	4 9	2 10	3 6	2 4	3 0
250	3 8	5 0	2 11	3 8	2 5	3 2
275	3 10	5 3	3 0	3 10	2 6	3 4
300	4 0	5 6	3 1	4 0	2 7	3 6
325	4 2	5 8	3 2	4 2	2 8	3 8
350	4 4	5 1	3 3	4 4	2 9	3 10
375	4 6	6 0	3 4	4 6	2 10	3 11
400	4 8	6 2	3 5	4 8	2 11	4 0

Length "l" = dist. c.c. trusses + figures below

Span	Class A S.T.	Class A D.T.	Class B S.T.	Class B D.T.	Class C S.T.	Class C D.T
ft.	ft.in	ft. in.	ft.in.	ft.in.	ft.in.	ft.in.
50	3 6	4 0	3 6	3 6	3 6	3 6
100	4 0	5 0	3 6	4 0	3 6	3 6
150	4 6	5 6	4 0	4 6	3 6	4 0
200	5 0	6 0	4 0	5 0	3 6	4 6
250	5 0	6 6	4 6	5 0	4 0	4 6
300	5 6	7 0	4 6	5 6	4 0	5 0
350	6 0	7 6	4 6	6 0	4 6	5 0
400	6 0	7 6	5 0	6 0	4 6	5 6

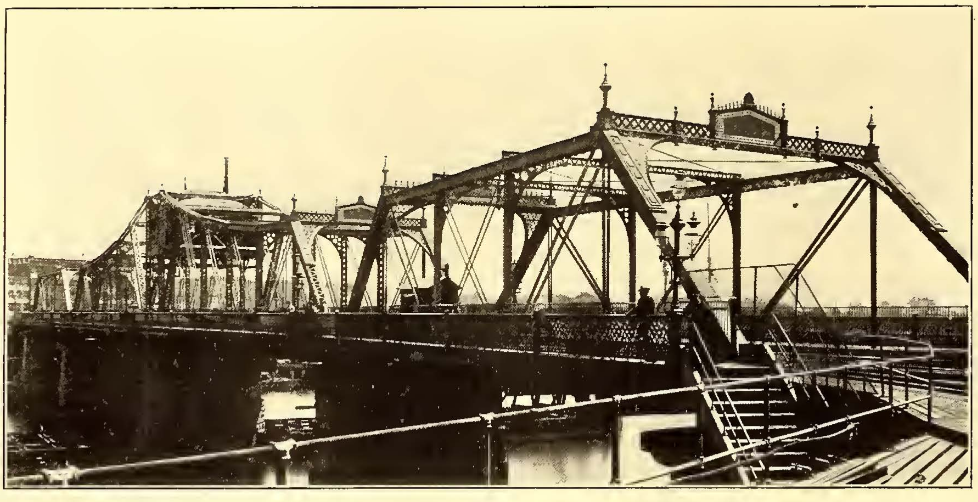
PRINCIPLES OF DESIGN

The fundamental principles upon which structures should be designed are embodied in the specifications appended to this article. A brief statement of the general features required in a good design and a few practical suggestions, however, may be useful to guide the engineer who is not a bridge expert in selecting the best designs of those offered by competing bridge companies.

Simplicity and rigidity are the first fundamental principles of a properly and well-designed structure. A steel structure should have as few parts as possible, and these should be plain, substantial and straight, without any unnecessary bends, twists and crooks. This simplicity of design should apply not only to the main members of a structure, but also to all its details and connections.

A structure not possessing the necessary rigidify is subject to excessive vibrations under the traffic, and therefore will be short-lived and require constant repairs, and will prove a general nuisance to the engineer who has charge of the maintenance of the same. Rigidity should therefore be particularly insisted upon in all kinds of structures carrying electric railways.

To make a structure rigid, the members of trusses (excepting in spans of such length that their own weight will produce the necessary stability), should be so designed that they can resist compression as well as tension, or in other words, should be stiff members and be rigidly connected. All adjustable members should be avoided and all antiquated, impracticable contrivances, such as rods with screw ends, loops, wing plates, floor beam-hangers, turn buckles and clevises, which are sometimes used in lateral and sway bracing of bridges and viaducts, are bad practice and should be entirely discarded.



SECOND AVENUE BRIDGE OVER THE HARLEM RIVER, NEW YORK

Adjustable members with their gim-crack connections are flimsy and not as reliable as plain, substantial work, and in time become out of adjustment and have to be readjusted, which is very undesirable in a permanent structure. The ideal structure has no adjustable members, and if properly designed, when once erected needs little or no attention, excepting a coat of paint once in a while.

The most substantial bridge, combining simplicity and rigidity, is a plate girder, and should therefore be given the preference over all other designs for all spans up to its practical limits, which limits may vary under different conditions, such as the practicability of transportation and erection. If the lengths of the spans are such as to preclude plate girders, riveted lattice trusses should be used. In accordance with good practice they should be used for spans up to 150 ft. For longer spans, or in cases where the conditions are unfavorable for a lattice truss, pin connected trusses may be used.

All bridges carrying any kind of railway traffic should be designed not only to carry that traffic with safety, but also to withstand the ordinary contingencies of traffic, such as derailment, a broken axle, or a collision. Structures designed in accordance with good practice may be damaged by such accidents, but should be able to stand up without collapsing.

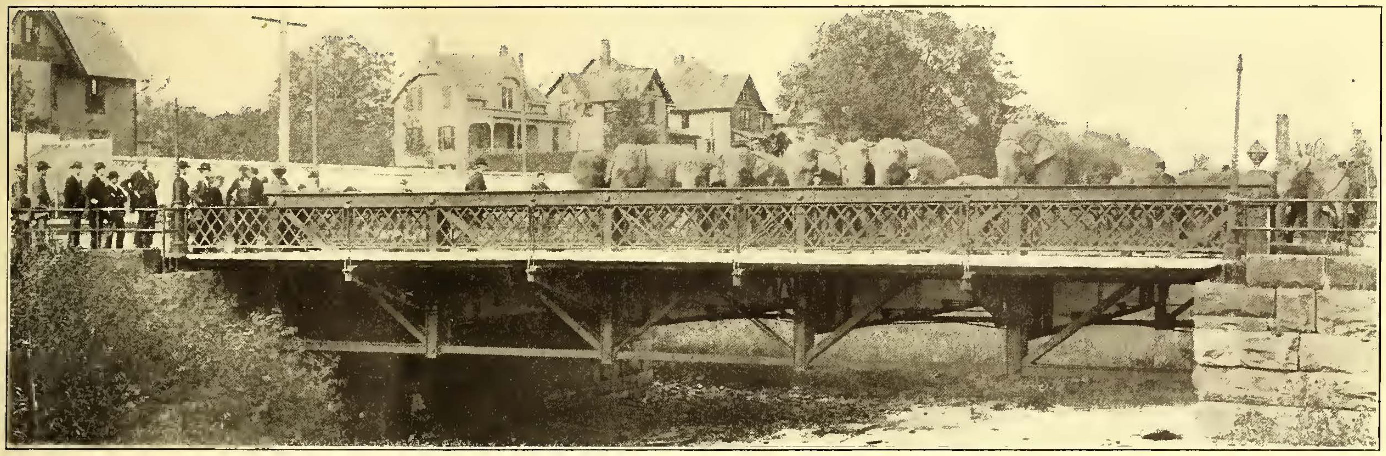
ESTHETICS IN DESIGN

Bridges and other structures carrying railway traffic are generally designed for utility. Strength and rigidity are of course the first considerations in any structure on the strength of which the safety of human life depends. While the writer does not advocate decorating structures with useless ornamentation, he is of the opinion that some consideration should be given to appearance, particularly in structures which are situated in prominent places or in public parks in the midst of beautiful landscapes. Such structures should be somewhat in harmony with their surroundings.

In looking at some existing structures, which on account of their situation should have been of a monumental nature, several of them being the most prominent objects in large cities, one is almost inclined to believe that some designers had taxed their ingenuity to make them as unsightly as possible. Some of these structural deformities are covered with tasteless decorations which do not improve their appearance, but tend to exaggerate the homeliness of their outlines. The prevailing notion that it requires an additional expenditure of money to give a bridge a pleasing appearance, and that good engineering and graceful outlines with artistic proportions do not go together, is erroneous, as the most ugly and unsightly structures in existence are those in the designs of which the fundamental principles of good engineering are violated.

The first principle of esthetics in a design are symmetry and correct proportions. A permanent structure should look just what it is supposed to be; it should have the appearance of permanency and strength, but not that of a temporary makeshift. Some of our elevated railway structures, located in the streets of a city, on account of which some attention should have been paid to their appearance, are particularly lacking in sightliness, not for lack of ornamentation, but because in their designs all principles of good engineering have been neglected. Good engineering consistent with economy requires plate girders for all spans up to 100 ft. Elevated railway structures composed of plate girder spans would certainly be a great improvement over those unsightly ones composed of lattice girders, having the appearance of temporary structures. The many intersecting members of their trusses are tiresome and offensive to the eye and take away the appearance of repose and stability contained in a plain structure of plate girders. Slovenly and ill-advised detail is another item which serves to spoil the appearance, while properly proportioned, well designed, neat-looking details not only enhance the appearance, but are the least expensive. Wherever brackets are needed for stiffness, they can be constructed so as to have strength as well as a graceful appearance without extra cost.

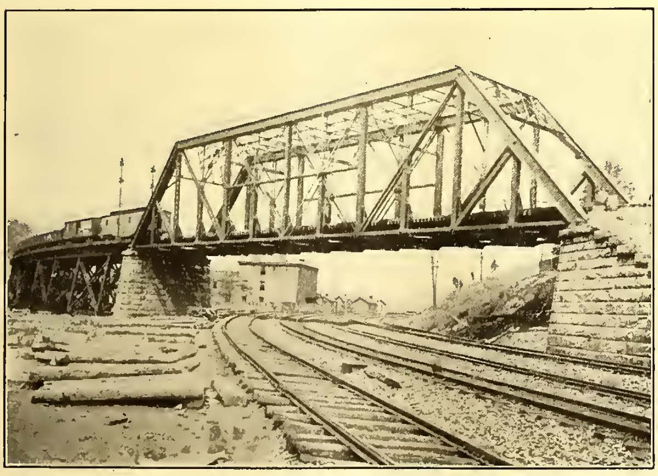
Why are some truss bridges so extremely unsightly? Because they are not proportioned in accordance with good engineering. Their depth is generally out of proportion to their length, thus, being composed of long, slim members, are lacking in stiffness and give to the truss a spider-web like appearance. Trusses with curved upper chords have a more graceful appearance than those with straight chords. For spans over 200 ft., good practice and economy require curved chords. Thus again good engineering corresponds with aesthetic designing. Metal arches, if properly designed, always have a graceful appearance and should be used in all cases where the location and surroundings are favorable, and are in the line of economy and good engineering.



A HERD OF ELEPHANTS CROSSING THE TUSCARAWA STREET BRIDGE AT CANTON, OHIO

MAINTENANCE OF STEEL STRUCTURES AND PROTECTION AGAINST CORROSION

The life of a steel structure depends: First, on the design, and second, on the care which is bestowed on its maintenance. A properly designed and constructed steel bridge needs very little care after it is erected. The most important factor in prolonging the life of a bridge is to have it well protected against corrosion as soon as it is erected, and continue to keep it well protected. Each bridge should be carefully examined from time to time by an intelligent and conscientious inspector. He should examine the details and test the rivets, especially those of the floor system, and determine when the protective coating should be renewed. The bridge should be repainted whenever the final coat becomes deteriorated and exposes the first field coat. In order to show more clearly when the bridge needs repainting, each coat should have a different color.



UNION RAILROAD BRIDGE OVER PENNSYLVANIA RAILROAD TRACKS AT BESSEMER, PA.

The kinds of paint recommended as the best protective coating are many and various, each manufacturer claiming special merits for his paint, and almost every engineer has his own opinion in this respect as well as his pet paint. The writer therefore refrains from expressing an opinion and from recommending any particular paint or composition; but his experience has convinced him that no substance has yet been discovered which can take the place of linseed oil.

Bridges over steam railroads or in other places where they are subjected to the corroding influence of the gases from locomotives or furnaces should be protected against those influences more thoroughly than can be accomplished by paint. Good results have been obtained by having the floor system and other exposed portions of the structures incased in concrete or reinforced concrete. As steel is practically an indestructible material, if kept from corrosion, there is no good reason why properly designed steel bridges, properly protected, should not last at least as long as stone bridges.

METHODS OF LETTING CONTRACTS FOR BRIDGE WORK

In letting contracts for bridges or other structural steel work, either of the following methods may be adopted by the railway company:

First: Prepare a complete survey plan and profile of the crossing, showing the location of the piers and abutments, their general dimensions (as far as they affect the steel superstructure), base of rail to masonry, distance between centers of track (if there is more than one), angle of skew and degree of curvature (if bridge is on a skew or curve).

Bids should be invited on the steel superstructure to be built in accordance with the engineer's plans and the specifications submitted therewith. In order to avoid trouble, it is advisable to invite only such manufacturers of structural steelwork as are known to the engineer to have proper facilities for doing the work satisfactorily.

The letter inviting proposal should state the kind of loading for which the bridge is to be designed, the time the work is to be completed, the kind of paint desired, where the steelwork is to be delivered, whether the railway company or the contractor will furnish floor bolts.

If bids are invited for the erection, it should be stated whether the bridge is on a new line or is to replace an existing one (in the latter case, the character of the same should be stated), and whether the contractor is to erect the steel superstructure ready for the ties or ready for the rails (the latter includes framing and placing of floor timbers); also if the field painting is to be included in the price of erection. The bidder should be requested to submit a price per pound for the finished steelwork, accompanied by an approximate estimate of weight. In order to have greater competition it is advisable to ask separate bids, one for the steelwork delivered and one for the erection of the same, and to invite contractors who are not manufacturers of steelwork to bid on the erection. After the contract is awarded, the contractor for the steelwork should submit strain sheets and designs, which should be referred to a competent expert for examination and approval. After the design is approved the contractor will make shop drawings to correspond with the approved design, which should again be examined and approved by the railroad company's expert before any work is done in the shop.

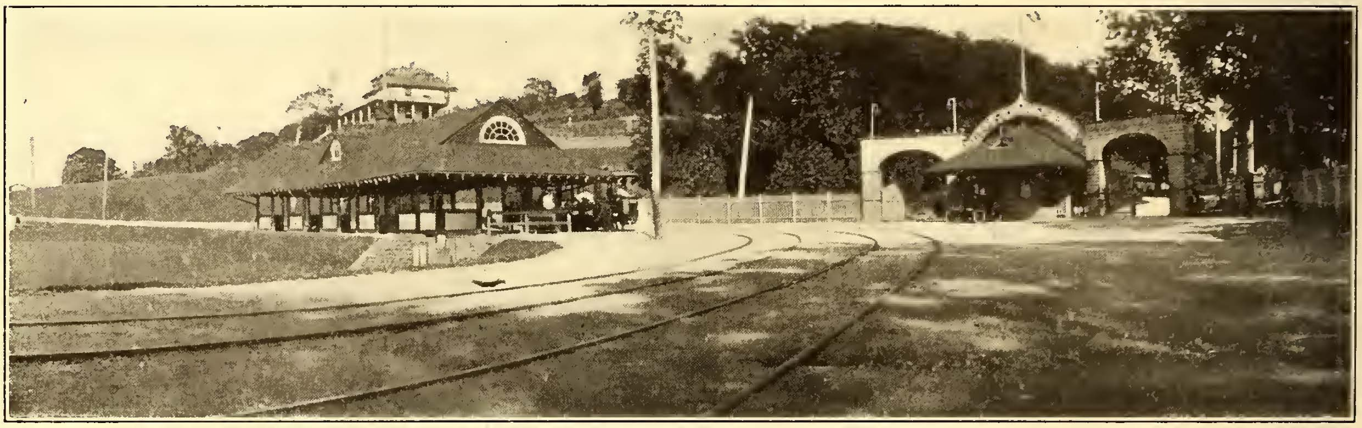
Second: The railroad company employs a competent bridge engineer either permanently or temporarily as a consulting expert, to make complete designs for all structures, and invites proposals on the designs furnished by the railway company in a similar way to that recommended for the first method where the contractor is to furnish the design; the contractor to make the shop drawings, that is, to put the engineer's designs into convenient shape for his workshop. Before commencing work in the shop, the shop drawings should be approved by the railway company's engineer.

The method still in vogue on a few railroads, to invite lump sum bids on steel structures accompanied by competitive designs, is not to be recommended. It is not in the interest of the railroad company and it is unfair to the honest contractor, as it puts a premium on the poorest design.

The standard practice to be recommended, as the only fair and business-like method, is to let contracts for structural steelwork on a pound price basis, on designs and specifications furnished by an experienced engineer employed by the railway company. This method is fair to the honest manufacturer, as all competitors bid on the same basis; it is an advantage to the railway company, as it employs the engineer who will protect its interests, study the conditions and requirements, and design a structure to suit the clients' needs.

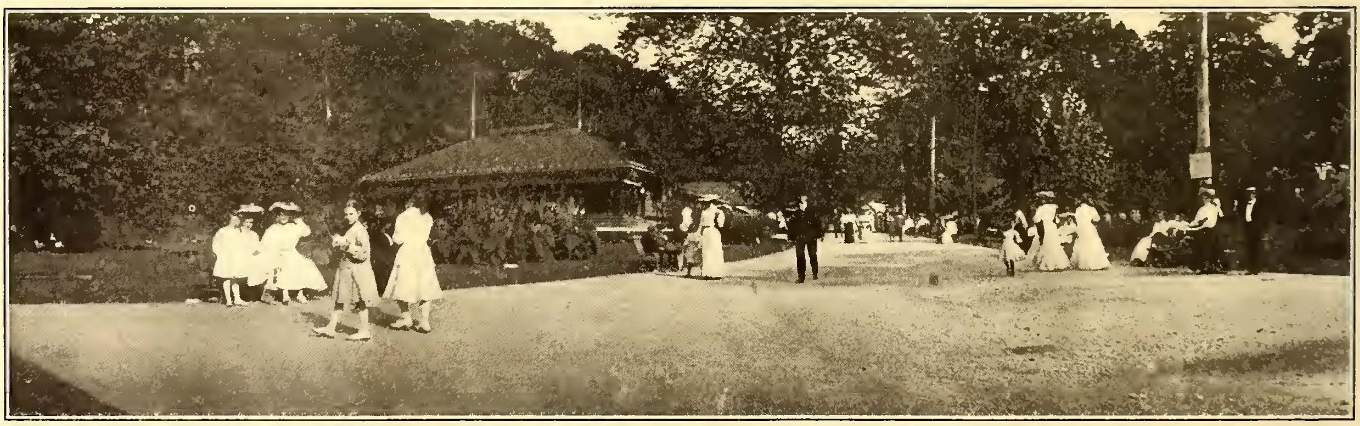
ROCK SPRINGS PARK, CHESTER, W. VA.

Rock Springs Park is located in Chester, W. Va., across the Ohio River from the city of East Liverpool, Ohio. The park is most charmingly situated, commanding a magnificent view of the Ohio River, and constitutes the chief pleasure resort of Eastern Ohio. Although devoid of the clap-trap features found at New York's Coney Island, it bears about the same relation to the territory tributary to the Ohio Valley as does this famous resort to the surrounding country. Rock Springs Park is served not only by several steam lines but also by the line of the East Liverpool Traction & Light Company, thus making it unusually easy of access to the population for miles around. The steam railroads find it advantageous to feature this park in their advertising literature, with the result that each season they carry from 80,000 to 100,000 excursionists to the resort, and not infrequently a dozen special excursion trains will be operated to the park in a single day, many of these coming from distant Ohio, West Virginia and Pennsylvania points.



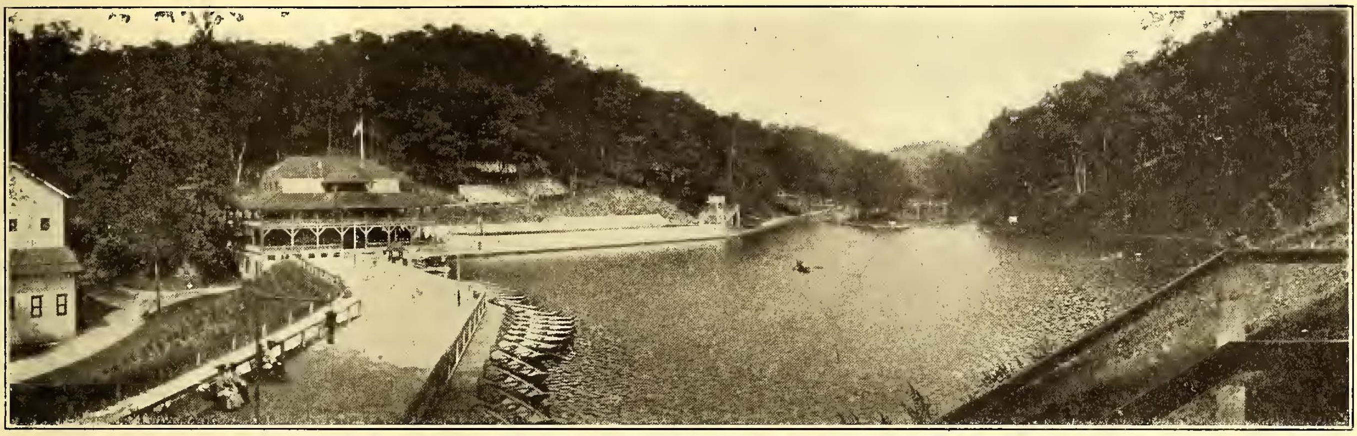
ENTRANCE TO ROCK SPRINGS PARK, CHESTER, W. VA.

The park line of the East Liverpool Traction & Light Company operates from the center of East Liverpool over its own steel suspension bridge, 1700 ft. long, crossing the Ohio River, and thence through the city of Chester, W. Va., to Rock Springs. On this line a frequent service is given, and it serves the double purpose of carrying the people from East Liverpool and neighboring points to the park as well as affording means whereby many of the steam railroad excursionists who visit the park can cross into Ohio and reach all points touched by the comprehensive system of the East Liverpool Traction & Light Company. A surprisingly large number of out-of-town patrons of the park take advantage of this ride, returning to Rock Springs Park in time to take the evening trains, this trolley ride being considered by many a



THE MAIN THOROUGHFARE OF ROCK SPRINGS PARK special part of the day's outing in addition to the pleasures and attractions afforded by the park itself.

The natural and artificial attractions of Rock Springs Park have been handled with rare skill to obtain the best effects. The grounds cover forty-three acres of woodland, and include a ravine which has been partly cleared to give accommodations for picnic parties and strollers. Recognizing the drawing attractions of aquatic features, the management has at considerable expense dammed a small stream which runs through the grounds, thereby creating a lake that may well be described as a gem of its kind. This artificial lake covers about five acres and is not over 40 ins. deep, but it possesses all the scenic attractions of a natural body of water and gives the fullest opportunities for rowing without the slightest danger. The company maintains about thirty first-class rowboats and several naphtha launches for the use of patrons. The dam which holds back the water of the lake is about 175 ft. long, 21 ft. high, 8 ft. at the base, and is built of concrete and masonry.



THE ROCK SPRINGS PARK SWIMMING POOL AND LAKE

SWIMMING TANK

A unique attraction, and perhaps the most popular at the resort, is a large swimming tank measuring 70 ft. long by 20 ft. wide and giving convenient accommodations for several hundred bathers. This swimming tank is built from ideas suggested by C. A. Smith, the present lessee of the park and its original promoter. The walls and floor of the swimming tank are formed of reinforced concrete. The excavation for the pool was first made by cutting away a portion of a hill. In the bottom of this excavation was laid 12 ins. of ashes directly on the earth. On this bed of ashes was placed a layer of concrete 14 ins. thick, with a 2-in. concrete dressing on top to give a smooth waterproof flooring. The side walls are 3 ft. thick at the base and taper to 18 ins. at the top. These walls are reinforced with steel cables 1 in. in diameter. One-half of the tank is designed to give a uniform depth of water of about 9 ft. In the other half the bottom is built on a slope, beginning at the water's edge and gradually sloping downward to give a depth of 8 ft. at the outer wall. This arrangement accommodates all classes of bathers. Children and young people can safely enjoy themselves in the shallow water, while the expert swimmers take advantage of the deeper sections to dive and swim to their hearts' content. At one end of the tank two wooden towers of different heights have been arranged with spring boards and platforms for those who enjoy diving. The tank when full holds about 600,000 gallons of water.

The water supply comes from a clear running stream and is fed into the tank from perforated pipes which pass along one side of the tank and deliver the water in a series of spray effects. As the spring water is rather cold there is an auxiliary line of piping for supplying sufficient hot water to keep the temperature in the tank at about 70 deg. F. The water for this purpose is heated in two ten-gallon heaters which burn natural gas. There is also a 20-hp boiler which is utilized for heating water. A point is made of keeping the water absolutely fresh and clean, and at frequent intervals the entire contents of the pool are drained off, the bottom is scrubbed with wire brushes, and a fresh supply of water is allowed to flow into the tank. Along one side of the swimming pool are concrete steps and a concrete platform upon which the bathers may rest and enjoy sun baths.

DANCING PAVILION AND WALK IN ROCK SPRINGS PARK

A commodious building at one end of the pool gives accommodations for 120 dressing rooms, and the structure has wide verandas which are utilized for refreshment stands and for spectators who may care to watch the antics of the bathers. There is also a grand stand at the side of the pool which gives seats for 800 spectators. In the basement of the bathing pavilion, under the dressing rooms, is an apartment containing the hot water apparatus and which is utilized as a laundry for cleaning and drying the bathing suits. In this connection, the management believes that the secret of successfully maintaining a swimming tank lies in the care used in keeping everything absolutely clean and sanitary. All of the bathing suits and towels, as soon as they have been used once, are put in a laundry machine in which they are washed and sterilized. They are then thoroughly dried in a centrifugal drying machine. The popularity of the bathing facilities at the park is due in very large measure to this care in washing and drying the suits and towels as well as to the attention that is paid in keeping the water in the tank in good condition. The degree to which the swimming tank is patronized will be understood from the fact that last season, constituting about one hundred days, over 25,000 people paid to bathe in the tank. The practice is to charge 25 cents for each person, which includes suit, towel, and the use of the pool and dressing rooms. On busy days each bather is limited to one hour in the pool. The pool is well lighted at night, and the bathing at night is almost as popular as in the daytime.

SWIMMING TANK AT ROCK SPRINGS PARK

CONCRETE PLATFORM AND DIVING TOWERS, SWIMMING TANK, ROCK SPRINGS PARK

OTHER ATTRACTIONS

Entrance to Rock Springs Park is through an artistic gateway which opens directly on to the main walk. The first building is the aquarama, or old mill, at the side of which is a check room where packages, lunch baskets and wraps are cared for. Opposite the check room on the right of the main wall are located the public dining room and kitchen for the use of excursionists and picnic parties. Here are seats and tables, and hot and cold water for making tea and coffee are supplied free. Another public dining room has lately been added to accommodate those who cannot find room elsewhere. In addition to these dining rooms for the use of basket parties, there is a well-equipped restaurant where meals are served for the convenience of those who do not care to carry their own lunches.

Following up the main walk the visitor comes to the theater, which has a seating capacity for 1400 people. Here high-class vaudeville entertainments are given every afternoon and evening.

Near the theater are the lake and swimming pool. The grounds around the lake have been left in their natural state except that walks have been laid out, trees trimmed, and the grounds improved to make the hillside attractive and easy of access without destroying the natural scenery. In the midst of this wooded landscape has been erected the band stand where free band concerts are given by celebrated musical organizations. The ground near the crest of the hill has been given over to the best of the usual park attractions, including merry-go-round, mysterious house, penny arcade, roller coaster, photograph gallery, shoot the chutes, pantograph or moving pictures, cafe, souvenir stand, rest houses, baseball grounds and casino. This last-named building has lately been constructed at a cost of $30,000. The ground floor is occupied with Japanese tea house, shooting gallery, bowling alleys and refreshment booths. The second floor is devoted to dancing and is 120 ft. x 150 ft. This building commands a wide outlook over the Ohio Valley.

In improving the park grounds the management has taken care to provide good drainage by installing an elaborate system of storm sewers and drain pipes.

The grounds and a portion of the buildings are owned by the East Liverpool Traction & Light Company, which has lately been purchased by the Ohio Valley Finance Company. The park is leased to C. A. Smith for a term of years, and is managed by J. H. Maxwell, acting for the lessee.

F. D. Norveil, assistant passenger agent, has just put into effect the new baggage rules promulgated by the traffic department of the Schoepf syndicate lines. These rules provide for the free handling of baggage by all the so-called merger lines in the two States. The lines adopting the new rules embrace all the Indiana Union Traction, Indianapolis & Northwestern, Indianapolis & Eastern, Indianapolis & Martinsville, Richmond Street & Interurban, Muncie, Hartford, & Ft. Wayne, and Indianapolis Coal Traction, the Columbus, Newark & Zanesville, Urbana, Bellefontaine & Northern, Columbus, Buckeye Lake & Newark; Columbus, London & Springfield; Dayton, Springfield & Urbana; Cincinnati Northern, Lima & Toledo, Cincinnati Interurban, and the Columbus & Lake Michigan Railroad.

SOME EUROPEAN BRAKES AND THEIR VALUE

BY JOHN P. FOX

A recent editorial in the Street Railway Journal referred to several fatal accidents in England from runaway electric cars which were all caused by skidding wheels descending grades. In this country we are perhaps too ready to pass by troubles from slippery rails, and to accept skidding wheels, with their collisions and runaways, as unavoidable. But if different methods of braking can materially reduce damages, it seems well to look into the matter carefully.

American braking to-day is usually on a clean-rail basis, and for this purpose the air brake has reached a high degree of development and is being constantly improved. There is no trouble at fairly high speeds and where the rails throughout are practically never dirty or slippery. The difficulty comes on street tracks, and as we do not clean our rail surfaces, we have to depend on sand for bad rails. Then, if the sand box does not work, or the motorman loses his head, there is little to do but to wait till the car chooses to stop. A few railways, it is true, are using magnetic, track or emergency brakes, but the wheel brake is the main reliance, and the present tendency is simply to make them more powerful. In England, on the other hand, such serious accidents have resulted with wheel brakes that it has been found necessary to put less and less work on the brake shoes, and on an increasing number of cars there is almost none at all. It sounds strange to hear engineering authorities speak of hand brakes as too powerful and air brakes as positively dangerous; but English rail conditions are so often like those of Pittsburg that wheels can be easily skidded with a hand brake, even with four tons weight on a wheel, so that air would obviously increase the risks instead of diminishing them. Of course, skidding wheels are often due to poor motormen, and sand-box failures to neglect; but English standards are certainly very high in such matters, as illustrated by the practice of rail cleaning, and the uncertainty of wheel brakes cannot be lightly explained away.

The growing dissatisfaction with ordinary braking methods in England has brought about such improvements that one can now find thousands of brakes on cars to-day apparently more powerful and more certain on bad rails than any air brakes in this country, the latest type giving, in the recent London tests, an emergency retardation of nearly 7 m. p. h. per second on a greasy rail without sand. These London tests were so important that it is worth while to look at some of the results. Very careful experiments were made last year for the purpose of finding an economical brake that would safely allow a higher speed limit. The types tested were hand, rheostatic (short circuit with resistances), momentum, magnetic track brake independent of wheels (type A), and magnetic track brake operating brake shoes (type B). Most of the work was done with a double-deck car weighing about 14½ tons, with maximum traction trucks, fitted with carefully tested instruments. Both service and emergency stops were made on dry and greasy rails without sand. Coasting tests were also conducted on a hill with different brake notches. The current generated by the motors was measured so as to find the extra work required by electric braking. The emergency stops are the most interesting, and are shown in Tables I. and II.

The performance of type B is the most remarkable thing in these tables, and it will be noted that on a greasy rail this brake gave even better results than on a dry rail. This apparent anomaly was attributed to a more skilful application of type B as the tests proceeded. The superiority of type B over other types was very important in one respect for London, because the majority of accidents with electric cars there have occurred at the lower speeds. Table III. gives a further analysis of the results, and it may be stated that the figures are the average of three stops for each speed. Moreover, no attempt was made to get ideal conditions, so that the results represent every-day working conditions and the figures are absolutely impartial. Sand was not used with greasy rails because it would have destroyed uniformity of conditions.

TABLE I.
Emergency Stops on Dry Rail.

Initial Speed in Miles Per Hour.	Stopping Distances in Feet.				
	Rheostatic.	Type A Magnetic Track.	Type B Magnetic Track and Wheel.	Momentum.	Hand.
1	..	..	..	..	1
2	1	2	..	1	2
3	5	4	2	2	4½
4	9	6	3	3½	7½
5	14	9	4	6	11½
6	20	12	6	9	16
7	26	15½	8	13	22
8	34	19½	10	17½	29
9	44	24	12	23	37
10	58	28	15½	29	46
11	74	33	19½	35½	56
12	90	38	24½	42	68
13	107	43½	31	50	81
14	122	49	40	57	96
15	...	..	52	67	111

TABLE II.
Emergency Stops on Greasy Rail.

Initial Speed in Miles Per Hour.	Stopping Distances in Feet.				
	Rheostatic.	Type A.	Type B.	Momentum.	Hand.
2	4	6½	1½	5	3
3	10	8	2½	8	8
4	19	11½	3½	12	15
5	30	16	4½	17	22½
7	52	26½	7	27½	38
9	75	37	10	41	53
11	102	48	13	57	68
13	135	63	18½	76	88
14½	175	80	30	90	120

TABLE III.
New Type B.—Emergency Stops on Greasy Rails.

Initial Speed in Miles Per Hour.	Stopping Distance in Feet.	Retardation in Miles Per Hour Per Sec	Retarding Force: Percentage of Car Weight.
2	1½	1.95	9
3	2½	2.64	12
4	3½	3.35	15
5	4½	4.08	19
7	7	5.14	23
9	10	5.94	27
11	13	6.82	31
13	18½	6.71	31
14½	30	5.14	23

The power of type B can be judged by further comparisons with the best results from the other brakes and on other railways, as given in Table IV.

TABLE IV.
Maximum Braking Results.

Test.	Brake.	Date.	Initial Speed in Miles Per Hour.	Stopping Distance in Feet.	Retardation in Miles Per Hour Per Sec.	Retarding Force: Percentage of Car Weight.
Zossen, Germany	Hand brake	1901	62	2,362	1.48	7
" "	Air brake	1903	112	4,500	2.09	9½
" "	Air brake	1901	73	1,805	2.19	10
" "	Air brake	1902	*10?	...	3.49	16½
Atsion tests, N. J	High speed brake	1903	51	613	3.12	14
North Eastern Railway, England	High speed brake	1901	56	855	3.29	15
Westinghouse-Galton tests, England	Air brake	1878	60	567	5.20	21
Dundee, Scotland	Pneumatic track brake.	1902	8	12	3.90	18½
London, England	Hand brake	1905	6	16	1.65	7½
" "	Rheostatic brake	1905	2	1	2.92	13
" "	New type A	1905	14	49	2.93	13
" "	Momentum brake	1905	4	3½	3.35	15
" "	New type B	1905	11	13	6.82	31

* Retardation occurring at end of long stop.

The superiority of type B is obviously due to the fact that the braking takes place not only on the wheels, but also on the track and the motors; but even then the results are surprising, considering the fact that with the maximum traction trucks only half the wheels were braked.

As to the effect on the motors of electric braking, the tests brought out most important facts. While electric braking is very common in Europe, the motors there are not worked so hard and are better maintained as a rule than in this country. But even in Europe, overheating and additional repairs have made electric braking unsatisfactory on some roads, and have also resulted in complaints of slow operation, uncertainty of action, and roughness of stops. The magnetic track brake, which is very popular in England, seems more satisfactory than the Continental electric brakes, especially in its greater power; but even then, the common type can cause undesirable overheating of the motors. Recently, however, the magnets have been made larger, less current passes through the shoes, although the magnets are much more powerful, and the overheating difficulty, judging from the London tests, can be wholly ignored in the future. This puts electric braking in a new light for this country. For while in England larger motors were not installed for magnetic brakes, in this country they are evidently necessary where conditions are at all severe, and this tends to make electric brakes cost more than air brakes.

Table V. gives the ampere-seconds with different types of brakes as found in the London tests, and illustrates still further the superiority of type B in its latest form.

TABLE V.
SERVICE STOPS ON DRY RAIL.

Initial Speed in Miles Per Hour.	Ampere-seconds.			
	Type A.	Type B.		Rheostatic.
		Common Design.	Latest Design.	
2	30	9	10	70
3	55	27	15	110
4	80	53	20	152
5	105	84	27	193
7	160	160	38	275
9	210	203	50	360
11	260	263	73	445
13	300	322	118	530
14½	330	367	168	595

On a greasy rail, type B shows up still better, as shown in Table VI.:

TABLE VI.
SERVICE STOPS ON GREASY RAIL.

Initial Speed in Miles Per Hour.	Ampere-seconds.		
	Type A.	Type B.	Rheostatic.
2	30	7	125
3	39	10	185
4	50	14	242
5	75	16	300
7	132	25	415
9	207	30	532
11	297	38	647
13	385	45	765
14½	455	50	850

The current in emergency stops is about the same as in service stops. See Table VII.

TYPES OF MAGNETIC BRAKES TESTED

Two types of A brakes as well as of B brakes were tested, the latest design of A having larger magnets and is more powerful than the first form; the ampere seconds, however, were about the same in the old and new designs. Only the results with the new design have been given. The heating effects of the latest types of A and B were calculated from the London tests, and were found to add to the ordinary motor heating about 8 per cent for type A, and 1¼ to 1½ per cent for type B, but as much as 25 per cent for the rheostatic brake. In regard to type B, one estimate tended to show that in braking practically no work was thrown on the gears and pinions, the current generated by the motors during a stop being almost identical with the kinetic energy of the revolving armatures. On the other hand, with type A, in which the magnetic track shoes have no brake shoes to assist them, about 60 per cent of the work of stopping must be done by retarding the armatures. With type B, the brake shoes in the tests apparently did about 54 per cent of the work, the track shoes 35 per cent, and miscellaneous friction, etc., the rest.

TABLE VII.
EMERGENCY STOPS ON GREASY RAIL.

Initial Speed in Miles Per Hour.	Ampere-seconds.		
	Type A.	Type B.	Rheostatic.
2	30	7	200
3	44	12	255
4	62	16	310
5	83	20	360
7	143	30	470
9	215	40	575
11	292	50	682
13	377	58	790
14½	440	65	870

Evidently, then, the latest design of type B, even for American work, would not require larger motors than otherwise used. Though at first sight the connections for setting the wheel brakes from the track shoes appear complicated, the maintenance cost appears to have been very satisfactory in England. Of course, such powerful brakes must be carefully operated, and the controllers should have sufficient braking notches, independent of the power connections, to allow easy retardation.

RECENT ENGLISH ACCIDENTS FROM RUNAWAY CARS AND THEIR LESSONS

Satisfactory as the magnetic track brake appears in the light of the tests, two serious runaways with cars equipped with them occurred recently in England. In both cases the wheels were skidded with the hand brakes, and the magnetic brake was not actually in operation. The first of these accidents can be briefly dismissed because the car appears to have gone out for work in an improper condition. All brakes need some adjustment, and if cars are put upon the road without proper inspection and repairs, accidents must be expected, even with the best of equipment.

The Highgate accident in London is more important. When the inexperienced motorman of a car tried to make a compulsory stop with hand brakes at the top of a long but easy hill, his wheels skidded. According to his story, he did all of the following things: signalled to the conductor to apply the rear hand brake, which was done without effect; released the hand brake and applied sand, but the wheels would not revolve; tried the magnetic brake then, though knew it would not work with the motors stationary; reversed the current twice to unlock the wheels, but merely opened the circuit breaker. The car was found with the controller handle on the last braking notch, but with the power reversed, which would prevent either braking or reversing. While the actual facts are somewhat obscure, it looks as though the disaster was primarily due to the locking of the wheels by the motorman, possibly made tighter by the conductor. English runaway cars are almost always due to this skidding of wheels by the hand brake, making the electric brake or reversing ineffective. It hardly seems safe to count on a motorman's releasing his wheel brake and applying again more skilfully. That takes too much courage and self-possession for some men on a runaway car, and it is easy in such an emergency not to release entirely. Sand will sometimes fail at the critical moment, and it appears as though complete safety lies only in absolutely preventing the possibility of skidding the wheels, and in braking on track and wheels together. Type A does this last, but retards the wheels through the motors, which counts against it as a service brake. Type B puts little or no strain or heating on the motors, and appears to allow an adjustment of the wheel attachment so that skidding can never occur. But some powerful hand brake is obviously necessary on every car, in case the electrical equipment fails, and to hold a car for any length of time. With type B, the hand mechanism should work directly on the track shoes only, as has been done on some cars in this country. The shoes should be pressed down so as to allow them to drag as if operated magnetically, and thus apply the wheel brakes. With type A only the track shoes can be applied by hand.

The hand attachment to the track shoes overcomes two objections to the magnetic brake: First, by allowing the brake to be applied when passing over any manganese special work, though of course no braking is desirable on special work except in an emergency. Second, by allowing braking if a car is derailed; and it might be a good practice, after throwing the controller handle into the emergency position, to apply the hand attachment quickly, so as to have the brakes hold in case of derailment or any electrical failure. A third advantage is the possibility of allowing track cleaning, somewhat after the method used in England with mechanical track brakes. It is a common custom on some English systems always to screw down the wooden track shoe at the top of a steep grade and leave it on all the way down, thus keeping the rails clean, while in this country we are apt to think slippery rails are unavoidable. One of the leading English managers has said that he finds from experience that a greasy rail cannot exist on steep grades where the track brake is in constant use, as the rail is kept free from slime and dirt by the constant action of the wooden track shoes. Perhaps it would be possible to mount on the end of the magnetic track shoe some spring cleaning block or scraper which would bear on the rails just before the magnetic shoe did. Then, when it was desired to clean the rails of dirt or snow or ice, either when descending a grade or even at other times, the hand brake could be lightly applied until the cleaning attachment was effective, while the magnetic attachment could be used just the same, leaving the cleaner always undisturbed at work. This would be a great improvement over the still too common method of trying to overcome slippery rails by the use of sand, either in a continuous stream or in intermittent heaps from sand boxes or scoops, to the detriment of track, motors, and wheels. If we had to be as economical of current as most European roads, we should clean our rails more, and not try to neutralize dirt by adding more dirt. The successful use of running water to clean tramway rails on ascending English gradients, and as an improvement over sand for railroad tunnels, might profitably be looked into by some American managers. If sanding were as reliable and as sparingly practiced as on steam roads, there would be little room for criticism. With skidding wheels, the friction has been found to be less than a third of that with the wheels revolving, and although on greasy rails sand has been found to give an adhesion equal to dry rails, its disadvantages have been realized for some time. Fortunately the magnetic brake makes its use unnecessary. And if this brake can be further used to remove existing dirt, it would be better still.

One obvious lesson of the Highgate accident was the need of preventing motormen from doing the wrong thing at the wrong time, especially from having too many possibilities. It may be said in defense of the European custom of having two or more independent brakes on a car, that the results in case of an accident can be no worse than with the American custom of having only wheel brakes. After the wheels are skidding hopelessly, the damage will be the same, and if the foreign motorman does lose his head, and fails to use the additional protective devices, he cannot make things worse, while if he keeps his head he may succeed in stopping his car. It has been suggested since the Highgate accident that motormen should be actually trained in stopping runaway cars on some safe grade. In this way nervous or unreliable men can be detected, and at least kept off dangerous routes. Another lesson is, of course, the danger of too powerful wheel brakes with uncertain rails, and especially with inexperienced men. The fatal car had a magnetic brake which, if used according to rule after the start had been made down the hill, would undoubtedly have stopped the car. But the preliminary stop was attempted with the hand brake. There should have been no choice. There is obviously a great advantage in having the emergency brake the same as the service brake, with simply an emergency position as with air practice. There is often no time to think, as in the Salisbury accident in England, where the brake handle was found in the running position on the locomotive, which accounts partly for the terrible destruction to the rolling stock. Evidently the thing was all over before the engineer could do even the most mechanical thing.

COMPARISON OF BRAKING EFFECTS

It may be well to compare the magnetic track brake further with other brakes, and first with air. If it is too powerful and liable to make too quick service stops, the same trouble occurs with air. Air braking on some city cars is very disagreeable because so jerky. The writer has found one motorman, trying to coast slowly down grade, apply and release about fourteen times a minute, being unable to make a single reduction that would keep the desired speed. The resulting motion of the car can easily be imagined. Of course all air brakes require more or less additional power, though little with axle driven compressors; while the magnetic brakes require none. With air brakes there is little chance of a motorman's running with brakes half on, as is so common with the hand equipment, but this practice is absolutely impossible with magnetic brakes, because the same handle is used for both power and braking. This leaves the right hand free for other things, like track cleaning, scrapers, etc. Again, in starting on a hill, there is no possibility of applying current before the magnetic brakes are released. This is very common on some air equipped lines, with jerks that are exceedingly disagreeable, to say the least. The fact, however, that air brakes are working so well on American electric cars makes it difficult to tell just where the limitations lie, just where to use them, and where not. Skidding wheels may not cause any accidents for a long time, and then, as has happened, three air-braked cars may collide in succession on a slippery grade. The general rule has been to install air on all occasions, except on the few Western roads referred to where its limitations were realized. But now, just as all brakes are adjusted to the weight of the car, should not the type selected be the one adapted to the worst possible rail conditions? and the worst possible employee, one might add? American manufacturers have rightly hesitated to install electric brakes in the past. But now that such remarkable improvements have been made in their foreign equipments, it is to be hoped that they will soon be available for reducing accidents in this country.

COMPARISON OF DIFFERENT TYPES OF TRACK BRAKES

Type A came through the London tests well, though not so well as type B; but the heating effects were regarded as negligible, and the lower cost and the simplicity from lack of any wheel connections were in its favor. It also eliminated all brake-shoe wear. Its weak point is the hand attachment, which, to avoid skidding, must be applied to the track shoes alone. This attachment might not hold the car in an emergency, especially as the shoes are metal instead of the more effective wood. Again, since the Highgate accident, it has been urged that magnetic track shoes should be wholly independent of the wheels, as in type A, and that only in this way could all skidding be prevented. But the wheels do not skid with type B, while it is well known that too strenuous braking even with the motors alone will stop the wheels entirely for a moment, and then cause them to slip slowly, with perhaps the same loss of friction as if skidding.

The ordinary English mechanical track brake, with wooden shoes and no electrical attachment, has strong advocates, and, as already stated, has given admirable results in rail cleaning on down grades. But it is at its worst on a wet rail, and once when the wheels skidded on a greasy 10 per cent grade in Chatham, the track brake was ineffective in preventing a fatal runaway. It needs the co-operation of a wheel brake, and then is like the magnetic brake, except that the harder the mechanical track shoes are pressed down, the more the weight is taken off the wheels which is a disadvantage, though the high friction of wood tends to make up for this. Still, in its pneumatic form the mechanical track brake is very attractive, and its operation is independent of the kind of steel rail, in spite of derailment, and without regard to electrical failure. An effective combination for dry rail braking would be the following: Air brake operated by the motorman's right hand, controller handle and track brake by the left hand. To make an emergency stop, the power would be shut off, and a brake handle thrown with each hand. But careful adjustment would be needed to prevent skidding in an emergency, and on a bad rail even the combination would probably fall far short of magnetic braking, though it might answer every need for interurban service, and be added to present air-brake equipments without other changes. The pneumatic track brake would seem to allow the possibility of rail cleaning on a level or up grade, by a very slight application of the shoes fitted with some spring cleaner.

An important form of the track brake is that designed by Mr. Wilkinson, the Huddersfield manager, in which each track shoe is pressed down by two powerful adjustable spiral springs, and can be let down on the rail either suddenly, by pressing on a foot pedal on the platform, or gradually, by turning a hand wheel which slowly releases the levers normally holding the shoes off the track. This allows an emergency application impossible with the ordinary track brakes which are screwed down by hand. But hand levers as found in San Francisco and England also allow a quick and powerful application.

Some think the magnetic track brake has another point of inferiority to the other track brakes, in that the shoes are metal instead of wood, causing less friction and more wear on the rail. But the friction between the metal and the steel rails certainly seems enough, and the London manager believes the wear on the rails is no greater with an iron shoe than with wood permeated with sandy grit.

OTHER EMERGENCY BRAKES

Special emergency brakes are not satisfactory if they depend on the revolutions of the wheels to set them, unless there is no possible way to skid the wheels, which seems never the case. And again, they may be forgotten at the critical time. In one English accident, the car had an emergency brake specially for keeping it from running backwards in climbing a hill, but also very powerful as an emergency track brake if slid under the front wheels. The runaway began as usual because the hand brake was too powerful for the state of the rails, and the sander failed, though apparently all right. The rheostatic brake was applied twice, without effect, of course, as the armatures were not revolving. Then the motorman released his hand brake and shouted to the conductor to apply, forgetting that with his wheels at last free either his rheostatic or emergency brake would have acted. Reversing had no effect, as the trolley came off. An American car would have come to grief in the same way under the circumstances, as the three ways of stopping would have failed. The English car had five ways, and so more chances; but skidding was possible, and the motorman finished things.

Continental brake practice does not suggest as much as English, probably because conditions are not so severe. Some managers prefer air, others electric brakes,

MAGNETIC AND OTHER TRACK BRAKES FOR TRAIN OPERATION

As to simultaneous braking on trains of two or more cars, of course nothing has been attempted yet with track brakes. But it is not impossible. Many trailers on the Continent are equipped with disc or solenoid brakes operated by current from the motor car. The magnetic track brake appears to have enough reserve power to apportion a third or a half to a light trailer. Some of the recent trailers tried in this country have been too heavy. A similar mistake has recently been corrected in Berlin, and the latest semi-convertible trailers built there now weigh only 9700 lbs., with cross seats for twenty-four passengers, requiring to haul them only one-third of the current of a motor car, in place of a previous one-half. With American seat allowance, these cars would seat thirty-two passengers. In one city in this country, with similar speeds to Berlin, recent trailers weigh about 21,800 lbs., with only thirty-four seats, and required automatic air brakes. Operation is so careful in Berlin that automatic air brakes have been found unnecessary, even with three-car trains, including two double-deck trailers.

If magnetic track brakes are desired on cars hauling light trailers as in Berlin, and automatic brakes are wanted for safety if the cars part, the following arrangement might prove satisfactory: Magnetic brakes on the motor car ought easily to handle a five-ton trailer. The latter could be equipped with a spring track brake after Wilkinson's pattern, which could be set by hand, and have wheel brake added or not as desired. If the cars parted, an emergency chain fastened to the motor car could pull a trigger setting the trailer brakes automatically, and then the motor car would be free to pull ahead out of the way.

REGENERATIVE BRAKING

Although the magnetic track brake seems in most ways about the last word in braking, it has rivals in England with one great advantage. The magnetic brake can, if rightly used, stop a runaway car; but it cannot prevent the initial running away, as is done by the systems of regenerative control now being widely tried in England. It is unfortunate that our experimenters should have abandoned direct-current regeneration, and allowed England to make it the working success it appears. Of course defects may still have to be remedied, but over a hundred cars are already in use on a dozen or fifteen lines, and a brief examination last summer made things appear very promising. On one line visited, regeneration was being tried, not so much to save current, as the city is comparatively level, as to save wear of wheels and brake shoes, the application of the latter being needed only when the car has nearly stopped. The braking down to this speed is done by simply bringing back the power handle notch by notch, each notch corresponding to a given speed up hill or down. This first part is even simpler than operating a magnetic brake, and quicker of application; for the shutting off of the power also does the braking. But whether the car actually responds as quickly as to a magnetic brake is a question. The retardation is certainly very smooth. For the final stopping, one system employs an automatic friction brake operated by a solenoid in connection with the controller, so that the brake is applied when regeneration ceases at about 1 m. p. h., and is released when current is applied for starting. This same brake is automatically applied in case the trolley comes off or the electric circuit is broken in any way; and so, if mechanically reliable, it might serve as an automatic brake for trailers. With the other regenerative system, if the trolley comes off, an automatic switch closes the circuit again through resistances, while if the electric circuit is out of order, an emergency notch on the controller introduces a special series winding, giving rheostatic braking as with ordinary motors. It is claimed that regenerative braking is easier on the motors than even magnetic braking, especially in the braking system where no resistances are used. But it is more or less of a disadvantage to have to use a second brake for the final stopping and holding of the car, except perhaps where the second brake is automatically applied and released. If this second brake applies both track shoes and brake shoes and the latter so as not to skid the wheels, it would be an advantage; but even then it could hardly hope to equal the magnetic brake for quickness of emergency stops.

For hilly routes, a system is certainly very attractive with which the speed of the car can never exceed that set for each controller notch, and in which descending cars can return to the line as much as 50 per cent of the current used in ascending the same grade, with an average saving said to range from 7½ per cent with a fairly level line to 30 per cent with a very hilly one. For a city like San Francisco, the system would seem an ideal substitute for the cable, as the cars would never exceed the maximum speed desired any more than if gripped to a cable, and the descending cars again, with their regeneration of power, would assist cars ascending grades. The latest regenerative motors have series parallel control. The motors in one system are compound wound. In the other the field coils are connected to serve as series windings during acceleration and as compound windings during regeneration. Fuller descriptions can be found in the English technical press.

After the Highgate accident, London "Engineering" strongly advocated regenerative control as the sure preventive of runaway cars; and for this purpose of keeping rigidly to desired speeds and always having a car under control, it may prove ideal, especially for hilly roads, even if slightly more complicated and expensive than former systems. But for level cities, where powerful emergency brakes are more needed than extreme economy of current, magnetic brakes at present seem preferable, unless it is feasible to combine the two, reserving the magnetic brakes perhaps for emergency applications.

AUTOMATIC SLOW-DOWNS POSSIBLE

With the Salisbury accident fresh in mind, and that at Providence where a motorman came on a sharp curve unawares at full speed, it may not be long before there is a demand for some method of slowing cars and trains down to safe speeds automatically at dangerous points. Automatic control is not considered too complicated for hoisting and conveying machinery, and its further extension to electric railways might sometimes pay well for the cost. The track stop in its present form is hardly suitable for frequent slow-downs. The latter may be better effected by varying heights of the third rail, after the idea on the Berlin Elevated and Underground Railway, where it will be remembered the contact shoe is dead at its lowest point, closes a power switch at its second level, and cuts in the car lights in the subway at its highest point, all automatically. The same controlling circuit might be operated by varying the heights of the trolley wire, and, in connection with regenerative control, this might afford perfect protection against too high speeds at the wrong place. The steady reduction of the human element is certainly more interesting than cleaning up wrecks, settling claims, and trying to explain to the public how avoidable things could not be avoided.

REGENERATIVE BRAKING FOR SUBWAYS

There may be urgent need of the use of regenerative control if subways are to be used indefinitely. Take the question first of iron dust from braking. This has caused concern in European subways from collecting on insulators and as being dangerous from its inflammability. But it has assumed most serious proportions in the New York subway, where the air is saturated with the shining metal particles, and where alone they amount in quantity to as much as the average weight of dust in the winter street air of New York. If this excessive amount of metal dust should prove to be injurious to those who have to work constantly in it, if not to the passengers' lungs and eyes, regenerative control would seem to offer the type of braking with least wear of metal. But it also affords a means of reducing current consumption and so of heat production. While subway heat has not been proved injurious to health, it does deter people from riding, and is one of the causes limiting the extent of subway travel in Europe. The traffic on one comparatively new European subway is already slowly falling off, although its average temperature last summer was over 10 degs. cooler than the New York subway. This European railway runs seven-car trains on a two-minute headway; but, although the average current consumption, with a speed of 14 m. p. h. including stops, is only about 37 watt-hours per U. S. ton-mile from careful tests, the subway temperature had risen last summer to over 20 degs. above the temperature of the line when first operated. If the temperature in the New York subway reached 98 degs. last summer with a production of only 56 per cent of the proposed heat and power, what will the future bring?

The immediate need in New York is, of course, a great reduction in current consumption without reducing, if possible, the present average speed. This may seem impossible at first, as it means the building of new side-door cars, at apparently prohibitive expense, to shorten the stops; and besides, side-door cars have been considered out of the question because of curved platforms. American and European improvements, however, have made possible the use of side doors at any subway station in New York, even at the City Hall with its 150-ft. radius curve. The present car dimensions would allow 100 seats to a car instead of the present 52, with comfortable standing room for 80 more, and ten doors on each side. The shortening of stops possible with such cars, and the great reduction possible of the maximum speed, etc., make it appear clear that the present rush-hour speed could be maintained with so much less current than now that the saving in cost of power would pay the fixed charges on the new rolling stock. It is not often that so new and costly an equipment can be replaced with actual profit, and it is fortunate that such is the financial inducement in this case, in view of the inadequate capacity of the present cars and entrances, of the danger of the wooden cars from further fires, and of the weakness of even the steel cars in case of derailment. The shortening of stops would seem to allow an increase in the number of trains, if desired, till the seating capacity of the subway reaches three times that at present, or, if eight-car locals are ever run, about four times the present limit.

Just how much saving in current regenerative braking by itself would effect in the New York subway seems uncertain yet, but further English experience may throw more light on the matter. Some authorities would put the percentage very high, but, even if low, the reduction of the iron dust might make it desirable, and in cutting down the heat supply every possible method may be necessary. In future subways, steeper grades and grades at all stations will be highly desirable. Such grades on the Central London supply about 25 per cent of the force needed for acceleration and 25 per cent of the force needed for braking. American acceleration has hitherto been too ambitious to take advantage of such means of assisting starts and stops. The effect of grades on braking is well illustrated in the Glasgow District Subway, where the air brakes are seldom used; a light application of the hand brake on the motor car suffices to stop the light trains. The profile of this line is so refined that, instead of having the stations level, the ascending gradient is continued to the center of the station platforms, and the descent begins at the same place, so as to assist braking till the last second, and acceleration as soon as a train starts.

POSSIBILITIES OF EMERGENCY BRAKING WITH TRACK BRAKES

While on railroads and interurban electric lines, with clean rails, air braking on the wheels can give rates of retardation about as high as comfortable, one cannot help thinking that many accidents might be at least lessened in severity if emergency stops could be as quickly made as with magnetic brakes. The low retardation results obtained at Zossen even under the best conditions, and the heating of the tires and other difficulties, suggest especially the possible value of high-speed experiments with magnetic and pneumatic track brakes. Wooden track shoes under the very worst conditions of wet street rails have been found to increase the retarding force about 20 per cent, and would therefore diminish the stopping distance 20 per cent. The effect of magnetic brakes on collisions can be seen from the following example: Suppose two 25-ton cars, running towards each other at 30 m. p. h. on the same track, fail to come in sight till 200 ft. apart, and then are braked at the rate of 3 m. p. h. per second. They will collide at a speed of 22 m. p. h. with a force of 410 tons each. If they have magnetic brakes that can retard at 6 m. p. h. per second, they will collide at a speed of only 9 m. p. h., with a force of 68 tons each, or one-sixth of the former amount. The maximum retardation found for magnetic brakes in the London tests would stop the cars 6 ft. apart without any collision at all.

Since the above was written, an English critic of the combined magnetic track and wheel brake has called attention to what he considers a danger of combining the two. While admitting the advantages under ordinary conditions, he is afraid that if the track shoe strikes a bad rail joint or a projecting paving stone the shoes would be crowded on the wheel so hard as to skid the wheels. The effect of such a blow would not be merely momentary, as the friction of the brake blocks on the rails would keep the extra pressure on. Wheels under this condition would remain locked after the hand brake had been taken off. The same critic, however, unintentionally suggests the remedy in advocating the use of an improved spiral spring of many turns in the hand-brake system to prevent skidding. This spring would be adjusted so as to give way when the force applied is a trifle less than enough to stop the wheels on the worst rail. A similar spiral spring, similarly adjusted, can be inserted with the magnetic track brake somewhere between the cam worked by the track shoe and the wheel shoe, and would then appear to make skidding impossible under any conditions.

GAS ENGINES CONSIDERED BY THE NEW ENGLAND STREET RAILWAY CLUB

The September outing of the New England Street Railway Club was held on Thursday, the 6th inst., with about 150 members in attendance. The members assembled at 8:45 a. m. in the trainmen's schoolroom of the Boston Elevated Railway Company at the Sullivan Square Terminal, and first listened to an informal talk on gas engines by President Paul Winsor, chief engineer of motive power and rolling stock of the Boston Elevated. At the conclusion of the talk three special cars, furnished by the courtesy of the company, were boarded, and the party was taken to the Clarendon Hills power station of the company at West Somerville. Here the members inspected the new 1200-hp Power & Mining Company's gas engine plant, with Loomis-Pettibone producers and Crocker Wheeler generators. After a short stay the route was taken up to the new gas engine plant of the Boston Elevated at Salem Street, Medford, which consists of three 500-hp De La Vergne gas engines direct connected to 325-kw Crocker Wheeler generators, and a Camden Iron Works gas producer outfit. Both of these plants were described in the STREET RAILWAY JOURNAL of Nov. 4, 1905.

After inspecting the gas plant at Medford the party was taken to the works of the New England Gas and Coke Company in Everett by special cars of the Boston & Northern Street Railway. During the stay of the members at the gas and coke plant, a light luncheon was served by the New England company. The afternoon was spent in the pursuit of pleasure at Wonderland Park and Revere Beach, admission to the park having been given to the party by the management of Wonderland.

In discussing the gas engine problem informally, Mr. Winsor stated that for several years it has been his opinion that the gas engine is the coming prime mover. Few steam plants show a better efficiency than 3 lbs. of coal per kilowatt-hour, but the Boston Elevated's plant at Somerville has averaged less than 1.5 lbs. of coal per kilowatt-hour for all coal consumed in regular service runs since May 2, 1906. This great economy in fuel is obviously the chief advantage of the gas engine plant. The chief trouble has been the noisy exhaust, but this is being remedied gradually. The Somerville plant has been operated sixteen hours per day in commercial service, beginning at 7 a. m. and shutting down at 11 p. m. The plant has been shut down only when power was not wanted, or when slight adjustments had to be made, incidental in getting a new installation in running order. The Medford plant was not ready quite as early as the Somerville station, and only one engine has been operated so far, as the company wished to reduce the noise as much as possible before inaugurating regular operation in the residential district where the station stands. It is expected that the station will become practically noiseless in due course. The fuel economy of the plant is the great point of value. It has been difficult as yet to obtain a correct idea of the labor cost of turning out power. It is at present rather high, but should compare favorably with a steam plant in the long run. Mr. Winsor then exhibited several drawings of the gas engine cycle, and discussed the features of the four-stroke cycle and also the cycle in which the engine does work in one stroke per revolution. Many engines are made with tandem coupled cylinders, corresponding in performance to a single cylinder steam engine. At the Medford plant gas and air pumps are mounted on the engine.

Discussing sources of fuel gas, Mr. Winsor emphasized the excellence of illuminating gas, but pointed out the objection of its high cost. As made by distilling coal heated in a closed retort, it has a thermal value of about 600 B. T. U. per cubic foot. Natural gas is admirable where it is available, and it has a calorific value of about 1000 B. T. U. per cubic foot. The cheapest gas is that of the blast furnace, but it has a thermal value of only about 80 or 90 B. T. U. per cubic foot, and is very dirty. Producer gas is made, generally speaking, by burning live coal in a closed chamber on top of a bed of ashes. Air is forced in beneath the bed or drawn in by a blower on the discharge side of the producer. The producer has a double top. The chemical reactions are relatively simple. The entering air burns the live coal to CO_2 as follows: $C + 2O = CO_2$. The CO_2 then passes through the upper part of the coal bed and is reduced to CO: $CO_2 + C = 2CO$; then the CO burns to CO_2 in the engine cylinder: $2CO + O_2 = 2CO_2$. The gases are passed through cooling and cleaning apparatus before being utilized in the engine.

In a soft-coal producer plant hydrogen and tarry matter are distilled at a fairly low temperature. The tar must not go into the engine, so it must be separated from the gas if soft coal forms the basis of operations. This process is called scrubbing, and it consists of passing the gas through a vertical tank in which are suspended horizontal trays of coke, over which water runs. The suction of gas can be run by the engine if desired; the suction stroke of the piston in such cases draws the gas through the producer and into the cylinders. The West Somerville plant is at present at something of a disadvantage in regard to ashes removal. The cleaning of the producer and removal of ashes has to be done when the plant is shut down, as the producers are installed in a unit pair. Both must be in operation at the same time.

This plant is equipped with a rotary blower which draws the gas from the producer to the engines. With soft coal the tar passes in this type of producer down through the hot coal and then passes off as a permanent gas. The company gets a large quantity of lamp black in the operation of its plant at West Somerville. It is separated by spreading it out and allowing it to dry. With this form of producer one can always see the fire. The drawback is the difficulty of cleaning. The fire is too hot for shaking grates and it makes a bad clinker unless cooled by a steam jet. There is no loss of heat in this way, for we get $H_2O + C = 2H + CO$, both of which are combustible gases. It is not possible to use a large amount of hydrogen in the engine cylinders. About 12 or 13 per cent of hydrogen is produced in this plant, and trouble occurs if this is much exceeded.

Few steam plants give an efficiency of 10 per cent from the coal. About double this can be obtained in a gas plant. In a producer plant about 25 per cent of the heat of the coal is lost, and about 30 per cent in a steam boiler installation. The principal losses in the gas plant are in the engine water jackets (25 per cent) and in the exhaust (30 per cent). The largest loss in the steam plant is the latent heat of the exhaust steam, as it is condensed.

The Somerville plant never requires over fifteen or twenty minutes for starting up. If it were shut down twenty-four hours it might take thirty minutes to commence operation. Thus far the principal troubles have been oil troubles. The quantity required was excessive, and the capacity of the filter was insufficient. This is being remedied, but on account of the large surface to be lubricated it is doubtful if the oil consumption becomes low. A good many premature explosions and miss fires have been noted, but the conditions are now improved. A rocker shaft was broken and a few mechanical difficulties were experienced, but more hours of work have so far been gotten from this gas plant than from a turbine installation which the company is inaugurating. Mr. Winsor closed by exhibiting some graphic examples of the energy loss in the different parts of a steam and a gas plant.

CORRESPONDENCE

HAND AND POWER BRAKES

New York, Sept. 10, 1906.

Editors STREET RAILWAY JOURNAL:

Some one has said that ever since the first railroad train was started there has been a constant effort to stop it. It was many years after the railroads were firmly established as a commercial necessity of the world before power brakes or brakes under the control of the engine man were accepted for general service, and it took twenty-five years more to put them upon freight cars. Electric roads have worked more quickly. They have condensed the experience and the advance of a decade on the part of the steam road into a year, and twenty years has seen the advance from the light 16-ft. car with a motor on the platform to the present heavy equipment of city and interurban lines.

With the increase of weight has come the increased necessity for efficient and quick-acting brakes. As far as efficiency is concerned the old-fashioned, slowly-applied hand brake does its work as well as any other after the brake-shoe pressure has once been brought against the wheels. The drawback consists in the time required to make the application. It is evident, of course, that the effectiveness of a brake-shoe does not depend upon the source of the pressure with which it is applied, but upon the actual pressure so secured. And it is also evident that the leverages can be so arranged that a pull upon the hand brake can be made to put the shoes against the wheels with as great a pressure as any air or electric brake. The difference between the two depends upon the time required to obtain the maximum pressure. With the hand brake so adjusted that the shoes are brought against the wheels with one and a half turns of the handle, the time required will range from 1½ seconds to 2½ seconds, dependent upon the man, the length of time he has been on duty, and the condition of the rigging. With the air brake this is cut down from ½ second to ¾ second, while with the electric and some forms of power brake it is again cut to from 3-16 second to 5-16 second. With a car running at a speed of 10 m. p. h., or 14 2-3 ft. per second, this means that the electric or air brakes can stop a car before the hand brake can be applied. In other words, the human effort is largely eliminated.

Incidentally it may be remarked that the condition of the brake rigging has a very important influence not only upon the speed of application of hand brakes, but the actual shoe pressure obtained. In brake tests carried out some time ago, where arrangements had been made to obtain a continuous pull on the brake chain of 450 lbs., it was noticed that the apparent effort of the man at the handle was much greater at some times than it was at others. This led to an investigation of the fractional resistances of the brake staff. It was a staff of the ordinary sort held by straps to the front dasher and by a strap at the bottom. A dynamometer put on the handle and another on the brake chain showed that, to obtain a pull of 450 lbs. on the latter, required a pull at the handle ranging from 30 lbs. to 50 lbs., while, after this brake-chain pull had been obtained, it could be maintained by one at the handle of from 25 lbs. to 45 lbs. In other words, more than 50 per cent of the energy of the man was apt to be expended in the mere turning of the brake staff and overcoming the frictional resistance in its bearings and supports without any return in useful work in the way of pressure at the shoe.

Another source of wastefulness on the part of the hand brake is its demand for close adjustment in order that the time required to make an application may be kept down to the lowest limit. For this reason roads that are using hand brakes have, or should have, the shoes adjusted daily and brought up so that there is not more than ⅛ inch clearance from the wheel. With this the motorman is apt to keep the shoes dragging at all times, thus putting a direct draft upon the coal pile, increasing the rate of wear of the shoe and wheel and thus adding a very appreciable though uncalculable amount to the cost of operation.

It would seem, then, that for street railway service the speed of application and the prevention of accidents that might be expected to result would be quite sufficient to warrant the use of air or electric brakes. As a matter of fact this supposition will not hold because of the personal equation of motormen and the public. An inquiry made among a large number of claim agents brought out the fact that the introduction of air brakes had produced no appreciable falling off in collisions and other street accidents and in the resultant claims for damages. The reason is that, as soon as the motorman finds that he can stop in a third of the distance that he could with the hand brake, he only allows himself that one-third distance, and the public, both afoot and in vehicles, soon learn the same fact and take their risks accordingly, so that the claim department still continues to work full time and there is no falling off in the street accident record. In spite of this undisputed condition of affairs the railroad company for whom the inquiry was made very shortly thereafter proceeded to equip its cars with air brakes because it was possible to run them at higher speeds at the same risk than it was with the old-fashioned hand-brake application. This meant the same service with fewer cars, or more frequent service with the same number of cars, together with more rapid transit.

These are general statements, while the efficiency of the brake depends upon a multiplicity of details that cannot be discussed at this time, such as the man, the brake rigging and apparatus in point of physical condition, the type of shoe used, its play and the like. But the summing up of the position may be embraced in the statement that the application of power brake-shoes does not decrease the number of accidents, although the fact that the company is using the best-known devices may lessen the jury awards for claims, although this in turn is doubtful. On the other hand, the air brake or its equivalent does permit the use of a faster schedule than the hand brake, due to a shorter time required to apply, while the latter does its work thoroughly and well when it is once on.

HENRY M. HUNTER.

MILAN EXHIBIT OF VIENNA MUNICIPAL TRAMWAYS

The Vienna municipality, which operates the local tramways, has installed an unusually elaborate exhibit at the Milan Exposition. The exhibit is designed to show in miniature the construction and operating features of a large railway system. The Viennese methods of collecting current both by the overhead and conduit systems are shown in connection with a piece of double track and switch. There are samples of various methods of suspending wires, installing insulators, pull-offs, etc. A typical waiting room has been built, containing the usual passenger accommodations, together with telephone and emergency apparatus for car accidents. As an example of its rolling stock the municipality shows a richly-furnished motor car for rental service. The car is finished in mahogany and gold, and several Viennese scenes are painted in water colors on the panels over the doors. Another rolling stock exhibit consists of a standard three-car train, consisting of one motor car and two trailers. One of these trailers has the entrance in the center between the two compartments. An especially interesting car is the one built for the Vienna-Baden branch. It has two trucks, each carrying two 300-volt, 15-cycle, single-phase Siemens-Schuckert motors which are wound also to use 500 volts d. c. on the city divisions. Another interesting exhibit is a motor-driven rotary snow plow, and the electric automobiles for accident relief work and minor repairs. A gasoline tower automobile for repairing overhead work is also shown, together with models of the shop tools employed.

OPENING OF THE RACINE DIVISION OF THE CHICAGO & MILWAUKEE ELECTRIC RAILROAD

The Racine extension of the Chicago & Milwaukee Electric Railroad was formally opened Sept. 1. The extension is 10 miles long, and is built on private right of way 100 ft. wide. Double tracks are now laid, but provision has been made in the construction of concrete arches and construction of stations for four tracks eventually. There are no grades on the line, and there are no curves of less radius than 45 minutes. The terminus in Racine is at the extreme west limits of the city. This construction and location was followed in view of the fact that the extension will eventually be a portion of the through line between Chicago and Milwaukee.

The opening of the Racine division was attended with much formality. Special cars on the Chicago & Northwestern Railroad carried invited guests of President A. C. Frost to Waukegan, where four special cars of the Chicago & Milwaukee Electric Railroad were in waiting to convey the guests to Racine. Here a banquet was held in Dania Hall. Mayor Nelson, of Racine, officiating, introduced the following speakers: Captain Anson, of Chicago; F. B. Jackson, of Evanston; Judge Pierce, of Highland; Mayor Jackson, of Lake Forest; Mr. Whitney, of Waukegan; A. C. Poss, of Milwaukee; Judge Barnes, of Zion City, and Senator A. C. Frear, of Wisconsin. All of the speakers were high in their praise of the constructed road and of President Frost.

President Frost, the host of the occasion, at the conclusion of the addresses in a modest manner expressed his appreciation of the many kind words uttered by the previous speakers. He added that in building his road he had built it only in accordance with what be believed the future of the territory traversed demanded. Referring to further extensions toward Milwaukee, he said that within a year he believed the road would be completed into that city.

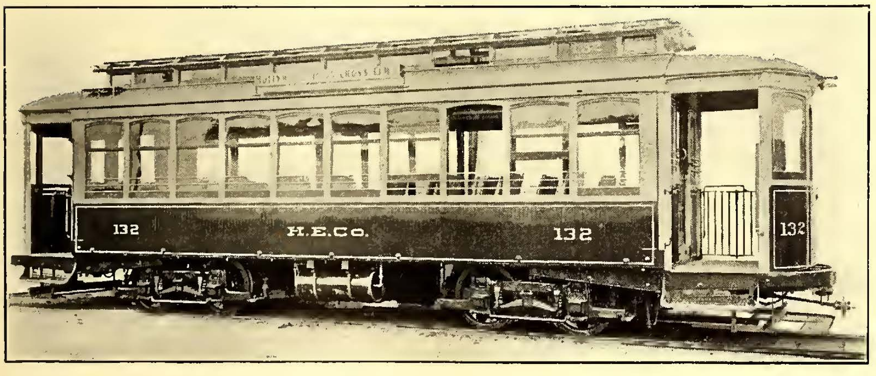
At 6 o'clock the guests were taken over the line in special cars to Ravinia Park, where dinner was served.

TWENTY NEW CARS FOR HOUSTON ELECTRIC COMPANY

The twenty new cars built by the American Car Company for the Houston Electric Company (Stone & Webster, general managers) have the Brill grooveless post semi-convertible feature, as will be seen by reference to the low window sills, window system, maximum interior width and other features which have made this type of car very popular. The present consignment will make thirty double-truck cars delivered to the Houston Electric Company within a year, all the cars being mounted on No. 27-G1 trucks having solid forged side frames with a wheel base of 4 ft. 6 ins.; axle diameter, 4 ins.; wheel diameter, 33 ins. Cherry constitutes the inside finish of the cars of the present order, and the ceilings are of three-ply birch, decorated. The length of the seats is 35 ins. and the width of the aisle 26 ins.

The principal dimensions are: Length over the end panels, 28 ft., and over the crown pieces 38 ft.; width over the sills, 8 ft. 6 ins., and the same dimensions apply to the width over posts at belt; from center to center of the posts is 2 ft. 8 ins.; height from the floor to the ceiling, 8 ft. 5⅝ ins.; height from the track to the platform step, 16 15-16 ins.; the framing includes side sills of 4 ins. x 7¾ ins.; center sills, 3¾ ins. x 4½ ins., and end sills, 5¼ ins. x 6⅞ ins., while the outside sill plates measure ⅜ ins. x 12 ins.; corner posts are 3¾ ins.; side posts, 3¼ ins.

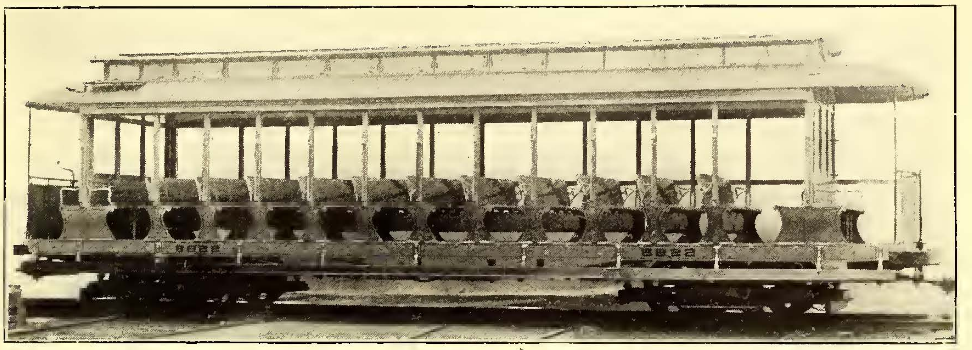
The Houston street railway system embraces fourteen routes, the length of trolley lines being 44 miles. Ten acres of land situated on the extension of the Franklin line were bought recently, on which has been erected a car house and shop building, the latter including an armature winding room, machine shop, blacksmith shop, paint and carpenter shop where repairs of all descriptions are made. The company is at present operating from this location, having erected temporary buildings while the permanent structures are in the course of construction. A short time ago, two miles of tracks were opened which belted together the Franklin and Congress lines, and this summer the company commenced to operate an extension which belted together the Montgomery line and the Houston Avenue line, a distance of about 2 miles. Inasmuch as this line serves Highland Park, which is owned by the street railway company, it is known as the Highland Park line. This summer has also seen an extension of the Louisiana line to the new suburb of Hyde Park, and in the early fall the Fairview addition to the City of Houston will be benefited by the extension of the South End line. Very extensive repairs to tracks and overhead lines have occupied the company's attention of late, and in the case of the latter, No. 00 trolley wire is being substituted for No. 0. The new cars will run over the following lines: South End, La Branch, Arkansas Pass and Louisiana.



COMPLETELY EQUIPPED CAR FOR THE HOUSTON ELECTRIC COMPANY

OPEN CARS FOR ATLANTIC CITY

In the STREET RAILWAY JOURNAL of Sept. 1 there appeared an article describing the rolling stock for the new West Jersey & Seashore division of the Pennsylvania Railroad, the cars being of the standard form of Pennsylvania Railroad day coaches and built by the J. G. Brill Company. No mention was made, however, of the fact that the same builders have lately delivered to this company six open cars for operation on the lines between the Inlet at Atlantic City and Longport, the cars being generally similar to other cars for summer service furnished heretofore by the same company. The new cars will seat seventy-five passengers, and in them will be found the usual features of Brill cars of this type. They measure 40 ft. 4⅜ ins. over the crown pieces, and the width over the sills is 7 ft. 9½ ins.; over the posts at the belt, 8 ft. 7½ ins.; sweep of posts, 5 ins.; distance from the center to the center of the posts is 2 ft. 6 ins.; side sills are 5½ ins. x 8 ins. and sill plates ⅝ ins. x 8 ins.; thickness of the corner posts, 3⅝ ins.; side posts, 2¾ ins. The cars are mounted on No. 27-G1 trucks having a wheel base of 4 ft.; axle diameter is 3¾ ins.; wheel diameter, 30 ins. There are four 40-hp motors on each car.


ONE OF THE LATEST OPEN CARS FOR THE WEST JERSEY & SEA SHORE DIVISION OF THE PENNSYLVANIA RAILROAD

In addition to the several lots of open cars which this car builder has delivered to this road, it has also furnished on two occasions cars of the semi-convertible type which were particularly pleasing specimens of this type of construction, being finished in mahogany. In short, practically the entire equipment for the lines running along the ocean front in Atlantic City were furnished by the builder of the present consignment.

The Lima & Toledo Traction Company, of Lima, Ohio, opened the first section of its new Toledo line as far as Ottawa on Sept. 15. A two-hour service was inaugurated. Within a few weeks the service will be extended to Leipsic. Rapid progress is being made on the balance of the line, and it is expected that it will be completed to Toledo next year.

FINANCIAL INTELLIGENCE

Wall Street, Sept. 12, 1906.

The Money Market

There has been a decided change for the better in the monetary situation during the past week. Following the announcement by the Secretary of the Treasury that he would facilitate the importation of gold from Europe by making advances to the importers pending the arrival of the gold at this side, caused a sharp relaxation in rates for both call and time accommodations. Call money, which at the close of last week loaned as high as 40 per cent, loaned as low as 2 per cent during the current week, while time contracts extending from ninety days to six months, declined to 7 per cent, which is about 1 per cent below the high rate attained last week. As was generally expected, the relief plan put into effect by Secretary Shaw on last Monday was followed by extremely heavy engagements of gold in the London and Paris markets, notwithstanding the fact that both the Bank of England and the Bank of France made further advances in their selling prices of the yellow metal, in order to check the outflow of gold to this side. Private discounts are higher at London, and it is expected in some quarters that further efforts will be made by the Bank of England to prevent imports of gold to this side on a large scale by advancing its discount rate later in the week. Up to the present time the amount of gold engaged is approximately $22,000,000. This does not include the $2,000,000 secured by a Boston institution, or the $2,000,000 engaged in the Australian market. Of this amount the Sub-Treasury has advanced to local institutions about $16,000,000, which was made immediately available for market purposes. Notwithstanding these heavy engagements of gold the foreign exchange market has ruled at a point which makes further engagements of gold for import permissible, providing the Bank of England does not make further efforts to keep its gold supply intact. The demand upon New York banks by interior institutions has continued heavy, and was reflected in the bank statement published on last Saturday. According to that document the clearing house banks lost nearly $16,500,000 in cash, and there is every indication of a continuance of the outward movement of money on a large scale for some time to come. Other features of the bank statement were a contraction in loans of nearly $12,000,000 and a decrease in deposits of $27,843,100. The reserve required was $6,960,775 less than in the preceding week, but the surplus reserve was entirely wiped out and a deficit of $6,577,925 created in its stead. The surplus in the corresponding week of last year was $4,831,350; in 1904, $38,438,250; in 1903, $15,372,200; in 1902, $715,075; in 1901, $7,110,550, and in 1900, $26,056,250. This deficit, however, has been more than restored by the advances made by the Sub-Treasury on gold engagements abroad. At the close of the week the market continued firm, with premiums demanded on all fixed periods, and indications point to a continued firm market in the near future.

The Stock Market

Although the price movement was feverish and irregular, and fluctuations were wide, the general trend of values on the Stock Exchange this week was toward a higher level. The really important development of the week was the action of Secretary Shaw in restoring the Treasury policy of advancing to national banks the amount of gold engaged for import. This was followed by the engagement of about $22,000,000 of the yellow metal, and it is the general belief that at least $25,000,000 gold will be imported in the near future. The advances by the Treasury save the importing banks the amount of interest on gold in transit from the other side, and is of great advantage and acts as an offset to any temporary firmness in sterling exchange. The monetary situation had become critical, and the rates for call loans reached a point which prohibited borrowing for speculative purposes. The Treasury announcement was followed by a sharp drop in the lending rate on call and lower rates on time. The net loss of cash by the New York banks for crop moving and other purposes amount to about $30,000,000 since the beginning of the outward movement, and if this amount of gold can be drawn from abroad, the banks will be in a position to extend more liberal accommodations to merchants and also to lend more freely for speculative purposes. If gold imports fall below expectation the Treasury is in a position to help out by deposit of public funds in national banks in the West and South, and thereby minimize the demand which otherwise would be made upon New York for funds.

The market has been stimulated by persistent rumors of deals and increased dividends. The most important of these has relation to the probability of control of the St. Paul by the Southern Pacific and the consequent abandonment of the proposed extension of the St. Paul to the Pacific Coast. The annual report of the Atchison showed surplus earnings of over 12 per cent for the common, and this stock advanced sharply, on the belief that at the October meeting the dividend on the common will be increased to a 6 per cent basis. The coal stocks were influenced by large earnings and by the action of the Pennsylvania in disposing of part of its investment holdings. An early announcement of the lease of the iron ore lands of the Great Northern to the Steel Corporation is expected, and the terms of the contract are said to be very favorable to the latter, while at the same time the deal will add largely to the income of the Great Northern. The trading in the steel shares has been chiefly in the common, the preferred having received little attention. The so-called Morgan stocks have been laggards in this bull market, but Erie came to the front during the week and made a good advance on heavy trading.

The stock market is likely to be governed by rumors or announcement of one or more of the long-discussed deals and by the developments in the money market. The Government crop report is bullish on stocks, and with large harvests and good prices for grain the prosperity of the country is assured. Politics have ceased to be a menace, and while a Congressional campaign is not to be regarded as a bull card, it will not this year have any adverse influence. Sentiment continues bullish, and the very unfavorable bank statement was not only ignored, but was followed by an extraordinary buying of stocks. The general situation favors a strong market, but there is a tendency to hold any reckless speculation in check.

Philadelphia

Trading in the local traction issues was extremely quiet during the week and prices generally yielded under light pressure. Philadelphia Rapid Transit, which was the most active feature of the group, opened at 29, and after a decline to 28 advanced to 29¼. About 3000 shares were traded in. Philadelphia Traction was exceptionally strong, several hundred shares selling at 100, the highest price recorded for some weeks past. At the close it sold at 98 ex. the dividend. Union Traction was under pressure, the price running off from 64¾ to 63½, on sales of about 600 shares. American Railways broke from 52¼ to 50⅞, on sales of odd lots, and recovered at the close to 51¼. Other sales included Frankfort & Southwark Passenger at 448, Philadelphia Company common at 49⅞ and 49½, Union Traction of Pittsburg preferred at 51, and United Companies of New Jersey at 258 and 254⅞.

Baltimore

The market for tractions at Baltimore has ruled unusually quiet and without material change in prices. United Railway 4s furnished the active feature, about $50,000 selling at 89½ and 89¼. The funding 5s brought 88½ and 88⅜, and the income trust certificates brought 69¾ and 69½. North Baltimore Railway 5s were exceptionally strong, $11,000 selling at 115 and 116. Norfolk Railway & Light 5s sold at 100, and Charleston Consolidated Electric 5s changed hands at 95 and 94¾.

Other Traction Securities

In the Chicago market the traction issues were practically neglected, but such transactions as were made were at slightly higher prices. Chicago Union Traction sold at 5¼, while the preferred advanced to 20⅛ on light purchases. West Chicago opened at 32½, and after declining to 31 recovered to 32. In the Boston market interest centered largely in Massachusetts Electric issues, the common stock advancing from 19¼ to 21, on the exchange of about 1500 shares, while the preferred rose from 70 to 73½, on the purchase of about 1700 shares. Boston Elevated opened weak at 150¼, but it subsequently rose to 153½, on purchases of odd lots, Boston & Worcester common sold at 34 and 33¾, and the preferred at 83 to 82 and back to 82½. West End common sold at 96½ and 97, and the preferred at 108½.

There was little activity in tractions in Cincinnati last week. Cincinnati, Newport & Covington preferred sold at 97¼ for several lots, and Cincinnati, Dayton & Toledo sold at 27¼ for several small lots. The 5 per cent bonds of this company were active at 93. Cincinnati Street Railway sold at 143.

Cleveland Electric advanced to 71 this week on indications that the company is gaining friends for its franchise renewal proposition. There were a few scattered sales on the certificates of the Forest City Railway Company, the new low-rate company at 94. Lake Shore Electric common showed considerable activity at 16. Cleveland & Southwestern common sold at 15¾ and the preferred at 60; there are strong indications that dividends on this stock will be started again early next year. A block of Detroit United sold at 94⅜. Northern Ohio Traction & Light sold at 28½. Washington, Baltimore & Annapolis securities have been quite active of late. Several lots of the underwriting were sold at 109¼, and several small lots of the stock sold at 13¼ and 14, par value $50. There was a rumor to the effect that the Sherwin-Bishop syndicate, which is promoting this road, had sold the bonds on the property at 90 to an Eastern syndicate. Geo. T. Bishop, one of the syndicate managers, says there is no truth in this. The bonds will probably not be sold until the road is completed.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Sept. 5	Sept. 12
American Railways	52	51¾
Boston Elevated	150¼	153½
Brooklyn Rapid Transit	78⅛	80¼
Chicago City	160	160
Chicago Union Traction (common)	5	4¾
Chicago Union Traction (preferred)	19¼	18
Cleveland Electric	—	71
Consolidated Traction of New Jersey	79	—
Detroit United	93¾	93
Interborough-Metropolitan, W. I.	37¾	38¼
Interborough-Metropolitan (preferred), W. I.	78½	77¾
International Traction (common)	—	54½
International Traction (preferred), 4s	—	76
Manhattan Railway	146	147
Massachusetts Electric Cos. (common)	19½	20
Massachusetts Electric Cos. (preferred)	70	72
Metropolitan Elevated, Chicago (common)	26	26
Metropolitan Elevated, Chicago (preferred)	66½	66½
Metropolitan Street	106	106
North American	91¾	91
North Jersey Street Railway	27	27
Philadelphia Company (common)	†49½	49½
Philadelphia Rapid Transit	28	29
Philadelphia Traction	99	*98
Public Service Corporation certificates	69	69
Public Service Corporation 5 per cent notes	94½	94½
South Side Elevated (Chicago)	96½	96
Third Avenue	125	124
Twin City, Minneapolis (common)	114½	113
Union Traction (Philadelphia)	64½	63
West End (common)	—	—
West End (preferred)	—	—

* Ex-dividend. † Ex-rights.

Metals

According to statistics collected by the "Iron Age," the production of pig iron by the steel companies declined during August to 1,237,485 gross tons, as compared with 1,323,391 tons in July, and the record of 1,400,395 tons in March. The number of active furnaces is increasing and relief is promised, but it can hardly be expected that it can come this month. Just how the situation lies with the foundry iron cannot be clearly indicated, statistically, because of the refusal of many makers to report on stocks on hands. The excitement in the foundry iron trade has subsided. The steel scarcity is acute. The next heavy purchasing movement seems destined to develop in steel cars. There is a heavy movement in wire and tubes. Foreign markets are strong.

Copper metal is strong and ⅛ to ¼c. higher at 18⅞ to 19⅛ for Lake, 18¾ to 19 for electrolytic and 18½ to 18¾ for castings.

DETROIT COMPANY OUTLINES ITS POLICY

An important session of the City Council was held in Detroit last week, at which the question of franchise extensions for the Detroit United Company was again considered. Perhaps the most important information elicited was that from Assistant General Manager Brooks, of the company, who said most positively that the company will not accept a franchise on the basis of eight tickets for 25 cents. He also said the company will not agree to any extension of the time of issuance of workingmen's tickets beyond the limits proposed in the Codd-Hutchins franchise. Mr. Brooks stated to the committee that the proposed rates of ten tickets and six tickets for a quarter in the new franchise would reduce the revenues of the company $700,000 a year, while a straight eight-for-a-quarter rate would reduce the revenues $400,000 more, and that it would be impossible for the company to operate and pay its interest and other charges under such a reduction of $1,100,000 in its yearly revenues.

W. R. KIMBALL GETS OPTION ON SYRACUSE & SOUTH BAY PROPERTY

An option upon all his claims against the Syracuse & South Bay Railroad has been given by William M. Brown to the W. R. Kimball interests. Mr. Brown, it is said, has named the amount which he will take for his $250,000 worth of notes of the Bay Road Construction Company, which are secured by $300,000 worth of bonds of the Syracuse & South Bay Railroad Company, and all other claims which he holds against the enterprise. Besides the $250,000 in notes Mr. Brown is a creditor for nearly as much more. It is learned that the intention is to form a new company and to make a compromise settlement with all the creditors of the enterprise, part to be paid in cash and part in stocks and bonds. This would include a payment to the creditors of W. B. Burns and W. K. Niver, which would probably prevent the bankruptcy proceedings against them from taking their course in the courts.

Creditors have already been approached with the plan, and it is said some of them have signed. What the terms of Mr. Brown's option are is not known. It is reported that New York capitalists are to finance the venture, paying Mr. Brown, the creditors of the road and the creditors of Mr. Niver and Mr. Burns a portion of their claims. This would mean that $500,000 would have to be raised. The creditors once before signed a reorganization plan with one or two exceptions, but it was blocked by the suit of Averill & Gregory against W. M. Brown, which was tried in the courts and recently decided in favor of Mr. Brown. Provided Mr. Kimball is successful the road will be finished this fall, so as to save the traffic agreement with the Syracuse Rapid Transit Company, which expires Jan. 1.

QUARTERLY MEETING OF THE NEW YORK STATE ASSOCIATION

The next quarterly meeting of the Street Railway Association of the State of New York will be held at the Fort Orange Club, Albany, N. Y., on Wednesday, Sept. 19. The conference will be devoted to mechanical subjects, and the session will be opened at 11:30 a. m. There will be reports by special committees on "Car Braking" and on the "Proper Height of Car Steps for Street and Interurban Cars." The committee on "Collection and Compilation of Mechanical Costs," which was continued from the Saratoga convention, will also make a report.

A portion of the afternoon session will be known as "A Trouble Meeting," and will be devoted to a discussion of mechanical troubles. At this session opportunity will be given to ask any questions or bring before the conference any special mechanical problems, and the best methods of remedying some of these troubles will be brought out.

This quarterly conference promises to be one of the most valuable ever held under the auspices of the association, and a large attendance of operating and mechanical men is expected. Anyone interested in electric railway mechanical topics, who is connected with an electric railway company, either in New York State or any of the neighboring States, is cordially invited to attend the meeting and take part in the discussions.

REVENGE BY RAILROAD AND EXPRESS COMPANIES ON TROLLEY PATRONS

In a remarkable petition filed with the Interstate Commerce Commission at Washington on Thursday, Sept. 6, by J. E. Walker, of Media, Pa., the Baltimore & Ohio Railroad and the United States Express Company are charged with punishing people who patronize a trolley line in competition with the railroad by a system of blacklisting. The complaint maintains that package express rates for sending goods out of Philadelphia to suburban towns were established in 1890 by the express company, and that he, with numerous other citizens, enjoyed the benefit of those rates on parcels from Philadelphia on defendants' lines. In 1902 an electric railway was built to the town of Hockessin, Del., 39 miles from Philadelphia, he avers, and presently it developed that the express company's agents would not accept packages for delivery to persons who were riding on the trolley cars. When a parcel was offered, the agent would consult a list he kept of the patrons of the trolley line. It is alleged that this was a blacklist and that in punishment for riding on the trolley cars the privilege was denied to the persons listed of sending their goods at the package rates.

ANNUAL REPORT OF THE BROOKLYN RAPID TRANSIT COMPANY

A short abstract of the report of the Brooklyn Rapid Transit Company. Report of the board of directors to the stockholders for year ending June 30, 1906, was published in the last issue of this paper. A fuller abstract follows:

The subjoined table shows a comparative statement of the results of the operations for years ending June 30, 1906-1905.

	1906.	1905.	Increase or Decrease.
Gross Earnings from Operation	$18,473,328.10	$16,333,444.59	+$2,139,883.51
Operating Expenses	10,441,377.37	9,803,870.32	+ 637,507.05
Net Earnings from Operation	$8,031,950.73	$6,529,574.27	+$1,502,376.46
Income from Other Sources	323,935.62	252,135.63	+ 71,799.99
Total Income	$8,355,886.35	$6,781,709.90	+$1,574,176.45
Less Taxes and Fixed Charges	5,612,934.23	5,178,491.55	+ 434,442.68
Net Income	$2,742,952.12	$1,603,218.35	+$1,139,733.77
Out of which was taken for Betterments and Additions to Property	580,342.87	453,284.87	+ 127,058.00
Surplus for the Year	$2,162,609.25	$1,149,933.48	+$1,012,675.77
Surplus for June 30, 1905-1904	984,723.20	1,594,189.72	— 609,466.52
Surplus June 30, 1906, and June 30, 1905	$3,147,332.45	$2,744,123.20	+ $403,209.25
Of this amount there has been appropriated:			
Old accounts written off	522.98	......	+ 522.98
In adjustment of Supply Accounts	......	12,600.00	— 12,600.00
For Discount on Bonds Sold	571,246.66	1,746,800.00	— 1,175,553.34
Contingent Reserve Fund	500,000.00	......	+ 500,000.00
Total Appropriations	$1,071,769.64	$1,759,400.00	— $687,630.36
Balance Surplus June 30, 1906, and June 30, 1905	$2,075,562.81	$984,723.20	+$1,090,839.61

The statement given below shows division of gross earnings for the last year:

		Increase.	Per Cent 1906 over 1905.	Per Cent 1906 over 1904.
Passenger:				
Surface	$11,531,125	+ $1,186,014	11.46	18.18
Elevated and Bridge	6,055,597	+ 751,308	14.16	29.62
Freight, Express, Mail, etc.	740,799	+ 180,266	32.16	283.92
Advertising	145,807	+ 22,296	18.05	9.91
Total	$18,473,328	+ $2,139,884	13.10	25.20

The total earnings from operation for the twelve months ending June 30, 1906, show an increase of $2,139,883.51 or 13.10 per cent over the previous fiscal year.

The percentage of operation to earnings is 56.52 per cent for 1906, as compared with 60.02 per cent for 1905.

The net earnings from operation for the twelve months ending June 30, 1906, show an increase of $1,502,376.46 or 23 per cent, as compared with the twelve months ending June 30, 1905.

SOME OF THE PROPERTY ADDITIONS AND IMPROVEMENTS

One hundred steel-framed fire-proofed convertible elevated motor cars, with center aisle and reversible seats, having a seating capacity for sixty passengers, have been received during the year and placed in operation. The work of rebuilding steam coaches for electrical operation has been completed, and the elevated passenger equipment now consists of 558 motor cars (320 of which are of a convertible type), and 269 closed trailer cars. The motor cars are equipped with two 150-hp motors, multiple-unit train control and automatic air brakes.

Two hundred and twenty-two convertible surface passenger cars have been received during the year, and 144 additional remain to be delivered. Six hundred and sixteen closed cars have been equipped with vestibules and 347 additional sets have been ordered. The company will have 1215 vestibuled cars in operation during the coming winter. Upwards of 1000 surface cars have been equipped with new fenders.

Two electric locomotives have been built in the company's repair shops. Four standard steel frame digger bar snow plows have been received, and ten box cars, twenty gondola cars and one snow sweeper are to be delivered during the present summer, available for use Sept. 1.

One turbo unit of 7500-kw capacity and one turbo unit of 5500-kw capacity have been put in operation at the Williamsburg power station. Three additional 7500-kw turbo units have been contracted for, one of which will be in operation by Nov. 1, 1906, and the other two before the summer of 1907.

Two new sub-stations have been put in operation, viz.: southern sub-station, 2000-kw capacity; Myrtle Avenue sub-station, 4000-kw capacity.

Four additional sub-station buildings are under construction and will be completed and put in operation during the ensuing year, viz.: New Utrecht sub-station, 2500-kw capacity; Canarsie sub-station, 1000-kw capacity; Hudson sub-station, 6000-kw capacity; Richmond Hill sub-station, 1500-kw capacity. Each building will be constructed of ample size to admit of additional installations.

Two additional sub-stations will be constructed during the next year, the land for which has been acquired and the apparatus contracted for, viz.: Corona sub-station, 1500-kw capacity; Lexington sub-station, 4000-kw capacity. The Coney Island and Parkville sub-stations have each been increased by 1000-kw capacity by the installation of additional convertors and static transformers.

Over 65 miles of duct have been laid in 8.5 miles of underground subway. Forty miles of high tension and 14 miles of low-tension feeder cables have been installed in subway conduits, and upward of 50 miles of overhead feeders have been installed.

The reinforcement of the elevated structure is progressing satisfactorily. The work of cleaning and repainting 50,000 ft. of structure contracted for last year has been completed and work is under way on 60,000 ft. additional. Two and four-tenths miles of single track have been relaid with standard 80-lb. rail.

Platforms have been lengthened on the Prospect Park and Coney Island and West End divisions for six-car elevated train operation and new platforms have been constructed on the Sea Beach division to provide for local elevated service. Four thousand lineal ft. of elevated platform extensions have been constructed during the year to accommodate six-car trains, and similar work is now under way at stations on the Myrtle Avenue division.

The new elevated yard at East New York with capacity for 327 cars and the elevated repair shop, inspection sheds, etc., are completed. The surface storage yard adjoining the elevated yard is also completed and has a capacity for 287 cars. These yards are divided into sections by fire walls built under specifications approved by the New York Fire Insurance Exchange, the surface yard having two storage compartments, and the elevated three compartments, exclusive of shop and inspection tracks.

Repair shop, inspection sheds and storerooms have been erected on the company's property east of Fifth Avenue between Thirty-Sixth and Thirty-Seventh Streets and the serviceable machinery and tools are being transferred from the old shop to the new shop. The old building will be removed to provide additional car-storage space in the elevated yard.

The new repair shops for elevated cars at East New York were put into service in January, and those at Thirty-Sixth Street and Fifth Avenue are nearly ready for operation. Attached to these plants are commodious inspection sheds, oil and waste houses, store rooms and all appurtenances necessary to first-class plants of this character. The ultimate capacity of these shops will be sufficient for the requirements of the company for many years.

The Thirty-Ninth Street repair shop at Thirty-Ninth Street and Third Avenue has been converted into a paint shop for both elevated and surface cars and a storage house constructed on Third Avenue adjacent to the repair shop for the storage of paints, oils, etc.

A new car house and storage yard of large capacity have been completed on Tenth Avenue between Nineteenth and Twentieth Streets and a two-story depot is under construction on the westerly half of the block, fronting Ninth Avenue. Plans are being prepared for a new surface depot and storage yards to replace the present Maspeth depot. This improvement will be completed during the coming year. An emergency crew station has been built on Fourth Avenue near Thirty-Eighth Street.

A new ash-receiving station has been erected at Bushwick Avenue and Gillen Place, East New York; also an incinerator plant for the burning of refuse, equipped with boilers, the steam being utilized for heating the adjacent buildings and furnishing power for the operation of compressors and steam hammers in the repair shops at this location. Baling presses have been installed at nine ash-receiving stations, to permit of the economical transportation of refuse to the incinerator plants. Steam pipes have been installed for the utilization of steam from the Third Avenue incinerator for heating feed-water in the adjoining power stations.

Extensive improvements, consisting of pits, cranes, hoists, new tracks, renovation of buildings and installation of fire lines and hydrants are under way at the East New York and Ridgewood depots. Fifteen thousand six hundred and ninety-six joints, or 75 miles of single track, have been electrically welded and tracks thoroughly repaired. A new electro-pneumatic interlocking plant has been erected near the junction of Broadway and Jamaica Avenue and an all-electric interlocking plant has been installed at Thirty-Sixth Street and Fifth Avenue.

The peculiar track geography of Brooklyn makes the transfer question more than ordinarily difficult to deal with. The fact, for example, that one may start from the Manhattan end of the New York and Brooklyn Bridge, and by the use of transfers work his way over some 30 miles of lines, and end up at the place of beginning, for one fare, is not without practical demonstration. The tendency to abuse the transfer privilege by manipulation, trading through agencies and the practice of other illegitimate methods by a class of operators, to whom the opportunity is sufficient excuse, increases with its extension, and to same unknown but very considerable degree unduly burdens the company and discomforts the paying passenger. The serious aspect of this feature of the street car traffic can be appreciated only by those having the problem to deal with; but the following may be of interest as showing its growth during the last two years in Brooklyn. In March of this year, the transfer privilege was materially extended. In May following, the points of transfer were increased in number and restrictions still further removed. In June month there were issued 12,700,000 transfers, against 7,300,000 in June, 1905, an increase of 75 per cent. For the year ending June 30, 1904, the number of transfers collected was 56,804,382 or 19.40 per cent of all cash collections. In the year next following the number was 70,080.877 or 22.24 per cent. In the year ending June 30, 1906, there were collected 96,455,314 transfers or 27.26 per cent of the whole number of cash fares handled, and an increase of nearly 40,000,000 or 69 per cent over 1904.

CANARSIE RAILROAD COMPANY

The Transit Development Company, one of your constituent companies, has acquired during the year the entire capital stock of the Canarsie Railroad Company, a new company organized to take over property and franchises of the former Brooklyn and Rockaway Beach Railroad Company, consisting of about 3½ miles of steam railroad tracks and right of way from East New York to Jamaica Bay at Canarsie. The Long Island Railroad Company has agreed to pay an amount equal to one-half the cost of the acquisition of this property, and to join with the Canarsie company in the reconstruction of the roadbed where the railroads of the companies are parallel, in consideration of acquiring under long lease certain portions of the railroad which are not required by the Canarsie company. The railroad thus made a part of the system has since acquisition been rebuilt and equipped as an electric railroad, and, by means of a new elevated structure from Pitkin Avenue to New Lots Road, has been connected with the structure and tracks of the Brooklyn Union Elevated Railroad Company—thereby making a continuous route from Park Row, Manhattan, and Broadway ferries to Canarsie.

COMPARATIVE SUMMARY OF OPERATIONS FOR YEAR ENDING JUNE 30, 1906

	1906.	1905.	Increase + or Decrease —.	Per Cent
Gross Earnings.				
Passenger	$17,586,721.57	$15,649,400.80	+ $1,937,320.77	12.38
Freight, Mail and Express	309,554.67	219,640.90	+ 89,913.77	40.94
Advertising	145,807.50	123,510.81	+ 22,296.69	18.05
American Railway Traffic Co.	431,244.36	340,892.08	+ 90,352.28	26.50
Total Earnings from Operation	$18,473,328.10	$16,333,444.59	+ $2,139,883.51	13.10
Operating Expenses.				
Maintenance of Way and Structure	815,147.34	816,275.50	— 1,128.16	.14
Maintenance of Equipment	1,642,799.00	1,655,622.62	— 12,823.62	.77
Operation of Power Plant	1,609,534.19	1,421,386.64	+ 188,147.55	13.24
Operation of Cars— Trainmen's Wages	3,036,966.45	2,768,860.41	+ 268,106.04	9.68
Operation of Cars—Other Expenses	1,214,370.83	1,148,942.33	+ 65,428.50	5.69
Damages and Legal Expenses	973,103.94	999,526.88	— 26.422.94	2.64
General Expenses	603,288.52	552,068.38	+ 51.220.14	9.28
Freight, Mail and Express—Expenses	203,961.90	139,515.04	+ 64,446.86	46.19
American Railway Traffic Co.—Expenses	342,205.20	301,672.52	+ 40,532.68	13.44
Total Operating Expenses	$10,441,377.37	$9,803,870.32	+ $637,507.05	6.50
Net Earnings from Operation	$8,031,950.73	$6,529,574.27	+ $1,502,376.46	23.01
Income F om Other Sources.				
Rent of Land and Buildings	59,656.41	59,741.28	— 84.87	.14
Rent of Tracks and Structure	97,302.93	101,504.27	— 4,201.34	4.14
Miscellaneous	166,976.28	90,890.08	+ 76,086.20	83.71
Total Income	$8,355,886.35	$6,781,709.90	+ $1,574,176.45	23.21
Deductions.				
Taxes	882,862.02	827,951.14	+ 54,910.88	6.63
Interest and Rentals—Net	4,730,072.21	4,350,540.41	+ 379,531.80	8.72
Total Deductions	$5,612,934.23	$5,178,491.55	+ $434,442.68	8.39
Net Income	$2,742,952.12	$1,603,218.35	+ $1,139,733.77	71.09
Special Appropriations	580,342.87	453,284.87	+ 127,058.00	28:03
Surplus	$2,162,609.25	$1,149,933.48	+ $1,012,675.77	88.06

CONSOLIDATED GENERAL BALANCE SHEET, JUNE 30, 1906

ASSETS.

Cost of Road and Equipment		$108,733,546.62
Properties owned in whole or in part by B. R. T. Co.		
Advances Account of Construction for Leased Companies		7,939,167.58
Brooklyn City Railroad	$7,221,478.84	
Prospect Park & C. I. R. R. Co.	717,688.74	
Construction Expenditures, Constituent Companies		4,506,274.84
To be reimbursed by issuance of B. R. T. 1st Refunding Gold Mortgage 4% Bonds, upon deposit with Central Trust Co., Trustee, of Certificates of indebtedness to cover.		
Guaranty Fund (Securities and Cash)		4,005,755.00
Underlying Bonds Deposited with Central Trust Co., Trustee		100,000.00
Treasury Bonds		1,075,500.00
B. R. T. 1st Ref. Gold Mortgage 4%	$943,000.00	
Other Issues	132,500.00	
Treasury Stock		146,228.00
Current Assets		3,665,299.11
Cash on hand	$2,001.558.65	
Due from Companies and Individuals	589,347.89	
Construction Material and General Supplies on hand	963,082.52	
Real Estate Mortgages	6,500.00	
Prepaid Accounts	104,810.05	
Bonds and Cash in Escrow covering Contractors' Deposits		42,120.00
		$130,213,891.15

NOTE.—The Certificates of Indebtedness issued by Constituent Companies aggregating $19,358,615.05 *against which B. R. T. Bonds have been issued*. do not appear separately on this Consolidated Balance Sheet, as the property purchased appears as an asset under the head of "Cost of Road and Equipment," and "Advances Account Construction for Leased Companies," and the liability is represented by the Bonds of the Brooklyn Rapid Transit Company, issued from time to time as such Certificates of Indebtedness are acquired and deposited with the Central Trust Co., Trustee.

LIABILITIES.

Capital Stock		$45,929,758.83
Brooklyn Rapid Transit Co	$45,000,000.00	
Outstanding Capital Stock of Constituent Companies	929,758.83	
Bonded Debt and Real Estate Mortgages		78,690,680.00
Brooklyn Rapid Transit Co	32,835,000.00	
Bonded Debt of Constituent Companies:		
Brooklyn Heights R. R. Co	250,000.00	
The Nassau Electric R. R. Co	15,000,040.00	
Brooklyn, Q. Co. & S. R. R. Co	6,624,000.00	
Sea Beach Railway Co	650,000.00	
Brooklyn Union Elevated R. R. Co	23,000,000.00	
Real Estate Mortgages	331,640.00	
Current Liabilities		2,819,694.09
Audited Vouchers	$1,241,317.59	
Due Companies and Individuals	117,590.49	
Taxes Accrued and not Due	818,502.93	
Interest and Rentals Accrued and not Due	642,283.08	
Contractors Deposits		42,120.00
Long Island Traction Co. Trust Fund		9,344.19
Accounts to be Adjusted		24,045.59
Insurance Reserve Fund		51,428.27
Depreciation Reserve Fund		71,257.37
Contingent Reserve Fund		500,000.00
Surplus		2,075,562.81
		$130,213,891.15

CHANGES PROPOSED FOR DUDLEY STREET TERMINAL, BOSTON

To prevent passengers from clashing while hurrying to and from cars at the Dudley Street terminal, Boston, and also to lessen the chances of confusion which might result seriously during the busy hours, the Boston Elevated Railroad officials have presented a set of plans to the Railroad Commissioners to meet the new conditions arising with the advent of the eight-car trains, the opening of the Washington Street tunnel, and the extension of the elevated system to Forest Hills. These plans, if approved by the Railroad Commissioners, will make the Dudley terminal the "hub" of the system.

As it is now, there is much confusion among the passengers, and in a few instances fatalities have resulted. In order to obviate this condition and separate the elevated patrons from the surface car patrons, it is proposed to construct a platform nearly 400 ft. in length on the outer side of the loop on the Washington Street side of the station. By means of a new overhead bridge on either side, passengers can walk to the surface car platform and alight without coming in contact with those leaving the same car. Also at the Washington Street platform passengers can change for the south-bound trains. Across the loop, and on the opposite side of the present platform used for surface cars, an additional platform will be erected, so that persons leaving shall not meet those who are entering the cars. The idea is that these extra platforms will leave no chance for rushing. The old platforms for the surface and elevated patrons will be used as heretofore, while the proposed platforms will be used for loading exclusively. On the outer side of the Warren Street loop, another new platform will be built for loading surface car passengers. Cars will run between this platform and the old one, thus eliminating the meeting of passengers going in opposite directions. The new platforms will be connected by an overhead bridge, so that persons leaving the elevated trains at the Washington Street platform can walk along the bridge and then descend a few steps to the surface cars without meeting anybody coming from the other direction. Underneath will be a subway so that passengers can go to either end of the station without difficulty. The present trackage on the gradients will require a slight change to coincide with the proposed conditions.

When the Forest Hills extension is completed, the elevated trains instead of regularly swinging around the loop so as to make a return trip north will take the opposite direction to go to Forest Hills. This end of the system is expected to be completed early next year.

THE SAN FRANCISCO TRUCE—PUBLIC SYMPATHY WITH COMPANY

It is proposed that the action of the motormen and conductors of the United Railway of San Francisco in returning to work, as noted in the Street Railway Journal for Sept. 8, will include not only the arbitration of differences between the carmen and the company, but also those of the linemen, electricians, firemen and construction workers now on strike.

The action of the carmen was practically forced by their national organization, and is a complete backdown from the position taken at a mass meeting several days ago. It was persistently rumored during the day that President W. D. Mahon, of the Amalgamated Association of Street Employees of America, with which the union is affiliated, had ordered the men back to work under threats of revoking their charter. This was denied by the leaders, who, however, admitted that they had received a telegram from Mahon, the contents of which they refused to give out, but which caused them to call the mass meeting.

Before the carmen struck, it is said that Mahon wired his disapproval of their contemplated action, stating the first principles of the national organization is arbitration by which, according to the contract between the carmen and the company, all disputes were to be settled. The resolution adopted by the union after several hours of heated discussion provides for an arbitration board of three members, one chosen by the carmen, one by the United Railroads, and these two to select the third.

The ending of the strike is a victory for President Calhoun, who has taken the stand from the first that he would not treat with the carmen or arbitrate until they returned to work.

ADVERSE REPORT ON T-RAIL AT HARTFORD

The special committee to which the Common Council of Hartford referred the petition of President Mellen, of the Consolidated Railway Company, for a franchise to occupy several streets with a double-track electric railway and T-rail in connection with the proposed fast interurban service between Hartford, New Britain and Waterbury, has adopted a report which in effect denies the application. Although the committee is unfavorable to the particular plan submitted by President Mellen, the report practically invites him to submit some other project. The report is not intended to be hostile to President Mellen's general scheme for combining trolley and steam systems in a rapid interurban electric service, but the streets and type of rail specified in the petition do not command the support of the municipal authorities.

The city authorities of Meriden have granted the petition of the Consolidated Railway Company to occupy several streets in connection with the proposed trolley between Meriden and Middletown. The action insures early commencement of structural operations. For a large part of the distance the steam tracks of the Waterbury, Meriden & Middletown branch, which will be equipped with an overhead trolley, will be used.

COMING MEETING OF CENTRAL ELECTRIC RAILWAY ASSOCIATION

Secretary Merrill, of the Central Electric Railway Association, has announced the program of the meeting to be held at Robinson Park, Ft. Wayne, Ind., Sept. 27. This being the first meeting after the summer vacation, the executive committee deemed it advisable that the meeting should assume a form of an outing, and for that reason Robinson Park, a beautiful resort on the line of the Ft. Wayne & Wabash Valley Traction Company, was selected. The meeting will be open for ladies, and the members are urged to bring members of their families with them. The management of the park has reserved the resort for the exclusive use of members and friends of the association, and has extended the courtesy of the free use of all the park attractions, and a special excursion by steamer has been arranged for the ladies. The program for the meeting is as follows: 11:00 a. m., business meeting; 11:15 a. m., "Lightning Arresters," paper by C. R. McKay; general discussion; 1:00 p. m., dinner; 2:30 p. m., vaudeville at the theater; 3:30 p. m., ball game, "Housers" vs. "Buckeyes;" 5:00 p. m., inspection of the power house of the Ft. Wayne & Wabash Valley Traction Company.

Secretary Merrill has made elaborate plans for the ball game, and he will be disappointed if they are not carried out. The members of the team will represent the prowess in athletic sports of the traction men of two States. Hugh J. McGowan, representative of the Widener-Elkins syndicate, Indiana, will be captain and manager of the Indiana team, and W. Kelsey Schoepf, representative in Ohio of the same syndicate, will hold a similar position for the Ohio team. Mr. McGowan has selected his team as follows: E. B. Peck, vice-president of the Indiana merger lines, pitcher; John W. Merrill, secretary, Central Railway Association, shortstop; A. W. Brady, president of the Indiana Union Traction Company, first base; Charles L. Henry, president of the Indianapolis & Cincinnati Traction Company, third base; William G. Irwin, president of the Indianapolis, Columbus & Southern, right field; C. D. Emmons, general manager of the Ft. Wayne & Wabash Valley, center field; C. C. Reynolds, general manager of the Indiana merger lines, left field; F. J. Wheeler, general passenger agent, Indiana merger lines, second base. The personnel of Captain Schoepf's "Buckeye" team is as follows: D. G. Edwards, vice-president, Indiana, Columbus & Eastern, first base; W. H. MacAllister, controller of the Cincinnati Northern, second base; E. C. Spring, president of the Central Electrical Railway Association, third base; J. L. Adams, general manager of the Indiana, Columbus & Eastern, second base; C. F. Smith, general manager of the Toledo Urban & Interurban, right field; C. M. Wilcoxson, general manager of the Cleveland & Southwestern, left field; F. D. Carpenter, general manager of the Western Ohio, shortstop. The substitutes on the Indiana team will be Frank D. Norviel, assistant general passenger agent of the Indiana merger lines, and H. A. Nichol, general manager of the Indiana Union Traction Company, and for the Ohio team they will be E. E. Darrow, general manager of the Toledo & Indiana, and J. R. Harrigan, general manager of the Canton-Akron. George S. Davis, of the Street Railway Journal, will be umpire.

CLEVELAND TRACTION SITUATION

Mayor Johnson, of Cleveland, last week announced that he would be glad to see the proposition of the Cleveland Electric Railway referred to the vote of the people providing it was presented and explained in detail. He also insisted that the Cleveland Electric put up a bond to abide by the decision of the vote in case the Forest City Company secured the majority.

The Mayor has again broached the subject of the leasing of the property of the Cleveland Electric Railway to a holding company representing the city. It will be remembered that about a year ago the Mayor made a similar proposition offering to lease the company's property on a basis of $85 for the stock. Last week the officials of the Cleveland Electric replied to this proposition and agreed to lease the property on a basis of par or $100 per share for the stock with a guaranteed dividend of 4½ per cent; at present the road is paying 5 per cent dividends on this basis. Mr. Andrews intimated that his company not long ago received a proposition from the Everett-Moore syndicate to lease the property on a 5 per cent basis of par with a $3,000,000 guarantee. The Cleveland Electric's proposition is of course contingent on the granting of a franchise extension to the company. Mayor Johnson intimated that the proposition was altogether too high, and said that the city would make a counter proposition in a few days. His latest scheme is to lease both the Cleveland Electric and the Forest City Company to a holding company which shall give the city the benefit of any profits and turn the property over to the city at such time as the Legislature gives the city the right to operate street railways.

Frank DeHass Robinson, representing the Cleveland Traction Company, is endeavoring to secure consents, and claims it will make bids on several routes now sought for by the Forest City Company. It offers a 3-cent cash fare with universal transfers, with ten tickets for a quarter from 5 to 8 a. m. and 4:30 to 6:30 p. m., and to pay the city 2 per cent of its earnings the first five years, 3 per cent the second five years, and 5 per cent for the remaining five years. The property to become eligible for purchase by the city at the expiration of the grant.

THE POTTSVILLE COMPANY PLANS IMPROVEMENTS

The Eastern Pennsylvania Railways Company, Pottsville, Pa., which has in contemplation the making of extensions and improvement to aggregate, it is said, $1,000,000, has decided upon some of the new work to be carried out. For one thing, it is planned to build the extension from Pottsville and Shenandoah, and from Middleport to Tamaqua. The construction of this new line will be pushed vigorously so that a through line can be established between Pottsville and Mauch Chunk at an early date. With the completion of the Pottsville-Shenandoah section, practically all of the electric railways in Schuylkill County will be linked together forming a connected system of more than 100 miles of track under two managements as at present. This system is divided into two principal groups of railways. Pottsville and Mauch Chunk are terminals of the southern portion, while Mahanoy City and Shamokin are terminals of the northern portion. Between Mauch Chunk and Shamokin the extreme eastern terminus and the extreme western terminus will be a distance of 75 miles as surveyed. The system belonging to the Eastern Pennsylvania Railways Company will be rearranged as regards the supply and distribution of power for railway and lighting purposes. In the district where there are now half a dozen old power plants, there will probably be substituted two new modern plants.

THE RHODE ISLAND COMPANY'S TUNNEL PROPOSITION

The written proposition of President Marsden J. Perry, of the Rhode Island Company, for a tunnel in Providence is in the hands of Chairman Cooke, of the East Side committee. The city's credit is to be used through the issuing of bonds to a sufficient amount to pay for the work as it progresses. The Rhode Island Company is to pay the interest and principal of those bonds, and on the retirement of the last of these obligations is to take absolute fee and title. President Perry's proposition is that the tunnel shall be built under the joint engineering direction of City Engineer Clapp and Fred N. Bushnell, the constructing engineer of the Rhode Island Company. Mr. Perry proposes that Waterman Street shall be extended to Canal Street by the removal of the Arnold block and the business block in the rear, facing on Canal Street, and that the tunnel shall follow the line of Waterman Street as far as Benefit Street, thence under Fones Alley to a point on Thayer Street.

TEST OVER ATLANTIC CITY LINE

Last Tuesday a test was made by officials of the General Electric Company and the West Jersey & Sea Shore Railroad of the line between Camden, N. J., and Atlantic City, which is now being equipped with electricity and will be formally placed in operation Sept. 18. This was the first trip over the entire line, previous tests being confined to that part of the road between Newfield and Atlantic City. Details of the equipment of the line so far as they have been made public were given in the STREET RAILWAY JOURNAL for Dec. 23, 1905, and March 17, 1906.

CHICAGO MATTERS

The Chicago Street Railway Company, with capital stock of $5,000, was granted a charter by the Secretary of State at Springfield last week. Its avowed purpose, according to its promoters, is to bid in the property of the North and West Chicago street railway lines should they be offered for sale by court decree at the end of the receiverships. Attorney Jacob Newman, who said he represented bondholders in companies underlying Union Traction, with aggregate claims of nearly $1,000,000, caused the corporation to be formed.

W. W. Gurley, general counsel for the Union Company, has announced that the traction companies will reopen negotiations with the city, Sept. 15, when the valuations of the several properties again will be gone over.

Arguments on the validity of the Mueller law certificates have been resumed before Judge Windes, Attorney Samuel Adams appearing as special counsel for the city, and Frank H. Scott appearing for the complainants.

SOUTHERN PACIFIC AND ELECTRICITY

The question of using electric power for operating trains on the Southern Pacific Railroad over the Sierra Nevada Mountain division has been broached again, and rumor has it that Westinghouse interests are making a thorough investigation of the problem. The Southern Pacific is planning the construction of some tunnels on its mountain division so as to eliminate the heavy grades, but whether the matter of electric traction is under serious consideration is problematical. The report is spread periodically that electric traction is to be used by the Southern Pacific, but there is no outward evidence of such work.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED SEPT. 4, 1906

829,945. Railway Track Structure; William M. Brown, Johnstown, Pa. App. filed Jan. 4, 1906. A means for removably securing the center of an inter-section plate in position on the supporting bed or block. Has circular wedges which are driven into position to hold the parts together.

829,968. Railway Signal and Safety Appliance; Charles J. Kintner, New York, N. Y. App. filed June 6, 1904. The roadway is provided with special contact plates adjacent to the track rails which are engaged by the wheel flanges to operate the signal circuits. An additional feature relates to a train stop arm, which projects horizontally above the roof of the car, so as to be engaged by a semaphore signal set at danger position.

829,969. Safety Appliance for Railways; Charles J. Kintner, New York, N. Y. App. filed Jan. 27, 1905. Relates to additional features of the above and particularly the operating mechanism for the semaphore signals. The signals are motor actuated and have circuits to cut out the motors after a predetermined rotation.

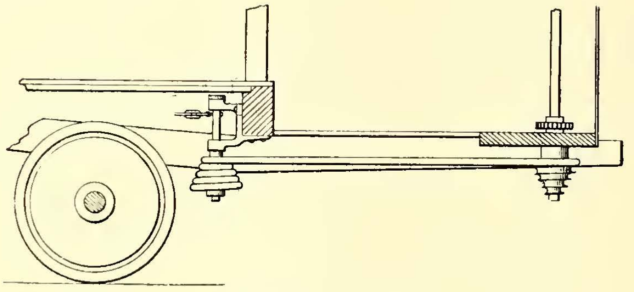
830,020. Railway Rail Joint; Solomon J. Stever, Fairfield, Ia. App. filed Sept. 18, 1905. A suspended joint for railway rails designed to support the same when a joint comes between two ties. The fish-plates have underhanging flanges which extend beneath the base of the rail and are bolted together at such point.

830,119. Control of Apparatus Governing the Passage of Cars or Vehicles Along a Railway; Herbert A. Wallace, New York, N. Y. App. filed June 13, 1906. Relates to signal installations of that class having insulated track sections charged with a direct current and connected to operate danger and caution signals. Patent specially relates to a train stop and the operation thereof.

830,131. Electric Railway System; William M. Brown, Johnstown, Pa. App. filed April 27, 1905. Railway of that class having sectionally energized rail charged during the passage of a train by switches in the roadbed. Patentee has a magnet on the train which attracts the switches successively into circuit-closing relation, the magnetic circuit being completed through the collector shoe and third rail.

830,154. Car Brake; Peter M. Kling, Elizabeth, N. J. App. filed Aug. 21, 1905. Provides an adjustable fixture or part which is applicable to cars having depressed platforms. The purpose is to accommodate the brake chains beneath the platform in spite of the amount of their depression.

830,155. Car Brake; Peter M. Kling, Allegheny, Pa. App. filed Sept. 30, 1905. A device for taking up objectionable slack in a brake chain. The chain has a traveling support and a slanting guide for said support.

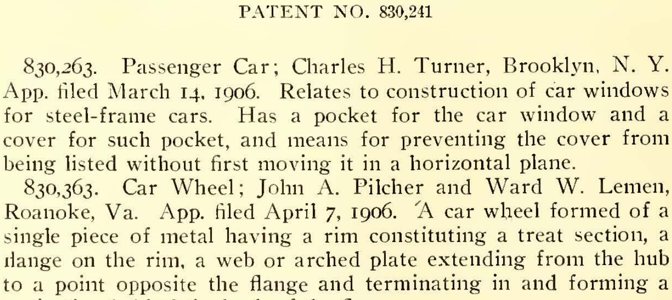


PATENT NO. 830,145

820,212. Car Protector and Rail Cleaner; Niels P. Danielsen, Council Bluffs, Ia. App. filed Dec. 2, 1905. A rotary brush in front of the car has a chain connection with the wheel axles through an intermediate gear whereby the direction of the brush is reversed.

830,241. Wheel Flange and Rail Lubricator; Andrew C. Love, Sacramento, Cal. App. filed Jan. 2, 1906. A source of lubricant is provided on the car, and electrically-operated valve connections with said source of supply are effective to deliver the lubricant to the track rail when desired.

830,247. Selective Signal System for Railways; Frank R. McBerty, Evanston, Ill. App. filed July 14, 1905. A complete signal installation for railways having means whereby the danger and caution signals are automatically set in operation, and by which a test circuit may be operated from two points of control, one operated in closing the semaphore, and the other by movement of a selector arm.



PATENT NO. 830,241

830,263. Passenger Car; Charles H. Turner, Brooklyn, N. Y. App. filed March 14, 1906. Relates to construction of car windows for steel-frame cars. Has a pocket for the car window and a cover for such pocket, and means for preventing the cover from being listed without first moving it in a horizontal plane.

830,363. Car Wheel; John A. Pilcher and Ward W. Lemen, Roanoke, Va. App. filed April 7, 1906. A car wheel formed of a single piece of metal having a rim constituting a treat section, a flange on the rim, a web or arched plate extending from the hub to a point opposite the flange and terminating in and forming a projection behind the back of the flange.

830,367. Automatic Switch Throwing Device; Clinton J. G. Rickerson, Colorado Springs, Col. App. filed May 22, 1906. A device for causing alternate movements of the switch point by repeated actuation of the operating part in one direction. The operating part has V-shaped cam grooves and a pivoted tongue which automatically controls the groove which shall be operative.

830,409. Trolley; Herschel L. Bryant, Tonkawa, O. T. App. filed Oct. 31, 1905. A pair of upwardly movable plates are hinged to the trolley harp and have link connections with the bearings of the trolley wheel whereby they are thrown upward whenever the wheel tends to leave the wire.

830,410. Car Seat; Edward G. Budd and Charles A. Conde, Philadelphia, Pa. App. filed May 19, 1905. A car seat of the "walk-over" type having arms depending from the back and a pair of levers pivoted at one end to one of said arms and at the other end to the frame. A form of pin gearing is used to insure simultaneous movement of the arms.

PERSONAL MENTION

MR. EDWARD C. BOYNTON has been appointed general manager of the Orange County Traction Company, of Newburg, N. Y. This line has been purchased by a Newburg syndicate headed by Ex-Governor Odell.

MR. ARTHUR REYNOLDS, of Fairfield, for a number of years superintendent of the Lewiston, Brunswick & Bath Street Railway, has been appointed superintendent of the Portland & Brunswick Street Railway Company.

MR. WARREN L. BOYER has been appointed superintendent of the New York Car & Truck Company, of Kingston, N. Y. This company has taken over the Peckham Works at Kingston and is now manufacturing and shipping Peckham trucks.

MR. EDWIN A. STURGIS, superintendent of motive power and machinery for the Worcester Consolidated Street Railway for two years, has been appointed superintendent of equipment for the Massachusetts Electric Companies, taking his new position Sept. 10. The vacancy at Worcester caused by Mr. Sturgis' resignation will be filled by the promotion of Mr. George W. Dunlap from the position of chief engineer of the Tremont Street power station.

MR. NORMAN McD. CRAWFORD, formerly general manager of the Hartford Street Railway Company, of Hartford, Conn., and a resident of that city for fifteen years, has accepted the office of vice-president of the Indiana, Columbus & Eastern Traction Company, the Lima & Toledo Traction Company and the Cincinnati Northern Traction Company. Mr. Crawford has a wide reputation as an electrical engineer. He has only recently returned from England, where he spent six months investigating electric street railways for the National Civic Federation. In Hartford his services in building up the local company are well known. As a contractor there in 1901 he put in the first section of the Glastonbury line and was retained as engineer. In 1894 he was made general manager of the company, and remained in that position until the Consolidated Railway Company, acting for the New York, New Haven & Hartford Railroad, took control last year.

MR. FRANCIS E. DRAKE, who has just been appointed general manager of the Societe Anonyme Westinghouse of Paris and Le Havre, has had an interesting career. Besides his earlier experience in the services of the Flint & Pere Marquette Railway, as telegraph operator, he had been five years sales manager of the Standard Electric Company, of Chicago, and nearly two years manager of the Walker Electric Company, Cleveland, when the United States Government appointed him director of machinery and electricity at the Paris Exposition (1900), for the purpose of organizing what was threatening shortly to become an embarrassing situation for United States exhibitors. When Mr. Drake arrived on the scene he found that, with careful pruning, and making a liberal allowance for withdrawals, the bona fide intending exhibitors required more than three times the space at his disposal. Few who remember the American electrical and machinery section of that year and its unique annex, housed apart in a beautiful building at Vincennes, are aware that Mr. Drake was responsible not only for the idea of a separate building, but also for its complete design, construction and lay-out. The idea was an immense success and gave great satisfaction to the American Government as well as to exhibitors, and resulted in his being decorated by the French Government. In 1901 Mr. Drake was appointed to reorganize the works of the Union Electricitäts Gesellschaft of Berlin, which he carried through and finished in 1903. The following two years found him again in America as president of the Lanyon Zinc Company, one of the largest zinc firms in the world. In April, 1905, Mr. Drake returned to Europe to organize the continental business of the Chicago Pneumatic Tool Company, and founded in Berlin the Internationale Pressluft und Elektricitäts Gesellschaft, m. b. H., of which concern he is general director. Mr. Drake is also a director of the Consolidated Pneumatic Tool Company, Ltd., of London, and a member of the Engineers' Club and the Lawyers' Club, of New York.