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Who Should Run the Road?

We submit for the edification and enlightenment of our readers this week an unique document which was prepared by the Amalgamated Association of Street Railway Employees of America, entitled a "Standard Form of Contract," between that organization and operating companies. The authenticity of this document cannot be questioned, as many street railway managers can testify, yet its contents are of such a startling character that at first glance it is hard to realize that their adoption could be seriously urged upon any employer. They are interesting at this time especially as an example of the unreasonable demands made on the part of labor unions, and an illustration of what the management of street railway companies have to contend with. No further explanation should be required by any fair-minded man after a perusal of these terms for the attitude of railway corporations in opposing "recognition of the union," which, in the case of a street railway company, would mean that the operation and management of the property would really be turned over to an irresponsible organization beholden to no one.

We believe that this document is without a parallel. Purporting to be a contract, yet in the entire seventeen sections into which it is divided the association assumes no responsibility, offers no consideration whatever in return for the concessions it would require of the company, and does not guarantee even that it will abide by the terms of the agreement in case they are accepted by the company, nor does it volunteer to hold the men to the proper performance of their duties. This is altogether too one-sided to be accepted by any business man, yet rejection of the terms here outlined have been followed in many instances by strikes, heavy financial loss to the operating companies, great inconvenience to the public and interruption to business, as well as the usual scenes of disorder, violence, intimidation and destruction of property which generally accompany acute labor troubles, and for which the union always disclaims responsibility.

A very bad feature of this plan is that it tends to destroy discipline among the employees and does not propose any method of maintaining order and providing suitable service. One of the very first provisions is that in case of the management rejecting the demands of the union, authority is given the officers of the association "to order the case to arbitration at once," thus inviting interminable controversy and practically refusing the employer any voice whatever in the direction of the property. The union does not even propose to recognize the right of the employer to discharge an employee without its sanction and consent, as it requires that a copy of the charges specified in writing shall be "furnished the secretary of the association within five days after the alleged offense is committed," at the same time it attempts to use the management in enforcing and increasing union control over the men. For instance, all motormen and conductors "must be turned in for initiation within sixty days after they are hired," and men in training must take out a "permit card from the association, paying the association the compensation of $1 for same." Again, when a member has been suspended from the union the company, upon receiving notice from the organization, "shall suspend said employee at once without pay until such time as the association shall request his reinstatement." In a word, the companies, whenever possible, are to be forced to build up an organization that is antagonistic to the interests of employers, arbitrary in its rule, and yet without any responsibility to the company or the community.

Pit Work in Car Shops

There has always been some controversy and variation in practice regarding pit work in car shops. There are those who believe that the less pit work the better for the quality of the work done, while others have arranged for the handling of motors and car wheels and the doing of all repairs as far as possible from the pit. The arguments in favor of the two methods are well known. If the motors are taken from the trucks into the pit the trucks can usually be left under the car bodies, and the same thing is generally true of wheel renewals. If the motors and other parts are to be worked at from above it necessitates removing the trucks from under the car bodies, whether the trucks are single or double. This theoretically involves some extra work; but those favoring the abandonment of pit work point to the fact that work done in the pit is sure to be inferior to that done from above with the trucks out in the open. It is not in accordance with human nature for a man to do his best work in a pit, which it is practically impossible to light, as well as the floor of a repair shop.

It is not to be expected that with a large amount of dirty apparatus over his head, ready to drop dust in his eyes, he will take pains to look up and see that all details are well attended to. At the present day in the larger shops and car houses probably the greater part of the repair work is done from the pit. In some of the smaller car houses, which are not as well equipped with pits and hydraulic jacks in the pits, more work has been done by taking the trucks from under the cars and working from above.

Just at the present time, however, there is to be noted the beginning of a tendency to abandon pit work. Two companies, very progressive as regards shop practice, have within the past year moved in the direction of abandoning pit work entirely, as far as new equipments are concerned. On old equipments, arranged to be handled from the pit, of course, such a move would be impossible; but the fact that the new equipments have been carefully designed to make the abandonment of pit work on them a possibility, is significant. The two companies referred to are the Milwaukee Electric Railway & Light Company and the St. Louis Transit Company. The former company even went so far as to insist on an entirely new design of motor, arranged so that it can be opened from above for inspection and can be lifted out of the trucks directly, with as much ease as the motors commonly in use to-day can be lowered directly away from the trucks. The latter company, although obtaining a new design of motor, has not gone as far in some particulars, and has retained some of the features of motors designed to be handled from below. In its new car shops, however, one division, which will be devoted to the repair of all the newer equipments, has been arranged without pits, and will be provided with motor-driven screw-jacks for lifting the car bodies, so that trucks can be quickly taken from under and worked at in the open.

Trolleys and Tunnels

The activity displayed by the promoters of tunnel projects to connect New York with the Jersey shore, and the establishment of direct trolley communication between New York and Philadelphia may be more than a mere coincidence, and some of those interested in these projects intimate that such is the case. Application has been made by the Hudson & Manhattan Railroad Company to the Rapid Transit Commission to build a single-track loop tunnel under Cortlandt Street, Church Street and Fulton Street, in New York, which is designed to be the continuation of a tunnel under the North River, beginning near Exchange Place, in Jersey City.

This is the second project of the kind that has been set on foot for trolley traffic, and its completion would be a great accommodation to New York business men who reside in the suburbs beyond the North River. The New York and New Jersey tunnel, promoted by the same interests which propose to invade the city at Cortlandt Street, is nearing completion. This tunnel is heading for Morton Street, and the company which is building it has planned a big terminal station on Christopher Street. It is reported that the company hopes to lay tracks in it in July of next year, and that when completed it is to be used by any railroad company that engages to run electric cars through it and pay for the privilege. It will anticipate the more ambitious Pennsylvania tunnel by about three years. The Union Terminal Company has planned a tunnel at Fourteenth Street, where the North River is narrowest, and is obtaining the consent of property owners along the route in Manhattan. President McAdoo stated at the hearing before the Rapid Transit Commission that the cost of the Cortlandt Street tunnel loop on the Manhattan side alone would be between $6,000,000 and $7,000,000, not including expenditure for real estate. It is, therefore, an undertaking of considerable magnitude, involving an outlay of probably $30,000,000.

In all plans of the New York-Philadelphia trolley projects it is proposed to secure entrance to both terminal cities by means of tunnels, that at the New York end crossing at some point under the North River, and that at the other extending between Camden and Philadelphia. This will give the project the advantage of much suburban patronage, provided passengers can be landed in the shopping district or at points easily accessible to the retail section. This feature of the project, however, seems to confirm the impression that no attempt will be made to operate at high speed between terminal cities. The possibility of the Pennsylvania system operating its Philadelphia section by electricity is confidently anticipated by many who are watching the development of that company's plans in connection with the Manhattan tunnel, although the executive officials and engineering staff have carefully refrained from encouraging this belief by any public utterances that would commit them to the electric system. It would not be at all surprising if electricity was adopted for the Philadelphia section, so that trains could be electrically operated from that city to New York by the time the Pennsylvania tunnel is completed; indeed, it will be a great disappointment if they are not.

The Troubles of Joint Ownership

Among the various electric interurban railways which have begun operation within the last year or two we call to mind one which is trying to live up to the distinction of being jointly owned and controlled by two different sets of individuals. It is a pleasure to record the evident financial success of the road, in spite of this burdensome condition, but it is far less agreeable to contemplate the evils which have arisen out of this modern attempt to discredit the old proverb that no man can serve two masters at one and the same time.

The road in question connects several populous towns with a busy manufacturing city, and runs largely upon a private right of way, or else at the side of highways, which permit operation at high speeds. The roadbed and track are of superior construction, and both rolling stock and power station machinery constitute examples of typically modern design. The power supply is direct current throughout, and the feeder system adequate for the schedules originally planned. Traffic growth, however, has been so great that the present line and car equipment is being pushed to the limit of its capacity, and things look as though the coming summer business of the line will call for the active utilization of everything on wheels which the road can muster into service.

All through the winter and early spring there were constant recriminations against the service by that one of the controlling organizations which was not identified with the actual operation of the road, and charges against poor equipment, low voltage, insufficient copper and general slackness in design and operation filled the air. From the first the men who were operating the railway realized that additional power supply and equipment was inevitable if the business of the system was to be properly handled, and they sought in every feasible way to impress the fact upon the balky contingent of owners who blocked progress by refusing to appropriate their share of funds for the purchase of the requisite apparatus. Finally, engineers, representing one set of owners, made exhaustive tests upon the road in the presence of similar experts representing the others, and absolutely determined the need of further facilities to accommodate the business which was expected to double the road's traffic during the coming summer. The engineers of each party agreed that the need was imperative, and recommended its purchase to their respective principals.

The whole point of the matter was missed in the resulting decision. Several new and higher powered car equipments were ordered, the rolling stock purchased being easily enough to take care of the maximum traffic which the summer would be likely to throw upon the road's hands. But not a single cent was appropriated for additional power supply and distribution by the owning corporation which had been showering the complaints. The result can be imagined.

This example has been mentioned because it is an instance only of a large number of cases with which we are acquainted, where the absolute needs of a property have been sacrificed to the cheese-paring ideas of the directors, or where, if an appropriation has been made, it has been so small as to be about as effectual as an attempt to operate a car without a controller. It is pretty safe to say that if one of these same short-sighted directors had been consulting a physician about any bodily sickness, the medical man's advice would have been followed at least to the extent of taking two pills instead of one if the prescription called for a double dose. Certainly expert recommendations, such as the operating man can give, are of little use if they are not worth following, and we believe that boards of directors are often unduly conservative in placing reliance of this kind, rendered by experts in their employ, upon opinions rendered. In the case above cited one party in the road's control appreciated the need of more power and equipment; they were willing to make their part of the requisite appropriation, but the inability of the other side of the house to realize the situation, even when their own engineers advised extension of the power system, blue-penciled the progress requisition in heavy lines.

The Life of Street Railway Equipment

We wonder whether the noisy contingent of howlers that fills the air with demands for 3-cent fares ever contemplated the real conditions of street railway operation. During a somewhat lengthy street car ride the other day we were lured into a reminiscent vein of contemplation, and began to think over the successive changes that the road had undergone in the fifteen years of its existence. It is a considerable system, dealing with a large total population, and at the present time its equipment is well up to date and its operating department is conspicuously well handled. It has never experienced any grave vicissitudes and has been managed throughout its history in a conservative and judicious manner. In particular, it has been well engineered, and its apparatus has been well cared for and subject to no unusual depreciation. Here, if anywhere, is a good opportunity of judging fairly as to the reasonable expectation of life of the equipment, both as regards physical degeneration, and that still more important depreciation due to change in the art. Change in the art is a somewhat indefinite phrase, but it covers broadly a multitude of things which have to be done to keep the material and service of the road up to the requirements of economy and the demands of the patrons.

To begin with, we were riding in a modern double-truck car, equipped with air brakes and motors of the latest improved type. It is to our knowledge the fourth type of car which the road has operated in its really short life. Even now the change to this modern car is only just under way, but everybody realizes that the old cars must gradually go, and be replaced by such as the present one. The road began with some remodelled horse cars and some short cars intended for electric service. Nearly all of these have gone to swell the scrap heap, and the bodies are doing service as owl lunch carts, cobblers' shops and the like in remote nooks of the suburbs. On rare occasions one of the early electric cars gets on the road for a day or two, and the conductor is greeted with facetious allusions to Noah's ark, farm wagons and other supplanted means of transportation. Next came a regular single-truck car, magnificent for its time, but now passing into innocuous desuetude. A few of this second crop are still in service, dodged by passengers who are not in a hurry and generally regarded as rattle-traps. The trailers they once proudly towed have long since passed into the indefinite beyond—the limbo of things cast off. The third crop was of good double-truck modern cars, constituting the majority of those in service. The change to a still better type has started, and will doubtless continue, but the fact is that the system is fairly on the third set of cars in fifteen years with another in sight. Likewise, the motors have changed with the cars, and with few exceptions the motors now in use are the third type in the road's history. The change was not complete at any one time, and is not complete now, but the motors of a dozen years ago have wholly disappeared, those of a succeeding type are practically all gone, and recent acquisitions are improvements on even the third general form used. As to the rails over which we run there is a similar story to tell. The early strap rails and low light girders have disappeared, the succeeding girders of medium weight are nearly gone, and modern heavy girders have taken their place. The special work has been changed still oftener, and the bonding and other details of the track return have been changed with the rest of the track.

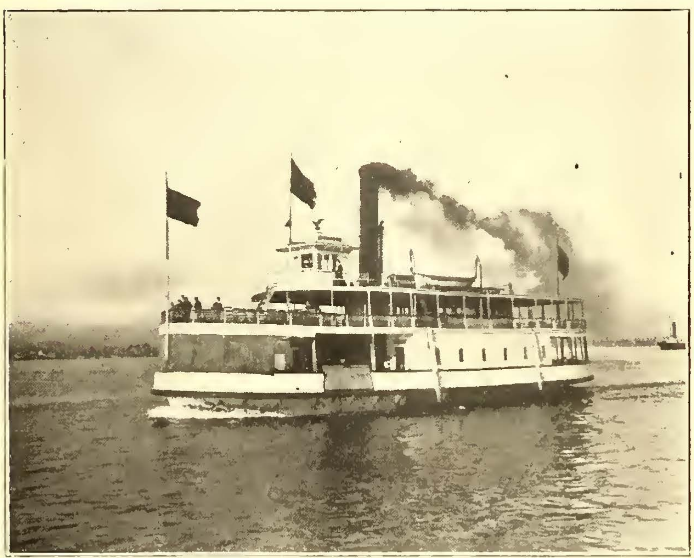
The power station has gone through a similar process of costly evolution. The little belt-driven generators of a dozen years ago were soon replaced by larger machines, then thought colossal, and these in turn by fine engine-driven generators. Even now, however, the steam turbine is looming up, and no one knows how long the present machines can economically be kept in service in view of the newcomer. The overhead construction has a similar history, and the long and short of the matter is that we have a system which, in fifteen years, is now well along in the third stage of its re-equipment, with the fourth beginning to appear as the last traces of the second are yet vanishing. Of course, these changes are not violent, nor have they fallen as a serious burden on any one year. They have been gradual, have been part of the general growth of the system, and with new equipment new lines have been initiated, but the fact of replacement remains. The old has gone, the new has come, and the cost of the change has been in the aggregate enormous. The actual total depreciation represented has been enormous, although the things discarded have not, as a rule, been fully worn out or wholly lost. But it is safe to say of any road, that ten years hence, even if not before, the equipment that is now new will be superseded, unless the steady march of improvement suddenly stops. To keep up with the times, to give the patrons of the road good service, and to keep the plant at the highest pitch of economy, constant improvements are necessary, and when summed up at the end of a decade the aggregate is startling. If people, generally, realized these responsibilities, which do not appear in the regular operating expenses, they would get an entirely new view of the working of a street railway system. Apparatus and equipment is improving yearly, and a street railway manager cannot let his present outfit wear out like an old shoe to its theoretical limit of existence.

TRANSPORTATION FACILITIES AT THE SOO

The street railway lines of the International Transit Company and the Trans-St. Mary's Traction Company are situated in Sault Ste. Marie, Mich., and Sault Ste. Marie, Ont. Each

RIVER TERMINAL OF CANADIAN RAILWAY AT FOOT OF BROCK STREET

place has a population of about 15,000, and is the center of a large water-power development, comprising the present capacity of 40,000 hp on the American side and 20,000 hp on the Canadian side, controlled by the Consolidated Lake Superior

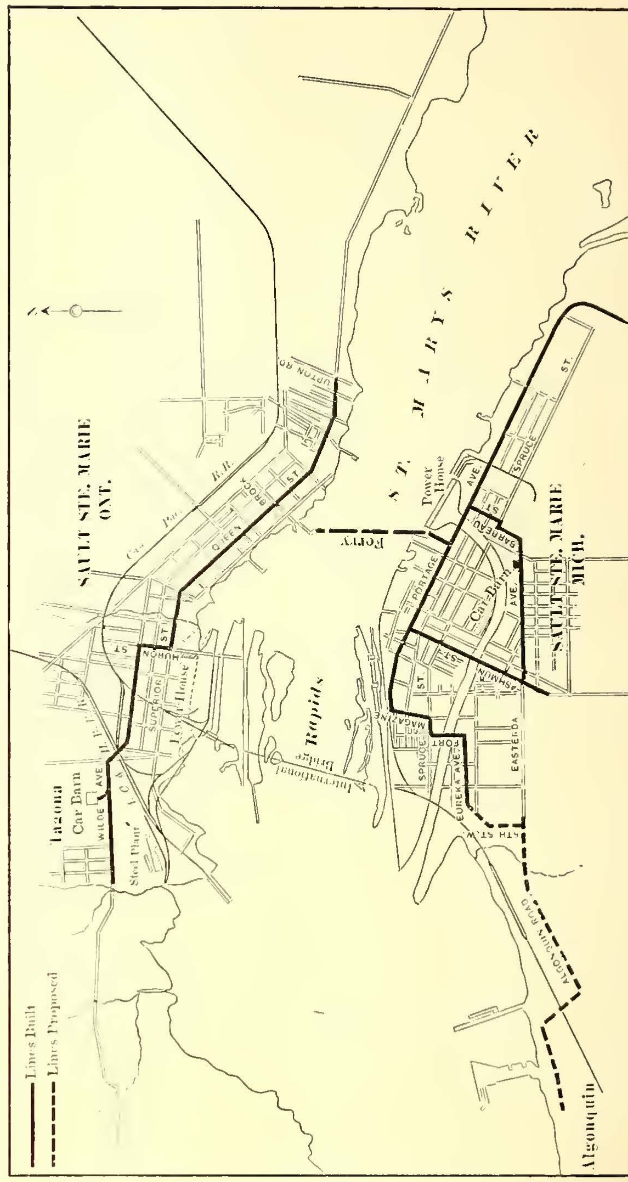


ONE OF THE STEAMERS PLYING BETWEEN RAILWAY TERMINAL DOCKS

Company, which established the local lines of electric railways and the ferry connecting the two cities.

The industries of the community comprise those largely connected with the water-power companies, but in addition on the American side there are large lumber mills and tanneries. On the Canadian side there is a large steel plant, two blast furnaces, a rail mill, with a capacity of 600 tons a day, a sulphite pulp mill, with a capacity of 50 tons a day, as well as reduction works, alkali works, a large saw mill, with a capacity of 100,000 ft. a day, and a veneer mill, all located in the western part of the town.

The accompanying map shows the relative location of the several points in each city and the general plan of the transportation system. St. Mary's Falls separates the two towns, and is immediately below the International Bridge. The length of track on the electric railway system on the American side now comprises about 8 miles, including sidings, and



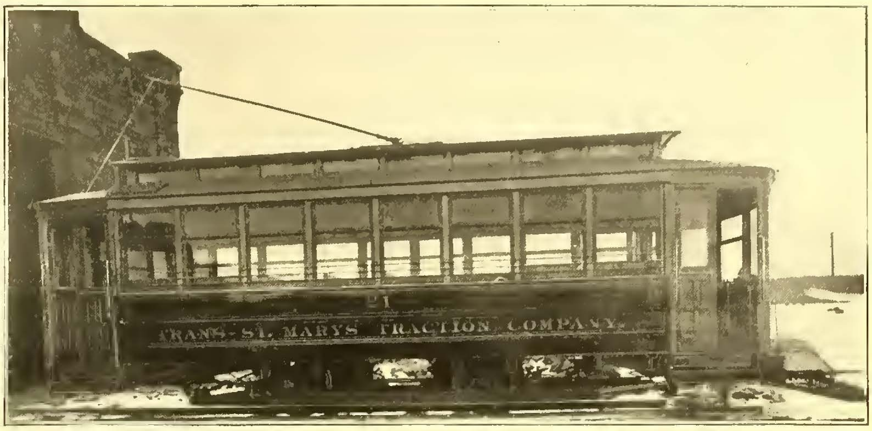
MAP OF TRANSPORTATION SYSTEM AT THE SOO

an extension of 1¼ miles is contemplated in the village of Algonquin, a short distance west of the main town. This place has a population of about 800. The present eastern

STANDARD PASSENGER CAR FOR CANADIAN SERVICE terminus of the railway is at the ship yard known as "Pullar's," where a large paper mill has been started. At this end of the town is located the Country Club and baseball park, and it is also proposed to establish a race track, which will be an additional attraction. The line on this side runs mainly east and west, following the direction of the river, with a belt line running out Ashmun Street, which is the principal business throughfare, around the outskirts of the town and into the residential district. The car houses are located on Easterday Avenue on the belt line, south of the Power Canal, which runs through the center of the city.

The lines on the Canadian side comprise about 4 miles of track, and have for their western terminus the village of Tagona, where the steel works are located, and at the east end terminates at the Boat Club, in the residential district. The car houses are located at the western end of the line in the village of Tagona. On the American side the railway runs down to the river, and has terminals on the dock immediately west of the power house of the Michigan Lake Superior Power Company,

The route which the railway follows on both sides of the river is very interesting, especially for strangers and tourists, as it runs directly along the locks of the United States govern-



STANDARD PASSENGER CAR ON AMERICAN LINE

ment on the American shore, giving an excellent idea of the extent and equipment of the canal, through which passes the greatest tonnage in the world.

POWER HOUSE AND RAILWAY TERMINAL DOCK ON AMERICAN SIDE

and communication across the river to Canada is maintained by a ferryboat giving a 20-minute service. This ferry is owned by the street railway company. The landing in Canada is at the foot of Brock Street, which is in the center of the business district.

The track is 80-lb. T-rail, A. S. C. E. section, with Bonanzo joints, four bolts to the joint. The turn outs have automatic spring switches, thus eliminating the necessity of turning switches, inasmuch as the traffic follows the switches through out. The ties are spaced 2 ft. on centers, and are of cedar, 6 ins. x 8 ins. x 8 ft. All curves have tie-plates or braces. The track generally is located in macadam streets, and in all cases has at least 6 ins. of crushed stone ballast under the ties except where the track is laid on the side of a street in the outskirts, and then it is laid on gravel ballast. The special work on the American side was furnished by the Falk Company, of Milwaukee, and on the Canadian side by the Pennsylvania Steel Company for the car houses, but all other special work was manufactured by the company itself at the shops of the Algoma Iron Works.

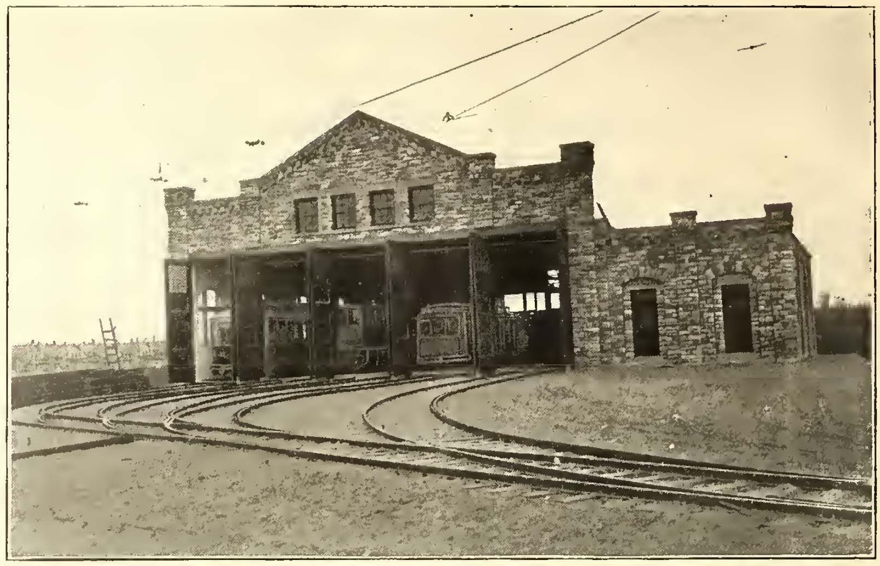
The overhead work is constructed in a most substantial manner. The poles are all of native Michigan cedar, very straight, not less than 7½ ins. at the top, and all painted a dark bronze green with white tops, presenting a very neat and attractive appearance. The cross-span wire is ⅜-in. galvanized iron, and the pull-off wire ¼ in. The overhead fixtures were supplied by the Ohio Brass Company. On the Canadian side Detroit ears are used, and on the American side a heavy clinch ear is used. All the trolley wire is figure eight, while the feeder wire used is 300,000 circ. mil weather-proof copper wire.

The bonds used were supplied by the Mayer & Englund Company, of Philadelphia, and are known as the "foot bond," the terminals being secured to the base of the rail and the bond being of a horseshoe shape. The capacity of these bonds is equal to that of 0000 copper wire.

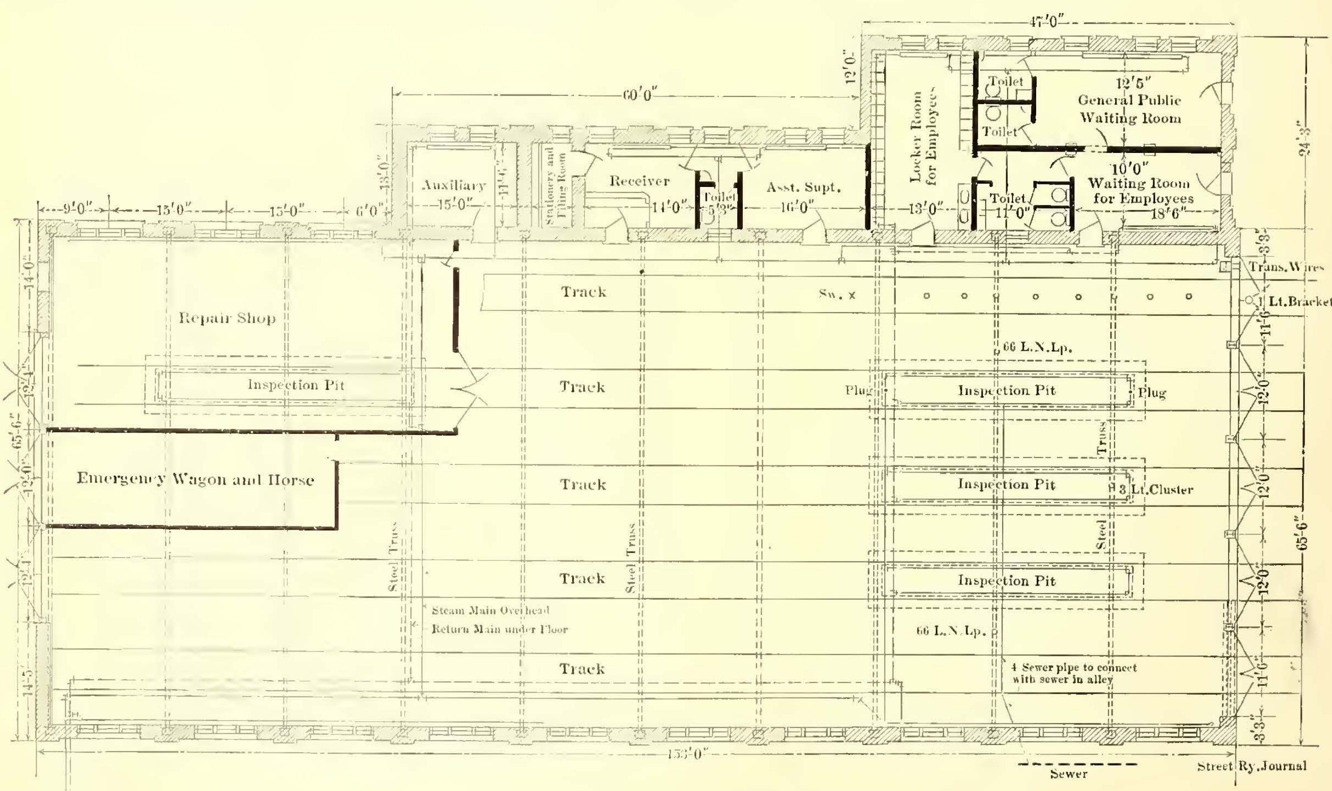
The car houses on each side of the river are of similar construction and size. The main building in each case is 65 ft. x 153 ft., with a large wing for offices. The repair shop is located in the barn proper. There are four inspection pits in the barn. The side walls are brick, the front stone, and the building has steel roof trusses with corrugated steel roofing. The interior of the building is finished in white, while the outside of the roofing is painted with dark green graphite paint. There is 3-in. pine flooring all over the building inside the car house proper. The machine shop is separated by corrugated steel partitions from the storage department.

All the cars used in this system are of the semi-convertible type, and were designed by G. W. Chance, the manager of the road. Those used on the American side, six in number, were built by the St. Louis Car Company. They are 32 ft. over all and will seat thirty-two to thirty-six people. There are four cross-seats on each side in the center of the car and in each end longitudinal seats. The cars have electric bells and Ohmer fare registers, and are all provided with type-"C" Providence fenders. The inside finishing of the car is in oak, while the outside is painted vermillion for the body color, and the upper part is given a citron shade. The electrical equipment consists of two No. 49 Westinghouse motors to each car, with two K-10 controllers and circuit breakers. The trucks are of the Dupont pattern, the wheels have 3-in. treads, ⅞-in. x 1⅛-in. flanges.

On the Canadian side the cars were built by the Ottawa Car

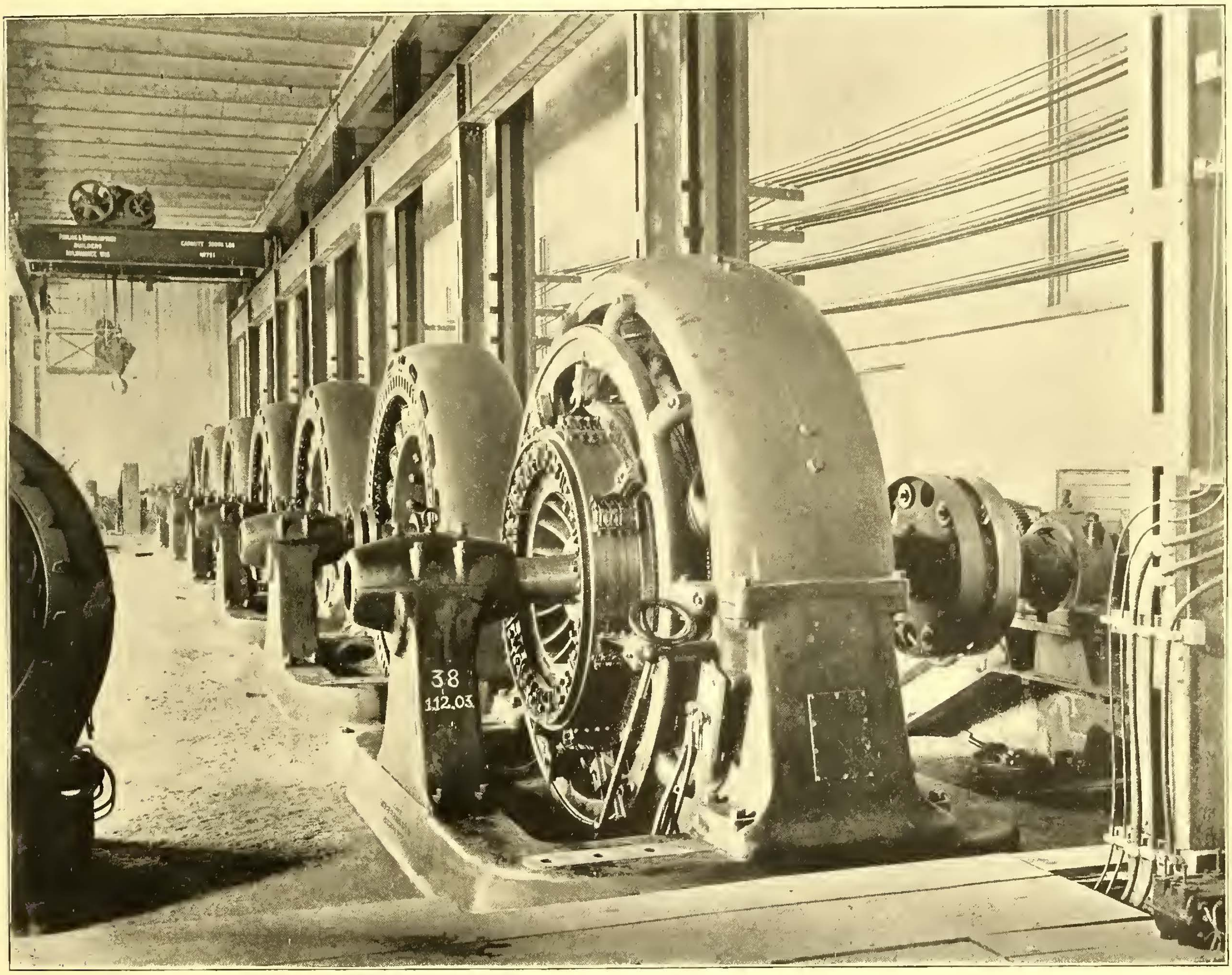


CAR HOUSE AND REPAIR SHOPS



PLAN OF CAR HOUSE AND REPAIR SHOPS

Company. They are eight in number, 42 ft. over all, and are mounted on Brill No. 27-G trucks, equipped with four Canadian General Electric No. 67 motors and two K-6 controllers and circuit breakers. The cars have five cross seats on each side, made by Hale & Kilburn, of the walk-over pattern, covered with pantasote, and on each end the seats are longitudinal, covered with rattan. The Momentum Brake Company, of Toronto, supplied the brakes, which consist of two discs with wooden rubbing surfaces. A sheave and winding chain throws the brake on. The cars on the American line are equipped with the Sterling safety brakes. It is intended to add three large cars of the same pattern as those now in use on the Canadian side for the American line, and equip them with four Westinghouse No. 49 motors and K-6 controllers.



NEW POWER PLANT AT AMERICAN SOO

The company owns two docks, one on each side of the river, each containing commodious buildings for ferry purposes. They also own two boats, each with a carrying capacity of about 1000 people. One boat at present is used for the regular ferry service and the other for excursion traffic.

On the American side the company takes power from the Michigan Lake Superior Power Company's plant, which was described in the STREET RAILWAY JOURNAL, Nov. 8, 1902. Stanley generators, furnishing current at 600 volts, are driven by water-wheels of special design, which are regulated by Lombard governors. Views of the power plant are presented.

On the Canadian side the company takes power from the Lake Superior Power Company. Canadian General Electric generators furnishing current at 550 volts are driven by water-wheels equipped with Lombard governors.

PLATFORM GATES FORBIDDEN IN KANSAS CITY

For several years the Metropolitan Street Railway Company, of Kansas City, had its electric cars equipped with what is commonly known as the Minneapolis gate, which is a platform gate controlled by the motorman and opened only at such times as the car is at a full stop. The latest form of these gates, embodying the same principles, was described and illustrated in the STREET RAILWAY JOURNAL, June 13, 1903. Last year an ordinance was passed in Kansas City, Mo., forbidding the use of gates of this type. This appears to be another one of the unexplainable proceedings of a body of city fathers. Usually the legislation is in the direction of increasing the safety of the public, or at least attempting to increase it. The City Council of Kansas City seems to have taken the other tack in forbidding the use of these gates. As to the practical effect of abolishing the gates the figures on step accidents in March, 1902, when the cars were equipped with gates, as compared with March, 1903, when the cars were not so equipped, tell the story.

W. A. Satterlee, assistant general manager, reports in 1903 ninety-seven accidents at the step, against none the year previous. Another month there were sixty-two step accidents as against none, and another month seventy-five as against none. This is counting the step accidents on cars formerly equipped with gates only. The cable cars have never had these gates. In Mr. Satterlee's opinion the worst feature of the whole business is that these step accidents, while they are not of the kind for which the company is justly liable, are, in reality, of a most troublesome and expensive kind.

THE ELECTRIFICATION OF BRITISH RAILWAYS

BY A BRITISH ENGINEER

The electrification of steam railways is a subject which is being much discussed at the present moment, and is attracting widespread attention. The chairmen and directors of English railway companies have of late frequently brought the matter under the notice of their shareholders, whilst some companies have even gone so far as to lay down experimental lines, as in the case of the North-Eastern Railway's lines at Newcastle, and the Lancashire & Yorkshire Railway's line from Liverpool to Southport.

There appears to be greater activity in this direction in Europe than in the United States. As is well known to all readers of the Street Railway Journal, the Italian government has lately gone into the question, with the result that at the present time there are two important long lines working electrically in that country, i. e., the Lecco-Sondrio Railway, equipped on the Ganz system, and the Milan Ceresio line, which uses the standard, series-wound, continuous-current motors of tramway practice. This is all that has been done in this quarter up to the present, but there are several other important sections of the Italian railways, the adoption of electric traction upon which is receiving serious consideration, and considerable developments may be looked for in the near future.

The Swiss government has not as yet converted any of its lines, but a government commission has been appointed to thoroughly investigate the subject, and it is probable that electric traction will shortly be adopted on one or more of its main lines.

In Sweden the subject is also receiving close attention, though the situation there is somewhat different from that which exists in other countries. There are large water powers available and coal is expensive. The government is considering the operation of its railways by electricity, generated by water-power, and this more to reduce its working expenses by dispensing with the coal bill, which forms one of the heaviest items, than for any other reason. With this end in view the Swedish government has laid claim to the ownership of all the various waterfalls in that country which may be used for power production. The main object in its case is not so much to increase and improve the traffic, but to reduce the operating expenses as much as possible.

Germany has taken a different view and spent a considerable amount of time and money in investigating the problem of how fast it is possible to run electric motor cars. The results of these experiments on the military line from Berlin to Zossen, which, owing to the light construction of the permanent way, were not very conclusive, have been already set forth in these pages and need not be entered into here.

The problem in Great Britain has several features peculiar to itself, and though a careful study of the results obtained in other countries is most helpful and instructive, great care should be taken in applying these results to the solution of the problem in this country. Although there have been proposals to construct lines, to be operated at abnormally high speeds, and powers have been obtained to construct a railway of this description between Manchester and Liverpool, this phase of electric traction will not, in the opinion of the writer, play any very important part at present in the great problem now before the nation. What the future may bring forth is, of course, uncertain, but under the conditions which obtain at the present, there does not appear to be any very extensive field for lines of this description in Great Britain.

That the importance of the introduction of electric traction on railways is realized by our government is shown by the fact that Gerald Balfour, the president of the Board of Trade, has recently introduced into Parliament a bill which is expressly designed to remove obstacles and facilitate progress in this direction. This bill is intended to enable railway companies to dispense with the necessity of obtaining an act of Parliament authorizing them to use electricity, either for electric traction or other purposes, which, owing to the fact of their being statutory companies, they are at present obliged to do. They will, instead, merely have to satisfy the Board of Trade as to the feasibility and general utility of their propositions, which being accomplished, they will be enabled to proceed with the work straight away, without the tedious and expensive proceeding of going to Parliament.

This applies, as mentioned above, to the use of electricity for all purposes, and a large field will thus be opened in the employment of electric power for operating cranes and capstans in goods yards. Many railway companies will doubtless be only too glad to avail themselves of the chance thus afforded them, as is instanced by the fact that the London, Brighton & South Coast Railway Company and some others have already applied to Parliament for power to utilize electricity.

Gerald Balfour's bill provides that the Board of Trade may make orders authorizing a railway company to use electricity, either as a motive power or any other purpose; to construct and maintain generating stations; to make arrangements with any body corporate or other person for the supply to the company of electric power, or the supply to or use of the company of any electrical plant or equipment; to modify any working agreement, so far as the modification is agreed to between the parties thereto, and is consequential on the introduction or use of electric power; to subscribe to any electrical undertaking which will facilitate the supply of electricity to the company, and to issue new capital for any of the purposes of the act. An order made in accordance with the provisions of the bill is to have effect as if enacted by Parliament, and the boon which this would confer on the railway companies can easily be imagined.

The railways in the United Kingdom may be divided into four distinct classes or sections:

(1) Long-distance main lines, such as from London to Scotland, Wales, Cornwall, etc.

(2) Branch lines which are practically light railways, though not regarded as such.

(3) Interurban lines, upon many of which there is an abnormally heavy service, as in the districts around Bradford, Manchester, Liverpool, Middlesborough, Newcastle, Birmingham, Wolverhampton, Glasgow and many other neighborhoods.

(4) Suburban lines, pure and simple, radiating from and surrounding the large towns, which serve to convey the workman and the man of business to and from his home in the suburbs and his work in the city. To supply proper facilities for this class of passenger is a problem of peculiar difficulty. A serious attempt at its solution is being made in London at the present time by the Royal Commission which has been appointed by His Majesty's government to investigate and report upon this intricate subject.

Amongst the various matters which the Royal Commission has to investigate and report on is the question as to whether or not it is advisable to create a new and special tribunal, to obviate, at least as far as London is concerned, the present expensive, cumbrous and unsatisfactory methods of procedure.

Tramway franchises may be sought in two different ways. First, by putting the case before Light Railroad Commissioners, who, if there is no serious opposition, and particularly if existing steam railroad companies do not oppose, recommend the bill, which is then created by the Board of Trade. If there is any serious opposition application has to be made to Parliament, which can only be done once a year, and if the opposition is strong it may be a very expensive matter.

Secondly, the franchise could also be sought under the Tramways Act by going direct to Parliament, a method which has hitherto proved cumbrous and unsatisfactory.

It is urged by many that a special tribunal, similar to the Rapid Transit Commission in New York, should be created, which should not only have the right to grant concessions but also to investigate and to decide upon the best routes and to suggest new lines and impose working conditions upon existing lines, which would enable all the various electric railway and tramway systems to work together to the greatest advantage of the traveling public.

In considering the question of British railways we must deal with the question under the four heads as above. Taking them in the order in which they there appear, we will briefly discuss the possibilities and probabilities of the application of electric traction in each case.

The question of electric haulage on the main lines in the United Kingdom is one which has chiefly attracted the attention of those business men and engineers whose knowledge of the subject is more theoretical than practical. These latter have been responsible for a large number of papers which have been read before the various engineering societies, and in which certain systems have been suggested for operating main line trains electrically. Many of the suggestions have been tried in the past and proved failures, whilst others are impracticable schemes which have been invented by the authors of the papers.

There are many reasons for considering that the time for the adoption of electric traction on main lines has not yet come. From the point of view of speed alone the limit with steam locomotives has by no means been reached, and could, in all probability, be increased some 10 per cent to 20 per cent. The reason why this is not done is because no great advantage would be gained therefrom. The great bulk of long-distance passengers would not be prepared to pay the increased fares which higher speeds would entail, because in most cases the saving in time which would be effected would be of little or no value to them. If the journey from London to Glasgow, for instance, is taken by night, it makes little difference whether nine hours or seven hours are occupied. As regards the day journey, it takes practically the whole day, and an hour more or less would not make any appreciable difference to the majority of travelers. It has not been shown in actual practice that it is possible to run trains at the enormous average speed of 100 m. p. h., and if it were possible the capital and working expenses would be so great as to more than compensate for any prospective profits. It must not be forgotten that whereas on the Continent of Europe, in many places, water-power is abundant and coal expensive, in England it is just the reverse; water-power is practically non-existent and coal is moderately cheap.

With reference to small branch lines electric traction can undoubtedly be adopted with advantage where water-power is plentiful, or where the traffic is sufficient to warrant a considerable number of trains per day being operated. This has been done in several cases on the Continent, descriptions of which have appeared in the STREET RAILWAY JOURNAL from time to time. There does not appear to be any very extensive field for this class of traction in Great Britain, and it is more probable that motor cars propelled either by petrol or else by steam on the Gardiner-Serpollet system, would suit the case better.

In this connection it may be interesting to point out that several of our railway companies, including the Great Western, the London, Brighton & South Coast and the North-Eastern, have ideas that by means of self-contained motor cars, either driven by ordinary steam engines or by special steam engines of the Gardiner-Serpollet type, or by means of oil and petrol engines, or by combining the latter with electric motors and generators and batteries of accumulators, the introduction of electric traction may be postponed for a time, if not indefinitely. Up to the present moment, however, although the South-Western and North-Eastern have actually constructed such motor cars, the former using steam and the latter the combined oil and electric system, the results obtained have been far from encouraging.

The use of automobiles is not so new as some think. The Belgium government has for fifteen years been operating steam motor cars, which are known under the name of "Train-Tramways." The mistake which English railway companies would seem to have made lies in their attempting to put into service motor cars which will give as rapid acceleration and as high an average speed as that which is easily obtained in the case of electric traction. These attempts have so far proved unsuccessful. Similar experiments with accumulator cars have been carried out by the Nord Railway Company in France, and by an Italian railway company between Bologna and St. Felice, but the results there obtained have not been so encouraging as to cause this system to be generally adopted.

Both the Nord and the Paris-Lyons and Mediterranean Companies, in France, have ordered Serpollet steam cars, and are going to experiment with them, but no record of results are as yet available, and in fact, in one case at any rate, the experimental car has not yet even been delivered by the makers.

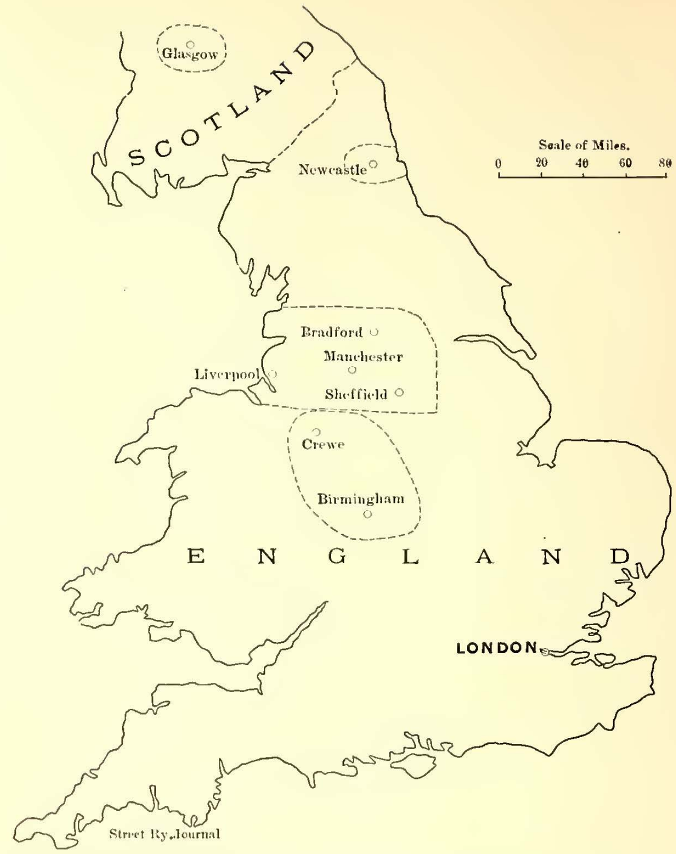
The last two of the four classes into which we divided railways, viz., interurban and suburban lines, are on quite a different footing to the main and branch lines, and it is agreed by all those who are in a position to judge, that there is a wide and extensive field in Great Britain for the application of electric traction on such lines, probably more so than in the United States or on the Continent of Europe.

With regard to the suburban traffic in London much will depend upon the Royal Commission which is now investigating the subject. This body is entrusted with a great responsibility, as it has not merely to consider and sanction, or throw out the various proposals which have been made, but to consider the entire question of the transportation facilities in London as a whole, and arrange the schemes under consideration, so that they may work in with the existing lines. The report of this commission, when issued, may bring about some very important changes, and will, in all probability, force the railway companies to adopt a more progressive policy than most of them have done hitherto. Besides this they will probably consider the whole question and lay out recommended routes which have not yet been brought forward.

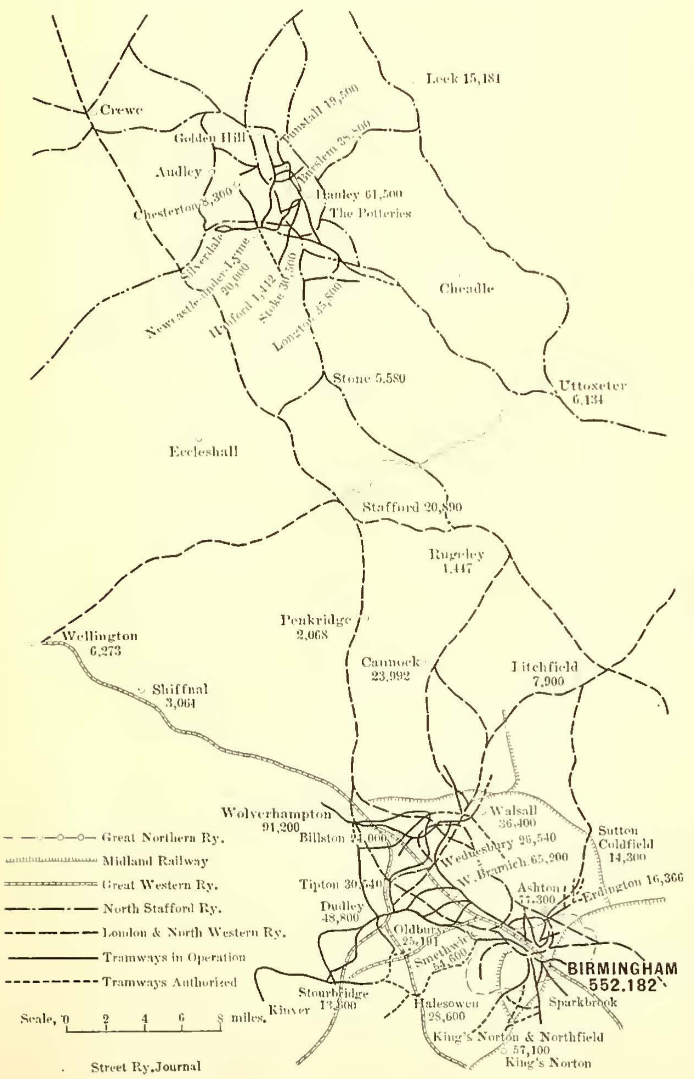
Till quite recently it has been more or less an unwritten rule for Parliament to refuse to grant franchises to tramways, light railways or other lines which could be shown to be in actual and sharp competition with existing railways, provided the latter were considered by Parliament to be capable of affording sufficient facilities to the districts through which they ran. The result has been that many of the railway companies have taken advantage of this, and being thus freed from competition have not troubled to give a proper service, such as would have been forced from them by the existence of a rival line. This is particularly the case with the Southern lines in or near London, serving some of the most desirable residential districts, and in all probability the action of the Royal Commission with respect to these will have most far reaching effects.

There is no doubt that the English railway companies have been far too conservative in the past, though the reason for their inactivity is not far to seek, and unfortunately certain members of the electrical engineering profession have done their best to give them an excuse to still hang back, owing to the many impracticable schemes which have been suggested for electrically operating suburban lines.

The dispute over the electrification of the Inner Circle, which culminated in the now famous arbitration to decide which system should be used, is a case in point. When railways see such a great difference of opinion amongst some of the leading experts, one can scarcely wonder at their concluding that the present is not a time for them to attempt to do anything. This is only an excuse, and doubtless if the will to progress were not lacking the way would not seem so difficult. Many of the railway companies do not want to make any drastic changes, and merely wish to appear progressive whilst in reality doing nothing. They are, in fact, lazy and do not feel inclined to take the trouble to make themselves acquainted with the new and changed condition of affairs, which would be a natural consequence of the introduction of electric traction. But this is not the only reason for their hanging back, and it must not be forgotten that the capitalization of our railways has a very important bearing on the subject; it is already so enormous that one can readily understand that the directors do not wish to increase it, and thus depreciate the value of their shares. Some idea of the state of affairs may be obtained from the fact that they are capitalized for, approximately, £30,000 per mile of single track, and that the net receipts represent only about 4 per cent of the total capitalization. In the past railway companies have not written off sufficient profits to amply cover depreciation and renewals; the writer is personally cognizant of cases where machinery purchased thirty years ago, and now practically obsolete, stands in the companies' books at an amount equal to the original purchase price. Thus the introduction of electric traction on a large scale is not at all welcome, since it would not only involve a considerable capital expenditure, but would also entail the writing off of large sums which represent on the books of the companies the value of large quantities of rolling stock, machinery and other material which would be rendered useless by this step. What this might mean can be gaged from the statement that the total capitaliza-



MAP OF ENGLAND AND SOUTH SCOTLAND, SHOWING LOCATION OF LARGE SCALE TRAMWAY AND RAILWAY MAP



MAP SHOWING BIRMINGHAM AND POTTERIES TRAMWAY SYSTEM

tion of the railways in the United Kingdom is in the neighborhood of $7,000,000,000.

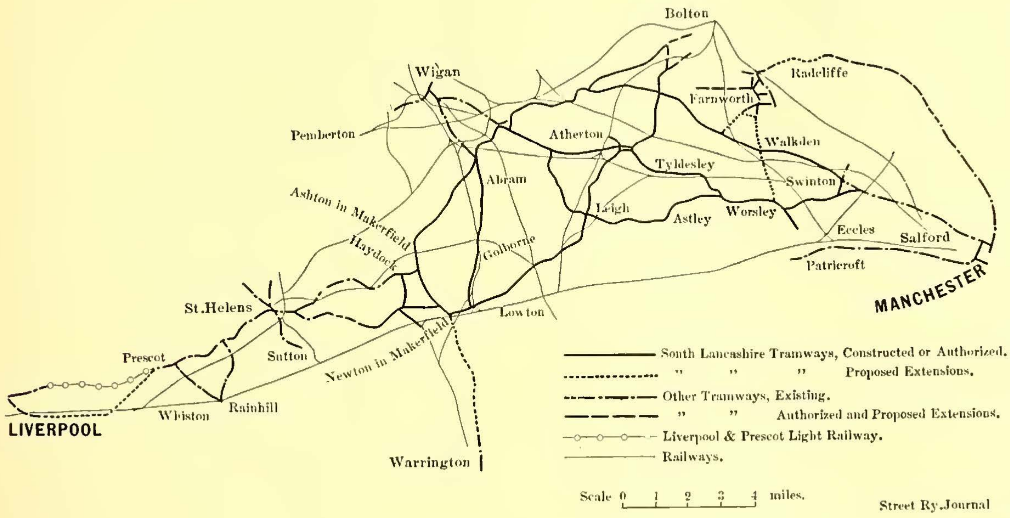
Besides being hampered by this enormous capitalization there are great difficulties to be faced in operating suburban traffic electrically, owing to the lack of terminal facilities to handle even the long-distance traffic. The extension of a terminus is an expensive operation; the London, Brighton & South Coast Railway Company is spending over a million sterling to improve its station and the approach to it at Victoria.

The question of suburban traffic in and around London is one of great interest, and much may be expected from the combination of tube, shallow tunnel, and surface railways which have been amalgamated by Mr. Yerkes, and which will most probably be in operation within the next two years. The chief importance of this system lies in the close connection which exists between the Metropolitan District Railway and many other railways, such as the Tilbury & Southend, the South-Western, the Great Western and the North-Western. The actual results of electric traction on the District Railway will doubtless go far towards persuading some of the companies to follow suit on portions of their own systems.

Other companies, such as the London, Brighton & South Coast Railway, are watching the progress of events, as is evident from their having appointed Philip Dawson, of Kincaid, Waller, Manville & Dawson, to act as their consulting engineer and advise them in this respect, so that doubtless they will not be slow to act when the time comes and will be fully prepared to meet any situation which may arise.

In the United States it is a very usual thing for suburban electric railways to run on their own right of way outside the towns, but on entering the towns to travel over the existing tramway tracks, and this method of procedure has met with considerable success. This, however, can scarcely be done in Great Britain, because the girder rails prescribed by the Board of Trade have such narrow grooves that wheels suitable for heavy suburban railway traffic cannot run on them. To this must be added the fact that the maximum speed allowed in our cities is very low, and that even if this were not so the majority of the main thoroughfares are so narrow and tortuous that high speeds could not be attained even if they were sanctioned. These circumstances render it difficult, if not impossible, to build such lines as are to be found radiating from many of the large cities in America.

There is, however, an alternative method which might be



SOUTH LANCASHIRE TRAMWAYS

adopted in the solution of the London and suburban traffic problem; that is to say, an arrangement by which the numerous suburban lines might be operated by high-speed electric cars or trains without involving the huge capital expenditure which would be entailed by an attempt to increase the terminal facilities of the existing railways. This might be effected by building special lines of tubes or subways which would come to the surface a few miles outside the town, and thus avoid the crowded and congested area near the center. When they come up to the surface they join up with the suburban lines.

It seems highly probable that if the railway companies do not show themselves to be ready and willing to initiate considerable reforms, not so much as regards lower and more uniform fares as in the direction of an accelerated and more frequent service, Parliament, under the advice of the Royal Commission, may be prepared to grant to other companies the right to do the necessary work, giving them powers to construct lines on the principle above, i. e., underground in crowded districts where terminal facilities on the surface cannot be obtained, and coming to the surface as soon as possible outside the town.

At present some of the prettiest and most desirable neighborhoods are either not served at all or only served very badly, and it is the rule, and not the exception, on the existing railways to get average speeds of less than 10 miles or 12 miles an hour, with stations from 1 mile to 2 miles apart. This deplorable state of affairs is beginning to be realized by the British public, whose eyes have largely been opened by the improvements of the tramways and tubes in London, and the promises which have been made by Mr. Yerkes as to what he is going to do.

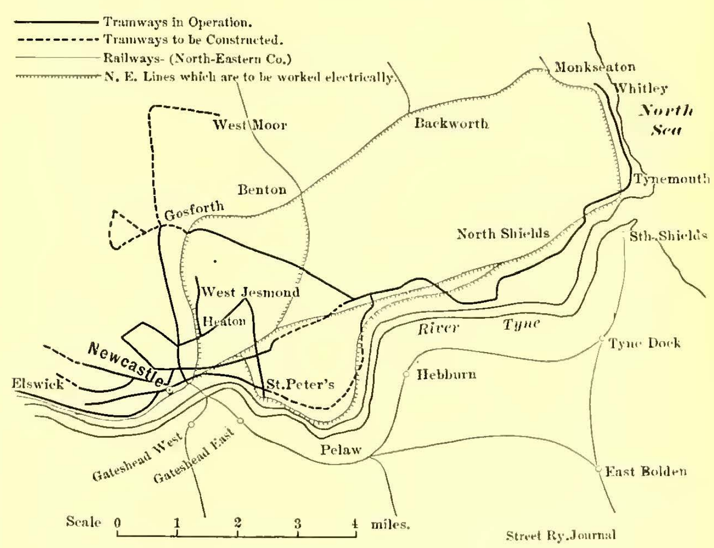
As already mentioned the whole question of London traffic is being very carefully investigated by the Royal Commission, and nothing fresh will be attempted until that body has made its report. The problem is exceedingly difficult and intricate, and is rendered more so by the fact that while the Commission is making its investigations Mr. Yerkes is building the tubes and other lines which have already been authorized, and any scheme of action which is drawn up will have to take these into account.

The situation in Great Britain, altogether, is surrounded by conditions peculiar to that country, and although much good may result from a careful study of what is and has been done in America and elsewhere, it should never be lost sight of that the problem is one which must be treated on its own merits if a successful solution is to be obtained.

London differs from most of the other large cities of Great Britain, in that the tramway systems in the latter are owned and operated by the municipalities, whereas, in London this is not the case at all; besides the London County Council there are several independent tramway, tube and underground railway companies.

Those who are interested in the subject of London traffic will, no doubt, have read the article which appeared in the last convention number of this paper (October, 1902,) which gave a very good idea of the existing network of railways owned by separate and divided interests. From this it will be seen that to operate all the existing tramways, railways and tubes, and make them work harmoniously together so as to best satisfy public requirements, is no light undertaking.

As already pointed out the railways, as a whole, are pretty well alive to the fact that if they do not change their ways the electric tramways which are springing up everywhere will seriously injure not only their suburban traffic but also the interurban traffic, especially in the densely crowded manufacturing districts which exist in various parts of the country. In fact, the competition of the tramways has already produced visible and tangible results. Under the auspices of Mr. Gibbs the North-Eastern Railway Company is at the present moment

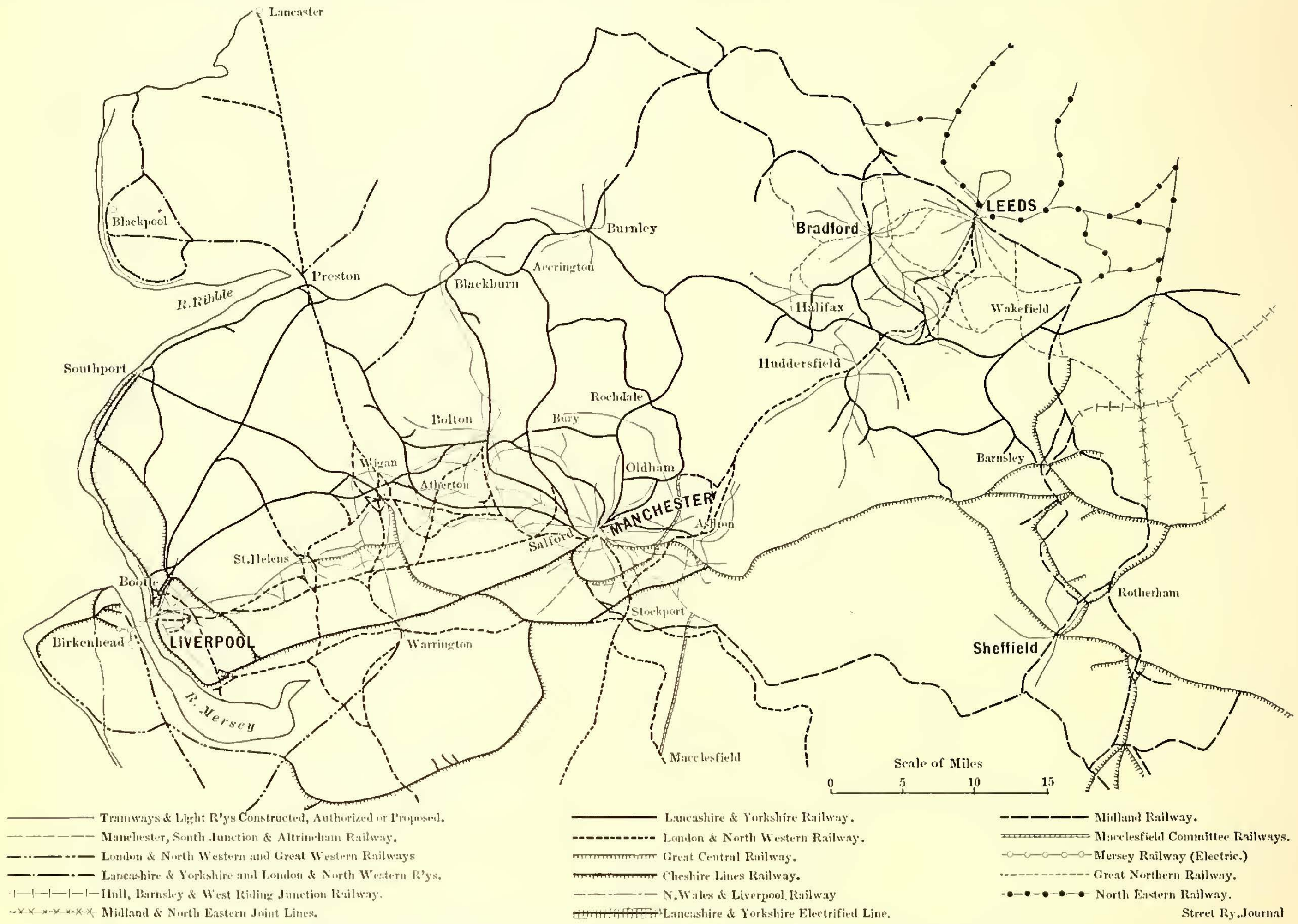


MAP OF TRAMWAYS AND RAILWAYS IN THE NEWCASTLE DISTRICT

equipping for electric traction the line which connects Newcastle and Tynemouth, this action being practically forced upon the company by the decrease in receipts caused by the tramways. A similar case is seen in the electrification of the railway between Liverpool and Southport, which is being carried out by the Lancashire & Yorkshire Railway, under Mr. Aspinall's supervision.

A very important tramway system, of which the first part has recently been completed, is that belonging to the South Lancashire Tramways Company, which was designed and carried out by Kincaid, Waller, Manville & Dawson, the consulting engineers to the company. The accompanying map shows the extent of the system. At the present moment the company has powers to construct 115 miles of tramways, which, when completed, will interconnect Liverpool, St. Helens, Warrington, Salford, Manchester, Oldham, Rochdale, Bury, Accrington, Blackburn, Bolton and Wigan, and weld into one complete system the various tramways which radiate from the large towns in the above district. Taken altogether, it means a vast system of intercommunication comprising some 600 miles of journey. It is obvious that to reap the full benefit of this network of tramways which will shortly be in operation, the various companies must have running powers over each other's lines, and if any difficulty is experienced in making such arrangements it is most probable that the opposing bodies will be compelled by government to grant running powers for the public good, independent of their private wishes.

The exact arrangements that will be made as to the details of the system in this and similar cases, and the division of the receipts from the passengers, are impossible to foretell definitely, but the following is an outline of the probable course



TRAMWAYS AND RAILWAYS IN THE LANCASHIRE AND YORKSHIRE DISTRICT

route, and serving a population of over 5,000,000 souls. These tramways when complete will constitute a rival to the railway companies that the latter cannot ignore, and whose competition will soon make itself felt if the railways persist in their refusal to advance with the times. A glance at the map, which has been specially prepared for this article, will show what a strong position this network of tramways will hold.

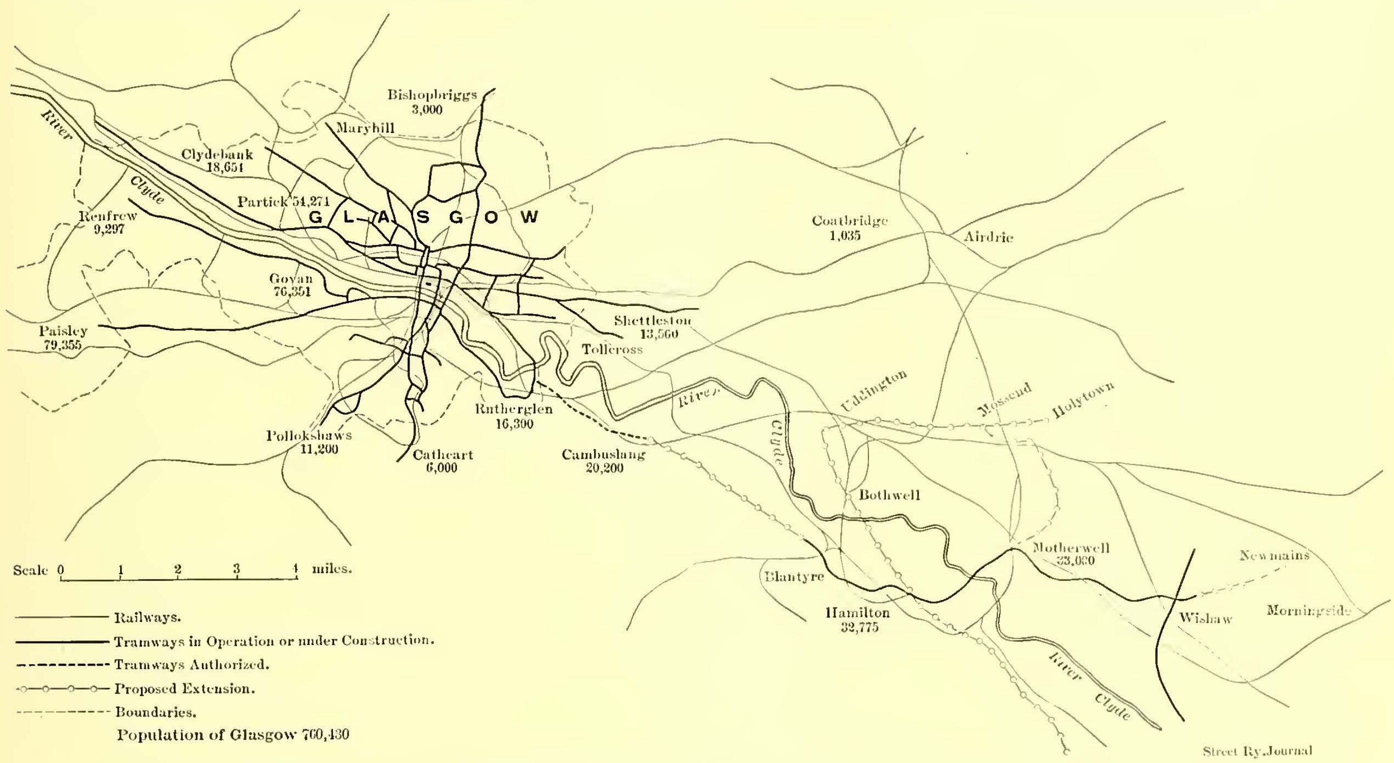
The map of Glasgow and its neighborhood is very interesting, as showing what could be done in that district, and what, in fact, will undoubtedly be carried out in the near future.

All the maps illustrating this article show very clearly how keen the competition of tramways with railways is becoming. This is especially evident in the case of the tramways in the South Lancashire and Yorkshire districts. As will be seen, when the various proposed extensions are completed, a very large and populous area will be covered with a continuous network of tramways, on which arrangements for through running will doubtless be made. Even in the present state of affairs it is possible to travel by tramcar right through from Liverpool Docks to Bolton, as was demonstrated practically on the occasion of the opening of the recently completed section of the South Lancashire tramway system by a car performing this of affairs: Each company or municipality will provide the electric power and the conductors and motormen for the cars that run over the lines owned by them, and will receive the fares of the passengers, but will pay a fixed rate per car-mile to the body who owns the cars for their use. To deal with through fares where passengers travel over lines of several different parties a clearing house would have to be used.

In the case of through routes and running powers in the London district it is very probable that some law will be passed giving compulsory running powers at specified rates to companies over each other's lines, also that to relieve Parliament from the burden of deciding such and other questions a special department will be formed. Such a proceeding would undoubtedly facilitate matters and generally tend toward reducing the useless waste of money and unnecessary delay which so constantly occurs in the present state of affairs.

The competition of tramways will not affect all railways in the same way and to the same extent. Thus, between Liverpool and Manchester, broadly speaking, there are two companies chiefly concerned, viz., the London & North-Western and the Cheshire lines, which, besides being subjected to outside competition, are rivals to each other; between Leeds and

America, and run high-speed cars on their own right of way, Bradford it is the Midland & Great Northern; between Huddersfield and Manchester it is the London & North-Western; the Lancashire & Yorkshire Railway are the lines chiefly concerned in the district around Bolton, Blackburn and Burnley. It seems pretty obvious that in the above and similar cases the various railways will be driven to electric traction to regain and retain their interurban traffic. In the event of their doing so they would undoubtedly be successful in securing this traffic, as by running on their own right of way they could use speeds quite out of the question for the tramways. The railways would then be in a very strong position, and even if the interurban tramways should develop, as has been the case in Corporation Tramways, and Mr. Cottrell, the enterprising engineer of the railway, decided to use more powerful motors, and by obtaining more rapid acceleration increase the schedule speed of the trains, and thus be able to give a more rapid and frequent service. An entirely new equipment has been installed by Dick, Kerr & Company, which gives an acceleration of over 3 ft. per second per second, which is higher than any to be met with in regular practice in any other part of the world. This enables an average speed of about 19 miles an hour, to be obtained with stations approximately 700 yds. apart, including 10 seconds wait at the stations. This action on the part of the Liverpool Overhead Railway has converted into considerable profit what was formerly a weekly loss.



MAP SHOWING GLASGOW CORPORATION, HAMILTON, MOTHERWELL AND WISHAW TRAMWAYS

the railways being first in the field would not be seriously affected, as the tramways would not have any greater inducements to hold out to the traveling public, and, consequently, there would be no reason for any great amount of traffic to be diverted from the railways.

If the hands of the railways are forced in this way they will, doubtless, see the wisdom of dealing with their suburban lines in a similar manner, for they will find it harder to regain their old supremacy in this direction than in the other. A glance at the map will show how the tramways and railways radiating from Manchester parallel each other, and when one considers the peculiar advantages which tramways have in dealing with this class of traffic it will be realized how serious is the case of the railways.

The conclusion at which most engineers who have had experience have arrived is, that the time for the transformation of our long-distance main line railways is not yet come, and that the transformation, besides being beset with most serious difficulties, would result in very few advantages when completed. On the other hand, for the heavy traffic on suburban and interurban lines electric traction is peculiarly suitable; it has an enormous advantage from the very rapid acceleration which the use of electric motors renders possible, and the importance of this is well known to all who are at all conversant with the subject. The great value of rapid acceleration has been recently demonstrated in a most striking manner in the case of the Liverpool Overhead Railway. This railway was suffering considerably from the competition of the Liverpool

It is pretty generally predicted by those who are conversant with the subject that within the next five years or ten years almost all our railways will be operating their suburban traffic electrically. The next ten years or so will also doubtless see the electrification of those lines connecting populous manufacturing centers which are not a very great distance apart, and between which a large traffic already exists.

In many cases the electrification of the suburban lines may be pushed forward until they reach from 40 miles to 50 miles out, particularly where it is desired to develop pleasure traffic. Suggestions for a high-speed line of this sort between London and Brighton have often been made, but so far have always been thrown out of Parliament, owing to faulty plans and inadequate financial backing. While such a line does not at present seem to be particularly necessary, there is no doubt that the London, Brighton & South Coast Railway are quite alive to what is happening and are quite prepared to construct such a line should it be required.

It seems quite probable that, as stated above, owing to the great want of terminal facilities, separate franchises may be granted to connect the various business and residential centers in London to the outskirts. Electric tramways would serve the district within a radius of from 4 miles to 5 miles, and the electric railways would run the first few miles without stopping, until they had reached the boundary beyond which the tramways cannot be operated satisfactorily.

The maps of the district round Liverpool, Manchester, Bradford, Leeds, Sheffield, Birmingham and Wolverhampton shows the enormous competition which the railways in that district will shortly have to face, and that the constitution of a few systems similar to the South Lancashire undertaking, but on a smaller scale, will suffice to cover this district with a complete network of electric tramways, which, unless the railways act promptly, would probably be followed by electric railways connecting the large centers and running over their own right of way.

TERMS OF A PROPOSED UNION CONTRACT

Following are the terms of a contract recently submitted to an operating company by the Amalgamated Association of Street Railway Employees of America, which had succeeded in organizing the company's motormen and conductors. Needless to say, the plan was rejected by the company, but as the terms demanded, and the form in which they were presented are identical with those adopted as the standard of the organization, they will be interesting generally to managers of other properties similarly situated:

Memorandum of agreement made and entered into this .... day of ......, 19.., between the .... Railway, party of the first part, and the Amalgamated Association of Street Railway Employees of America, Division No. ...., party of the second part.

Witnesseth, That in the operation of the lines of the party of the first part both parties mutually agree:

Section 1.—That the party of the first part, through the properly accredited officers, will treat with its employees through the Amalgamated Association of Street Railway Employees of America, Division No. ...., through their properly accredited officers and committees.

Section 2.—The properly accredited officers of the association shall have full power to adjust all differences that may arise between the parties hereto with the properly accredited officers of the company. All differences shall be submitted to the superintendent or manager of the company by the properly accredited officers of the association, and if they cannot agree the president, or in his absence the secretary of the company, shall be called to the conference. If, after such conference, there still remains a disagreement the properly accredited officers of the association shall have power to order the case to arbitration at once. The board of arbitrators shall consist of three disinterested persons, one of whom shall be chosen by each of the parties hereto. A third shall be chosen by the two first selected. The finding of the majority of the said board shall be binding on both parties hereto, the cost and expense of which shall be paid as follows: Each party to pay its own arbitrator and both parties shall jointly pay the third arbitrator.

Section 3.—That all business arising between the parties hereto shall be transacted directly by the properly accredited officers of the company, and the properly accredited officers of the association, respectively. Any member of this association under this agreement laid off, and after investigation found not guilty, shall be reinstated in his former position and paid for time lost.

Section 4.—That any member of this association by act or word interfering with or disturbing the course of negotiations between the properly accredited officers of the company and the association, respectively, upon any subject whatsoever, or interfering with or disturbing the service in any manner contrary to the conditions and spirit of this agreement shall, upon mutual satisfactory proof of the same, be dismissed from the service.

Section 5.—That all members of the association in the service of the company shall be entitled to free transportation over all lines owned or operated by the company. Said free transportation to consist of book tickets or annual card passes the same as now in use.

Section 6.—In all cases where the officers of the company charge a member of the association with any offense said charge shall be specified in writing and a copy of the same be furnished to the secretary of the association within five (5) days after the alleged offense is committed.

Section 7.—In case the association suspend a member who is an employee of the company for any violation of their laws or rules it shall request his suspension in writing, signed by the officers of the association. The officers of the company shall suspend said employee at once without pay until such time as the association shall request his reinstatement.

Section 8.—Any member of Division No. ...., elected or appointed to office in this Division or the International Association, shall, upon his retirement from said office, have his respective place in the company's employ again.

Section 9.—That all motormen and conductors shall be members of this association and must be turned in for initiation within sixty (60) days from the time they were hired. When men are put on to practice they shall take out a permit card from the association, paying the association the compensation of one dollar ($1.00) for same.

Section 10.—From eight (8) to ten and a half (10½) consecutive hours shall constitute a day's work on all regular passenger runs. All motormen and conductors shall receive one-half pay for all necessary dead-heading, and when men are called upon to do any work they shall be paid from the time they have been instructed to report, and must in all cases be paid from said time until they are relieved or their car in the car house. No order to report for duty shall be considered as less than one (1) hour of service. No regular man shall be required to do any extra work when an extra is available, and should he be able to secure substitute he shall be allowed to do so.

Section 11.—Motormen and conductors on regular cars that are derailed, disabled or delayed in any way shall be allowed to work the number of consecutive hours their run calls for, and if over-time is worked they shall be allowed pay for same at schedule rate.

Section 12.—All motormen and conductors shall have their respective places on their respective lines on the board in accordance with the time they were hired, it being understood that this is to have effect on all men hired in the future. The present list to remain as it is. Motormen and conductors to have the preference of regular passenger and freight runs according to said list.

Section 13.—That all cars running over any line owned, operated or managed by this company shall be manned by members of Division No. ...., who shall have their place on said cars in accordance with their age in the service on their respective lines as provided for in this agreement.

Section 14.—All runs of less than eight (8) hours shall be considered extra runs. First extra to have the preferred run open to him each day and so on through the list, and that the board be marked up at the time the last day run gets off. If the time-table is so arranged that there is a greater number of runs of eight (8) hours or more on Saturday and Sunday they shall be considered extra runs. Runs of the greater number of hours to be preferred runs regardless of starting point. Runs of an equal number of hours and the same starting point, the ones starting first to be preferred. (Details covering local conditions are omitted for obvious reasons.)

Section 15.—All bulletins issued by the officers of the company relative to the duties of the motormen and conductors shall be posted at all starting points, or each man shall be furnished a printed copy.

Section 16.—Motormen and conductors on city lines shall be paid (many details are inserted here).

Section 17.—This agreement and provision thereof shall continue in force and be binding upon the respective parties hereto until one year from date.

................................Railway.
By .... President.

Seal.
.....................................Secretary.

Seal, For the Association,
By ...., President.
......................., Secretary.

REGULATIONS FOR ELECTRIC CARS AND AUTOMOBILES IN LEIPZIG

Recent regulations for electric cars and automobiles in Leipzig have been issued in conformity with the municipal ordinances, which prescribe that electric street cars shall not run at a higher rate of speed than 9 miles an hour in the business sections: with trailers, 7.2 miles; in residential sections, 10.8 miles an hour, or 9 miles with trailers, and in the suburbs, 15 miles, or 12 miles with trailers. The penalty for exceeding the speed limit is a fine up to $15 or imprisonment for fourteen days, or both. In case of accident a higher penalty may be inflicted. The City Council, at a recent meeting, passed an ordinance prohibiting the use of automobiles in most of the streets of the inner city, and in other parts allowing them to be driven only along those streets which are traversed by electric cars.

EMERGENCY CAR AND OTHER WRINKLES ON THE ORANGE & PASSAIC VALLEY RAILWAY

A convenient and novel type of emergency car has recently been built in the shops of the Orange & Passaic Valley Railway, of Orange, N. J., and is illustrated in the accompanying engravings. The Orange & Passaic Valley Railway has about 10 miles of track and operates a belt line through the Oranges, connecting the steam and electric railway lines which traverse this populous territory, and which radiate from Jersey City and Newark. The line has up to within recently been operated independently, but is now part of the system of the Public Service Corporation, which has just been organized as a successor to the North Jersey Street Railway Company, to operate all of the lines in this part of New Jersey.

The emergency car, a plan view of which is shown in Fig. 3, was designed by W. B. Brown, master mechanic of the company. The frame is of seasoned white oak throughout, with all tenoning, mortising and studding close driven in white lead. The outside and inside sheathing is of selected white pine, with tongue and groove painted, so that any shrinkage will not show streaks. The entrances to the car consist of two doors, 4 ft. wide by 6 ft. 6 ins. high, at each end of the car, one at the corner, as shown in the plan, and the other in the middle; also two sliding doors, 6 ft. wide by 6 ft. high, in the sides of the car. The platforms are vestibuled and provided with Brill angle-iron buffers and Smith headlights. The tower is one used on a Trenton tower wagon. It is 4 ft. sq., and is raised by means of a windlass from the outside of the car. It is equipped on top with a swinging platform with collapsable sides. When lowered the roof is perfectly water tight, as the sides of the tower are fitted with rabbitted pieces, which fit inside of the sealing pieces on the roof. A novel feature of the tower is that directly under the tower platform are small boxes each containing a number of extra ears, solder and acid, the three materials most frequently used when the tower is raised. It has been found a great convenience to have a supply of these articles so easily available by being stored in a permanent compartment close to the hands of the men while working on the tower.

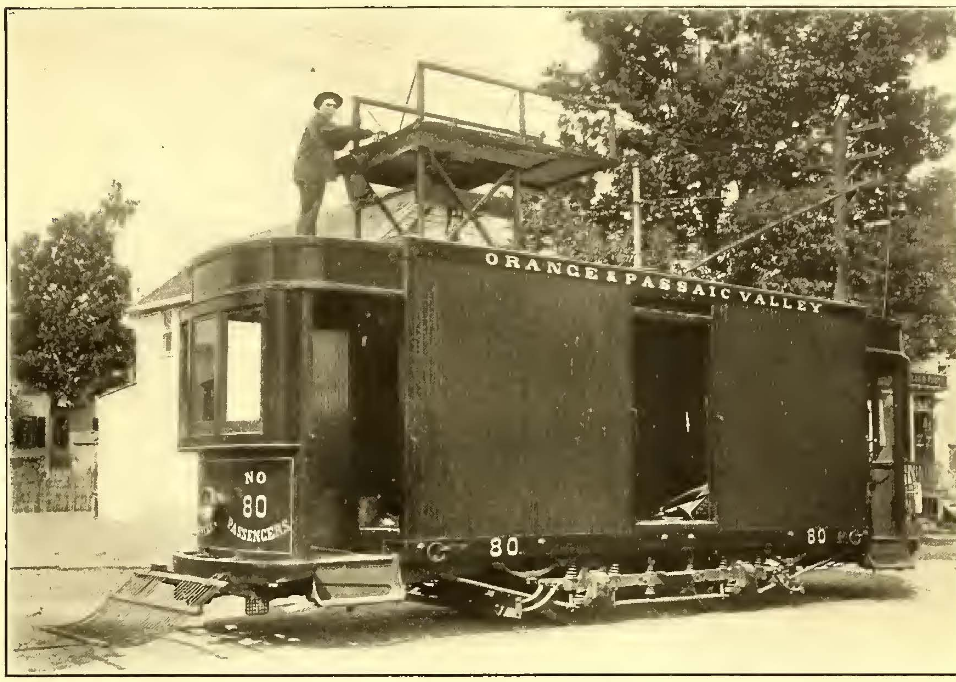


FIG. 1.—EMERGENCY CAR WITH TOWER RAISED

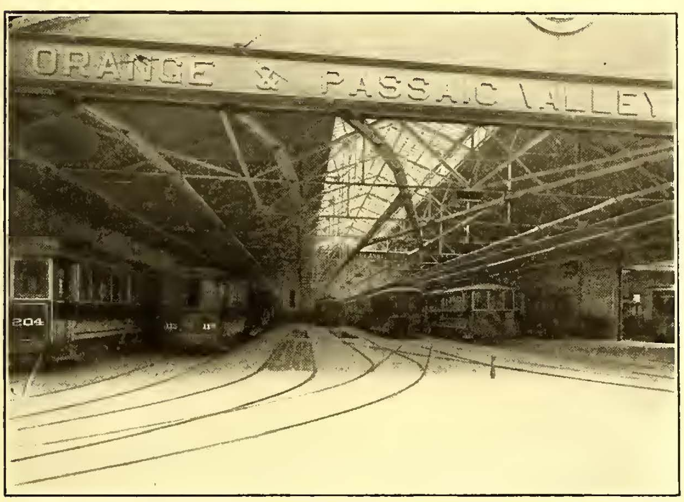


FIG. 2.—INTERIOR OF CAR HOUSE

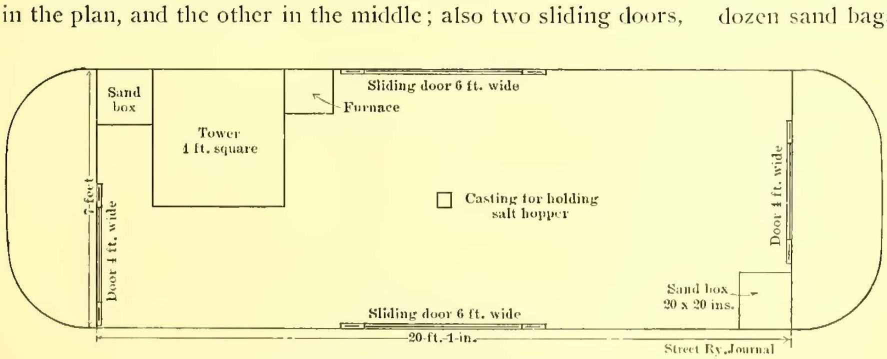


FIG. 3.—PLAN OF EMERGENCY CAR

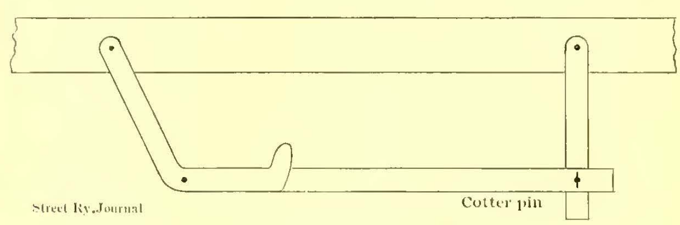


FIG. 4.—BRACKET FOR HOLDING LADDER

The sand-boxes, which are at each end of the car, are of the Brill type, with hoppers 20 ins. and 20 ins. x 32 ins. high. The hoppers hold forty-two pails of sand and are lined with sheet steel. There is room enough on the floor of the car for two dozen sand bags, as a supplementary supply, and this quantity is sufficient to sand the entire road. The sand-box is worked from the platform by hand, and the lever moves in a rack, which is provided with six notches, so as to give any sized opening up to the maximum, which is 2½ ins. In this way the flow of sand can be regulated according to the speed of the car.

Salt is not used in the sand-boxes, but when the track has to be salted a special hopper is placed in the middle of the car. At this point, as indicated in the plan, a casting has been located, provided with two cast-iron sockets. To these sockets hose or leading pipes can be connected to carry the sand directly to each track, and as these leaders are midway between the wheels they are always directly over the track. The salt hopper is of oak, 26 ins. long by 16 ins. wide, and the salt is shoveled into it as required.

A feature of the emergency car is its compactness and the method by which all needed parts have been stowed away to take up the least amount of room. This can be seen from the plan. Adjoining the base of the tower in the inside of the car is a small box, 15 ins. sq. by about 35 ins. high, for holding the primus No. 4 flame kerosene furnace for soldering. Several sizes of these furnaces have been tried, but the one mentioned has been found the most desirable, as it will melt solder in six minutes. Underneath the furnace-box is a small drawer for holding the salammoniac for cleaning the irons. A spring is attached to the inside of this drawer so that it is self-closing. The racks for holding the supplies are attached to the stationary part of the tower, which is inside the movable part, while the span wire and other coils of wire are hung over hooks attached to the walls of the car and are strapped down to prevent their swinging.

FIG. 5.—STRINGING LIVE TROLLEY WIRE

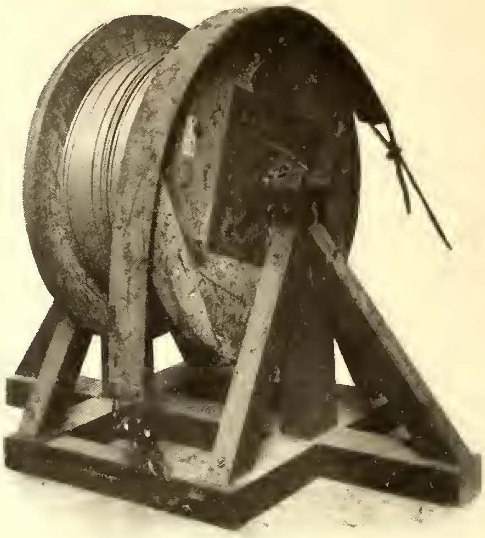


FIG. 6.—REEL FOR PAYING OUT LIVE TROLLEY WIRE

FIG. 7.—INTERIOR OF EMERGENCY CAR

One of the most ingenious features of the emergency car is the method of stowing away the 25-ft. ladder which is hung from the roof. A diagram of the bracket used for holding this ladder is shown in Fig. 4. It can be released by the removal of the cotter pin and bolt shown, which requires only a second or two, when the frame drops down. A 25-ft. extension ladder is long enough for all ordinary work, but a 36-ft. ladder can be carried in the car in case it is necessary to send two men up a pole to adjust a hot feeder or do other heavy work.

Another ingenious feature of the car is the provision made for stringing a live trolley wire. The Orange & Passaic Valley Company, with others, has suffered somewhat from trolley wire thieves, and it has been sometimes a matter of vital importance to be able to put up new trolley wire in a hurry. For this purpose, the reel of trolley wire is mounted on the frame shown in Fig. 6, the frame being carried in the middle of the car. The free end of the wire is then passed through the roof over two guide wheels, which are electrically connected through a cut-out switch to the controller. The wire to be strung can then be attached to the live overhead system and can be connected to the span wires as the car reaches them by men on the roof of the car, while the car receives power from new wire through the roof connection described. The wire in the car is kept taut by means of a band-brake, shown in Fig. 6, as surrounding one flange of the reel. The pressure on this band-brake is regulated by a block and fall attached to the end of the brake and to a ring in the floor. As, of course, the wire in the reel is alive the band-brake is insulated, as shown, by two globe strains, but the reel itself is not otherwise insulated, as it is found that the wood insulation of the reel, frame and car are sufficient if care is taken in paying out the wire.

Door cranes are not used, as it has been thought they would be in the way. Instead narrow windows are placed over the tops of the side doors, as shown in the side view of the car. In case any heavy stuff has to be lifted in or out of the car these windows are opened and a 4-in. T-bar is laid across, from one top door frame to the other, to carry a block and fall, and this arrangement is found to answer all practical purposes. The side doors have a self-locking latch so they cannot be opened from the outside. The bell cord is carried on one side of the car only, to avoid interference with the coils of wire which are hung inside the car.

Special fender castings were designed, so that when the fender is raised it clears the buffer entirely, so that cars can be pushed directly by the buffer instead of through the fender. The car is equipped with rings in staples screwed into the sills for hauling, and also with a 14-in. dedenda gong. This gong is considerably larger than those used on the ordinary cars and is of a different sound, so that the approach of the emergency car can be recognized for some distance.

The car is mounted on a Peckham single truck and a convenient step for the side-door on each side has been provided by riveting an angle-iron to the top side bar.

When the tower is raised men can work with comfort on a 22-ft. 6-in. trolley wire.

SAND DRIER

The method of drying, screening and storing sand used in the car house of the Orange & Passaic Valley Railway is very in-

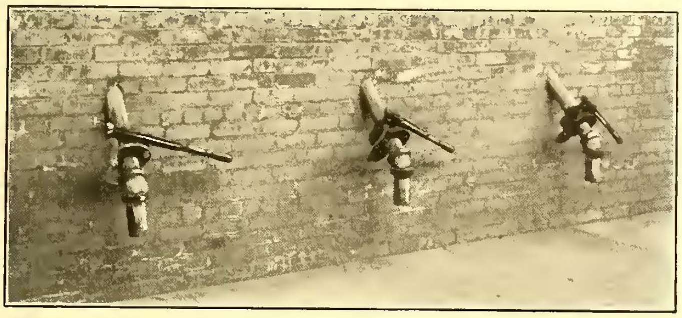


FIG. 8.—SAND VALVES IN CAR HOUSE

FIG. 9.—INTERIOR OF SAND-DRYING ROOM

genious and convenient, as practically all handling of the sand is done by machinery. The sand-drying apparatus is all contained in a small room about 12 ft. sq. with brick walls, adjoining the car house, and shut off from it by a fireproof door, as the sand-drying furnace contains a fire.

The sand is received in carload lots, and is dumped directly into a hopper. From this hopper it is shoveled into the drier, which consists simply of a spherical stove with an exterior cylindrical casing of sheet-iron. Directly over the hopper surrounding the stove is a hood connecting with a flue surrounding the stove-pipe and leading out into the open air, so that as the moisture which is dried out of the sand rises it is caught by the hood and passes outdoors through the flue. As the dry sand falls from the drier it passes through the screen, or is shoveled through the screen as the occasion demands, and then falls into a pocket, from which it is elevated by a bucket conveyor driven by a small 2-hp motor, to a sand bunker above. It is then in condition to be used at any time. From this bunker three pipes are led through the wall of the car house at an angle of 45 degs. Each pipe is provided with a home-made gate valve, and any motorman desiring sand can get out as much as he wants in a pail. The sand valves are shown in Fig. 8, and the interior of the sand-drying room in Fig. 9.

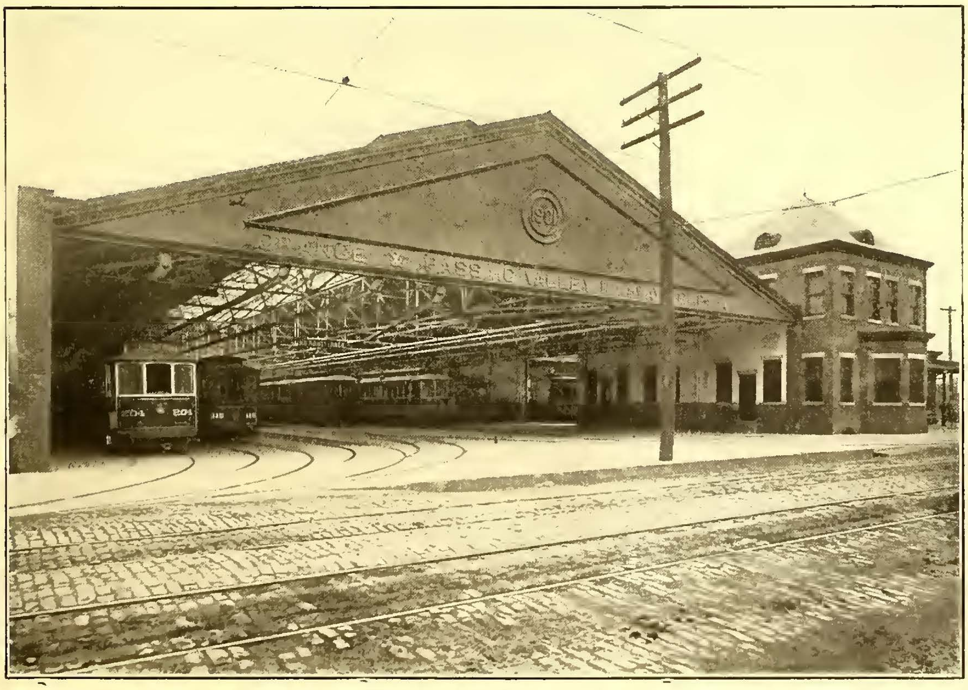


FIG. 10.—GENERAL VIEW OF CAR HOUSE

CAR HOUSE

The exterior and interior of the car house are also illustrated herewith. The floor is of concrete with concrete pits, and at one end is a brick building for the offices of the company, waiting rooms for the passengers and room for the conductors and motormen. The car house proper is divided into two bays, one of which contains the repair tools and is heated in winter. Here most of the pit work is done. The storage bay is not heated. The car house has a capacity of sixty cars.

THE SPRINKLER

A slight improvement has been added to the sprinkler, which is worthy of mention. The sprinkler is a double ender with two jets at each end, supplied through a 5-in. pipe. The flow of water was controlled by a valve in this pipe, but its use has been discontinued and a 3-in. tap has been put near the end of each of the four sprinklers. This gives a control over either side of the sprinkler and is economical of water, as there is less spill when the water is turned off.

AN EMERGENCY TRACK BRAKE USED BY THE UNITED RAILROADS OF SAN FRANCISCO

From the time street cars were first run in San Francisco the necessity of a brake which would stop cars on heavy grades and on slippery rail became very apparent. This necessity is explained by the fact that San Francisco is very hilly, and also that during the winter season the drizzling rains and fogs make the rail very slippery. To give an idea of some of the grades it might be stated that electric cars are operated on 17 per cent down and on 14 per cent up grades. Cable cars are operated on 18 per cent grades, and one electric line, with counterbalancing device, is operated on a 25 per cent grade.

The first experiment with track brakes was made in 1883, when the Market Street Railway Company built a cable line on Market Street, the principal business street of San Francisco. The brake was similar in principle to the brake which will be hereafter described. It was placed on the rear truck and operated by a lever placed alongside of the grip lever. The cars were also equipped with wheel brakes, those on the front truck being operated by a foot lever, and those on the rear truck by an ordinary staff and handle on the rear platform, the two being independent of each other.

In 1893 the Market Street Railway Company consolidated with several other lines, and in 1894 commenced to change the motive power of some of its lines from horse and cable to electric. The first cars were equipped with the ordinary hand-wheel brakes. It was immediately discovered that an emergency brake other than a wheel brake was required. The cable cars were, in a measure, safer than the electric cars, for as long as a grip on the cable was maintained the car could at least not go faster than the cable. The electric cars had no such safeguard. In 1895 G. W. Douglas, then master mechanic of the Market Street Railway Company, started to experiment with track brakes on electric cars. Twelve single-truck cars, running over the steepest grades, were equipped with track brakes, and operated quite successfully until 1899. The electric system kept growing rapidly, and Mr. Douglas kept pace with it by improving on his brake. In 1899 he reconstructed his brake and made it applicable to double as well as to single trucks. This is the brake which is now so successfully used in San Francisco.

Primarily, the brake (see Fig. 1) consists of a hand lever, *A*, on the left-hand side of the controller, connected by a brake-rod, *B*, to an arm, *C1*, keyed on a shaft, *D*, extending across the truck. This shaft is connected on each end by means of a short lever, *E*, keyed to the shaft, to a connecting link, *F*, and to a toggle lever, *G1*. The connecting lever, *F*, is connected to a lever, *H*, keyed to a short shaft, *I*, and to a toggle lever, *G2*. A shell, *J*, for holding the shoe is fastened to the two toggle levers. By pulling back

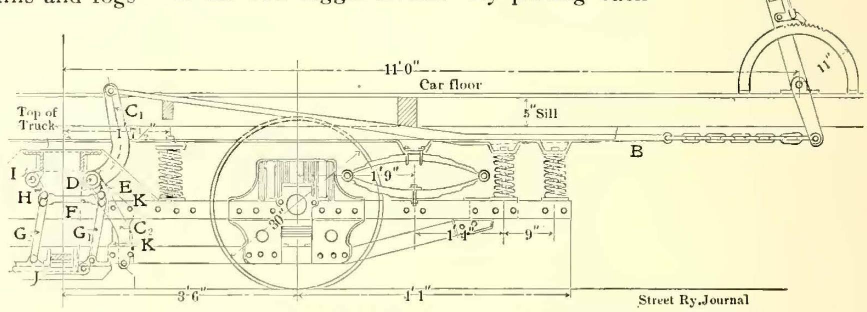


FIG. 1.—TRACK BRAKE APPLIED TO A PECKHAM SINGLE TRUCK

on the hand lever, *A*, the shaft, *D*, turns from left to right, tending to make the short lever, *E*, assume a vertical position. This motion is also transmitted to lever, *H*, by means of connecting lever, *F*. The simultaneous parallel movement of levers *E* and *H* cause the toggle levers *G1* and *G2* to force the shoe to rail, thus braking the car.

In order to adapt this brake to a Peckham single truck it is necessary to fasten a flat iron, *K*, bent, as shown, to the side frames, using the holes on each side of one of the spiral body springs. Two angle-irons are placed transversely across the truck, and fastened to the bent iron, *K*. To these angle-irons the brass boxes for holding shafts *D* and *I* are bolted. The large shaft, *D*, is held in position by three boxes, one on each end and one next to the arm, *C*. The short shaft, *I*, is held by two boxes, one on each side of lever *H*. It was also found advisable to use heavier iron than is usually furnished on trucks to connect the pedestals. Instead of using one brace, *K*, two are used, being so placed as not to interfere with the toggle levers.

To operate the track brake from the other end of the car an arm, *C2*, is keyed to the shaft *D*, the brake-rod being placed under and on one side of the motor, as shown in Fig. 2.

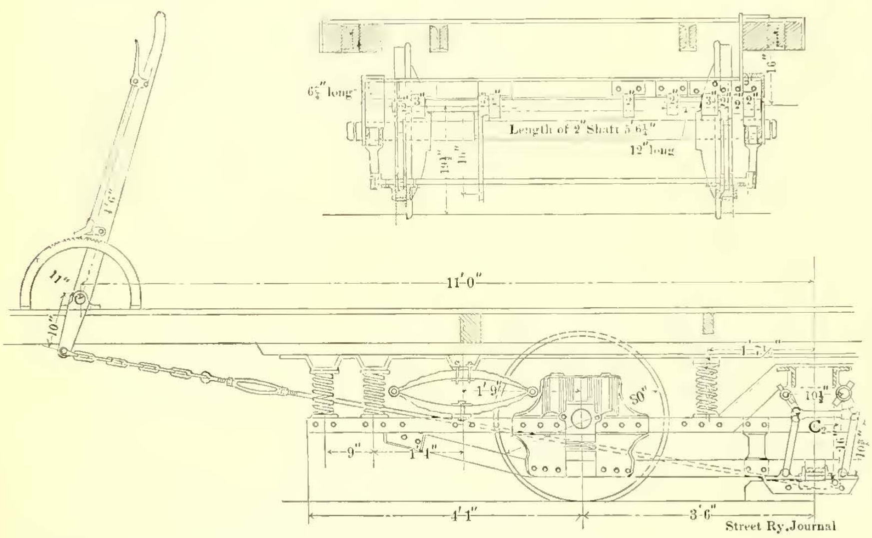


FIG. 2.—DIAGRAM SHOWING CONNECTION TO OPPOSITE END OF TRUCK

Considerable ingenuity is required to place these brakes on some cars on account of the sills of the car body not being in the proper position. Arm, *C1*, for instance, in many cases has to be placed under the seat, as the floor may have to be cut. The same result could be accomplished by raising the car body by means of placing a riser on the top rail of the truck.

This brake is placed on double trucks in practically the same manner as on single trucks, except that each truck has an independent brake, operated from the end of the car nearest the truck. On double trucks it is not necessary to provide angle-irons, as the boxes for holding shafts are bolted to the transom angles. Fig. 3 shows the track brake as applied to a

Brill 27-G double truck, and Fig. 4 shows its application to a Peckham 14-B 3-S double truck.

Fig. 5 shows the standard shoe used in San Francisco. This shoe is made of Oregon pine and costs about 3 cents. The material to be used for shoes was the subject of many experiments. All kinds of hard and soft wood, all kinds of metal, combinations of metal and wood, and metal with all kinds of

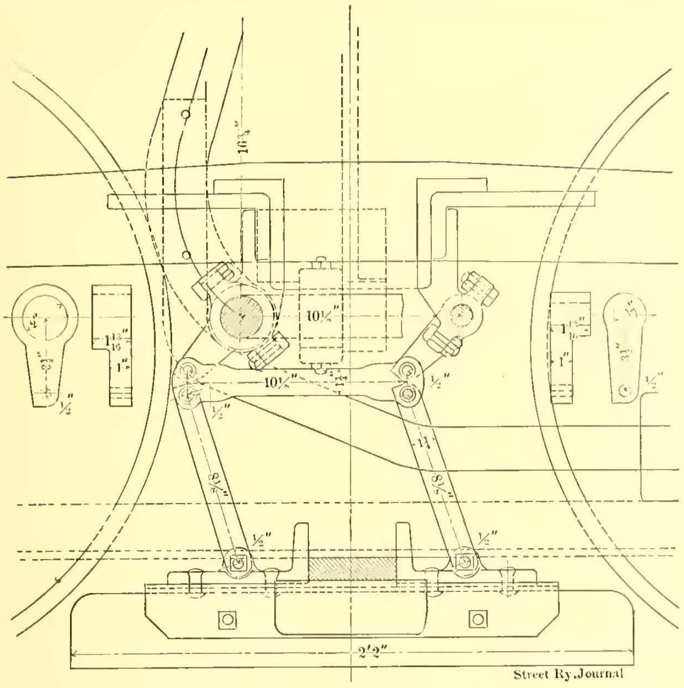


FIG. 3.—TRACK BRAKE APPLIED TO BRILL 27-G TRUCK

inserts were experimented with. For cheapness, general utility and highest braking efficiency the Orgon pine shoe was found superior to anything else. The shell for holding the shoe is made in two parts, held together by two bolts. The bolts pass through the recesses in the shoe, not only clamping the shoe by means of the shell, but also keeping the shoe from slipping backward or forward. In order to facilitate the removal of worn-out shoes, sections of rail slightly longer than the shoe, are hinged in the car house tracks. The cars are placed with

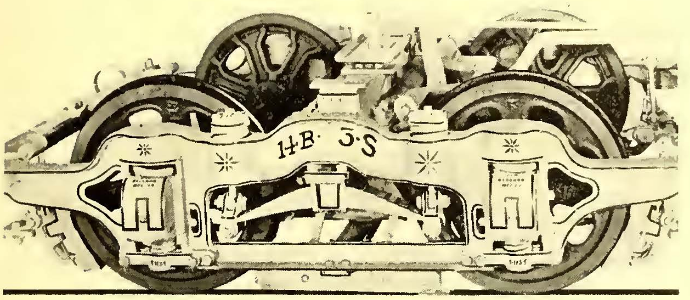


FIG. 4.—TRACK BRAKE ON PECKHAM 14-B 3-S TRUCK

the shoes over these hinged rail sections, the section of rail swung out, and by loosening two bolts the shoe drops out. The time required for replacing four shoes on a double-truck car is about five minutes.

As stated in the title this brake is an emergency brake. It is not intended to be used on curves, crossings, switches, etc., on account of the liability of tearing out the shoes. It is used, however, regularly in coming down steep grades, making service stops on grades, and in many cases for service stops on level streets on a slippery track.

It is especially valuable for making quick stops in San Francisco, on account of the style of cars. San Francisco cars, as a rule, are open on both ends, and have a closed section in the center. The seats are all longitudinal, thus leaving a kind of a cab for the motorman. The wheel brakes are operated by a lever on the right side of the controller. The track brake lever is on the left-hand side. If a quick stop is desired the motorman takes hold of one lever with each hand, and by

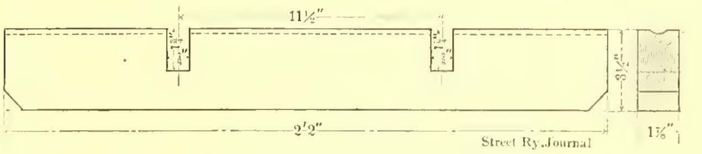


FIG. 5.—STANDARD TRACK BRAKE-SHOE

throwing his weight back on these levers he applies both track and wheel brakes simultaneously.

A test was made with a double-truck car, 40 ft. long and weighing 32,500 lbs., to find how quickly the track brakes would stop the car. The car was run down a 10 per cent grade at full speed for half a block. The track brake, alone, was then applied, and the car stopped within 60 ft. A similar test was made with the wheel brakes, and although the wheels were locked so that every wheel was "skidded," the car was not stopped until a distance of 260 ft. had been gone over.

TRACKLESS TROLLEY CAR-SLED

The accompanying cut illustrates a trackless trolley car-sled, manaufactured by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, Germany, under the patents of Carl Stoll. The regular car body is mounted on three pairs of wheels, the two motors used being placed on the center axle. When it is desirable to use the car as a sled, runners are substituted for the

TRACKLESS TROLLEY CAR SLED

third pair of wheels, and the other wheels are fitted with special ice-gripping tires. Owing to the flexibility of the current-taking device, these cars and sleds can be steered from one side of the street to the other very readily. As vehicles of this character can be safely operated at moderate speeds, they should prove of value for handling urban passenger traffic and light freight business.

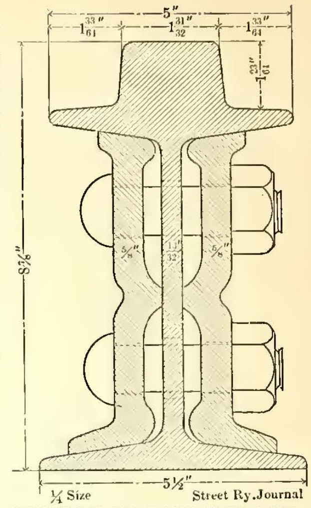
By an order of the Supreme Court of Connecticut the construction of an electric road between Wallingford and Montowese has been authorized. This will complete the through electric line between New Haven and Boston by way of Meriden.

TRACK CONSTRUCTION AT KANSAS CITY

Under the supervision of Ford, Bacon & Davis a large amount of track construction and reconstruction is going on at Kansas City on the lines of the Metropolitan Street Railway Company. All the cable lines are to be abandoned and 35 miles of cable road are to be changed to electric.

The rail used at Kansas City is peculiar, being practically a girder rail with a narrow tram on each side of the head. This type of rail has been used in Kansas City for many years. It is advantageous from an operating standpoint because dirt slides off the head of the rail onto the tram, so the rail is always clean. The standard rail adopted for the new construction is the Lorain Steel Company's 106 lbs., section number 364, which is reproduced here. Guard rails are 119 lbs. For the support of the rails concrete is depended upon to a large extent. In fact, where there is a good street foundation the track is laid without ties, and held to gage by tie-rods and supported on concrete beams. The tie-rods are placed 6 ft. apart. The concrete beams are 2 ft. wide and extend 8 ins. underneath the base of the rail. The joints are cast-welded.

Fig. 1 shows some of the construction without ties, with the moulds in place ready for the cast-welded joints. The moulds are covered with sand, so that the joints will cool slowly after being cast. If the street is already paved with good asphalt pavement the entire pavement is not removed, but trenches are cut in the asphalt pavement for the rail, as seen in Fig. 2, and grooves for the tie-rods. It is, of course, important that there be a good foundation for the paving in this case, so the settling of track and paving will be even. Asphalt paving is not carried fully up to the rail, because there is danger of vehicle-wheel wear near the rail. A row of toothing stones is placed each side of the rail, as seen in Fig. 3. Where there is not a good street foundation ties are laid every 6 ft., as shown in Fig. 4. The



SECTION OF RAIL USED IN NEW CONSTRUCTION, KANSAS CITY

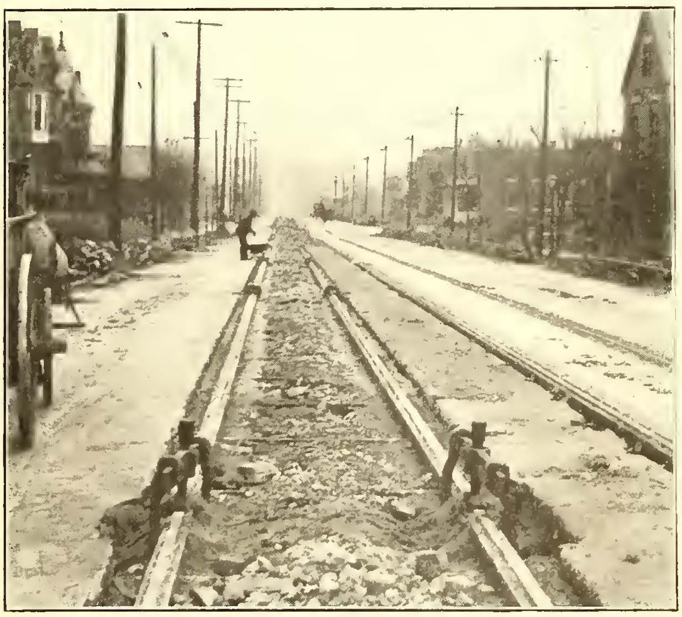


FIG. 1.—MOULDS SET READY FOR WELDING

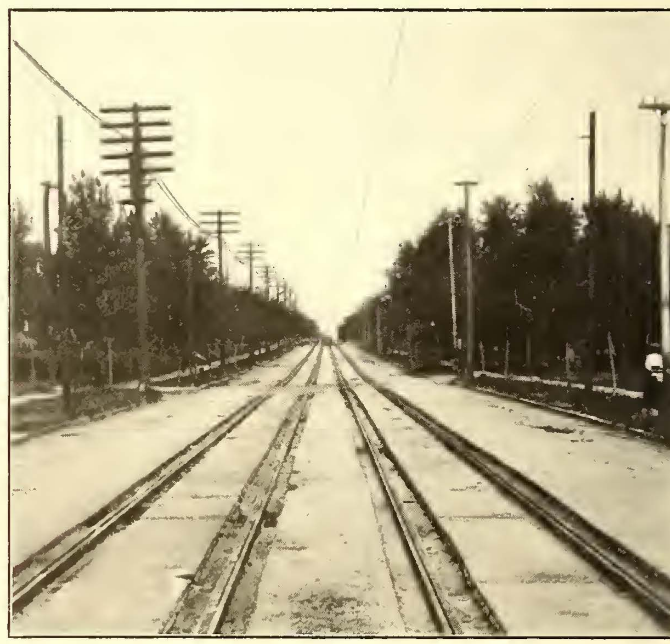


FIG. 2.—TRENCHES FOR BLOCKS IN ASPHALT PAVING

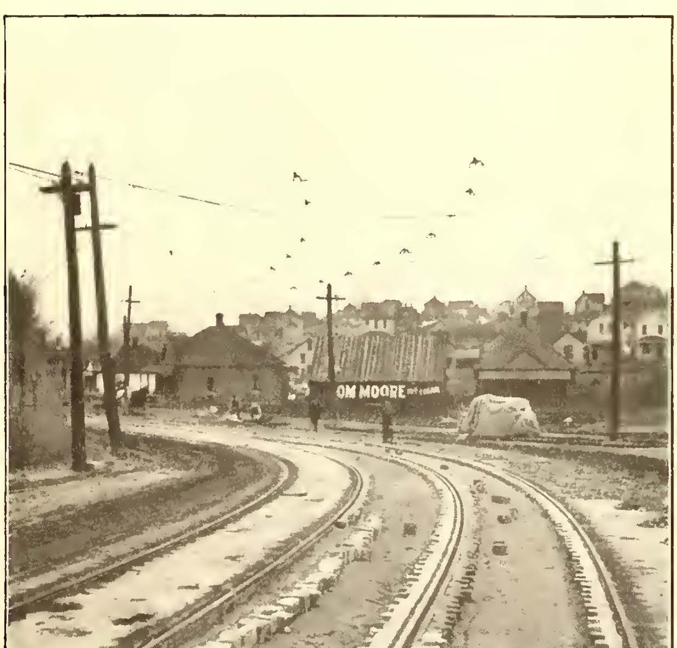


FIG. 3.—VIEW ON CENTRAL AVENUE, SHOWING METHOD OF LAYING PAVING

FIG. 4.—VIEW ON SUMMIT STREET, SHOWING SPACING OF TIES AND TIE BARS

track is laid with fish-plates on the joints. After the concrete is set the fish-plates are taken off and the joints cast-welded. Concrete is then laid around the joint. The track is laid with ⅛-in. opening between the rail ends, which is filled when the joint is cast-welded.

NEW TYPE OF SUBURBAN CARS ON THE ILLINOIS CENTRAL RAILROAD

As is generally well known the Illinois Central Railroad does a very large suburban business between the center of Chicago and the towns south of that city. As the road has four tracks for the greater part of this distance, and as the stations average a mile or less apart, the service is very similar to that of an elevated railroad, so that the new departure made by the company in the way of cars especially fitted for this traffic is extremely interesting. At the time of the Chicago World's Fair the company built a number of side entrance cars especially for the World's Fair traffic; and although the cars were in many respects very crude it was found possible to load 1000 passengers in ten seconds and unload them in the same amount of time, and on one occasion five trains, each carrying 1000 passengers, were unloaded and discharged successfully from the same platform in four minutes. The total number of passengers carried during the day on which this record was made was 509,000, and no accident of any kind occurred.

The company has two sizes of suburban cars at present in use. One is of the same dimensions as those used on the elevated railways, with a seating capacity of forty-eight passengers. The other is known as a "large suburban" car; it is 51 ft. long, with a seating capacity of fifty-six passengers, and the seats are arranged as shown in Fig. 1. The successful experience with side-entrance cars during the World's Fair, however, has induced the company to try the plan again, and eight cars are being built to determine the practicability of this type of car for suburban service. The June issue of the "American Engineer and Railroad Journal" gives some particulars and plans of these cars, from which the accompanying information is obtained:

Plan No. 1 is intended for a road with terminal loops and platforms on the outside of the track, although it may be used without the terminal loops by having the platforms on the same side (east or west) of each track. Plan No. 2 serves the same purpose as plan No. 1, with the further provision that passengers may enter and leave the car on both sides. This plan is intended for use where the platforms are principally on one side, with an occasional island platform on the other side of the track. The capacity of this car is the same as that of plan No. 1. Plan No. 3 is intended for use where there is considerable travel of moderate volume entering and leaving the car on both sides. The provision of having the aisle extend one-half length on each side, with cross aisle in the middle, is a desirable one where there is no great rush of travel, as it gives the seated passengers the same freedom from passing travel in and out of the car as does plan No. 1. There is, however, a loss of a few seats by this arrangement, this plan for the small car seating four passengers less than plans Nos. 1 and 2. Plan No. 4, with aisles and doors the full length on both sides of the car, is designed to meet the requirements of the very heaviest

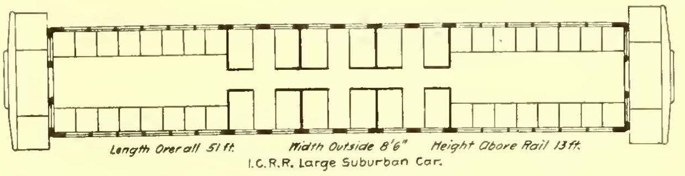


FIG. 1.—PLAN OF PRESENT SUBURBAN PASSENGER CAR

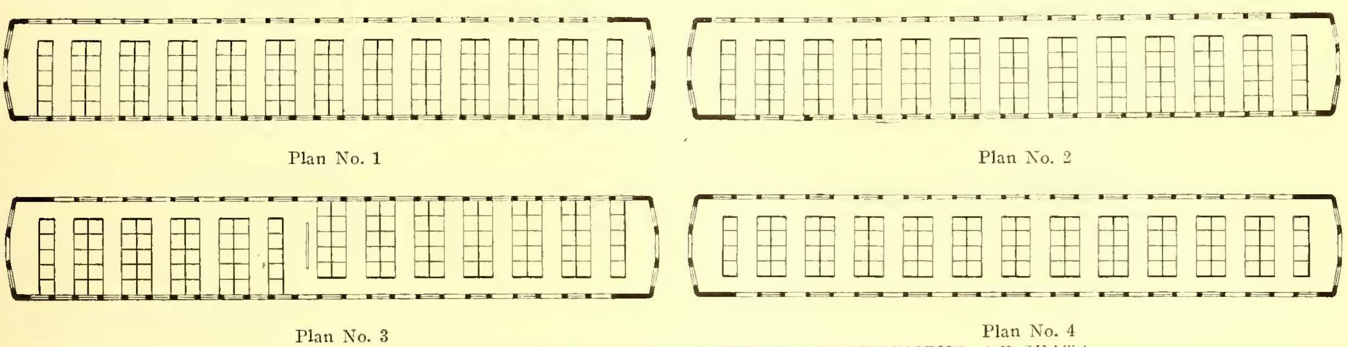


FIG. 2.—SEATING PLANS, SHOWING DIFFERENT ARRANGEMENT OF SEATS

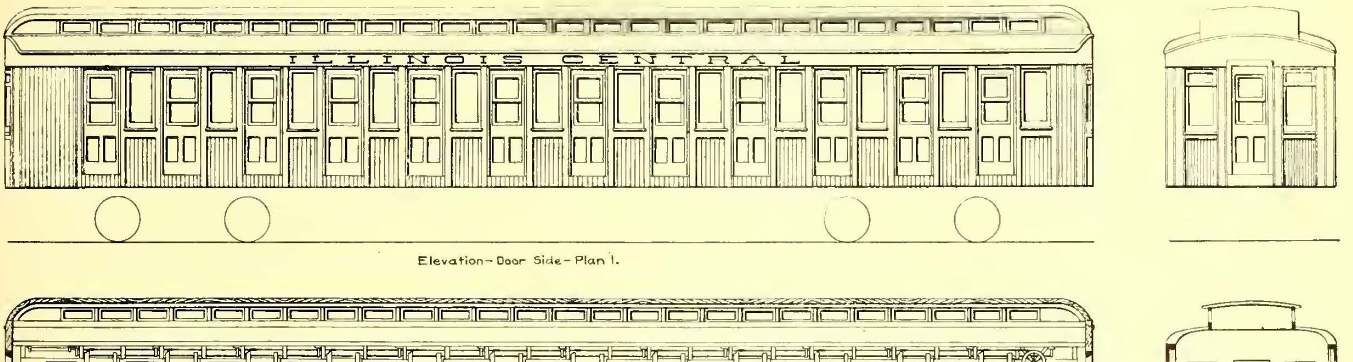


FIG. 3.—ELEVATIONS AND SECTIONS OF STEEL-FRAME, SIDE DOOR SUBURBAN PASSENGER CARS FOR ILLINOIS CENTRAL RAILROAD

travel, with frequent stops at intermediate stations having platforms on both sides of the track.

The weight of the new car per passenger by this construction will be greatly reduced, combined with an increase in the strength of the car beyond that of anything heretofore attained in car construction, as will be seen from the following figures:

	Length	Seating Capacity	Weight	Weight Per Passenger	Floor Strength: Safe Load Per Sq. Ft.	Floor Strength: Ultimate Load Per Sq. Ft.
			Lbs.	Lbs.	Lbs.	Lbs.
Improved suburban car	65 ft.	120	78 000	650	160	800
Regular suburban car	51 "	56	38,000	679	76	380
Standard coach	61 "	62	86,000	1,387	81	405

The following table shows the seating, standing and total capacity of the different plans compared with the cars now in use:

	Seating Capacity	Standing Capacity: Clear of Entrance and Exit	Standing Capacity: Full	Total Capacity: Seats Standing and Clear	Total Capacity: Seats Standing and Full
Plan 1	120	48	60	168	180
Plan 2	120	48	60	168	180
Plan 3	115	53	65	168	180
Plan 4	96	72	96	168	192
I. C. Suburban	56	0	41	56	97

In the matter of standing room there is great advantage to the passengers in that so large a number can stand clear of the entrances and exits. It is also an advantage to avoid having a large group of passengers standing together, particularly when dependent for support upon straps suspended from the roof of the car. The solid group of passengers which can gather in one mass in a car having a wide center aisle will be less able to resist the lunging effect of high rates of acceleration and retardation than when they can individually brace themselves against a rigid support of medium height, and thus avoid discomfort and frequently the distress that comes from the swaying of such a mass of passengers.

It is of more importance now than ever before that passenger cars should be constructed of the greatest strength consistent with reasonable weight. To obtain this result a metal frame work is necessary not only for the floor of the car but for the walls and roof, in order that when collisions occur, especially at high rates of speed, or when derailments occur and cars rub against the walls of tunnels or other structures, the floor and sides of the car will not be demolished, as is quite likely to be the case with lightly constructed wooden cars.

The greatly increased capacity of the improved suburban car is not due altogether to its larger size, as the following comparative statement shows that per foot of length the new car has 46 per cent greater carrying capacity than the old:

	Present Suburban	Improved Suburban: Plan 1	Plan 2	Plan 3	Plan 4
Length of cars	51 ft.	65 ft.	65 ft.	65 ft.	65 ft.
Length of cars, per cent	100	127	127	127	127
Passengers seated	56	120	120	115	96
Passengers seated, per cent	100	214	214	205	171
Passengers standing	41	60	60	65	96
Passengers standing, per cent	100	146	146	159	234
Passengers, total	97	180	180	180	192
Passengers total, per cent	100	186	186	186	198
Passengers per foot, seated	1.10	1.85	1.85	1.77	1.48
Passengers per foot, seated, per cent	100	168	168	161	134
Passengers per foot, standing	0.80	0.92	0.92	1.00	1.48
Passengers per foot, standing, per cent	100	115	115	125	185
Passengers per foot, total	1.90	2.77	2.77	2.77	2.95
Passengers per foot, total, per cent	100	146	146	146	155

The side doors may be operated either by hand or by compressed air, the controlling mechanism being located within the walls of the car and out of sight. The mechanism provides for the positive opening, closing and locking of the doors by air or by hand. It also provides for closing the doors, locking and unlocking, but not opening them, leaving that to be done by the passengers, which, during the season of cold weather, would probably be the preferable way. The doors may be operated from either end of the car, and if necessary also from the middle. The quickness with which the doors may be manipulated and the absolute control of them by the trainmen will greatly reduce the time of the stops.

There being no grab-handles on the outside of the car and no possible means of effecting an entrance when the doors have been closed, there is no temptation nor any opportunity for a belated passenger to get aboard after the train has started, neither is there any opportunity for a passenger to get off the train before it has come to a full stop, because all the doors are closed by air pressure and can be released only by the trainmen, which will not be done until the train has stopped. All movements, therefore, of entrance and exit can be made only when the train is standing at the station platform, and one of the principal hazards of the service is thus eliminated.

As to the opening and closing of the doors: the walls of the car being hollow and the doors moving between them, there is no chance for a passenger to be caught and injured by them when opened; when closed, the movement, at first rapid, is graduated automatically by air cushions, so that the final closing movement is gentle and safe. Should any portion of a passenger's garment become caught by the door when closing the elasticity of the air pressure against the door will admit of the garment being withdrawn without injury. Furthermore, the air cylinder for the operation of the doors being quite small, it has not sufficient power to cause injury by its pressure should a passenger inadvertently be caught in the doorway when the door is closing.

NOTES ON SUB-STATION PRACTICE

The modern electric railway sub-station may fairly claim to be one of the most interesting features of the system. Its development has grown apace with the long-distance transmission of power, and at present it is considered an almost indispensable requirement in the operation of roads depending upon the alternating current for their primary supply of electrical energy. Many improvements in location and design have been made in the sub-station since the early days of its being, but in the last analysis it is a necessary evil with an uncertain future, and an existence only justified by the continued use of direct-current low-voltage motors in railway practice.

Doubtless it will be a long time before the last rotary converter sub-station disappears from sight. It is far too useful to die a sudden commercial death. But the day which sees the successful operation of an alternating-current railway motor is going to mark the beginning of the end. As long as we have the sub-station with us, however, its proper location, design and operation will justly claim our consideration.

The controlling feature in sub-station location is the position it is to occupy in the general distribution system of the railway. The problem of power supply is of such vital importance that it often is folly to build a sub-station at one point on the system, while it ranks with the highest wisdom to locate it at another place. Central position with reference to the load distribution is of high consequence, and before the site is fixed careful calculations should be made showing the first cost and operating economy with that particular location for several schedules likely to be adopted. The influence of location upon the first cost and annual charges upon the feeder system should be considered for various loads, and compared with other locations on the same power basis, if possible. It is not enough to figure out the line, conversion and distribution losses for a given location on a single probable schedule. Figures should be prepared showing the estimated annual cost of operation, including fixed charges, under widely different schedules and distribution of equipments. The possibility of double tracking the road in the future should be considered, and it should never be taken for granted that a location which shows greatest economy in yearly expense under the early conditions of operation is always going to remain the most economical situation. Too much stress cannot be laid upon the necessity of careful financial analysis before a sub-station is finally located. Such work pays every time. These are days when the elimination of waste is the battle cry of progress itself, and the engineer who makes such comparative figures upon widely different bases runs immeasurably nearer the goal of high efficiency in his final decisions than he who locates a sub-station merely by rule of thumb.

It is naturally a difficult matter to estimate the probable traffic which will be carried by the road for five years after it begins operation In fact, it is well nigh impossible to do this accurately, but the need of figuring over several widely different cases—of going to extremes—is all the more apparent. Every road has certain well defined limitations in the matter of schedules and number of transportation units which can be operated upon it. If these maximum conditions are borne in mind, and figures also made intermediate between the most severe conditions likely and the probable early business of the road, enough data will generally be secured to enable an intelligent judgment to be formed at the best location of the sub-station from the distributing point of view. The figures must be carefully made, as was stated before, but they often need not be carried out to precise refinements as to decimals.

Analysis of these conditions will frequently show little change in operating cost through quite a wide zone of territory. Considerable latitude in the choice of location thus may exist. In such cases other points in regard to situation have increased influence. It must always be kept in mind that the location and design of a sub-station are subservient to operating conditions, and the key to the whole problem is simplicity of arrangement.

Healthful surroundings for the attendants are of greatest consequence. Miasmic swamps and fever-smittten marshes are poor places for the practice of operating and first cost economy. Drainage should be good, and, if possible, thoroughly modern sanitary arrangements provided. Continuous service from the sub-station depends quite as much upon able-bodied attendance as upon liberally designed machinery, and if it is possible to locate a sub-station in a congenial place, judged by human standards, it should be done.

While it is usually advantageous to build a sub-station alongside the track of the road which it supplies, the simplest arrangement is sometimes found in locating it somewhat off the main line and running a spur track to it. In the case of an air-line high-voltage system between the power station and distributing points, it is often a grave step to turn the main high-potential wires from their course to traverse a new right-angled right of way to a sub-station situated on the railway track a mile off. Special work, additional unnecessary bends and turns are nearly as much to be avoided in laying out a 50,000-volt line as sharp curves in the path of a "Twentieth Century Limited" making 90 m. p. h. and behind time at that. In any such system continuity of service is of literally tremendous importance, and the experience of high-voltage power transmission in this country is showing that wires carrying current at enormous potentials cannot be run too directly in their course from point to point. It is, of course, possible that a sub-station may be located at an important turnout, and constitute a place of use to the car despatcher, and in such case it would not be feasible to locate it on the main air-line route of the transmission circuits. All such contingencies must be discussed before the choice of location is made, and no factor of importance left unconsidered.

When the conditions permit the establishment of a sub-station in connection with a car house, repair shop, ticket office or passenger station, a considerable gain for the road in the wages element of power cost may be effected. The cost of power at the direct-current bus-bars of a modern sub-station is largely conditioned by the labor item. Fortunate is the road which can utilize the spare time of its sub-station attendants in other ways than requiring them to doze away the day in the machine room with one eye and ear always upon the apparatus. In large city systems the choice of sub-station location is narrowed down usually to very close limits by the cost of real estate, and the labor problem is also less elastic in its demands. Here, as in the country, a car house is an advantageous neighbor, but in all cases the responsibility of the sub-station's continuous operation must be laid upon some one individual, and not divided among various nondescript employees in the belief that they will all be equally conscientious in regard to the plant. Apparatus should always be installed to give instant and loud notice of any failure of current supply or output.

When large water-cooled transformers are to be operated the question of water supply becomes of moment, although this is but a minor factor in the location of the sub-station.

Coming now to questions of design and construction, one of the first requirements is protection against fire. Whenever possible a sub-station receiving current at from 20,000 volts to 50,000 volts should be of brick, and be made as near fireproof as human skill can insure. It is advisable that such measures be adopted below those voltage limits, but the fire hazard is much greater with the high potentials, which must be treated with the respect due to lightning itself. Too much care cannot be taken in regard to the high-tension circuits. Complication in arrangement should be shunned like the plague, and there should be liberal elbow room from foundations to roof. Moisture must not be allowed to enter with the downward slant of the high-potential lines, and in cases where such circuits both enter and leave the building they should be separated by its full width if possible. The quality and type of insulators should be the same on both line and interior sub-station circuits, and all low-tension wiring kept entirely out of the neighborhood. As far as possible wires should run in plain sight, or in the case of low-voltage direct-current circuits beneath the floor in conduits, or basement that is instantly accessible. The various transformations of current should be effected in one continuous line of wiring path whenever possible. It is essential to avoid any doubling back of circuits, and it should be possible to stand in one place in the sub-station and see the successive chain of transforming operations without stirring from one's position. Of course, compromises must sometimes be made between these various desirable features, but they must all be duly considered, and given up only after the best of reasons preclude them. In country sub-stations there is little excuse for anything but the most faultless design, as the cost of real estate is of little importance as a factor in limiting elbow room. Cramped designs are to be abhorred. It is imperative that plenty of room be allowed between the different machines, transformers and switchboards, especially at the back of the latter. Far too often sub-stations are built in the most temporary manner in some old barn or shed—"anything to get the road running," is the cry. Expensive machinery demands something better than cheap housing.

When storage batteries are installed in sub-stations the acid fumes and electrical machinery must be absolutely prevented from becoming acquainted. It is to the credit of the manufacturers that this precaution is seldom omitted. It is always desirable that a spur track of the road, or else main line, be carried close up to a large double or sliding door, big enough to permit the entrance and exit of the largest single piece of apparatus which the station is to contain. An overhead crane is useful in very large sub-stations, but in the majority of cases it can be dispensed with at small loss to the road.

If a sub-station is one of a series of distributing points it should always be possible to cut it out of circuit in case of trouble without interrupting the current supply of any of the other stations. Common sense would seem to indicate the importance of locating the sub-station telephone in a sound proof booth, and yet there are plenty of installations to be found in modern practice that are almost worthless because of the noise made by adjacent machinery. The telephone should be so placed that the operator can see the switchboard instruments plainly, and thus report the loads, voltages, etc., to the headquarters on demand. A reliable clock should not be omitted in the outfit.

If air-blast transformers are installed it should be a simple matter to arrange for the supply of cool air from out of doors, rather than to pump in the warm air of the machine room. Cleaning of apparatus should always be done by air blast, and a small motor-driven compressor supplied for this purpose. With its absence of steam-driven machinery there is little excuse for a sub-station being kept in anything but immaculate condition. Plenty of windows should be provided, and the walls painted white or some light color that will show up the accumulation of dust and dirt. Provision should always be made for a small store room and work bench, where minor supplies can be reached or light repairs undertaken. Various car supplies can also be doled out as required, if the sub-station is a factor in the transportation department.

Switchboard apparatus should be as simple as is consistent with the size and character of work to be done. While space should be left on the panels for the usual full complement of instruments, it is often a needless expense to install frequency and power factor indicators and a multiplication of alternating-current ammeters, voltmeters and indicating wattmeters. It is important, however, to install an ammeter in each direct-current feeder circuit and in connection with the rotary or motor generator sets, a voltmeter which will indicate the potential of the high-tension line, another for the direct-current bus-bars and a third for use in parallel operation of generating machinery; and almost, above all, a direct-current recording wattmeter for each of the operating rotary converters or motor generators.

Unauthorized persons should not be permitted to browse around or in the sub-station during the absence of the attendant. While the free admission of interested visitors should be encouraged, they must be made to understand that such incursions are accomplished at their own risk. The station must never become a house of refuge for tramps or other discredited wanderers, and when the attendant is afar off it should be kept locked.

The matter of records is constantly growing more important. Blanks should be freely provided by the operating company for periodic tabulation of readings from the instruments previously mentioned. In addition, a daily record of unusual happenings should be forwarded to the main office for filing. This will include the number and time of circuit breaker openings, the jotting down of official visits and inspections, variations from the ordinary routine of machine operation, failure and repair of apparatus, etc.

The direct-current circuits should usually be so connected with the sub-station that they may be operated past it, through it, or to it, as the case may require. The value of such sectioning at times of line trouble or tests is high.

Lastly, the sub-station attendants should be well considered in the matter of wages, hours and days off. It should be made possible for them to take one day in seven away from the confining limits of the plant. Cheap attendance in sub-stations is dear at any price, and wages should be at least attractive enough to attract reliable men. As long as things go well, sub-station work is not very onerous, but when emergencies arise the story is different. It is a pretty good plan to gradually advance sub-station attendants to more responsible and desirable power house and mechanical department positions as opportunity permits, and by a kind of rotation in office qualify them for wider opportunities. Discipline is here as important as in the city power station, and it is also quite as desirable for the management to appreciate the joys and sorrows of the sub-station life as to concern itself with the hours and pay of its other employees. Two or three of the best technical journals should regularly find their way into the sub-station, and a proper place be provided for the writing down of records and reports. In a few words, the whole sub-station situation should be made the most of as long as it is with us, and the cardinal doctrines of simplicity, efficiency, cleanliness, order and convenient location exemplified in practice, coupled with that firm yet liberal treatment of employees which is inseparable from good management.

STREET AND ELEVATED RAILWAY MILEAGE, CARS AND CAPITALIZATION IN THE UNITED STATES AND CANADA

The accompanying table showing the mileage, number of cars and capitalization of the street railways in the United States and Canada for the year 1902, has been compiled from the 1903 edition of "American Street Railway Investments." An examination of the table shows the total mileage in the United States to be 26,429, with 71,312 cars, capital stock $1,632,073,254, and funded debt $1,274,459,491, making the total capital liabilities $2,906,532,745. The mileage in Canada is 815, with total capital liabilities of $46,450,152.

The increase in the mileage in the United States for the year was 3245 miles, or 12.3 per cent, the percentage for the various geographical divisions being as follows: The New England States show 336 additional miles of track, an increase of 8.3 per cent; the Eastern States, 999 additional miles, an increase of 14.5 per cent; the Central States, 1532 additional miles, or 16.6 per cent; the Southern States, 105 additional miles, or 12.5 per cent; the Western States, 273 additional miles, or 16.6 per cent. There were 60 miles of new track built in Canada during the year.

The increase in capital stock for the companies in the United States was $271,361,016, and the increase in the funded debt was $219,007,674, making an increase in total capital liabilities of $490,368,690. The total capital liabilities of the companies in Canada were increased $4,513,514.

The supplementary table published below, in which statistics are given for the several divisions as to capitalization and cars per mile of track and capitalization and miles per capita, are also of interest. The Eastern States lead in the first three items, but New England has more track per capita than any other section of the country. The largest increases in capitalization occur in New York, where it amounts to $101,121,479; Pennsylvania, $63,228,823; Virginia, $30,657,000; California, $26,931,560, and Rhode Island, $23,795,800. These increases are due in most cases to the formation during the year of large holding companies in a few cities in each State.

Statistics of Mileage and Capitalization Per Capita and Cars and Capitalization Per Mile of Track

	Capitalization Per Mile of Track	Cars Per Mile of Track	Capitalization Per Capita	Miles of Track Per 100,000 Capita
New England States	$59,213	2.5	$43.15	73
Eastern States	165,328	3,7	69.91	42
Central States	92,021	2.3	35.37	38
Southern States	90,847	1.9	8.90	10
Western States	89,313	1.5	24.19	27
Grand average	109,975	2.6	38.56	34

The statistics published in these tables were compiled from the annual "American Street Railway Investments," published by the Street Railway Journal, and the several reports from which the information was taken are in the main for the year ending Dec. 31, 1902. In a few cases the figures on capitalization had to be estimated, but these were in all cases small roads, so that the percentage of estimated values is very small.

STREET AND ELEVATED RAILWAY MILEAGE, CARS AND CAPITALIZATION IN UNITED STATES AND CANADA.

COMPILED FROM THE STATISTICS OF THE VARIOUS PROPERTIES CONTAINED IN "AMERICAN STREET RAILWAY INVESTMENTS," EDITION OF 1903.

STATES.	No. of Roads.	ELECTRIC RAILWAYS. Track Mileage.		Motor Cars.		Trail and Service Cars.		CABLE RAILWAYS. Track Mileage.		Grip Cars.		Trail Cars.		HORSE RAILWAYS. Track Mileage.		Cars.		STEAM RAILWAYS. Track Mileage.		Cars.		TOTAL RAILWAYS. Track Mileage.		Cars.	
	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902	1901	1902
New England States.																									
Maine	20	329	350	426	450	59	52	....	....	....	....	....	....	3	3	4	4	....	....	....	....	332	353	489	506
New Hampshire	17	159	223	206	245	34	58	....	....	....	....	....	....	....	....	....	....	....	....	....	....	159	223	240	303
Vermont	10	91	95	94	98	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	91	95	96	100
Massachusetts	122	2,309	2,466	6,712	7,256	41	24	....	....	....	....	....	....	3	....	244	....	....	....	....	....	2,312	2,466	6,997	7,280
Rhode Island	8	318	347	753	765	93	103	....	....	....	....	....	....	....	....	....	....	....	....	....	....	318	347	848	868
Connecticut	22	527	591	1,052	1,116	88	102	....	....	....	....	....	....	....	....	....	....	....	....	....	....	527	591	1,140	1,218
TOTAL	199	3,733	4,072	9,243	9,930	317	341	....	....	....	....	....	....	6	3	248	4	....	....	....	....	3,739	4,075	9,808	10,275
Eastern States.																									
New York	130	2,608	3,043	11,463	14,834	676	1,721	....	....	....	....	....	....	110	110	1,025	1,025	a194	....	2,717	....	2,912	3,153	15,881	17,580
New Jersey	50	838	907	1,750	1,800	146	232	....	....	....	....	....	....	9	....	39	25	....	....	....	....	847	907	1,935	2,057
Pennsylvania	199	2,472	2,842	6,308	7,000	444	448	....	....	....	....	....	....	....	....	....	....	3	....	23	....	2,475	2,842	6,775	7,448
Delaware	8	62	127	108	173	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	62	125	110	175
District of Columbia	8	239	316	500	602	480	552	....	....	....	....	....	....	....	....	....	....	....	....	....	....	239	316	980	1,154
Maryland	11	442	486	1,256	1,491	356	220	....	....	....	....	....	....	....	....	....	....	....	....	....	....	442	486	1,612	1,711
Virginia	17	300	371	493	578	60	60	....	....	....	....	....	....	....	....	....	....	....	....	....	....	300	371	553	638
West Virginia	10	148	222	198	300	11	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	148	222	209	303
TOTAL	433	7,109	8,314	22,076	26,778	2,175	3,238	....	....	....	....	....	....	119	110	1,004	1,050	195	....	2,740	....	7,425	8,424	28,055	31,066
Central States.																									
Michigan	32	1,153	1,199	1,642	1,741	164	168	....	....	....	....	....	....	2	2	2	2	....	....	....	....	1,155	1,201	1,808	1,911
Ohio	82	2,107	2,881	4,052	4,499	240	390	7	7	72	56	....	....	....	....	....	....	2	....	3	....	2,116	2,888	4,367	4,965
Indiana	32	804	1,026	923	1,095	213	180	....	....	....	....	....	....	7	7	13	28	....	....	....	....	811	1,033	1,149	1,305
Kentucky	12	222	250	535	569	257	284	....	....	....	....	....	....	3	....	6	....	....	....	....	....	225	250	798	853
Wisconsin	22	405	507	580	783	211	77	....	....	....	....	....	....	....	....	....	....	....	....	....	....	405	507	791	860
Illinois	55	b1,724	1,871	4,000	4,031	216	801	82	82	708	559	2,645	2,433	18	10	16	10	10	10	99	45	1,834	1,973	7,684	7,879
Minnesota	9	351	383	781	811	304	304	....	....	....	....	....	....	3	....	3	....	....	....	....	....	354	383	1,088	1,115
Iowa	24	358	442	410	729	138	113	....	....	....	....	....	....	9	4	9	4	....	....	....	....	387	446	607	846
Missouri	22	829	974	2,240	2,394	60	71	38	33	211	187	224	198	10	8	13	9	....	....	....	....	875	1,015	2,748	2,859
TOTAL	290	7,953	9,533	15,163	16,654	1,853	2,388	125	122	991	822	2,869	2,631	52	31	62	53	12	10	102	45	8,164	9,696	21,040	22,593
Southern States.																									
North Carolina	8	45	62	82	109	14	11	....	....	....	....	....	....	2	2	3	3	2	....	2	....	49	64	101	123
South Carolina	5	69	73	102	107	30	16	....	....	....	....	....	....	3	3	6	8	....	....	....	....	72	76	138	131
Georgia	12	274	330	439	459	26	22	....	....	....	....	....	....	11	6	9	6	....	....	....	....	285	336	474	487
Florida	7	54	63	55	58	12	8	....	....	....	....	....	....	6	6	4	4	9	9	18	18	69	78	89	88
Alabama	11	180	213	295	287	56	110	....	....	....	....	....	....	7	7	7	7	20	....	43	....	207	220	401	404
Mississippi	6	25	39	39	59	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	25	39	41	61
Tennessee	13	257	208	392	394	110	110	....	....	....	....	....	....	....	....	....	....	17	17	21	21	274	285	523	525
Louisiana	6	207	207	554	611	52	7	....	....	....	....	....	....	9	9	14	14	....	....	....	....	216	216	620	632
Arkansas	6	44	65	99	119	26	27	....	....	....	....	....	....	8	....	11	....	25	....	10	....	77	65	146	146
TOTAL	74	1,155	1,320	2,057	2,203	328	313	....	....	....	....	....	....	46	33	54	42	73	26	94	39	1,274	1,379	2,533	2,597
Western States.																									
South Dakota	1	....	....	....	....	....	....	....	....	....	....	....	....	2	2	2	2	....	....	....	....	2	2	2	2
Nebraska	6	112	115	180	202	60	52	....	....	....	....	....	....	22	19	21	23	....	....	....	....	134	134	261	277
Kansas	12	112	112	108	116	63	55	....	....	....	....	....	....	15	17	22	26	....	....	....	....	127	129	193	197
Indian Territory	1	....	20	....	9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	20	....	9
Oklahoma	1	....	7	....	7	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	....	9
Texas	20	310	343	436	548	65	50	....	....	....	....	....	....	17	9	28	10	....	....	....	....	327	352	529	608
Colorado	9	234	245	377	377	82	62	....	....	....	....	....	....	2	2	2	2	77	86	84	84	313	333	545	525
Montana	5	61	01	71	74	17	25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	61	01	88	99
Idaho	1	4	4	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	4	2	2
Utah	3	97	105	101	103	26	26	....	....	....	....	....	....	....	....	....	....	8	....	2	....	105	105	129	129
Washington	11	199	255	200	301	113	26	26	21	61	75	45	67	....	....	....	....	....	....	....	....	225	276	419	469
Oregon	8	138	159	214	241	36	96	2	2	16	4	2	....	3	3	2	2	6	....	9	....	149	164	279	343
California	34	969	1,113	1,047	1,103	159	244	86	84	539	561	40	40	39	39	140	84	27	16	71	58	1,121	1,252	1,996	2,090
Arizona	2	11	11	10	10	7	7	....	....	....	....	....	....	3	5	4	5	....	....	....	....	14	16	21	22
TOTAL	114	2,247	2,550	2,746	3,093	628	645	114	107	016	640	87	107	103	96	221	154	118	102	166	142	2,582	2,855	4,464	4,781
United States	1,110	22,217	25,789	51,285	58,658	5,301	6,925	241	229	1,607	1,462	2,956	2,738	326	273	1,649	1,303	400	138	3,102	226	23,134	26,429	65,900	71,312
Canada	40	755	815	1,902	1,973	355	333	....	....	....	....	....	....	....	....	....	....	39	39	73	98	794	854	2,330	2,404

STATES.	CAPITAL STOCK. Total. 1901	1902	Increase for Year.	FUNDED DEBT. Total. 1901	1902	Increase for Year.	CAPITAL LIABILITIES. Total. 1901	1902	Increase for Year.
New England States.									
Maine	$4,089,348	$4,547,075	$457,727	$5,009,519	$5,708,000	$698,481	$9,098,867	$10,255,075	$1,156,208
New Hampshire	4,237,000	4,914,900	677,900	2,818,500	10,043,500	7,225,000	7,055,500	14,958,400	7,902,900
Vermont	1,765,124	1,825,000	59,876	1,345,000	1,450,000	105,000	3,110,124	3,275,000	164,876
Massachusetts	73,510,492	85,655,050	12,144,558	36,341,235	40,058,000	3,716,765	109,851,727	125,713,000	15,861,273
Rhode Island	16,972,000	27,725,000	10,753,000	5,719,700	18,762,500	13,042,800	22,691,700	46,487,500	23,795,800
Connecticut	23,772,940	23,851,240	78,300	15,557,000	16,751,000	1,194,000	39,329,940	40,602,240	1,272,300
TOTAL	124,346,904	148,518,265	24,171,361	66,790,954	92,773,000	25,982,046	191,137,858	241,291,265	50,153,407
Eastern States.									
New York	288,011,467	348,706,598	60,695,131	245,683,474	286,109,782	40,426,348	533,694,901	634,816,380	101,121,479
New Jersey	79,925,180	85,252,300	5,327,120	64,702,500	73,733,000	9,030,500	144,627,680	158,985,300	14,357,620
Pennsylvania	176,675,742	227,484,286	50,808,544	138,743,685	151,163,964	12,420,279	315,419,427	378,648,250	63,228,823
Delaware	1,920,000	4,020,000	2,100,000	900,000	3,505,000	2,605,000	2,820,000	7,525,000	4,705,000
District of Columbia	28,205,000	34,438,500	6,233,500	19,920,000	30,226,350	10,306,000	48,125,000	64,664,850	16,539,850
Maryland	30,404,000	31,759,000	1,355,000	51,698,694	52,251,695	553,001	82,102,694	84,010,695	1,908,001
Virginia	9,856,250	25,086,250	15,230,000	14,829,500	30,257,000	15,427,500	24,685,750	55,343,250	30,657,500
West Virginia	3,603,000	4,653,000	1,050,000	3,684,000	4,089,000	405,000	7,287,000	8,742,000	1,455,000
TOTAL	618,600,639	761,399,934	142,799,295	540,161,813	631,335,591	91,173,978	1,158,762,452	1,392,735,725	233,973,273
Central States.									
Michigan	32,703,400	34,008,400	1,305,000	30,325,000	33,773,000	3,448,000	63,028,400	67,841,400	4,813,000
Ohio	124,655,350	154,061,050	29,405,700	64,339,000	78,592,500	14,253,500	188,994,350	232,653,550	43,659,200
Indiana	24,233,600	29,175,900	4,942,300	26,813,500	31,701,500	4,888,000	51,047,100	60,877,400	9,830,300
Kentucky	7,596,900	8,390,900	794,000	8,263,300	8,604,300	341,000	15,860,200	16,995,200	1,135,000
Wisconsin	10,795,500	15,239,500	4,444,000	12,267,050	13,818,050	1,551,000	23,062,550	29,057,550	5,995,000
Illinois	158,791,060	165,197,660	6,406,600	93,189,900	99,610,650	6,420,750	251,980,960	264,808,310	12,827,350
Minnesota	23,625,495	25,186,495	1,561,000	13,726,000	13,881,000	155,000	37,351,495	39,067,495	1,716,000
Iowa	13,398,000	16,788,000	3,390,000	6,624,000	11,273,000	4,649,000	20,022,000	28,061,000	8,039,000
Missouri	53,479,600	66,497,800	13,018,200	63,555,000	86,379,000	22,824,000	117,034,600	152,876,800	35,842,200
TOTAL	449,278,905	514,605,705	65,326,800	319,102,750	377,633,000	58,530,250	768,381,655	892,238,705	123,857,050
Southern States.									
North Carolina	1,465,600	1,815,600	350,000	1,075,000	1,375,000	300,000	2,540,600	3,190,600	650,000
South Carolina	2,012,000	2,012,000	......	3,028,000	3,035,000	7,000	5,040,000	5,047,000	7,000
Georgia	14,911,400	16,736,400	1,825,000	12,823,000	14,072,500	1,249,500	24,734,400	30,808,900	3,074,500
Florida	1,131,000	1,606,000	475,000	994,300	1,532,000	537,700	2,125,300	3,138,000	1,012,700
Alabama	8,755,000	8,475,000	*280,000	6,892,000	7,633,000	771,000	15,647,000	16,138,000	491,000
Mississippi	685,500	885,500	200,000	630,000	680,000	50,000	1,315,500	1,565,500	250,000
Tennessee	9,625,000	9,632,000	7,000	7,765,000	8,100,000	335,000	17,390,000	17,732,000	342,000
Louisiana	16,095,100	32,538,000	16,442,900	12,354,000	12,521,000	167,200	28,449,100	45,059,200	16,610,100
Arkansas	1,170,500	1,200,000	29,500	1,159,500	1,400,000	240,500	2,330,000	2,600,000	270,000
TOTAL	55,851,100	74,900,500	19,049,400	46,720,800	50,378,700	3,657,900	102,571,900	125,279,200	22,707,300
Western States.									
South Dakota	100,000	100,000	....	....	....	....	100,000	100,000	....
Nebraska	3,777,500	5,687,500	1,910,000	1,280,000	4,110,000	2,831,000	5,057,500	9,797,500	4,740,000
Kansas	2,750,000	2,665,000	*85,000	1,325,000	1,595,000	270,000	4,075,000	4,260,000	185,000
Indian Territory	....	500,000	500,000	....	418,000	418,000	....	918,000	918,000
Oklahoma	....	160,000	160,000	....	160,000	160,000	....	320,000	320,000
Texas	8,886,000	16,187,000	7,301,000	8,475,000	10,575,000	2,300,000	17,361,000	20,962,000	9,601,000
Colorado	8,205,000	11,305,000	3,100,000	9,214,000	9,564,000	350,000	17,419,000	20,869,000	3,450,000
Montana	2,120,000	1,395,000	*725,000	1,546,500	1,196,500	*350,000	3,666,500	2,591,500	*1,075,000
Idaho	54,000	54,000	....	....	....	....	54,000	54,000	....
Utah	3,400,000	3,400,000	....	1,263,000	1,263,000	....	4,663,000	4,663,000	....
Washington	11,815,000	16,889,100	5,074,100	7,960,000	10,909,000	2,949,000	19,775,000	27,798,100	8,023,100
Oregon	3,067,000	4,807,000	1,740,000	5,173,000	9,978,000	4,805,000	8,240,000	14,785,000	0,545,000
California	68,385,190	69,421,750	1,036,560	46,414,000	72,309,000	25,895,000	114,799,190	141,730,750	26,931,560
Arizona	75,000	77,500	2,500	25,000	61,500	36,500	100,000	139,000	39,000
TOTAL	112,034,690	132,648,850	20,014,160	32,675,500	122,339,000	30,663,500	195,310,190	254,987,850	59,677,660
United States	1,360,712,238	1,632,073,254	271,361,016	1,055,451,817	1,274,459,491	219,007,674	2,416,164,055	2,906,532,745	490,368,690
Canada	26,848,100	28,903,894	2,055,794	15,088,538	17,546,258	2,457,720	41,936,638	46,450,152	4,513,514

NOTATIONS.—*a* includes 178 miles of elevated track, 08 in Brooklyn and 110 in Manhattan and the Bronx. *b* includes 120 miles of elevated track in Chicago. * Indicates decrease.

THE KANSAS CITY FLOOD

BY W. O. HANDS

As most of the readers of this paper know, the Kansas, or Kaw, River, which runs through Kansas City, burst through its banks on May 31, 1903, and left all the low lands in a state of destruction. Connecting Kansas City, Mo., and Kansas City, Kan., were fourteen bridges. These caught the drift that came down the river and filled the regular channel, throwing the water out on each side—into the residence district on one side and into the packing house, stock yards and wholesale district on the other. Careful estimates of the loss have been made by different persons, and a fair average would place it at about $15,000,000 within the limits of the two Kansas Cities.

The fourteen bridges mentioned were, with one exception, swept entirely away, and with two exceptions were of steel. Parts of them, weighing a ton or more, have been found 16 miles down the river. But for the most part the drift pushed them around to the river bank, broken and twisted beyond all possibility of repair. The Metropolitan Street Railway Company lost four bridges and a temporary trestle. In the four bridges was 2100 ft. of truss spans. The "L" road lost 900 ft.

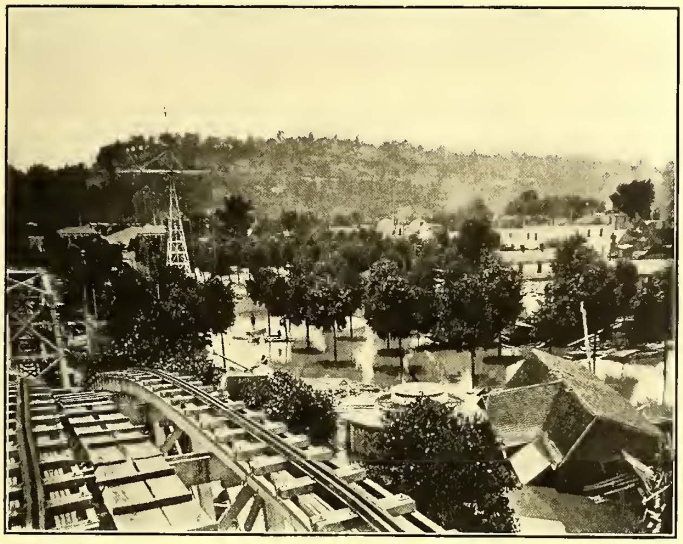


FIG. 2.—VIEW OF "ELECTRIC PARK" JUNE 7, SHOWING COTTAGE RESTING ON ELECTRIC FOUNTAIN

of steel and 1500 ft. of wooden structure. The temporary trestle that was washed out had been erected but a few weeks previous, for the purpose of diverting traffic until the old bridge could be rebuilt.

By noon, Sunday, four of the Metropolitan Railway Company's power houses were under water and out of operation. pany's electric power houses were under water and out of operation. This stopped practically all the electric cars. To make matters worse the city waterworks were flooded, and the city was without water. This caused all the cable power houses to shut down temporarily until water could be hauled from ponds or wells. A spring in an old abandoned power house basement had nearly filled the basement, and a portable pump forced this water to two cable power houses and kept them supplied. Several small reserve generators in these cable power houses were put to work, and by noon, Tuesday, a number of the lines, both cable and electric, were giving fair service.

The water continued to rise until noon, on June 1, when it stood nearly stationary for two days, then began to slowly recede. But not until June 7 was it possible to begin any repairs, either to machinery or streets, and on account of the crippled condition of the waterworks it was necessary to haul water to operate some of the power houses until June 15. It is not possible yet to estimate the loss to the electrical machinery. In the two principal power houses the water reached a little more than half-way up on the big generators and soaked into the thousands of small interstices, leaving them full of slimy mud, which was hard to remove, especially where it dried. To clean them a hose, with a very small nozzle, which threw a small stream of water at great pressure was used, and kept going day and night until the machinery was thoroughly clean. In the meantime steam fitters and carpenters had been busy surrounding the generator with pipes and a huge wooden box.

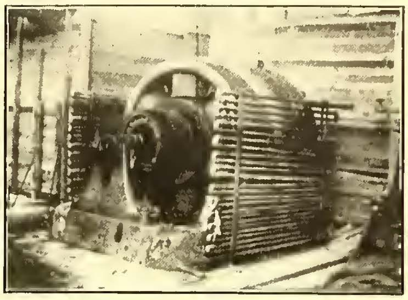


FIG. 1.—METHOD OF DRYING OUT A ROTARY

Steam was turned into the pipes, the doors of the box closed, and the temperature kept at 160 C. to 180 C. for forty-eight hours. Then a heavy current of 7½ volts was sent through the machine while it was slowly run. This was the plan used with nearly every one of the electric machines, both big and little. Fig. 1 shows the steam coils about one of the small rotary converters. The plan has been very successful, as only two coils have been lost in the large machines, but as the full load has not been put on them yet several lines are running only part of their complement of cars. The engines, boilers and pumps required a great deal of cleaning up, but were found to be otherwise uninjured. This experience goes to show that modern machinery, especially electric machinery, will stand more abuse than is generally supposed. One of the plants works at 6600 volts, and it is the opinion of the company's electricians that no further trouble will be experienced.

"Electric Park," which is located in the East Bottoms, was to have opened May 31; but on that date 7½ ft. of water stood all over the park. Several houses were washed into the grounds, and one cottage rested directly on top of the electric fountain, as shown in Fig. 2. This picture was taken from the top of the Loop the Loop June 7, one week after the highest part of the flood, but while 2½ ft. of water still covered the park.

The damage done to the elevated structure is partly shown in

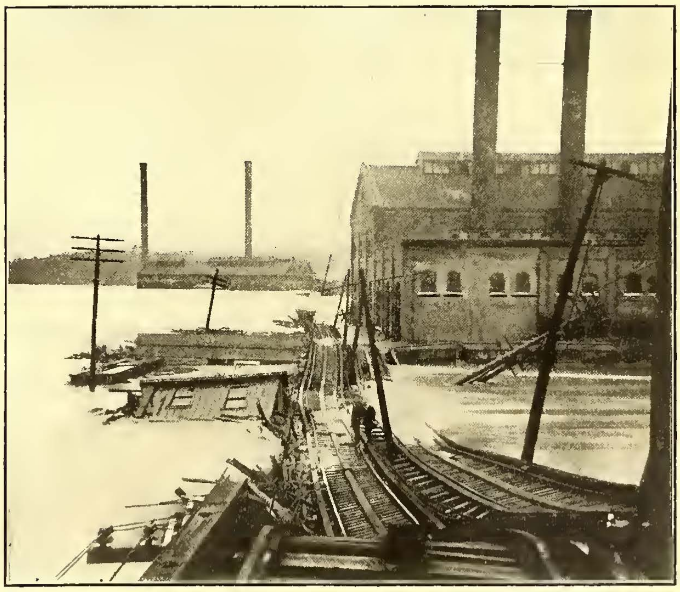


FIG. 3.—PARTLY SUBMERGED ELECTRIC LIGHT STATION AND WRECKED ELEVATED STRUCTURE, CENTRAL AVENUE POWER STATION IN DISTANCE

Fig. 3, which also shows the partly submerged electric light power house in the foreground and the Central Avenue power house of 5500 hp in the distance. The bridge connecting the space between these power houses was a steel double-deck, double-track structure, and was entirely destroyed, as was also part of the connecting structure on both sides of the river. The twenty-five heavy copper cables that were carried by the bridge and structure were the direct cause of the collapse. Fig. 4 shows the west end of the structure, about 30 ft. of which is left standing, in fairly good condition, but just beyond this again the structure, which was of wood, is entire gone for 600 ft.

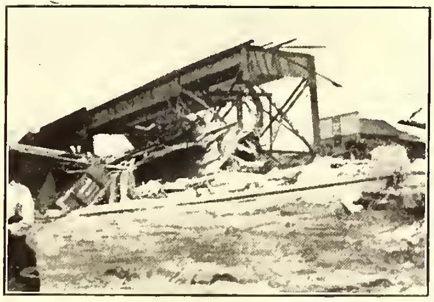


FIG. 4.—WEST END OF L ROAD

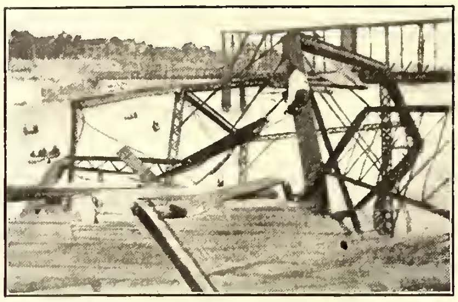


FIG. 5.—WRECK OF JAMES STREET BRIDGE

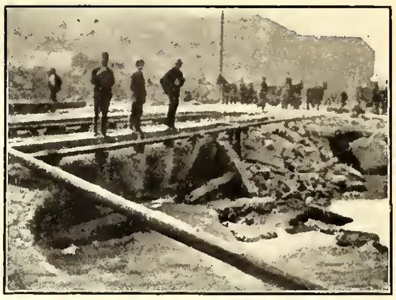


FIG. 6.—WASHOUT ON JAMES STREET

Fig. 5 shows the destruction of the James Street Bridge, which was entirely of steel. This bridge stood several feet above the water, and its collapse was due to the piers in the center of the river being entirely washed out. The abutments are standing in good condition. This was one of the last bridges to go out, and a mass of drift, over ½ mile long and the full width of the river, struck it.

In many places the street is entirely washed away for 20 ft. to 60 ft., as shown in Fig. 6. James Street is entirely gone on both sides, although the old concrete cable slots span the chasm without the slightest deflection.

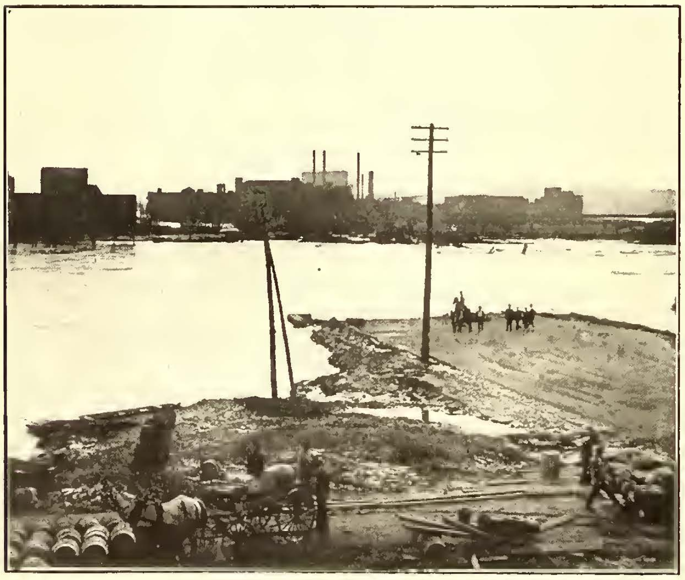


FIG. 7.—FORMER SITE OF KANSAS AVENUE BRIDGE

Of all the bridges that cross the Kaw River but one stood the terrible pressure of the drift that came against it, and it stands a monument to the good judgment and nerve of superintendent of terminals of the Missouri Pacific Railway, W. S. Carson. When he heard the water was rising he filled both tracks with the heaviest engines at his command and then hired a boat and kept as close as safety would allow. It is said that for sixty hours he did not sleep nor leave the immediate vicinity of the bridge. Were it not for this bridge Kansas City would be cut off from all its Western connections.

In the meantime craft of every conceivable kind is plying between the two Kansas Cities until bridges are built, which will not be long. The Metropolitan Street Railway Company will soon have finished the first new bridge over the Kaw. It will be a temporary one built on piles, which are now driven, and by June 23 cars will be running over it. It is being built at James Street. Other temporary pile bridges will connect the Kansas Avenue ends and the Twelfth Street Bridge in Armourdale. It will require a great deal of work to put the elevated road in operation again.

Fig. 7 shows how completely the Kansas Avenue Bridge was swept away; not a stone of the original structure is in sight.

The practical reader will see by this hurriedly written article that much hard work and trying delays are ahead of the officials of this company before cars will be running with their accustomed regularity. But it is a pleasure to note how such trying incidents as these draw the heads of the different departments together, and to see the interest taken, even by the humblest employee, in trying to give the very best possible service. The public notices this and shows its appreciation by not complaining of having to hang on the straps and by filling up the center of the cars.

COMMUTATION TICKETS

The Cleveland & Southwestern Traction Company has adopted a new form of commutation tickets which gives practically 3-cent fare in all the towns on its system. They are in the form of coupon books containing 200 tickets. One class is good for the individual only and is not transferable, and sells at $6, while another class is good for any member of a family and sells at $8. Each coupon entitles the holder to a ride over a 5-cent division of the road, and as many coupons are taken up as the holder rides divisions. The individual tickets are good for sixty days and the family tickets for six months. With the individual tickets the rate is about 1 cent per mile. These books take the place of the old form of commutation books, which were available only between specified points. The plan saves the expense of printing a large variety of books and gives a greater latitude to the holder.

IMPROVEMENTS AT DAVENPORT AND ROCK ISLAND

The Tri-City Railway Company, which is operating lines in Davenport, Ia., Rock Island and Moline, Ill., expects soon to shut down its steam power station and hold it simply as a reserve. Power will be obtained from the People's Power Company, which has a large water-power at Moline, obtained by means of a dam across that part of the Mississippi which flows between the Illinois shore and the island upon which the Rock Island arsenal is located.

General Manager J. F. Lardner, of the Tri-City Railway Company, is a prominent director in the People's Power Company. The latter company also furnishes electric light and power in Davenport and in Rock Island.

The Tri-City Railway Company is now building its own cars. The new cars being built are 44 ft. long over all, with crossseats and center aisles, adapted for either summer or winter use.

HIGH-SPEED ELECTRIC RAILWAY PROBLEM*

BY A. H. ARMSTRONG

Among the many questions to be considered in a new railway project, perhaps the one of primary importance is the question of the proper speed at which to operate, as depending upon this factor is not only the first cost of the road, but its cost of operation and probable receipts. It is the purpose of this paper to touch briefly upon some of the fundamental relations existing between first cost of a railway system, its probable cost of operation and schedule speed, discussing also the probable traffic receipts to be secured with different methods of operation. In considering so broad a problem in a paper of this length it will be necessary to omit detailed proof of many of the statements made, but the method of arriving at the conclusions will be outlined. Most of the data presented is obtained from a very elaborate series of experimental tests, so that the results obtained may be considered of direct practical application.

Owing to the wide field covered by the electric railway motor it is not possible to consider all classes of railways, and therefore this discussion is limited to the relatively high-speed roads. It is a mistaken idea that acceleration problems are met with only in city or elevated work where the stops are frequent. Although the so-called high-speed roads stop at comparatively infrequent intervals, the relation existing between stops and schedule speeds often calls for the most serious consideration of fractional speed running of the motors. Such roads really act as tributaries to large city street railway systems and must be able to operate over several miles of city tracks at slow schedule and with frequent stops, and also be adapted for operation at 40 m. p. h. or 50 m. p. h., with infrequent stops on a private right of way.

While each road presents its own local characteristics they can generally be divided into two broad classes, those having frequent stops and those having very few stops. Both classes of service will probably parallel one or more steam lines and must make a schedule speed that will compare favorably with that obtaining on the competing steam road. This high schedule speed must also be made with more frequent stops than given by the steam service, and in nearly all cases over a track which has many sharp curves, which have the effect of still further increasing the number of stops. Interurban roads having very infrequent stops, say one stop in 5 miles or 10 miles, private right of way, and an alignment free from curves of less than 3 degs., can give a service equal or superior to any competing steam line, and can furthermore provide the frequent service which has proved one of the valuable assets of electric roads. Moreover, the generating station, feeder system, motor capacity and power consumption will be moderate in first cost. The problem of high-speed electric service, therefore, is comparatively simple, provided the alignment is free from sharp curves and the stops are very infrequent, and such a service can be operated at a less cost and will attract more traffic than the competing steam line with its antiquated method of operating with steam locomotives.

Suburban roads, however, that pick up their load at frequent intervals along the route and still have to compete with parallel steam lines, present problems much more difficult to solve from an economic standpoint. It is the custom of such roads to establish stopping points, say 1 mile or less apart, and stop at these points only on signal. During certain portions of the day, however, cars will be obliged to stop at nearly all these stations, and will either fall behind their schedule at such times or will have too much leeway during the remainder of the day when stops are much less frequent. Moreover, owing to the considerable city running at necessarily slow speeds, these suburban roads must make as good time as possible on the suburban route in order to bring the passengers from the more distant points within a reasonable time, including city running. In fact, such roads when paralleling steam lines operating on private right of way through the city, and moreover giving excellent service morning and night to commuters, are compelled to face very serious engineering and economical problems due to the tremendous aamount of generating apparatus, line copper and motive power required to give equally good service.

A suburban road will develop a considerable amount of traffic, due to its frequent service, but there comes a time when such roads will extend beyond the zone of half-hour runs into the city and try to reach the outlying districts hitherto belonging exclusively to the steam lines. The frequent service will always be a valuable asset and one that cannot be duplicated with the steam locomotive, except at higher cost of operation, but if it takes considerably longer to reach the city by means of the electric line than by the steam road with its better facilities for high speed, the electric line will fail to obtain the proportion of suburban business to which it has been accustomed in its more limited scope. In other words, it fails in its purpose, due to the frequent stops to which its previous popularity was due.

In considering the proper speed at which to operate a new electric line, it is necessary, therefore, to go very carefully into local details and especially canvass the competition with existing steam lines not only when operated in their present form, but also consider the possibility of their adopting electricity as a motive power.

In considering the possible speeds of a car or train of cars the investigator is met with the necessity of obtaining some accurate data on the question of car and train friction. The greater part of the data now existing on this subject has been obtained with trains hauled by steam locomotives. Many of these results were obtained by draw-bar pull, and, hence, neglected the wind-friction of the locomotive, and those taken by indicator diagrams are open to the objection that the steam locomotive is not square ended like a car, and wind-friction results so obtained are not applicable to the operation of the train electrically without locomotive. Moreover, all these results were obtained with more than a single car in the train, and do not apply to suburban electrical operation which almost universally uses single car trains. Tests are being made from time to time with electrically operated trains, and due to the refinement of the carefully calibrated voltmeter and ammeter it is possible to obtain wind-friction values at various speeds and with different number of cars in a train with greater accuracy than in the previous steam tests. These results are not at all complete and the only attempt known to the writer to obtain friction values with different number of cars was made by W. J. Davis, Jr., through the courtesy of the International Railway Company on their Buffalo & Lockport line in March, 1900. Using these tests as a basis the writer has drawn up three friction curves in Fig. 1, designating them A, B and C.

The C curve will hold approximately for single car operation where the car weighs in the vicinity of 40 tons. The B curve applies to the operation of two such cars in a train, and the A curve to a train of such cars, say eight or more in a train. These curves are not published with the idea that they are correct, in fact, the speeds at which they were obtained do not exceed 60 m. p. h., and hence extension beyond this speed is based upon a formula which will follow curve shape up to 60 m. p. h. As the results obtained by using them are not dependent upon their numerical values, intermediate points being easily interpolated, it is not of prime importance that the three friction-curves given represent accurately the conditions as set forth. In fact, with the different shaped cars now in use and the different cross-section of cars having the same weight, etc.,

* Read at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., June 30, 1903.

it is hardly possible to make one friction-curve which would apply accurately to all cases. It is probable, however, that the curves given have the general shape and the numerical values applying to average conditions. The friction curves have been extended to maximum speeds approaching 90 m. p. h. in order that questions of motor capacity, train energy, possible schedule

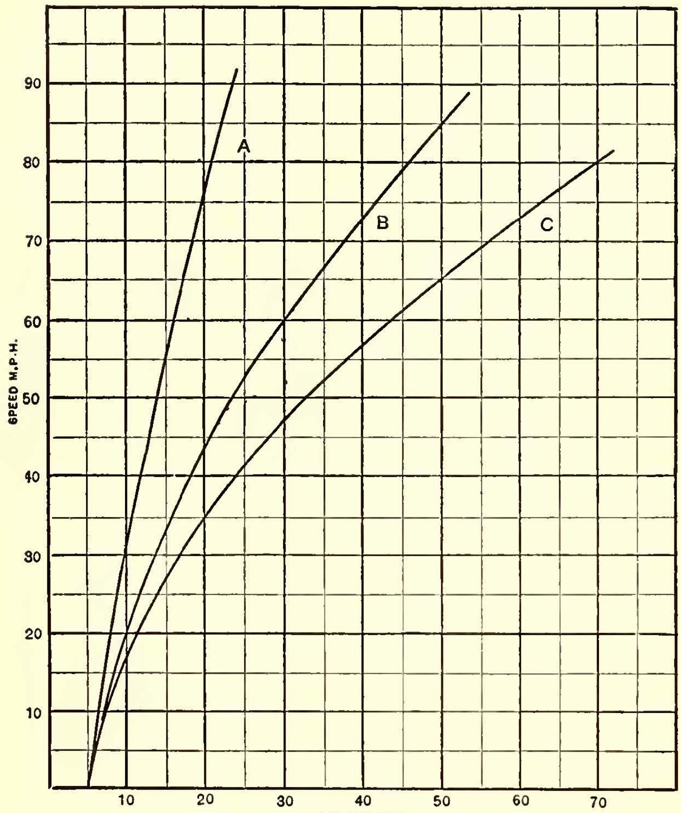


FIG. 1.—FRICTION CURVES

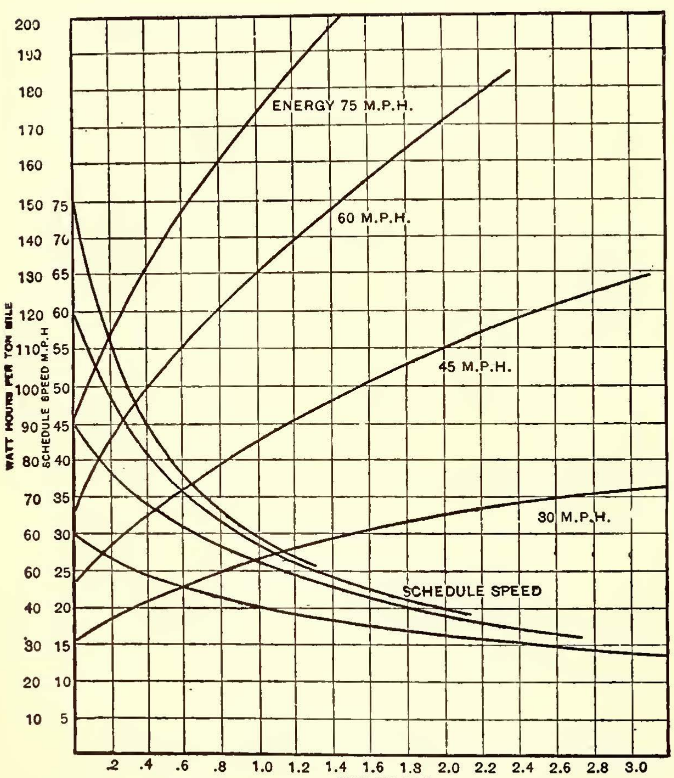


FIG. 3.—SPEED AND ENERGY CURVES (FRICTION CURVE B)

speeds, etc., can be followed up to maximum speeds equal to or better than those in vogue on the present steam roads. As will be pointed out later in this paper, the consideration of the proper method of operating a railway service at these high maximum speeds leads to very interesting results as determining the size of trains and frequency of service to be adopted.

With the friction curves in Fig. 1 as a basis, the curves in Figs. 2, 3 and 4 have been calculated, showing the possible schedule speeds and energy consumption required for these speeds up to and including 75 m. p. h. maximum. The method

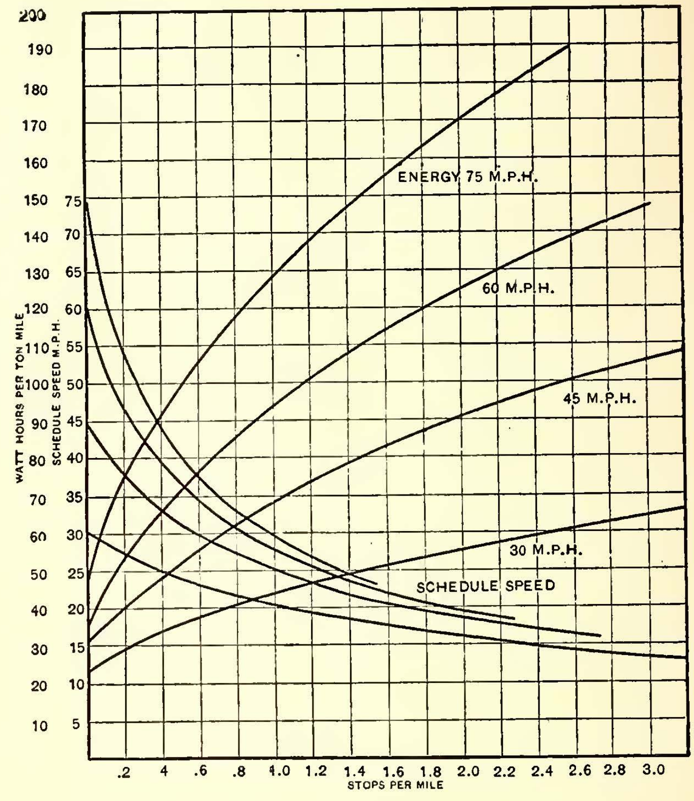


FIG. 2.—SPEED AND ENERGY CURVES (FRICTION CURVE A)

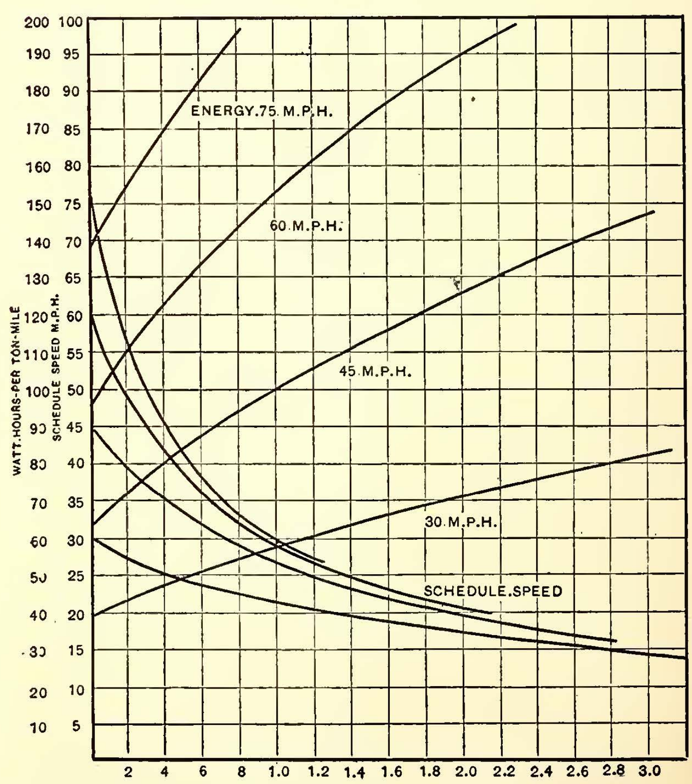


FIG. 4.—SPEED AND ENERGY CURVES (FRICTION CURVE C)

used in making up these curves is similar to that pointed out in a paper entitled "A Study of the Heating of Railway Motors," presented by the writer at the annual meeting of the Institute in 1902. As indicated in that paper the rate of acceleration and rate of braking do not have a marked effect on the energy consumption or possible schedule speeds for these comparatively high-speed roads. The shape of the motor characteristic also is not a determining feature and can be neglected without introducing a possible error of more than a few per cent. The controlling factor in all of these curves is the friction curve, which includes track, rolling, journal and wind-friction.

The constants assumed in calculating the above curves are those pertaining to average high-speed suburban work as folows:

Gross accelerating rate........	120 lbs. per ton
Braking effort (average)......	120 " " "
Duration of stop..............	15 seconds each

Track assumed to be perfectly straight and level.

In the above curves due consideration is given to all the losses occurring during acceleration with the standard series-parallel controller and direct-current motors. If the curves are to be used for alternating-current motors allowance must be made for the difference in accelerating efficiency of the two types of motors and their methods of control. The inertia of the rotating parts of the equipment generally amounts to 5 per cent, and this value is taken throughout, being perhaps a little high for the higher speeds and low for the lower speeds. The speed-curve of a standard 125-hp motor is used throughout. The energy curves given are somewhat affected by the amount of coasting done, although this is not so determining a factor in this high-speed work as it is in slow-speed rapid transit accelerating problems. In order that the energy curves should be conservative, they are plotted with only 10 seconds of coasting permitted, and therefore the schedule speeds given are nearly the maximum possible, and the energy curves given are also practically the maximum possible with the maximum speeds assumed. Should power be shut off earlier and more coasting permitted, the energy consumption would have been decreased and the schedule speeds decreased somewhat also, especially with the more frequent stops per mile.

An inspection of these three sets of curves will bring out the very great effect of the wind-friction when using trains of one or two cars at very high speeds, in fact, at 75 m. p. h. maximum speed the operation of single-car trains becomes impracticable with light 40-ton cars of standard construction, and even at 60 m. p. h. is questionable. To quote from the curves, it requires an energy consumption of 47 watt-hours per ton-mile for a train of several cars, as against 137 watt-hours per ton-mile for a single car operating at 75 m. p. h. without stops; that is, a single car operation would demand 3.7 times the energy per ton that would be required for the operation of a train of many similar cars. Even a two-car train will require but 92 watt-hours per ton-mile, or only 67 per cent of the energy required per ton for single car operation. As these values are for constant speed running, while more or less frequent stops would obtain, a comparison at say one stop in 4 miles would be nearer the actual results in practice. Here a single car requires 157 watt-hours per ton-mile, a two-car train requires 120 and a train of several cars 79 watt-hours per ton-mile. The results would indicate that in a class of service calling for very high maximum speeds, the tendency of electric roads will be to follow steam railroad practice and operate trains of several cars at more infrequent intervals rather than follow present practice of suburban electric roads and run single cars at frequent intervals. It will be a question for local consideration whether sufficient additional traffic would be gained by the operation of single cars, say on half-hour headway, or trains of two or three cars on one-hour headway or more, the latter requiring but 60 per cent or 70 per cent of the power per ton moved, and also effect a considerable saving in train crew expenses. As the maximum speed of the service is reduced the difference in energy consumption between single cars and trains of cars is also reduced, and at 30 m. p. h. a single car will require but slightly more energy per ton than a train when operated at the frequent stops characteristic of low-speed service.

Another very interesting feature which is well known but perhaps not fully appreciated is brought out by the curves of schedule speeds possible for different maximum speeds. Thus, with one stop in 8 miles it is possible to make a schedule of 61 m. p. h. with maximum speed of 75 m. p. h., and a schedule of 28 m. p. h. with maximum speed of 30 m. p. h. If stops be increased so that they average one per mile, however, the schedule speed possible with a maximum speed of 75 m. p. h. is dropped to 29 m. p. h., while the 30 m. p. h. maximum speed permits of a schedule speed of 22 m. p. h. Thus while 30 miles is but 40 per cent of the higher maximum speed it permits a schedule at one stop per mile of 76 per cent of that possible with 75 m. p. h. maximum speed. The fallacy of using high-speed equipments for frequent stops is forcibly brought out by referring to the energy curves in Figs. 2, 3 and 4. With one stop per mile it requires 200 watt-hours per ton-mile with 75 mile maximum speed equipment, and the 30 miles maximum speed equipment can obtain 76 per cent of the same schedule with an expenditure of only 28.5 per cent of the energy. The two values taken for the maximum speed are the extreme, but serve the purpose of bringing out the tremendous price paid for high schedule speeds at frequent stops. The conditions of acceleration and braking are the same in both these equipments, while if higher schedule speeds were required with, say, one stop per mile, a higher rate of acceleration and, if practical, a higher rate of braking would be adopted. The difference in energy values would be considerably reduced thereby, but neither the average rate of acceleration nor the braking could be very largely increased without incurring the possibility of discomfort to passengers.

Before considering the application of the previous curves to a concrete case, it is necessary to include the effect of the different friction curves at high speeds upon the capacity of the motor equipment. In the paper by the writer at the last annual meeting of the Institute, the manner of fully determining the capacity of a motor for any service was indicated. The details of this method will not be gone into in the present paper, but for convenience a sample motor capacity-curve of a 125-hp equipment operating at a maximum speed of 45 m. p. h. is shown in Fig. 5.

The means taken to determine the capacity of this motor is to obtain from a series of temperature runs made upon an experimental track the degrees rise per watt loss in different parts of the motor for different ratio of losses for armature and field. It is obvious that so long as the motor losses and their distribution are the same, the temperature rise of the different parts of the motor will also be practically the same. This assumes that the car will travel at the same average speed, which is not necessarily the case owing to the fact that the same motor cycle could be obtained with a considerably different train cycle. A service capacity-curve similar to Fig. 5 on the 125-hp motor is therefore not absolutely correct unless the thermal capacity curves be obtained from actual tests giving the same train cycle as that indicated. It is not necessary to conduct so elaborate a series of tests, as a sufficiently close result can be obtained for practical purposes by obtaining the experimental thermal capacity curves at moderate average speeds upon an experimental track, and assuming that the conditions of ventilation so obtained will hold true for all the schedule speeds. It is admitted that a source of error is thus introduced and that motor-service capacity curves will read too conservative at the very high speeds and will possibly be too liberal at the lower speeds; but conservatism at speeds approaching 75 m. p. h. could not be criticised as poor engineering, and the results given in following curves are therefore presented with full confidence that they will meet a long felt want and will, moreover, be approximately correct for types of motors similar to those serving as basis of calculation and experiments.

An inspection of the curves given in Fig. 5 discloses the fact that for a given temperature rise the capacity in tons per motor is practically a fixed amount. For example, a temperature rise of 60 degs. C. will be obtained with approximately 16.2 tons per motor over a range extending from one stop in 4

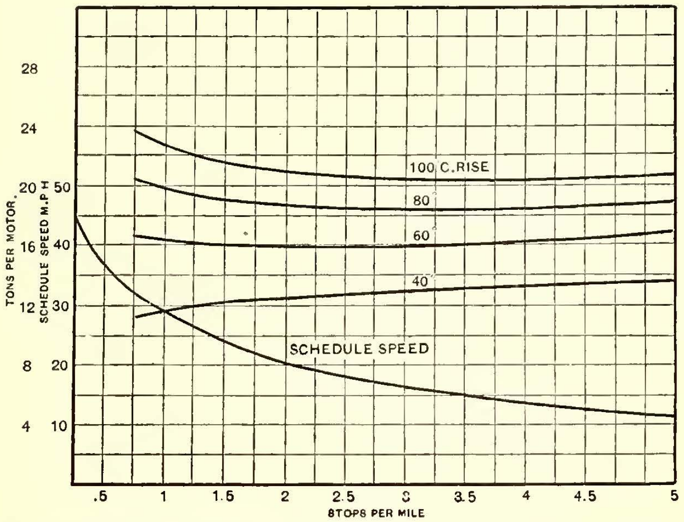


FIG. 5. MOTOR CAPACITY CURVES, 125-HP MOTOR (FRICTION CURVE B)

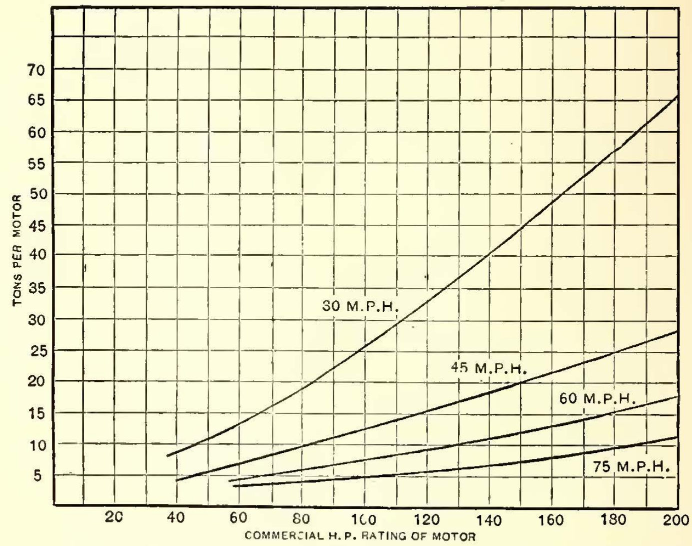


FIG 7.—MOTOR CAPACITY, 60 DEGS. C. RISE (FRICTION CURVE B)

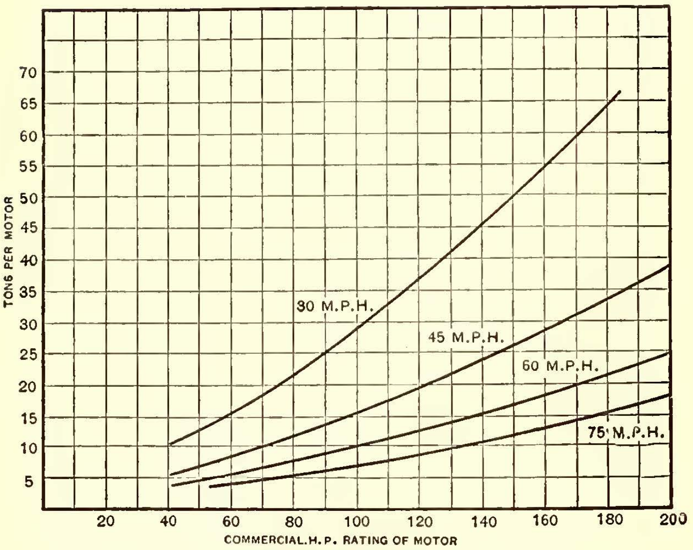


FIG. 6.—MOTOR CAPACITY, 60 DEGS. C. RISE (FRICTION CURVE A)

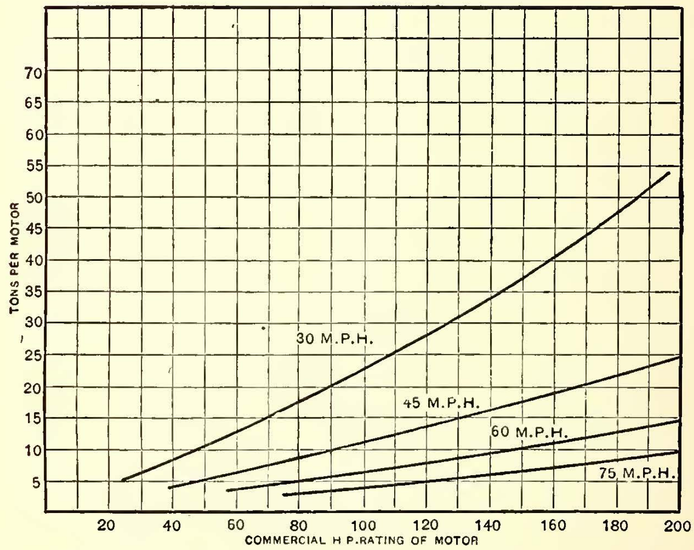


FIG. 8.—MOTOR CAPACITY, 60 DEGS. C. RISE (FRICTION CURVE C)

miles to five stops per mile. It is thus sufficient to associate a given motor and gear ratio with a definite car weight which it can operate with a given temperature rise, and with any schedule speed which the number of stops per mile will permit. This at once affords a means of comparing motors of different capacity by means of the "tons per motor" which is permitted for, say, 60 degs. rise and a given maximum speed equipment. In presenting the curves in Fig. 6, the results of a large number of experiments and calculations are incorporated on motors of similar design, giving the relation between the commercial one-hour rating of the motor and the number of tons which that motor will carry at maximum speeds of 30 m. p. h., 45 m. p. h., 60 m. p. h. and 75 m. p. h. The curves of 30 m. p. h. and 45 m. p. h. are probably accurate, those at 60 m. p. h. may be open to the criticism of being conservative, and at 75 m. p. h. with the superior ventilation afforded by the schedule speeds incident to such high maximum speeds, the motor capacity curves perhaps indicate too low a ton weight for 60 degs. rise. As no electric road as yet affords means of obtaining experimental values at this high maximum speed, the degree of error cannot be determined and in any case should not exceed more than a possible maximum of 15 per cent. Figs. 7 and 8 are plotted for 60 degs. also, but using friction curves B and C, so that by means of Figs. 6, 7 and 8 it is possible to determine the capacity of motor required for any maximum speed and any weight of train; while from Figs. 2, 3 and 4 the possible schedule speed and energy consumption can be obtained for any maximum speed and frequency of stops. The maximum speeds of 30 m. p. h., 45 m. p. h., 60 m. p. h. and 75 m. p. h. have been chosen as covering the present field of electric railroading, and intermediate values may be readily interpolated.

The relation between the commercial one-hour rating of a railway motor and its service-capacity performance is very difficult to express. In fact, it is almost impossible to compare two motors differing essentially in their mechanical design, as the stand-test of a motor has no direct bearing on its service performance with its different distribution of losses and better facilities for ventilation. It is necessary, therefore, to obtain by experiment the performance of each individual motor under conditions approximating service operation, and determine the relation of stand-test to service operation for the particular motor in question. By carrying on a series of exhaustive tests on each individual motor it becomes possible to plot the results of such tests in curve form and show the relation between stand tests and service capacity, provided motors are of the same general design. Having obtained the capacity in tons per motor for different maximum speed equipments, the results were all found to follow the general law noted in Fig. 5, that is, the temperature rise was found to be practically constant over a wide range in stops per mile and schedule speed. With this simplification it becomes possible to compile curves 6, 7 and 8, giving the capacity-motor required for any train weight, schedule and frequency of stops, the motors all being of similar design. These curves are all plotted with motors of the closed type, it being assumed that in miscellaneous operation advantage cannot be taken of opening ventilators. Where motors can be operated partially or fully open, the capacity, especially at high speeds, will be considerably increased. It is probable, however, that motors operating at speeds approaching 60 m. p. h. to 70 m. p. h. will be upon a surface track where it would be advisable to protect the motor from dust and moisture, and thus operate closed.

The results brought out by curves 6, 7 and 8 are very instructive as determining the probable trend of very high-speed electric railroading where trains of one or more cars are used. For example, a 40-ton car equipped with four motors, thus giving 10 tons per motor, will require a 133-hp motor for 60 degs. rise when operating a train of several cars at 75 m. p. h. maximum speed, while the same weight of car would require a motor of at least 230 hp if operated as a single car with the same temperature rise and similar design of motor. That is, the motive power is doubled in going from train to single-car service. Thus not only is train friction the determining feature of energy values, but it is the controlling feature as well of the motor capacity required to perform a given high-speed service.

As pointed out in the earlier part of this paper it is not necessary that the friction curves A, B and C shall in themselves correctly give the numerical values for train, single-car and two-car work. The general shape of the curves is undoubtedly that pertaining to their respective size of train, and as the three curves are taken and subsequent calculations are all made upon a three-curve friction basis, it is relatively an easy matter to interpolate and obtain the energy, schedule speed and motor capacity required for any train friction expressed in pounds per ton. The friction curves are of use, therefore, only in determining the fundamental values of train energy and motor capacity given in the subsequent curves, and the energy, schedule speed and motor capacity can be obtained from these curves whether the friction pertaining to the case in hand is, say, 33 lbs. per ton at 50 m. p. h. for single-car operation, or more or less than this value. The application of the motor and energy curve is, therefore, universal, and it is only necessary to obtain sufficient experimental data of the particular type of car or train proposed to determine accurately its friction for a given maximum speed and obtain the various values required by interpolation in the curves given.

Having obtained the data upon which to base calculations for the proposed electric road, perhaps the best method of showing its application would be to take a concrete case. Let the distance from A to B be, say, 100 miles, or great enough to get over the consideration of location of sub-stations in relation to the length of the line. Assume also that the proposed road will parallel a steam line, or that there are other reasons necessitating a high schedule speed, that stops will occur every 4 miles, and will be of 15 seconds duration, and that the motors will be direct current, supplied from sub-stations, fed from a single central generating station. It is desired to know the effect that single car or train operation will have upon first cost and cost of operation.

It is assumed that the competing steam road will have a schedule speed in the vicinity of 40 m. p. h. Such express trains as exceed this schedule will offer such very infrequent service, and will, furthermore, be so restricted to their through travel that they will not enter as a factor for consideration. By referring to Fig. 4 we find that a schedule speed of 40 m. p. h. can be obtained, with a maximum speed of approximately 48 m. p. h. with one stop in 4 miles. The energy consumption will be 82 watt-hours per ton-mile, and the motor capacity will consist of four 110-hp motors operating a single 40-ton car with a temperature rise of 60 degs. (Fig. 8). The energy consumed at the car will, therefore, be 131 kw or 144 kw at the sub-station bus-bar, allowing an average drop of 10 per cent in the third rail. With a sub-station bus-bar potential at 600 volts, each car will average 240 amps.

Assuming that the road will be double track, with 80-lb. track rails and 100-lb. third rail, the distance apart of the sub-stations will be approximately 13 miles, with a maximum drop of 170 volts when two cars are passing midway between sub-stations, one of which is accelerating. This drop is permissible, as it is momentary only. Each sub-station must be able to accelerate one car and supply another at full speed, or must give 850 amps. momentary output and a sustained output of 500 amps. The sub-station will, therefore, be called upon to deliver momentarily 510 kw, and should contain not less than one 300-kw rotary converter, and preferably two, one being a reserve. This size of converter is based upon the assumption that cars run always as single units and not in trains, and that converters can stand a momentary overload of 100 per cent. With half-hour service cars will be spaced 20 miles apart, so that there will be required a generator capacity of two cars every 20 miles (double track) or 340 kw, assuming 15 per cent loss in rotary converter sub-stations and transmission line. The generating station capacity per mile of track will, therefore, be 17 kw, and the sub-station 46 kw with reserve, and 23 kw with no reserve. Taking the cost of generating station in round numbers at $100 per kilowatt, and sub-station at $35, the cost of a 40-ton car complete with four 110-hp motors, controllers, etc., at $9,000, we arrive at the following approximate cost for installing:

APPROXIMATE FIRST COST PER MILE, SINGLE-CAR TRAIN

Generating station	$1,700
Sub-stations with reserve	1,610
Equipment (plus 20 per cent reserve)	1,120
Total	$4,430

The above total of $4,430 thus represents the approximate first cost of the various items noted when operating a single 40-ton car every half-hour at 40 m. p. h. schedule speed and stopping 15 seconds once in 4 miles. Following through the same process with two 40-ton cars operating on one-hour headway at 40 m. p. h. schedule with the same track and third-rail construction, we arrive at the following conclusions:

Watt-hours per ton-mile, 63; train energy at train (80 tons), 202 kw; distance apart sub-stations, 9.1 miles; size sub-station, two 400-kw units.

Each train, consisting of two 40-ton cars, will consume 224 kw at the sub-station, or 264 at the generating station, allowing the same percentage of loss as above. These trains making the same schedule speed at double the headway will be spaced 40 miles apart and the generating capacity will, therefore, be 528 kw every 40 miles, or 13.2 kw per mile. The sub-stations, consisting of two 400-kw units (with reserve), every 9.1 miles, will have capacity per mile of 88.0 kw. Expense for cars will be the same as before and the following approximate costs obtain:*

APPROXIMATE FIRST COST PER MILE, TWO-CAR TRAIN

Generating station	$1,320
Sub-stations	3,080
Equipments	1,120
Total	$5,520

The first cost of the two-car train system will be $5,520 as against $4,430 with single-car train. The energy consumed for the two methods of operation is 17 kw per mile of track with single car as against 13.2 kw per mile with two-car train. Thus, while the two-car train at one-hour headway will cost 24½ per cent more to install (for the items mentioned only) it will consume but 77.6 per cent of the energy required to operate a single car individually.

The difference in power required is 3.8 kw per mile of track. Assuming twelve hours per day operation at the above headway, the total kilowatt-hours per day will be 45.5, which, at $.007 per kilowatt-hour, would be $116.50 per year, or 10 per cent on $1165. It would, therefore, pay to invest the $1,090 per mile of track difference in cost between one-car and two-car operation, as found above, provided the same receipts could be secured with one-hour headway as with 30-minute headway. The relation of traffic receipts and frequency of travel is a question which can only be determined experimentally, and while the desirability of the two-car service seems evident from the data at hand in the above case, it might result in a falling off of receipts to such an extent as to more than make up the saving in operating expenses. There is an additional saving in train crew expenses which was not entered into above, and which would amount to something more than half as much as the cost of power. With two-car operation it is possible to reduce the motor capacity per car from four 110-hp motors to four motors of approximately 95 hp, thus reducing the cost of the equipment item. Owing to the fact, however, that it might be desired to operate a single car during certain parts of the day, which would result in overheating the smaller motor equipment, it would be more conservative to consider the same size of equipment whether one-car or two-car train were operated. With more than two cars in a train advantage could be taken of the smaller equipment required, but it is probable that in two-car work this advantage of the smaller motor possible for two cars would only result in the cooler operation of these motors when operated in two-car trains and would show up, therefore, in the repair account rather than as a first cost. The sub-stations with two-car trains being placed somewhat closer together would have a labor account per mile of track in excess of that for single-car operation. This may be balanced against the saving which would result from smaller crew expenses of the two-car train.

These examples serve to illustrate the very broad application of the foregoing curves. Although it has been necessary to assume a number of constants, acceleration, braking, coasting, etc., these constants are those pertaining to average operation and can vary considerably without making a serious difference in the results. The curves given are not, therefore, absolutely correct, but are sufficiently so for approximation purposes. For the slower speed work where stops are more frequent and where acceleration is a more important factor, it will be necessary to have more complete curves to determine the proper rate of acceleration, especially if the problem is one calling for very high schedule speeds in relation to the number of stops.

As previously stated, it is not necessary that friction curves A, B and C should represent the actual friction in pounds per ton of train, two-car and single-car work. Having the motor capacity and energy values for three different friction rates at a given maximum speed, it is possible to interpolate and secure the proper motor capacity and energy value for the friction value corresponding to the case in hand. The importance of the wind-friction as affecting electrical operation at a very high speed in service with the very small light trains of one or more cars, will probably lead to the construction of special cars reducing wind-friction to a minimum when the higher maximum speeds are put into commercial operation. No conclusive data is at hand upon the effect of different shaped car ends on single or two-car operation.

The compilation of the above curves entailed a large amount of careful work, and the writer is very much indebted to E. F. Gould for his very valuable assistance.

USE OF AUTOMATIC MEANS FOR DISCONNECTING DISABLED APPARATUS*

BY H. G. STOTT

This subject may preferably be divided into three sections, as follows:

(a) Generating apparatus.

(b) Transmission apparatus.

(c) Receiving apparatus.

(a) Generating Apparatus.—That no overload device should be used in the generating plant to disconnect disabled apparatus may be stated as a general proposition.

Experience has probably been responsible for the evolution of the art to a point where it has become not only possible, but necessary to eliminate all overload devices.

Only a brief statement of the reasons for abandoning the use of overload apparatus will be necessary.

In case of an accident to one generating unit, the other units in multiple with it will immediately begin to force current into the disabled one, and the increased load on the good units, due to their normal load plus the short-circuit current supplied to the crippled unit, will, in all probability, trip all the circuit breakers simultaneously, thus interrupting the service.

Without automatic circuit breakers the overload on the good units would cause the potential of the system to fall so low that the service would, in all probability, be as completely interrupted as in the former case, unless the attendant succeeds in locating and disconnecting the crippled unit immediately. Should he fail to do so the service will inevitably be interrupted and a great deal of damage done to the crippled unit by the current from the good machines.

It is then evidently necessary to have some means of discriminating between a current coming out of the machine and one going into it. Modern apparatus can safely carry 200 per cent or more load for a few minutes, but if a unit has become crippled it will immediately cease to be a generator and become a receiver. All that is necessary to do then is to install on each generator a suitable circuit breaker which will operate only when the direction of flow of energy through it is reversed.

This type of safety device has been developed for both direct-current and alternating-current apparatus, so that it operates quite satisfactorily.

As an additional precaution in large plants a second reverse current relay should be installed which will merely light up a letter or number in front of the operator so that in the event of the failure of the first automatic device the faulty machine may be quickly disconnected by hand. These reverse current relays should have a time-limit and current-limit attachment, which should be set for not less than three seconds, so that a slight reverse current, or one of momentary duration, such as is liable to occur at the moment of multiplying, will not operate the circuit breaker.

(b) Transmission.—When transmitting power through overhead and underground cables it is essential to successful operation to be able automatically to disconnect the feeders from (1) the generating station, and (2) if there are duplicate transmission lines, from the receiving station.

(1) At the generating station this should obviously be done by an overload circuit breaker whose operation is delayed by a time element which may be set at from 1 second to 10 seconds, according to the local conditions.

This is all the protection necessary or desirable where only one transmission line exists.

(2) With two or more transmission lines in multiple an entirely different set of conditions exist, as in case trouble develops in one, current will be fed back from the receiver end

* Opening of discussion at the twentieth annual convention of the American Institute of Electrical Engineers, Niagara Falls, N. Y., July 1, 1903.

into the fault through the good feeders; the result will be that all the feeder overload breakers at the generating station will trip, thus shutting down the entire line and, in all probability, shutting down all synchronous receivers on the system, due to the resultant fall in potential.

Reverse current relays at the receiver end of the feeders operate satisfactorily, provided the fault is not severe enough to drop the potential.

If, however, the fault amounts to a short circuit the potential at the receiver end will fall so low that the potential coil of the differentially-wound relay will not receive enough current to enable the relay to operate.

Reverse current relays on the receiving end of feeders are not as yet to be depended upon, but recent improvements give promise that we may soon expect to find a satisfactory solution of this important problem.

When only two feeders are in use a method devised by L. Andrews, of England, seems to be very satisfactory. At the receiver end the two feeders are connected together through a choking-coil wound entirely in one direction. The current is drawn from a tap in the center of this winding. Under normal conditions the feeders supply equal current through each half of the winding to the tap, but as the currents pass in reverse direction through the winding the resultant flux is nil and, therefore, the resultant inductance is nil, the only loss being that due to the ohmic resistance of the coils.

Should a short circuit occur in one of the lines, the current from the other line will flow through both halves of the reactive coil in the same direction, thus producing a strong choking effect and limiting the current to an inconsiderable amount.

As the overload circuit breaker on the faulty feeder at the generating station will trip immediately, it is then only necessary for the attendant at the receiving station to open-circuit the section of the reactive coil connected to the faulty cable and short-circuit the other half connected to the good cable. This device, I am informed, has given excellent results in England, but for obvious reasons would not be suitable for more than two feeders.

Where possible, the safest plan at present is, in the writer's opinion, to run the feeders entirely separate at the receiving end, only putting the direct-current end of the rotaries in multiple; or in cases where low-tension alternating-current (2000 volts or less) is supplied, putting the secondaries in multiple. If, under these conditions, reverse current relays are installed at the receiving end of the feeders they will operate very satisfactorily, as the reactance of the rotaries and transformers will be sufficient to limit the reverse current in the faulty cable, thus allowing the reverse current relays to operate, as there has been no serious fall of potential.

The greater the number of feeders used between the generating station and the sub-station the better this method becomes, as, for instance, with two cables a fault in one will only reduce the capacity 50 per cent until the operator can synchronize all the apparatus which was running on the faulty cable, and as the apparatus and converters will continue to run at full speed only a few minutes will be necessary to synchronize on the good feeder, which will in the meantime carry the whole load, so that no interruption to service will occur. With three cables this would mean a loss of capacity of 33.3 per cent, and with four cables 25 per cent, etc.

(c) Receiving Apparatus.—This should be treated in exactly the same way as the generating apparatus, namely, use reverse current relays only to operate the circuit breakers on the rotaries, etc., and use time-element overload relays only on the low-tension feeders leaving the sub-station.

These remarks apply generally to both direct-current and alternating-current apparatus, with the exception of the part devoted to transmission apparatus, which, of course, only applies to alternating-current transmission.

THE INTERURBAN TERMINAL STATION AT INDIANAPOLIS

Bids have been opened for the construction of the elaborate interurban terminal station planned by the Indianapolis Traction & Terminal Company for the use of its lines and the lines of the interurban companies operating into Indianapolis. The building will be erected at Market Street and Wabash Street. It will be a ten-story structure, and, according to the provisions under which bids were submitted, the building must be ready for occupancy by April 1, 1904. The building is to have a 163-ft. front in Illinois Street, and extend 70 ft. in Market Street and Wabash Street. On the north side will be sheds, waiting rooms and tracks running the entire length of the building and extending about 100 ft. The general plan of the tracks will be like that of the Union Station. A high iron fence will surround the inclosure. Entrance will be through a 15-ft. archway in Illinois Street. The cars will enter the station from Market Street and Ohio Street. The offices of the terminal company and the interurban companies will be in the building. The work of building the cross-town line and constructing the down-town loop and making various extensions of the street railway system, required by the city as a consideration for the terminal station franchise, will be taken up as soon as the building is begun.

INTRAMURAL ROAD FOR THE ST. LOUIS EXPOSITION

As recently noted in these columns, the management of the Louisiana Purchase Exposition has decided to build an intramural railway for transportation inside the fair grounds. This road will be put in operation as soon as possible, in order that it may carry visitors and others who may wish to make use of it before the opening of the exposition. It is expected to have it in operation this summer. The St. Louis Car Company has been given an order for ten 14-bench open cars mounted on St. Louis Car Company No. 47 trucks. The present tracks in the grounds, which have been laid for use during construction, will be utilized as far as possible.

DISTRIBUTION SYSTEM OF THE UNION RAILWAY COMPANY OF NEW YORK

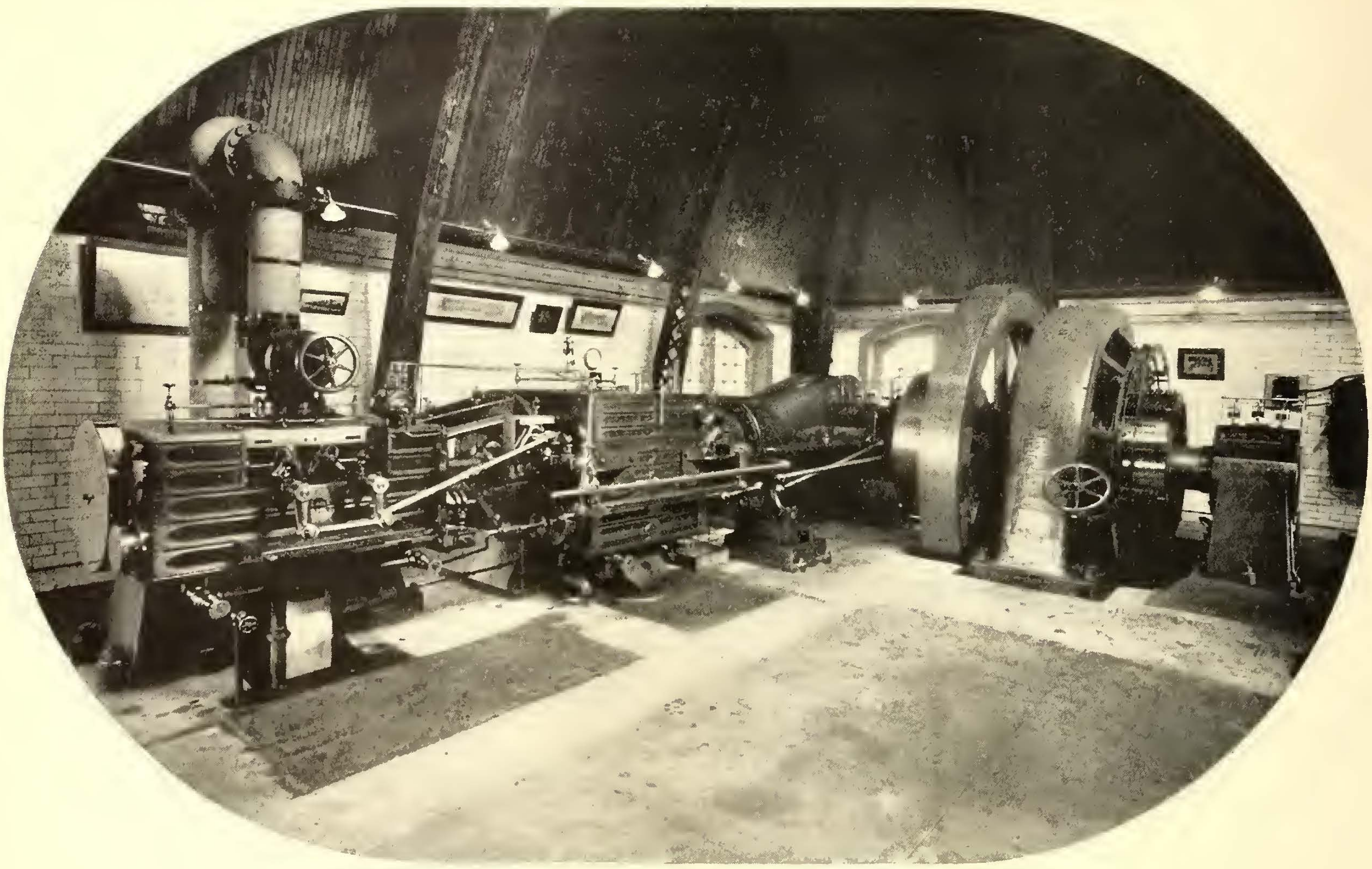
The Union Railway Company of New York City is building three new sub-stations in the vicinity of New York, one at West Farms, one at Mount Vernon and the other at Yonkers. They will be equipped with Westinghouse apparatus and will be supplied from the power station of the Interurban Street Railway Company, at Kingsbridge. The sub-station at West Farms will contain nine 375-kw oil-insulated static transformers, divided into three groups, supplying current to three 1000-kw rotary converters. The switchboard consists of high-tension alternating-current receiving panels with electrically-operated oil circuit breakers, low-tension alternating-current rotary panels and load panel, with direct-current rotary panels and load panel; also about twenty direct-current feeder panels. The other two sub-stations, now in course of construction, will have similar equipments, excepting that the capacity in each case will be three 500-kw units instead of three 1000-kw units.

RATE WAR IN INDIANA

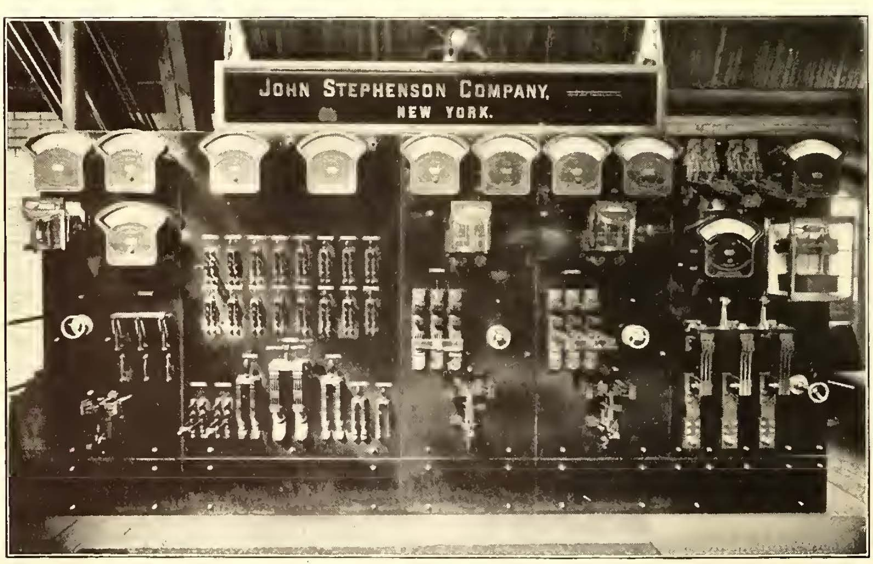
War has been declared by the Wabash Railroad Company against the Fort Wayne & Southwestern Traction Company and the Wabash & Logansport Traction Company. The Wabash agent in Logansport, Ind., has received instructions to make the fare between that city and and all points along the line to and including Fort Wayne the same as that charged by the interurban companies. This is the first rate war in Indiana between the railroads and interurban electric lines.

IMPROVEMENTS AT THE STEPHENSON WORKS

A number of improvements and additions to the equipment have lately been made at the car shops of the John Stephenson Company, at Elizabeth, N. J., including the installation of a 450-hp generating set and a large number of additional motors, aggregating upwards of 200 hp, and making the total capacity of the motors approximately 1100 hp. The company has also recently installed three portable motor-driven air compressors for the operation of pneumatic tools in the woodworking departments and machine shop, and a 5-in. forger operated by a 15-hp electric motor.



NEW UNIT IN STEPHENSON POWER PLANT

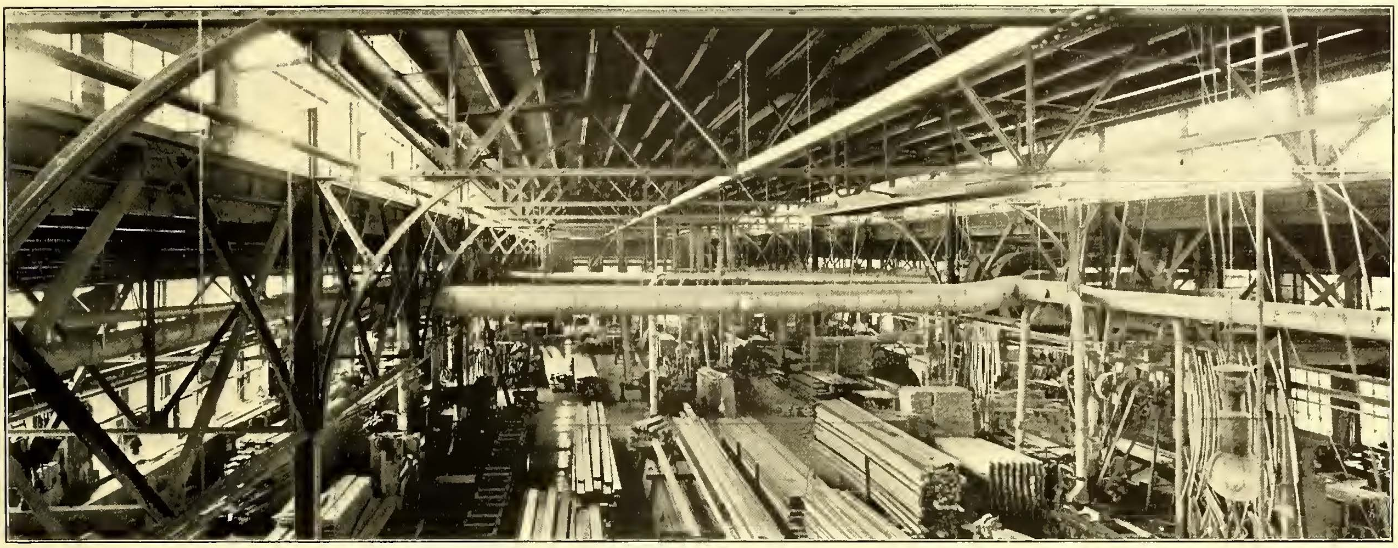


SWITCHBOARD FOR TROLLEY, POWER AND LIGHTING PLANT AT CAR SHOPS

POWER PLANT

When the original plant was installed in 1898 it was thought that ample provision had been made to anticipate the requirements for several years, but since then the business has extended so rapidly that the shop facilities in every department have long since been taxed to their utmost, and there is consequently a much larger demand for power than was originally provided. The initial power plant comprised two 150-kw General Electric direct-current generators, directly connected to two Harrisburg Ideal self-oiling engines rated at 240 hp each. The engines were designed for a working pressure of 125 lbs. to the square inch. The size of the cylinders is 16 ins., with 16-in. stroke, one right-hand and one left, the piston rods being fitted with metal packing. The speed of these units is 150 r. p. m., but they may be run up to 200. The engine shaft is a solid forging 7¼ ins. in diameter, extended on one side and supported by an out-board bearing for the armature of the generator. The fly-wheels are extra heavy for this type of engine.

The generating set which has just been installed by Edward H. Ludeman, of New York, comprises a horizontal engine, made by the Fitchburg Steam Engine Company, directly connected to a General Electric generator, and it practically doubles the capacity of the original equipment. The engine is of the horizontal slow-speed type, making 150 r. p. m. It has 20-in. and 34-in. cylinders with 28-in. stroke. The engine is rated at 450 hp when operating at 115-lb. steam pressure, non-condensing, but it can develop 600 hp. The generator armature and the fly-wheel are mounted on a steel shaft 15 ins. in diameter. The fly-wheel rim weighs 26,000 lbs. The bearings are 12 ins. in diameter and 24 ins. long, and are supplied with water-cooling chambers. The steam valves on both cylinders are double-ported, and are operated by the cam-valve motion. They respond quickly to the governor in opening and closing. The exhaust valves are driven by a separate eccentric, and the inlet valves by the governor eccentric. The low-pressure piston is fitted with metal rings to provide against excessive wear. The main bearings are removable from the housings, and the cheek pieces may be adjusted readily. The generator, which is directly connected to this engine, is a General Electric direct-current machine, with a capacity of 1200 amps. at 250 volts.



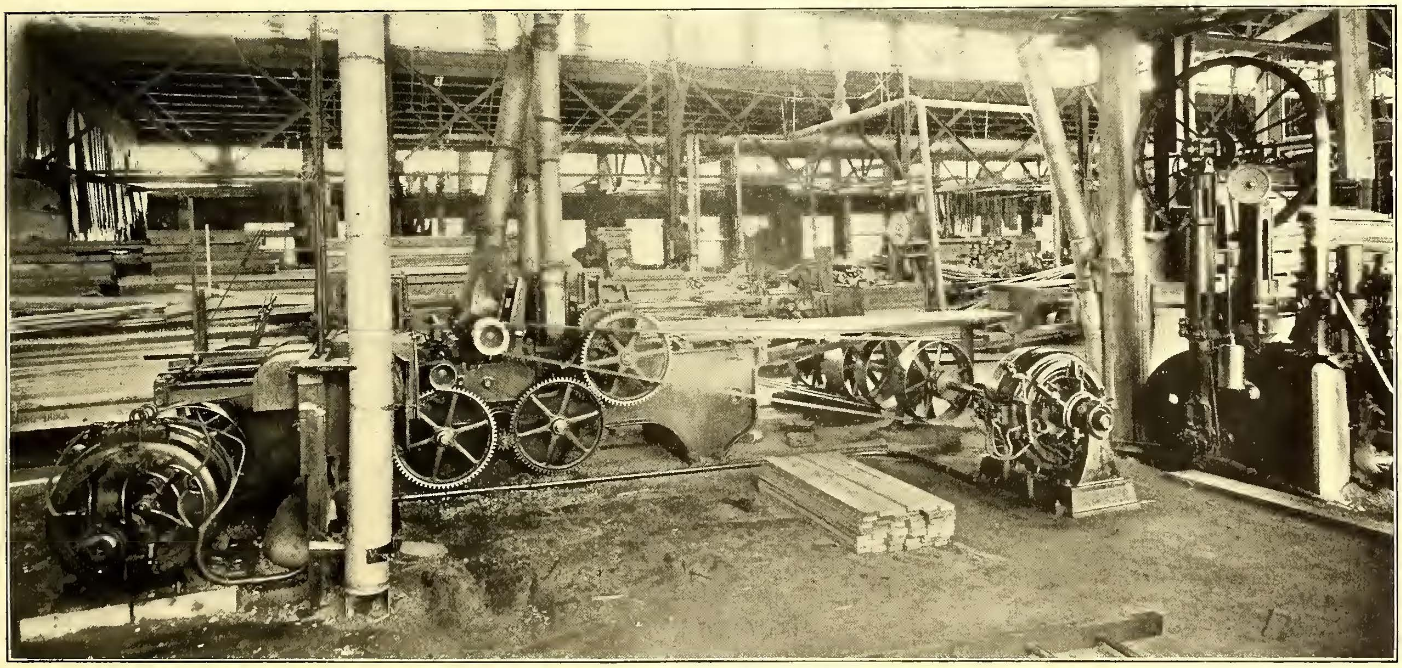
85-HP MOTOR DRIVING SHAVINGS EXHAUST SYSTEM IN MILL

This generating plant supplies current for operating the entire works, and it is located in the base of the 275-ft. clock tower, east of the main buildings, occupying a room 52 ft. sq. and 30 ft. high. In addition to the engines and generators already mentioned, this room contains a 25-kw General Electric motor-generator, which is utilized to operate the trolley line and furnish current for testing purposes, the main switchboard, the steam-driven air compressor and pump for furnishing the water supply, and an underwriters' pump for the system of fire protection. The floor is of cement, the sides of brick with Potsdam red sandstone trimmings, and the roof of curved rafters. The interior is finished in cream-colored glazed brick and the dome in oiled yellow pine. The appearance of the engine room may be gained from an inspection of the accompanying views, showing the new generating set and the switchboard.

DISTRIBUTION SYSTEM

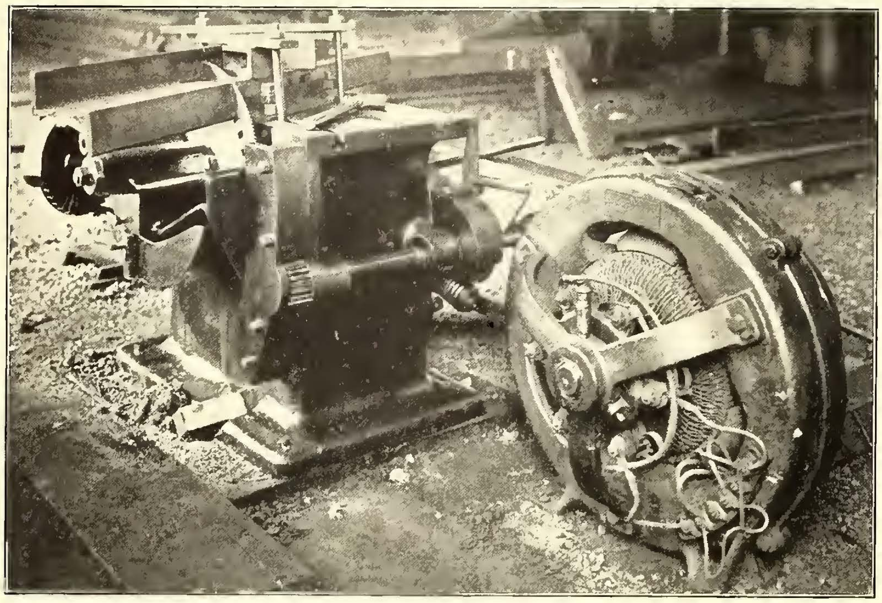
When the additional unit was installed a new panel was added to the switchboard, which is made on 1½-in. slate, enameled on the front side and carrying the power and lighting circuit switches, main switches, field switches, Weston illuminated dial ammeters and voltmeters and Thompson recording wattmeters, all mounted in an iron insulated frame. The bus-bars at the back of the board are ½ in. x 4 ins., and all exposed copper carrying current is thoroughly insulated. The board now comprises five panels, three for generators, one for the motor-generator and one feeder panel.

The mains from the switchboard are carried underground through a tunnel which connects all of the buildings, and is used also for carrying the service water-pipes, steam-pipes and hot-water heating pipes. There are no electric wires overhead in any part of the grounds, excepting the trolley wires for the electric railway and the transfer tables. The system of distribution provides for separate power and lighting circuits for each building, and the switches controlling these circuits are marked on the main switchboard. At the present time 107 motors, aggregating 1100 hp, are connected upon this system, and 3000 incandescent lights and thirty enclosed arc lamps are



MOTOR-DRIVEN PLANER IN MILL

also supplied with current. Throughout the works local distribution in each department is effected through panel boards carrying knife switches and enclosed in slate-lined iron boxes with hinged doors. All work is screwed or bolted into place, and great care has been exercised to make the installation as nearly fireproof as possible.



MOTOR-DRIVEN COLD METAL SAW IN BLACKSMITH SHOP

AUXILIARY EQUIPMENT

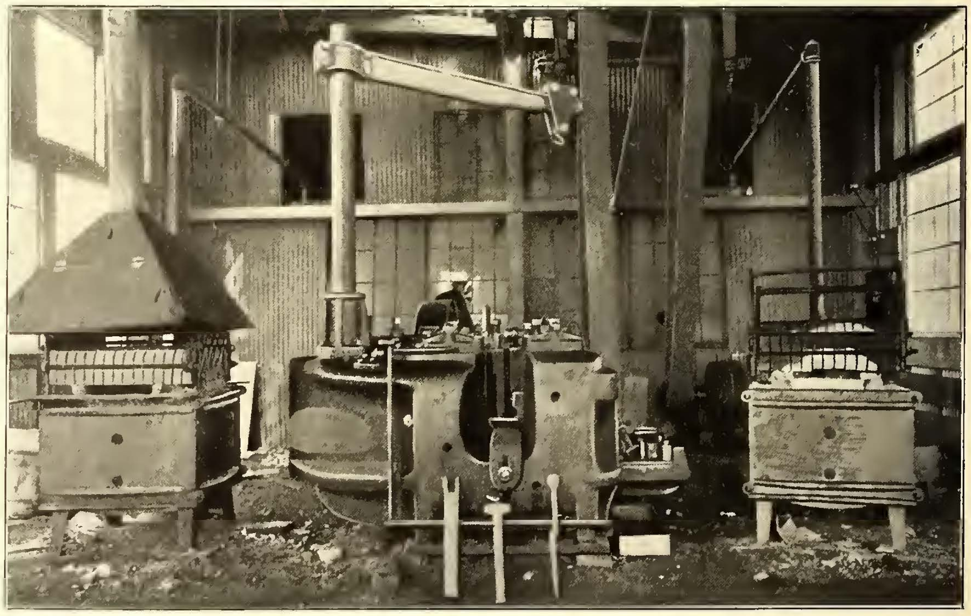
An interesting feature of the system is the provision that has been made for supplying water for fire-fighting purposes and for consumption in all parts of the works. Two wells were driven near the engine room, one 250 ft. deep and the other 300 ft. An Ingersoll-Sargeant air compressor in the engine room supplies air at 80 lbs. pressure to a Pohle air-lift pump in each well, and thus forces the water to the surface and discharges it into an underground storage reservoir, alongside the engine and boiler houses, which has a capacity of 100,000 gals. The underwriters' pump, which is also installed in the engine room, has a capacity of 1000 gals. per minute, and is supplied from this reservoir, but there is also a connection with the city mains so that ample water supply is always assured when needed. This fire pump, which, according to the underwriters' regulations, must be kept constantly in motion, furnishes all the water necessary under ordinary conditions for the several departments.

MOTOR SERVICE

As has already been mentioned, the machinery throughout the works is operated by electric motors, and several interesting illustrations are herewith presented. In the original plan it was proposed that each machine should have its individual motor directly connected to it, but in practice it was frequently found much more desirable to group several machines and drive them by a motor through shafting. This was particularly the case in the woodworking department, where the largest number of motors was required. At the present time fifty motors are in daily operation in the mill and ten in the cabinet shop. These range in capacity from ½ hp up to 85 hp, the largest one being used for operating the shavings exhaust system which takes up and transmits to the boiler room the refuse from the wood mills. In the blacksmith shop and in the machine shop the original plan of furnishing separate motors for each machine was followed to a much larger extent than in the woodworking departments, although this practice was not adopted exclusively; in fact, a large number of the iron-working machines are now grouped together and belted to shafting, which is driven by one motor. In the paint shop, finishing shop, brass shop and buffing shop motors furnish power for operating whatever machinery is needed.

ELECTRICALLY OPERATED FORGER

One of the most interesting applications is found in the temporary structure which has just been erected as an addition to the blacksmith shop for the large forging machines shown in the accompanying cut, together with the two heating furnaces in which the iron is brought to the proper condition for working it. The heading, upsetting and forging machine was built by the Ajax Manufacturing Company, of Cleveland, and will be used largely in the production of forgings for trucks. This machine is capable of producing forgings of great variety in either square or round stock 5 ins. and under, and will operate on flat stock up to 15 ins. width, making bolts, upsets and special shapes. It has a lock and automatic stop between the pitman and header slide, arranged to give one or more blows as desired, and stop with dies wide apart. This is effected without the use of a clutch or similar device, so that the machine does its work



FORGER FOR LARGE WORK

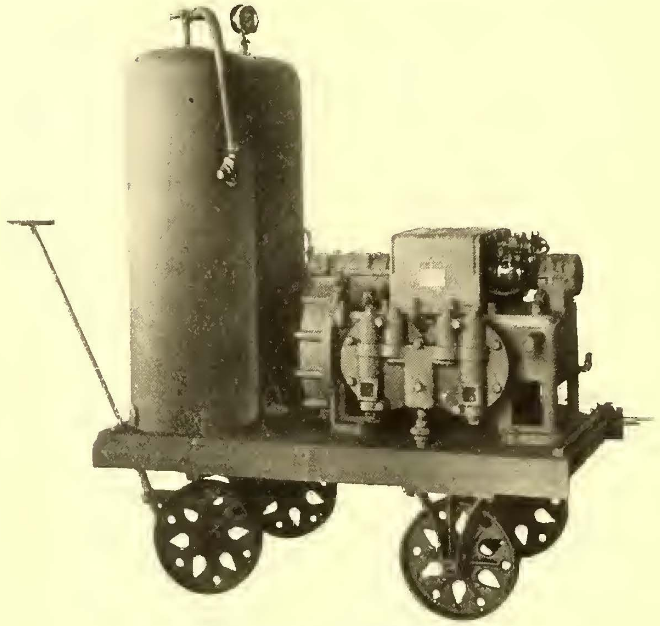
without shock and is practically noiseless. The gripper slide is connected to and driven by the header slide, and each is provided with heavy liners to prevent wear on the bed casting and to provide means for realignment of the slides in case of wear. The crank shaft and the pinion shaft are of steel, and run in solid sleeve-boxes let into the bed casting, which is bored out to receive them. This construction is claimed to be possible only by the use of a single crank shaft. The machine is powerfully geared, the teeth being cut from the solid. The gear, pinion and fly-wheel are each firmly keyed to their respective shafts. The machine requires 15 ft. x 9 ft. floor space; the diameter of the belt wheel is 56 ins., and the speed of the belt wheel is 175 r. p. m., the width of the belt is 8 ins., the ratio of gearing is 5 to 1, and the total weight of the machine 85,000 lbs. A 15-hp motor furnishes power for operation. This machine effects a considerable saving in time and labor, as it will turn out as much work in one day as twenty-five men. Moreover, it eliminates repetition in handling and heating the pieces, and as much of this work is very heavy the economy in time and labor is very great, while the saving in power is correspondingly large.

MOTOR-DRIVEN AIR COMPRESSORS

Another addition to the equipment that has greatly increased the capacity of the shops is the introduction of pneumatic tools, power for which is furnished by three portable air compressors of the Christensen type, driven by electric motors. One of these equipments was first installed in the mill, where a temporary connection for the motor driving the compressor had been made with the power circuit from which current is taken for the motors operating saws, planers and other woodworking machinery. These outfits are moved from point to point about the shops wherever compressed air is required. They have been found very convenient and economical, as they can be used for heavy work which could not be brought to the immediate vicinity of the main power plant, as in the example cited, where the mill is half a mile from the generating plant, and the cost of transmitting compressed air such a distance for this work would be prohibitive. Moreover, the multiplicity of compressor plants about an establishment of this size, should equipments be installed permanently in all departments where pneumatic tools could be used to advantage, would increase the cost of apparatus beyond all reasonable limit, especially as there would be only occasional demands for compressed air and the outfit would not be operating under advantageous conditions.

ENCLOSED MOTOR AND GOVERNOR ON AIR COMPRESSOR

The compressors are shown in detail in the two views of the machines themselves which are here presented. Each equipment consists of one Christensen type "H," size D-4, intermittent running compressor, having a piston displacement of 50 cu. ft. of free air per minute, one automatic governor, by means of which the compressor is stopped and started at maximum and minimum pressures respectively, two 16-in. x 45-in. seamless cold-drawn steel reservoirs with pet cocks, one pressure gage, one switch, one fuse and one length of ¾-in. air hose with stop cock and coupling head, all mounted, complete with necessary wiring and piping, on a four-wheeled truck. These may be provided with a cover for the electrical parts, as shown in one of the cuts, and fitted with doors, giving access to the governor and armature. Such an arrangement is particularly desirable in mills where dust and dirt are ever present. These illustrations also give a very good idea of the compactness of this apparatus, the dimensions of the outfit being: Length over all, 5 ft.; width, 3 ft., and height 5 ft. 5 ins.; net weight of complete equipment approximately 1625 lbs. These equipments have been found to be very economical in power consumption, as they are only in operation the actual length of time necessary to compress the amount of air required for the work in hand, and the fact that they are portable and can be taken from place to place in the shop, wherever work is being done, greatly reduces the cost of installation, as it eliminates the expense of long pipe lines and the loss in transmission. The machines shown in the illustrations are not water jacketed, as they are intended for intermittent running at the ratio of one hour in three, but Christensen compressors are also made in water jacketed patterns for portable use, for continuous operation. The compressor and governor and some of the other apparatus in these portable equipments are of the same general pattern as that used in connection with the



PORTABLE AIR COMPRESSOR

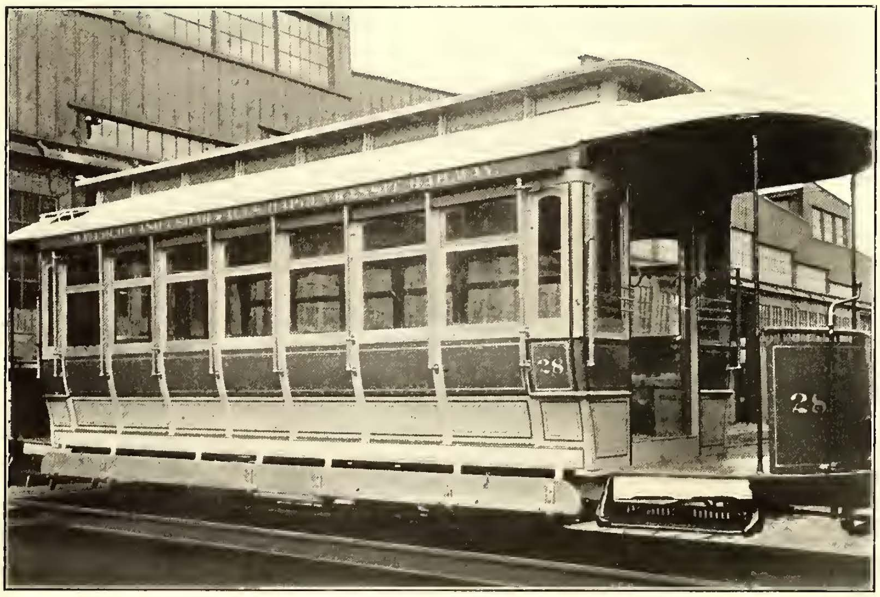
Christensen air brakes on electric cars. The whole equipment has been designed for simplicity, durability, compactness, economy of operation and accessibility of parts for repairs.

NEW DOWNTOWN SUB-STATION FOR ST. LOUIS TRANSIT COMPANY

Among other improvements to be put in before the World's Fair, the St. Louis Transit Company will place a new sub-station near the center of its downtown load at Eighteenth Street and Locust Street. This will be a rotary converter sub-station with extensive storage battery auxiliary. There will be seven or eight General Electric rotary converters of 1000-kw capacity each, with step-down transformers to reduce from 6600 volts, three-phase. Contracts have been let for Chloride storage batteries, to give 600 volts across their terminals, and be capable of discharging 5000 amps. for one hour. The batteries will be in the basement of the sub-station building, and the rotary converters and boosters on the first floor. The St. Louis Transit Company has ordered fifteen 1000-kw rotary converters for delivery before the opening of the World's Fair, several of which will go in sub-stations already established.

THE CONVERTIBLE CAR IN IOWA

The accompanying illustration shows the style of convertible car (Brill patent) recently built by the American Car Company, of St. Louis, for the Waterloo & Cedar Falls Rapid Transit Company. This railway system, as the name indicates, is an interurban road, but the company also operates the city lines of both Waterloo and Cedar Falls, and at the former the operation with the convertible is intended. The system is extensive, some 40 miles of lines being in operation, and 36 miles of additional lines are in course of construction. The exceedingly fertile valley of the Cedar River, through which the lines run, is thickly dotted with towns and villages, with the two important railway centers from which the company takes its name. Within the last year or two this type of convertible car has come into considerable use in the States of the Middle West, in Illinois, Michigan, Indiana and others, seeming to indicate that the double-sheet steel panels, with their 5/8-in. air space between, are amply sufficient to keep the car warm in the severe wind storms of winter that are characteristic of the comparatively level land in that region.



CONVERTIBLE CAR FOR THE WATERLOO & CEDAR FALLS

The general dimensions are as follows: Length over end panels, 20 ft. 7 ins.; length over crown pieces, 25 ft. 1 in.; from panel over crown piece, 4 ft. 6 ins.; width over sills, 6 ft. 10 ins.; width over posts at belt, 7 ft. 9 ins; from center to center of posts, 2 ft. 7 ins.; sweep of posts, 5 ins.; side sills, 5¼ ins. x 6 ins.; end sills, 4¼ ins. x 6 ins. The side sills are plated on the outside with 5/8-in. x 6-in. steel. The side posts are 3⅜ ins. thick, and end posts, 3¾ ins. The interior is finished in white ash, with decorated birch ceilings, making a bright, attractive appearance. Six revolving double seats on each side and single seats at the corners afford a seating capacity of twenty-eight. The inside trim is of solid bronze. A guard rail slides behind the grab handles on either side, and is shown in raised position under the water board, held up by gravity catches. The Brill 21-E truck which is used has a wheel base of 7 ft. 6 ins. The wheels are 33 ins. diameter. Motors of 25-hp are used. Total weight of car body and truck is 13,000 lbs.

TRANSFERS IN NEW YORK

Acting upon the decision of Judge O'Gorman in the last transfer suit in New York, the Metropolitan Street Railway Company announced on June 27 that it would no longer refuse transfers between its cars at various corners or to the cars of the Third Avenue system. The new transfer regulations will go into effect Aug. 1, and will be practically universal.

ALTERNATING-CURRENT INSTRUMENTS

The electrical instruments herein described, which embody a number of interesting features, are manufactured by Elliott Brothers, of London, England, who are well known as makers of mathematical, electrical and optical instruments.

Fig. 1 illustrates a small alternating-current ammeter, switchboard type, provided with a separate series transformer,

FIG. 1.—ALTERNATING-CURRENT AMMETER

consisting of a straight bar for connection in the main circuit and a thoroughly insulated secondary winding connected to the instrument terminals. This method has the advantage of permitting the placing of the instrument at a little distance from the transformer, and the instrument is thus entirely insulated from the main circuit.

Fig. 2 shows a portable standard wattmeter with two transformers. There are two pairs of terminals on the indicating instrument, one pair of which is shown connected to the secondary winding of a small portable series transformer, the primary winding of which forms part of the main circuit. The other pair of terminals on the indicating instrument is connected to the secondary terminals of a step-down transformer, whose high tension is connected across the high-tension mains. Under these conditions the instrument is entirely insulated from the main circuit. The design of the transformers having received special attention, the indications of the instrument are independent of errors due to change of frequency within wide limits, and to change of shape of curve due to variation of load with alternating-current generator.

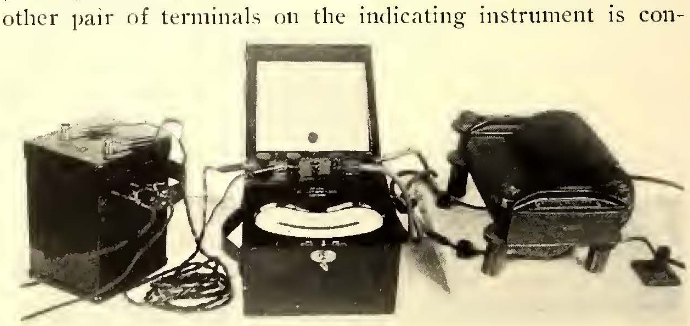


FIG. 2.—PORTABLE ALTERNATING-CURRENT WATTMETER

It has been found with the type of transformers adopted that errors in wattmeter indications due to a change of the value of the power factor from 1 to 6 are, in all cases, less than 1½ per cent.

The step-down transformer method is employed in the case of wattmeters for use on circuits above 600 volts; for lower pressures resistances are used in circuit with the high-resistance coil in the instruments.

Fig. 3 illustrates a power factor indicator of the illuminated

FIG. 3.—POWER FACTOR INDICATOR.

dial type. The indications of the instrument give the factor by which the volt-amperes should be multiplied to obtain the true watts.

The standard portable alternating-current ammeter, shown in Fig. 4, is provided with a separate series transformer having four ranges in one case. By this means one indicating instrument can serve to measure the following maximum currents, 5 amps., 25 amps., 100 amps. and 400 amps. This equipment can be used on a circuit of 5000 volts or 6000 volts, and it is stated that the portable instrument is perfectly safe to handle.

This firm has also designed a portable polyphase wattmeter for two-phase or three-phase circuits. By using suitable sets of transformers with this instrument it can be made to indicate

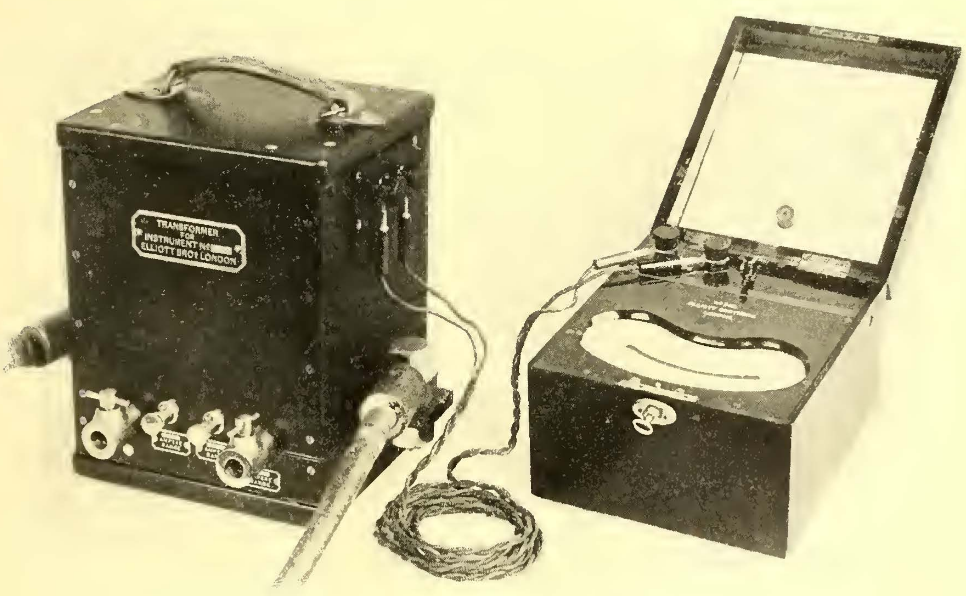


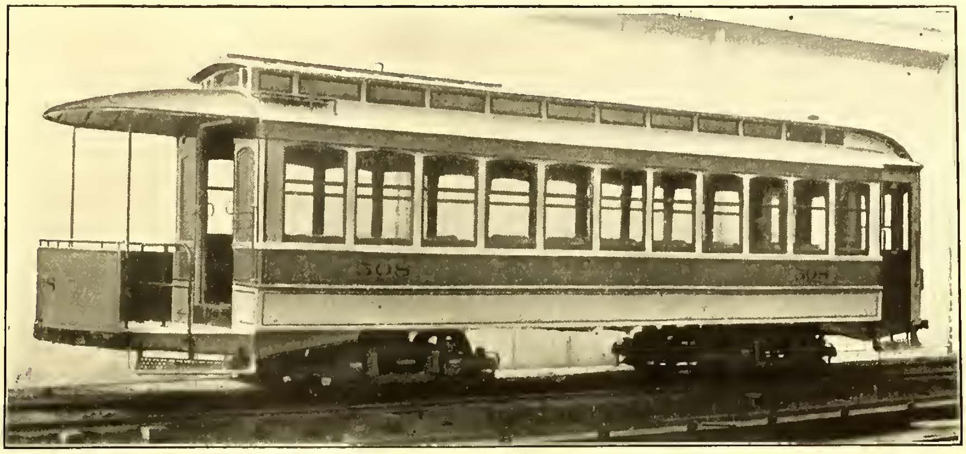
FIG. 4.—PORTABLE ALTERNATING-CURRENT AMMETER

directly the total output of a three-phase circuit even when the loads are not equally balanced between the phases.

The Stark, Ohio, Electric Railway Company has had all its motormen and conductors sworn in as special officers in Mahoning and Stark Counties. They will have authority not only on the company's property but will have power to pursue and capture any one who attempts to escape. Failure to suppress lawlessness renders the employee liable to a fine of from $5 to $25.

SEMI-CONVERTIBLE CARS FOR TOLDEO

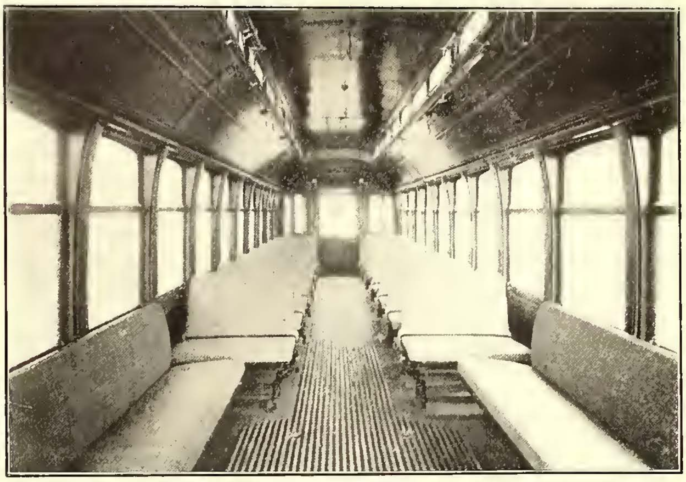
The Toledo Railways & Light Company has lately received ten Brill semi-convertible cars. Some interesting features are combined in these cars that experience has apparently approved



SEMI-CONVERTIBLE CAR, WITH DETROIT PLATFORM, FOR TOLEDO

in relation to the conditions found in Toledo. The cars run in one direction, and therefore the entrance is from one side. "Detroit" platforms are used at the rear for the purpose of loading and unloading from that end only, the pipe rail (shown in the illustration) divides the platform and keeps the entrance clear. The illustration of the interior of one of the cars shows the seating arrangement, with longitudinal seats at the rear, to prevent crowding at the door. Unfortunately, the cross-seats were made to face the rear when the photographs were taken, creating a wrong impression as to the direction which cars are to run; as has been said, the cars run only in one direction, and, therefore, the cross-seats will always face the forward end. The cross-seats are 34 ins. long, and the aisles 26 ins. wide. The wide aisles are obtained by having the seat-ends between the posts against the side lining, there being no wall window pockets to interfere. The width over the posts at belt is 8 ft. 2 ins. The front end of the car is vestibuled and has a folding door on the right side. The sheathing is of steel, extending from the vestibule post around to the corner post of the car. The deck at this end is of steam-car form, while at the other end the deck ends in the ordinary monitor style, in conformity with the open platform; from center to center of window posts is 2 ft. 8 ins.; thickness of side posts, 3¼ ins., and of corner posts, 3¾ ins. The window sashes slide into pockets in the side roofs when not in use. An unusually low window sill is allowed in this car because of the absence of wall window pockets. The interiors are finished handsomely in natural cherry. The seats are spring cane, and the seating capacity of each car is forty-four. The wide aisle and wide space near the rear door, together with the large platform, afford much larger amount of standing room than usual.

Structurally the cars are very substantially built. Side sills, 4 x 7¾ ins., are plated on the inside with ⅜-in. x 12-in. steel. The end sills are 5½ ins. x 6⅞ ins. The platform timbers are plated with angle-iron and the ends are stiffened and protected by Brill patented angle-iron bumpers. Length of cars over end panels is 30 ft. 8 ins.; length over vestibules, 41 ft. 4½ ins. From panel over crown piece at the rear, 6 ft.; from panel over

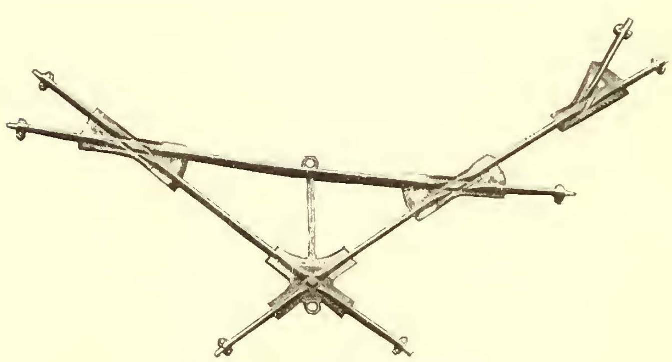


INTERIOR OF CONVERTIBLE CAR

crown piece at the front end, 4 ft. 8½ ins. Width over sills, 7 ft. 10½ ins., and over posts at belt, 8 ft. 2 ins. The trucks are Brill No. 27-F, with 33-in. wheels and 4-ft. wheel base. Four 50-hp motors are used per car.

SPECIAL OVERHEAD CROSSING

The Electric Tramway Company, of Birmingham, England, has from time to time designed and manufactured numerous special overhead fittings to suit the more onerous conditions of English Board of Trade requirements. In the construction of many of these appliances much ingenuity has been exhibited. The accompanying illustration shows a multiple-overhead crossing that this company has just made for the Nottingham Corporation. This crossing has been put up in the market



SPECIAL OVERHEAD FROG

place, where the traffic is very congested and the overhead wires cross in several directions. It was made in five sections, but when fitted together formed a solid cross-over, under which the trolley wheel ran very smoothly, with a barely perceptible "click." Other wires run parallel to the main lines of the crossing, there being altogether about thirty frogs and crossings at this spot.

PNEUMATIC REVOLVING CRANES

The extensive use of pneumatic revolving cranes by street railways has led the Garry Iron & Steel Company, of Cleveland, Ohio, to build cranes of this type to meet the wants of street railways. These cranes are made in two forms, called "B" and "C."

Form "B," which is shown in Fig. 1, has a capacity of 1000 lbs., 7-ft. reach, and 12-ft. 6-in. hook lift. The total height from the rail to the top of boom is 10 ft. 2 ins.

Form "C" cranes are similar to Form "B," but are designed for larger capacities, being made for 2000 lbs., 3000 lbs., 4000 lbs., 6000 lbs., 8000 lbs. and 10,000 lbs. capacity. The standard dimensions are as follows: Reach, 12 ft.; hook lift, 12 ft. 6 ins., and total height from rail to top of boom is 15 ft. 8 ins. A crane of this form is shown in Fig. 2.

Both of these forms are built mounted on a standard car, and arranged for standard gage. The gage may, however, be altered to meet special requirements, or cranes may be mounted on special hand trucks.

The cranes are usually equipped with a set of rail clamps,

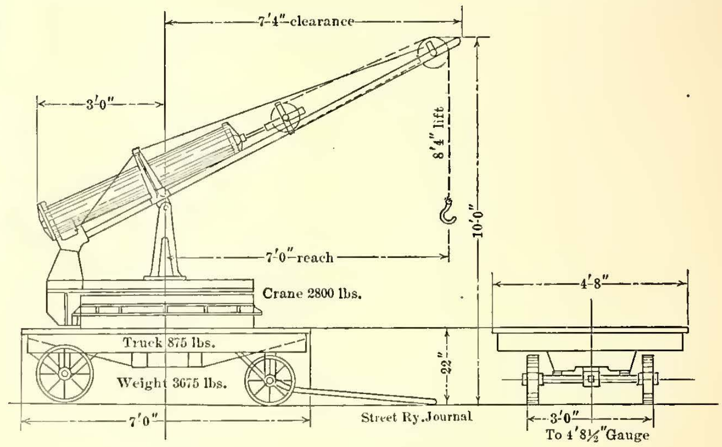


FIG. 1.—1000-LB. REVOLVING CRANE

which secure the car to the rail to prevent tipping when lifting the load; the machines in themselves are not heavy enough to prevent tipping without being anchored. In special cases cranes are furnished with counter balance on the turn-table, which obviates the use of the rail clamps.

The crane base is bolted directly to the car having a machined-ball race, containing 193 ground steel balls at its upper edge. The bottom of the base is machined to receive the cylinder, rack, guides, pivot and stop. The under side of the projecting ring is machined for rollers and brake; the brake bracket is equipped with rollers and air cylinder actuated by a foot valve, which is convenient to the operator and is attached to the turn-table. The hoisting cylinder is securely fastened

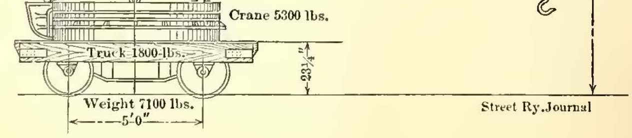


FIG. 2.—REVOLVING CRANE FOR HEAVY-DUTY

to the turn-table and the brake bracket, and is also supported on the top of turn-table by means of the vertical members of the boom proper, which are attached to the top of turn-table. The air for hoisting is applied to this cylinder. The brooms are made of heavy channels stiffened by top truss rods. The cables are usually made in two parts for 12-ft. 6-in. hook lift, which may be modified to suit the hook lift required. The air is so applied as to permit the operator to stand on the top of turn-table and handle crane for all movements without changing his position.

For traversing the car up and down the track either motor or hand traversing arrangement can be furnished.

Among recent orders for these cranes are the following: The New York Central Railroad, Lake Shore & Michigan Southern, Chicago, Burlington & Quincy, Standard Oil Company, American Car & Foundry Company, of Detroit, Mich.

The cranes described in this article are the Garry Iron & Steel Company's standard forms, but the company is prepared to build cranes to any specification. It also manufactures traveling cranes, electric cranes, hand cranes, roofing, siding and pneumatic painting machines, besides doing general machine and structural work.

BOOSTING EXTRAORDINARY

On the Creve Coeur Lake line of the St. Louis Transit Company last summer some voltage boosting was practiced which probably represents about the high-water mark for that work. On this line, with a load of 1400 amps., the voltage at the power station reached a maximum of 1700 volts. This was a line to a lake resort, on which the traffic was heavy only once a week. Since then the arrangement of feeders has been changed, so that such excessive boosting is not necessary. Last summer it was customary to operate this line with three railway generators in series, and to vary the voltage according to the load requirements by means of throttling the engines more or less as the load varied. A potential wire was run back from the point at which the boosted feeder tapped into the trolley line, so that the station attendants could keep the voltage on the distant trolley line as nearly 600 volts as possible at the point of feeding into the trolley line. No trouble was experienced with the insulation of the feeders, even though they were run at three times normal potential. The trolley line, which was fed through the boosted feeder, was not run as a separate section, but was connected in parallel with that portion of the line fed in the ordinary manner. This tended to prevent any dangerous rise of potential on the trolley wire itself. With the trolley wire, which was fed by the boosted feeder in parallel with the direct-fed trolley lines, the only effect of too high potential on the boosted feeder would be to open the circuit breakers on the generators supplying the boosted feeder.

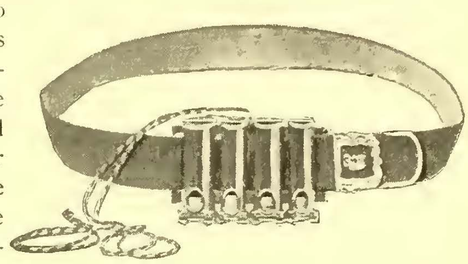
LARGE SHIPMENT OF TIES

The interurban electric railway extension going on this year is evinced by the large demand for ties as well as for other material. A large part of the ties used in the Central West comes, as is well known, from Michigan, and the accompanying engraving shows a recent shipment made for one electric railway company from the tie yards of the Maltby Lumber Yards, of Bay City, Mich. This particular order represents eleven hours work, and there are a little over 5000 ties on these cars. The company also supplies cedar poles.

LARGE SHIPMENT OF TIES FROM MICHIGAN

RAPID READY-CHANGE CARRIER

Street railway conductors will be interested in the Rapid Ready-Change Carrier, illustrated herewith, by means of which change can be made quickly and correctly and as readily in the dark as in the light. This device, as illustrated, consists of four tubes attached to an adjustable belt, which is worn about the waist, either inside or outside the coat, according to weather conditions. These tubes have slots at the top for pennies, nickels, dimes and quarters respectively, which are released one at a time by the wearer of the carrier. By the manipulation of the finger and thumb the bottom coin is unlocked and readily removed. The tubes can be filled either at the top or bottom, but the coins can only be released at the bottom. They are particularly useful for street railway conductors who are often put to no little trouble and inconvenience in making change on a crowded car having many stops. Those having used them speak in the highest terms of them.



RAPID CHANGE CARRIER

Some of the advantages of this device are: (1) That it is more convenient than the coat pockets, and there is practically no wear and tear to the clothing. The saving in one coat alone will more than pay for the entire outfit. (2) The loss of money in making change under the old coat pocket method, by the sudden lurching of the car or from any other cause, is entirely obviated by the use of this device. A spring at the bottom locks and holds the money in tubes, and can only be manipulated by the wearer. (3) Fares can be more easily collected and change made much more quickly, especially in a crowded car, than under the present coat-pocket method. (4) The conductor always knows just what change he has and is thereby enabled to get rid of undesirable coins. (5) Change can be handled in cold weather with gloved hands, simply exposing the ends of forefinger and thumb. (6) They are very substantial and able to withstand the hardest usage. Being simple of construction they are not liable to get out of order. They can be worn either on a belt or hooked in the vest or coat pocket or the waistband of the trousers, and the weight being supported by the guard over the neck. The change carrier is manufactured by Charles F. Etter, of Harrisburg, Pa.

LONDON LETTER

(From Our Regular Correspondent.)

The two experimental trains which the Metropolitan District Railway put into service a few weeks ago, and which were described in a recent issue, are still continuing to give great satisfaction, and much valuable experience is being gained from them day by day which will enable the company to eliminate many possible slight difficulties when the specifications for the complete equipment are prepared. On the Ealing & Harrow line, where these trains are operated, stations 2500 feet apart are staked off, and the trains stop at them, remaining for twenty seconds, which is about the average period of a rest at all stations on the underground. The cars are running regularly 165 miles a day, and travel on a schedule of 15.7 miles per hour. Current readings are constantly taken, together with the acceleration, and full data is, therefore, arrived at for consideration of the cost of operation. The men are now being educated on this line, and it is hoped to commence a regular service of these trains for the public in a few days. In the meantime the work of laying the third rail in the underground tunnel has commenced, and about 500 men are working for a few hours every night when the present service of trains is stopped. It will, however, most probably be a year before electric trains are operated on the underground railway.

As stated recently in these columns, the city of Birmingham has determined on municipal tramways, having refused the offers which the British Electric Traction Company had made to the city. This was a setback at the time for the British Electric Traction Company, but Mr. Garcke has evidently no intention of resting, and is still drawing his line closer round the municipal boundaries. His most recent success in this way has been the purchase of the Aston District Council Tramways, Aston being practically a suburb or portion of Birmingham. The Birmingham officials are evidently much astonished and tremendously annoyed by this action on the part of the Aston Council, as they were already in communication with them with a view to their purchasing by the Birmingham Corporation.

The Town Council of the city of Wolverhampton has at last decided to refuse to accept from the Lorain Steel Company the surface contact system which they have been operating for the city for the past year. We have already referred to the report which was recently issued by Mr. Shawfield, and after about three or four days' discussion on this report by the Council they have voted by a large majority that the system has not come up to its requirements, not so far as operation was concerned, but as a financial proposition. A tremendous amount of argument has taken place, pro and con, but the fact that it was stated by those who had investigated the system that it would cost some thousands of pounds extra to operate the tramways compared with what it would cost had the tramway been on the ordinary overhead system, proved too much for the Town Council, and accordingly the decision above referred to was arrived at. The tramways committee has also decided upon carrying out a new policy, and has advised the Lorain Steel Company that it has not fulfilled the terms of its contract, and has requested the latter company either to remove the system or to proceed to arbitration. The tramways committee has also instructed Mr. Shawfield to prepare estimates and specifications for the equipment of the existing lines on the overhead system. Needless to say, the Lorain Company intends to proceed immediately to arbitration, and it has obtained Mr. Moulton, K. C., and Mr. Rufus Isaacs, K. C., to represent them. Naturally a curious state of affairs exists in Wolverhampton, as until the overhead system has been erected the Council will have to depend upon the surface contact system, which is now in operation, and the Lorain Company is so incensed by what it claims to be such unfair treatment by the Corporation that the company has refused to assist the Corporation in any way, and has withdrawn all repair parts and spare parts from the Corporation premises. A bitter fight may, therefore, be expected.

The Glasgow Corporation tramways have issued their traffic return for the year ending May 31. The mileage of line open for traffic (double track) now is 65, compared with 52 last year, the car miles run 14,008,750, last year 12,615,021; passengers carried, 177,179,549; last year, 163,678,190, and the receipts £653,199 18s. 2d., as against £612,826 2s. 4d. last year.

The London County Council has issued an analysis of the accounts for the past year of the local authorities and other companies undertaking the electricity supply of the metropolitan area. This return applies to thirteen borough Councils and fifteen companies now actually supplying electric current. The borough Councils return a supply of 16,736,056 units, and the companies a total of 62,736,054 units. For this the total revenue receipts were respectively £259,307 and £1,234,661, and the total expenditure is returned at £173,442 and £678,905, thus leaving a respective excess of revenue of £85,865 and £555,756. Allowing for interest paid on loans and repayment of loans, five of the borough Councils find a decreased balance of £13,075 and six a net increase of £5,951, while of the companies ten had an increased balance of £17,530 and five a decreased balance of £9,467.

A contract has been signed between the directors of the Wirrall Railway Company and the British Westinghouse Company for the electrification of the railway on the same system as that now successfully working on the Mersey Tunnel Railway. The Wirral Railway is about 15 miles in length, and connects Liverpool by means of the Mersey Railway with the residential district of the Wirral peninsula in Cheshire, West Kirby and New Brighton being the terminal points.

The London County Council has already decided to electrify the tramways in North London at present leased to the North Metropolitan Company. In a report the highways committee recommend that the Council do the work itself in accordance with its general policy—of arranging wherever possible for the use of an underground system of electrical traction on the tramways in the more central parts of London; reserving the use of the overhead trolley system of traction for the more outlying districts. The length of line for which it is suggested that the conduit system should be installed is about 26 miles, and includes all the tramway routes in the more central districts; while the length of tramways upon which it is proposed that the overhead system should be installed, and the use of which on those routes is not likely to cause inconvenience, is about 28 miles. In summary, it may be said that all the tramways "inside" the Angel, Highbury Railway Station, King's Cross (on the Northwest), Cambridge Road, Ampthill Square and Stamford Hill will be on the underground system, as will a number of the new lines already authorized. The consent of the borough Councils concerned will be necessary to the adoption of this scheme of electrification.

Some time ago Mr. James More, Jr., M. Inst. C. E., F. R. S. E., was appointed by the Leith Corporation to report to them upon the value of the present tramway undertaking, and to submit a proposal and estimate for converting the lines for overhead electric traction, along with a report as to the probable financial results. At a recent meeting of the tramways committee of the Leith Town Council this report was read and amplified by Mr. More verbally, with the result that the matter was remitted to a subcommittee to confer with the directors of the Edinburgh Street Tramways Company, with a view to the purchase of the Leith lines (at present operated by the company), and the reconstruction for the trolley system. At a subsequent meeting it was agreed to petition the corporation and the company that the system should be sold for £60,000. It is to be hoped that later, when the Leith trmaways are electrically equipped, some arrangement may be made with the Edinburgh tramways so that through cars may be run. At the present moment the muddle at Pibrig, where all passengers have to change, is a reproach to both cities.

A. C. S.

PRECAUTIONS ON JERSEY TROLLEY LINES

The new management of the Jersey trolley lines, operated by the Public Service Corporation of Newark, is exercising every precaution to make the service not only prompt and reliable, but safe in every way. Passengers on the trolley route between Jersey City and Newark last week had to walk across the draw of the Hackensack Plank Road bridge. President Thomas McCarter, of the Public Service Corporation, refused to run cars over the draw until its engineers declare the old structure safe. The cars were stopped on either side of the draw and thousands walked across.

Engineers of the Public Service Corporation made an examination of the draw on Monday and came to the conclusion that it was unsafe for traffic. Portions of the trusses and stringers have been patched and repatched with cleats and planks nailed or bolted upon the original timbers. President McCarter said that arrangements had been made for a thorough examination of the bridge and that the Public Service Corporation stood ready to pay its share of the cost of reconstruction.

General Manager Wheatley, of the Public Service Corporation, condemned as unsafe the vehicle elevator running between Hoboken and Jersey City Heights, and ordered it to be discontinued. Mr. Wheatley said that work on a new elevator would be begun at once, and that it would probably be completed in less than a month.

As indicated in these orders the new management is making a thorough examination of the property with the view of introducing a number of improvements in the equipment and operation of the system.

MEETING OF THE INSTITUTION OF CIVIL ENGINEERS

A meeting of the British Institution of Civil Engineers was held at London, June 16 to 19, and at the meeting several papers of electric railway interest were presented. In the railway section a short paper was read by S. B. Cottrell, of the Liverpool Elevated Railway, on "The Relative Advantages of Overhead, Deep-Level, and Shallow-Subway Lines, for the Accommodation of Urban Railway Traffic." The Liverpool road is the only elevated railway in England, and the first to be operated by electricity. Mr. Cottrell believes that this type of road solves the problem of urban communication along a line of docks, but that, owing to its unsightly character, roads such as are in operation in New York, Boston and Chicago would not be allowed along important public streets in British cities. Deep-level railways have the advantage that they can be constructed without interfering with sewers, gas pipes, etc., and in the author's opinion the tubes for such lines should not be less than 13 ft. 6 ins. in diameter. The time for ascending or descending in elevators requires from one minute to two minutes. The subject of ventilation has not yet been satisfactorily settled. The especial advantage of shallow railways is that persons can reach the trains without using elevators, and that they are self-ventilating. He, therefore, advocates for urban traffic (1) elevated railways, if they can be constructed in back streets where compensation would be immaterial, and their unsightly appearance would not be objectionable; (2), shallow subways, where they can be constructed, and the cost is not prohibitive; (3) deep-level railways. In all cases electric traction is preferable to any other.

Lieutenant-Colonel H. A. Yorke also read a paper in the railway section on "The Organization and Administration of an American Railway." He pointed out that the president exercises much more power in the management of an American road than does the chairman of the board of directors of an English road, and cited a number of cases in which the president is also an engineer. The president is assisted by a number of vice-presidents, each of whom supervises one of the departments into which the administration is divided, and which usually are the legal department, treasurer's department, traffic department and operating department. The division between the two latter is that the traffic department has charge of the rates, interchange of business with other railways and the commercial relations with the public; the operating department, the construction and maintenance of the road, its equipment, stations, personnel and discipline of the service. In England these two departments are usually united, but Colonel Yorke believes the American plan better. The operating department, which is in charge of the general manager, is usually sub-divided into the road department, the machinery department, and the transportation department. The first is in charge of the chief engineer, the second under the superintendent of motive power, and the third under the general superintendent, all of whom report to the general manager. Roads exceeding 300 miles in length are generally divided into divisions, which do not usually cover more than 100 miles, each in charge of a division superintendent, who has a trainmster, a master mechanic and a division engineer or road-master.

In the section devoted to shipbuilding, Professor Rateau, of Paris, read a short paper on "Steam Turbines." He referred to the advance made in the art during the last ten years, due especially to the endeavors of Messrs. Parsons and De Laval, although in the history of turbines the services of the French engineer, Tournaire, should not be forgotten. He pointed out that the turbine can be more exactly designed than the piston engine, as the latter has losses at admission and exhaust ports and from cylinder condensation, and that with turbines the expansion of the elastic fluid can be pushed to its extreme limit much more conveniently than in the case of piston engines. Professor Rateau believes that for low-pressures, turbines are more advantageous than reciprocating engines, while they generally use more steam than the latter when the pressure of the exhaust is that of the atmosphere or higher. He divides steam turbines into "action" and "reaction" turbines. He classes the Parsons among the latter, as the steam acts on the blades at once by its pressure and its velocity. In this type of turbine there is a difference of pressure on the two faces of the wheel, causing a longitudinal thrust, and making it necessary also to reduce to a minimum the clearance between the movable wheels and the walls to prevent leakage. It is also indispensable that the distribution of the steam should be effected over the whole circumference of the movable wheel in order to avoid movements of pulsation very prejudicial to efficiency. In the action turbine, the steam only acts on the movable wheels by its velocity, and each wheel revolves in a casing, in which the pressure is uniform. It is, therefore, possible to provide sensible clearance between the moving and fixed parts, and consequently to disregard the wear of the shaft bearing. It is further possible to project the steam on to one point only of the circumference. The prototype of the simple-action turbine is that of De Leval. The author, however, has constructed on the same principle a multiple-action turbine, composed of a number of wheels, which run with very little loss from friction or other leakage, and are capable of direct connection to commercial dynamos.

There were two papers in the section devoted to "Application of Electricity." One of "High-Speed Electric Traction on Railways," by Mr. Jacomb-Hood; the other on "The Position and Protection of the Third Rail on Electric Railways," by W. E. Langdon. Mr. Jacomb-Hood gives simply a brief review of the important problems to be overcome. Mr. Langdon recommends the employment of a fourth rail between the two wheel rails, as insulated, or, at all events, an independent rail return, a plan followed in the Mersey tunnel, the Metropolitan District, the Metropolitan and other British lines, and a protected third rail, also that the support of the latter should be independent of the track ties. He adds a list of third-rail roads, to which the editors of this paper have made some additions:

Name of Railway	From Top of Positive Rail to Top of Track Rail, Inches	From Track Gage-Line to Center of Positive Rail, Inches
Main-Line Railways, Electric and Steam Service		
Baltimore & Ohio Railroad (old location)............	1¾	24
Baltimore & Ohio Railroad (new location)............	3½	30
New York, New Haven & Hartford Railroad........	1½	Center.
Paris-Orleans Railway, France	7⅞	25⅝
Milan-Gallarate, Italy	7½	26⅝
Mersey Railway, Liverpool	4½	22
North-Eastern Railway, Newcastle....................	...	19¼
Paris-Versailles Railway, France......................	7⅞	25⅝
Fayet-Chamonix Railway, France......................	9	23
Wannseebahn, Berlin	12⅝	33½
Interurban Railways, Electric Service only		
Albany & Hudson Railroad, New York................	6	27
Aurora, Elgin & Chicago, Illinois....................	6 5-16	20⅛
Lackawanna & Wyoming Valley, Pennsylvania.......	6	20⅜
Grand Rapids, Grand Haven & Muskegon, Michigan.	5¾	20⅜
Seattle-Tacoma Electric Railway, Washington........	7½	20
Elevated and Underground Electric Railways		
Metropolitan West Side Elevated, Chicago...........	6¼	20⅛
Lake Street Elevated, Chicago........................	6½	20⅛
South Side Elevated Railway, Chicago................	6¾	20⅛
Northwestern Elevated Railway, Chicago.............	6½	20⅛
Brooklyn Elevated Railway	6	22¼
Kings County Elevated Railway, Brooklyn...........	5¼	19½
Boston Elevated Railway Company....................	6	20⅜
Manhattan Railway, New York........................	7½	20¾
Central London Railway, London.....................	1½	Center.
Liverpool Overhead Railway..........................	1½	Center.
Berlin Elevated, elevated portion	7	....
Berlin Elevated, underground portion................	9	....

WATER WHEELS FOR THE PUYALLUP RIVER

The Pelton Water Wheel Company has been awarded a contract for four impulse and reaction wheel units, and two exciter wheels, with accessories, to be installed in the Puyallup River, Washington, power plant, now under construction by Stone and Webster interests. Each of the four large wheels is to drive a 3500-kw General Electric alternator, for furnishing power to Seattle, Tacoma and the neighboring districts, as well as the Puget Sound Electric Railway, formerly known as the Seattle-Tacoma Interurban Railway, and described in the issue of May 2, 1903.

The wheels are of the disc type of cast steel, approximately 10 ft. in diameter on the centres of the buckets, and are to run at 225 r. p. m. The exciter wheels are of rated capacity. Each drive a 150-kw exciter, and will be run at from 600 r. p. m. to 800 r. p. m. The ultimate capacity of each main wheel is 7500 hp. Each wheel unit is to be composed of two wheels, and the governors are to be the Lombard type "L," hydraulic mechanism, with electric control. There are to be two nozzles for each unit, consisting of a combination needle and deflecting nozzle, arranged with 24-in. inlets and heavy ball joints of cast steel. Either one or both nozzles may be operated by hand, and they are counterbalanced to reduce the inertia of the moving parts.

The effective head of water is 850 ft. minimum.

Sunday, June 28, was the greatest day in the history of the Brooklyn Rapid Transit Company, so far as the passenger traffic was concerned. Every car that could possibly be used was put in commission, and it is estimated that over 1,500,000 passengers were carried, 250,000 more than on the best day hitherto.

LAKE STREET ELEVATED DISSENSIONS

Stockholders in the Lake Street Elevated Railroad Company, of Chicago, met in Chicago June 22, and appointed a protective committee. Over fifty stockholders were in attendance. The sense of the meeting was expressed in the following resolutions:

Whereas, It has been reported from time to time that the securities committee of the Lake Street Elevated Railroad Company, in the plan to be submitted by them, will provide for an assessment of $10 per share against the stock of said company, and,

Whereas, It has also been reported from time to time that for the purpose of freezing out the stockholders in case said stockholders should not accept said plan and pay said assessment, default would be made in the payment of the interest on the first mortgage bonds, and that said bonds have been acquired by interests allied with the Northwestern Elevated Railroad Company for the purpose of foreclosing the mortgage securing the said bonds, and thus wiping out all of the stock of said road, and,

Whereas, The stockholders have been unable to acquire any accurate information as to the intentions of the management of said road, and as to whether said management would protect the interests of the stockholders of this road in the event of said attempted foreclosure against the aggressions of the interests controlling the Northwestern Elevated Railroad. Therefore, be it

Resolved, That the owners of stock in said Lake Street Elevated Railroad Company assembled in this meeting hereby appoint Charles T. Gray, James Bolton, E. A. Dicker, W. H. Colvin and R. H. Donnelly as a protective committee to take such action to protect the stockholders as in their judgment may be necessary, and to call a meeting of the owners of stock of said company at any time to take action on any plan that may be submitted; and, be it further

Resolved, That each person present at this meeting will make an effort to ascertain and learn the names of other owners of stock and furnish the names of such owners to the said committee to the end that the owners of the stock of said company, by uniting together, may be prepared to protect their interests as it may become necessary.

A PECULIAR DAMAGE CLAIM AT KANSAS CITY

A most remarkable suit for damages was recently brought against the Metropolitan Street Railway Company, in Kansas City, and results of the tests made by the company in connection with this may be of value should similar claims ever arise elsewhere. A woman brought suit against the company, claiming that immediately after alighting from a car, at a certain corner, a bolt of lightning, or flash from "the overcharged trolley wire" struck her, and that she fell unconscious in the street, where she lay for some time before being discovered. Of course the claim was preposterous on the face of it to any electrical man, but the company began to investigate to learn if there could be any possible cause for an optical illusion, which would give a basis for such claims. It was found upon investigating the corner at which the accident happened that there was an electric light wire hanging a short distance above the trolley wire, and that by raising the trolley wire the electric light wire could be brought into temporary contact with the trolley wire and that a flash would result, such as would occur from a partial short circuit. This flash would cause a small amount of burning metal to drop away from the point of contact. But this metal never reached the ground in a molten state, in fact would be entirely burned in the air so as to leave no trace at the point where it apparently was falling. In order to investigate the possibilities of injury from sparks from a cause of this kind, an apparatus was rigged up in the power house, whereby a cross could be produced between two lines with several hundred amperes flowing. A white sheet was spread under the point where the flash occurred to catch the red-hot sparks. It was found impossible, however, to discover any traces of these sparks, as whatever metal was set free by the short circuit was immediately consumed before it struck the sheet. Assistant General Manager Satterlee then stood directly under the short circuit and tried repeatedly to catch enough sparks on his coat to burn it, but they proved to be too minute, either to be felt or to burn the coat. Of course it is conceivable that enough molten metal might be caused by a short circuit so that a drop would fall several feet, but this experiment demonstrated that it would take a very heavy short circuit indeed, and one long continued, to melt enough metal so that this metal would not be entirely oxidized or burned in the air before falling any distance.

SIGHT-SEEING SERVICE IN SEATTLE, WASH.

The Seattle Electric Company proposes instituting a sight-seeing car service on its city lines this summer. A lecturer will accompany each car and point out to tourists the principal points of interest, historical and otherwise. Los Angeles is the only city on the Coast that has as yet this feature added to its street car service, but it is very popular in Eastern cities.

SENSATIONALISM IN BOSTON

Several of the Boston daily papers jumped out of the traces last week in a wild race to print the sensational details of a comparatively slight accident which occurred in the East Boston tunnel on the night of June 19. With the memories of the terrible explosion in the old Tremont Street subway still in the public mind, considerable credence was given to the livid accounts printed in some of the morning journals, although later investigation showed that not only were the early reports grossly exaggerated, but many of them were entirely false.

The accident was caused, according to best belief, by the compressed air in the section extending westward from Atlantic Avenue under State Street, which escaped through a seam of sand in one of the drifts with force enough to cause a cave-in of a portion of the street. One laborer was killed, another severely injured, and several others bruised.

Borings taken in the immediate vicinity of the cave-in preparatory to the work gave no indications of the existence of a fissure in the clay at that particular point, the excavation of the large Atlantic Avenue shaft strengthened the supposition that the ground was solid, and every precaution had been taken to provide against such accidents by bracing the adjacent buildings, and constructing enormous bulkheads to save Atlantic Avenue and the elevated railway structure from danger. The accident will only delay the work of connecting the tunnel with the Atlantic Avenue station by about ten days; neither water nor gas service was injured in the slightest degree, and the trains of the Boston Elevated Railway Company ran regularly by State Street, simply reducing their speed to about 3 miles per hour as a precaution.

Barring the regretable loss of one life and the injuries sustained by another the accident was one of small consequence, and as far as can be seen, unavoidable. In almost every great piece of engineering work accidents are certain to accompany the construction period from the very temporary nature of the things which are being utilized and built, and a casualty list of some sort seems inseparable from the creation of the great fabrics of civilization. In the vast majority of cases there is little or no reason for the display of literary fireworks by either the lay press or the public, and the judgment of sane and reasonable minds in this unfortunate, but comparatively slight, Boston accident attaches no blame to the officials in charge of the tunnel construction, because there is every reason to believe that human foresight and skill had done its best to avoid injury to either human life or the property adjacent to the rapid transit route.

MASSACHUSETTS ELECTRIC COMPANIES

The order of the Railroad Commissioners fixing the price of $120 for $2,000,000 Boston & Northern stock, and $105 for $1,009,500 of Old Colony stock, has been accepted by the Massachusetts Electric Companies. The latter company owns nearly all the stock of the other companies.

The Boston & Northern and Old Colony companies have cancelled their notes with the proceeds of the new stock issue, except notes amounting to less than $1,000,000, which are held by savings banks on a year's time.

The above issue gives the Massachusetts Electric Companies 167,000 shares of underlying stock for its treasury, dividends upon which are to provide the necessary funds to pay all charges and 4 per cent upon the $17,432,400 of outstanding preferred stock.

The gross earnings of the sub-companies are showing an average weekly increase from 7 to 10 per cent over last year.

Since the organization of the Massachusetts Electric Companies in 1899 between $9,000,000 and $10,000,000 has been spent in improvements.

PROGRESS ON THE EAST BOSTON TUNNEL

The Boston Transit Commission will soon call for bids on the Scollay Square section of the East Boston tunnel. This is the last large contract on the work east of the subway.

Through a larger part of the course of the tunnel the material encountered has been solid and compact, the harbor section coming wholly within the blue clay stratum. A small sand pocket, presenting difficulties, was encountered immediately under Atlantic Avenue, where the East Boston section was connected with the State Street end of the tunnel. As the side drifts approached the bulkhead at the foot of State Street it was found that the ground would not hold the high air pressure of 22 lbs. per square inch used in driving the work under water. It was found possible to use a pressure of 12 lbs. per square inch by placing a temporary lining of cement on the sandy walls and roof, filling each crack and completely sealing the whole pocket.

RAPID TRANSIT IN BROOKLYN RELIEF FOR BRIDGE CRUSH

It is announced that the Brooklyn Rapid Transit Company intends to make the extensions proposed by Chief Engineer William Barclay Parsons, of the Rapid Transit Commission, for the improvement of transit facilities in Brooklyn. The estimated cost of this work is $20,000,000, all of which will be paid for by the railroad company. The plans provide for the connection of the Brooklyn and Williamsburg Bridge by means of a subway in Manhattan, and for extensions of the surface and elevated lines in Brooklyn. They also provide for the removal of the elevated trains from the present bridge to give more room for the passage of trolley cars and trucks. The subway connecting the Williamsburg Bridge with tne Brooklyn Bridge will carry the elevated trains running across the Williamsburg structure. Should the Maiden Lane-East River tunel be built the subway will be extended to connect therewith. When the elevated trains are removed from the bridge structure the trolley tracks can then be moved into the space now occupied by them. Engineer Parsons' plans also call for the placing of a third track on all the Brooklyn elevated lines, the construction of lines extending from the Franklin Avenue station of the Fulton Street line to the Blackwell's Island Bridge and the Williamsburg Bridge, and other minor extensions. Mr. Parsons' plan was given in detail in the Street Railway Journal of March 21, 1903.

The announcement has also been made that differences between the parties at interest in the improvement of the surface car terminus facilities at the Manhattan end of the Brooklyn Bridge have been amicably adjusted, and work on the plans approved many months ago will be resumed at once. Contracts for the materials necessary to carry out the plans were completed soon after the order for the additional loops was given by the Bridge Commissioner, and most of the material is now ready. Some of the shoring necessitated by the proposed elimination of a part of the mezzanaine floor has already been done. The four new loops are to be built inside the present loops or further away from Park Row than those now in use. In order that they may be of the required size the roadways on either side of the bridge, near the Manhattan terminal, will have to be widened. The present galleries also will have to be cut away in part, and a new gallery built. Some of the present stairway also will be affected and a new stairway will have to be erected. Much of the interior work of the Manhattan station, in fact, will have to be reconstructed.

The four new loops, it is believed, will materially relieve the congestion at the Manhattan terminal during the evening rush hours and will enable the company to operate more cars at more frequent intervals, the present loops being insufficient to accommodate the great number of cars crossing the bridge when traffic is at its height. The carrying out of this plan also will effectually settle the proposition of Neils Poulson, president of the Hecla Iron Works, to build an overhead loop at the Park Row end of the bridge.

TRAMWAY ATHLETICS IN ENGLAND

About twelve months ago the employees of the Liverpool Corporation Tramways formed an organization named the Tramways Social, Athletic and Thrift Society, which now has a membership of about 1500. The tramways committee has assisted this society by providing a clubroom at each of the depots, where the daily newspapers are furnished and games played. Glee, entertaining and musical parties have been formed in the entertainments section; swimming, cricket, lacrosse and football clubs in the athletic section; while in the thrift section special terms have been arranged for the supply of everyday requirements in the homes of the men. C. R. Bellamy, the general manager of the Liverpool Corporation Tramways, has taken great interest in this society. He recently hit upon the happy idea of giving a silver challenge shield for annual competition among the depot football teams. The shield measures 21 ins. x 16 ins., and is surmounted by the city arms, chased in high relief. The centre is occupied by a boldly bossed plaque, bearing the following inscription: "Presented to the Liverpool Corporation Tramway Employees' Social, Athletic and Thrift Society by C. R. Bellamy, C. E., general manager, for annual competition between the depot football teams, April, 1903." Above this, and occupying the upper portion of the shield, is a very fine engraving of the latest type of city car, while the lower portion is occupied by a boldly-executed group of football players. The shield, which is surmounted by laurel leaves, rests on a scalloped shell foot, flanked by dolphins. The Smithdown Road team was the first to win the trophy. On accepting the shield, the captain of the team said that all the men in the service appreciated what Mr. Bellamy did for them.

CHANGES IN THE WESTINGHOUSE PUBLICATION DEPARTMENT

The Westinghouse Companies' Publishing Department is extending the scope of its work, and has made several important changes lately in its organization.

W. M. Probasco is appointed an assistant manager of the department, in charge of advertising, exhibitions and conventions, with headquarters at the New York office.

H. F. J. Porter is appointed an assistant manager, in charge of articles, publications, general publicity and superintendence of department, with headquarters at East Pittsburg.

Mr. Probasco has long been identified with the Westinghouse interests, and for several years has been associated with the publishing department. His familiarity with all branches of the Westinghouse organization and acquaintance with the general field fit him particularly for the special work upon which he will hereafter be engaged.

Mr. Porter is well known through his long association with the Bethlehem Steel Company, of Bethlehem, Pa., first as its representative at Chicago, later at South Bethlehem, and then in New York City. Mr. Porter has also achieved a high reputation as an author and lecturer on engineering subjects, especially those connected with the steel industry. During his connection with the Bethlehem Company Mr. Porter devoted the greater part of his time to the study of the use of hollow-forged, open-hearth and nickel steel shafts to power station service, and this naturally brought him into relation with the street railway and electrical industry. He has attended most of the conventions of the American Street Railway Association, and was largely instrumental in securing the introduction of this type of shaft in electric railway power stations.

ANNUAL REPORT OF THE MEXICO ELECTRIC TRAMWAYS ROAD

The fifth annual report of the Mexico Electric Tramways, of Mexico City, Mex., was submitted at the annual meeting of the company, held in London on May 28. The result of the company's operations, after charging interest on the debentures of the Compania de Ferrocarriles del Distrito Federal de Mexico, and after payment of the 3½ per cent on the share capital of the company (under the terms of the lease), shows a net profit of $136,600, which, at the rate of exchange of 18½d., gives the sum £10,529 11s. 9d. to be carried forward to the credit of the London profit and loss account.

The interest received on the debentures of the Compania de Ferrocarriles del Distrito Federal de Mexico (held by this company) and the dividend declared by the Compania de Ferrocarriles del Distrito Federal de Mexico on its share capital (all of which is held by this company) is then added, and after charging expenses and obligations, etc., against the same, a net balance is shown to the credit of profit and loss account of the sum of £20,260. The usual dividend of 6 per cent has been paid on the preference shares. During the year the company issued 112,987 preference shares, completing the issue of the 500,000 preference shares authorized. One small, but important, addition to the service in the city was made during the last year. The total distance now operated on by electricity is about 72 miles. During the year 31,132,030 passengers were carried, as against 26,709,225 passengers during the previous year, being an increase of 4,422,805 passengers. The receipts amounted to $2,400,788, as against $2,103,175 in 1901, showing an increase of $297,613.

MOTOR-DRIVEN WOODWORKING MACHINERY

The S. A. Woods Machine Company, of South Boston, Mass., has for several years past recognized the advantages derived by using electric drive, and has given particular attention to equipping its woodworking machinery with specially designed motors, the machines being built to conform to motor speeds. This makes their machines particularly suitable for electric railway repair shops. Among the tools brought out for electric drive is a horizontal hollow-chisel mortiser. This machine requires a floor space 6 ft. x 5 ft., and weighs 4000 lbs. The machine will mortise from 5-16 in. to 1½ ins. The table, which is extra long and moved by hand wheel, will clamp timbers up to 10 ins. thick on regular machine. It can, however, be furnished for greater thickness if desired. The belt for the bit spindle wraps two-thirds of its diameter, and has an automatic tightener, preserving uniform tension. The pneumatic pulley on the bit spindle is claimed to give at least 30 per cent additional traction. Among other tools manufactured by this company for railways may be mentioned timber dressers, planers, moulders, hand jointers, boring machines and railway saws.

NEW CHRISTENSEN AIR BRAKES SALES AGENTS

On account of the resignation of J. E. Eldred, who has been in charge of the Chicago sales office of the air-brake department of the National Electric Company, F. C. Randall, the general manager of the air-brake sales department of this company, has made a redistribution of the territory to be covered by the several sales agents of the National Electric Company, and orders for Christensen air brakes will be handled by the following corps of sales agents:

The territory heretofore covered by Mr. Eldred has been subdivided into three parts to be handled by J. S. Hamlin, J. J. Nef and S. I. Wailes. Mr. Hamlin will make his headquarters at the Chicago office, No. 1020 Old Colony Building. Mr. Hamlin was formerly general sales agent of the Neal Duplex Brake. Mr. Nef will also make his headquarters in the Chicago office. Mr. Nef was formerly connected with the Standard Air Brake Company. S. I. Wailes will make his headquarters at the Cincinnati office. Mr. Wailes was formerly connected with the engineering department of the Brooklyn Rapid Transit Company.

W. A. Grauten will make his headquarters at the Brown Palace Hotel, Denver, Col. He remains in charge of the Pacific Coast territory. H. N. Ranson remains in charge of the Cleveland office of the company at No. 812 Prospect Street.

J. T. Cunningham, who has charge of the New England territory and New York city, will make his headquarters at the general sales office, 135 Broadway, New York city. W. W. Power, who looks after the company's interest in Pennsylvania and in the Southeastern States, will make his headquarters at the Philadelphia office, 1402 Erie Avenue.

J. D. Maguire will be connected with the general sales office as special representative of the air-brake department, and in charge of sales of electrical machinery for the Eastern District. Mr. Maguire was formerly president of the Magnet Wire Company, of New York city.

SLIGHT STRIKE AT ONEONTA

There was a slight strike last week among the laborers on the construction end of the Oneonta, Cooperstown & Richfield Springs Railroad, just a few miles south of Mohawk, where the line is hastening its connections with Mohawk and Herkimer. This road operates a high-speed passenger and freight electric service in Central New York from Oneonta to Mohawk, a distance of 67 miles. The road is practically complete, with the exception of a few miles on the northern end.

The trouble was caused by a disagreement between the New York owners of the property in regard to the control of the line, during which the payments to the sub-contractors have been withheld. It is understood that negotiations for settlement of the differences are now under way, and that work will be resumed immediately. In the meantime arrangements have been made for satisfying the demands of the laborers.

The company will have track connections with the Ulster & Delaware, Delaware & Hudson, Delaware, Lackawanna & Western and the West Shore Railroads, and is already handling a large amount of carload freight on the part of the line which is in operation, and it has a very promising future when fully completed.

MORE PAY AND SHORTER HOURS FOR JERSEY TROLLEYMEN

The Public Service Corporation, which controls the big trolley roads in Hudson County, N. J., issued an order June 26 arranging a uniform scale for motormen and conductors, and fixing ten hours as the limit for a day's work. Men who have been continuously in the service for more than ten years will receive 22 cents an hour; over five years, 21 cents an hour; over two years, 20 cents an hour, and less than two years, 19 cents an hour. The new schedule went into effect on July 1. The employees of nearly all the lines controlled by the company have been working 12 hours a day.

IMTERBOROUGH RAPID TRANSIT COMPANY APPLIES FOR ADDITIONAL SUBWAY FRANCHISE

Two new franchise applications have been made to the New York Rapid Transit Commission by the Interborough Rapid Transit Company, of New York. The first application is for the right to build a subway down Broadway, from Forty-Second Street to Union Square (Fourteenth Street). The second application requests a franchise to construct an elevated structure as part of the rapid transit system from 130th Street and Manhattan Street, where there is a subway station, down to the Fort Lee (N. J.) ferry.

STRIKE ENDED AT DUBUQUE

The strike on the lines of the Union Electric Company, at Dubuque, Ia., was ended June 23, having been on since May 6. A full account of the beginning of this strike was given in the STREET RAILWAY JOURNAL of May 30. The main point at issue was the demand of the strikers that none but union men be employed; that all new men be required to join the union within thirty days of the time when they were put on to practice, and that whenever men were expelled from the union they should also be discharged from the employ of the company. There was also a demand by the employees for the reinstatement of three former employees, who were officers of the union, who had been discharged some time previous to the time that the demands of the strikers were first presented. This demand, however, came after the first demands were presented. The company, of course, refused to give the management of its employees over into the hands of a union, and in its reply to the demands of the strikers, quoted the anthracite coal commission, which, in its decision, allowed no discrimination between union and non-union men.

The strike was marked by severe rioting at various times, and the local authorities were notably lax in preventing lawlessness. Men were brought in from outside to operate the cars, but there were periods during which no cars were operated, because of the entire lack of police protection and the great amount of mob violence. The rioting became so bad that at last the business men held a meeting and made a formal demand of the Mayor for police protection of the cars, so that the company could operate. The Mayor told the company he would do all in his power to prevent any acts of violence, and that afternoon the cars were started out of the barns. This was the signal for even more severe rioting, which the police and sheriff could not or did not stop. This led to the calling out of the militia, and the local company was put on duty at once. The rioting continued, and the company refused to operate cars again until the arrival of more troops. The Governor would not send any more, so the business men got together and circulated a petition for more companies of militia. With this the Governor sent three companies to the city. The next day the cars were put in operation, and more rioting followed. Then Governor Cummins arrived on the scene, with Labor Commissioner Brigham, of Iowa, and President Urick, of the State Federation of Labor.

This was the beginning of a settlement, which was finally signed at the rooms of the Dubuque Club, June 23. As one of the Dubuque papers mildly puts it, "the settlement can hardly be called a compromise," as it contains practically the same terms for which General Manager Dame stood out at the beginning of the controversy. The company agrees not to discriminate against the union, but it shall be free to engage or discharge its employees without regard to membership or non-membership in any organization. Provisions are made for the appeal of grievances from the superintendent to higher officers of the company. The company is to provide free transportation for trainmen when not in uniform. Any trainmen called for duty shall not receive less than five hours' pay for any one day, regardless of the time actually employed. This does not include the regular reports for duty of extra men unless they are assigned to work. The company will recognize the union to the extent of treating with its members either individually or through a grievance committee, in the consideration of any differences which may in future arise between the company and its employees belonging to the union. The three discharged men will not be taken back, but will be given clearance cards, stating that their services have been generally satisfactory.

PEACE IN RICHMOND STRIKE

As a result of the strict enforcement of the law by the militia in Richmond, no further disturbances have occurred, although on June 25 an incendiary attempt was made to destroy the Virginia Passenger & Power Company's trestle bridge on the Seven Pines road. The company is operating cars on all its Richmond lines under military protection. The cars are being liberally patronized, and, so far as Richmond is concerned, the strike seems to be a thing of the past. It is feared, however, that there may be trouble in Manchester if the company attempts to operate cars there, as the police force is very small and the Mayor of Manchester sympathizes with the strikers.

OPENING OF BOSTON & WORCESTER ROAD

The first car of the new Boston & Worcester Street Railway to run into Worcester entered that city on June 26, the occasion being the trial trip and official tour of inspection of the Massachusetts Railroad Commissioners. In a few days the line will be opened for traffic.

NEW PUBLICATIONS

The Car Builder's Dictionary. 1903 edition, 374 pages, 4971 illustrations. Published by the Railroad Gazette, New York. Price $5.00.

This book, which is compiled for the Master Car Builder's Association by Rodney Hitt, assisted by Messrs. Waitt, of the New York Central Railroad; Lentz, of the Lehigh Valley Railroad, and Appleyard, of the New York, New Haven & Hartford Railroad, has won its place as a necessity in the library of every master car builder and those interested in the details of steam railway rolling stock. The book has passed through four editions, viz., 1879, 1884, 1895 and 1903, and the present edition brings the definitions and standards up-to-date, with the latest practice of the Master Car Builders' Association. Following the practice inaugurated in the 1895 edition, some space has been devoted to electric railway rolling stock, and ten pages are given to car bodies, ten to motors, controllers and multiple unit systems, and three to trucks. The editors do not claim that this part of the book is at all complete, but recommend another work, devoted exclusively to this branch of car building. The 1903 edition of the dictionary also includes a new feature in a department of car shop machinery, in which all of the principal tools used in repair shop practice are illustrated. Owing to the growing tendency toward unification in steam and electric railway work the dictionary will be found very useful to many electric railway car builders and master mechanics.

Die Betriebsmittel der Elektrischen Eisenbahnen. By E. C. Zehme. Published by C. W. Kreidel, Wiesbaden. 322 pages, including 315 illustrations and 66 lithographed plates. Price, 27 marks.

This book, whose title would be expressed in English as Electric Car Appliances, has been compiled with a great deal of care, and while most of the practice described is that followed on the Continent, enough attention has been given to American and English apparatus to make the work representatively international. The author is the first, so far as we know, to devote an entire book to this one subject, but has treated the theme with a completeness which is praiseworthy. The book is not divided into chapters, but the topics discussed, in their order, are trucks, wheels, axles, car springs, brakes, sand and salt boxes, fenders, car bodies, heaters, electric locomotives, electric motors, gearing, controllers, multiple unit systems and trolleys. More attention has been given to the mechanical side than to the electrical, as of the 322 pages, only forty-four are devoted to motors, and of these a large part of the space is given up to the mechanical features. As an example, it might be said that nineteen lithographed pages are given up to illustrating different types of trucks, eight good sized plates to journal boxes, and nine to couplings. The book is well printed and illustrated.

The New England Street Railway Club has just issued an electric railway guide called The Trolley Wayfinder. The guide gives the distance, fare and time from Boston to points touched by trolley cars throughout New England, and also from Boston to New York, and New York to Philadelphia. The price of this guide is 10 cents, mailed to buyer. Copies may be obtained by addressing John T. Lane, Herald Building, Boston, Mass.

The publishers of the "Cassier's Magazine" have just issued in pamphlet form the article on the bonus system which appeared in their machine shop number, published a few weeks ago. Of the various methods of encouraging increased production among workmen, especially in engineering works, no system has ever produced such satisfactory results as some form of a bonus system, but a bonus system without some method of imparting the necessary information both to the employer and the employee is not likely to prove workable. This pamphlet discusses the system in detail, and gives reproductions of the blanks used. It is sold for 10 cents.

HALF-FARE FOR CHILDREN

An opinion has been given by the corporation counsel, of Chicago, that elevated railroad companies can be compelled by the city to carry children under 12 years of age for half fare. It is proposed to introduce an order in the Council that proceedings be commenced against any or all of the elevated railroad companies if they decline to obey the law. The surface companies, on demand of the Council, made an arrangement that two children could travel for 5 cents, but that one child must pay 3 cents. The surface lines, however, had once adopted the half-fare system, but had dropped it several years ago. The elevated roads have always charged full fare. The order, if passed, will mean a considerable difference in the income of each road, and may affect the Union Loop, which gets a percentage of each fare.

KINGSTON'S PARKS

The Kingston Consolidated Railroad Company has just issued a very interesting pamphlet descriptive of Kingston Point Park, with a number of attractive views illustrating it. The pamphlet contains a brief description of the spot itself, and relates some historical incidents connected with its early days, which, of course, add to the interest of visitors as well as to that of the residents of Kingston who frequent this resort. The company furnishes an excellent service and makes it possible for visitors to reach these points conveniently and with comfort. Trolley lines run through the principal streets of the city, and pass a number of very picturesque points on the line to the park.

CHICAGO MAY LOWER VAN BUREN STREET RAILWAY TUNNEL

The Illinois Supreme Court has decided that the city of Chicago may lower the Van Buren Street tunnel in the interest of Chicago River navigation. This decision is the result of a mandamus petition brought by the city to compel the West Chicago Street Railway Company (Union Traction Company) to lower its Van Buren Street tunnel to a depth of 21 ft. In making this decision, the court holds that even if the railway company should be compelled to lower its tunnel its right to build tunnels, as authorized by its charter, would not be taken away.

PERSONAL MENTION

MR. C. B. GREEN has been appointed trainmaster of the Columbus, Buckeye Lake & Newark Traction Company, succeeding C. W. Hoisinton, who has resigned.

MR. M. J. LOFTUS, who resigned his position as general manager of the Indianapolis & Martinville Rapid Transit Company, has been appointed superintendent of the Columbus, Grove City & Southwestern Railway Company.

MR. EDWIN C. FABER, at present general manager of the Elgin, Aurora & Southern Traction Company, has been appointed to a similar position with the Aurora, Elgin & Chicago Railway, succeeding Mr. Warren M. Bicknell, who goes with the Lake Shore Electric Railway. Mr. Faber will be succeeded by Mr. John T. Huntington, at present auditor of the Cincinnati, Dayton & Toledo Traction Company. Mr. Faber was formerly general superintendent of the Cleveland Electric Railway Company under Mr. Ira McCormick.

MR. D. A. BELDEN has resigned as general manager of the Birmingham Railway, Light & Power Company, and has accepted a position as president of the New Hampshire Traction Company. His headquarters will be at 50 Merrimack Street, in Haverhill. The New Hampshire Traction Company is a holding company for the following lines in Massachusetts and New Hampshire: Exeter, Hampton & Amesbury Street Railway Company; Hudson, Pelham & Salem Electric Railway Company; Haverhill & South New Hampshire Street Railway Company; Lawrence & Methuen Street Railway Company, and Lowell & Pelham Street Railway Company.

MR. GEORGE O. NAGLE, who, for some time, has been connected with Stone & Webster, with headquarters in Boston, has been appointed to the position of general manager of the Wheeling Traction Company, of Wheeling, W. Va. Mr. Nagle was born in Milton, Pa., Dec. 31, 1868. He received his early education in Lima, Ohio, moving to Chicago in 1886. Shortly after this he entered the employ of the Chicago, Burlington & Quincy Railroad, first in the ticket auditor's office, and later in the general auditor's office. In February, 1891, he entered the employ of the Chicago City Railway Company as junior in the claim department. Six months later he was promoted to the position of private secretary to the superintendent, which place he held until appointed superintendent, on Jan. 18, 1898. After Mr. Nagle resigned from the Chicago City Company he became connected with Stone & Webster, of Boston, taking the position of manager of the Savannah Electric Company, which controls the lighting and street railway properties of Savannah, Ga. Mr. Nagle remained at Savannah as manager for several years. Early in the present year he retired from the management of the Savannah company to take general charge of the firm's Southeastern properties. Mr. C. E. Flynn, who has been manager of the Wheeling system, is planning to take a vacation for the next few months to look after some personal matters, but will engage in railway work again later in the year.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. *** Including taxes.** † Deficit. *a* Including taxes, damages, tolls and rents.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O. Northern Ohio Tr. & Light Co	1 m., May '03	71,258	40,231	34,027	22,427	11,600
	1 " " '02	60,747	33,911	26,836	17,123	9,713
	5 " " '03	311,011	178,057	132,955	108,765	24,189
	5 " " '02	251,306	148,773	102,533	80,202	22,331
ALBANY, N. Y. United Traction Co.	1 m., Apl. '03	134,501	97,085	37,416	24,645	12,771
	1 " " '02	117,072	81,527	35,545	23,603	11,941
	4 " " '03	505,004	349,954	155,050	97,295	57,755
	4 " " '02	464,409	339,293	125,116	92,806	32,310
BINGHAMTON, N. Y. Binghamton St. Ry. Co.	1 m., May '03	20,312	10,066	10,246	------	------
	1 " " '02	17,194	9,118	8,075	------	------
	11 " " '03	203,029	115,579	87,450	------	------
	11 " " '02	187,658	103,986	83,672	------	------
BUFFALO, N. Y. International Tr. Co.	1 m., Apl. '03	295,332	167,669	127,663	127,168	549
	1 " " '02	250,850	142,515	108,336	123,422	†15,086
	4 " " '03	1,154,805	662,577	492,227	505,471	†13,244
	4 " " '02	998,919	580,979	417,940	497,053	†79,113
CHICAGO, ILL. Chicago & Milwaukee Elec. Ry. Co.	1 m., May '03	20,042	7,157	12,886	------	------
	1 " " '02	16,441	7,353	9,088	------	------
	5 " " '03	71,238	32,104	39,134	------	------
	5 " " '02	61,189	30,987	30,202	------	------
CINCINNATI, O. Cincinnati, Newport & Covington Light & Traction Co	1 m., May '03	100,891	*a*59,688	41,203	20,997	20,206
	1 " " '02	92,536	*a*50,322	42,214	21,067	21,148
	5 " " '03	469,141	*a*279,888	189,253	105,328	83,925
	5 " " '02	428,111	*a*246,059	182,052	104,694	77,358
CLEVELAND, O. Cleveland & Southwestern Traction	1 m., May '03	39,038	22,146	16,892	8,182	8,709
	1 " " '02	25,045	13,073	11,973	5,362	6,611
	5 " " '03	156,304	98,045	58,259	40,896	17,363
	5 " " '02	103,194	63,584	39,609	26,808	12,802
Cleveland, Painesville & Eastern	1 m., May '03	18,699	10,519	8,180	------	------
	1 " " '02	18,254	10,165	8,089	------	------
	5 " " '03	71,639	44,423	27,215	------	------
	5 " " '02	65,429	38,799	26,630	------	------
DETROIT, MICH. Detroit United Ry.	1 m., May '03	375,707	*221,302	154,405	81,194	73,211
	1 " " '02	334,867	*185,678	149,189	78,868	70,321
	5 " " '03	1,649,252	*994,691	654,561	407,942	246,619
	5 " " '02	1,485,380	*855,826	629,554	383,490	246,064
DULUTH, MINN. Duluth-Superior Tr.	1 m., May '03	52,389	28,594	23,795	10,225	13,570
	1 " " '02	44,475	20,288	24,187	9,745	14,442
	5 " " '03	235,379	144,019	91,366	50,994	40,366
	5 " " '02	196,910	110,278	86,632	48,189	38,443
ELGIN, ILL. Elgin, Aurora & Southern Tr.	1 m., May '03	39,148	21,794	17,354	8,333	9,020
	1 " " '02	35,115	19,628	15,488	8,333	7,154
	5 " " '03	168,544	102,178	66,366	41,668	24,699
	5 " " '02	152,583	92,167	60,415	41,668	18,749
FINDLAY, O. Toledo, Bowl'g Green & Southern Traction Co.	1 m., May '03	24,778	15,229	9,549	------	------
	5 " " '02	108,072	69,127	38,945	------	------
HAMILTON, O. The Cincinnati, Dayton & Toledo Trac. Co.	1 m., May '03	46,174	25,022	21,152	16,051	5,102
	1 " " '02	40,114	21,922	18,193	16,799	1,393
	12 " " '03	489,493	271,812	217,681	193,673	24,008
ITHACA, N. Y. Ithaca St. Ry. Co	1 m., May '03	11,247	4,860	6,388	1,747	4,641
	1 " " '02	10,419	10,701	†282	1,910	†2,192
LONDON, ONT. London St. Ry Co.	1 m. May '03	13,145	8,950	4,195	2,224	1,971
	1 " " '02	12,234	7,886	4,348	2,410	1,938
	12 " " '03	59,345	40,752	18,594	10,734	7,860
	12 " " '02	51,421	34,609	16,813	11,306	5,507
MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co.	1 m., May '03	246,285	121,408	124,878	71,702	53,175
	1 " " '02	218,633	103,835	114,797	65,638	49,159
	5 " " '03	1,186,992	612,780	574,212	352,313	221,899
	5 " " '02	1,052,179	505,111	547,068	323,539	223,529
MINNEAPOLIS, MINN. Twin City R. T. Co.	1 m., May '03	339,735	159,328	180,407	78,328	102,079
	1 " " '02	296,991	136,964	160,028	76,233	83,794
	5 " " '03	1,570,909	753,627	817,282	391,928	425,354
	5 " " '02	1,356,556	649,003	707,553	380,300	327,253
MONTREAL, CAN. Montreal St. Ry. Co.	1 m., May '03	172,987	112,141	60 846	20,614	40,232
	1 " " '02	178,408	86,780	91,628	18,672	72,955
	8 " " '03	1,362,563	872,072	490,492	140,470	350,022
	8 " " '02	1,257,518	786,238	491,280	124,907	366,373
NEW YORK. Interurban St. Ry. Co.	3 m., Mar. '03	3,724,805	1,835,805	1,889,000	2,174,596	†285,596
OLEAN, N. Y. Olean St. Ry. Co.	1 m., May '03	7,534	3,014	4,520	2,010	2,510
	1 " " '02	4,822	2,137	2,685	1,319	1,366
	10 " " '03	67,430	34,799	32,631	18,232	14,399
	10 " " '02	50,990	26,062	24,927	14,731	10,196
PEEKSKILL, N. Y. Peekskill Lighting & R. R. Co	1 m., May '03	9,308	*4,960	4,348	2,083	2,265
	11 " " '03	96,712	*59,256	37,456	22,918	14,538
PHILADELPHIA, PA. American Railways	1 m., May '03	114,149	------	------	------	------
	1 " " '02	97,695	------	------	------	------
	11 " " '03	1,122,339	------	------	------	------
	11 " " '02	908,350	------	------	------	------
PUEBLO, COL. Pueblo & Suburban Traction & Lt. Co.	1 m., May '03	39,496	------	------	------	------
	5 " " '03	191,083	------	------	------	------
ROCHESTER, N. Y. Rochester Ry.	1 m., May '03	102,238	50,656	51,582	25,534	26,047
	1 " " '02	88,453	48,062	40,391	24,749	15,642
SYRACUSE, N. Y. Syracuse R. T. Co.	1 m., May '03	66,584	38,329	28,255	20,222	8,053
	1 " " '02	57,769	32,558	25,211	19,025	6,186
	10 " " '03	687,633	383,950	303,683	216,685	92,998
	10 " " '02	632,420	349,466	282,955	209,221	73,734
TOLEDO, O. Toledo Rys. & Lt. Co.	1 m., May '03	135,416	70,726	64,690	40,837	23,853
	1 " " '02	117,006	60,246	56,759	37,851	18,908
	5 " " '03	630,633	329,400	301,234	200,935	100,298
	5 " " '02	548,602	288,224	260,378	189,179	71,190
YOUNGSTOWN, O. Youngstown-Sharon Ry. & Lt. Co.	1 m., May '03	41,397	*24,873	16,524	------	------
	4 " Apl. '03	161,955	*102,495	59,460	------	------
	12 " Dec. '02	444,986	*214,972	200,014	------	------