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The Electrification of British Railways

Most American street railway managers and engineers have been so occupied with the problems connected with the electrical equipment of the city and interurban railways of this country that they have not watched particularly closely the progress being made in Great Britain toward the electrification of certain of the trunk line systems. As shown by an article by a British engineer in our issue of July 4, however, the competition of the electric tramways with the steam railways around Manchester and Liverpool, Birmingham and other dense centers of population is very keen, and the electric lines have so spread out from the various towns and cities that it will soon be possible to go straight from Liverpool to Leeds by the trolley car. The railways in these districts are feeling the competition very sharply, and, it is needless to say, are also sustaining heavy losses as a result.

Thoroughly to understand why the steam railway companies have been endeavoring to defer installing electrical equipment until absolutely forced to do so, a few words of comment are necessary.

England is an old country, and the safety and general welfare of the traveling public have always been safeguarded by very stringent regulations, which in some cases have tended towards mere grandmotherly legislation. As a consequence of this the railway lines built in the first half of the last century were constructed so solidly that the capital expense involved was enormous; furthermore, speculators rushed wildly into railway enterprise, and the cost of obtaining statutory powers and purchasing land was excessive.

In time certain amalgamations were brought about by the large companies absorbing the smaller ones, which greatly reduced the number of competing lines. The amounts paid to bring about these changes were, in many cases, very large, with the result that the majority of the lines are overcapitalized, and to make matters worse, the great mistake has been made in bygone years of writing off far too little each year of the value of rolling stock and machinery for depreciation. This position greatly handicaps railway company directors, since the introduction of electric traction would necessitate not only a considerable increase of capital (already too large), but also a decrease in the assets, owing to the high value at which machinery and rolling stock, which would have to be scrapped, stand in their books at the present day.

The railways, consequently, adopted a "dog-in-the-manger" policy. They had no wish to introduce electric traction themselves, but still less did they desire anybody else to do it, and they did everything in their power to impede the progress of electric tramways and interurban railways. But though in the early stages of the campaign their efforts to quash the tramways were successful, the need for the latter was so urgent that the railways soon found that they had "bitten off more than they could chew," and they are now rapidly realizing that their stop-progress attitude cannot be kept up much longer.

Under the stimulus of the keen competition of the electric tramways the steam lines are beginning to bestir themselves. Some of the more progressive spirits amongst them have gone so far as to introduce electric traction experimentally on some of their branch lines, as in the case of the North-Eastern Railway around Newcastle-on-Tyne, and the Lancashire & Yorkshire Railway with its Liverpool & Southport line. Other companies, likewise realizing the necessity for action, but not being quite so venturesome (or probably not feeling the pinch of competition quite so sharply), have called in the services of electrical traction experts to advise them; in other cases the permanent officials of the company have carefully investigated the whole problem, and have studied the course of progress in America and on the Continent of Europe. Mr. Jacomb-Hood, the chief engineer of the London & South-Western Railway Company, appears to be a firm believer in the future electrification of steam railways, certainly in respect to hauling local and suburban trains, and has expressed his views on this subject in a paper which he read at the Engineering Conference which was recently held in London. He also draws attention to the serious financial difficulties which have to be met owing to the over-capitalized condition of the railways.

While some of the companies are thus honestly trying their best to solve the problem before them, there are, unfortunately, other cases where the permanent officials are trying to delay the introduction of electric traction as long as possible, because they know that should such a step be taken the changed condition of affairs would result in more work for them to accom-

plish and new methods to which they would have to adapt themselves. This they are unwilling to do, and so are attempting to preserve the old regime until their terms of office shall have expired.

The problem is further complicated by the large number of side issues which have been raised, such as the contention that in many cases the congestion of tracks in freight yards and terminal stations would so complicate the installation of the electric conductors as to render their installation practically impossible.

At the present moment the rapid transit problem in London is receiving very careful consideration, and a great and useful work is being carried out by the London County Council, and also by Charles T. Yerkes and his associates. The various other proposals made by numerous private interests are being carefully weighed and discussed by the Royal Commission which has been appointed for the purpose. This body will not only recommend the adoption of a better and simpler form of legislation in respect to the granting of franchises, but will thoroughly sift the whole matter to the bottom. To a certain extent this commission is on much the same lines as the Rapid Transit Commission of New York, and we look for important and far-reaching recommendations to result from its work.

The whole situation in Great Britain may be briefly summarized as follows: The steam railways are over-capitalized, and apparently the fact that plant depreciates has been ignored.

The directors in a very large number of cases have no practical experience in railway work, and their only thought is to be able to declare a dividend, lest they lose their position.

Many of the permanent officials fight shy of electric traction, because it is to them a new thing, concerning which their knowledge is negligible, and also because its introduction would mean a considerable amount of personal hard work. They are not blind to the fact that electrification is bound to come, but if they can help it they do not mean it to come in their time.

The probabilities are that in the near future, notwithstanding the very low average speeds which are legalized in the streets, the ever-growing competition of the electric tramways and the clamoring of a public educated thereby to a much higher standard of comfort than is given by the railways, will force the hands of the latter and compel them to supply a better and cheaper service of trains. Parliament has hitherto always safeguarded the interests of railways as long as they serve the public properly, but if the railway companies do not bestir themselves it will, very properly, grant franchises to other companies to do the necessary work, and there would be no difficulty in raising the requisite capital for such purposes.

That railways are not in a worse position than they are at the present day is largely due to the rules and regulations which so carefully safeguard the life and limbs of the British subject in his own country. Were this not the case it would be quite feasible for the tramway companies to have high-speed interurban lines built on their own right of way in the open country between towns, and to run the cars over the existing tracks belonging to the town tramways on coming within the boundaries of the latter. Although this is not possible at present, owing to the regulations as regards the narrow grooved type of rails imposed by the Board of Trade, there is no doubt that the necessary capital will be found to build either underground tubes or elevated lines within the boundaries of large towns, by means of which high-speed railroads could reach the crowded centers.

The amount of capital required is, however, considerable, and this has somewhat delayed progress and prevented the competition of the electric roads from becoming as dangerous to the steam roads as would otherwise have been the case. But this situation will not last much longer, and the electrification of suburban lines in the big English towns will undoubtedly take place within the next few years.

Standard System of Accounting in Great Britain

The owners and operators of the municipal and other tramways of Great Britain will, at no great distant day, congratulate themselves that the subject of a standard system of accounting has reached the point of serious consideration with them. Ever since the adoption of the American standard by the Street Railway Accountants' Association of America the subject has been a topic of more or less debate among tramway managers in Great Britain, as evidenced by the submission of a proposed standard system to the Board of Trade by the secretary of the Tramways & Light Railways Association, the presentation of a paper on this subject, by James Dalrymple, C. A., at the meeting last month of the Municipal Tramways Association, and a similar paper read last July at the London meeting of the International Tramway Association, which embraces the principal tramway companies on the Continent. Mr. Dalrymple's paper and proposed standard are published in full in this issue.

Of the three standard systems of accounting which have been brought forward for European use Mr. Dalrymple's seems to us the most desirable. Yet it is with great regret that we notice that the proposed form differs radically, and it seems to us needlessly, from its predecessor, adopted by the Street Railway Accountants' Association of America, to which the writer refers in his report. This feeling of regret is caused, of course, not entirely because the American standardization happened to be the first adopted, although that of itself would constitute one great reason in favor of its adoption in principle, but also because it seems to be the simpler and therefore the more effective. Owing to the close relation now existing in the mechanical conditions of the two countries, a like similarity in the classing accounts, especially of operating accounts, is much to be desired.

We, of course, recognize that an absolutely verbatim copy of the American system could hardly be used in Great Britain, at least until at such a future date when operating conditions are more similar. But now that the British Association has arrived at the time when standardization of accounts is recognized as desirable, it might as well, while causing the confusion out of which is to come uniformity, go a step farther and arrive as closely as possible to an international uniformity, at least with America.

The proposed standard classification of the International Tramway Association, as given in the report printed in this journal of the London meeting last summer of that association, is so completely at variance with the adopted American or the proposed British municipal standard classification that it can hardly be considered. At any rate, it does not destroy any argument for a standard classification that may be useful and operative in countries that have so much in common as America and England. This is all the more forcefully brought out when it is remembered that investors of either country are large holders of the securities of the other. The support given to the American standard classification by the financial interests of the country has been so cordial and uniform that should the

Municipal Tramways Association adopt one along the same plan it would be considered a fortunate and wise action.

The complete report, as published elsewhere in this issue, deserves the careful and thoughtful consideration of everyone. It will be noticed that the usual British custom of providing for depreciation is included, the figures which Mr. Dalrymple uses being a little more than 18 per cent of the total working (operating) expenses.

Accounts, No. 20, Local Taxes; No. 21, Properties and Income Tax; No. 38, Permanent Way Renewal Fund, and Nos. 39 to 46, Depreciation, will give a very great difference in "per cent of operating expenses to gross earnings" when used as a comparison with American reports.

The general plan of the report closely follows the published annual reports of the Glasgow Corporation Tramways, of which Mr. Dalrymple is chief accountant, but, as Mr. Dalrymple says in his letter of submission, he has consulted the American report, for the definitions of the accounts are frequently identical. Having gone thus far, it would be easy to take the whole plan of the American association, which is quite flexible enough to allow such changes that are necessary and still follow the arrangement of maintenance, transportation and general divisions of operating accounts.

From an American point of view, the American income account, which is the gist of the year's figures, is more logically arranged and is expressed compactly, while in the report under discussion it is not gathered into any one tableau of figures, but is spread through revenue, net revenue and appropriation accounts. It would also seem that capital expenditure and capital accounts, which are shown on two debit and two credit pages, are more clearly shown in their relation to each other, without repetition, in the American schedule "D."

The report is of undoubted ability, and while it is probably intended solely for use by British municipal corporations it cannot be considered a British standard until unified with the "Model Form of Returns," referred to above, as having been drawn up by the Tramways & Light Railways Association, and which is open to certain serious criticisms. Space will not permit a detailed consideration of this report here; it may, however, be explained as being prepared from an engineering rather than from an operating standpoint. These two forms are so dissimilar that it would seem they could never be combined without destroying wholly what similarity there is between the Municipal Tramways proposed report and the American standard, and in view of the great desirability of an international standard, it is to be hoped these two British associations will see the advantages of adopting the American standard, not because it is American, but because it has been in use long enough to have been thoroughly tested and found worthy of the name "standard." In addition to this, while the effort to make uniformity will create its confusion and somewhat dissipate comparisons for at least a year, the adoption of the American standard will cause no more confusion to adopt and will result in intelligent understanding of the report or returns of the companies of either country by the investors and operators of the other. It is to be hoped, therefore, while giving Mr. Dalrymple full appreciation for his excellent work, that the question may be squarely faced whether it would not be better after all to adopt the American standard, not in any sense as "American" but as international, for the reasons given above and which will be recounted: (1) The American system is much simpler and is hence more effective; (2) from the standpoints of both the operating manager and investor like systems of classifying accounts, especially operating accounts, is most desirable; (3) the American system has already been adopted by a large number of companies, and so could not be easily changed to the English standard, whereas the latter, being as yet only proposed, could easily be modified to similarity with the American standard; (4) the American standard has proved satisfactory after an experience of five or six years by railway companies varying in size from those operating small systems to the very largest, whereas the English standard is still largely theoretical; (5) the changes required for practical uniformity are not radical, and could easily be made without any sacrifice of principle.

Sleeping Cars on Interurban Lines

While there may have been a disposition in some quarters to think lightly of the proposition to establish sleeping car service on electric interurban lines, there is no doubt in the minds of those familiar with the conditions of interurban service in Indiana, Ohio and Michigan that there will soon be a great demand for this service over certain routes. Those who think slightingly of the proposition are those who are least familiar with the present status of interurban railroading and the practical requirements of the traveling man, who is the best patron of the sleeping car service on the steam railroads. At the present time there are a number of cities which are not a sufficient distance apart to make a night's journey on a steam road, but which are, nevertheless, far enough apart so that an annoying amount of time is consumed in traveling the distance between them. Take, for instance, two cities in the Central States from 100 miles to 150 miles apart. The chances are ten to one that a traveling man, to whom every minute of the business hours is valuable, and yet who can little afford to break into a regular night's rest, is obliged either to consume part of the business day making a journey between those two towns, or if he does not do this he is obliged to lose a part of his night's rest. Electric sleeping cars, making the trip in a night between towns situated as outlined, are sure to have patronage. A little investigation of this matter by those not familiar with the steam road schedules between large towns 100 miles to 150 miles apart would prove a revelation. Trains are run to suit the convenience of passengers traveling between the largest terminal cities. Those boarding or leaving the train at smaller intermediate points must simply make the best of an inconvenient schedule.

There is also another opportunity for the interurban sleeper which is, perhaps, more limited than the business just outlined.

Where two large cities are too near together to make a full night's ride on an ordinary steam road schedule, say, 150 miles to 225 miles, it is customary for the steam roads to provide sleeping cars which can be occupied all night without regard to the time of arrival and departure of the train; but this is true only between the larger cities, and further than this one who has had experience with this class of service knows that a sleeping car standing still on a hot night is not the most desirable place to rest. The average traveler would much prefer to be moving even though at a slow rate of speed.

As said before, it is only between the larger places that all-night sleeping cars are provided in present steam road service, and there are dozens of routes between smaller towns which offer opportunity for profitable interurban sleeping car service for distances of 150 miles to 250 miles. In case of direct competition between steam and electric sleeping cars the cleanliness of the electric service ought to be sufficient to take many away from the somewhat faster service on the steam roads.

ELECTRIC INTERURBAN BETWEEN COLUMBUS AND ZANESVILLE

In the articles describing the Appleyard system of roads in Ohio, published in the STREET RAILWAY JOURNAL of May 16 and May 23, reference was made to the connecting lines controlled by Tucker, Anthony & Company, of Boston, the plans being worked out by the two interests for operating through trains between Cincinnati, Cleveland, Pittsburg and Toledo were explained, and a map was presented showing the proposed system. As was intimated at the time the chief efforts of Tucker, Anthony & Company are being directed toward the completion of a through line between Columbus and Cleveland. At present the most important property in this group is the Columbus, Buckeye Lake & Newark Traction Company, which, by reason of an extension to Zanesville, is soon to be known as the Columbus, Newark & Zanesville Traction Company. The line has been in operation between Columbus and Newark for about fifteen months, and it undoubtedly places in the hands of its owners the key to the most desirable route east from Columbus, as it forms the logical entrance to Columbus for lines building to the northeast. The Ohio River & Western Railway, an Appleyard property extending from Zanesville to Wheeling, will secure connection with the capital city over this line.

REVERSE CURVE ON C., B. L. & N. RAILWAY, WHERE IT PASSES CANAL ON ONE SIDE AND THE STEAM LINE AND HIGHWAY ON THE OTHER

THE ROUTE

Between Columbus and Hebron, 29 miles, the line follows the old National Pike, a military road built by the national government before this section of the country was settled, and over which the company has twenty-five-year franchises from the counties traversed. This highway is also followed by the Columbus, London & Springfield Railway between Columbus and Springfield. The trolley is built at the side of the highway, but because of this it should not be considered in the same class as ordinary pike roads, since the highway is nearly 100 ft. wide and the railway is separated from the wagon road by a ditch. It is, moreover, practically fenced in on one side by the company's pole line, the other side having already been occupied by the long-distance lines of a telephone company. This portion of the line is almost a perfect tangent, and the few grades met are long and hardly noticeable, as the country is very flat. Between Hebron and Newark, a distance of 9 miles, the line traverses the berme bank of the Ohio & Erie Canal, under a lease from the State. There are, of course, no grades on this section of the road, but the meanderings of the canal introduce nineteen curves in the 9 miles. Only a few of these are severe enough to necessitate the use of guard rails, and in every case they can be taken at a good rate of speed. This portion of the route provides rather unique scenery, and at one point, side by side, are exemplified four ages or methods of transportation, namely, the National Pike, the old and abandoned canal, the steam railway and the up-to-date electric railway. A view of this interesting feature is presented herewith.

The road under construction from Newark to Zanesville is on private right of way, ranging from 50 ft. to 75 ft. in width, the greater portion being cross-country route. The line parallels the Licking River, and at one point there is a tunnel nearly 400 ft. long, which was built to avoid several bad curves. In Newark the syndicate operates 8 miles of city lines with a suburban line to the neighboring town of Granville, 7 miles. These constitute the Newark & Granville Railway, which was purchased by the syndicate several months ago, and is operated by the interurban management. From Hebron to Buckeye Lake, 2½ miles away, there is a cross-country spur line, while between Etna and Pataskala, 2¼ miles, a private right of way has been secured and a spur line will be built at once. When completed, as outlined, the system will include 64 miles of main line, 12 miles of spur lines and 8 miles of city lines, a total of 84 miles, not including sidings.

The company built its own entrance into Columbus by way of Mound Street as far as the interurban loop, and all cars operate to the Union Passenger Station on Gay Street. The city portion of the line is leased to the Central Market Street Railway, which furnishes city service. All of these features, as well as the type of construction used on the city line, were described in the article on the Appleyard system in the May 16 issue of this paper.

The Newark & Granville Railway has recently been rebuilt with 9-in. 90-lb. girder for the city lines, and 70-lb. T-rails for the suburban, and new overhead construction throughout. The interurban system is designed for high speed, with 70-lb. rails in 30-ft. lengths, laid on 6-in. x 8-in. x 8-ft. oak ties. American Steel & Wire protected bonds are used on a portion of the system and General Electric flexible bonds on the balance. They are used in connection with standard six-bolt, 30-in. fish-plates. Sidings are 400 ft. long, and are 5 miles apart. They have spring switches, low-stand targets and frogs of steam railway pattern. On the present line there are six steel bridges, from 20 ft. to 156 ft. in length, seventy tile and iron culverts, varying from 6 ins. to 3 ft. in diameter, and three concrete arch culverts of 6-ft. span, as well as drainage tile under all highway and driveway crossings. There are several large pile trestles, and at Alum Creek, near the Columbus city limits, there is one 800-ft. trestle and steel bridge, forming an overhead crossing over two steam roads as well as crossing the

stream. Six inches of gravel is placed under the ties and filled up even with the tops on the interurban line, while the paving used in cities is vitrified brick in thick concrete base and grouted with cement.

OVERHEAD WORK

Poles are 35 ft. tall, and spaced 100 ft. apart; a portion of them are red cedar and the balance chestnut. There are two cross-arms, the upper for the high-tension wires and the lower for the direct-current feeders. There are also two sets of small side brackets for the telephone system and block signal system. Brackets 9 ft. long, of 1½-in. pipe, and provided with guy wires, are employed, and a single trolley wire of the 0000 grooved pattern is used. Between Hebron and Columbus there are two 0000 copper feeders, and between Hebron and Newark two 0000 copper and two 330,000 circ. mil aluminum feeders, the latter supplying the Newark & Granville system. At the Newark city limits the feeders divide; the city system is supplied by one 0 and one 0000 copper feeders, while the Granville suburban line is supplied by three feeders arranged as follows: One 330,000 circ. mil aluminum, 4 miles; one 0000 copper, 6 miles, and one 0 copper, 7 miles. The high-tension wires are of No. 4 B. & S. gage. Two of these are attached to the ends of the upper cross-arm, while the third is mounted on a saddle-pin at the top of the pole. This pin is of iron, with a wooden tip, and it is attached to the pole by three lag screws on each side. No. 2 triple petticoat Provo-type insulators are used for securing the high-tension wires.

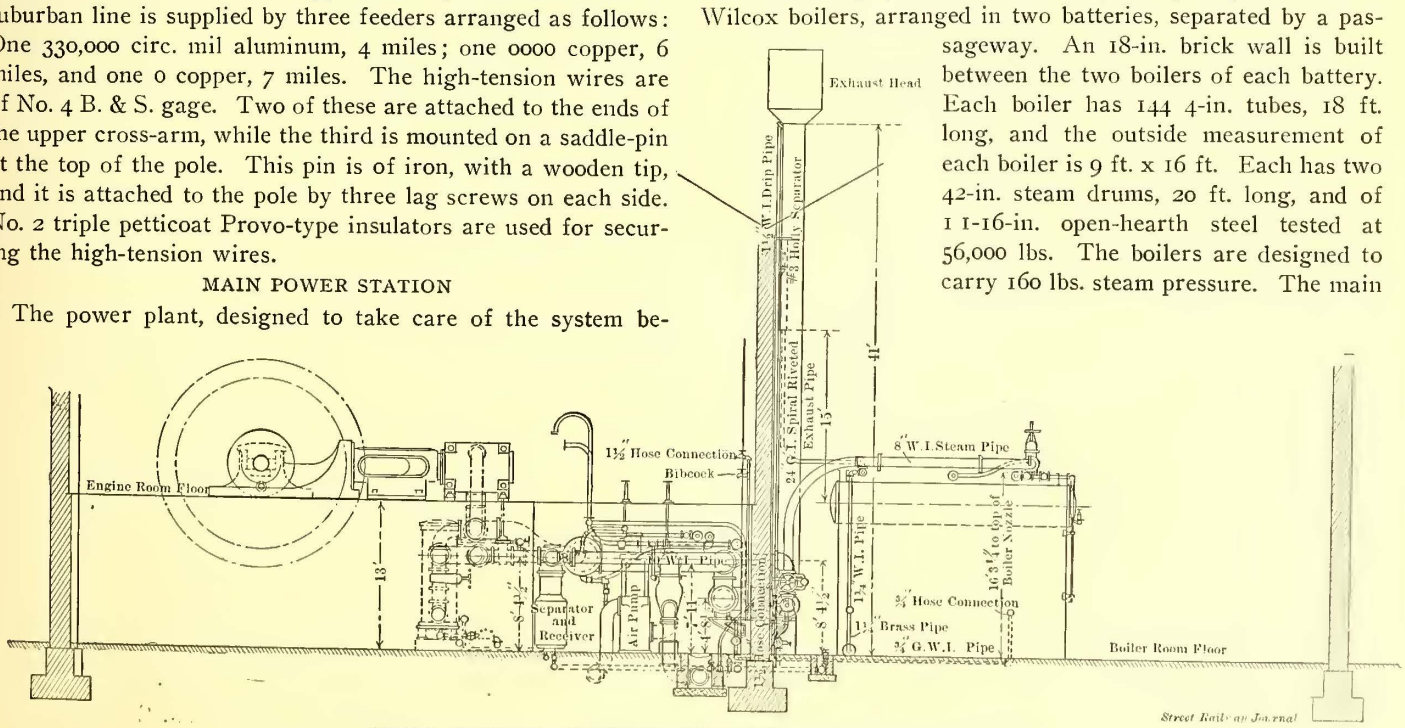
BIG WALNUT BRIDGE ON C., B. L. & N.

HEBRON POWER HOUSE, C., B. L. & N.

MAIN POWER STATION

The power plant, designed to take care of the system between Columbus and Zanesville, is located at the village of Hebron, within a short distance of the bank of the canal from which water is obtained. A constant supply of good water is always assured, since the location is only about 2 miles from Licking reservoir, better known as Buckeye Lake, which feeds a greater portion of the canal system. This location was selected also because of its proximity to the pipe lines from neighboring natural gas fields, from which the plant derives its chief fuel supply.

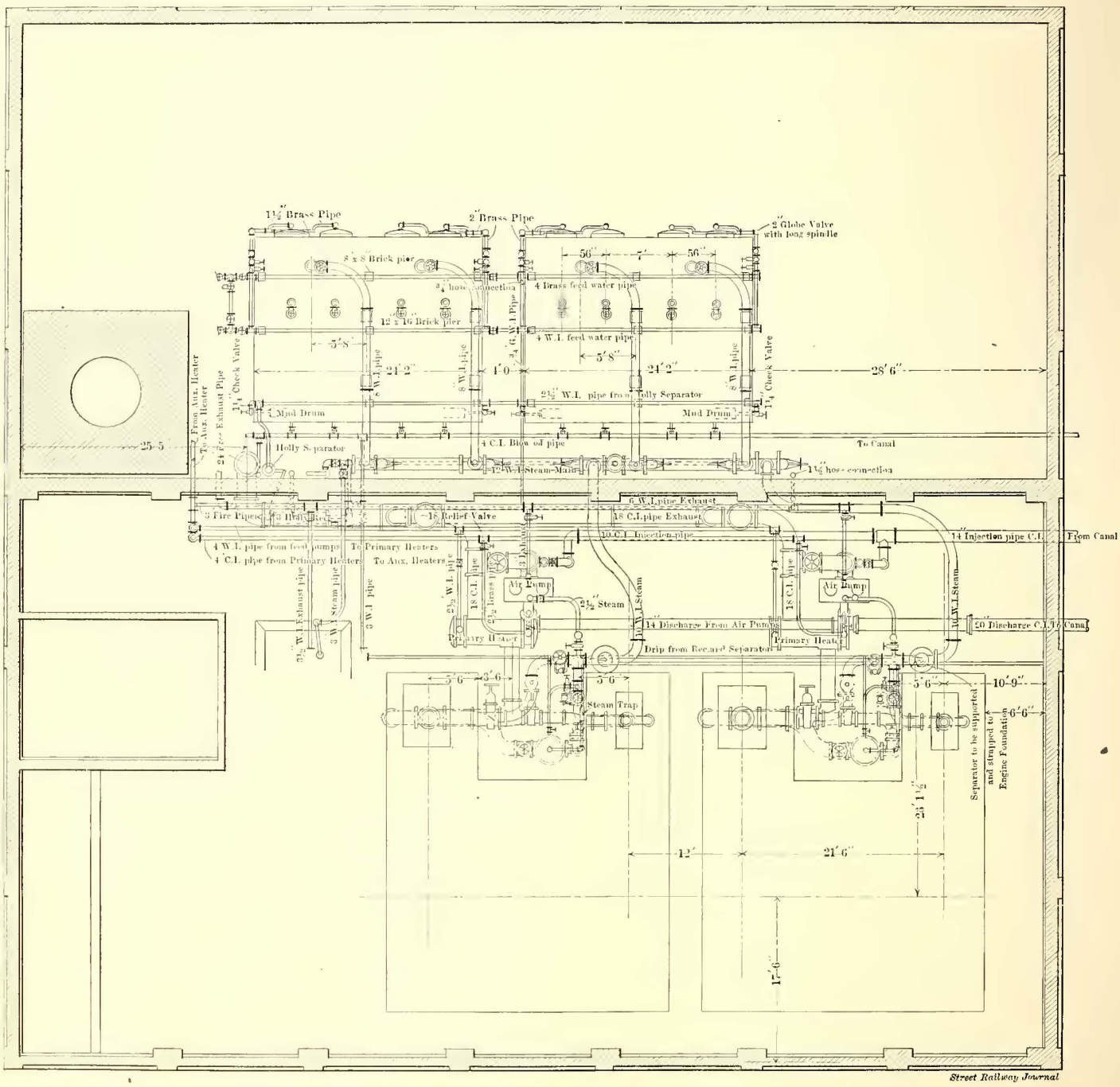
The building is a large brick structure of unusually attractive design. It is divided into two wings, the engine room, 61 ft. x 112 ft., and the boiler room, 50 ft. x 112 ft. At the side of the boiler room there are coal bunkers, 22 ft. x 112 ft., having a capacity of 1000 tons. There is a steel I-beam trestle for dump-bottom coal cars. The roofs are iron truss with slate, and there is a stack 150 ft. 6 ins. tall, with 7-ft. flue. It is constructed of radial brick and rests on a square base within the boiler room. The boiler equipment consists of four 300-hp Babcock & Wilcox boilers, arranged in two batteries, separated by a passageway. An 18-in. brick wall is built between the two boilers of each battery. Each boiler has 144 4-in. tubes, 18 ft. long, and the outside measurement of each boiler is 9 ft. x 16 ft. Each has two 42-in. steam drums, 20 ft. long, and of 1 1-16-in. open-hearth steel tested at 56,000 lbs. The boilers are designed to carry 160 lbs. steam pressure. The main



CROSS SECTION, SHOWING PIPING IN HEBRON POWER PLANT

steam header is 12 ins. in diameter, and the connections have 2-in. flanges. A Walworth valve, having an 18-in. gate, separates the two sets of boilers, and each boiler is also fitted with a separate valve, so that any of the four may be cut out. There are also separate valves on the tops of the boilers.

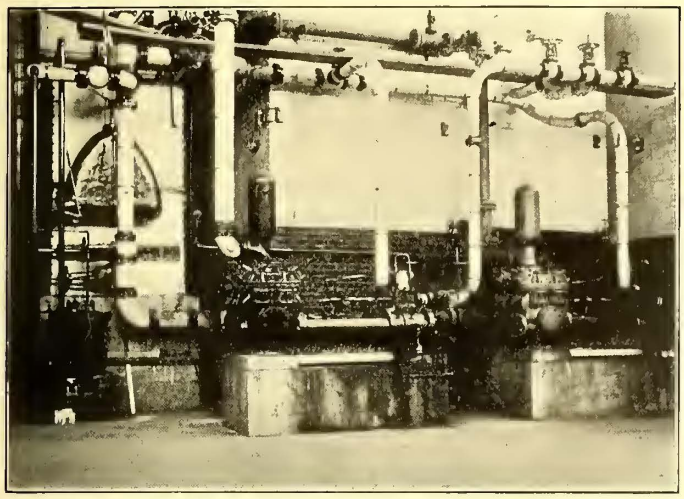
As already intimated, natural gas is used for fuel supply. This is received through a 4-in. pipe, tapped from an 8-in. main, supplying the city of Newark, and passing a short distance from the power station. The pressure in the main line varies from 80 lbs. to 140 lbs., necessitating equalizing and reduction. A regulator house has been erected a short distance from the plant, containing two sets of reducing regulators, the first of which cuts the pressure down as low as 20 lbs., while the second, or low-pressure regulator, reduces the pressure to the desired number of ounces. In the boiler room is located a steam gas regulator, which governs the flow into the burners. There is a lever provided with weights similar to the balance on a scale, and this is set according to the steam pressure desired in the boilers. Connected with the steam regulator outfit are two meters, each carrying half the load. Readings are taken every morning by the gas company. The gas burners are a modification of the Klein type, furnished by Tate, Jones & Company, of Pittsburg. There are three sets of burners for each boiler, two at the sides and one above. The center burner is 14 ins. above the grate inside the center door, and throws its flames through the center towards the rear of the boiler. The side burners are set at the same height at each side, so that the flames incline towards the center of the flues. Only three of the four boilers are equipped for gas, the other being held in reserve for the speedy use of coal. It is claimed that it is not necessary to remove the burners if it is necessary to burn coal, but they can be taken out in two hours if it is desirable to do so.



PIPING PLANT OF HEBRON POWER STATION

The plant is supplied with recording watt-meters, and a careful record is being kept of cost of generating current, but by reason of recently discovered discrepancies in the instruments the management deemed it inadvisable at this time to go into a detailed statement relative to the efficiency and the economy derived through the use of gas. It is known, however, that there is a saving of from one-fourth to one-third, compared with Sunday Creek run of mine coal, at $2.20 per ton.

which has been used on certain occasions. The engineer of the plant stated that during several days' continuous tests an average of 35 ft. of gas was consumed per electrical horse-power. J. R. Harrigan, general manager of the company, states that the present cost of power is estimated at 0.5 cents per kilowatt-hour. From an informant, other than the company itself, it is understood that gas is purchased at the low rate of 8 cents per 1000 ft.



FEED-WATER PUMPS AND COCHRANE HEATER AND PURIFIER IN BOILER ROOM

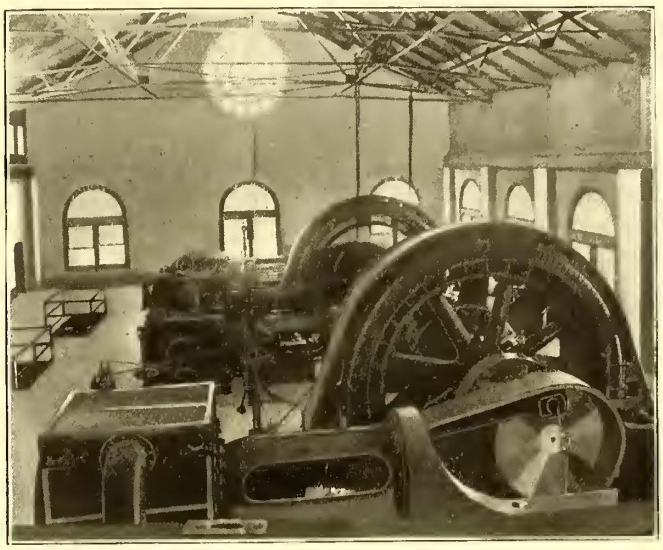
In the boiler room there is a Cochrane open heater and purifier, also two Blake double-feed water pumps. The engine room floor is 10 ft. above that of the boiler room, and in the auxiliary room below and extending up through the floor are two Blake vertical twin condenser pumps. These are designed to run at 27-in. vacuum. There is a primary heater in the exhaust line and the feed water passes through this first and then through the Cochrane heater, enabling the water to be put into the boilers at 206 degs. The exhaust line is 18 ins. in diameter, and in the line is an atmospheric valve.

THE ENGINE ROOM

There are two engines of the Hamilton-Corliss cross-compound type; the high-pressure cylinders being 26 ins. in diameter, and the low pressure 50 ins., with a stroke of 48 ins. There is a reducing valve in the main steam line connected with the low-pressure cylinder, so that in case it is desired to run the low-pressure side of an engine independent of the high-pressure side the latter may be cut off from the main steam line. A fire system has been provided throughout the plant in which the feed-water pumps may turn their full pressure into fighting fire.

Directly connected to the engine shafts are 800-kw General Electric generators. They are of the three-phase, revolving field type, operating at 94 r. p. m., and wound for 13,200 volts, the pressure selected for the transmission lines. This system makes it unnecessary to step-up the current in the station. Attached to the fields are the engine fly-wheels, which are 18 ft. in diameter, and have a web 18 ins. deep and 20 ins. wide; the total weight being 100,000 lbs. Current for excitation of generator fields is supplied by two 35-kw, 125-volt exciter sets; one of them driven by a small General Electric marine engine, and the other by an induction motor. The engine-driven set is used in starting, and is shut down when the generators are up to voltage and the motor-driven exciter is started.

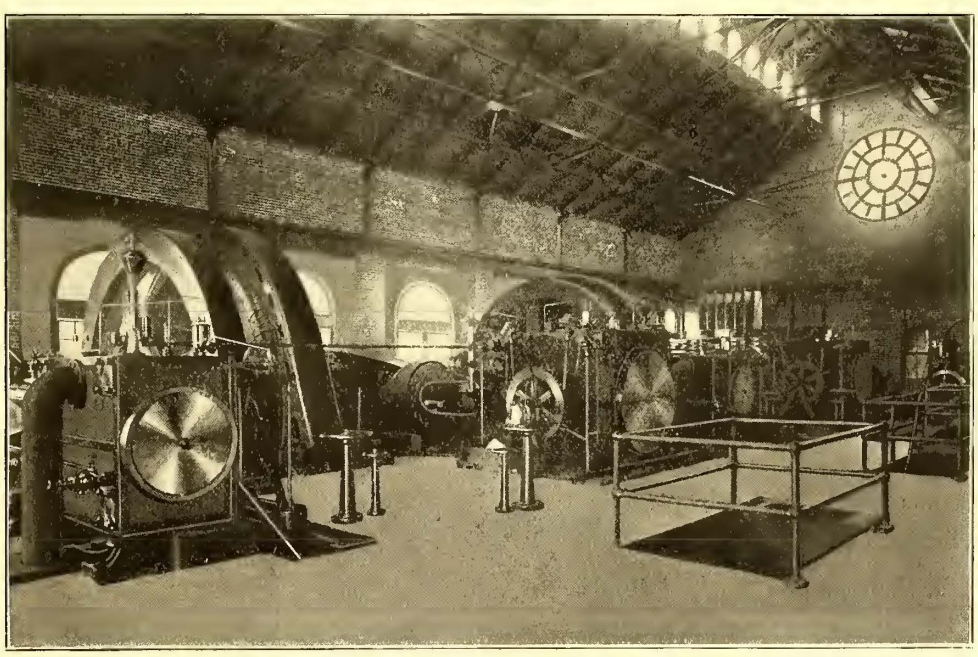
There is a sub-station outfit in the main station. Two 300-kw



GENERATING SETS IN MAIN POWER HOUSE AT HEBRON

rotary converters adjoin the exciter sets at one end of the building and the floor below these is open, affording good ventilation. To the rear of the converters is the station switchboard, and back of these are the oil switches, transformers and lightning arrester gallery.

There are two rows of oil switches of the General Electric hand-operated, single-pole, form K-type, the three single-pole switches for one circuit being controlled by one handle. These

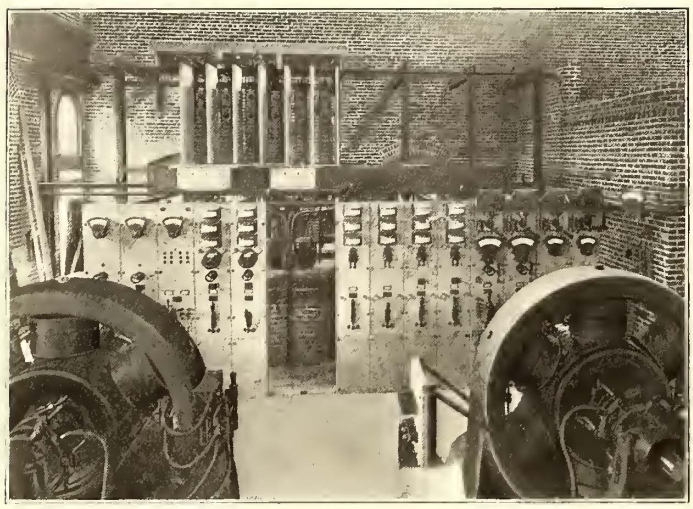


GENERAL VIEW OF ENGINE ROOM IN HEBRON POWER HOUSE

are in brick concrete and soapstone cells. Current from the generators is carried to the generator switches by triple-conductor, paper-insulated lead-covered cables. The three phases are separated in terminal heads and current passes through the generator oil switches, and from there to the station bus-bar, located above and between the two rows of oil switches.

High-tension oil switches of the same type are also used between the bus-bars and the transformer banks for the rotaries in the station. There are three 120-kw transformers

for each rotary. Current is reduced in the transformers to 370 volts for the rotaries. There is a reactive coil in front of each bank of transformers, which adds to the compounding and assists in hand regulation of voltage. The transformers are cooled by fans driven by 1-hp 350-volt induction motors. In line with modern practice the whole basement under transformers, blowers, reactive coils, etc., has been walled off for an air-blast chamber, thus giving a convenient place to work on wiring, etc., that enters the bases of transformers.



ROTARIES AND SWITCHBOARDS IN HEBRON POWER HOUSE

The lightning arresters for the outgoing lines are suspended on an iron frame and isolated by means of barriers.

SWITCHBOARD

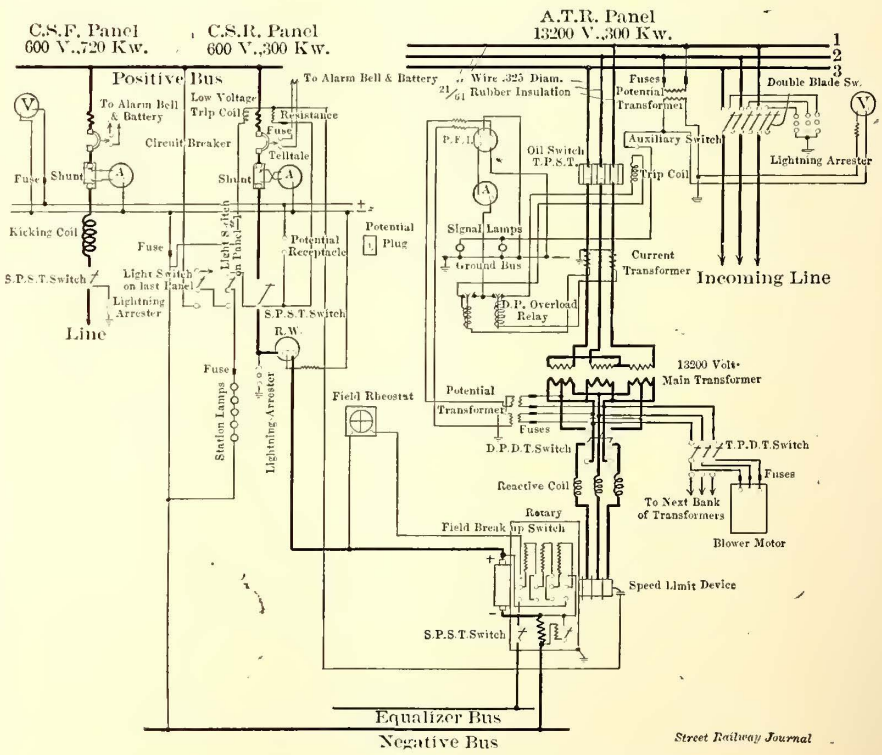
The station switchboard is of blue Vermont marble, and has fifteen panels, arranged as follows from left to right: Two exciter panels, one exciter feeder or field panel, two generator panels, two spaces for future panels, two outgoing transmission line panels, two 13,200-volt alternating-current panels, two direct-current converter panels and two for direct-current feeders. On each generator panel there is a power factor indicator, an ammeter, a voltmeter and a recording wattmeter. The two outgoing line panels have three ammeters each. The direct-current converter panels have automatic circuit breakers and ammeters, also recording wattmeters. Current transformers for ammeters on the board and potential transformers for the volt meters are located above the oil switches; the former are connected in series with the line and the line and the latter are connected across the line.

There has recently been installed in the station a gravity system of oil-feed which is saving the work of one man. Another valuable device is a Christensen air compressor outfit, which is used in blowing out the bearings of all machinery. One corner of the room is partitioned off for an office for the engineer. It is neatly furnished and provided with connection from the line telephone system. A person visiting the station cannot fail to be impressed with the extreme cleanliness pervading the entire place, made possible by the use of gas as fuel. The walls of both engine room and boiler room are painted white. When the station is in operation lighting current is taken from the railway circuit, and when it is closed down current is taken from the 125-volt steam exciter. A 58-ft. crane has been installed. It spans the entire engine room, and comprises a 15-ton hand-power crane and a 3-ton auxiliary hoist. The outfit weighs 36,000 lbs., and was furnished by the Whiting Foundry & Engine Company, of Chicago. The power station was designed by Sheaf & Jastaad, of Boston.

THE SUB-STATIONS

At the present time but one sub-station is in operation. This is located at Hibernia, half-way between Hebron and Columbus. The equipment of this station consists of two 300-kw rotaries, six 120-kw air-cooled transformers, arranged in two banks, together with the necessary oil switches, circuit breakers and switchboard. The sub-station feeds directly to the center of Columbus on one side and half-way to Hebron in the other direction. While the Hibernia station is theoretically a terminal station for this system, it is equipped with outgoing high-tension lines which connect with the Columbus sub-station of the Columbus, London & Springfield Railway. As outlined in the description of the power equipment of the system published in the May 23 issue of the Street Railway Journal, the power houses of the two systems may be operated in parallel through the compensating transformer equipment in the Columbus sub-station.

At present the rotary equipment in the main station supplies between Hebron and Newark, the Newark city system and the Newark & Granville line. To provide for the extension now under construction to Zanesville, there will be two additional sub-stations. One of these is under construction in connection with the car houses at Newark, plans for which are presented on another page, while the locations of the other two have not been fully decided upon. The equipment of these will be similar to that of the Hibernia sub-station, except that they will have two three-phase air-cooled transformers instead of six single-phase. Additional current for the extension will be provided by a new unit, consisting of a 1500-kw General Electric generator, directly connected to a 2500-hp Hamilton-Corliss engine. This will necessitate the extension of the building southward, but there is space at present for the additional oil switches, switchboard, lightning arresters and other auxiliary equipment that will be required. All machines will be run in parallel.



SWITCHBOARD WIRING FOR SUB-STATION

CAR HOUSE AND REPAIR SHOPS

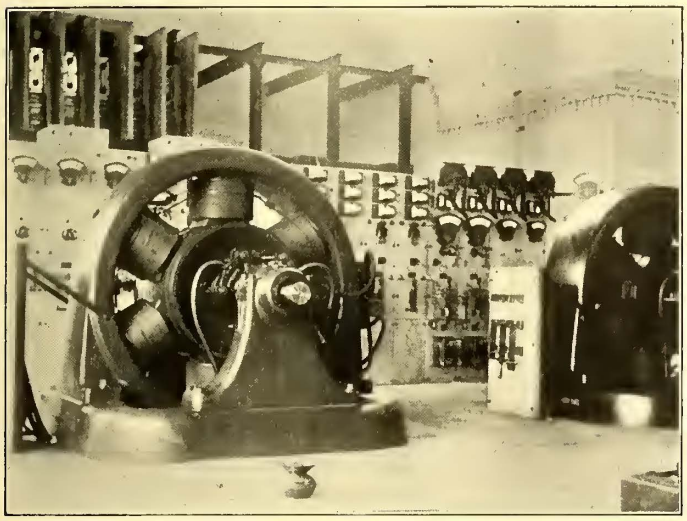
At Newark are being erected the car house, shops and rotary station mentioned. The structure is of brick with sandstone trimmings. It is divided into two parts by a brick fire-wall.

Each half is 60 ft. from wall to wall, and contains working pits, wash room, repair shops, etc. There are ten tracks, with capacity more than sufficient to hold all the cars on the system. The roof consists of steel trusses covered with corrugated iron on purlines. An annex, as shown, contains the offices, men's lounging room, boiler room and sub-station.

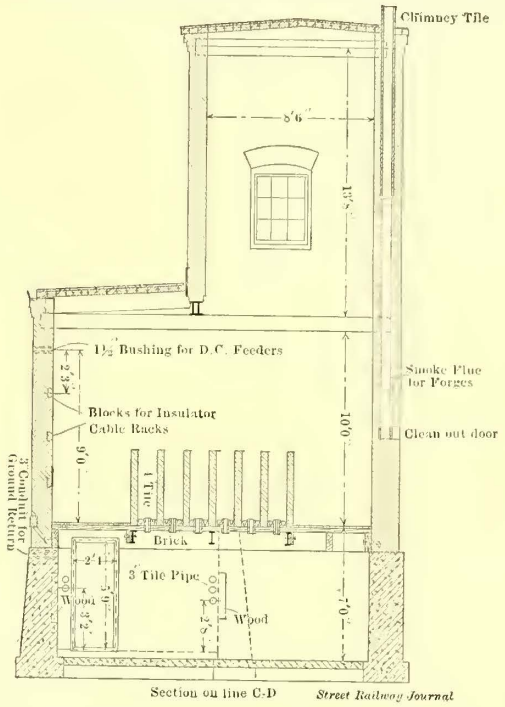
Plans for this structure were prepared by E. H. Kitfield, of Boston, from whom the accompanying diagrams were procured.

CAR EQUIPMENT

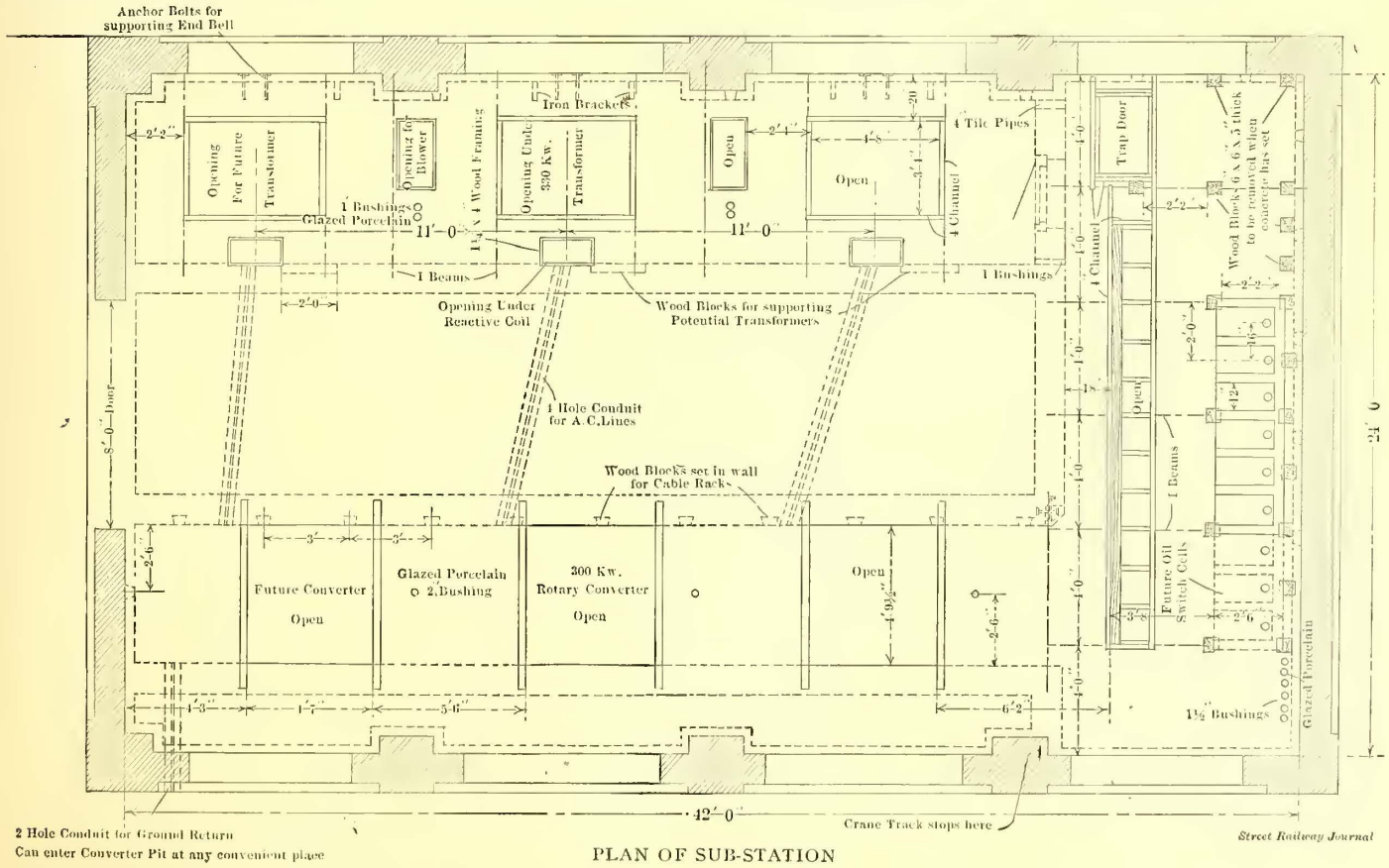
The rolling stock for the present Columbus-Newark line consists of four 62-ft. and four 50-ft. Barney & Smith cars. The former seat sixty-two people, and have baggage compartments in addition to smokers, while the latter seat fifty people. They are finished in dark mahogany, and each has a water-cooler and closet. They are equipped with four General Electric No. 73 motors, mounted on Barney & Smith type-J trucks, center nose suspension. M. C. B. journals and 33-in. wheels with Chrome steel tires are employed. The longer cars weigh about 75,000 lbs. Four of these cars are used on hourly headway, and they make the 37 miles in 1 hour and 50 minutes. The company will shortly institute limited service between these points, and for this purpose has a 62-ft. Barney & Smith parlor car with chair seats, which will make the run in 1 hour and 20 minutes. For express service there are two 60-ft. Barney & Smith express cars equipped with four General Electric No. 57 motors. The summer traffic on this line is very heavy, and for this service there are five 62-ft. semi-convertible cars, built by the Jewett Car Company. They have center aisles and slat seats, and are equipped with Peckham M. C. B. No. 32 trucks and two General Electric No. 73 motors. The Newark & Granville line has a 50-ft. combination passenger and baggage car, built by the



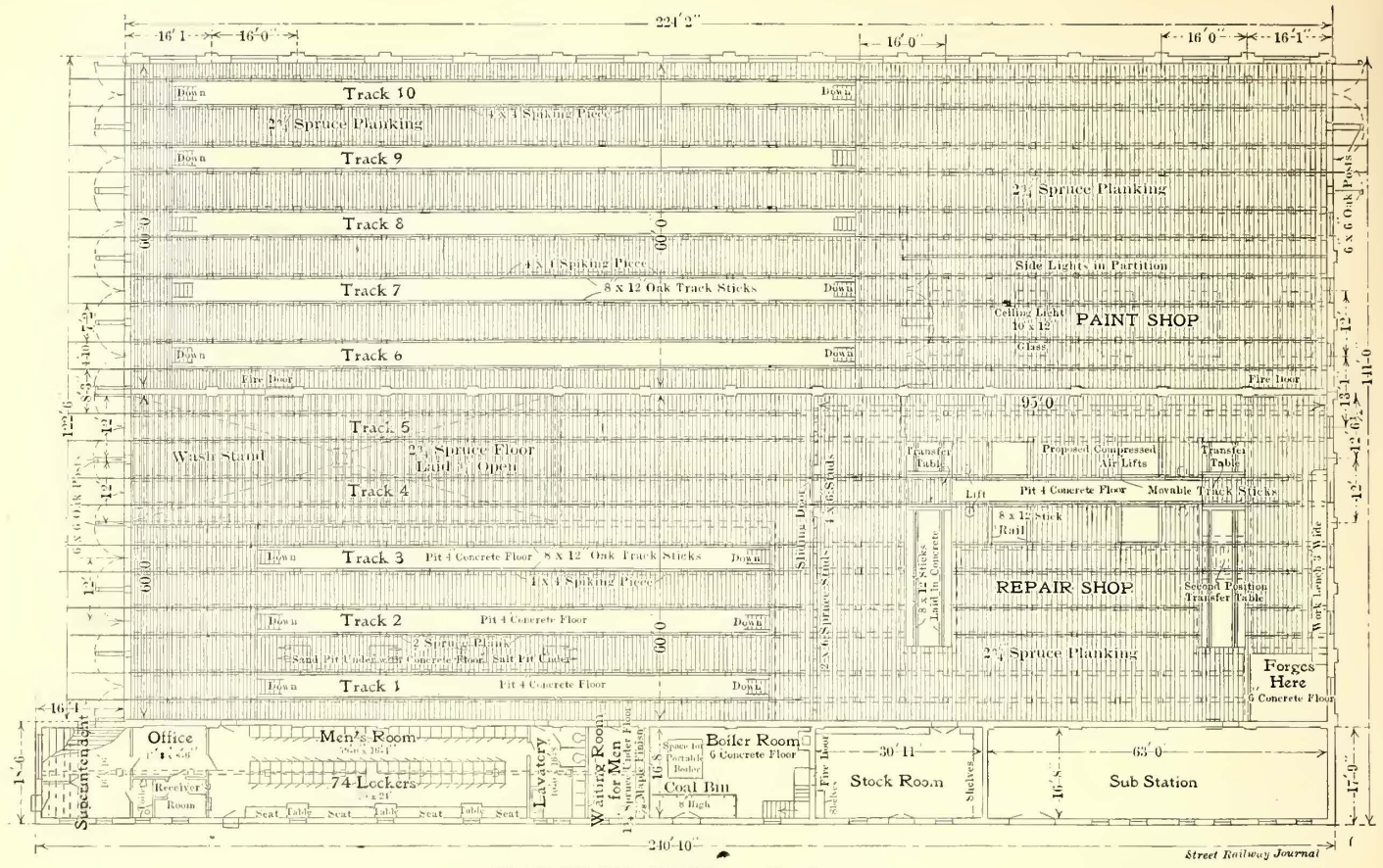
ROTARY CONVERTERS, SWITCHBOARD AND HIGH-TENSION SWITCHES



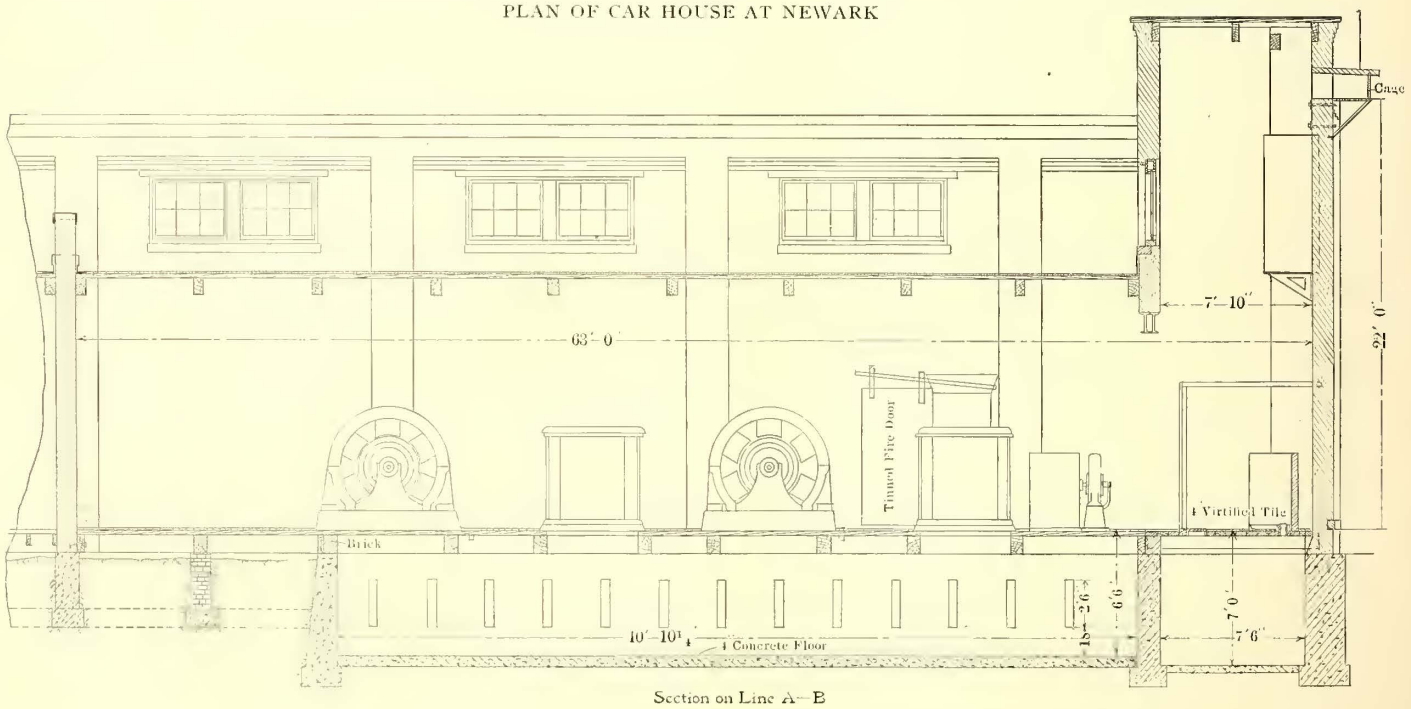
SECTION OF SUB-STATION IN CAR HOUSE



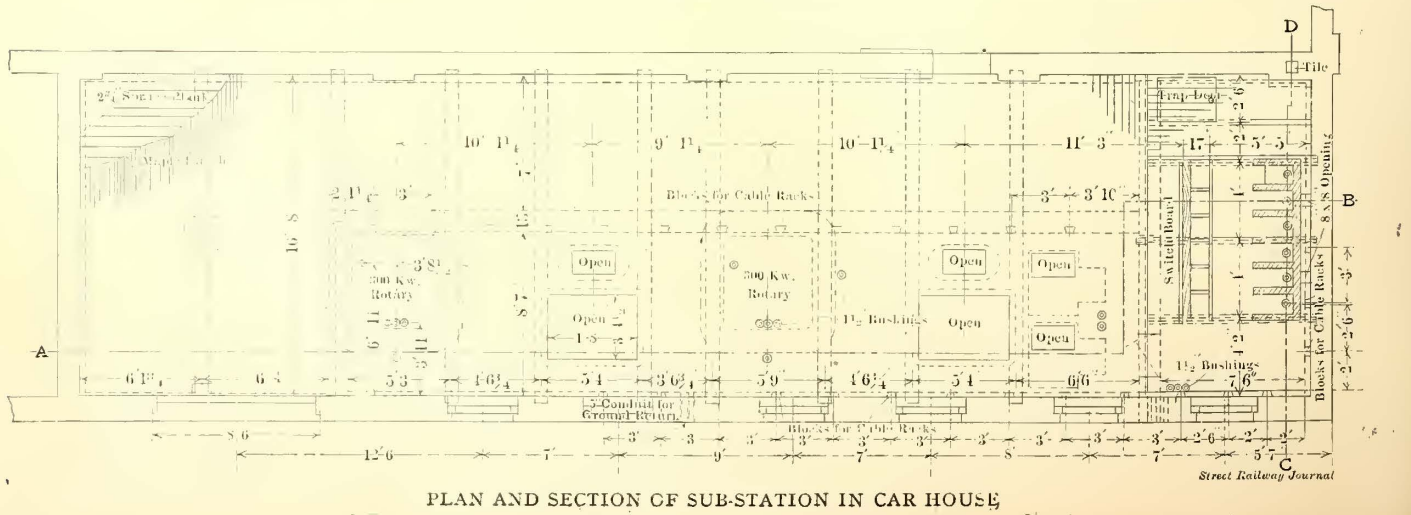
PLAN OF SUB-STATION



PLAN OF CAR HOUSE AT NEWARK

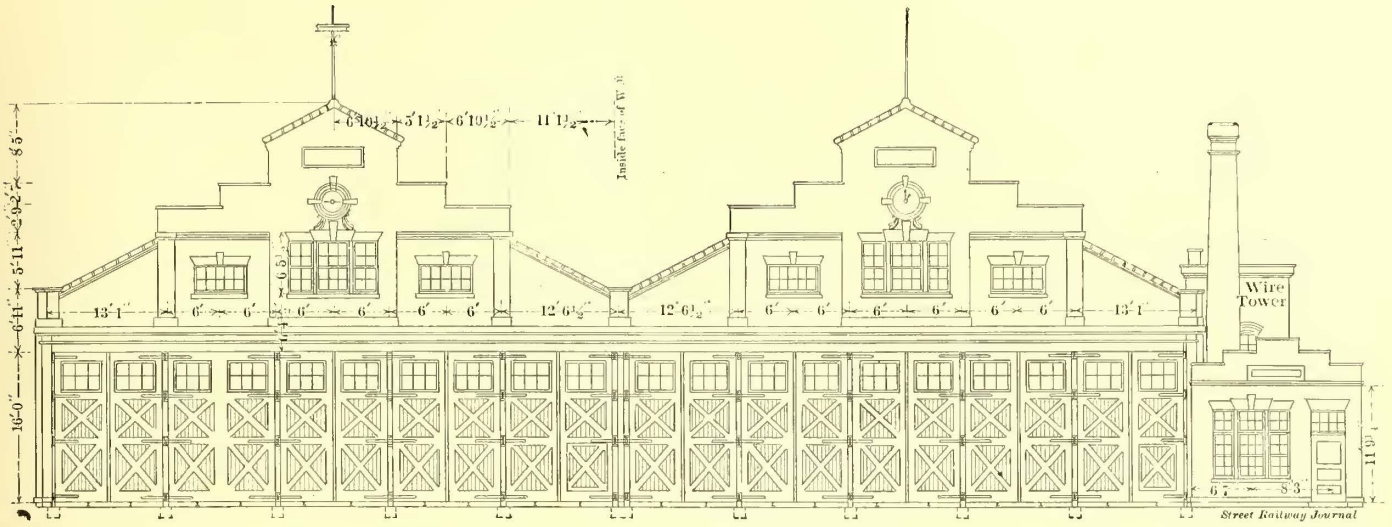


Section on Line A—B



PLAN AND SECTION OF SUB-STATION IN CAR HOUSE

Jewett Car Company. It has Peckham trucks and four General Electric No. 57 motors. For the Newark city service there are six very handsome 34-ft. double-truck cars, built by the Jewett Car Company. They are finished in oak and are equipped with



FRONT ELEVATION OF C., N. & Z. CAR HOUSE

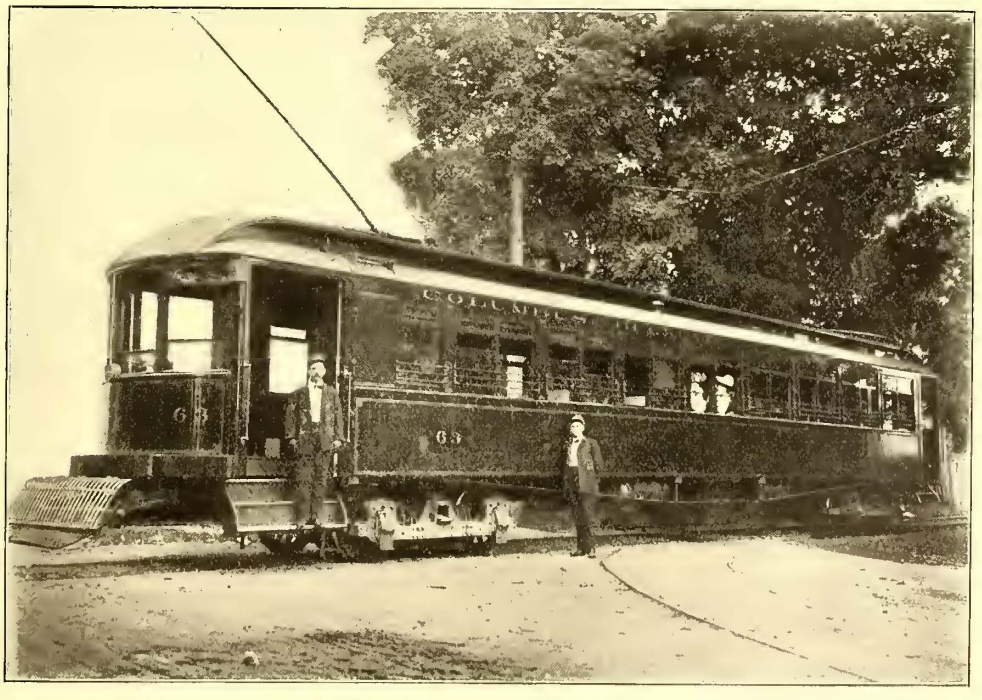
Peckham trucks and two General Electric No. 67 motors. There are also ten single-truck open cars and two fifteen-bench open excursion cars. To provide for possible third-rail operation when the through systems are connected up, all trucks on interurban cars are provided with lugs for third-rail shoes.

SEMI-CONVERTIBLE CAR

The interurban cars all have Christensen air brakes, Nichols-Lintern air sanders, Knutson trolley retrievers, Wagenhals arc headlights and are operated by the General Electric multiple-control system. The management of the road is thoroughly convinced as to the advantages of the "dead man's" handle, and has stringent rules against "plugging" the device. This is the result of a recent incident in which a car was making a high rate of speed along the canal bank, when some one threw a stone which struck the motorman in the head, knocking him insensible. A few seconds later the car came to a stop at a curve, which could not have been taken at high speed.

DESPATCHING SYSTEM

The system is covered by the United States Signal Company's block system of red and white lights, but train despatching is done by telephone from the despatcher's office at Hebron, where a ten-drop switchboard is installed. Each division has a separate circuit, and telephones have been placed in all the offices and sub-stations along the line. The booths are provided with switches so that the telephone is cut out when the door is shut. The despatcher does not employ the usual train sheet, but has a board with pegs, showing the movements of cars. When orders are given from the despatcher's station they are written in triplicate or quintuplicate (on heavy days cars are run double headers), and copies are given to conductors and motormen. An order taken on the line is received by the conductor, who writes it in duplicate on a pad in the booth, the despatcher at the same time making a copy in his station. The conductor then repeats the order back to the despatcher, who, if order is correct, will say "complete," adding the time of the order. The conductor notes the time and hands one copy to the



62-FT. PASSENGER CAR

motorman. The fact that the time is indicated on the order is the motorman's assurance that it has been repeated and is complete. This system was devised by C. W. Hoisington, trainmaster, formerly despatcher for the Rock Island Railway at Chicago. While the method takes a trifle more time than some other systems it has been found to be very safe and satisfactory, as demonstrated by the fact that the road has never had an accident caused by misunderstanding of orders. In addition to

BUCKEYE LAKE, SHOWING BOAT LANDING

the use of standard steam colored signals for day and colored lamps for night, all cars are provided with "fugees" for use during foggy weather or on dark nights. These are manufactured by the Consolidated Fireworks Company, of Chicago, and they burn for 15 minutes after being dropped from the car. A red light is a signal to stop, and a green light a warning that the car is not making standard time.

THE TERRITORY

The present road draws from a population of about 250,000, including Columbus, and the extension to Zanesville will bring about 50,000 more into the company's territory. Newark, the operating headquarters of the road, is the seat of Licking County, one of the banner agricultural counties of Ohio. The city has a population of about 22,000, and within the last few years has made remarkable strides as a manufacturing city as well as a distributing center. It has five prosperous banks, a stove works that employes 500 men, glass plants giving work to

PICNIC GROUND AT BUCKEYE LAKE PARK

several hundred more, and is the home of the Jewett Car Company. Although the Pennsylvania and the Baltimore & Ohio operate between Columbus and Newark, the frequent service, high speed, comfortable cars and low rates of the electric line have taken from the steam road the majority of the business, including the better class of traveling men, who, in other localities, seldom take an electric car when they can catch a train. Zanesville has 35,000 inhabitants, and is a prosperous manufacturing city. The electric road will undoubtedly capture the great majority of the passenger business between Zanesville, Newark and Columbus, since only a branch steam line, with infrequent service, connects them. Granville is a college town of 1500. There is no direct steam route between Granville and Columbus, and the electric road furnishes the most desirable service. The farming country along the national pike in this district is noted as being among the best in the State. It was settled very early, and the people are prosperous as a rule. The towns along this route are:

Reynoldsburg, 400.
Wagram, 150.
Etna, 350.
Kirkersville, 300.
Hebron, 650.

The steam lines to Columbus do not come within 3 miles to 5 miles of these towns, and the electric road carries practically all the business, both passenger and freight. The rates of fare on the present line are shown in the accompanying table:

Stations	A. M.		Fare	Round Trip	Miles from Columbus
Lv. Columbus	6.00	Thereafter	---	---	---
Capital University	6.25	every hour	5c	10c	4.2
Doneys	6.30	until 10 p.m.	10c	20c	6.9
					11.1
Reynoldsburg	6.40	Running	15c	25c	
Wagram	6.50	time between	20c	35c	14.9
Etna	7.00	Columbus	25c	45c	17.3
Kirkersville	7.15	and	35c	60c	21.9
*Hebron	7.30	Newark	45c	75c	27.6
Ar. Newark	7.50	1.50	60c	$1.00	36.9

In Newark the company gives fifteen-minute service over 8 miles of road, connecting all parts of the city. The local cars,

HOTEL AT BUCKEYE LAKE

together with the Newark & Granville car, connect with the interurbans in front of the company's waiting room facing the public square. City tickets are sold at the rate of six for 25 cents. These are also good on the Granville line, the fare being 15 cents one way or 25 cents round-trip. In the city of Columbus the company handles the local traffic, as it is obliged to do so, and sells seven tickets for 25 cents, but the Central Market Street Railway, which operates over the same tracks, takes up the greater portion of this business, since it sells eight tickets for 25 cents; of course, the tickets are not interchangeable. The company sells round-trip tickets only at ticket offices, which are maintained in all towns. The interurban cars have no fare registers, and duplex cash fare tickets are used. In connection with all the Columbus interurbans the company sells mileage books, which are transferable and afford a rate of 1¼ cents per mile.

PLEASURE RESORTS

As a route for pleasure and summer traffic few roads enjoy the advantages of the Columbus, Buckeye Lake & Newark. Picturesque scenery and quaint villages mark the line, and there are a large number of pleasure resorts worthy of more than passing mention.

The road affords the only direct route between Columbus

and Buckeye Lake and the shortest route between Newark, Zanesville and this resort, which has long been one of the most popular pleasure points in Ohio. The lake is owned by the State, and it is set aside as a public park. It is a beautiful artificial body of water, 7 miles long, with an average width of 2 miles. It is stocked with fish of many kinds, and in the fall it is famous as a duck hunting ground, and a number of sporting clubs have houses on its shores. There are camp grounds and cottages thickly distributed around the entire lake and on the numerous islands. The company has taken advantage of these opportunities and has spent thousands of dollars in improving the resort. It has purchased 95 acres of land adjoining its terminal, and has erected a summer hotel, a large dancing pavilion, dining hall, bath house, boat house, laughing gallery, figure-eight roller coaster and merry-go-round. Two 40-ft. naptha launches make regular trips around the lake, and rowboats, bathing suits and fishing tackle are supplied. No admission is charged to the grounds. The resort is operated on a percentage basis by W. C. Wells. No liquors are sold or allowed on the ground, and every effort is made to exclude undesirable people.

GOV. NASH AND STAFF AT STATE ENCAMPMENT ON NEWARK & GRANVILLE LINE

The company is further planning to establish summer towns along the lake. Three miles of lake front has been leased, and it is the intention to lay out streets and give ten-year leases to parties who will erect cottages. It is the plan to divide the tract into communities for Columbus, Newark and Zanesville people; no lease to be made without the consent of the cottagers in the respective communities. In this way each city will be represented by a summer town of its own.

Idlewilde Park, located at the junction of the main line and the Newark & Granville line, 3 miles from Newark, has recently been acquired under a five-year lease. This is second only to Buckeye Lake as a pleasure resort for this district. Formerly the Licking County Fair Grounds, it has been greatly improved during the last few months. There is an artificial lake of 50 acres, and overlooking this a large casino and summer theater has been erected. This is provided with 1500 opera chairs, a stage, 56 ft. x 56 ft., and is decorated after the Japanese fashion. The manager is a member of the Association of Vaudeville Managers, and is in the Burke circuit of attractions, which includes parks at Boston, Cincinnati, Philadelphia, Erie, Toledo and other places. High-class vaudeville will be given for forty weeks each year. One of the chief attractions of the park is a huge artificial mound, three-quarters of a mile in circumferance, erected by the mound builders. Inside the mound a half-mile trotting track and a baseball diamond have been constructed, together with a large grandstand. The park supports a baseball team, and three professional games a week are scheduled. A summer trotting meet is also held. A hotel, bowl-alley, shooting gallery, boating and numerous other features are among the attractions. This is also a temperance resort.

BRIGADE REVIEW ON THE PARADE GROUND

GENERAL VIEW OF STATE ENCAMPMENT

Still another source of great revenue for this road is the Ohio State Encampment Grounds, constituting one of the most famous prehistoric works to be found in America. It consists of a circular fort, containing 20 acres, connected with another mound, octagonal in form, having eight openings with a protecting wall in front and containing 80 acres. The tract of 150 acres is owned by the State, and the entire State militia, comprising infantry, artillery and cavalry, make their annual encampment here from May until October. The presence of hundreds of troops with drills, parades, martial music

HOLIDAY SCENE DURING STATE ENCAMPMENT ON NEWARK & GRANVILLE LINE

and receptions attract thousands of visitors. Several views of the State Encampment Grounds, the brigade review and Governor Nash's headquarters are presented, together with a view

PREHISTORIC MOUNDS

showing the dense throngs that are attracted by this display. The encampment is reached by the Newark city cars and the Newark & Granville line, which run within a short distance of Idlewilde Park. Typical views of Buckeye Lake, showing some of the characteristics of this beautiful resort, are also presented. This park is particularly adapted for picnics and family gatherings, and its location is exceptionally favorable for attracting this class of visitors. During the season the lines leading to the parks are very well patronized.

EXPRESS

The package express business is now being developed by this company, and the cars for this service make two round-trips each day. Goods are delivered from the interurban union station in Columbus and from the company's freight station at Newark. The standard steam classification is used, and the table in use is shown herewith. The rates average about 15 per cent less than express charges:

RATE-BASING SHEET
To Be Used In Connection With Classification.

Stations From / To	Columbus	Capital University	Crumms	Reynoldsburg	Wagram	Etna	Parkinsons	Kirkersville	Luray	Hebron	Buckeye Lake	Tailor's Bridge	Armstrongs	Newark
Columbus	0	1	1	1	1	1	1	2	2	2	2	2	2	2
*Capital University	1	0	1	1	1	1	1	2	2	2	2	2	2	2
*Crumms	1	1	0	1	1	1	1	2	2	2	2	2	2	2
*Reynoldsburg	1	1	1	0	1	1	1	1	2	2	2	2	2	2
*Wagram	1	1	1	1	0	1	1	1	1	2	2	2	2	2
*Etna	1	1	1	1	1	0	1	1	1	1	2	2	2	2
*Parkinsons	1	1	1	1	1	1	0	1	1	1	1	2	2	2
*Kirkersville	2	2	2	2	2	2	1	0	1	1	1	1	1	1
*Luray	2	2	2	2	2	2	1	1	0	1	1	1	1	1
Hebron	2	2	2	2	2	2	1	1	1	0	1	1	1	1
*Buckeye Lake	2	2	2	2	2	2	1	1	1	1	0	1	1	1
*Taylor's Bridge	2	2	2	2	2	2	1	1	1	1	1	0	1	1
*Armstrongs	2	2	2	2	2	2	1	1	1	1	1	1	0	1
Newark	2	2	2	2	2	2	1	1	1	1	1	1	1	0

*Prepaid

Rate Basis	Classes—Rates in Cents Per 100 Lbs.					
	1st	2d	3d	4th	5th	6th
1	10	9½	9	8½	8	7
2	12½	12	11½	11	10½	10

ORGANIZATION

The Columbus, Buckeye Lake & Newark Traction Company has an authorized capital stock of $1,500,000, with $1,000,000 issued. The funded debt is $1,500,000, of which $1,125,000 was issued to build the original 40 miles of road. The balance sheet, dated Dec. 31, 1902, indicated that the investment was $2,634,927. No financial statement has yet been issued, for the reason that the road was opened for business last spring, but under

SCENE IN IDLEWILD PARK

conditions which gave no criterion of the earning value of the property. The road was operated for several months with direct current at a three-hour headway, which was afterward shortened to a two-hour headway, but the system practically did not get into full operation until late last fall. Another feature which has militated against a good showing from an operating standpoint is the fact that a great deal of little work had to be done to get the road into first-class condition; all of which tended to increase the operating cost.

The officers are: S. Reed Anthony, president; Arthur E. Appleyard, vice-president; Frank W. Merrick, secretary; Chauncy Eldridge, treasurer; J. R. Harrigan, general manager, and A. M. Frazee, superintendent of motive power. The entire work of construction was in charge of the Great Northern Construction Company, of Boston, of which A. E. Appleyard is president, and C. A. Alderman, chief engineer.

CAR ATTENDANCE IN THE SOUTH

The discussion of the "Jim Crow" laws in Southern States as applied to street railway companies has brought out some interesting information about operating practice in that section which illustrates the difficulties under which some of the companies labor. In one city where the negro population comprises about one-half the total population, the street railway company estimates that only 25 per cent of the patronage comes from the blacks, and most of this traffic is confined to an hour in the morning and an hour in the evening when they are going to work and returning to their homes. At these hours the whites do not ride at all if they can help it, so that the entire service is at the disposal of the colored element. This is the result of a tacit agreement, and its recognition by both whites and blacks has prevented any violent conflict. The company has done much toward removing any cause for complaint by taking extra precautions to have its cars in first-class condition at all times. At the end of every trip the cars are run into the car house and cleansed thoroughly. They are washed down, inside and outside, and compressed air is used for clearing all crevices and corners where dust and dirt might accumulate. After the runs devoted to negro traffic disinfectants are used and special precautions are taken. The cars are painted frequently, so that they present a very attractive appearance at all times.

These precautions make it necessary for the company to spend considerable money in the course of a year, and keep more cars on hand than might be necessary otherwise, but it has prevented any serious trouble over the race question, and the entire community is satisfied. The wisdom of this policy is therefore shown in the results attained.

THE MISSOURI RIVER POWER STATION OF THE METROPOLITAN STREET RAILWAY COMPANY, OF KANSAS CITY, MO.

One of the largest electric railway power stations at present under construction in the United States, and probably the largest outside of New York city, is that being built by the Metropolitan Street Railway Company at Kansas City, Mo., under the supervision of Ford, Bacon & Davis. This station is known as the Missouri River power house of that company. On account of its size and also because of the proposed use of steam turbines, its design presents many features which make it of interest. As far as the mere matter of size goes, several of the mammoth stations in New York city equal or exceed this, but the introduction of steam turbines involves new problems in design, which have only recently been grappled with. Next after the Fisk Street station of the Commonwealth Electric Company, of Chicago, which was the first station to be designed for the use of 5000-kw steam turbine units, this Kansas City power house is the farthest along in design and construction of any of the large new generating stations in the country in which the use of Curtis steam turbines is contemplated.

FIG. 1.—VIEW OF POWER STATION SITE BEFORE WORK WAS BEGUN

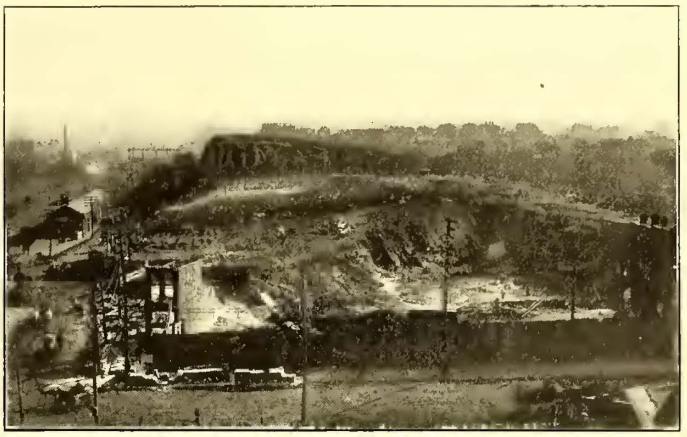


FIG. 2.—POWER-HOUSE SITE ON OCT. 11, 1902

FIG. 3.—POWER-HOUSE SITE ON NOV. 15, 1902

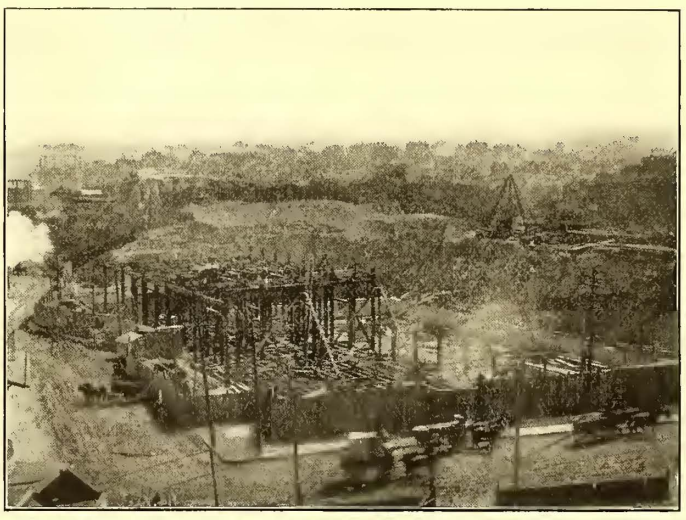


FIG. 4. POWER-HOUSE STRUCTURE ON MARCH 25, 1903

The station is laid out for an ultimate nominal capacity of 40,500 kw. Owing to the fact that three reciprocating-engine units were already ordered at the time the design of this station was begun, and because of the necessity of obtaining power from this station before the steam turbine makers could insure delivery, about 10,000-kw capacity of this station will be in the form of engine-driven units. The balance of the capacity, it is expected, will be in the shape of 5000-kw turbines. It might be noted incidentally that the engine room space required by the three 3500-kw engine units to be first installed is practically the same as the space that will be required by the six 5000-kw turbine units.

The power station has been laid out on broad gage lines, and will provide for the needs of the company both for railway and electric lighting service for many years to come, unless the street railway and electric light development in Kansas City is out of proportion to any street railway growth which has been recorded. There has been no temporizing in the design of this plant. It is laid out to give the company all the advantages to be derived from electric railway power generation on the largest scale and with the most economical apparatus known to modern engineers.

The few facts just stated by way of introduction will serve to give a general idea of the magnitude and importance of the work now under way at Kansas City, and the several features of this undertaking will now be taken up one by one.

THE POWER STATION IN KANSAS CITY

Before taking up the actual features in the construction of the Missouri River power house it is in order to look briefly at the situation as regards the Metropolitan Street Railway Company's power. On account of the great number of heavy grades cable lines have been retained in Kansas City much longer than would have been otherwise the case. At the time Ford, Bacon & Davis were called as consulting engineers for this property the Metropolitan Street Railway Company was operating about 33 miles of cable road and about 149 miles of electric. The cable lines, of course, cover many of the routes of heaviest

traffic. Comprehensive plans were made by which most of these cable lines can be abandoned and electric traction substituted for them by slight changes in routes, so that grades in excess of 8 per cent will be avoided. All the details have not been worked out for the abandonment of some of the cable lines, but it has been decided to operate practically the entire system by electricity. This, in itself, will call for a considerable increase in the amount of power. Besides this the growth

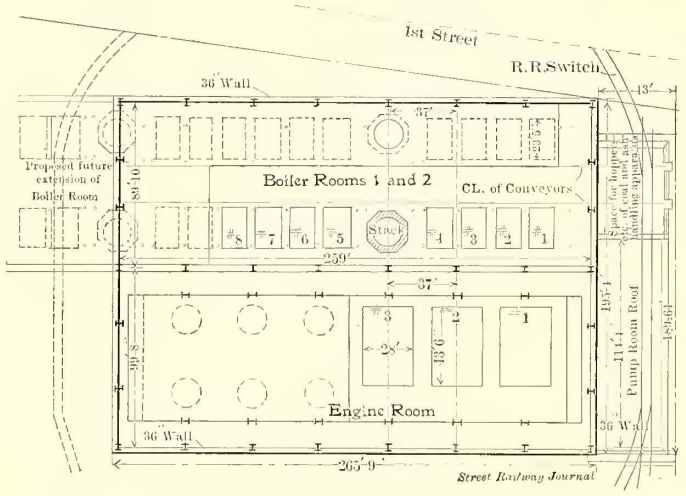


FIG. 5.—PLAN OF PROPERTY AND POWER STATION

of business has necessitated immediate action to relieve the present power house of an overload. About 245 cable and electric cars are now operated on regular schedule plus 153 trippers at rush hours. It will be remembered, from previous articles in the STREET RAILWAY JOURNAL, that the Metropolitan Street Railway Company has a large direct-current power station situated on Central Avenue, just west of the Kaw River, in Kansas City, Kan. This station is about 2 miles west of the center of load, and is a station which has had a national reputation for economical power production. It is, however, fully loaded, and various temporary expedients have been resorted to to aid in carrying the load, including purchase of power from the Kansas City Electric Light Company, an allied corporation.

The new Missouri River power house is to be an alternating-current station of sufficient capacity for operating the entire system, and further for supplying power to the Kansas City Electric Light Company.

A number of the cable power houses will be turned into sub-stations, though at the present writing the location of all the sub-stations has not been determined. The Missouri River power house is a short distance north of the business part of the city, is about 800 ft. from the harbor line of the Missouri River, and situated so as to be served by several lines of railroad and obtain condensing water from the river. Being able to obtain coal supply from several roads and of having good terminal and storage facilities is of first importance in connection with power plants of such large capacities, where the ultimate coal consumption will reach into thousands of tons. Although Kansas City has a great amount of water front, as it is situated at the intersection of the Missouri River and Kaw River, it was not entirely an easy matter to secure a location for a large power plant, which would have a sufficient number of railroad approaches to permit of the delivery of enough coal each day to supply the needs of the station, and also allow the station to be run with condensing water from the river, as there is great variation in the height of the latter at different seasons.

When the Missouri River power house is completed it will be of sufficient capacity to allow all the small, wasteful, temporary electric railway and light stations to be shut down and the Central Avenue direct-current station can be used simply to supply the western portion of the territory, the part of the territory it is geographically best located to supply.

PREPARATION OF THE SITE

The land selected adjoined and formed part of a bluff about 100 ft. high. A view, Fig. 1, taken before work had begun is here shown, but it does not give as good an idea of the amount of excavation required as some of the subsequent views, Figs. 2, 3 and 4, taken from the same position. The method of excavating, as seen in these views, was practically that used in placer mining—streams of water, under high pressure, being thrown against the side of the bluff until it was gradually eaten away and the mud flushed into a sewer which passes directly under the property. In this way much of the excavation of the bluff was done by washing it into the sewer, and so ultimately into the Missouri River, which is about 800 ft. distant. A temporary pumping plant was also used at

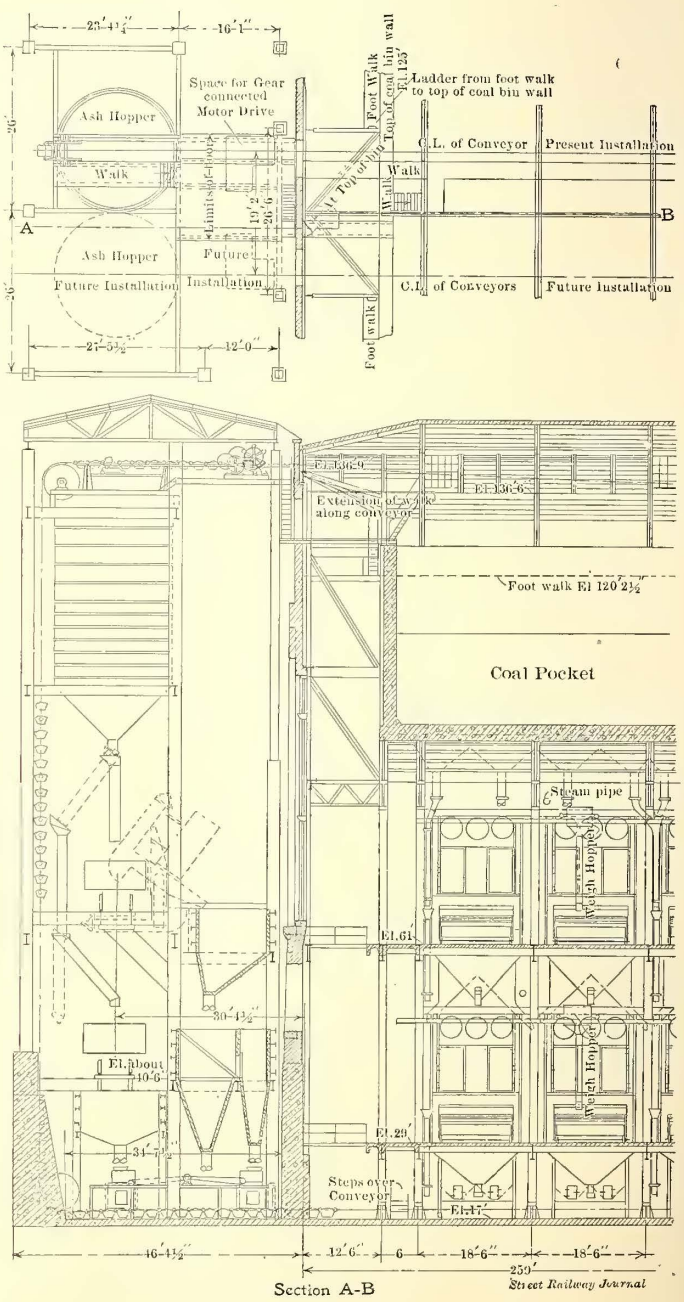


FIG. 6.—SECTION AND PLAN OF END OF BOILER-ROOM, SHOWING CONVEYOR SYSTEM

the site, discharging into a pipe line running to the river, and part of the excavation was done by teams. Comparing the view taken of the power house site during the latter part of the work with the one taken before construction began, it is seen there was an immense amount of excavation, amounting in all

to about 175,000 cu. yds. In the view taken April 25, 1903, Fig. 8, the tracks of the Chicago & Alton and other roads are seen at the left, while at the right at the southern edge of the property are the tracks of several other steam roads. As seen by the accompanying plan of the power house and property,

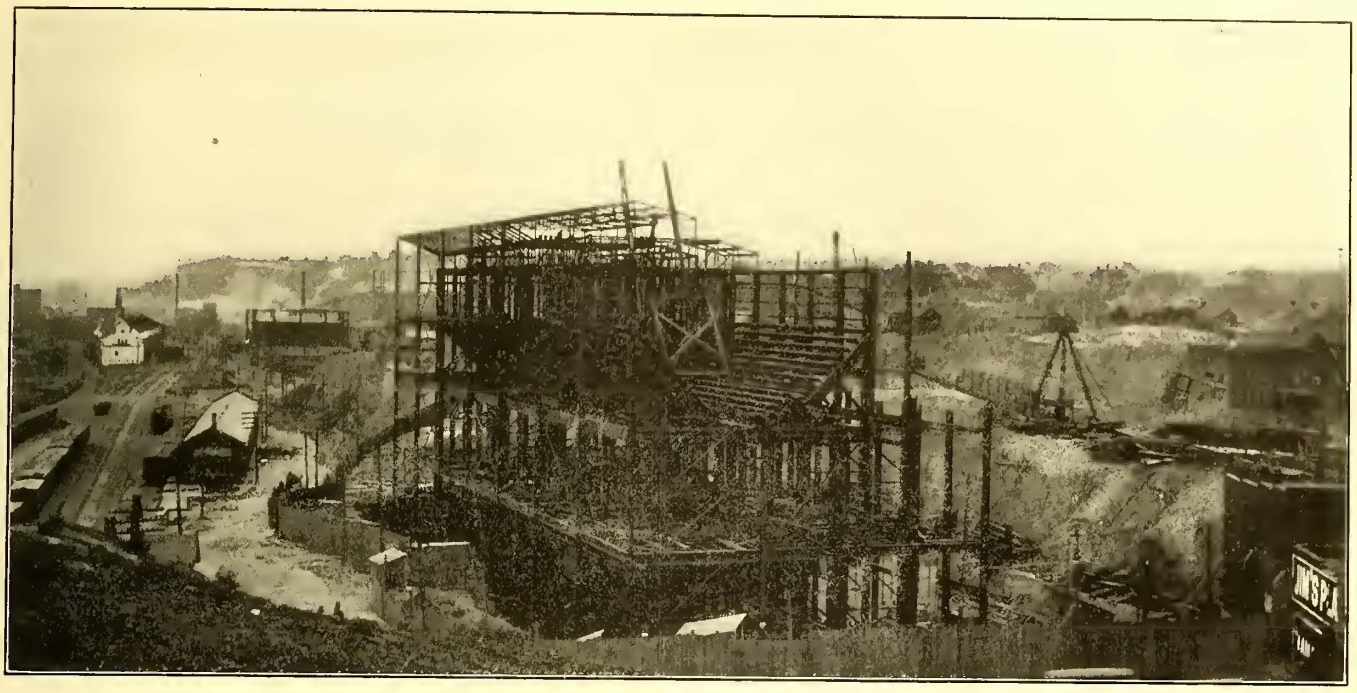


FIG. 8.—THE STEEL STRUCTURE ON APRIL 25, 1903

Fig. 5, the company has over two city blocks. The frontage on First Street is 374 ft. The property widens to 544 ft. on Second Street. The company owns the entire plat of land except one lot located in the southwest corner.

POWER-HOUSE ARRANGEMENT

Referring again to the plan, Fig. 5, which gives a general idea of the lay of the property and the ground plan of the power house, it is seen that the present building occupies a space 266 ft. x 195 ft. The boiler room is in the north part of the power house, and the engine room in the south part. The engine room, or turbine room, as it might more properly be called, is 99 ft. 8 ins., and the boiler room is 89 ft. 10 ins., inside measurement. The boiler room is to have two boiler floors, above which is the coal storage. At present the engine units numbered 1, 2 and 3 will be put in, and the boilers numbered 1 to 8 inclusive on one floor of the boiler room, and on the second floor eight more boilers occupying the same relative position, so that there will be sixteen boilers in all. Provision is made for two stacks in this part of the power house, although one only will be erected at present. From the dotted lines it can be seen that the idea is ultimately to extend the boiler house through to the Grand Avenue boundary, thus giving boiler capacity that may be needed with large turbine units. Provision for the future does not end there, however, because a good-sized boiler house can be and is planned to be erected, when required, south of the engine room, between the present house and Second Street.

In designing this steam turbine power house the engineers have had to meet the perplexing problem, which has only recently come up, of designing a steam turbine power house which shall be symmetrical, so as to permit of extensions according to a predetermined plan, and at the same time secure enough boiler capacity for each turbine unit without wasting station space and without undue length of piping or other objectionable arrangements of boilers. A symmetrical power house can obviously only be obtained when boilers to supply a given unit occupy the same length in any section of the power house as the steam consuming unit. As the steam consuming units are gradually increased in size and their outputs per square foot of floor space is increased, engineers have been compelled to resort to various expedients to get enough boiler capacity for these large units within a reasonable piping distance and into a reasonable cubic space. Now the steam turbine has further enormously increased the difference in the relative space occupied by the boilers and generating units. A 5000-kw steam turbine takes a formidable array of boilers to supply it. In the first large station designed for the use of 5000-kw steam turbines, namely, that of the Commonwealth Electric Company in Chicago, land was plenty and the boilers were placed all upon one floor and in rows at right angles to the direction of growth of the power house. In this case each turbine unit has what might be considered its own special battery of boilers. In the Kansas City plant under discussion sufficient boiler capacity has been obtained by placing the boilers in two tiers, one above the other, and placing two rows on each floor. The Chicago arrangement has the advantage of requiring only one boiler room floor, while the Kansas City arrangement saves ground space and makes it possible to serve the entire row of boilers on one floor with the same

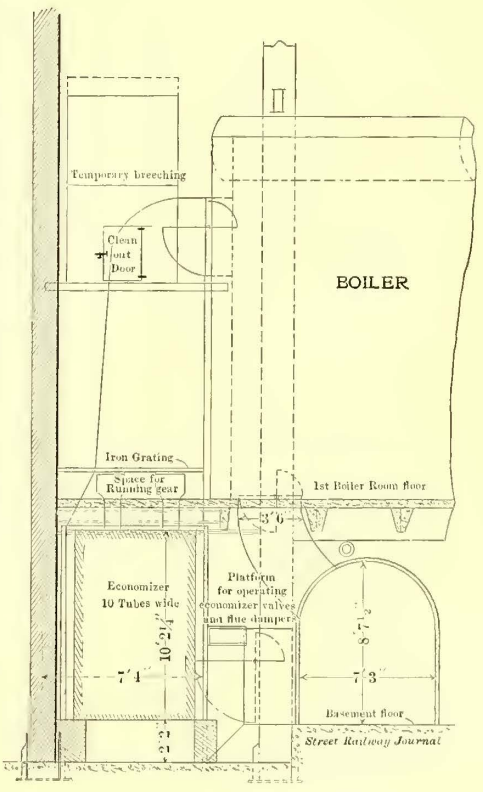


FIG. 7.—PROPOSED ARRANGEMENT OF ECONOMIZERS

coal conveyors, and somewhat simplifies the coal handling.

The present stack is not being located exactly in the middle of the building, the reason for which will be obvious when it is seen that when the boiler room is extended another pair of stacks will be placed in what is now the west wall of the power station.

There are to be sixteen Babcock & Wilcox water-tube boilers of a rated capacity of 578 hp each. The general plan, Fig. 5, showing the boiler equipment which will be first installed, is published herewith, from which all dimensions can be obtained. Provisions have been made for economizers for each boiler, although these economizers will not be put in for the present. The space in the middle between the two sets of boilers and near the stack will be used for pumps, heaters and all main boiler feed connections. A freight elevator for coal, ashes and machinery will be located in the middle of the east end of the building, and nearby will be a passenger elevator and

well as the foundations for all the auxiliary machinery, are solid concrete mixed in the proportions of one part Portland cement, three parts sand and six parts broken stone. Practically all of the rock for the concrete was taken from and crushed on the site.

Both enclosing and division walls of the building are brick, laid in cement mortar. These walls are approximately 100 ft. high. The window sashes and door frames are of iron. The window frames are made up from T, L and Z-bars, which support the galvanized iron casings. The windows being of such great height and width require unusual methods of construction. These windows will have the horticultural type of sash openers. All the floors will be of the concrete slab construction, laid between I-beams with expanded metal in the concrete. The stairs will be of iron.

The high-tension oil switches and bus-bars will be located in compartments on the mezzanine and engine room floors next

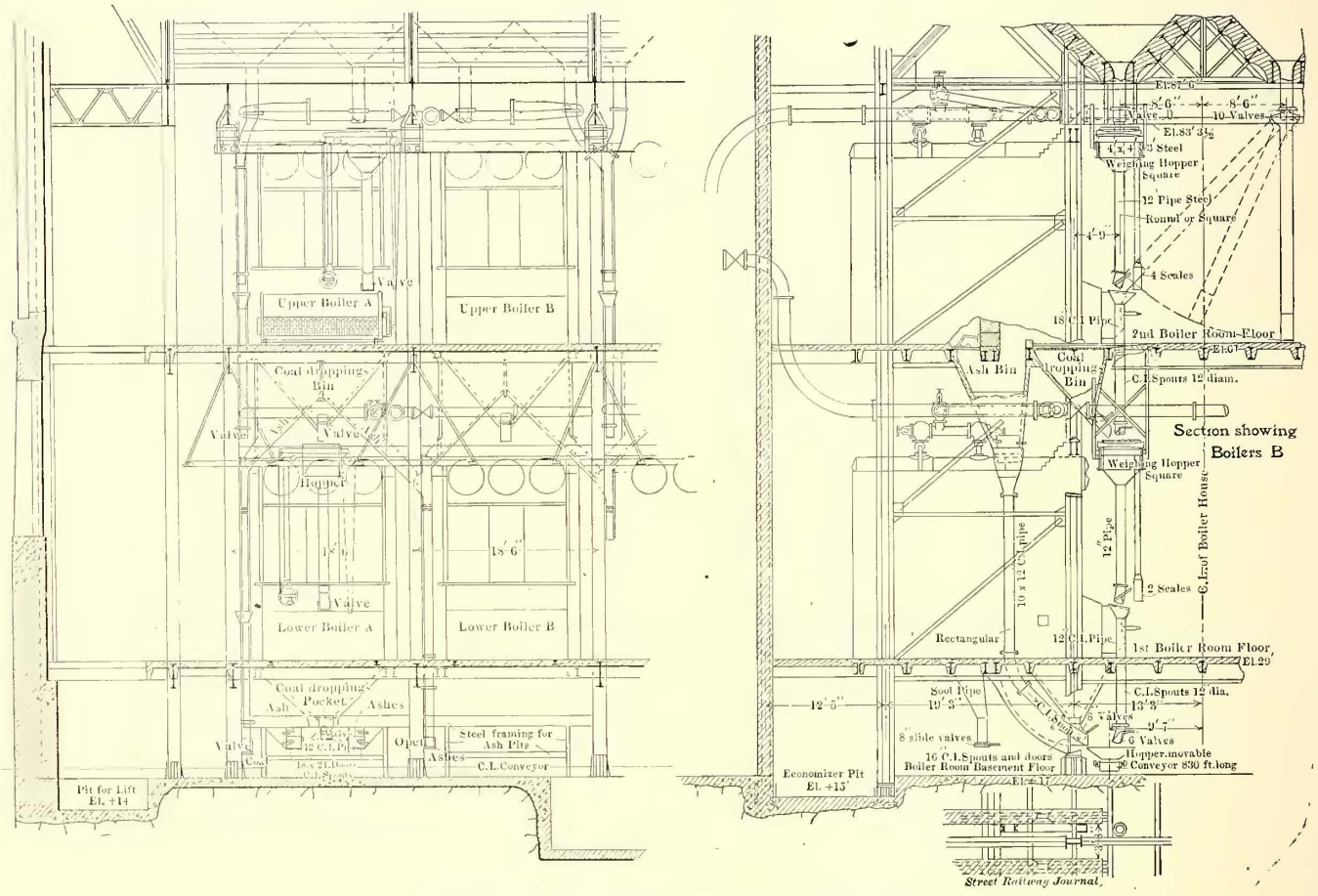


FIG. 9.—COAL AND ASH HOPPERS ON BOILERS

stairs the full height of the building, for access to conveying machinery, coal bunkers and the various floors. The engineers' rooms are also in the east end of the engine room, as the east end is the permanent end, the west end being arranged to permit of extension of the station in that direction. On the first floor of the boiler room will be the firemen's lavatory.

The location of the feed pumps is to be in the basement between the stacks. The ash conveyors run through the basement, taking the discharge of the ash hoppers as indicated. When fuel economizers are installed they will be placed for the boilers on the first floor in the basement, and for the boilers on the second floor under the coal pockets. The accompanying diagram, Fig. 7, which gives a longitudinal section through the proposed economizers and flue, shows the arrangement for the boilers on the first floor. The building has, as will be seen, a massive steel frame resting on concrete foundations, which were carried to solid rock, about 25 ft. below the engine room floor. The engine and generator foundations, as

to the division wall, and above on a gallery, which also supports the steam headers, will be located the controlling and operating boards. Of course, full precautions will be taken to keep any water drip away from these switch compartments.

The boiler house has three floors with the basement, with a mezzanine floor between the first and second floors. The main entrance to the building for the operating forces is from Locust Street to this mezzanine floor, while the public entrance will be on the engine room floor level on Grand Avenue.

BOILER HOUSE

As said before, the present equipment is to be sixteen Babcock & Wilcox boilers of 578 rated horse-power each. They will be equipped with the Green traveling link grates. The present boiler house will hold twenty such boilers on each floor, or forty boilers altogether. The proposed extension of the boiler house will accommodate sixteen more boilers of the same size. The superheating coils which will be used in these boilers are to be installed for only the amount of superheating

considered permissible with the reciprocating engines which are to be installed at the start, or, in other words, for about 100 degs. F. to 125 degs. F. of superheating. As more superheating than this will be permissible with steam turbines, because there are no pistons or valves to lubricate, the superheating coils are so designed that they can be enlarged when the steam turbines are installed. Two open feed-heaters of the Warren Webster type, located at the base of the stack on the first boiler room floor, take the exhaust from the auxiliary engines, including feed pumps and condenser air pumps. The feed pumps will be Blake, two in number, compound duplex with outside-packed plungers and pot valves. Each of these pumps will be good for feeding 10,000-hp of boilers. All the other pumps, including the sump tank and oil pumps, are of Blake manufacture also. The hot-well and sump pit are in the basement, together with a blow-off tank and all the drainage features of the station. The coal pockets are in two divisions, one on each side of the stack. The ventilation of the boiler house is also provided for between and on the sides of the coal pockets. The stacks, one of which will be built at present, are to be 265 ft. high by 14 ft. inside diameter. For a height of 90 ft., or about the height of the power house building, they will be of hard-burned brick lined with firebrick. Above that there will be hollow, radially moulded brick of the Custodis make. The stacks are designed to stand 50 lbs. per square foot of wind pressure.

COAL AND ASHES

Storage is provided in two coal pockets above the boilers for about 10,000 tons of coal. The entire boiler house is served at present by one endless Mead conveyor, which deposits coal in the pockets above the boilers and takes the ashes from the basement. The coal cars from the steam railroads enter the east end of the building, as seen in the

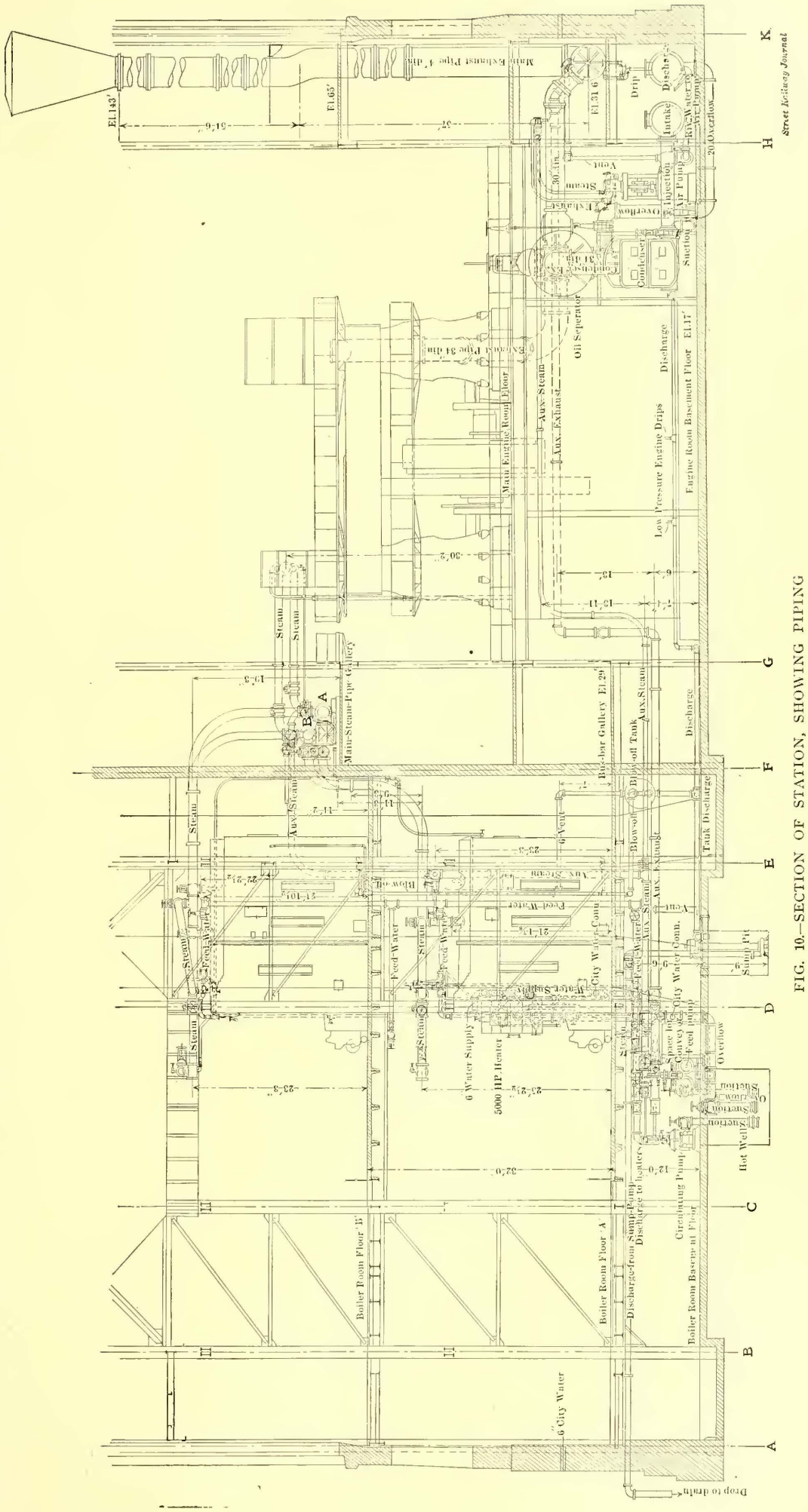


FIG. 10.—SECTION OF STATION, SHOWING PIPING

plans, Fig. 6. There are two of these coal tracks, one directly above the other.

Provision is made for the use of bottom-dump cars, but in case these are not available a car dumper or unloading machine can be installed. This is indicated by the dotted lines on the plan Fig. 6, which show the position when dumping the coal. Coal when dumped falls into hoppers which feed the coal crushers, that in turn discharge into the coal conveyor, which takes it to the pockets above the boilers. These same cars, or cars on the same track, can be loaded with ashes from the large ash pocket directly over the switch tracks, and the pipes or chutes from the

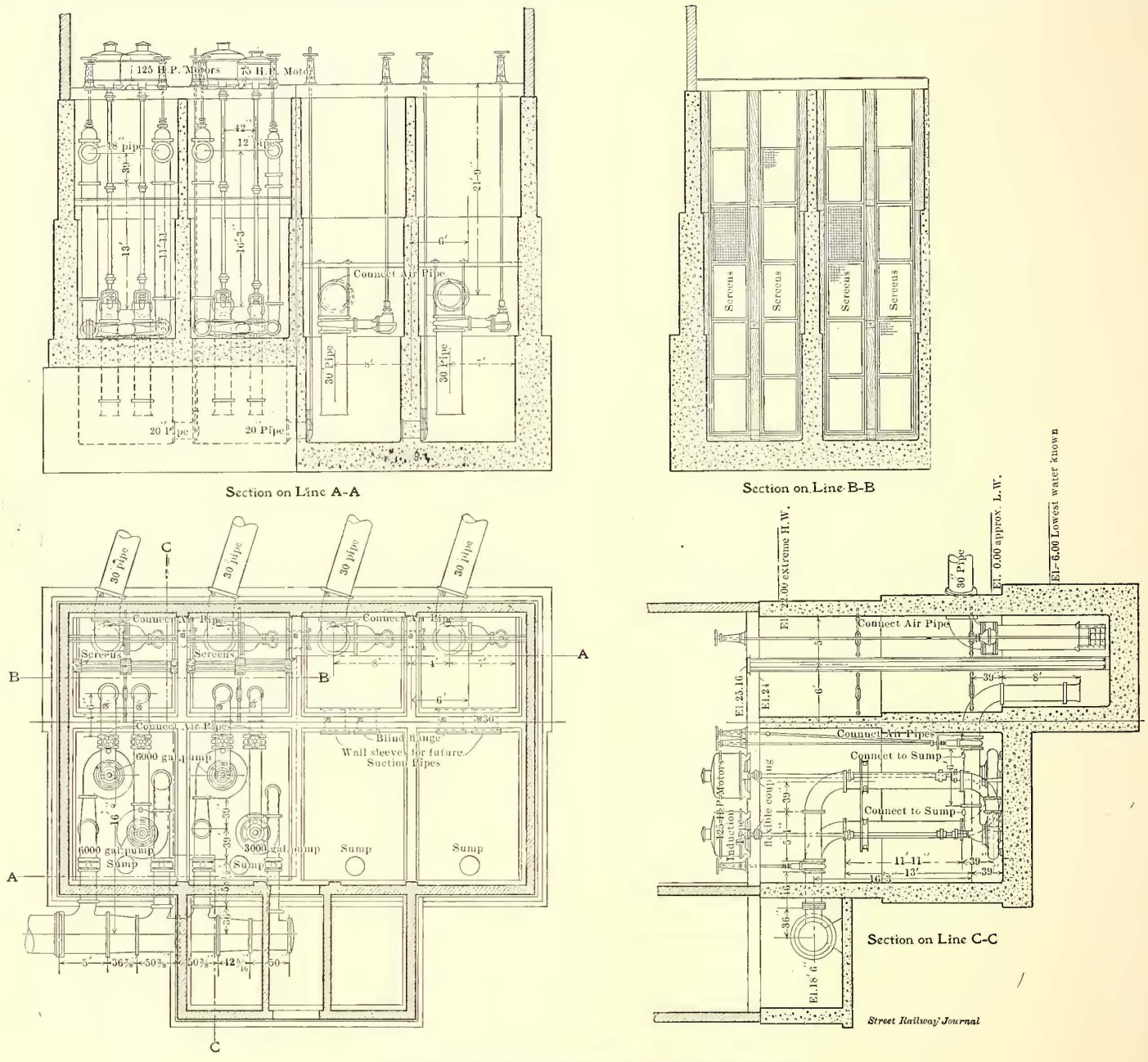


FIG. 11.—GENERAL PLAN OF POWER STATION

ash pocket are so arranged that the cars on either the upper or lower decks can be made to receive the ashes. When conveying ashes the conveyor dumps automatically above the ash pocket. The relative size and position of the coal pockets is best shown by a photograph of the steel structure, Fig. 8, taken April 25, 1903. The automatic movable weighing hoppers and pipes for discharging coal from the coal pockets to the hoppers of the automatic stokers are well shown in the accompanying detailed drawing, Fig. 9. The coal when descending from the coal pockets to the boilers first passes directly to weighing hoppers for the upper boilers and through long spouts to the lower weighing hoppers, which in turn can be used to return coal to the conveyor in case of fire in bunkers. On the opposite side of the boiler room coal is delivered into spouts, which can be swung either to feed the upper tier of boilers or to discharge into a pipe which will take the coal through the lower weighing hopper to another tier of boilers. One feature in this plant which has not heretofore been common is the hopper for taking the fine coal droppings from the traveling link grates, which droppings are usually shoveled up by hand. A hopper for these coal droppings is placed under the front end of the link grates, and this hopper can be made to discharge into the coal conveyor in the case of the lower tier of boilers, or in the case of the upper tier of boilers the hopper can be discharged either into the lower tier or into the conveyor. The ash bins under each boiler discharge into the coal conveyor at such times as it is desired to use it as an ash conveyor. The coal conveyor is to be driven by a variable speed direct-current motor. An independent direct-current motor will drive the coal crushers. A take-up device to prevent slack in the conveyor is located in the west end of the boiler house in the basement. The coal crushers are located under the hoppers into which the coal cars discharge when the coal first enters the building.

ENGINE AND TURBINE ROOM

The engine and turbine room is designed to take six 5000-kw steam turbine units and three 3500-kw engine-driven units. The three engines will be of the vertical Reynolds-Corliss type,

made by the Allis-Chalmers Company. They will be compound condensing, 46-in. and 94-in. x 60-in. stroke, running 75 r. p. m., and rated at 4600 hp. They will have Corliss valves, and operate under 100 degs. superheat to 125 degs. superheat. The flywheels are 28 ft. diameter, and weigh 320,000 lbs. Each engine will have on its shaft a revolving field, 25-cycle, 3500-kw, three-phase General Electric generator, and each engine will have a Wheeler surface condenser. The exciter plant will consist of two 150-kw motor-driven generators, together with a storage battery consisting of 78 cells, having a capacity of 60 kw, based

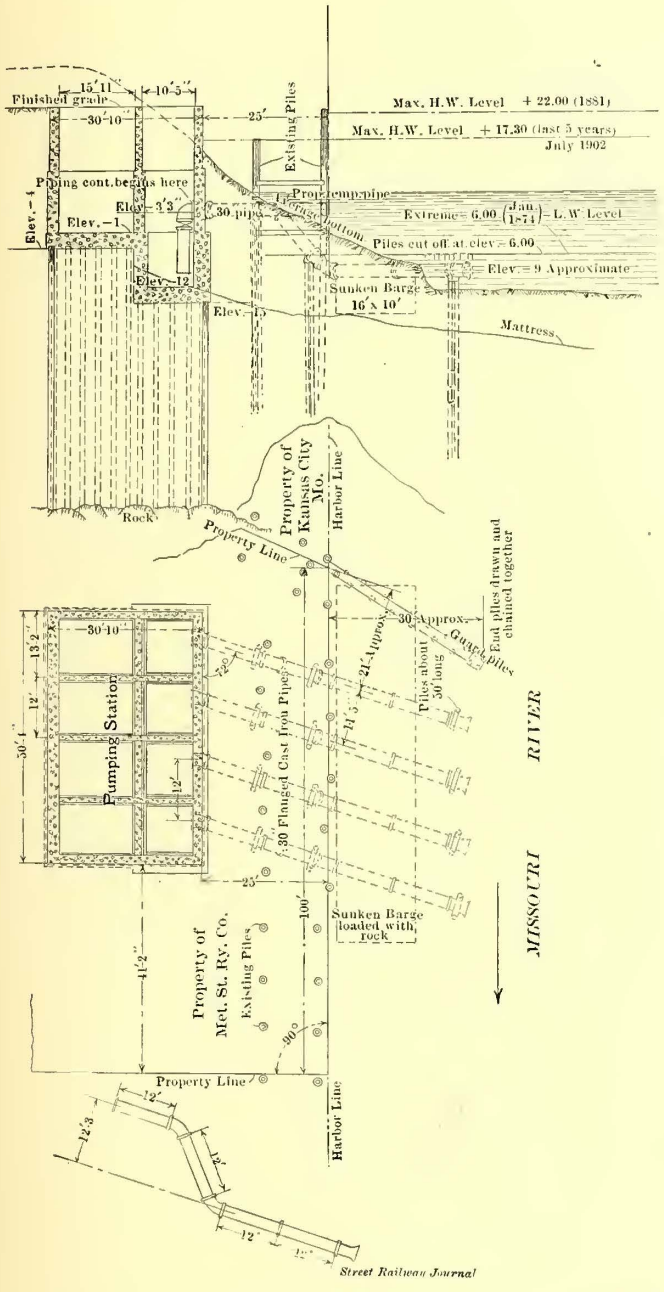


FIG. 12.—CIRCULATING WATER PLANT, SHOWING LOCATION

upon the hour discharge rate. The piping, as can be seen from the accompanying plans, Fig. 10, will be practically in duplicate, consisting of duplicate headers and separate pipes to each header from all boilers and engines.

CONDENSING PLANT

Each of the Wheeler surface condensers has 10,000 sq. ft. of cooling surface, and will be capable of condensing the steam from a 5000-hp engine when operating at 50 per cent overload. These surface condensers have copper tubes of 1½-in. diameter. Blake twin vertical air pumps, 14 ins. and 38 ins. x 21 ins., have been ordered. In each engine exhaust next to the condenser in the basement is to be a Cochrane 48-in. oil separator. A Blake 30-in. automatic relief valve, with hydraulic control, will be placed in each engine exhaust, to allow the engine exhaust to the atmosphere in case the condenser fails to operate. All engines will exhaust into one common main. This exhaust main will be of riveted steel.

The condensing water will discharge through a 48-in. cast-iron main into the large city sewer which passes under the company's property, this sewer saving the company the expense of a separate discharge pipe to the river. This discharge from the condenser to the sewer is sealed, to give the advantage of the negative head afforded by the fall to the sewer. The main in-take and discharge pipes connect to each condenser, and the amount of water to each condenser can be regulated by means of valves in these pipes. The air pump suctions can be all connected together, so that any pump can work on any condenser. The air pumps discharge into the hot-well in the boiler room basement.

The plant for furnishing the circulating water to the condensers, shown in Fig. 12, is an important feature in itself. The pump house shown in the accompanying plans is located at the harbor line of the Missouri River. Centrifugal pumps, driven by induction motors, force the water through a 48-in. cast-iron water main about 1000 ft. long from the pump house to the condensers. The variation in the height of the river, as shown by the plans, is 28 ft., and the concrete foundation walls of the pump house are built so as to leave a clearance of about 2 ft. above the highest water ever recorded. The suction pipes from the pump house point slightly down stream to avoid the danger of catching mud and drift-wood. They are located 3 ft. below extreme low-water level, and are supported on piles. These in-take pipes are 30 ins. in diameter. The lift to the power house with extreme low water is 27 ft., and therefore with extreme high water there will be practically no lift. The drawings make plain the arrangement of the pump house, centrifugal pumps and piping. In order to place the centrifugal pumps near the water level the vertical shaft type of pump and induction motor was decided upon. This type of pump, which is used extensively in California irrigation work, having proved to be the most efficient because of the possibility of placing the pumps practically at or below water level. The induction motors are of General Electric make, 440-volt three-phase. The centrifugal pumps will be furnished by the Morris Machine Works. Thrust bearings on both motors and pumps will be provided, and there will be a flexible coupling between the motor and the pump. Three of the pumps will be of a capacity of 6000 gals. per minute, driven by 125-hp motors. One pump will be of 3000 gals. capacity, driven by a 75-hp motor.

For the design and construction of this power house and the other important engineering work which Ford, Bacon & Davis have undertaken for the Metropolitan Street Railway, a large branch office of that firm has been established at Kansas City, with C. N. Black as engineer in charge. H. P. Quick, as steam engineer and chief draughtsman, has had the mechanical features of the design of this power house as his special work.

FREIGHT BUSINESS ON OHIO INTERURBANS

The Toledo, Bowling Green & Southern Traction Company is making preparations to enter the freight business on an extensive scale, following the example of the Toledo & Western Railway. Standard box freight cars will be purchased, and they will be hauled by electric locomotives. In Toledo the cars will be operated to the center of the city over the Toledo Belt & Terminal Railway by means of steam locomotives. The line is to be straightened and a large consolidated lighting and railway power house will be erected. To carry out these improvements the company will pass its dividends for the year. At present the company has a surplus of $150,000, which will also be used for improvements.

DENVER & NORTHWESTERN INTERURBAN ROAD FOR HAULING COAL

There are not many, in fact there are very few, street railway companies that can have their coal brought direct from the mine to the power house by cars operated over their own tracks and supplied from their power station. This unique and economical method is being carried out in Denver, Col., and it possesses several interesting features. Although a number of different corporations enter into the mining, transportation and use of the coal, they are all owned by the same financial interests, and may be considered as allied companies. The Leyden Coal Company owns the coal lands and mines and sells the coal, the Denver & Northwestern Railway Company owns the electric railway over which the coal is hauled, and the Denver Tramway Power Company owns and operates the power station where the coal is being used as fuel. This last-named corporation is very closely allied with the Denver City Tramway Company, the street railway operating company of Denver, to which it supplies all its power. As stated above, these companies are closely associated, but they are kept distinct as far as their functions and operating departments are concerned, for business reasons.

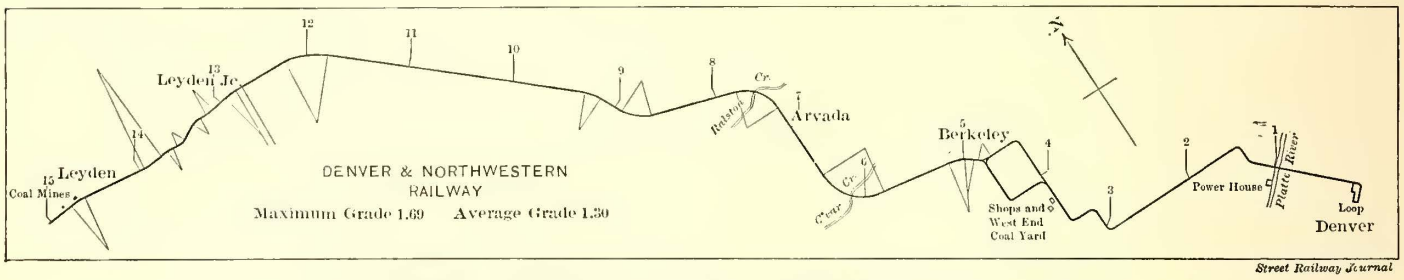


FIG. 1.—MAP OF SYSTEM OF DENVER & NORTHWESTERN RAILWAY

COAL MINES AND PLANT

The Leyden Coal Company owns about 1000 acres of coal land at, and in the vicinity of, what is now called the town of Leyden, located 15 miles northwest of Denver (see map, Fig. 1). The vein of coal is about 7 ft. to 14 ft. thick, and lies from 600 ft. to 1000 ft. below the surface. The coal is a high-grade bituminous lignite, and is the best coal for steaming purposes in the Northern Colorado coal fields. It can be mined with comparative ease, and can be transported easily, as the country in that vicinity and en route to Denver is rolling and the grades are low. The Rocky Mountains are just beyond to the west.

At present the company is mining coal from a 6-ft. 9-in. x 8-ft. shaft that is 705 ft. deep. An Ingersoll-Sergeant air compressor is used to operate the pneumatic coal cutters used. This shaft first began to produce coal on Jan. 20, 1903, and is now turning out from 30 tons to 50 tons a day. The capacity of the plant is 400 tons per day, but before it is brought up to this production the company will have in operation its main shaft, which is now being sunk a few hundred feet from the first one. The new shaft will be 8 ft. x 17 ft. in size, and will have a daily capacity, when developed, of 1500 tons to 2000 tons of coal. Plans are now being drawn for the power plant equipment. The boiler equipment will comprise six 66-in. x 18-ft. horizontal tubular boilers, and there will be installed two 20-in. x 42-in. direct-acting hoisting engines, feed-water heaters, shaking screens, etc. It is possible also that electric power from the city power house will be used eventually for operating chain cutters and punchers.

Fig. 2 shows the present temporary shaft house and the method of discharging coal from the hoist into two hopper cars at the same time. In Fig. 3 is illustrated a coal train, consisting of one motor car and four trail cars, all being of the hopper-dump type. Back of the train may be seen the operations that have been begun on the new main shaft. In the distance are indicated, in dim outlines, the foothills of the Rocky Mountains.

At present the Leyden Coal Company is hauling coal to a distributing yard a little over 3 miles from the heart of the city, at what is known as the West End car house, as shown in Fig. 1. There the dump cars are run onto the elevated track illustrated in Fig. 4, from which they are automatically dumped into receiving bins. The wagons used in the local distribution of coal are loaded from these bins. It is the company's plan to locate five of these distributing yards at convenient points about the city, so that any prospective customer may be quickly reached. The dump cars will be hauled to these yards at night over the tracks of the Denver City Tramway Company. The facilities at the West End yards are such that thirty carloads, or 450 tons of coal, can be hauled there in a day. The coal company pays the Denver & Northwestern a stipend per ton for all coal hauled over its line from the mine to the city. This charge is so reasonable and the other items of expense so low that the company is already able to retail coal in competition with the other local dealers at $3.50 a ton, which is 75 cents a ton cheaper than the prevailing rates for the same

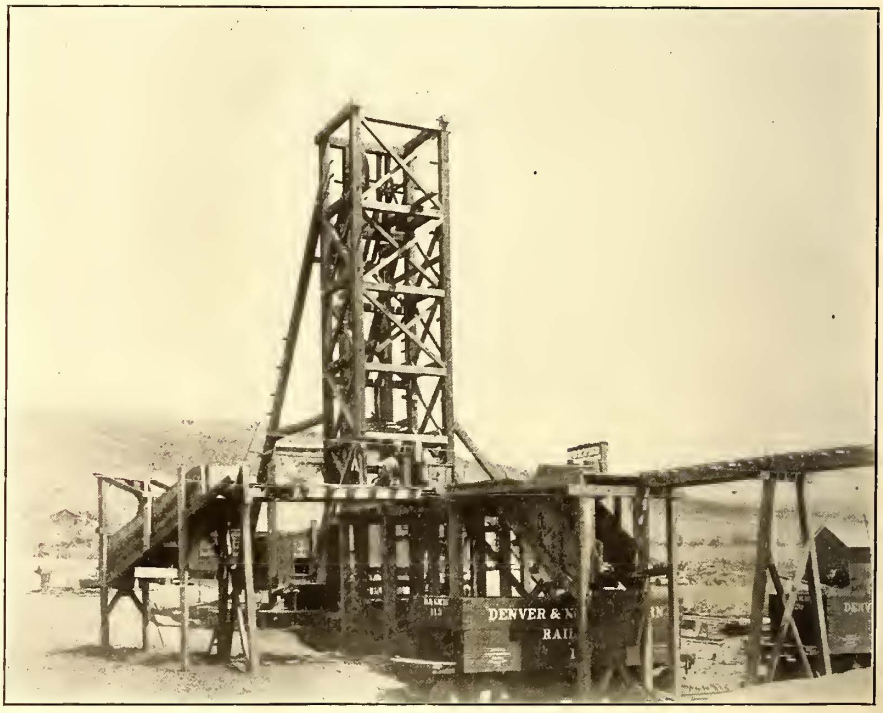


FIG. 2.—TEMPORARY COAL SHAFT AT LEYDEN

grade of coal. For receiving coal at the Tramway Company's new power house on the Platte River, in Denver, special provisions are being made. A track will be run into an annex of the boiler room, where the coal will be dumped into a large receiving bin. This bin will discharge into a cross conveyor that will carry the coal to the main conveyor, which will discharge into the hopper bins above the boilers. By this arrangement the coal will not be handled manually after it is mined. As the coal receiving apparatus will not be ready for several weeks, coal is now being temporarily dumped directly through windows onto the boiler room floor. Only a little coal is being received in this way, however. The power station uses about 120 tons of lignite slack a day, and gets it at prices varying all the way from a little over $1.00 to $2.16 per ton. It is not known exactly at which price the coal can be delivered under the new arrangement, but it is evident that the officials figure on a cost of less than $1.00 a ton.

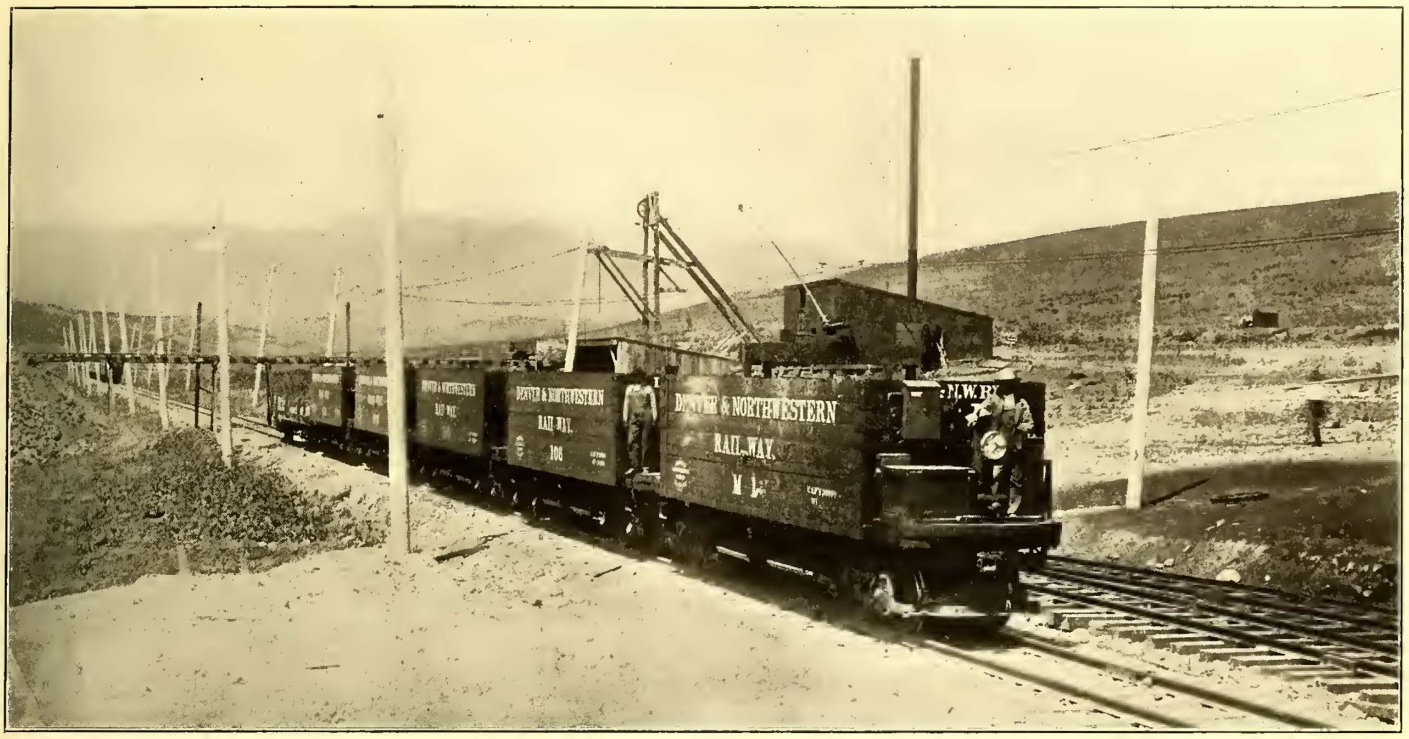


FIG. 3.—TRAIN OF COAL DUMP CARS AND WORKINGS FOR NEW SHAFT

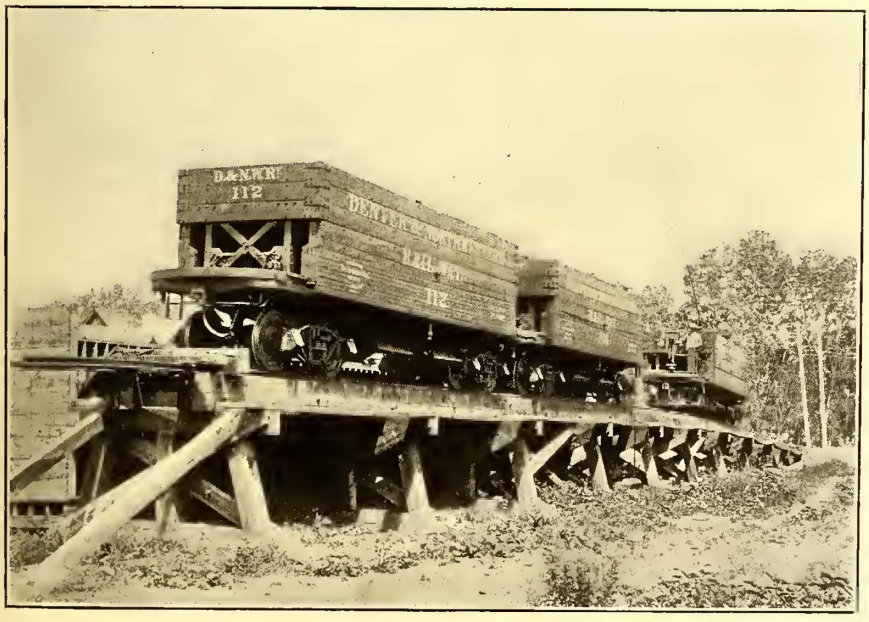


FIG. 4.—UNLOADING TRACK AND BINS AT WEST END YARD

The track of the Denver & Northwestern, as well as that of the Denver local system, is all laid on a 3-ft. 6-in. gage, so that standard coal cars used on steam roads cannot at present be handled. The road is laid, however, with ties long enough for an extra rail, and it is the company's intention to lay this rail soon, so that it can compete for the steam road trade. The electric motor cars will be able to haul these standard-gage coal cars as well as the narrow-gage dump cars. The details of the management of the Leyden Coal Company are under the supervision of S. M. Perry, general manager, and J. G. Perry, superintendent.

TRACK CONSTRUCTION

The track construction of the Denver & Northwestern is built for carrying 100-ton standard gage locomotives, although at present only the narrow-gage track is laid. It seems unfortunate that an interurban road of this nature, where heavy freight will be regularly handled, had to be built on a 3-ft. 6-in. gage, but that is the gage that is used throughout Denver by the Denver City Tramway Company, and as it was quite necessary that the city system be used in the distribution of the coal there was no other alternative than to build the track and rolling stock to conform with the city practice. As stated above, the roadbed is built for standard steam road operation, and it is the company's plan to lay a third rail, so as to accommodate standard freight cars. This will be done at least from the coal mines to Leyden Junction, where connections may be made with the new Denver, Northwestern & Pacific Railway, popularly known as the Moffat Short Line, which is now being built from Denver to Salt Lake City. This latter railway is to be a standard-gage steam railroad, and when originally proposed it was planned to run over the track of the electric road from Denver to Leyden Junction, or beyond. This plan has since been deemed impracticable, however, and it has been decided to use a slice of the private right of way of the electric road from a point just outside of Denver to Leyden Junction, and build a separate roadbed and track for

the steam line. In Fig. 5, which is a view of straight track on the electric line, the graded roadbed for the steam road may be seen at the right. The tents belong to one of the construc-

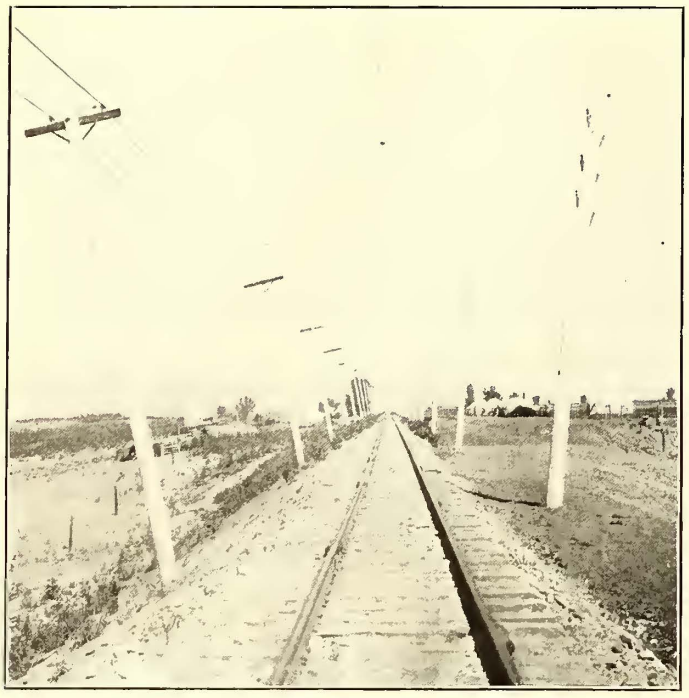


FIG. 5.—VIEW SHOWING TRACK AND OVERHEAD CONSTRUCTION

tion camps that are now scattered along the route of the new Moffat Short Line every few miles.

The Denver & Northwestern track is laid with 80-lb. T-rail, A. S. C. E. section, in 33-ft. lengths with angle-bar and Weber railway joints. Spring frogs are used at turn-outs. All the special work was constructed at the shops of the Denver City Tramway Company, and conforms to that company's excellent standard. The track and overhead work were constructed by the tramway company. The ties are made of Ozark Mountain white oak and Texas long-leaf pine, and are 6 ins. x 8 ins. x 8 ft., long enough for standard gage rails, as shown in Fig. 5. The ties are laid a little less than 20 ins., center to center, or 3220 to

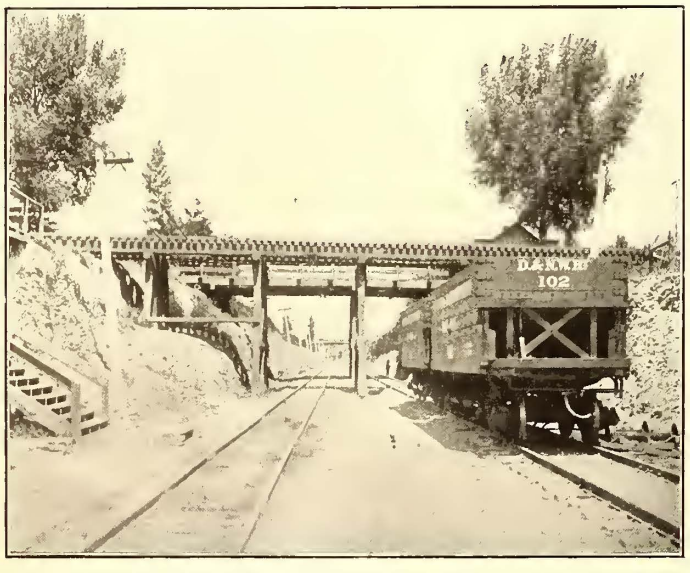


FIG. 7.— CUT UNDER STEAM AND WAGON ROADS AT ARVADA

the mile, with 14 ins. rock and gravel ballast, including the bed. The gravel is obtained from the company's own pit in a cut on the line. For track bonding there are used Ohio brass crown bonds, 10 ins. between centers, American Steel & Wire 316.000-circ. mil bonds and Brown solid copper bonds.

The map, Fig. 1, shows the general alignment and direction of the road from where it leaves the Denver City Tramway Company's loop at Fifteenth Street and Arapahoe Street to the end of the line at Leyden. From the loop to Berkeley, a distance of 4.78 miles, the track is part of the local city system and is operated and maintained by the tramway company. Beyond that point the Northwestern Company owns its own private right of way. The total length of track, including the city end, is 15.02 miles. There are five sidings en route and about 3000 ft. of sidings at the coal mines. At Arvada, where are located the superintendent's and despatcher's office and pole and storeyard of the company (Fig. 6), there is a Y and about 1100 ft. of sidings. Another Y is located at Leyden, half a mile from the end of the line.

The maximum grade on the line is 1.69, while the average grade is 1.30. Just beyond Arvada, as shown in Fig. 7, is the deepest cut on the road. It is 26 ft. deep and about 1200 ft. long. The road at this point passes under the track of the Colorado & Southern Railroad and two wagon roads. The curvatures of the track reach as high as 12 degs.. The greatest fill is about 2800 ft. long and 25 ft. high. A heavy fill is also shown in Fig. 8, where the track crosses Clear Creek on a

FIG. 6.—STORAGE YARD, FREIGHT HOUSE AND DESPATCHER'S OFFICE AT ARVADA

400-ft. wooden bridge, supported on piling. As this stream is apt to run high in the spring, wing dams have been thrown up and down stream, each about 500 ft. long. Fig. 12 shows the typical bridge construction adopted by the Denver & Northwestern, and illustrates the method of supporting the trolley poles.

OVERHEAD CONSTRUCTION

For the overhead work 35-ft. and 40-ft. Idaho cedar poles are used, set 100 ft. apart. They have 9-in. tops, are set 6 ft. in the ground on level roadbed, and are painted with P. & B. paint. The side pole and span wire construction is used throughout, the bracket construction not being in favor among the Denver traction men. At all curves the poles are guyed by means of 6-in. Stombaugh guy anchors. From Berkeley to Arvada No. 0 trolley wire is used and from there on the trolley is No. 0000 American Steel & Wire grooved wire, supported by Detroit clamps and cap and cone insulators from 5-16-in. span wire. Pole ratchets are used on one end of the spans and 5/8-in. eye bolts on the other end. Brooklyn strain insulators are employed for dead-ending the trolley wire at Y's and side tracks. The plan adopted at sidings is to run a full span of

trolley wire beyond the switch points, with no overhead switches, so as to allow the main line cars to take the siding points at high speed.

From the power house of the tramway company in Denver to Arvada there are run one No. 0000 and three 500,000-circ. mil copper stranded feeder cables. From Arvada to Leyden Junction two of the heavy cables are carried, and one is run on to a point near the end of the line. By the aid of a booster at the power house a very good working potential is maintained all along the road. A No. 0 feed tap is used between feeder and trolley every 500 ft. The feeder wire outside of the city limits is bare, and is supported on Knowles No. 2 cable glass insulators with grooved tops. General Electric, style MD, magnetic blow-out lightning arresters are used, there being twenty-five of them in 11 miles of track.

The cross-arms are of Oregon fir, 4 ins. x 6 ins. x 6 ft., and are secured to the poles by means of ¾-in. bolts with sheet washers, one washer being straight and the other curved to conform to the pole. The washers are made of ⅜-in. iron. The cross-arm braces are made of ¼-in. iron, 26 ins. x 1½ ins.,

FIG. 8.—400-FT. BRIDGE ACROSS CLEAR CREEK

put on with ⅝-in. lag screws, 3 ins. long on the arms and 4 ins. on the poles. Figs. 5 and 8 illustrate the different features of the overhead construction spoken of above.

At the Berkeley Junction, or Y, a special construction was used to make a turn in the feeder lines, as no pole could be erected at that point. A set of No. 101 Peru porcelain knob insulators were supported by means of steam insulators from an adjoining pole, as illustrated in Fig. 13. The car shown in this picture is one of the new forty-one combination cars used on the Denver city lines. Fig. 13 also illustrates a telephone station for the despatching system. These telephones are of the Bell type, and are placed at each siding and at the terminals. They are mounted on separate stub poles. All cars, freight, passenger and work cars are operated strictly on a despatching system, the despatcher at present being located at the despatching office of the tramway company in Denver. Eventually the despatcher's office for the Denver & Northwestern line will be located at Arvada.

There is now being installed in the power house a 1600-kw, 2300-volt, 25-cycle alternator, and it is the intention in the very near future to run a transmission line to Arvada, a distance of nearly 7 miles, and install there a rotary convertor sub-station to feed the railway in both directions. The transmission will probably be made at 26,000 volts, three-phase.

ROLLING STOCK

The rolling stock of the Denver & Northwestern Railway

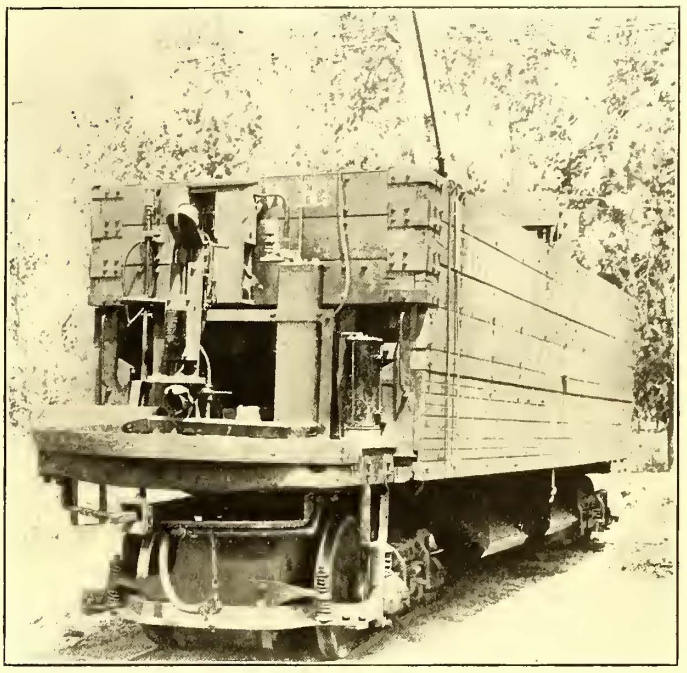


FIG. 9.—MOTOR DUMP CAR

consists at present of five motor and thirty trail dump cars, built expressly for hauling coal, and twelve flat cars and two steam motors used in construction work. The dump cars were built by the American Car & Foundry Company, of St. Louis, under specifications drawn up by L. L. Summers, consulting engineer for the Denver City Tramway, and are the first of their type to be placed in operation in the country. Each car is designed to carry 15 tons of coal, and the hoppers were made especially for use in handling the slack coal used in the power house. Figs. 9 and 10 illustrate the ends of one of the motor

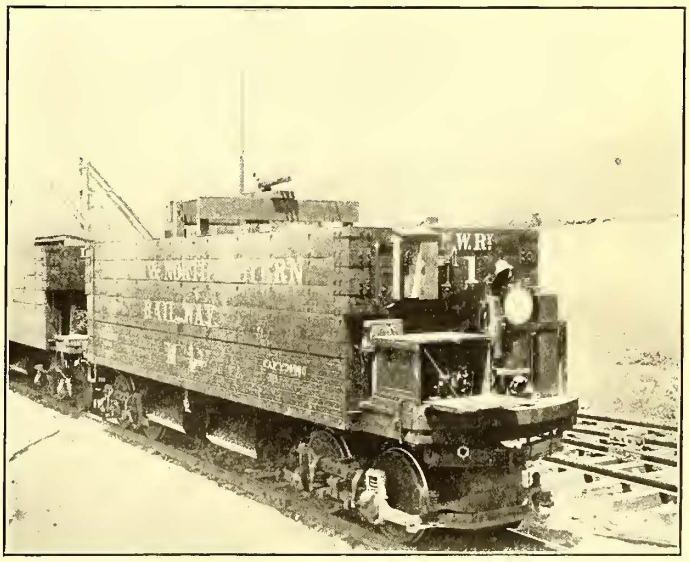


FIG. 10.—MOTOR DUMP CAR, SHOWING COMPRESSOR MOTOR

dump cars. The type of trail cars is illustrated in several of the accompanying pictures.

Outside of the addition of the electrical and air-brake equipment the motor cars do not differ from the dump cars used as trail cars. The cars are equipped with four hoppers, arranged to dump all the load on either side, and the cars are entirely self cleaning. The hoppers are placed well back under the running gear so that it will not foul. The door opening of

FIG. 11.—STANDARD PASSENGER CAR

each hopper is 3 ft. 10½ ins. long and 16 ins. wide. The doors are slung underneath on long rods operated by levers at the ends of the car. A 12-in. I-beam runs the length of the car and forms the support for the hoppers. The inside length of the car is 24 ft., and the overall height to the top

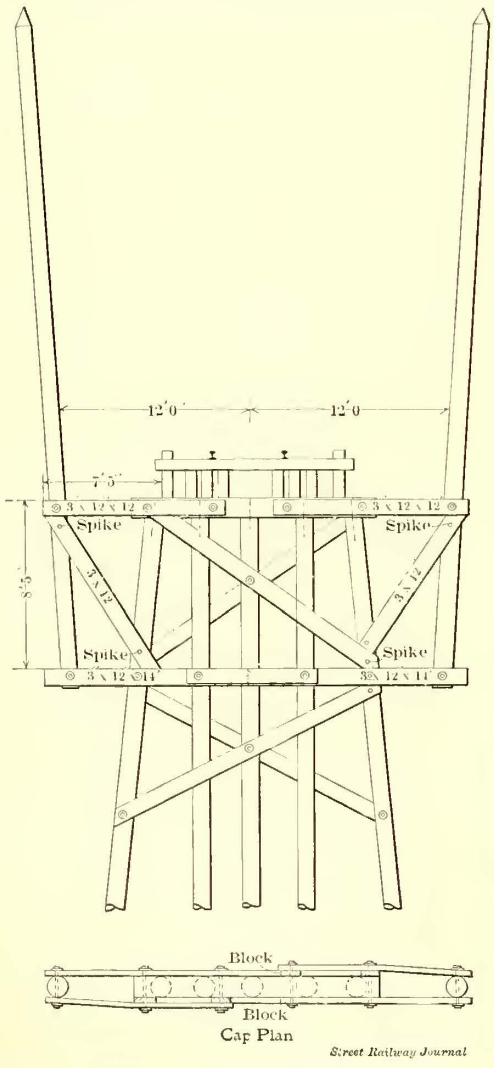


FIG. 12.—TYPICAL BRIDGE CONSTRUCTION

of the car from the track rail is 9 ft. 6 ins. The top of the platform is 4 ft. 4 ins. above the track. The stakes that hold the planks of the car sides are 4½ ins. x 4 ins., and are placed inside the car so as to make a smooth outside surface that will not catch on obstructions. The inside width of the car is 7 ft. 2 ins., and 2¾-in. planking is used for the sides and ends. The sills are rounded so that the cars may take sharp curves with facility. The bumpers are provided with coiled springs.

The motor cars are mounted on double Brill trucks of special G-27 type. Each truck is equipped with two General Electric 53 railway motors. These motors are rated at 42-hp, but are capable of developing 50 or more horse-power each. The cars are equipped with the General Electric multiple train-control system, and each motor car is capable of hauling a train of five or six loaded trail cars to Denver from any point on the road. The cars are geared for 12 miles an hour, but can be arranged to make 25 miles an hour. All cars are equipped with the Christensen automatic air-brake system, 90 lbs. pressure being carried in the main reservoir. The motor-driven air compressor is mounted on one end of the motor car, as shown at the left of the front platform in Fig. 10.

The dump cars were received from the car works without any electrical equipment, that being subsequently installed in Denver under the supervision of A. M. Ballou, chief electrician for the Denver City Tramway Company. All connections are run in covered cable, and the switches, connectors, fuses, etc., are installed in boxes lined with ¼-in. sheet asbestos. Each car is equipped for Eureka arc headlights, but at present Syracuse incandescent headlights are used, as shown in Fig. 12. The weight of each motor car empty is 41,600 lbs., while the trail cars empty weigh 24,000 lbs. each.

The company expects in the near future, as its mining operations are developed, to add to its rolling stock several more dump cars and also flat and box cars. No tests have as yet been made of the operation and performance of these hopper cars, but it is expected that they will be made soon, and some interesting and valuable data are looked for. As stated above, each motor car is capable of hauling a train of five or six loaded trail cars and, by equipping the trail cars with elec-

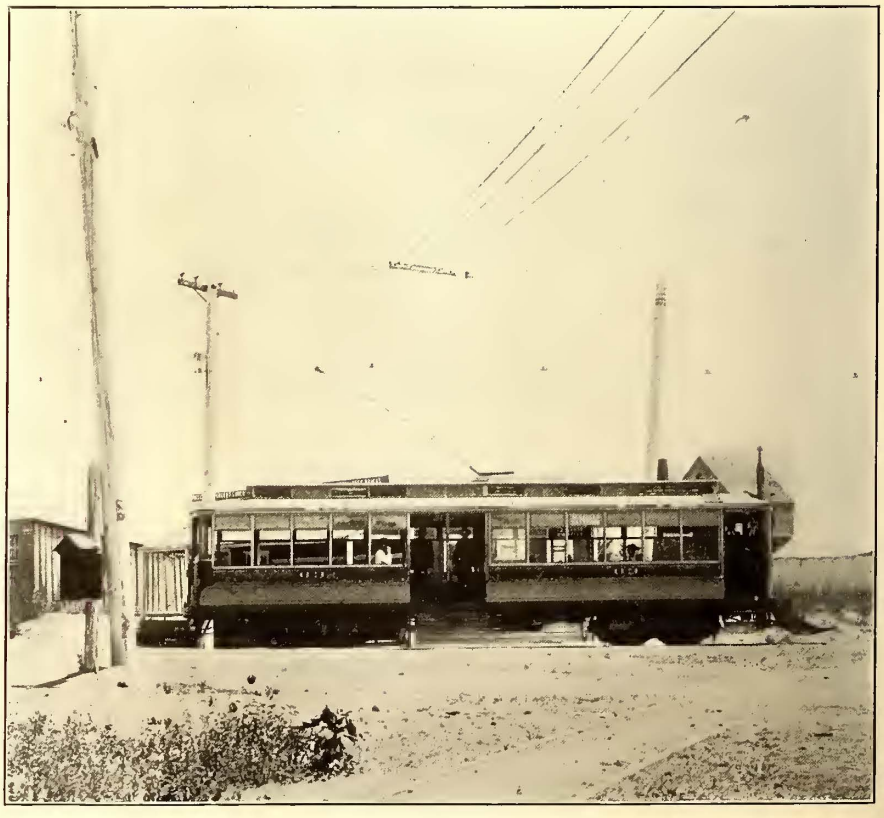


FIG. 13.—BERKELEY Y, SHOWING SPECIAL FEEDER SUPPORT

trical connections, trains of twenty-five cars or thirty cars can be handled with the five motor cars distributed throughout the train. A train of one motor and four trail cars is shown in Fig. 3.

PASSENGER OPERATION

The passenger traffic on the new road is handled entirely by the operating department of the Denver City Tramway Company, and the cars used are owned by that company. These cars are of the 41-ft. combination type, which were built by the Woeber Carriage Company, of Denver, and only recently delivered. One of the cars is illustrated in Fig. 11. They are equipped with double 27-G Brill trucks, each truck having two General Electric 58 motors. The equipment also comprises K-6 controllers and Christensen air brakes. The general features of this car were described in the STREET RAILWAY JOURNAL of Feb. 7, 1903.

On week days an hourly service is run and on holidays and Sundays a 30-minute service is put on. This road can hardly be called an interurban line, as there are scarcely 1000 people living along the route, Arvada having only about 700 people and Leyden not more than 100. Yet the passenger traffic has been very satisfactory, and on Sundays and holidays the half-hour service has been taxed to the utmost. There are several reasons that can be given to explain this large traffic. One is, that Denver has no other really interurban electric railway, that is to say, none extending beyond the suburbs, and as Denver has many pleasure-seeking people who patronize the street railways, and is always filled with tourists and transients, the new road attracts a great many passengers, especially as the ride is made directly toward the mountains, affording a good view of them the entire distance. Another factor that has helped materially to increase the passenger receipts is that many of the workmen and officials employed on the new Moffat Short Line ride back and forth between Denver and the working camps on the electric cars. Those who are working beyond the electric line ride to Leyden Junction, where they are met with wagons and carried farther on. One weekday morning when the writer rode over a portion of the line, there were 105 passengers carried, many of them, however, being members of a new gang of workmen who were going to one of the steam road camps.

Arvada and Leyden are rapidly growing towns, and there is no doubt but that this electric road will repeat the history of other interurban lines in the East, and create considerable new traffic to exceed the present demand. Branches of the road are talked of to Golden, 15 miles west of Denver, and Boulder, 29 miles northwest.

CONCLUSION

The Denver & Northwestern is also doing considerable business in hauling package freight and supplies for the contractors of the steam road. This freight is received in Denver or at Arvada from the Colorado & Southern Railway, and hauled to different points along the line. Some local freight business is also being done for farmers and truck raisers living in the districts tributary to the road.

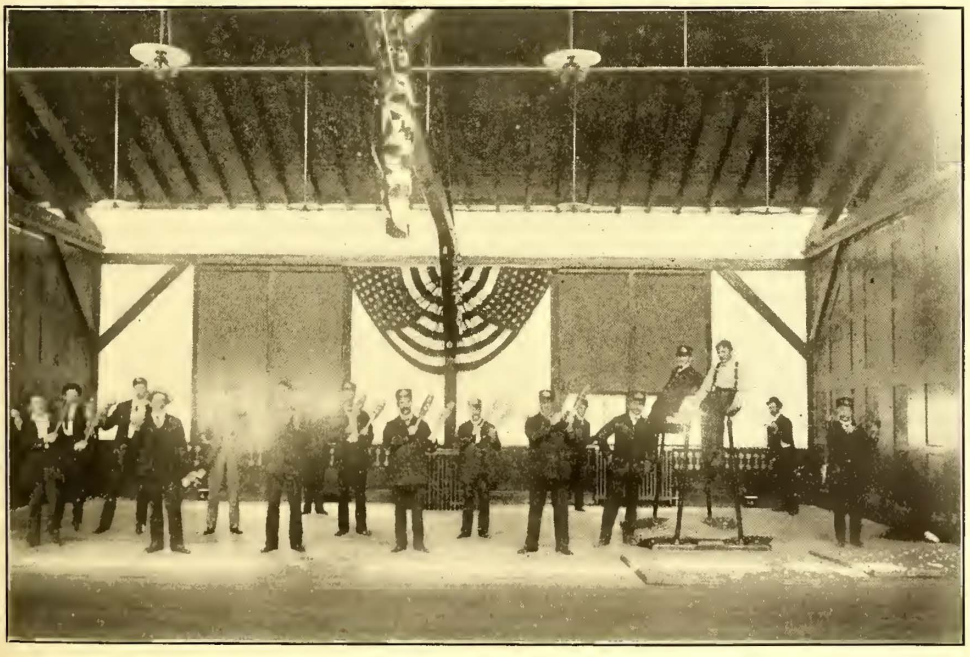
The company will have its shops at the West End barns in Denver, while a blacksmith shop for small repairs is located at Arvada. The pole yard and storage for supplies and material, as illustrated in Fig. 6, is also maintained at Arvada.

The following-named gentlemen are officers of the Denver & Northwestern Railway Company: President and manager, S. M. Perry; vice-president and general superintendent, W. G. Smith; secretary, Fred. G. Moffatt; treasurer, Thomas Keely; purchasing agent, F. A. Perry; engineer, W. A. Burbower; chief electrician, John A. Beeler.

Y. M. C. A. STREET RAILWAY WORK IN BROOKLYN

The movement which culminated in the opening on July 7 of a magnificent building for the use of employees of the Brooklyn Rapid Transit Company was inaugurated five years ago by Clinton L. Rossiter, then president of the company.

VIEW OF BUILDING, LOOKING FROM JAMAICA AVENUE



SWINGING INDIAN CLUBS AND DUMBBELLS IN THE BROOKLYN Y. M. C. A. GYMNASIUM

Mr. Rossiter believed that the Young Men's Christian Association work which has met such unqualified success on steam railroads was equally adaptable to street railway men. J. L. Greatsinger, Mr. Rossiter's successor, endorsed his plans and enlarged them. President E. W. Winters, now in office, and General Manager J. F. Calderwood have greatly broadened the original plans and have surprised all concerned by carrying to completion the splendid club house now at the disposal of the company's employees.

The structure as now equipped has cost the company about $40,000. The designing and furnishing of the building was in the hands of D. R. Collin, the architect, who is entitled to much credit for the results which he has achieved for the amount of money expended. Of the five illustrations given here one shows the club house on its opening day, the others being views of different parts of the interior.

A detailed description of this building was presented in the STREET RAILWAY JOURNAL for Dec. 13, 1902, but it may be well

to restate its principal features. The structure has three stories in front and two in the rear, and is 60 ft. wide by 170 ft. long. The first floor contains bowling alleys, tub and shower baths, lockers and lavatories. The second floor contains the auditorium, gymnasium, car instruction room, billiard room, reading room and the secretary's office. This floor has been so planned that by removing the sliding doors the capacity of the auditorium can be increased from 400 to 1000. The third floor contains three class rooms.

LIBRARY AND READING ROOM

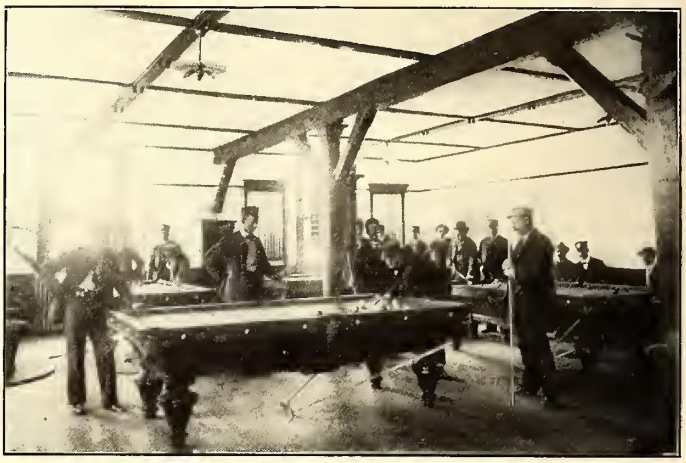
Among the principal social features will be entertainments, which are to be given in the auditorium by home talent or professional actors. The company has also arranged to give excursions twice a week during August, for the benefit of the men and their families, to Rockaway Beach, a fine seaside resort near Brooklyn. The cost of these excursions, including meals and fare, will be 60 cents each for adults and 30 cents each for children. These outings were instituted last year and have become very popular.

The benefits of the finely equipped gymnasium will be greatly enhanced by the presence of a competent physical culture director, who will instruct the men in the intelligent use of the gymnasium facilities. Bowling and billiard tournaments will also be a prominent feature.

THE AUDITORIUM ON THE OPENING NIGHT

The educational department will include an instruction room on the second floor, where the company intends to place a skeleton car, to be used for teaching the men the principles of car operation. The class rooms on the third floor will be used for teaching English, penmanship, arithmetic, electricity, mechanical drawing and music. Classes in each study will be held about two nights a week.

The club house is furnished with an excellent reading room, and an arrangement has been made with the Brooklyn Public Library whereby the latter will establish a branch in the building, placing over 1000 volumes at the disposal of the employees. In addition to this about fifteen portable libraries of fifty to 100 volumes each will be circulated between the power houses, shops and depots of the street railway system. Plans are also being prepared for a technical library.



POOL ROOM

The building is managed by a committee consisting of the following employees of the company: John Keating (chairman), conductor on the elevated division; F. A. Overfield, shop foreman; T. J. Clisset, timekeeper; D. S. King, motorman. The greater part of the club house is free to all employees, regardless of membership in the Brooklyn Rapid Transit Employees' Sick and Death Benefit Association or the Young Men's Christian Association. The very small fee of $2.00 a year is charged for use of the educational classes, gymnasium, baths and lockers.

The general supervision of the work is in the hands of J. M. Dudley, who has devoted many years to similar labor in the steam railroad branches of the Young Men's Christian Association. Mr. Dudley has spent over a year and a half in Brooklyn to study the situation, and he believes that the Young Men's Christian Association, because of its non-sectarian character and tolerance toward all creeds, and its practical efforts to raise the physical, intellectual and moral standard of its members, must prove as successful in the street railway as in other fields.

SOME DUTIES OF THE GENERAL MANAGER

BY LINCOLN NISSLEY

If there is any line of business in the world that requires thorough organization it is electric railroading. There is no line of business in which such a large proportion of the gross earnings go back to supervision and labor as in electric railroads. There is no line of business that requires better or quicker action. There are more emergencies occurring in the electric railway service than in any other line of business, and owing to its great ramification the business must of necessity be handled by the various heads of departments, who must be capable of acting wisely and quickly without being able to advise and consult at all times with the general manager. This makes it especially important that in electric railroading there be first-class organization.

To maintain such an organization, not for one year but indefinitely, to have for the heads of departments men of character and ability to operate progressively and economically, to properly manage men and to have loyal and efficient

co-workers, are some of the more important duties of the general manager.

We are confronted to-day with a set of conditions entirely different in many respects from those existing some years ago. The number of employees coming under one organization is growing larger and larger; there is a growing tendency to centralize authority; the organization of labor into unions, once local, is now national, and there is a strong influence in some cases towards separation of interest between executive heads and other employees, and these are the conditions we have to meet to-day. It is not the intention of the writer to discuss here the merits or demerits of all of these conditions, as they are too large and somewhat beyond our control.

Among organizations as large as are often found in electric railways it would seem that enthusiastic and loyal effort must be a most important factor to the railway. To establish the condition of active thought is one of the highest duties of the general manager. It means leadership and breadth as against mere supervision and keeping everything to oneself.

When minds are at work on problems they are sure to produce results, and when they are not they produce nothing. But the moving spirit in bringing about such a condition, like water, cannot be expected to run from a lower level to a higher one, it must start from the higher level. No theorist alone can meet the call. He is required to furnish superior copy and forever divorce himself from the pernicious theory of a certain aristocracy of the service based on official position and prerogative. This relic of Babylonian age, yet extensively adhered to by a large per cent of the official strata, has robbed the stockholders of vast sums by its implied imputation of personal inferiority of the operative whose nature is quick to resent. The result is that many of his possibilities, which will always lie outside the limit of the mechanical rule, are allowed to lie dormant, and he remains indifferent to the threat of injury to the interests involved. On the other hand, the successful manager fashions these possibilities into a magnet to save from waste the thousand atoms from the much-stirred mass, which, under the regime of the theoretical manager, will continue to find their way to the commercial scrap heap.

The writer is equally convinced that the average American operative leans strongly to the side of loyalty and superior effort, but he looks for an affinity in his immediate and managing official, and yields in a degree according as that affinity is recognized. He is quick to take his cue from such discovery. It is to be deplored that so many officials seem to dread a certain lowering of the dignity from any kind of familiar contact with the operative. The real dignity of ability can never be lowered, but it can attract and elevate and form an example. It is a sacred duty of the general manager to the stockholder that he recognize this truth and act on it.

On the other hand, it is not uncommon to see leaders of labor with radical and sometimes violent views and feelings; men half-learned and teaching half-truths to the large body of those with whom they have associated. Such teachers and bad literature are the sources from which they derive their view of things at times, and this goes on in many cases uninterruptedly and without any counteracting influence from executive heads. This is not a proper condition of affairs.

Why is it that one man is selected from among a number to direct or command? For one reason, and only one, viz., because he has greater intelligence, because he knows more and is a greater force. It is a mistake to elect or select on any other grounds. This is the fundamental law of all organizations and government.

The moral responsibility of every one is as great and as constant whether one is here or there, or doing one thing or another, and this responsibility is in exact proportion to the intelligence of the individual. Therefore, if one occupies a position as a result of superior intelligence it is hardly sufficient that it should carry with it greater skill or mere supervision of work alone. The greater intelligence must carry with it in a higher degree all the attributes that go to make a better manhood, including better judgment and greater justice.

The selection of a suitable man for a position is a matter that is constantly arising, and often the right man does not appear to be at hand. Whenever this is the case it is evidence that an important duty has been neglected. It is a clear indication that sufficient time and interest has not been devoted to the most important requirement. Managers too often think only of power stations, cars and shops and neglect men and organization.

How are we to operate progressively and economically? All that may be supplied in the way of facilities and equipments will avail but little without men to properly direct their use. A cheap head of department is neither progressive nor economical. Having found the right man for a position he should be given every opportunity to progress; every reasonable inducement should be held out to him to "think" and to make his thoughts known. He should be given an opportunity to demonstrate, to some extent, some of the creations of his mind, for this is the food on which a thinking man lives. It is far better to grant such opportunities, and thus stimulate thought and action, rather than to suppress it. Among hundreds or thousands of employees there are more men having capacity than we think, but this capacity must be sought and invited to activity. There are plenty of men there. The fact of the matter is, if the influence, the proper influence, is exerted they will come out; but it is terribly neglected. The writer has personally known a great many young men, who, as a result of having an opportunity and good influence, developed into excellent men, but they required both the opportunity and the influence.

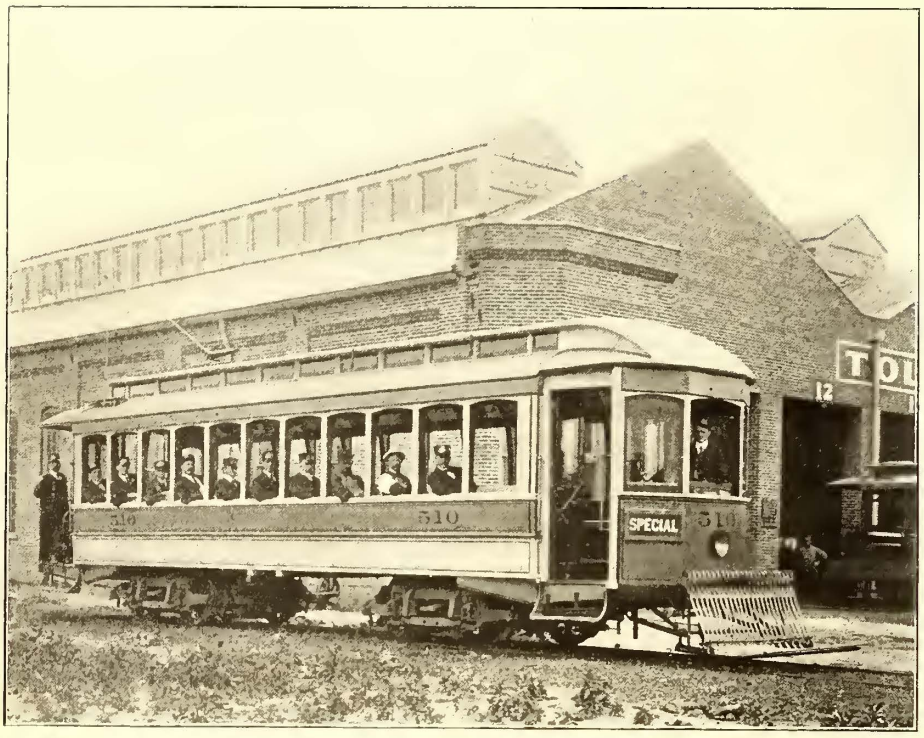
It should be understood, of course, when such opportunity and authority are given, an exact accounting should be required. The principle of having authority and discretion go with responsibility is the one above all others that is most important in obtaining the best results. There are conditions sometimes existing in electric railway organizations where the responsibility is imposed and the authority restricted, or where both responsibility and authority are restricted to an unreasonable extent, but such a plan is not likely to effect the best results. The first condition implies "heads of departments" fit in every way to carry the responsibility. It requires that men "shall be responsible" and maintains action. It makes men of sterling qualities and establishes confidence, making the organization self-sustaining and equal to the constantly growing demands. The other conditions will not accomplish this, they breed irritation, distrust, discontent, and kill that "loyal and voluntary" effort that counts far more than anything else in a large organization.

The general manager should know how to maintain an organization. He should know how to select, he should know how to develop and make responsible, and he should know how to discipline, and those who grow up under him will know how to do these things also. On the other hand, one who blindly drives, accepting no suggestions, will raise antagonisms that will alienate the support that is indispensable. No man can stand by himself alone. The writer would like to have anyone point out whether anything of lasting value was ever accomplished except by intelligence and better impulses. He contends that it is a most important duty of executives to consider that their responsibility does not end with the production of power houses, car equipments, etc., but in the management of men by their own action and their greater intelligence to exert an influence that will tend to better understanding, confidence and harmonious work, to the end that the organization may be maintained.

AUTOMATIC CAR FENDER

The Toledo Railways & Light Company has recently placed on trial an automatic car fender, invented by W. T. Watson, of Newark, N. J. The accompanying cut shows one of these fenders attached to a Toledo car.

This fender has the advantage of being furnished with two automatic releasing devices in addition to the ordinary foot-



AUTOMATIC FENDER ON TOLEDO CAR

drop in common use. One of the automatic devices consists of a front trip-bar, which is forced back on coming in contact with obstructions. The transmission, through levers and cranks, of the motion caused by the impact operates the foot-pawl of fender. Where snow obstructs the track this trip-bar might, however, prove inconvenient. It may, therefore, be turned against the fender and the other automatic device used instead. This latter is operated by the weight of the body struck falling on the fender cradle, which causes the fender to drop to the roadbed. The dropping of the fender pulls forward rocker-arms connected to levers, which operate the foot-pawl just as if the motorman's foot were used.

The complete fender may be quickly attached to the car by two bolts connected to the outside sills of the car platform. It folds compactly, is interchangeable to any style of car, and does not interfere with car coupling or car headlights.

THE IMPERIAL RAIL-JOINT

By introducing the Imperial rail-joint to British tramway engineers, Estler Brothers, of London, believe that a considerable advance has been made toward the attainment of a perfect rail-joint. This rail-joint has already met with great success on the European Continent and other parts of the world through the efforts of the patentees, Scheinig & Hoffman, of Linz, Austria, and has been in use on a number of electric railways long enough to demonstrate its merits. Among the electric tramways using this rail-joint may be mentioned those in Aussig and Peplitz, Bohemia; Rouen, France; Barcelona, Spain; Elberfeld, Germany, and the railway between Linz and Urfahr, in Austria.

The construction of the rail-joint is clearly shown in Fig. 1. The joint consists of three parts, namely, a heavy cast-steel shoe, "A," with recess to fit flange of rail, a cast-steel block, "B," provided with machined recess to fit the opposite side of flange, and a wedge-shaped piece, "C." Besides these three parts a thin zinc sheet, about .2 mm thick, is placed over the face at "D," and gripped by the recesses in the shoe and block. This is required for making a good electrical joint.

The joint is fitted in the following manner: The shoe "A" is heated in a portable forge until bright red, and meanwhile the block "B," which is not heated, is driven firmly over the rail flange so that the joint in rail is midway between the ends of the block—the rail flange having been thoroughly cleaned previously with a wire brush and file, and the sheet zinc mentioned above placed in position. The red-hot shoe can now be driven in position, care being taken that block "B" is not loosened. Finally the wedge, "C," can be driven home, care being taken that it is driven quite straight. The wedge "C" must be quite parallel longitudinally. If the wedge fits too easily a thin liner must be added. On the cooling of the above a thoroughly solid and firm joint is obtained, which is also very good electrically, owing to the large contact surface of zinc. This latter quality is evident from the following data:

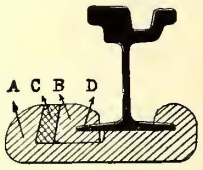


FIG. 1.—CROSS SECTION OF IMPERIAL RAIL JOINT

Some resistance tests were made of rail-joints under different conditions with rails weighing about 90 lbs. per yard. The resistance of an old joint with angular fish-plate, about 20 ins. long, and copper bond, 39 ins. long by .18-sq. in. cross-section, was .0000930 ohms, and that of 1 m of rail only .0000343 ohms; of a joint with patent shoe (no zinc in joint) and the same bond as before, .0000233 ohms, and that of 1 m of rail .0000337 ohms; of a joint with patent shoe, but fitted with sheet zinc, as described, and without copper bond, .0000085 ohms, and that of 1 m of rail .0000367 ohms.

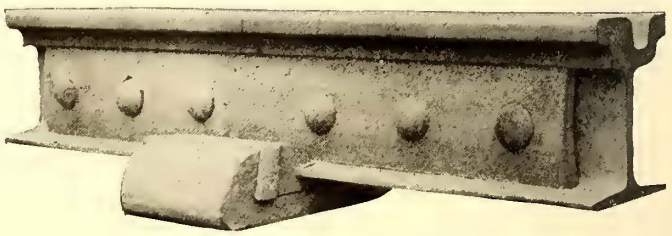


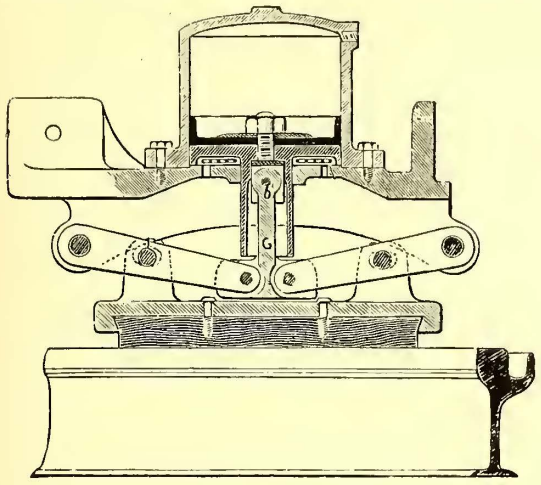
FIG. 2.—RAIL-JOINT ATTACHED TO RAIL

Fig. 2 shows a complete joint in actual piece of rail by means of the Imperial rail-joint. About four men are necessary to make the joints, and the entire operation takes only from 5 minutes to 10 minutes. Very little difficulty is experienced in fitting this joint, as hardly any excavation is necessary and traffic need not be stopped.

The Union Traction Company of Indiana has placed orders for three buffet cars for use on its lines. The cars will be the same size as the ones now in use; but the interior and exterior finish will be more elaborate. It is stated that the service will include everything usually offered in railway diners. Another innovation planned by the company is the operation of sleeping cars. These cars will be placed in service as soon as the company completes its line to Chicago.

PNEUMATIC SLIPPER BRAKE

The following is a description of an emergency brake which has met with considerable success in England. After being in practical use for over two years it is now in service upon 150



CROSS SECTION OF PNEUMATIC SLIPPER BRAKE

cars, yet not a single accident is said to have occurred to a car equipped with Hewitt & Rhodes pneumatic slipper brakes.

This brake is in use on the electric tramways at Oldham, Stockport, Dundee, Rochdale and the Potteries Electric Traction Company at Stoke-on-Trent. It is adaptable to all types of cars and can be used in connection with any style of air compressor.

The section view of the brake shown in the cut clearly indicates the construction. An air cylinder is carried on a bracket attached to the truck. The piston of the cylinder is connected by a swinging rod to two levers which have their fulcrums on another bracket. The levers carry a slipper shoe, on which is fixed a brake block of oak, beech or other hard-wood. The brake blocks can be used efficiently until they are worn down to within a quarter of an inch of the steel shoe, and can be renewed in a few minutes. There is nothing in the slipper brake which is likely to get out of order, but it is necessary to examine the flexible connections daily to insure their being in perfect condition.

Exhaustive tests have been carried out with this brake, and the makers believe that it is the most powerful emergency brake on the market, while on the other hand it can be so easily controlled that it can be used with considerable advantage as an ordinary service brake. It has been found that a considerable saving is effected in the cost of maintenance of car wheels and tracks where this slipper brake is in use.

GARBAGE CARS ON SAVANNAH ELECTRIC RAILWAY

The Savannah Electric Company will shortly place in service on its lines six dump cars, each of 30,000 lbs. capacity, which will be used for hauling garbage under a contract with the city of Savannah.

These cars are of the side-dump pattern, with a raised letter "A" floor and a water-tight false bottom. The cars are to be set under a loading platform on which the city wagons will be driven and the garbage dumped directly into the cars through hatches on their roofs.

This loading work will be carried on during the day, and drains in the bottom of the cars will, in the meantime, be left open to allow the liquid material to drain into the sewers. At night, after the traffic ceases, the cars will be hauled to the county farm, which is about 3 miles from the city. An elevated track has been built on this farm. The cars will be run on this trestle and their contents dumped. The material will then be picked over by the county convicts. All matter suitable for fertilizing will be used on the county farm, and salable pickings will be sacked up and sold by the county.

SPIRAL JOURNAL BEARINGS

A journal bearing which has become well known among steam railroads and is now beginning to find more extensive use among electric railroads because of the increasing weight and speed of cars which are being employed, is the spiral journal bearing made by the St. Louis Car Company. This bearing is now usually put on the journal boxes of the heavier trucks manufactured by that company. The greater part of its business in spiral journal bearings in years past has been with steam railroads, which are quick to appreciate anything that will relieve the tendency to hot-boxes, which are likely to be so troublesome with heavy cars and high speeds. The construction of this journal bearing is illustrated by the four figures herewith. Fig. 3 is a malleable iron back. Fastened to this back is a skeleton bronze lining, Fig. 1, from which the spiral journal bearing gets its name. Around and over this skeleton bronze lining is poured babbitt metal, so that the journal, when

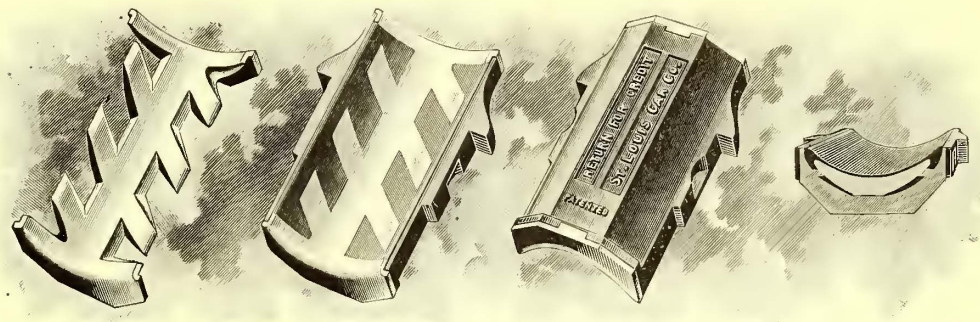


FIG. 1.—SKELETON BRONZE LINING

FIG. 2.—BEARING SURFACE AFTER LEAD LINING IS WORN THROUGH

FIG. 3.—BACK VIEW

FIG. 4.—SECTIONAL VIEW

finished, is in section like Fig. 4. After the babbitt is worn out of the bearing it presents the appearance shown in Fig. 2. That is, part of the bearing is on the skeleton bronze lining. The bearing is not renewed as soon as the babbitt is worn through, as is likely to be the case with the common journal bearing. The malleable iron backs and bronze linings, of course, last indefinitely. The babbitt is the only part that it is necessary to renew.

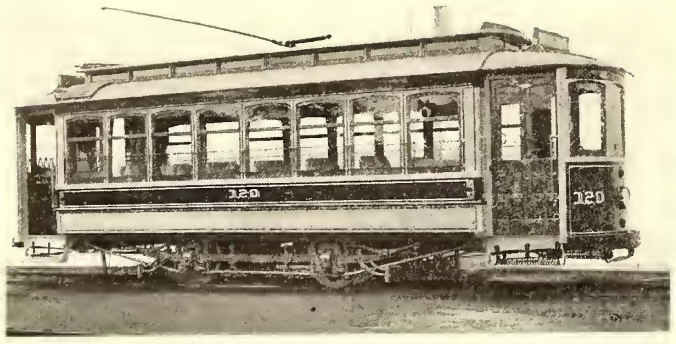
CLOSER INSPECTION REQUIRED

Only a few days ago the air brakes on a car equipped with 200 hp in motors failed to work near a cross-over in a prominent Eastern town, and a collision occurred, which, fortunately, caused no loss of life. In a section of an adjoining city an electric light pole crashed into the street, barely missing a death-dealing blow to a crowd of passers-by. When the pole was examined it was found to be so rotten that an ordinary pencil could be pushed far into it.

Such incidents ought not to pass unheeded by the operating companies' management, and illustrate the never-failing truth that upon eternal vigilance depends the safe and successful operation of great and small industrial enterprises. There are some accidents which human skill seems powerless to forestall, but the two quoted above are not of that order.

SEMI-CONVERTIBLE CARS FOR NASHVILLE

The J. G. Brill Company recently shipped twenty-five semi-convertible cars of its patented type to the Nashville (Tenn.) Railway, fifteen of which have 30-ft. 6-in. bodies, and ten



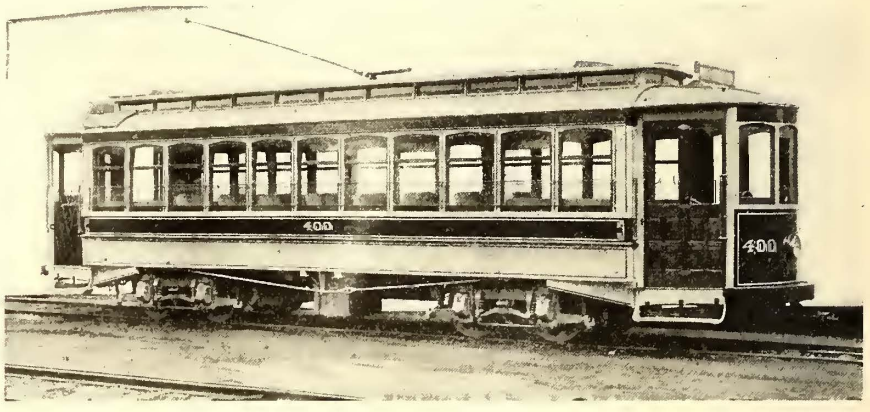
SINGLE-TRUCK SEMI-CONVERTIBLE, FOR THE SOUTH

measure 22 ft. 7 ins. These cars are shown in the accompanying illustrations. The cars are intended for city and suburban service, and therefore the step heights were arranged to be as easy as possible to facilitate ingress and egress, and the longitudinal seats at the doors of the longer cars doubled in length to prevent crowding at these points. Wherever a transverse seating arrangement is desirable the builders claim that the features of this type make it especially suitable. The absence of wall window pockets, by reason of the roof pocket storage of windows, has enabled in this case the use of an unusually low window sill. From top of floor to top of window sill is but 25 ins., giving a large window opening and adding much to the comfort of the cars in warm weather. The window sill is too low to be reached by the elbow of a seated adult passenger, and, therefore, an arm-rest is bracketed to the side lining just below the sill, and of a length not to interfere with the window lifts. Simple as it is this arm-rest is an important item, and was specially devised recently by the builders, and a patent applied for. A removable net window guard is an excellent feature in connection with the low window sill.

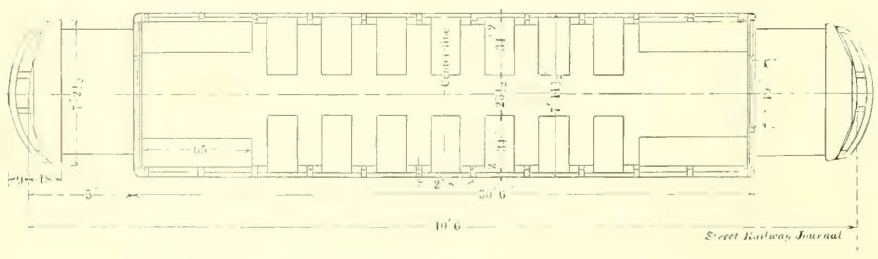
The interiors are richly finished in cherry with bird's-eye maple ceilings undecorated. The vestibules are also finished in cherry. The doors are double and have openings 40 ins. wide. The lower window sash is 25½ ins. x 29⅝ ins., and the upper, 17¼ ins. x 29⅝ ins. Spring-cane walk-over seats are 34 ins. long, and 65-in. longitudinal seats are placed at the corners of the long cars. The seats are brought against the side linings between the posts, leaving the aisle 23½ ins. wide. The windows in the ends are arranged to drop into pockets, as are also the vestibule windows. The platform knees are reinforced with angle-iron and protected and strengthened at the ends with angle-iron bumpers of the builder's patented type. The four steel rafters at the center of the cars, under the trolley base, are extra heavy, to enable the roof to support 500 lbs. extra which may be placed upon it in the future.

The dimensions of the larger cars are as follows: Length over corner posts, 30 ft. 6 ins.; length over vestibule dashers, 40 ft. 6 ins.; length over bumpers, 42 ft.; width over sills, 7 ft. 8 ins.; width over water table (widest part of car), 8 ft. 1½ ins.; height from under side of sill over trolley board, 8 ft. 8⅝ ins. Length of platforms, 5 ft.; length of steps, 3 ft. 6 ins. From center to center of posts, 2 ft. 8 ins.; thickness of side posts, 3¼ ins.; corner posts, 4½ ins. x 5½ ins. Distance between bolster centers is 18 ft. 8 ins.; under truss rods, 1⅛-in. diameter, are secured at bolsters. Side sills of long-leaf yellow pine are 4¾ ins. x 7¾ ins., plated on the inside with ⅜-in. x 12-in. steel, turned on end sills 6 ins. White oak end sills are 5¼ ins. x 6⅞ ins. Four cross sills are 3⅜ ins. x 4¼ ins., and two needle beams, 4½ ins. x 5½ ins. A large water-proof tool box is secured under the center of these cars. The trucks are Brill 27-G, with 4-ft. wheel base, 33-in. wheels. Each truck is equipped with two 38-hp motors. Weight of a truck is, without motors, 5725 lbs., with motors, 10,665 lbs. Total weight of car, trucks and motors, 40,700 lbs. The seating arrangement is shown in the accompanying plan.

The dimensions of the shorter cars are as follows: Length over corner posts, 22 ft. 7 ins.; length over vestibule dashers, 32 ft. 7 ins.; length over bumpers, 34 ft. 1 in. Length of platforms is 4 ft. 6 ins.; length of steps, 3 ft. Width and height are the same as longer cars. Side sills are 4½ ins. x 6 ins.; wheel pieces, 4¼ ins. x 4 ins., plated with angle-iron, ⅜ ins. x 3½ ins. x 6 ins.; end sills, 3½ ins. x 6⅝ ins.; cross sills, 3½ ins. x 5½ ins., plated with ½-in. x 2½-in. steel. These cars are mounted on Brill 21-E trucks, with 7-ft. 6-in. wheel base and 33-in. wheels. The trucks are equipped with two 38-hp motors. Weight of truck without motors is 5165 lbs.; with motors, 10,000 lbs. Total weight of car, truck and motors is 23,100 lbs. All the cars are furnished with radial draw-bars, "Dumpit" sand-boxes, "Dedenda" gongs and other patented specialties of the builders' make.



LARGE SEMI-CONVERTIBLE CAR FOR NASHVILLE



SEATING PLAN FOR LARGE SEMI-CONVERTIBLE CAR

The summer season is in full blast at East Lake, the summer resort maintained by the Birmingham Railway, Light & Power Company, of Birmingham, Ala. To meet the traffic demands Manager J. B. McClary, of the railway department, has put on a fast night schedule. East Lake is 7 miles from Birmingham, and the old running time of 40 minutes has been reduced to 15. A few days ago, on a regular trip timed for speed, the car that left the city at 8:20 pulled into the station at East Lake at 8:35. This trip, too, was made with a dozen stops for railroad crossings. The track is 90-lb. steel on 14 ins. of slag ballast.

ANNUAL CONVENTION OF THE MUNICIPAL TRAMWAYS ASSOCIATION OF GREAT BRITAIN

The first annual conference of the Municipal Tramways Association of Great Britain was held on July 8 and 9 in the Council chamber of the magnificent Municipal Chambers of the City of Glasgow, which had most kindly been put at the disposal of the association by Lord Provost Sir John Primrose and the members of the Glasgow Corporation. The association was formed about a year ago, but outside of committee meetings to arrange the objects of the association, and decide upon those members of corporations and local authorities eligible for membership no actual conference had previously been held. This first meeting, under the presidency of Mr. John Young, of Glasgow, is consequently the first actual meeting of the kind in Great Britain, and marks a new era in municipal ownership of tramways, and the diffusion of that general information so necessary for their successful operation. The executive committee for the past year, 1902-3, consisted of the president, John Young, Glasgow; the vice-president, C. R. Bellamy, Liverpool; the secretary and treasurer, J. M. McElroy, Manchester, and J. Aldworth, Nottingham; A. Baker, London; A. L. C. Fell, Sheffield; J. B. Hamilton, Leeds; E. Hatton, Salford, and F. Spencer, Halifax, members of committee. A full report of the papers read at the meeting is given below, and it is only necessary to state here that a very full attendance was manifest when Mr. Young called the conference to order on Wednesday morning, punctually at 11 o'clock. It was interesting to learn that nearly all the corporations operating tramways had joined, the membership now being ninety-three.

The first paper presented was in the shape of a report by J. Dalrymple, the able accountant of the Glasgow Corporation Tramways, on the Standardization of Tramways Accounts, accompanied by the presentation of a suggested form of accounts, so that each corporation could readily compare the expenses of the various departments with those of other corporations. This form had been drawn up after communicating with all the members of the association, and with the treasurers of other associations, in other countries. It had been confidently expected that Mr. Duffy, of the Street Railway Accountants' Association of America, would be present to give valuable information on this point, but unfortunately at the last moment he found it impossible to get away. The vexed question of depreciation was specially recommended to be left out of the discussion, and though there were a few minor differences of opinion, it appeared to the members discussing the report that the suggested form was a very good one, and a sub-joint committee was formed to act with the Burgh Treasurers' Association to fully consider and recommend a standard system of tramway accounts.

An able report by Mr. Baker, of London, was then read on the Hours of Labor, etc., of Tramway Employees, and largely discussed by the members present. Fifty-four hours a week was generally conceded to be about right for motormen and conductors, though there was a wide difference of opinion as to whether a motorman ought to have more wages than a conductor.

After luncheon, served in the City Chambers, a report on Permanent Way Construction and Maintenance, prepared by Mr. King, of Glasgow, was submitted by the chairman, and widely discussed, especially with regard to the question of rail-joints. Some members were of opinion that sooner or later some method of bolting the rails down to the concrete bed would be adopted.

In the evening a dinner was tendered to the members in the magnificent banquet hall of the City Chambers, at the invitation of the tramways committee of the Glasgow Corporation, Lord Provost Sir John Primrose presiding. The dinner proved to be a most enjoyable function, the Lord Provost especially making a most eloquent speech in favor of municipal tramways, reminding all the members present of the responsibilities which attached to their labors, and the great work of the amelioration of the masses and the improvements in the cities in which they were working, by the tramway systems in which they were individually engaged. Sir John succeeded in placing the tramway enterprise on a high plane of civil life, and stirred the best sentiments in those present to redoubled effort. John Young came in for many thanks in the course of the evening for the uniform courtesy which he has extended to visiting delegates, and also for the able management which he has shown in the conduct of the Glasgow tramways.

Previous to the conference being resumed the business meeting was held. The vice-president, C. R. Bellamy, general manager of the Liverpool Corporation Tramways, was elected president in succession to Mr. Young, and Alfred Baker, chief officer of the London County Council Tramways, was appointed vice-president in room of Mr. Bellamy. Six new members were elected to the executive committee—namely, Councillor Walter Paton, Glasgow; Councillor Boyle, Manchester; and Councillor Smithson, Leeds, as representing Corporations; and Mr. C. J. Spencer, Bradford; H. England, Sunderland; and P. Fisher, Dundee, as representing tramway managers. The conference of 1904 was fixed to be held at Liverpool.

On Thursday C. J. Spencer, of Bradford, read a most interesting paper, which he had very hurriedly prepared on Tramway Conditions in America and Great Britain, which opened almost too wide a subject of discussion, every point in tramway management, from the universal fare of America, as compared with the fares by stages in Great Britain, and the use of half-penny fares, to the smallest detail in overhead or track construction, being eagerly discussed.

A paper on Selection and Training of Motormen and Conductors was then presented by L. MacKinnon, traffic superintendent, Glasgow Tramways, was then taken as read, the time being short.

After luncheon, again served in the City Chambers, special cars took the members to the Pinkston power station, and by a circuitous route through the west end of Glasgow to the Corporation Car Works, on the south side. In the evening an informal dinner of the association was held in the banqueting hall, Mr. Young presiding, Sir John Primrose and Lady Primrose being present as guests. Many other ladies were present, and it is safe to say that never was a more enjoyable evening spent, as the press not being present (at least as members of the press) most informal speeches and songs followed, and a thoroughly happy evening was spent. The succeeding day was devoted to pleasure, an excursion to Inverary on the turbine steamer "King Edward" being arranged for and taken advantage of by almost all the delegates and their ladies who could possibly stay. Though not particularly favored by the weather, except on the homeward way, when coming through the beautiful "Kyles," yet all appeared to enjoy themselves thoroughly, in spite of the Scotch mist, doubtless assisted by other Scotch productions of strongly antidotic tendencies.

It is, perhaps, not out of place here to say that undoubtedly the association has now taken strong root, that it is founded on the proper lines, and will in time work an immense amount of good, especially in the way of that standardization in all departments so much needed, and evidently the lack of which is not yet sufficiently comprehended by the various corporations or their consulting engineers, and which prevents that unity of enterprise, that interchange of traffic and that economy of operation which must follow its more general adoption. Finally, we have to thank Mr. Young and the members of the association for a most enjoyable time in their midst, and for the many acts of courtesy extended to us.

THE SELECTION AND TRAINING OF MOTORMEN AND CONDUCTORS ON THE GLASGOW CORPORATION TRAMWAYS

BY L. M KINNON, TRAFFIC SUPERINTENDENT, GLASGOW

In Glasgow the selection of these men is attended to personally by the traffic superintendent. This necessarily entails a considerable amount of work, and takes up a good deal of time, but the advantages of this method more than compensate for the extra labor. The superintendent thus knows his own men thoroughly from the very start, and by choosing the best class of men for the service his work is afterwards very much lightened. Roughly speaking, three applicants are found to be unsuitable for every one whose application is worth considering, and out of those whose applications are considered only about 40 per cent. are finally accepted, and enter the service of the department.

No man is engaged as a motorman or conductor who is under twenty-one years of age, and it is the endeavor of the department to obtain the services of young men.

When the traffic superintendent considers that an applicant, from his general appearance and from his replies to a few preliminary questions, will make a good servant, he hands him two schedules to be filled up in the applicant's own handwriting. The first schedule, or application form, requires the applicant to give particulars of his employment for previous five years. The second or supplementary schedule requires the applicant to answer the following questions:

1. Are you at present in good health?
2. From what ailments have you suffered? (Mention only those which lasted more than one week.)
3. Have you ever had:
   Rheumatism?
   Spitting of blood?
   Fits of any kind?

4. Have you ever met with a serious accident?

5. Have any of your parents, brothers, or sisters died of consumption?

6. Have any of your parents, brothers, or sisters suffered from insanity?

7. If you are married, please say if your wife is in good health, or what ailments she has suffered, or is suffering, from.

When these schedules are received back at the head office, former employers are communicated with, and in the event of the replies received being satisfactory, applicant is called to head office on a Friday morning at 9 o'clock. During the forenoon he is tested by one of the officers of the traffic department for eyesight, color sense, hearing, and general intelligence.

For eyesight, "Snellans'" test card is used. The applicant is placed at a distance of 12 ft. from the card and asked to read the bottom line on same, the type being 3-16-in. long. If he is able to do this promptly he is marked "V. G." Those who are able to read the bottom line on card at a greater distance than 12 ft. are marked "Ex." The second line on card is ¼ in., and applicants who are only able to read this line are passed and marked "G." All men unable to read this line are rejected. Each eye is tested separately, and the usual test is also applied for astigmatism.

For color sense variegated wools were used for a long time, but lately "Rumbles'" test for color blindness has been adopted. This is a large card with two small circles near the top. At the back of the card two discs are attached with a series of colors in celluloid. When the card is held before a window or artificial light and the disc turned, the various colors are shown through the circular holes, and the applicant is required to name them, and also to match the colors shown on one circle with the colors shown on the other. In examining men, especially from the country, cases of color ignorance are often found, which should not be confounded with color blindness.

Hearing is tested with a small ratchet operated by the examiner while the applicant stands at a distance of 10 ft. from him, and each ear is tested separately. Location of sounds is also tested by buzzers operated by the examiner.

When the applicant has passed satisfactorily through the preceding tests, he is afterwards asked to write a report on a subject set by the examiner. If this is also satisfactory, he is instructed to return in the afternoon to be examined by the medical officer.

The instructions to the medical officer are as follows:

The medical officer will reject applicants for any of the following: Tubercular disease; constitutional syphilis; bronchitis; heart disease; generally impaired constitution; loss of teeth, if numerous; deformity of chest, or joints, including flat foot; abnormal curvature of spine; hernia; hæmorrhoids; varicose veins or varicocele beyond a limited extent; obstinate skin disease; chronic ulcers; fistula; or any defect or disease unfitting applicant for employment either as conductor or motorman.

Should the applicant get through all these tests, he is put under training as a conductor for eight days, during which period he is paid full wages. The best qualified conductors at each depot take charge of the learner and train him carefully in his duties. During his period of training he is expected to have a turn on all the routes operated from the depot at which he is trained, and he is frequently visited by an inspector, who observes his progress. At the end of his period of training, if satisfactory, the probationer's practice note is signed by the men who have been teaching him, and he undergoes an examination by a ticket inspector, who also signs the practice note, if satisfied. On presentation of this note at the head office, the applicant is engaged. All the men are finally seen by the general manager.

After a period of satisfactory service as conductor—generally about six months—each man is withdrawn from the cars and put under training as a motorman.

In Glasgow a fully equipped school for training motormen has been fitted up at the Coplawhill Car Works, where the men are trained by an experienced engineer.

The period of training extends over twelve days, during which full wages are paid to the men. A single truck car of the standard type is erected over an inspection pit and supported on blocks so that the motors and gearing may be seen in operation. The car body is simply a skeleton which is mounted on a truck. All motor cables and lighting wires are painted in distinctive colors. This enables learners more readily to understand the general scheme of connections and location of various switches, fuses, etc. The braking gear and sand apparatus can easily be inspected. The car has a movable floor, so that the motors may be laid open for examination. On the platform a series parallel controller is erected with the usual operating gear, and glow lamps are connected across the motor terminals so that the action of the controller may be more easily understood. The trolley is connected to a "live" wire supplying the necessary current for motors and lights. The school is also equipped with samples of each trolley pole and standard used on the cars.

On a long platform at the side of the school, opposite the car, ten controllers and brake handles are erected in the same position as they are fitted on the cars, and samples of all types of controllers in use on the system are fitted up for examination and inspection. The brake spindles on the platform are each connected to a strong spring, so that their action is practically the same as the actual car brake.

Large diagrams showing controller connections are used to explain the action and proper working of the controllers and electric brakes, and men are also instructed in the use of a telephone similar to those erected at various points on the system.

The class in the school generally consists of twelve or fifteen men. From 25 per cent to 30 per cent fail to pass the necessary examination. Each man is supplied with instruction book, and during his first three days' tuition he attends the school. On the first day the instructor carefully explains the use and action of the various appliances fitted on the car, and shows how the mechanism should be operated. Learners are also drilled by means of the fixed controllers and brake already referred to, and the correct manipulation of the handles is explained, particular attention being paid to correct methods of acceleration and braking of cars for service and emergency stops.

On the second day the men are taught how to detect common faults in the car equipment, and also what to do in the event of any breakdown in the electrical apparatus or overhead gear. On the afternoon of the second day all the points taken up are again gone over and a preliminary examination made to see how each man is progressing.

On the third day the class is taken out to Coplaw Street, where a depot connection with a considerable grade has been laid. Here the men are tested on a special school car fitted with magnetic and rheostatic brakes. Each man is carefully coached in running the car both backwards and forwards, and every possible care is taken to instruct the men in all points relating to practical operating of the cars. Men are also taught to handle live wires and how to make them "dead" when necessary.

For the next four days—that is, on the fourth, fifth, sixth and seventh days—the learner is out on the road under the care of an experienced motorman, who has, after examination, been authorized to instruct learners. He here learns to handle the car through traffic. The learners are frequently visited on the road by the motor inspectors, who make notes of the progress shown, and report to the chief instructor.

On the afternoon of the seventh day the learner goes back to school for a preliminary examination in his knowledge of car details and platform duties, unsuitable men being rejected and returned to conducting. The next three and a half days are again spent on the road, under an experienced motorman, and special attention is given to those men who have shown signs of nervousness or carelessness. The afternoon of the twelfth day is taken up with an examination conducted by the chief instructor at the school, when suitable men are passed, and their lines forwarded to head office. As the tramway system has been steadily extending, there have been for some time past about forty men under instruction each month.

A system has been instituted in Glasgow of examining each motorman or motorman-conductor once every three or four months, and men who fail to answer questions satisfactorily at this examination are withdrawn from the list of motormen. These periodical examinations are absolutely necessary on a large system, as it is impossible for the superintendent otherwise to get at the undesirable. Some men who qualify will forget all they have learned within a very short time. A periodical examination every three or four months has also been instituted for conductors. This examination embraces all the rules laid down as to the duties of conductor.

It will be admitted that every possible precaution is taken to secure the very best possible material for motormen, and there is no doubt that the stringency of the examination before admitting men to the service has tended towards getting a better class of men into the department, and it has also had the effect of making those who secure situations value them more highly.

The Public Service Corporation of New Jersey has adopted as standard for its cars a yellow upper-body with an orange underbody and slate-colored trucks. The combination is extremely pleasing and harmonious, and does not show the dust and wear so readily as does the color scheme in use at present. As a matter of fact the new color scheme is similar to that in use in New York, St. Louis and Detroit. On each car will be painted in dark letters, edged with gilt, the name, "Public Service Corporation."

HOURS OF LABOR AND RATES OF PAY OBTAINING

BY ALFRED BAKER, CHIEF OFFICER, LONDON COUNTY COUNCIL TRAMWAYS

In this paper Mr. Baker confined himself to the pay of conductors and motormen and gave the statistics printed below. He states that, with only one or two exceptions, every town has adopted a graduated scale of pay for drivers and conductors, new men starting at the lowest rate and rising to the maximum by length of service varying from six months to three years. Taking the maximum rate of pay in all cases for motormen and conductors, the average over the whole country is as follows: Motormen, 6¼d. per hour; conductors, 5¼d. per hour. This works out, taking 60 hours a week as the standard, at 31s. 3d. for motormen and 26s. 3d. for conductors.

Out of the 33 towns observed only two, viz., London and Glasgow, pay motormen and conductors equal wages. In the remaining 31 towns motormen are paid at higher rates than conductors. For this he does not see any legitimate reason.

Placing the towns in order according to the wages paid, the list comes out as follows:

Towns	Motormen per hour	Conductors per hour
London County Council	7½d.	7½d.
Brighton	7d.	5½d.
Manchester	7d.	6¾d.
Halifax	7d.	5¾d.
Glasgow	6¾d.	6¾d.
Huddersfield	6¾d.	5½d.
Rotherham	6¾d.	5¼d.
Birkenhead	6½d.	5½d.
Burnley	6½d.	5½d.
Cardiff	6½d.	5¾d.
Bradford	6½d.	5½d.
Nottingham	6½d.	5¾d.
Sunderland	6½d.	5d.
Leeds	6¼d.	5d.
Rochdale	6¼d.	5¾d.
Wallasey	6¼d.	5½d.
Blackpool	6d.	5½d.
Bolton	6d.	5½d.
Darwen	6d.	5d.
Dundee	6d.	5d.
Oldham	6d.	5d.
Portsmouth	6d.	5d.
Southport	6d.	5d.
Stockport	6d.	5d.
Warrington	6d.	5d.

Other towns slightly less.

With regard to hours of labor the position is different. Glasgow, Doncaster, Cardiff, Plymouth, Halifax and Manchester have adopted a nine-hour day, 54 per week. Warrington and Darwen follow with 56 and 57 hours per week, respectively, while all the remainder, with the exception of three, have set up the 60 hours' standard. With regard to these three, it is only fair to say that considerable reductions in the hours of labor have been made as compared with the companies who worked the undertakings previous to the corporations obtaining possession. In one case the men worked under the company as much as 91 hours a week; this has been reduced to 65. In another 95 hours a week were worked; this is reduced to 63. In the third case 81 hours has been reduced to 64¼. I am quite sure that in some towns the men would rebel at anything less than 60 hours a week; that is, if the reduction involved a diminished earning capacity. I believe that having had their hours reduced to reasonable limits the tendency of the men will be rather toward increased rates of pay.

In the course of his inquiries Mr. Baker found only one town where preferential treatment seems to have been meted out to tramway men, even as against employees of the same corporation. Here the men work 54 hours a week, but are paid time and a half for Sundays, double time for bank and national holidays, and an attempt is being made to classify Good Fridays and Christmas Days as national holidays. Besides paying the men who work on bank holidays double pay, the men who do not work are paid a day's wages. He believes that every town must pay its men according to local conditions, and if it is the practice in the neighborhood to deal with the workmen in this magnanimous way there is nothing further to be said. If this policy is improperly forced on the corporation he considers that municipal tramway enterprise in this country is seriously prejudiced, besides which a grave injustice is being done to the ratepayers.

TRAMWAY CONDITIONS IN AMERICA AND GREAT BRITAIN COMPARED

BY CHRIS. J. SPENCER, GENERAL MANAGER OF THE BRADFORD CORPORATION SYSTEM

I was in the United States and Canada in the latter part of April and the early part of May, 1902, and while there visited the cities of New York, Pittsburg, Cleveland, Buffalo, Boston, Philadelphia, Toronto and Montreal, so that the impressions gathered of American and Canadian practice were from the above mentioned places. My British comparison was the state of affairs in Bradford, a city in the West Riding of Yorkshire with a municipal tramway system of about 230 cars serving a population of 281,000 (each of whom has a different opinion on tramway administration) scattered over an area of 22,800 acres of very hilly ground, so that the lines in Bradford present, in addition to traffic problems, engineering difficulties.

FARES

I found that in the majority of cities the fare problem, as we know it in England, did not exist. We all no doubt have met the man who requires a stage 100 yards or so further along the route, nearer a point where he happens to live. Not, of course, because it would in any way benefit himself, but for the welfare of the city. On the other side of the Atlantic the universal 5-cent fare does away with the stage system. I believe that to this universal fare system, the Americans owe a great measure of their success. We all know that tramways are achieving a great social reform in this country—that the health and happiness of the community is being directly benefited by the removal of the crowded population from the restricted area of the center to the broad acres of the suburb. To achieve this, cheap long-distance fares have to exist.

Unfortunately in England the 1d. seems to be the only universal fare that can be considered, and as most systems depend upon the receipts from the short distance passenger, it is often found that traffic returns will not allow more than about 2 miles for this fare. The possibilities of the nimble 1d. are certainly wonderful but they are limited. Compare this with the American (2½d.) fare. We must remember that the receipts from the short distance passengers are 150 per cent. higher than we obtain in England.

Not many tramway committees would, I venture to suggest, consider very long what to do did they know that their passengers would be willing to pay 2½d. where they now pay 1d. for short distances, on consideration that all stages be abolished. True, wages and perhaps some other expenses are higher in the States than here, but not by any means are they pro rata with the fares. Apart altogether from the outcry of the public, an increase in the minimum fare on British tramways would not pay. Englishmen will walk short distances rather than pay even 1d. Scotchmen, I am informed, are much worse; not so the American; he realizes that time is money, and that the expenditure of a 5-cent fare is small compared with the saving of time. I have heard it suggested that the street railway companies always manage to have the streets in a state that makes walking nearly a craze for the bold and brave. I have, however, no evidence to offer on that point, and do not desire to commit myself. We are, it is said, being Americanized, and perhaps even the American universal fare will yet come as a boon and blessing, and a balm for all our sorrows in respect to fares.

FARE COLLECTING

Everything in America appears to be standardized, and the system of fare-collecting is no exception to the general rule. No conceivable system could be simpler. The conductor receives his 5 cents and registers the fact on a clock face indicator, by pulling the indicator cord running the full length of the car. The check. I was informed, is the fear of the unknown passenger, who can easily see if any roguery is taking place. Should a man be reported by a "spotter" for sharp practice, his chances for further employment as a car conductor for the company by which he was employed, or any other, are remote. His photograph is sent round to each line along with the cause of his dismissal. On the face of it this system seems good and should be very effective, though one is inclined to think that the amount of power in the hands of the spotter is a trifle excessive. Yet I regret to state I saw three or four distinct cases of fraud on street cars. In two cases my own fare was taken by the conductor, who failed to register it.

I had the pleasure of discussing the matter with a street railway manager, who admitted freely the weaknesses of the system. I naturally asked if the bell-punch and tickets had been tried, and he replied, "Yes, but I guess it takes too much gilt off the nickel." I also asked if they had tried a locked fare box, similar to what we use in Bradford, and those I had seen in Montreal and Toronto. His reply was "Yes, and that would have been all right, but our

passengers thought the conductor was carrying a spittoon, and used it for that purpose." Fare-collecting systems are determined by the conditions that determine fares, so that a simple system similar to the American is only possible where fares are simple also.

TRAFFIC CATERING

So far as the frequency of service, etc., is concerned, I saw nothing different to the usual practice in this country; the service run on any particular section is determined by the earnings per car mile. Americans are, perhaps, as may almost be expected, just a little more enterprising in this direction than the average tramway manager here. For example, in one city visited I noticed on a traffic return sheet that a certain section was earning not more than 6 or 7 cents (3d. or 3½d.) per car mile, and that a fairly good service was being run. Upon inquiry I found that this particular section had been laid for the purpose of developing an estate, which I presumed was owned by the street railway company.

PLEASURE TRAFFIC AND ADVERTISING

Our traction friends of the States quite appreciate the effect of good pleasure attraction at the outside terminus of a line. In many places I found street railway companies owning and running pleasure parks, etc., and advertising with due modesty the wonderful beauty and suitability for pleasure purposes. In these matters we certainly have something to learn. I believe that many lines which are at present non-paying could be improved by a little judicious expenditure in the direction just mentioned.

SPEEDS

To mention speeds to a British tramwayman is almost like waving a red rag to a bull. It is unnecessary to state that speed limits in America are very different from what obtains at this side of the "pond." Though they are fixed by the various cities in which the street railway companies operate their lines, yet it seems to be recognized that the speed per hour allowed is the average schedule speed, and not the maximum attained between any two given points.

On the other hand, cars do not travel in the busy streets of the cities much quicker than they do here. I heard it stated, for example, that the average speed, including stops, was 10 miles per hour on Broadway, New York. I tested this one morning when I was in a hurry, but if the average speed exceeded 3 miles per hour on that occasion I am very much surprised; so I found that the American tramway manager can no more perform miracles than his English brother.

Much, however, is made of quick acceleration, and a good average speed is obtained more by this means than by running at the high maximum rate. The controlling pointer is shifted from the zero position to full speed in an incredibly short space of time, and it is as well that American passengers have become accustomed to it. I am afraid that did we in Bradford commence to accelerate our cars at such a rate as, say in New York, the number of nervous ladies clinging to stout old gentlemen, who in turn would be compelled to sit down hurriedly on the laps of other ladies, would, I am afraid, be appalling, and cause quite a public uproar. We have, however, something to learn with regard to acceleration, and I do not think its benefits have yet been fairly recognized in England. In Bradford I have for twelve months been gradually increasing the acceleration with a result that my average speed has increased from about 5½ to 6¾ miles per hour on all sections, and current consumption falling from 1.6 to 1.4 units per car mile. The passengers can be educated to the quick start, and its benefits are far reaching. True, the wear and tear on the equipment is increased, but to use a trite Americanism, "it pays."

We have been successful in Bradford in getting increased speed, and our maximum, previously 8, is now 12 miles per hour. We have had this granted, so say the Board of Trade, due to our good conduct, and it is held out that some time in the dim future, if our conduct is still good, that on certain quiet country roads we may be allowed to run as high as 16 miles per hour. I am afraid that by the time our conduct has attained such perfection nature will have provided for us wings, and new legislation for aerial navigation will be required.

OUTWARD APPEARANCES

In outward appearance the average American system does not strike an Englishman favorably. The overhead equipment is generally put up roughly, cheap and nasty. The cars are far from clean and the track in many instances bad. Neither can the average conductor be complimented on his civility. I must say that my remarks do not apply to all the systems I saw. Several are the very opposite, and rank, I should say, among the smartest and best tramway organizations of the world. After dealing with merely outside appearances, one must acknowledge that the facilities which the tramways give the public in the way of rapid transit from one point to another with frequent quick services, are excellent. In one case only did I see a slower service than a five minutes, and in the busy parts of the cities there was a continuous stream of cars going in both directions. In fact, every one seemed to be riding and no one walking. I am told that the American cannot afford to walk—he has not time. Trams are, therefore, to him not a luxury, but a necessity.

OVERHEAD EQUIPMENT AND PERMANENT WAY

I saw nothing in the overhead department very different from our standard practice here. I was very much interested in the different systems of permanent way construction—the electric welded joints in Buffalo, and cast welded joints in other cities visited, provided interesting matter for British consideration. As this subject, however, is being dealt with in another paper before the conference, it is unnecessary for me to go into further detail.

ROLLING STOCK

On the question of design, up-keep and care of cars, I found that matter stood pretty much the same as they are here. Engineers have different ideas, and work differently. In some cities I found the engineer advocated a regular overhaul of the equipment. At others it was considered good policy to allow the motors, etc., to run until they showed distinct signs that unless an immediate overhaul was made, a breakdown would occur. At Cleveland, Ohio, I found a system of inspection of equipments that I considered very good, and have since adopted the principle at Bradford, with excellent results.

Motors, controllers, etc., are examined daily while the cars are in service at some convenient terminus. It thus becomes unnecessary to employ a large staff of nightmen for inspection on small work repairs. The motor inspector notes any defect which is developing, and orders the car to remain at the repairing depot—he is better able to find and hear of the little faults in the daytime and during service hours. This, to my mind, seems better than either of the extremes, viz., waiting for breakdowns to know that something is wrong; or incurring heavy expenses by a regular and periodic overhaul.

I also found many useful practical hints, especially in the workshop and car-repairing department. As the majority of the workshops that I visited were originally built for other purposes, I did not find that the buildings themselves were very well adapted for the work for which they were employed. I found, however, all sorts of little plans of overcoming what might be termed natural difficulties, and a great number of labor-saving devices in the way of machinery employed to bring down the cost of running.

In all the workshops I came across a compressed air plant was in operation, which was used for various purposes; cars were swept out, motors cleaned, and building surfaces cleaned by air jets. Pneumatic tools—drills, chisels, hammers, lifts, etc., in successful operation, connected to the compressed air main laid in the shop. We have since my visit adopted a compressed air plant in our own repairing shops with corresponding benefits.

GENERAL

I fail to see that we are behind America in this country with regard to tramway matters, and while we may learn much from our friends across the Atlantic, yet in some things I feel that the Americans would equally benefit by a visit to this small island.

I desire to place on record my grateful thanks to those officials in the States who kindly placed so much information in my hands, and helped me in my inquiries. The uniform courtesy and friendliness that I received was very welcome to a stranger, and I hope that I may some time have the opportunity of reciprocating the kindness.

STANDARDIZATION OF TRAMWAY ACCOUNTS

BY JAMES DALRYMPLE, C. A., OF THE GLASGOW CORPORATION TRAMWAYS

As requested by the executive committee of the Association, I have the pleasure to submit herewith a report on Standardization of Tramway Accounts. From the report you will see I have considered it advisable to confine myself to a form of the annual financial statement, including revenue and expenditure account, capital account and balance sheet, with an appendix giving a complete classification of construction and equipment accounts and operating expense accounts. The purchasing, receiving and despatching of stores, and the recording of time and material might form the subject of another report.

I have been in communication with all the members of the Association, and with several financial officers of the corporations concerned, and have endeavored to draw out a form which

could be adopted by all municipal tramway managers and borough accountants in stating their annual tramway accounts. In so doing I have endeavored to adhere as closely as possible to the standard form which has been adopted by the street railways and steam railroads of America. The report on the uniform classification of working expenses presented at the meeting of the International Tramways Union in London in July, 1902, was also consulted in this connection.

I trust that at the meeting of the Association to be held in Glasgow the report will be fully discussed, and that it will be possible to adopt a standard form of tramway accounts, which can be brought into use during the coming year.

SUGGESTED STANDARD FORM OF ACCOUNTS

REVENUE ACCOUNT FOR YEAR FROM JAN. 1 TO DEC. 31, 1902

Kw-Hours, 1,920,000. Car Mileage, 2,181,819.

EXPENDITURE

DR.	Average per Kw-Hour d.	Average per Car-Mile d.	£ s. d.	£ s. d.
Power Expenses—				
1. Salaries and wages	.16	.15	1,363 12 9	
2. Fuel	.14	.13	1,181 16 4	
3. Water	.013	.012	109 1 10	
4. Oil and waste	.03	.027	245 9 1	
5. Miscellaneous supplies	.003	.003	27 5 5	
	.35	.322		2,927 5 5
Traffic Expenses—				
6. Superintendence		.07	636 7 3	
7. Wages of motormen and conductors.		2.27	20,584 8 3	
8. Wages of other traffic employees		.18	1,688 5 5	
9. Cleaning and oiling cars		.26	2,363 12 9	
10. Lighting cars		.017	154 10 11	
11. Cleaning, salting and sanding track		.05	454 10 11	
12. Fuel, power, light and water for depots		.03	272 14 6	
13. Ticket check		.13	1,181 16 4	
14. Uniforms		.08	727 5 5	
15. Miscellaneous		.039	354 10 11	
		3.126		28,418 2 8
General Expenses—				
16. Salaries of general officers and staff.		.14	1,272 14 7	
17. Auditors' fee		.004	35 0 0	
18. Store expenses		.02	181 16 4	
19. Rents of offices, etc		.03	272 14 6	
20. Local taxes		.31	2,818 3 8	
21. Property and income tax		.075	681 16 4	
22. Printing and stationery		.024	218 3 8	
23. Fuel, light, and water for offices		.006	54 10 11	
24. Legal expenses		.002	18 3 7	
25. Accident insurance (third party)		.12	1,090 18 2	
26. Employers' liability insurance		.012	109 1 10	
27. Fire and boiler insurance		.03	272 14 6	
28. Miscellaneous		.04	363 12 9	
		.813		7,389 10 10
Repairs—				
29. Track and roadway		.20	1,818 3 8	
30. Electrical equipment of line		.10	909 1 10	
31. Buildings and fixtures		.06	545 9 1	
32. Steam plant		.01	90 0 0	
33. Electrical plant		.01	91 16 4	
34. Workshop tools and sundry plant		.015	136 7 3	
35. Cars		.11	1,000 0 0	
36. Electrical equipment of cars		.22	2,000 0 0	
37. Miscellaneous equipment		.15	1,363 12 9	
		.875		7,954 10 11
Permanent Way Renewal—				
38. Permanent way renewal fund at £450 per mile of single track per annum.		.87		7,909 1 11
Depreciation—				
39. Electrical equipment of line		.30	2,727 5 5	
40. Buildings and fixtures		.17	1,545 9 1	
41. Power plant and sub-station plant		.35	3,181 16 5	
42. Workshop tools and sundry plant		.035	318 3 8	
43. Cars		.23	2,181 16 5	
44. Electrical equipment of cars		.23	2,000 0 0	
45. Miscellaneous equipment		.02	181 16 4	
46. Furniture		.008	72 14 7	
		1.343		12,209 1 11
Total amount of working expenses		7.349		66,807 13 3
Balance, carried to net revenue account, folio 5		2.71		24,601 8 10
		10.06		91,409 2 6

REVENUE

CR.	Average per Car-Mile d.	£ s. d.
Traffic Revenue	10.00	90,909 2 6
Sundry Revenue—		
Advertising	.06	500 0 0
	10.06	91,409 2 6

NET REVENUE ACCOUNT

DR.	Average per Car-Mile d.	£ s. d.
I. To Interest on Capital @ 3 per cent	1.03	9,390 0 0
II. To Sinking Fund—		
Sinking fund on £320,921 12 4 @ 2 per cent. £6,418 8 7		
Interest on £6,285 14 9 @ 3 per cent. 188 11 5	.73	6,607 0 0
	1.76	15,997 0 0
To balance, being net surplus carried to appropriation account	.94	8,604 8 10
	2.70	24,601 8 10
CR.		
By revenue account, folio 4	2.70	24,601 8 10
	2.70	24,601 8 10

APPROPRIATION ACCOUNT

DR.	£ s. d.
To amount carried to general reserve fund	12,000 5 6
To balance carried to balance sheet, folio 8	8,604 8 10
	20,604 14 4
CR.	£ s. d.
By net surplus for year to Dec. 31, 1901	12,000 5 6
By net surplus for year to Dec. 31, 1902	8,604 8 10
	20,604 14 4

CAPITAL EXPENDITURE ACCOUNT

Amount Expended on Capital Account for Year to Dec. 31, 1902

DR.	£ s. d.	£ s. d.
To Permanent Way (Track and Roadway)—		
Paid to account of various extensions during year		5,000 0 0
To Electrical Equipment of Line—		
Bonding	100 0 0	
Duct and manholes	1,000 0 0	
Feeder cables	1,500 0 0	
Poles and Rosettes	300 0 0	
Overhead wires	400 0 0	
		3,300 0 0
To Buildings and Fixtures—		
Brown Street Depot—paid to account	1,500 0 0	
Car works extension—paid to account	500 0 0	
		2,000 0 0
To Power Plant—		
Engines—paid to account	1,500 0 0	
Boilers—paid to account	1,000 0 0	
Switchboards—paid to account	500 0 0	
		3,000 0 0
To Cars—		
Fourteen cars, at £500 each		7,000 0 0
		20,300 0 0
CR.	£ s. d.	£ s. d.
By amount debited to capital account, folio 7		20,300 0 0

CAPITAL ACCOUNT

DR.	£ s. d.	£ s. d.
To Permanent Way (Track and Roadway)—		
Cost of construction as at Dec. 31, 1902		110,000 0 0
To Electrical Equipment of Line—		
Bonding	5,000 0 0	
Ducts and manholes	25,000 0 0	
Feeder cables	25,000 0 0	
Poles and rosettes	8,000 0 0	
Overhead wires	5,000 0 0	
Section boxes	1,000 0 0	
Telephones	200 0 0	
Miscellaneous	300 0 0	
	69,500 0 0	
Deduct—Depreciation as at last balance £2,500 0 0		
Deduct—Depreciation for year to Dec. 31, 1902 2,727 5 5		
	5,227 5 5	
		64,272 14 7
To Ground		15,000 0 0
To Buildings and Fixtures	50,000 0 0	
Deduct—Depreciation as at last balance £1,400 0 0		
Deduct—Depreciation for year to Dec. 31, 1902 1,545 9 1		
	2,945 9 1	
		47,054 10 11
To Power Station and Sub-Station Plant	50,000 0 0	
Deduct—Depreciation as at last balance £3,000 0 0		
Deduct—Depreciation for year to Dec. 31, 1902 3,181 16 5		
	6,181 16 5	
		43,818 3 7
To Workshop Tools and Sundry Plant	15,000 0 0	
Deduct—Depreciation as at last balance £318 3 8		
Deduct—Depreciation for year to Dec. 31, 1902 318 3 8		
	636 7 4	
		14,363 12 8
To Cars	25,000 0 0	
Deduct—Depreciation as at last balance £1,900 0 0		
Deduct—Depreciation for year to Dec. 31, 1902 2,181 16 5		
	4,081 16 5	
		20,918 3 7
To Electrical Equipment of Cars	25,000 0 0	
Deduct—Depreciation as at last balance £1,900 0 0		
Deduct—Depreciation for year to Dec. 31, 1902 2,000 0 0		
	3,900 0 0	
		21,100 0 0
To Miscellaneous Equipment—		
Sundry vehicles	700 0 0	
Horses	500 0 0	
Harness	70 0 0	
Uniforms	1,000 0 0	
Miscellaneous	1,000 0 0	
	3,270 0 0	

Deduct—Depreciation as at last balance	£181 16 4		
Deduct—Depreciation for year to Dec. 31, 1902	181 16 4		
		363 12 8	2,906 7 4
To Office Furniture		500 0 0	
Deduct—Depreciation as at last balance	£72 14 7		
Deduct—Depreciation for year to Dec. 31, 1902	72 14 7		
		145 9 2	
			354 10 10
To Parliamentary Expenses			10,000 0 0
To Preliminary Expenses			1,000 0 0
			350,788 3 6

CR.

	£ s. d.	£ s. d.
By amount of capital account carried to balance sheet, folio 8..		350,788 3 6
		350,788 3 6

BALANCE SHEET

As at Dec. 31, 1902

DR.	£ s. d.	£ s. d.
To Capital Account—		
Amount of capital account as on folio 7		350,788 3 6
To Stores—		
General stores	5,000 0 0	
Depot stores	1,000 0 0	
Stores in power station	2,000 0 0	
Stores in car works	2,000 0 0	
Permanent way material	5,000 0 0	
Salt and sand	50 0 0	
Fuel	300 0 0	
Tickets	100 0 0	
Miscellaneous	100 0 0	
		15,550 0 0
To Sundry Debtors		1,000 0 0
To Unexpired Licenses		50 0 0
To Cash in Bank		100 0 0
To Cash on Hand		599 7 10
		368,087 11 4

CR.	£ s. d.	£ s. d.
By Amount Borrowed as at Last Balance	320,921 12 4	
Deduct—Amount of sinking fund applied in reduction of debt	12,891 14 9	
	308,029 17 7	
Add—Amount borrowed during year to Dec. 31, 1902	10,000 0 0	
		318,029 17 7
By Sinking Fund—		
Amount for year to Dec. 31, 1901	6,285 14 9	
Amount for year to Dec. 31, 1902	6,606 0 0	
		12,891 14 9
By Permanent Way Renewal Fund—		
Amount as at last balance	7,500 10 6	
Add—Amount debited to revenue for year to Dec. 31, 1902	7,909 1 11	
	15,409 12 5	
Deduct—Amount expended during year on renewal of permanent way	2,500 10 11	
		12,909 1 6
By General Reserve Fund—		
Amount transferred from appropriation account		12,000 5 6
By Sundry Creditors		3,431 16 9
By Prepaid Tickets—		
Value of tickets sold and in hands of public		220 6 5
By Appropriation Account—		
Net surplus for year to Dec. 31, 1902		8,604 8 10
		368,087 11 4

SUNDRY INFORMATION

Total borrowing powers	£
Borrowing powers exercised	£
Unexhausted borrowing powers	£
Gross capital expenditure	£
Capital expenditure, as reduced by depreciation	£

Mileage of Track—

	SINGLE			DOUBLE			TOTAL		
	Miles	Fur	Yards	Miles	Fur	Yards	Miles	Fur	Yards
Owned									
Leased									
Totals									

Population served by tramways	
Traffic revenue	£
Total revenue	£
Working expenses (excluding depreciation)	£
Working expenses (including depreciation)	£
Interest on capital	£
Sinking fund	£
Net balance	£
Disposal of net balance	£
Car miles	
Passengers carried	
Average number of cars in use for hour day	
Percentage of working expenses (excluding depreciation) to receipts	
Percentage of working expenses (including depreciation) to receipts	
Average traffic revenue per car-mile	
Average traffic revenue per mile of single track	
Average total revenue per car-mile	
Average car-miles per day per car	
Average speed per hour	
Average car-hours per day	
Average working expenses per car-mile (excluding depreciation)	
Average working expenses per car-mile (including depreciation)	

Scale of Fares—

	½d.	1d.	1½d.	2d.	2½d.	3d.	3½d.	Average Fare charged per mile
Aver. distance (miles),								

Average fare paid per passenger	
Average number of passengers per car-mile	
Average journeys per head of population per annum	
Numbers of cars in stock	
Total amount of sinking fund	£
Amount of sinking fund applied in reduction of debt	£
Amount of renewal fund	£
Amount of reserve fund	£

CLASSIFICATION OF CAPITAL ACCOUNTS FOR ELECTRIC TRAMWAYS

A.—Permanent Way (Track and Roadway).
B.—Electrical Equipment of Line.
C.—Ground.
D.—Buildings and Fixtures.
E.—Power Station and Sub-Station Plant.
F.—Workshop Tools and Sundry Plant.
G.—Cars.
H.—Electrical Equipment of Cars.
I.—Miscellaneous Equipment.
J.—Office Furniture.
K.—Parliamentary Expenses.
L.—Preliminary Expenses.

Account A.—Permanent Way (Track and Roadway)

Charge to this account all expenditure for track and roadway construction, including labor, materials, tools, freight, cartage, cost of grading, excavating, track laying, ties, yokes, slot rails, sewer manhole frames and covers, rails, rail fastenings, welded joints, special work (including crossings, crossovers, curves, frogs, guard rails, switches), concrete, paving, oils, pitch, gravel, chips, asphalt, bitumen, drain boxes, sewer boxes, F. C. traps, gratings, C. I. pipes, F. C. pipes, iron paving blocks, bricks, bolts and nuts, coal, cement, dog spikes, road metal, sand, spelter, F. C. syphons, lifting wood, fences, bridges, culverts, trestles, subways, tunnels, etc., engineering and superintendence, wages of clerks, timekeepers, watchmen, light and water, street improvements, and other expenses not detailed above.

The cost of tracks in car depots and other buildings should be charged to this account.

The cost of preparing rails for bonding should be charged to Account B.

Account B.—Electrical Equipment of Line

Charge to this account all expenditure for electrical equipment of line, including labor, materials, tools, freight, cartage, cost of preparing rails for bonding, rail bonds, ducts, manholes, poles, rosettes, cables, guard wire, span wire, strain wire, supplementary wire, trolley wire, ground feeders, underground feeders, pole fixtures, overhead appliances, conduit appliances, surface contact appliances, engineering and superintendence, wages of clerks and timekeepers, and other expenses not detailed above.

Account C.—Ground

Charge to this account cost of ground purchased for power station, substations, workshops, car sheds, offices, and other buildings used in operation of line.

Ground purchased to form tramway track should be charged to Account A.

Account D.—Buildings and Fixtures

Charge to this account all expenditure for buildings and fixtures, including labor, materials, tools, freight, cartage, and all other expenses incidental to the work.

Buildings and fixtures include power houses, sub-stations, car sheds, workshops, stores, stables, offices, waiting rooms, etc.

Account E.—Power Station and Sub-Station Plant

Charge to this account all expenditure for steam and electrical equipment of power station and sub-stations, including foundations for equipment.

The cost of buildings used for power station and sub-stations should be charged to Account D.

Account F.—Workshop Tools and Sundry Plant

Charge to this account all expenditure for shop tools and workshop machinery, car-shed tools, granary machinery, permanent-way plant, sand-drying plant, and other appliances, including foundations for same.

Account G.—Cars

Charge to this account all expenditure in the construction of cars from the operation of which revenue is derived.

The term "car" includes the car-body and truck and all fixtures or appliances inside of or attached to the car-body or truck.

The electrical equipment should be charged to Account H.

Account H.—Electrical Equipment of Cars

Charge to this account all expenditure for electrical equipment and wiring of all cars.

Account I.—Miscellaneous Equipment

Charge to this account cost of sundry vehicles, including water cars or carts, sand and salt cars or carts, store cars, snow plows, sweepers, lorries, vans, broughams, horses, harness, uniforms, cash boxes, ticket boxes, bell punches, etc.

Account J.—Office Furniture

Charge to this account cost of furniture for head office, sub-offices, etc.

Account K.—Parliamentary Expenses

Charge to this account costs of acts of Parliament promoted by the Corporation for tramway purposes.

Account L.—Preliminary Expenses

Charge to this account all preliminary organizing expenses not chargeable under any of the foregoing accounts.

CLASSIFICATION OF WORKING EXPENSE ACCOUNTS

POWER EXPENSES

Account No. 1.—Salaries and Wages

Charge to this account proportion of chief engineer's salary and all wages in the power station and sub-stations, except wages of men engaged in repairing plant. This account should include wages to the following employees: Superintendent of station, engineers, greasers, feed-pump attendants, stokers, coal and ash attendants, electrical engineers, switchboard attendants, motor attendants, basement attendants, cranemen, cleaners, boiler fitters, clerks and storemen, watchmen, sub-station attendants, sub-station improvers, sub-station cleaners.

ACCOUNT No. 2.—Fuel

Charge to this account all expenditure for coal or other fuel used at the power station, including freight, cartage, and removal of ashes.

ACCOUNT No. 3.—Water

Charge to this account cost of water for boilers and condensers.

ACCOUNT No. 4.—Oil and Waste

Charge to this account all expenditure for lubrication of power plant and sub-station plant, including oil, grease, waste, rags, etc.

ACCOUNT No. 5.—Miscellaneous Supplies

Charge to this account all sundry expenditure in the operation of the power station and sub-stations not detailed under the foregoing accounts. Material used in repairs should not be charged to this account.

The following is a list of some of the items chargeable to this account: Globe metal polish, emery and glass paper, brushes and mops, oil cans and spouts, soaps and sodas, tallow, turpentine, graphite, stenoline grease, pumice stone, ground black lead, bath bricks, chalk, squeegees, toilet rolls, twines.

TRAFFIC EXPENSES.

ACCOUNT No. 6.—Superintendence

Charge to this account salary of traffic superintendent and assistants.

ACCOUNT No. 7.—Wages of Motormen and Conductors

Charge to this account wages of motormen and conductors engaged in operation of cars.

ACCOUNT No. 8—Wages of Other Traffic Employees

Charge to this account wages of depot clerks, traffic regulators, trolley turners, points boys, etc.

ACCOUNT No. 9.—Cleaning and Oiling Cars

Charge to this account wages paid to car cleaners and oilers and costs of all cleaning material, brooms, brushes, buckets, chamois skins, dusters, mops, polish, soap, sponges, waste, disinfectants, oil, grease, etc.

ACCOUNT No. 10.—Lighting Cars

Charge to this account cost of power for light and incandescent lamps.

ACCOUNT No. 11.—Cleaning, Salting, and Sanding Track

Charge to this account wages of men employed in cleaning, salting and sanding track, cost of tools for cleaning track, salt and sand.

ACCOUNT No. 12.—Fuel, Power, Light, and Water for Depots

Charge to this account cost of fuel for depot offices, power for shifting cars, cost of lighting depots and water other than water for cleaning cars.

ACCOUNT No. 13.—Ticket Check.

Charge to this account cost of tickets, conductors' punches, wages of ticket inspectors, clerks in punch and ticket office.

ACCOUNT No. 14.—Uniforms

Charge to this account cost of uniforms supplied to traffic staff.

ACCOUNT No. 15.—Miscellaneous

Charge to this account cost of trolley rope, bell cord, commutator brushes for cars, tools for motormen, employees' badges and inland revenue and police licenses for cars.

GENERAL EXPENSES.

ACCOUNT No. 16.—Salaries of General Officers and Staff

Charge to this account salaries of general manager, accountant, and all officers and clerks not engaged exclusively in any one department.

ACCOUNT No. 17.—Auditors' Fee

Charge to this account fee paid to auditors for audit of books and accounts.

ACCOUNT No. 18.—Store Expenses

Charge to this account all salaries and expenses in connection with store-room, including wages of vanmen conveying supplies from general store to depots and collecting scrap.

ACCOUNT No. 19

Charge to this account rental of head offices, sub-offices and wayleaves.

ACCOUNT No. 20.—Local Taxes

Charge to this account all local rates and taxes, including municipal rates, police rates, poor and school rates, etc., on the annual value of the tramways undertaking.

ACCOUNT No. 21.—Property and Income Tax

Charge to this account annual charge by the inland revenue authorities for income tax on profits and property tax.

ACCOUNT No. 22.—Printing and Stationery

Charge to this account all expenditure for printing and stationery supplies. The cost of tickets should be charged to Account No. 13.

ACCOUNT No. 23.—Fuel, Light and Water, for Offices

Charge to this account cost of coal and other fuel for head office and sub-offices, also cost of electric light, gas, and water for same.

ACCOUNT No. 24.—Legal Expenses

Charge to this account all legal expenses except those incurred in connection with damage claims.

ACCOUNT No. 25.—Accident Insurance (Third Party)

Charge to this account the annual premium on third-party policy or if claims are settled by the department the amount of claims paid and the legal expenses connected therewith.

ACCOUNT No. 26.—Employers' Liability Insurance

Charge to this account the annual premium on employers' liability policy, or if claims are settled by the department, the amount of claims paid and the legal expenses connected therewith.

ACCOUNT No. 27.—Fire and Boiler Insurance

Charge to this account the annual fire insurance premium and boiler insurance premium.

ACCOUNT No. 28.—Miscellaneous

Charge to this account any other sundry expenses not included in any of the foregoing accounts, including repairs to office furniture.

REPAIRS.

ACCOUNT No. 29.—Track and Roadway

Charge to this account all expenditure for repairs of track and roadway, of culverts and subways, of tracks in yards, depots, and other buildings, including wages, material, tools, fuel, light, water, freight, cartage, and other expenses in connection with this work.

The cost of taking up track, whether or not a new track is laid in its place, should be charged to this account.

The cost of preparing rails for repair of bonding, and of removing and relaying paving, etc., for repair of electrical equipment of line, should be charged to Account No. 30.

The cost of repairing harness and carts used in connection with this work should be charged to Account No. 37.

The proportion of feed and keep of horses used in connection with this work should be charged to this account.

The expenses of the permanent way yard, including wages of yardmen, would be distributed over the accounts benefited.

ACCOUNT No. 30.—Electrical Equipment of Line

Charge to this account all expenditure for repairs of overhead, conduit, or surface-contact electric line, including wages, material and tools employed or used in taking up, resetting, and repainting poles, taking down trolley, feed, guard and supplementary wires and substituting new, repairing conduits for wires, repairing rail bonding, removing and relaying paving for repairs of the electric line, repairs to ducts and cables, section boxes, etc.

The cost of repairs of electric line in yards, depots and other buildings should be charged to this account.

The proportion of feed and keep of horses in connection with this work should be charged to this account.

The cost of repairs of harness and carts and tower wagons used in connection with this work should be charged to Account No. 37.

ACCOUNT No. 31.—Buildings and Fixtures

Charge to this account all expenditure for repairs of buildings and fixtures used in connection with the operation of the tramways, including wages, material, tools, freight, cartage of materials, and all other expenses connected with this work.

The term "Buildings and Fixtures" includes power station and sub-stations, workshops, office buildings, waiting rooms, car sheds, stables, stores, etc., and all fixtures, including gas pipes, water pipes, drains, heating apparatus, lighting fittings.

The cost of repair of tracks in yards, car sheds and other buildings, should be charged to Account No. 29.

The cost of repairs of electric lines in yards, car sheds, and other buildings should be charged to Account No. 30.

ACCOUNT No. 32.—Steam Plant

Charge to this account all expenditure for wages, material, tools, freight, cartage of material, and all other expenses in connection with repair of steam plant, including engines and engine parts, appliances and fixtures, belts, belt tighteners and fixtures, receivers, lubricators and oiling devices, boilers, furnaces, economizers, pumps, feed-water heaters, tanks, condensers, coal and ash conveyors, mechanical stokers and, other boiler-room appliances, piping and steam fitting, including valves, separators, water connections and water meters.

ACCOUNT No. 33.—Electrical Plant.

Charge to this account all expenditure for wages, material, tools, freight, cartage of material, and other expenses in connection with repair of electrical plant, including generators, switchboards, cable and feeder terminals, storage batteries, transformers, rotaries, boosters, rheostats, circuit breakers, ammeters, and other electrical equipment.

Commutator brushes for generators should be charged to Account No. 5.

ACCOUNT No. 34.—Workshop Tools and Sundry Plant

Charge to this account all expenditure for repair of workshop tools, machinery, and appliances, such as engines, boilers, shafting, motors, etc.; also permanent way plant, including temporary crossovers, street lamps, and timber for barricading.

Hand tools of tradesmen or laborers should be charged to the account benefited by their use.

ACCOUNT No. 35.—Cars

Charge to this account all expenditure for repairs of cars, including wages, material, tools, freight, cartage of material, and all other expenses connected with this work.

The term "Cars" includes car-bodies and trucks and all fixtures or appliances inside of or attached to the car-body or truck, except the electrical equipment of the car.

Bell cord, trolley rope, commutator brushes and other supplies should be charged to Account No. 15.

The cost of incandescent lamps should be charged to Account No. 10.

ACCOUNT No. 36.—Electrical Equipment of Cars

Charge to this account all expenditure for repairs of the electrical equipment and wiring of cars, whether revenue cars or other cars, including wages, material, tools, freight, cartage of material and other expenses connected with this work.

The cost of commutator brushes and other supplies for the electrical equipment of the cars should be charged to Account No. 15.

The cost of incandescent lamps should be charged to Account No. 10.

ACCOUNT No. 37.—Miscellaneous Equipment

Charge to this account all expenditure for repairs of water cars or carts, sprinkling cars, sand and salt cars, supply cars, snow plows, sweepers, lorries, wagons and other sundry vehicles, including wages, material, tools, freight, cartage of material, and other expenses connected with this work.

Replacing horses and repair of harness should be charged to this account.

Repairs of electrical equipment of all sundry vehicles should be charged to account No. 36.

PERMANENT WAY RENEWAL.

ACCOUNT No. 38.—Permanent Way Renewal Fund

Charge to this account the estimated annual amount necessary for the renewal of the track. This sum should be carried to a permanent way renewal fund, and all expenditure for renewals should be taken from this fund.

DEPRECIATION.

ACCOUNT Nos. 39 TO 46

Charge to these accounts the estimated annual amount which is necessary to keep the plant, buildings and equipment up to their original perfect condition. In other words, the amounts here charged annually are the estimated amounts necessary to meet the depreciation which has taken place during the year, in addition to the sums which have been expended and charged under accounts Nos. 30 to 37.

PERMANENT WAY CONSTRUCTION AND MAINTENANCE

BY CHARLES A. KING, B. SC., C. E., OF GLASGOW

This article is based upon a long list of replies to some seventy questions on track construction, which were sent to different roads by the managers of the Glasgow tramways, and which replies were tabulated. Replies were received mainly from British roads, but eight American and Canadian roads, viz., those in Boston, New York, Baltimore, Pittsburg, Philadelphia, Washington, Montreal and Toronto also supplied information. Six continental replies were also received, viz., from roads in Dresden, Munich, Zurich, Milan, Budapest, Berlin. The paper summarizes these replies as follows:

In Great Britain and Ireland the girder rail is the only rail in use on public streets. For straight track rails the minimum weight recorded is 65 lbs. per yard, and the maximum 105 lbs., but by far the greater number of systems adopt a rail weighing

between 90 lbs. and 100 lbs. A large number of towns use a heavier rail on curves, in one instance the weight being 117 lbs. per yard. Almost 50 per cent of the systems have a rail 7 ins. deep, a considerable number having 6½ ins. and 6 ins. Except in America, where deeper rails are used, these limits are very rarely exceeded. It is of interest to find that out of every three tramway systems, two use rails with a flat head, and one has the head coned.

The width of the groove on straight track rails varies on different British systems from 1 in. to 1¼ ins., but only on seven systems is the groove wider than 1⅛ ins., this width and 1 in. being by far the most common. In America 1⅜ ins. is in use on straight track. A large number of systems widen the groove on curves by about ⅛ in. Norwich is unique in widening from 1 in. on straight track to 1⅜ on curves, and, what is worthy of note, the managers state that they consider this too wide, and would prefer 1¼ ins. on curves. About 35 per cent of the tramways reporting use a specially high guard lip on the curve, of which the maximum height in this country seems to be ¾ in. above the tread. Several systems use check rails on the sharper curves.

There has been some controversy as to the best length of rail to use. The returns show that at the present time 40 per cent of the systems use 45 ft. rails, the 60-ft. rail coming a close second with 33 per cent in its favor, the remaining 27 per cent of the systems using shorter lengths than 45 ft. Each length has its keen supporters, and the chief arguments in favor on each side are as follows:

Those who support 45 ft. lengths say: Most convenient to handle and turn; most easily curved; less movement than longer rails; also that the longer rail causes more trouble with paving; more undulatory movement and hogbacking and acquires a permanent set by sagging with its own weight. Those who favor the 60-ft. rail put forward as their main argument: Fewer joints, and, therefore, less maintenance and less electrical resistance, and maintain that the extra difficulty in handling is very slight, and that this long rail sits quite as securely on its bed as its shorter rivals.

There is considerable variation in the gages adopted. The most common is 4 ft. 8½ ins., but several systems have a 4-ft. gage and about twenty use 3-ft. 6-in. gage. One or two systems have gages peculiar to themselves. That this is an inconvenience is apparent to everyone, and in the future as lines extend and in many cases join this will be more acutely felt.

The tests which engineers require the rails to satisfy vary considerably in severity, but the nature of the tests is very similar. A given weight falling from a fixed height on a given length of rail resting on rigid supports placed at a specified distance apart must not produce more than a given maximum of distortion or permanent bending. This is known as the drop test, and is almost universal. In many cases this is the only mechanical test applied; but it is often accompanied by the ordinary tensile test, with a specified elongation and contraction. A few specifications require, in addition to the drop test, the bending of a small bar cold, without fracture, or the bending of the rail to a small radius without showing any signs of cracking or rupture.

The chemical composition specified by the different systems shows that a considerable difference of opinion exists among tramway engineers as to what is required. With regard to the carbon, which is the main constituent, one specification is as low as from .28 per cent to .40 per cent, while another is as high as from .55 per cent to .66 per cent. The average carbon aimed at in the majority of cases seems to be about .53 per cent. Regarding the rail in its capacity as an electrical conductor, the percentage of manganese is of importance. One specification asks for an average of 1.10 per cent, and another specifies no more than .1 per cent, showing a very wide divergence of opinion. The average quantity of manganese wished for in most cases appears to be about .90 per cent, which certainly does not err on the low side. In several cases a high silicon is specified with a very high carbon, which, if obtained, would necessitate a careful handling of the rails. It would be interesting to have some records of the analysis of the actual rail as compared with the composition specified. Generally, the tendency is to specify a higher carbon rail than was formerly used.

After the rail itself there is no more important problem which presents itself to the engineer than the method to be adopted in joining these into a continuous smooth running road.

Having only comparatively recently adopted electric traction on a large scale, we in this country are realizing to the full the very exacting demands it makes on the permanent way as compared with horse traction. Nowhere is this more in evidence than at the joints. The number and diversity of the devices used, as shown in the replies, is evidence of this. There are at least a dozen separate methods, and many combinations of two or more of these.

Of the replies received 30 per cent rely on fish-plates unaided, 23 per cent combine these with anchor-plates, and 21 per cent use sole-plates in addition to fish-plates. Of the remaining methods of jointing the most interesting is, perhaps, the cast weld joint, largely adopted on four systems, two of those in America. That few of the above have proved entirely satisfactory is shown by the large number of systems on which trials are being made of other forms of joint than at present in use on these systems.

In this connection, mention must be made of the chemical welding material, "Thermit," lately put on the market. At least eight towns are at present experimenting with this device. At Dresden, on the Continent, and Leeds, in this country, the trials have been extensive, and both towns have reported very favorably. In Glasgow we purpose making a trial of several hundred joints this summer. The returns for cast weld joints are curiously at variance. Of nine towns reporting as having tried this method, in America two were favorable and two unfavorable. On the Continent one was favorable and one unfavorable; in this country, one favorable and one unfavorable; one made no comment. Only one city reported having used electric welded joints—Boston, United States. The result is stated not to have been a success. It must, however, be noted that these welds were made in 1893, at which time, it is now admitted, even by the contractors, that the methods were defective. The Lorain Steel Company, which owns the welding plant, claim that the present method is a great advance on the practice of 1893, and this form of jointing is making considerable progress in America. It has been arranged to make a number of these joints also in Glasgow in the autumn.

Before passing from the consideration of welded joints, it may be noted that the present practice regarding the bonding of these is to put no bonds with chemical and electrical welds. With cast welds about 50 per cent seem to bond in addition.

Apart from the question of joints, but to a certain extent connected with it, is the fixing down of the rails to the bed, not only at the end, but at intervals in the length. The tendency seems to adopt this much more largely in the future. Taking into consideration the increasing length and height of the rails, and the close butting of the ends, this is undoubtedly a step in the right direction. The rails are close-butted at the ends on over 75 per cent of the tramway systems under consideration.

A question of considerable interest and importance, affecting not only the permanent way, but also the rolling stock and the overhead trolley wires, is the placing of the rail joints. Of the total systems reporting, two out of every three have the joints placed opposite each other. Taking especially into consideration the rolling stock and overhead work, the writer believes this to be the best practice. At the same time the longer experience of some of the earlier systems has led them to adopt staggered joints. On most systems square joints are not insisted on at curves, but where the fish-plate adopted is long, the writer is strongly of opinion that on sharp curves the joints should be squared or far enough apart to get at least one tie-bar between them, otherwise a knee at the joint will result.

The most important feature in special work is, without doubt, the points, and more especially the tongues or switches. A defective tongue in a facing point may easily lead to serious accident. The returns show a variation in the lengths of tongue between 3 ft. 6 ins. and 9 ft. 6 ins. The tendency is clearly to go in for longer points and tongues than in the past. There can be no question that it is advisable to have the tongues at least six inches longer than the length of the single-truck car wheel-base to avoid the leading wheel throwing the tongue over before the rear wheel has entered. Other obvious benefits are derived from a long tongue, especially if curved on the branch-off side.

There is considerable diversity of opinion as to whether tongues should be placed on the inside or outside of curves; and as to the advantage of having two movable tongues instead of one tongue and a mate or dumb point. Also on some systems no tongue is used on trailing points.

The replies to the question regarding the "kicking" or rising vertically of the tongues of trailing points are of great interest to Glasgow, as this trouble has been considerable on this system. The great majority have had no such experience. Twelve towns—three in America—had the same trouble to a more or less extent. Without wishing in any way to disturb the peace of mind of those who have recently adopted electric traction, the writer notes that in all places where this action has developed, electric traction has been in use for a considerable time, and a large proportion of those towns reporting no trouble with trailing points have had only a short experience of the wear and tear of heavy electric cars. The writer has been giving attention to this matter for some time and is satisfied that the wearing of the floor of the casting is the cause of the springing upward of the

tongue, and that the depression on the top of the tongue is caused by the consequent heavy blow which it receives on rising to meet the advancing wheel. A pin in the nose of the point tongue lessens this evil to only a limited extent.

The replies regarding the use of hardened steel renewable center pieces are remarkably unanimous. About thirty towns, including four in America, have these in use; twenty are pronouncedly in favor; two—Montreal and New York—consider them unsatisfactory, the others have not had sufficient experience to express an opinion.

The essential feature of hardened steel renewable centers is that these can be renewed. It is certainly strange to find such perfect belief in this work as the replies disclosed, when practically the whole of the believers have had no experience of how this essential feature will work in actual practice. Carried out as directed by all the makers of this work, the results are anything but satisfactory. Great difficulty is experienced in cutting out the spelter and getting at the keys, and even when this is accomplished the center piece itself is difficult to lift out of its bed. In some cases the whole casting has to be lifted and taken to the yard, and the renewable piece removed there.

As will be seen from the report, the replies give very little help in this matter, with the exception of the three from America. Two indicate the method of replacing, but only one, that from New York, gives the whole operation. It is as follows: "Melt zinc with blow lamp or torch, wedge center in place, and pour in melted zinc, caulking well around the edges."

This is not quite such a simple matter as it seems, especially with large castings and long renewable pieces. After about a year's intermittent experiments, the writer has devised a means of melting out and renewing which will enable the work to be done in about one-fifth of the time formerly required, and effect a considerable saving in cost. About twenty-one towns have in use, to a greater or less extent, special work of wholly manganese steel. In most cases the work seems to have been lately laid down, and no opinion is expressed as to its merits, but five towns approve of this material.

In the list of questions sent out, one question was to the effect of special work constructed wholly of manganese steel throughout (as distinguished from manganese steel renewable pieces) in wearing down or cutting away the flanges of steel tired or other wheels. One of two replies to this question have been received from towns, which state that they have no special work wholly of manganese steel. Deducting all doubtful replies, the experience of four towns has been that there is considerable wear and chipping with this class of work. As a very considerable number of towns have put down this type of special work recently, this seems a point which it would be of considerable value to the Association to have a report further on.

In laying new track where a new concrete bed is required the replies show that engineers are divided almost exactly equally between two methods. The one section lay the concrete bed first. The rails are then laid down, lined and packed with fine concrete. The other section lay the rails first, setting them up to line and level on blocks. The concrete bed is then put in below the rails and leveled up tightly under the flange. In several cases the adherents of each system state that they purpose to adopt the other system in future. The balance of converts is slightly in favor of the method of laying the rails first and leveling the concrete bed up to them.

Wooden ties are used only to a limited extent in this country, but largely in America and on the Continent. The claims put forward on behalf of this construction are: Easier traction, more elasticity, easier riding of cars, acts as an anchor for rail, keeps track to gage, and lessens the noise. Toronto has used them under the old work and is of the opinion that cross ties are of no advantage.

The dimensions of the tie vary on different systems, but the general practice seems to be about 7 ft. x 8 ins. x 6 ins. Naturally, the timber used differs in different countries and localities. In this country Baltic redwood is the most usual, and this is creosoted in every case. Two replies from the Continent state that oak is used untreated. Oak, chestnut, long-leaf yellow pine and cedar are used in America, and in the majority of cases are not treated. The general practice is to place the ties between 2 ft. to 3 ft. apart. In Leeds, however, eight ties are put in under each 60 ft. length, the ones at the joints being 1 ft. 8 ins apart, and the others about 9 ft. 8 ins. apart. The rails are usually fixed down to the ties by spikes, but in Leeds three-quarter in. bolts, with fang washers and clips, are used.

The majority of the systems reporting pave the tracks with granite blocks, wood being the next in favor, and then basaltic blocks. It is unfortunate that only in very few cases is the class of wood used specified. The general experience with wood paving seems favorable with light traffic, but of doubtful efficiency in city streets, especially alongside the rails. From a limited experience of wood paving in Glasgow the writer is of opinion that the nature of the grouting of the joints has a considerable influence on the success or failure of wood paving, provided, of course, that the wood itself is satisfactory. The experience of those with large areas of wood paving would be of value to the Association, especially in view of the present crusade against "noisy streets."

In about a dozen towns widening of the gages has resulted from the expansion of the wood paving. The testimony against the use of asphalt between and alongside the rails is very strong. In most cases a toothing of stone or wood is laid alongside the rails, but even with this protection the asphalt has in most cases proved unsatisfactory, except under very light traffic.

Many towns experience trouble from the paving setts or blocks rising alongside the rails. This has been assigned to several causes, as, water getting down under the blocks and rails, the bitumen grouting in hot weather forcing the blocks up, the blocks resting on the rail flange; action of heavy traffic, etc. Probably each of these has at different times been a factor in raising the paving. The writer considers it certain that in almost every case where this evil of rising paving has been met with, it will be found that the rail is not lying soundly on its bed and is springing with the traffic. A small movement in the rail will raise the blocks butting against it very considerably. Each time the rail rises it takes up the paving blocks, and when it goes down again it leaves the block up, allowing sand and dirt to drop in beneath, and this taking place time after time, packs the block up. In wet weather this takes place much more quickly, owing to the water below the rails and paving.

The following are some of the remedies suggested in the replies: Anchor joints, holding-down bolts, use mastic packing to prevent the rail springing, use well tarred chippings laid on bottom flange to keep out water.

"Rutting" of the paving by heavy traffic seeking the rails is a source of expense in towns. About a dozen systems use cast-iron blocks chilled on the surface and laid alongside the rails to mitigate this wear. In Glasgow we have found them of very considerable value where the weight of individual vehicles is not excessive.

By far the greater number of towns use bitumen and oil for grouting the paving joints, some using this for part of the joint and cement and sand for the remainder.

The construction of the duct or cable track is a matter of great importance and interest, and more information on this subject would have been of value. Earthenware ducts or pipes are used on 65 per cent of the systems reported on. Almost all these lay the ducts solid in concrete. Thirteen per cent of the replies state that the cables are laid in earthenware or wooden troughs, and run solid with bitumen, while the cement lined iron duct laid in groups in concrete claims 9 per cent in its favor. The remainder are in pipes presumably of cast-iron. Note may be taken of the method in Zurich, where the earthenware ducts are laid in sand, and Zurich, where the lead cables, armored with iron strips, lie in the earth without any special duct. It is a matter of regret that the position in the roadway of the duct track was not stated, also the cost per yard and the depth at which the ducts are laid.

The spacing of manholes varies remarkably on different systems. The shortest distance apart recorded is 30 lineal yards, and the maximum 300 lineal yards. The average distance is about 100 yards. Only three systems go beyond 150 lineal yards. All these distances are, of course, on the straight; on corners the distance apart must vary with the radius of the curve.

The replies show that in no case has any chemical action on the cables from the material of the duct track been found. In view of sinister rumors, which probably most of you have heard, this is a reassuring return. The replies giving the methods of bonding were, unfortunately, not detailed enough to be of much value. The general result shows that by far the greater number of lines are bonded with solid or flexible Chicago or Neptune bonds. Plastic bonds claim one-sixth of the whole returns.

Cross bonding of the track is almost universal. The usual distance apart of the bonds is 40 lineal yards, but seven systems place these as far apart as 80 yards, which is the maximum distance recorded. In only four cases has any trouble been experienced from bonds working loose. The method of bonding up the special work is on almost all tramways the same as that adopted on straight track, with the addition of long bonds round the castings. Dublin varies its practice by bonding ordinary work into the web, and special work into the flange. Toronto, Canada, bridges the whole special work with cables. In Glasgow we are now adopting this system, and about a month ago applied it to a large and intricate three-story junction with a very considerable saving in time and cost.

We in Glasgow have had a considerable number of the horse shoe bonds in the flange of the rail but by the working of the paving stones under heavy traffic. Practically all the replies stated that this had not been experienced. Five towns—two in Britain and three in America—had found the same trouble. The very exceptionally heavy vehicular traffic in Glasgow is the chief cause of the evil.

The returns of the cost per mile of single track are interesting, but not of much practical value without full particulars in each case. The cost is greatly affected by so many different conditions as, the nature of the paving, the road-bed, whether in the central districts of a town or suburban, the facilities allowed for opening up the roads, and many other contingencies.

The average cost of 4 ft. 8½ ins. track per mile of single line seems to be between £5,500 and £6,000. Regarding the actual construction of the lines, one-half of the systems reporting do the work themselves, and the other half by contract; a few adopt both methods.

On very few systems does it seem possible to estimate the wear due to electric traction. In almost every town with tramways in the streets the vehicular traffic takes advantage of the easier traction on the rails to as large an extent as possible. This is bound to cause considerable wear, the extent of which it is difficult to arrive at. Figures for the wear due to both electric traction and vehicular traffic are of value only at the place where they are taken, unless particulars of the class, speed and frequency of the vehicles are given in addition to the car service. One reply states that a rail, after having been in position for five and a quarter years, and having carried 185,800 cars, showed 1-16 in. of wear. But we do not know the quantity or class of vehicular traffic over this rail. The general opinion appears to be that the wear from vehicular traffic is small compared with that from electric cars.

The writer, taking the replies of the number of men in the various permanent way squads, endeavored to arrive at an estimate of the average number of men per mile of track maintained, but found it was impossible to get this satisfactorily adjusted. The systems which have been longest in operation naturally have a larger proportion of men than those whose lines are recently put down. Towns with large engineering works, causing heavy vehicular traffic, have much more repair of paving than those where such works are few. Each town and system must be considered by itself, in conjunction with the special conditions obtaining there.

It is also useless to attempt any summary of the annual cost per mile of track for maintenance, the replies showing in some cases a few pounds, and in others many hundreds.

The general indication is that the greater part of the cost of maintenance in most towns is expended on the paving. It would be interesting to know the general practice of allocation of the cost of restoring paving which has become disturbed (as distinguished from rutted or worn) alongside the rail. This is not really a paving cost. The writer suggests that a good criterion of the actual wear on the paving would be the ratio of new stones used on repairs to the whole area of paving. In Glasgow "new setts" or paving blocks are a very large item of maintenance. Great numbers of setts, even of the hardest Scotch granite, are shattered and split the whole depth (6 ins.) of the sett, and are, of course, useless for redressing.

The limitations imposed on lines laid down in streets is well brought out by the return showing twenty-one systems on which it has been necessary to use curves of a radius of 35 ft. and under. The nicety of adjustment of both wheels and track to avoid severe grinding on such a curve must be patent to every one. In aggravation of this, one often finds that, owing to the hang of the street surface, the super-elevation must be put on the wrong rail.

In considering the question of curves it is interesting to note that there is very little variation in the lengths of the single-truck car wheel bases. Very few of the returns show a wheel base outside the limits of 5 ft. 6 ins. and 6 ft.

The grades in streets where it is imperative to have a tramway are frequently very severe. One system has a grade of 1 in 8.4, while there are seven records of grades less than 1 in 10.

The returns show that 65 per cent of the tramways sand both rails on gradients, while the remainder sand one rail only. A mechanical track cleaner is used on several systems, but its success seems doubtful. Information as to its ability to remove iron punchings, etc., jammed in the rail would be valuable, as these are very frequent in large towns.

The need of an emery rail grinder seems to be felt only on very few tramways. This is probably accounted for by the fact that the majority of the replies come from recently laid or relaid systems.

Seventeen tramways report the use of portable temporary cross-overs or shunts with electric cars without experiencing much trouble. It would be of value to know in how many of these cases bogie or double-truck cars were used.

Eight towns make provision for obviating a stoppage of the car traffic when the hose of the fire brigade is laid across the car lines. Six towns use a fire bridge which carries the cars over the hose. In three towns—Dublin, New York and Glasgow—the bridge accompanies the emergency wagon. In Newcastle and Munich the bridge is brought by the fire brigade. In Montreal the hose is carried by slings from the span wire. Ayr gets rid of any chance of stoppage from hose across the track by duplicating the fire hydrants.

LONDON LETTER

(From Our Regular Correspondent.)

The question of extending the system of half-penny stages on the Leeds tramways has, for some time past, occupied the attention of a special sub-committee and the general manager, Mr. J. B. Hamilton. There are now eleven stages in the city, chiefly arising from extensions to existing lines, but it is now recommended to the general committee that there shall be considerable additions by way of experiment. The special committee fixes a distance of about half a mile for each cheap stage, but in no single case will its recommendations affect the penny or through fares, if passengers ask the conductor for such tickets.

An agreement has been arrived at regarding the scheme for connecting Dundee and Broughty Ferry by tramway, and the question of running powers in Broughty Ferry is also being arranged. Steps are now being taken to arrive at an understanding with the Dundee authorities to permit the cars to run into the center of the city via the Ferry Road and Seagate route. Correspondence has been opened with Dundee with this end, and the promoters hope that a satisfactory understanding may be arrived at.

A decision recently given by the House of Lords will have an important bearing upon tramway development in England. The British Electric Traction Company, having obtained the co-operation of seven local authorities, adjacent to Birmingham, sought running powers over the lines belonging to, or to be acquired by the Birmingham Corporation. After a few days' hearing, the House of Lords refused to hand over the control of the streets of Birmingham to a private company. The decision is a check to the enterprise of one of the greatest of the tramway combines, and a great victory for those who believe in the municipalization of tramways. The result is that Birmingham will now take in hand the provision of electric tramways, not only for the city, but for the adjoining townships, either directly or by a system of through cars with a change of conductors at the boundary, and the division of profits on the railway clearing-house system.

Experiments of the Thermit system of welding rail joints are being carried out at Sunderland on the local tramways, the Tramways Committee having for some time past had this method under consideration. By the employment of the Thermit system of welding, fish plates and copper wire are dispensed with, and a continuous rail secured. The Thermit process of welding metals comes from Germany, its inventor being Dr. Goldschmidt.

The bill promoted by the South Lancashire Tramways Company has passed the House of Lords, the only opponents being the corporation of St. Helens. An arrangement was arrived at in the House of Commons by which the company is to have such running powers over the lines of the corporation (now leased to a company) as are necessary to conduct a through communication of passengers' luggage, and small parcels, and the company is not to enter into agreements with the company working the St. Helens lines except so far as is necessary to give effect to the running powers. Any dispute on the matter is to be referred to the Board of Trade.

Sir William Tomlinson, J. Briggs and other members of Parliament have made representations to the Board of Trade in favor of the principal provisions of the Railways (Electrical Power) Bill being extended to canals. The measure proposes to enable railway companies to issue new capital and acquire land with a view to the use of electric traction, and it is understood that this would apply also to canals owned by railway companies. The members who desire to extend similar powers to independent companies point out in the statement of their case that "more than one-third of the canal mileage of the country is already in the hands of railway companies, and to handicap the independent waterways by withholding the required powers would be to crush out such competition between railways and canals as still subsists, and would greatly impair the utility of the Canal Bill proposed by the Association of Chambers of Commerce, and approved by the Board of Trade." It is added that the Association of Independent Inland Waterways, which includes the Aire and Calder Navigation and other import-

ant canals, desires that the provisions in question should be extended to canals. It is understood that this object is beyond the scope of the present bill, the title and primary purpose of which cannot at this stage be modified, but it has been suggested to the Government that another short bill of one or two clauses extending its application might meet the case.

Another section of the electrified portion of the London County Council's South London tramway system has now been opened, this being the line running from Camberwell Green to Kennington, and thence over the already opened routes to Westminster, Waterloo, and Blackfriars Bridges. Previous to this only one series of electric cars ran from the bridges—that to Tooting, by way of Clapham—but now that the Camberwell route has been completed the advantage of the barriers which have been erected at Blackfriars Bridge, to obviate the rushes which took place every evening, is seen, and long lines of home-going workers wait patiently for the arrival of the cars.

As a direct result of the competition of the electric tramways the number of licensed cabs in Glasgow has decreased in the last twelve months by 150. A. C. S.

PARIS LETTER

(From Our Regular Correspondent.)

One of the main points of interest in traction matters in Paris has been the case brought in the courts by the Compagnie Generale des Omnibus against the city authorities. The hearing of the case has taken a long time and a deal of interest has been aroused. The results have been somewhat disappointing to the Cie Generale des Omnibus, but yet afford some hope of success in regard to new arrangements with the city, and the consequent extension of the company's monopoly. The following is a resume of the case. By concession which the city granted to the company in 1860 the latter secured the monopoly of street traction in Paris, the terms of the franchise being such that the company has deemed itself injured by every subsequent franchise given by the city to later concerns, such, for instance, as the Metropolitan Railway and the Tramways de Penetration. The Omnibus Company has always maintained the right to claim damages from the city for all such franchises, and, therefore, started an action to rescind its contract and to obtain damages.

The courts have interpreted as follows the exclusive right granted to the company in 1860. It has been held that the exclusive right of stationing vehicles was in no way prejudiced by the concession granted to the Metropolitan, which was in no way similar to that owned by the Omnibus Company. It was furthermore held that the Metropolitan Railway, the concession for which, by the way, was granted by the State as well as by the city authorities, is a railway of local interest, and does not in any way make use of the street surface and public roads. It was held also that the concessions granted to the Tramways de Penetration did not infringe the rights granted to the Compagnie Generale by the city, as they hold a State concession, and the only concessions given by the city interfering with the surface traffic over the public streets is the Funiculaire de Belleville, which is a rather small enterprise. Finally the court considered that the Cie Generale was not entitled to a recision of its contract, and concludes that the same must be maintained, but allows the company damages, the amount of which is to be fixed by experts from the city.

The general opinion seems to be that the Cie Generale did not get as much as might have been expected, but the net result appears to be that the city will be disposed to examine the projects of improvements offered by the Cie Generale, with a view to certain concessions and arrangements. It can be stated briefly that the proposed improvements amount to a quicker service, with cheaper fares, an authorization to use the trolley system being anticipated from the city, making thereby a practical guarantee of regular service and speed.

The public is very indifferent to the matter, and has not yet realized the fact that the trolley system is the only practical solution of the present difficulties.

The trolley system seems also to have found advocates among the inspectors and engineers of the "Service de Controle," who thus far have been opposed to the system, and it is this body who lead the public opinion and evolve most of the regulations governing Paris traffic.

The plans proposed by the Cie Generale appear to be fairly well worked out, and have in view a complete modification of its system. Some of the existing lines which are now carried on at a loss, will, it is hoped, become profitable, and quarters of the city which have hitherto been poorly supplied with means of public conveyance will be furnished with the same. The main modifications proposed comprise: (1) Reduction of running or operating expenses by the adoption of the trolley system; (2) sectioning of lines and the use of corresponding fares. The fares would be 3 cents, first class, and 2 cents, second class; each payment carrying the right to extend the journey on payment of an additional fare for the distance covered. The proposed system of the Cie Generale aggregates some 200 km of track.

As in the preceding plans of the Cie Generale no mention is made of any proposed change in the type of cars, it might be inferred that the present cars give complete satisfaction. This is, however, not the case, and many examples could be cited in support of this opinion. The Paris street cars have not yet arrived at their final shape and arrangement. The Cie Generale Parisienne de Tramways has lately put in service a central entrance type of car of a rather eccentric construction. No satisfactory results have thus far been obtained from this type of cars, and accidents to passengers owing to the use of an unaccustomed car are rather frequent. The type of car which appears to be most in favor is the single-truck car, with long rear platform. The Brill 21-E type of truck is generally used under these cars. On the other hand the "Cie de l'Est Parisien" has now definitely given up the central platform car, and adopted a long double-ended car, with which they have been experimenting. Fifty of the new type of cars have been ordered.

Returning to the Metropolitan lines in Paris the northern lines of the No. 2 project have been practically completed, and are in full working order. The southern part of the No. 2 line, which it will be remembered forms a belt around the city, will be completed before the bridges are prepared for their services. The bridges will take another two years for study and construction. The two bridges contemplated are those of Passy and Austerlitz. The Passy bridge has just been commenced, and will be constructed to allow of foot and vehicular traffic, as well as the Metropolitan line.

The most important work is just at present the great block of masonry being constructed beneath the Place de l'Opera. There is a small rectangular space or spaces railed in on the Place, and this is all that can be seen of the great work proceeding beneath. It will be remembered that there are three lines of the Metropolitan converging at this point, and for certain reasons they must be placed one above the other. This necessitates a very solid construction. The sub-soil at this point is of light sandstone, with plenty of water, and the construction work has, therefore, to be advanced by means of caissons. The lowest of the three lines is 21 m beneath the surface. The whole work is being carried out without the least hindrance to the traffic at this important point. The soil removed is carried underground to the neighborhood of the Gare St. Lazare, and there raised by cranes. Several months have yet to elapse ere the excavation will be ready for the concrete construction.

The important station at La Nation has proved a great boon to the congestion hitherto obtaining in the line No. 2, but not a radical remedy to traffic congestion, which is being greatly felt at certain hours of the day. Besides, this station has a vast siding of 1200 m in length, and is thus capable of giving standing room to several trains, which can be moved out at very short notice. The Metropolitan trains are limited as to length by reason of the shortness of the platforms, which cannot be increased, and the headway of the trains cannot be decreased from the present limit of safety. However, it has proved very useful to have the reserve of trains offered by La Nation Station, and the place had much added to the already great success of the No. 2 line.

The last few weeks have been devoted to annual general meetings of the most influential tramway and traction companies.

In the last Paris letter reference was made to the report of the Cie Generale des Omnibus, and announced the Metropolitan railway report. The latter operates at 58 per cent to 60 per cent, and its total receipts in 1902 were £2,946,340, against £1,894,056 in 1901.

The report of the Compagnie Francaise Thomson-Houston is very interesting, as this company operates several systems in France, including one in Paris. The total amount of orders received from Jan. 1, 1903, to May 20 was £11,500,000, compared with from £10,000,000 to £11,500,000 during all of 1902. The £11,500,000 for new orders is made up of 34 per cent from allied companies, and 66 per cent from other customers. The total amount is divided as follows:

	Per cent
Tramway supplies and contracts	27
Railway and other power stations	31
Power transmission	11
Motors and sundries, including mines and metallurgy, telegraph and telephone, etc.	31
Total	100

To show the present state of tramway and light railway affairs

in the French capital a few extracts of annual general meetings of several other companies are given.

Among the more interesting is the Compagnie de Tramways Ouest Parisien. This company operates in the western part of Paris and suburbs and was originally equipped with the surface contact system and partly by trolley. The surface contact system never operated satisfactorily, and the whole aim of the company is now to obtain an authorization for the trolley system over all its lines. Meanwhile its business is in a very bad way. Without taking account of fixed charges, its operating expenses alone exceed the receipts by 40,000 to 50,000 francs per month. As has already been stated, the company has been authorized to raise the fares to the standard adopted by the Council of the Department of the Seine. The report of the company states that the new operation with increased fares has given poorer results than had been hoped for, and instead of supplementing the receipts by about 40,000 francs per month, the improvement amounted to only a small sum. The operating expenses in 1902 amounted to 1,394,910 francs. The total receipts for 1902 was 975,045 francs, making the deficit for the year 419,864 francs, exclusive of fixed charges.

The Compagnie des Tramways de l'Est Parisien has now 138 km. of track, with gross receipts during 1902 of 4,400,000 francs. This company also cannot earn its operating expenses, which, in 1902, amounted to 4,673,488 francs.

The total annual deficit is about 1,000,000 francs. It will be seen that the future of the company is very problematical in regard to dividends. This is especially true when it is noted that one of the best paying lines of the company, the line from the Opera Les Lilas, running right through the center of Paris, is threatened with dangers which are more than visionary. There is first a threatened application to replace the present trolley line, which was provisionally granted because of the Metropolitan tunnels disturbing the surface contact system, and, second, another danger consists in the competition of the new Metropolitan line running parallel to this line.

The company is not slow in realizing its dangerous condition and is doing its best to obtain from the authorities authorization of higher fares and more extended use of the trolley system.

The company known as Tramways Mecaniques des Environs de Paris operates 56 km. of track in the northwestern part of the city and suburbs. The financial situation of the company would not seem encouraging were it not that the receipts of the lines for the first five months of 1903 have increased very rapidly compared with the same period of 1902. The consumption of current on this line per car-kilometer is very high at present, owing to the partial use of storage batteries. The latter will be entirely abandoned by the company, which has now obtained leave to install the trolley, which will enable the company to meet the increasing demand for transportation of a district which is the busiest and richest of its system. The cars at present in use are rather heavy and unsuited to the needs of the light traffic on some of the smaller lines, being provided with double-decks, a double compartment body, two platforms at the ends and a center platform. The receipts for the first five months of 1902 amounted to about 703,000 francs, and for the same period of 1903, about 800,000 francs. The expenses during the first five months of 1902 were 877,000 francs, and during the same period in 1903, 794,000 francs. It will be seen from this that the line shows a small profit for the first five months of 1903, and the company's policy is that of increasing this profit by a careful improvement in operating conditions and reduction in cost of power.

Fortunately, the situation is not so bad, although not by any means good, for a number of other companies, among which can be mentioned La Compagnie des Tramways de Paris et du Department de la Seine, which operates some 125 kms. of track in the north of the city. There are a number of lines which penetrate the city and terminate at the Madeleine and the Etoile, called Tramways de Penetration, and these lines are allowed the use of the trolley outside the city limits. The greater number of the lines inside the city limits are operated with the use of storage batteries, and the results of the year's operation with this expensive system would show large losses had it not been for the higher fares than on the average of the other lines. The operating expenses in 1902 amounted to fr. 5,096,000 out of the total receipts of fr. 6,435,000. The 1902 receipts amount to some 200,000 francs over those of 1901. Some details can be given regarding the traction systems operated by the company. The steam locomotives are of the Lamm Francq system, and in 1901 ran some 648,457 kms., at a cost of 468,638 francs, and in 1902, 602,951 kms., at a cost of 354,868 francs, making for 1902 a cost per car-kilometer 0.588 francs, against 0.723 francs in 1901. Electric traction figures give for 1901 4,618,789 kms., at a cost of 2,043,519 francs, and for 1902, 5,057,327 kms. at a cost of 2,239,907 francs. These figures give for 1901 a cost per car-kilometer of 0.442 franc, and for 1902, 0.44 franc for electric traction.

The Tramways du Nord Parisien is but a small company operating some 17 kms. of track inside and outside of Paris, the whole operated by the trolley and the surface contact system, the latter, as usual, being inside the city limits. The company shows a profit for 1902 of some 150,000 francs. The surface contact system is on the Claret Vuilleumier system, and special switch boxes are placed outside the tracks in the street at intervals, each box controlling a number of contacts in the street. The system appears to be one of the least objectionable of the surface contact systems actually working in Paris, although it is sometimes out of order. The length of track operated is not great and the traffic is not heavy, as only 24 motor-cars are in service, with a few trailers. The car-kilometers run are less than 1,500,000 per year.

General remarks concerning the situation may not be out of place. The situation could be most favorable to the companies using the trolley, and where this has not been authorized, the underground conduit system appears to be the next best, notwithstanding the high cost of construction. Several companies have some few lines operating in various parts of the capital of this system.

The Compagnie Generale Parisienne de Tramways, or Tramways Sud, is undertaking some important changes, and rumors are afloat regarding a new generating station in Paris, destined for this company. The news may be rather premature, but of one point we are absolutely certain, the transformation of three lines (1) The Malakoff-Les Halles line, about 7 kms. This was first run by trolley and storage batteries, the former for one-fifth and the latter for four-fifths of the distance covered. Subsequently two-fifths of the part then run by storage battery was converted into conduit system. The tendency is now to abandon the storage batteries completely. (2) The line St. Phillip de Roule, which is a short line of 7 kms., which was first operated one-quarter by trolley and three-quarters storage battery. The properties are now reversed, two-fifths being operated by battery only, and three-fifths by trolley. The line is not very important. (3) The Clamart-St.Germain de Pres line, which is 9 kms long and was formerly run half trolley and half battery. Later the trolley absorbed two-thirds of the line and storage battery one-third, and now the trolley part amounts to three-fourths of the length. The remaining one-fourth storage battery will probably soon give way to the underground conduit system.

A number of the principal cities of France are appreciating the advantage of electric traction and endeavoring to change their system. Paris is slow to adopt the trolley for æsthetic reasons. The fight is not so keen, however, against the adoption of trolley in the country towns. For instance, Lille, a town of about 130,000 inhabitants, in the north of France, is a fair example of a good traction system and installation. In operation for a few months only, the lines are now approaching completion by a line from Lille to Roubaix. The service on this line is now by steam cars, but the electric service will soon be inaugurated.

Projects of trolley installations are made at Nantes, an industrial town on the seaboard and near the estuary of the Loire. The fares will be 2 cents, which bids fair to be popular in that industrial city. Low fares would also be a success in Paris were it possible to use the trolley system. There is little chance of satisfying the public wants in this respect as long as the authorization for a larger use of the trolley is refused.

We referred above to the fact that the Cie Generale des Omnibus was endeavoring to obtain a concession, or, rather, a renewal of the old concessions. The company submitted plans for a complete installation of the trolley system, with the use of the conduit system in the heart of the city. Some influential papers and the public itself, disregarding the obvious advantages of the trolley system, represented the company as threatening to invade the whole of the city with the odious trolley line and spoil the appearance of all the principal thoroughfares, have voted against the project and there is a rather hot fight about to occur on the very point. It is to be hoped that sound common sense will prevail and that practical considerations will outweigh sentimental and æsthetic reasons in providing a good tramway system for Paris, with a service at least comparable to any other modern cities of Europe.

In spite of the various difficulties which beset its path in more than one country of Europe, electrical traction is undoubtedly making progress, not only in tramway, but also in light railways and in the main lines of the country.

The Fayet-Chamonix line extension to Switzerland will soon be opened to public service and over the border. In Switzerland itself there is a great progress all along the line. Experiments and discussion is also taking place on a large scale in Germany,

where the Union Elektricitats-Gesellschaft has been authorized by the State to make experiments on the Johan line in the suburbs of Berlin. The U. E. G. is actually transforming two three-axle coaches of the railway company into motor-cars and three passenger cars are used as trailers. It is understood that the power will be derived from the Oberspree electrical station, single-phase alternating current being supplied at 6000 volts. It should be stated that the daily traffic on the line includes twenty-three trains in each direction, and the experiments are to be carried out without interference to the daily service. It is very desirable that such experiments be encouraged by all the various governments and central bodies in whose territory electrical traction appears to have a future. In Germany the fact is well recognized that electricity has come to stay, and railway companies vie with the government in giving all facilities to the promoters of the new schemes, who are, of course, on common ground with the constructors of electrical material. Switzerland is also to the fore in these matters. It should be noted that expenses are divided between interested parties, while the State gives its aid in a very practical way by means of grants.

In Italy electric traction is proving a very great success, and there is no reason why its application should not be greatly extended. The Milan Gallarate and Gallarate Varese lines are in full operation, and a duplication of its tracks is just receiving consideration of the public authorities. There is also a scheme for electric traction between Milan and Bergamo, the distance approaching 43 kms., with a difference of level of 119 m. It is expected that a maximum grade as high as 7 per cent will be encountered, the average grade being 3 per cent.

A company has also been formed, with a capital of 2,000,000 lire, for completing and operating the line near Naples and connecting Castellemare and Sorrento.

NEW YORK ELEVATED TIED-UP IN RUSH HOURS

Traffic was entirely suspended for about three-quarters of an hour during the busiest of the rush hours Thursday, July 23, on all lines of the Manhattan Elevated Railway, of New York, as a result of an explosion in a manhole in front of the company's power house at Seventy-Fourth Street and the East River. The feed wires were disarranged, and until repairs were made no trains could be moved. It was about 5.45 when all trains on the Sixth, Ninth, Third and Second Avenue lines came to a sudden stop wherever they happend to be. In nearly every case they were packed with persons returning home from offices and shops, and in many instances hundreds of men and women alighted from the trains and walked to the nearest stations, and there took surface cars. At the City Hall station, on the Third Avenue line, an enormous crowd jammed the platform and stairways at the bridge. Orders were rushed to the various ticket sellers, and they discontinued the sale of tickets until the trains began to move, shortly after 6.30 p. m.

NEW POLYPHASE TRAMWAY STATION AT BRUSSELS

The new power station, which has just been erected by the Brussels Tramways Company for operating the street railway system in that city, and the preliminary drawings for which were published in this paper for September, 1902, was officially opened last month. The Brussels company was one of the first to install the overhead system on a considerable scale in Europe, and its previous power station, equipped with direct-current apparatus and built in 1894, was considered at that time a model power station. The extension of the conduit system throughout the city, however, has compelled the introduction of more power and has resulted in the completion of one of the most modern and complete power stations on the Continent.

The new station contains seven units of 1500-kw each. The engines are cross-compound and were built by the Vandekerchove Machine Works, of Ghent. The alternators are of the General Electric type and were supplied by the Union Elektricitats Gesellschaft, of Berlin. They operate at 250 r. p. m. and generate three-phase current at 6600 volts and 25 cycles per second. The boilers were supplied by the Babcock & Wilcox Company and superheaters are used for raising the temperature of the steam to 330 degrees C. Green economizers are employed, and the tramway company has a guarantee of an indicated horsepower on 4.75 kg (10.45 lbs.) of steam. The switchboard was built at Schenectady by the General Electric Company.

The King of Belgium was present at the opening of the station, at which there were also a number of prominent electrical engineers and tramway managers from other countries. The King was received by Mr. Fayens, president of the Brussels Tramways Company, and Mr. Leon Janssen, general manager of the company, and made a personal inspection of all of the electrical apparatus, in which he expressed a great interest. Others present from the Brussels Tramways Company included Messrs. A. Janssen, D'Hoop, Pedriali, Lechat and Dugniolle. The following were also present: Messrs. Lavalard, manager of the General Omnibus Company of Paris; Pons, manager of the Toulouse Tramways Company; Hanspolen, general manager of the Union Elektricitats Gesellschaft; Perouse, member of the State Council of France; Loewe, president of the Union Electricitats Gesellschaft, and C. De Burlet, general manager of the Chemins de Fer Vicinaux, of Brussels.

LARGE TRIPLE EXPANSION ENGINES FOR MANCHESTER, ENGLAND

In the STREET RAILWAY JOURNAL for Sept. 6, 1902, a description was given of the new Stuart Street power station of the Manchester Corporation. The two 6500-hp engines for this station have just been completed by the Wallsend Slipway & Engineering Company, Ltd., Wallsend-on-Tyne. They are of the triple expansion, vertical type, having four cylinders, diameters, 37 ins., 59 ins., 72 ins. and 72 ins., respectively, with 60-in. stroke, capable of working either condensing or non-condensing without valve alteration. The boiler pressure will be 200 lbs. per square inch, and at the engine stop valve 190 lbs. per square inch, the steam being superheated to 500 deg. F. Special attention has been given to crank balancing, and all working parts on both engines will be interchangeable. Each engine will indicate 6500 hp when running at 75 r. p. m., making 13,000 ihp for the two engines. The crank shafts are 21 ins. diameter and the generator shafts 24 ins. diameter, increased to 30 ins. diameter in way of the fly-wheel, on each side of which are two large generator bearings 5 ft. 4 ins. long. All the crank shaft bearings are the same diameter. The bed-plates are provided with large wells, all suitably piped to the outlets for catching the waste oil. The cylinders are all made of special cast iron, and have separated liners fitted. Steam jackets are fitted to both the cylinder barrels and the covers. The piston rods are fitted throughout with United States metallic packing. The columns are of the partly enclosed type. The main bearings are of the half-round type fitted with water jackets, and arranged so as to be easily removable by simply easing up the crank shaft. The valve gear is of the Corliss type and so designed that it can be readily adjusted by hand if necessary.

Each engine is provided with two governors. One governor is designed to automatically control the speed so that it does not vary beyond certain fixed limits between no load and full load, whether working non-condensing or condensing. The second governor acts as an emergency governor, and cuts off all steam automatically if the speed of the engines increases more than 6 per cent. The emergency valve can also be worked by hand from starting position. The cylinders, main bearings, cross-heads, guides, crankpins, etc., are all lubricated by means of forced lubrication. Receivers of cylindrical type are fitted between the high and intermediate pressure cylinders and also between the intermediate and low pressure cylinders, the latter being arranged for reheating the steam as it passes to the low-pressure cylinders with steam direct from the boilers. The reheater is provided with by-pass fittings.

Each engine can be manipulated from one position on the floor, all the necessary apparatus being brought together for this purpose. Each engine is fitted with two air and two circulating pumps working by levers off the high and intermediate pressure engines.

It is recognized that the most extensive experience of multiple crank engines has been obtained by marine engine makers, and the successful work in large engines of this class by Andrew Laing, the managing director of the company's works, has been fully utilized in the design and construction of these engines.

FROM INDIANAPOLIS TO DAYTON

The connection between the Dayton & Western Traction Company and the Richmond Street & Interurban Railway Company has been made, thereby completing one of the longest traction lines in the world, reaching from Indianapolis, Ind., to Dayton, Ohio, a distance of 150 miles. In a short time the service will be extended to Columbus, Ohio. A through service from Indianapolis and Dayton will be established as soon as possible. As the line parallels the Pennsylvania Railroad all the way it is expected that company will be given stiff competition.

A NEW LINE IN THE OHIO VALLEY

It has developed that the proposed system of electric railways to be built between Avalon and Freedom, in the Ohio Valley, which Pennsylvania Railroad officials were quoted as favoring, is a project fathered by Murray A. Verner and his associates in Pittsburg and Youngstown. The plan is to build twenty-one miles of line to connect Pittsburg with the system of the Mahoning Valley Railway. Entrance to Pittsburg will be made on an elevated line on Liberty Avenue, and it is said that an elevated structure will also be built in Allegheny. In order to carry out the scheme six companies have been incorporated, viz: West Side & Mahoningtown Street Railway Company, Mahoningtown & Moravia Street Railway Company, Moravia & Wampum Street Railway Company, Wampum Street Railway Company, Wampum & Hoytdale Street Railway Company, Hoytdale & Beaver Falls Street Railway Company. The officers and directors of the various corporations have not yet been made public.

The new line will form a continuous system from Warren, O., through Youngstown, New Castle, Beaver Falls, Coraopolis and McKees Rocks, or through Allegheny to Pittsburg.

From Warren, O., to New Castle, passing through the towns of Niles, Lowellville, Edenburg, Hillsville and a number of other smaller villages, the Mahoning Valley Electric Railway system, also controlling the local trolley lines in New Castle, Youngstown, Niles and Warren, is without competition in the trolley passenger business. It is now intended to extend the lines from New Castle to Beaver Falls, at the latter place linking up with the Beaver Valley Electric Railway system and over the latter's tracks cars can be run as far as Freedom, to which point the Beaver Valley lines now extend. Commencing at Coraopolis, the continuous line to Pittsburg will likely be utilized in the project. To accomplish this object, bridging of the Beaver near Freedom would be necessary and an extension of the Beaver Valley lines from that point to Coraopolis.

Surveys for the entire route between Beaver Falls and New Castle have already been made. For the most part the new line will follow the west bank of the Beaver and will pass through Moravia, Hoytdale and Wampum.

CHICAGO TRACTION REORGANIZATION

The outline of the plans proposed for the reorganization of the Chicago Union Traction Company was presented in these columns last week, and since then an official statement has been issued confirming the announcement. As a result of these preliminaries, a new set of leases between the Union Traction and the North and West Chicago Street Railway companies was drawn up and adopted, subject to approval by the stockholders, by the members of the protective committees representing the three roads. The members of the protective committees of the two underlying roads were made members of the two boards of directors prior to the modification and adoption of the leases.

A formal statement setting forth what has been done by the three protective committees was issued after the conference as follows:

"Important developments heretofore foreshadowed took place, when a modification of the leases between the Chicago Union Traction Company and the North and West Chicago Street Railroad Companies was voted for, subject only to the approval of the stockholders at a meeting to be called later, and subject, further, to the approval of the Circuit Court of the United States.

"This action, in the opinion of the North and West committees, will prevent a disintegration of the property and dispose of the embarrassment growing out of the ambiguity in the previous leases. It is provided that the lease agreements made in 1899 between the three corporations, under which it was claimed that the leases of the underlying North and West Side Companies were absolute transfers of those leases are made a subletting only, and the provision whereby the guaranty fund, in case of termination of the lease, becomes the property of the Chicago Union Traction Company is so changed that the fund shall be forfeited for failure to keep the covenants of the lease as to payment of rental or otherwise.

"For a period of five years from date the rentals reserved in the lease are to be a preferential charge up to 12 per cent and 6 per cent, but to the extent of 8 per cent upon the stock of the North Chicago, and 4 per cent upon the stock of the West Chicago companies, it shall be a preferential cumulative charge, and shall be payable before any dividends are paid upon the stock of the Chicago Union Traction Company, or its successors.

"After five years, as theretofore, the rentals shall continue to be paid up to 12 per cent and 6 per cent of the net earnings of the lessee company, but instead of being a cumulative preferential charge of 8 and 4 per cent it shall be a fixed charge, and failure to pay this fixed charge of 8 and 4 per cent after five years shall operate as a default under the lease, and a forfeiture of the guaranty fund to the North and West companies.

"The Chicago Union Traction Company is required to make any and all changes and improvements in and about the rehabilitation of the property, and bear all cost of maintenance of the property during the continuance of the leases, which is for the remainder of the unexpired period of 999 years.

"It is believed this is a most important step in the rehabilitation of the railways of the North and West street railroad systems. It puts all the properties in a position where there is internal harmony, and where any ambiguity in the construction of the leases is disposed of, and where important progress has been taken toward the solution of the transportation problem of the city.

"The modifications were brought about by the efforts of the two protective committees, who were unanimously in favor of them, the North protective committee being composed of Henry A. Blair, Charles L. Raymond, Azariah T. Galt, Charles R. Corwith and Fred H. Rawson, and the West committee of Benjamin B. Lamb, Wallace Heckman, James Bolton, Charles R. Corwith, Edward L. Brewster, William H. Gray and Fred H. Rawson, who became directors of the two boards before the modifications were voted for.

"The changes were also approved unanimously by the general protective committee, whose members are Walter G. Oakman, John J. Mitchell, Marshall Field, H. N. Higginbotham, John H. Wrenn, R. R. Govin, George E. Adams, H. B. Hollins, Norman B. Ream, Charles Steele, P. A. Widener and Oakleigh Thorne.

"Besides the formal communication which is to be made for the call of the meeting of stockholders, the two committees, now the members of the two boards of the North and West Side companies, will fully communicate to the stockholders their views as to the desirability of the changes made in the contractual relations of these companies."

It is generally believed that this action on the part of the committee will receive the sanction of the stockholders and the Court, although opposition is threatened by minority stockholders represented by Levy Mayer. Action will be taken on the leases Aug. 18.

PERSONAL MENTION

MR. MATTHEW NEILSON, manager of the St. John Street Railway Company, has been appointed manager of the Mexico Heat, Light & Power Company, of which Senator Cox, Sir William Van Horne and other Canadian capitalists are the promoters.

MR. E. W. CHANDLER, for some time purchasing agent for the Columbus, Delaware & Marion Railway, has been made superintendent of construction of the Joliet, Plainfield & Aurora Railway, which is being built by the Fisher Construction Company, of Columbus, Ohio, and Joliet, Ill.

MR. GEORGE A. COOKE, formerly of the Westinghouse Electric & Manufacturing Company died July 11 in Chicago. Mr. Cooke was the son of Mr. William J. Cooke, of the McGuire Manufacturing Company, and although a young man had established a high reputation in electrical work. After a course in electrical and mechanical engineering in Purdue University, which he finished about eight or nine years ago, he entered the service of the Westinghouse Electric & Manufacturing Company in its construction department, and visited a number of cities for it in the installation of railway and lighting plants, and also mining apparatus. He also spent a considerable time in Toledo installing underground conduits for the Toledo Traction Company. His health becoming impaired, he spent a winter in Florida, another in Arizona, and then went to Honolulu.

MR. J. S. BADGER, general manager of the Brisbane Tramways Company, Brisbane, Australia, and formerly of New York, is making a visit in this country. Mr. Badger was one of the pioneers in the electric railway business in this country, and supervised the installation of a number of the early roads for the Sprague Electric Railway & Motor Company, and its successor, the Edison General Electric Company. He was called to Brisbane from Schenectady, N. Y., about seven years ago to install an electric tramway system in that city, and upon its completion was appointed general manager of the company, a position he has since held. Mr. Badger left Brisbane on his visit to this country on May 18. He is a delegate to the Fifth Annual Convention of the Chambers of Commerce of the British Empire, as a representative of the Brisbane Chamber, and expects to attend the Convention to be held in Montreal September 17-20. He also expects to attend the convention of the American Street Railway Association in Saratoga. After the close of the Saratoga and Montreal conventions he is planning to visit London, where are located the headquarters of the Brisbane Tramways Company. He will then return to Brisbane via New York, and expects to reach home about the end of 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., June '03	77,971	43,736	34,234	23,279	10,975
	1 " " '02	67,631	36,589	31,042	18 187	12,854
	6 " " '03	388,981	221,793	167,189	132,024	35,164
	6 " " '02	318,937	185,362	133,575	98,390	35,185
ALBANY, N. Y.						
United Traction Co.	3 m., June '03	429,949	316,080	113,869	------	------
	3 " " '02	379,379	255 075	124,304	------	------
	6 " " '03	1,590,357	1,083,171	507,186	------	------
	6 " " '02	1,471,516	1.011,263	460,253	------	------
ANDERSON, IND						
Union Traction Co. of Indiana	1 m., June '03	97,302	------	------	------	------
	1 " " '02	81,424	------	------	------	------
	6 " " '03	502,076	------	------	-----	------
	6 " " '02	339,067	------	------	------	------
BINGHAMTON, N. Y.						
Binghamton St. Ry. Co.	1 m., June '03	22,774	11,022	11,753	------	------
	1 " " '02	20,243	10,645	9,598	------	------
	3 " " '03	61,321	31,267	30,054	------	------
	3 " " '02	52,280	29,105	22,675	------	------
	12 " " '03	226,702	126,600	100,102	68,100	32,002
	12 " " '02	207,900	114,631	93,270	65,319	27,951
BUFFALO, N. Y.						
International Tr. Co.	1 m., May '03	327,126	174,458	152,669	131,698	20,971
	1 " " '02	264,185	146,787	117,398	125,476	† 8,078
	5 " " '03	1,481,935	837,035	644,896	637,169	7,727
	5 " " '02	1,263,104	727,766	535,338	622,529	† 87,191
CHICAGO, ILL.						
Chicago & Milwaukee Elec. Ry. Co.	1 m., June '03	22,483	7,743	14,740	------	------
	1 " " '02	17,750	7,065	10,685	------	------
	6 " " '03	93,721	39,847	53,874	------	------
	6 " " '02	78,940	38,052	40,888	------	------
Metropolisan West Side Elevated Ry.	1 m., June '03	167,420	------	------	------	..
	1 " " '02	152,614	------	----	-----	.. ..
	6 " " '03	1,031,51:	------	------	---	------
	6 " " '02	936,613	------	------	------	------
South Side Elevatad Ry	1 m., June '03	127,893	....	...	------	------
	1 " " '02	114,674	-----	------	------	------
	6 " " '03	782,283	------	------	------	------
	6 " " '02	712,368	------	-----	------	------
CLEVELAND, O.						
Cleveland Electric Co.	1 m., June '03	238,863	....	.. ..	------	------
	1 " " '02	214,985	------	------	------	------
	6 " " '03	1,318,356	------	------	------	------
	6 " " '02	1,170,544	------	------	------	------
Cleveland, Painesville & Eastern	1 m., June '03	19,765	11,487	8,278	------	------
	1 " " '02	18,716	10,488	8,228	------	------
	6 " " '03	91,404	55,910	35,494	------	------
	6 " " '02	84,145	49.287	34,857	------	------
DETROIT, MICH.						
Detroit United Ry	1 m., June '03	384,936	*222,797	162,139	82,823	79,316
	1 " " '02	336,744	*183,171	153,573	78,594	74,979
	6 " " '03	2,034,189	*1217487	816,702	490,765	325,935
	6 " " '02	1,821,266	*1038997	782,269	462,572	319,697
ELGIN, ILL.						
Elgin, Aurora & Southern Tr	1 m., June '03	42,575	22,818	19,758	8,333	11,424
	1 " " '02	33,874	19,433	14,441	8,333	6,108
	6 " " '03	211,120	124,996	86,124	50,060	36,124
	6 " " '02	186,457	111,600	74,857	50,000	24,857
HAMILTON, O.						
The Cincinnati, Dayton & Toledo Trac. Co.	1 m., June '03	46,496	23,767	22,729	16,070	6,659
	1 " " '02	40,586	20,576	20,009	16,330	3,679
	12 " May '03	489,493	271,812	217,681	193,673	24,008
HARRISBURG, PA.						
Harrisburg Traction Co	1 m., June '03	481,423	263,141	218,280	60,650	157,630
	1 " " '02	466,530	198,673	267,857	168,857	100,000

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
LONDON, ONT.						
London St. Ry Co	1 m., June '03	16,224	10,484	5,740	2,154	3,586
	1 " " '02	13,643	8,558	5,084	2,287	2,797
	5 " " '03	75,569	51.236	24,334	12 888	11,446
	5 " " '02	65,064	43,167	21,897	13,593	8,304
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co	1 m., June '03	249,684	121,334	128,350	72,134	56,217
	1 " " '02	222,450	107 193	115,257	66.015	49,242
	6 " " '03	1,430,676	734,114	702,562	424,447	278,115
	6 " " '02	1,294,629	612,304	662,325	389,554	272,771
MINNEAPOLIS, MINN.						
Twin City R. T. Co	1 m., June '03	347,745	168,745	178,999	60,890	118,109
	1 " " '02	309,884	131,367	178,516	58,733	119,783
	6 " " '03	1,918,653	922,372	996,281	365,318	630,963
	6 " " '02	1,666,439	780,370	886,069	351,533	534,536
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., June '03	209,377	121,580	87,797	24,198	63,599
	1 " " '02	187,662	80,655	107,007	19,392	87,615
	9 " " '03	1,571,941	993,652	578,289	134,667	413,622
	9 " " '02	1,445,180	846,893	598,287	144,299	452,988
OAKLAND, CAL.						
Oakland Transit Consolidated Co.	1 m., June '03	95,312	47,843	47,469	------	------
	1 " " '02	82,920	45,139	37,151	------	------
	6 " " '03	542,588	280,328	262,260	------	------
	6 " " '02	449,486	278,133	171,353	------	------
PHILADELPHIA, PA.						
American Railways	1 m., June '03	114,742	------	------	------	------
	1 " " '02	101,154	------	------	------	------
	12 " " '03	1,240,807	------	------	------	------
	12 " " '02	1,009,504	------	------	------	------
ROCHESTER, N. Y.						
Rochester Ry	1 m., June '03	105,802	51,338	54,464	25,647	28 817
	1 " " '02	90,044	47,618	42,426	24,754	17,672
ST. LOUIS, MO.						
St. Louis Transit Co.	1 m., June '03	645,590	------	------	------	------
	1 " " '02	557,114	------	------	-----	------
	6 " " '03	3,467,464	------	------	------	------
	6 " " '02	3,014,587	------	------	------	------
SAN FRANCISCO, CAL. United Railroads of San Francisco	1 m., June '03	488,113	------	------	------	------
	1 " " '02	454,219	------	------	------	------
	6 " " '03	2,966,671	------	------	------	------
	6 " " '02	2,537,151	------	------	------	------
SAVANNAH, GA.						
Savannah Electric Co.	1 m., June '03	46,104	26,889	19,215	------	------
	1 " " '02	44,897	22,493	22,404	------	------
	6 " " '03	499,470	294,868	204,602	------	------
	6 " " '02	458,679	272,034	1866,45	-----	------
TOLEDO, O.						
Toledo Rys. & Lt. Co.	1 m., June '03	141,545	71,806	69,739	41,135	28 604
	1 " " '02	122,682	65,142	57,540	37 851	19,686
	6 " " '03	772,178	401,206	370,972	242,070	128,902
	6 " " '02	671,284	352,381	318,903	227,033	91,870
Lake Shore Electric Ry. Co	1 m., June '03	51,541	------	------	.. ..	------
	1 " " '02	41,010	------	------	------	------
	6 " " '03	254,621	------	------	------	------
	6 " " '02	197,507	------	------	------	------

NEWS OF THE WEEK

CONSTRUCTION NOTES

STOCKTON, CAL.—A new loop is to be added to the present street car lines of Stockton, and will be the first of the several extensions to be made by the Stockton Electric Railroad Company.

CHICAGO, ILL.—Application has been made for a franchise permitting the Indiana, Logansport & Chicago Railway Company to enter Indianapolis with its proposed railway. The president of the Crescent Construction Company, which has the contract for building the new road, is quoted as saying that the line will be completed from Indianapolis to Indiana Harbor by December, 1905.

EAST ST. LOUIS, ILL.—The surveyors for the proposed interurban electric railway, from Evansville to East St. Louis, have completed the survey to Belleville. The line was surveyed through Irvington, Ill., 5 miles north of Richview. The surveyors will now survey for a line from Salem to Centralia, Marion County, to connect with the main line, which passes through Irvington.

GALESBURG, ILL.—The Galesburg Electric Motor & Power Company, which recently passed into the control of the McKinley syndicate, has elected new officers as follows: S. L. Nelson, president and manager; E. A. Bancroft, vice-president; Edward Woodman, of Portland, Me., treasurer; H. E. Davison, secretary; Charles Munson, superintendent; S. L. Nelson, of Fort Wayne; Fred Seacord, R. G. Duncan, H. E. Davison, C. Munson, E. A. Bancroft, of Chicago; George L. Price, B. F. Arnold and H. F. Arnold, directors. The company has in contemplation the improvement of the local system, and proposes to build a line to Monmouth. Four new semi-convertible cars for the local lines have been ordered from the St. Louis Car Company. These cars are to be 29 ft. over all, with a 20-ft. body. They will be mounted on Peckham trucks, and will be equipped with Westinghouse motors and controllers.

GALESBURG, ILL.—The Galesburg & Oneida Street Railway Company has been granted a franchise by the City Council to construct a line on Main Street from Third Street to Division Street.

ANDERSON, IND.—Work has been begun on the Indiana Union Traction Company's branch line from Anderson to Newcastle, by Grant & Co., of Des Moines, Iowa, and on the Anderson-Elwood branch line, by T. N. Stillwell & Co. This line will be 15 miles shorter than the present line to Elwood, by way of Alexandria.

JEFFERSONVILLE, IND.—The Louisville & Cincinnati Electric Company has been granted a franchise for an electric railway to run through the county, its ultimate destination being Madison, where it will connect with an electric line from Cincinnati.

INDIANAPOLIS, IND.—Last week the Kokomo, Marion & Western Traction Company completed its line to Greentown. The remaining gap in the line to connect Kokomo and Marion will be pushed to completion by Sept. 1. The Consolidated Company, building between Indianapolis and Crawfordsville, has doubled its force, and now has 125 teams at work. Engineer Mansfield said a few more such weeks and the line will be finished. It is expected the following lines will be open for business in September: The Indianapolis-Northern to Noblesville; the Kokomo & Marion to Greentown; the Indianapolis & Northwestern to Lebanon and Frankfort; the Indianapolis & Greenwood, from Frankfort to Columbus.

INDIANAPOLIS, IND.—The Danville Construction Company has been incorporated, with a capital stock of $100,000, by F. M. Fauvre, J. Chipman, M. B. Wilson and others. The company will build the Indianapolis, Danville & Rockville Railway. Work is to be begun at once under the supervision of J. W. Chipman.

INDIANAPOLIS, IND.—The Indianapolis & Northwestern Traction Company has connected its interurban track with the Indianapolis Traction & Terminal Company's track at Thirty-fourth Street. It is expected to run cars between Lebanon and Indianapolis in a short time.

LAWRENCEBURG, IND.—It is said that a deal is on between the promoters of the Indiana Southern Electric Railway, which has a franchise to haul both freight and passengers, and one of the steam roads leading into Cincinnati, whereby electric cars are to run over the latter's track into Cincinnati by using the third-rail system. The competition of the traction lines has been keenly felt between Aurora and Cincinnati, and this plan is likely to be adopted to meet the traction invasion. Accommodation trains have been abandoned, and a double track to Aurora will soon be completed by the steam road.

MUNCIE, IND.—The Indiana Union Traction Company will build a five-story terminal station building for the interurban lines entering this city. Although the building will be constructed by the Indiana Union, other roads that enter the city will become part owners. The lines are the Muncie & Portland, the Muncie, Hartford City & Ft. Wayne, the Alexandria & Muncie, the Muncie & Newcastle and the Dayton & Muncie.

RICHMOND, IND.—The Dayton & Western Traction Company ran its first cars in Richmond over its new road on Sunday, July 19. As soon as the tracks under the steam railroad are lowered the cars will be run through to Indianapolis.

SOUTH BEND, IND.—The Chicago & Air Line Electric Railway Company has formally accepted the franchise granted it by the Council, and filed a $10,000 indemnifying bond against any loss by reason of negligence during the construction of its line, and also posted the $1,000 forfeit provided in the measure if the system in South Bend is not ready for operation in two years.

SOUTH BEND, IND.—The Indiana Northern Electric Railway Company has obtained a franchise through this city and St. Joseph County to the Laporte County line. The franchise grants right to carry passengers, freight and express matter.

WABASH, IND.—The contract for the building of the interurban railway between this city and Marion has been awarded to J. G. White & Co., of New York. The work is to be begun at the earliest practical date, and be finished and cars running by May, 1904. The length of the line is 20 miles. Contracts for the steel and ties have been placed, and other equipment is now being contracted for.

WATERLOO, IND.—The engineers of the Seagrave line, which is an extension of the Toledo & Western Railway, have surveyed two routes from Auburn to Waterloo, and have decided on the west survey as the more practical. The line will be nearly one hundred and fifty miles long.

LOUISVILLE, KY.—The directors of the Louisville & Cincinnati Interurban Electric Railway Company have elected the following officers: President, George W. Lewman, of Louisville; vice-president, Louis Hartman, of New Albany; secretary and treasurer, John F. McCulloch, of Charlestown township, Ind.

ELKTON, MD.—The Cecil & Kent Light, Power & Railway Company has taken steps to construct the proposed electric railway between Elkton and Chesapeake City. A committee was appointed to make a contract with the Tennis Company, of Philadelphia, to build the road. Judge Edwin R. Cochran, Jr., of Wilmington, stated that work on the road would start not later than Aug. 1, and that the gang of men at work on the trolley road between Middletown and Odessa, Del., would be transferred here to commence work upon the completion of the road in Delaware. The Cecil & Kent Company has completed a traffic arrangement with the City Passenger Railway Company, of Wilmington, for the use of its line from Stanton into Wilmington.

DARTMOUTH, MASS.—The Board of Selectmen of Dartmouth has granted a franchise to the Horseneck Street Railway Company to build an electric railway through the town.

BILOXI, MISS.—The construction of the Biloxi Electric Street Railway has been begun.

HELENA, MONT.—The Butte & Salmon River Electric Railroad Company, with a capital of $2,000,000, has been incorporated by P. B. Moss, the Billings banker, and other Eastern Montana men. The company proposes to build an electric railway from Butte to a point in the Salmon River country, Idaho, at or near the mouth of the north fork, by way of Horse Prairie, in Beaver Head County, Mont., and Lemhi Pass. The line will be 187 miles long. It may be extended to Thunder Mountain.

NEWARK, N. J.—With a view to relieving the delay and inconvenience caused by the congestion of trolley traffic at Broad and Market Streets, the Public Service Corporation has presented to the Board of Street and Water Commissioners two plans, which, taken together, the management believes, will accomplish the object desired. These plans consist of two loops, one of which is to be used principally by cars entering the business district by way of Market Street, and the other by cars entering by way of Broad Street.

ALBANY, N. Y.—The Newburgh, Highland & Poughkeepsie Traction Company has been incorporated. The company will build and operate an electric railway from the easterly terminus of the New Paltz turnpike at Highland west through the village of Highland, Centerville, Lloyd, Ohioville, Put Corners, through New Paltz westerly to the turnpike over the Main Street bridge to Wallkill. The capital stock is $100,000. Among the incorporators are Joseph A. Duffy, Thomas G. Hinds and others of Jersey City, N. J.

BROOKLYN, N. Y.—It is unofficially stated that the Brooklyn Rapid Transit Company, to conform with the new law which compels the abolition of grade crossings of steam roads within the city limits, has decided to elevate the tracks of the Brighton Beach Railroad. This projected improvement will cost fuly $1,000,000. The ine runs over a private way, which the company owns in fee, but the trains pass through the most aristocratic suburban section of the borough.

BUFFALO, N. Y.—The International Traction Company has ordered fifty motor cars and fifty closed smokers. The smokers will be built by the J. G. Brill Company, of Philadelphia, and the motor cars by the Kuhlman Car Company, of Cleveland.

CLEVELAND, OHIO.—The Mansfield & Eastern Traction Company has filed a mortgage for $600,000 to the Central Trust Company, of Cleveland, covering a bond issue for the same amount. The road is being built between Mansfield, Mifflin and Ashland, and will furnish heat and light, as well as operating freight and passenger cars. William J. Pentz is president, and J. W. Galbraith, secretary of the company. The offices are at Mansfield.

CLEVELAND, OHIO.—At a conference of the banking houses interested in the Havana & Jaimanitas Traction Company, of Cuba, held in Cleveland, it was decided to close the option on the steam road operating from Havana to Mariano, and at present owned by an English syndicate. A bond issue of $1,500,000 was also decided upon, to be taken by the underwriters' syndicate. The steam road will be converted into an electric railway.