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Power Shortage

About two years ago we had occasion to refer to the fact that the majority of the large street railway companies of the country were suffering from the lack of sufficient power house capacity to carry the increasing business. This was due to the rapid increase in traffic which began about 1899, and the difficulty of getting new machinery from overworked factories without placing orders many months ahead. While some large roads have succeeded in catching up with the demand for power, the general condition over the country seems to be that the power house still is considerably behind the growth of traffic, and everything is being worked up to and above its capacity. While what has been said refers more especially to city roads it is also true that a number of interurban roads have not been able to handle as much freight business as they might easily have done had they had more power and rolling stock.

With the present congested conditions of the market, the addition of power machinery is not a matter which can be quickly performed, so that it is well to make preparations for additions to the generating plant a considerable time before they are actually required.

Planning Interurbans

The series of articles on the engineering preliminaries of an interurban railway, by Ernest Gonzenbach, which is begun in this issue, deals with questions in the engineering layout of an interurban electric road in a somewhat different manner from the ordinary method of treatment by writers, and is of especial value because it discusses a concrete case; and in the discussion of a concrete case it is possible definitely to present the arguments for or against a certain practice with more force than in a purely general or abstract article. The experience of the author of this article, as electrical engineer of the Aurora, Elgin & Chicago Railway, and previous to that with the Albany & Hudson, makes him especially competent to write on matters pertaining to heavy electric railway equipment.

Mr. Gonzenbach in the first chapter given in this issue calls attention to the fact that the third rail is too frequently compared in cost of construction with an overhead line, having, as a rule, a much less current-carrying capacity. With the same conductivity in both cases, Mr. Gonzenbach finds the third rail considerably cheaper than the overhead trolley system with copper feeders.

The time-table proposed, which gives a combination, local and express service to all portions of the line, is somewhat of a novelty in interurban work, and is no doubt worthy of serious consideration. The first chapter also serves to call attention to the advisability of going a little slow in the selection of very heavy motor equipments for interurban service of the ordinary type. High rates of acceleration and high maximum and schedule speeds are justified and necessary in handling suburban traffic near a large city, but in the ordinary run of interurban work, serving the neighborhood of cities of moderate size, there is no necessity for an excessive expenditure in motors and power-supplying apparatus in order to maintain a high-schedule speed with frequent stops. An excessive expenditure of this kind can only hamper the company with too great financial burdens.

Storage Batteries in Sub-Stations

The value of the storage battery in keeping down the initial investment in power apparatus for an interurban road using alternating-current transmission does not seem to be as thoroughly understood as it should be. A storage battery, used as an auxiliary to a direct-current power house, is one thing; a storage battery used as an auxiliary to a sub-station is quite another, from the standpoint of the investor. In a direct-current power house the assumption commonly made by engineers is that the addition of a given capacity of storage battery to a plant will cost approximately as much as the addition of an equal capacity of generating machinery. As far as the initial investment goes, therefore, it is not usually considered that the storage battery reduces the power apparatus investment for carrying a given maximum load. Its value to the direct-current plant is mainly in the way of affording a reserve which can be quickly drawn upon, and in making it possible to operate engines and generators at a more economical load, but a storage battery, when placed in the sub-station of an interurban road, supplied by alternating-current transmission lines, should mean much more than the mere cutting down of fluctuations of load on the sub-station machinery. It should mean a material reduction in the investment required to handle the given number of cars.

Assuming a storage battery of 100-kw capacity to be installed in the sub-station, it is fair also to believe that this storage battery has provided the sub-station with capacity enough, so that

the rotary converter capacity of the sub-station can be reduced 100 kw, and the step-down transformer capacity can also be reduced 100 kw. Going back to the power station, the 100-kw battery in the sub-station has the effect of reducing the engine, generator and boiler capacity by over 100 kw, if the road is ot the most modern high-speed type, by knocking the peaks off the fluctuations. Assuming that the 100-kw battery costs approximately the same as the 100 kw in generating station machinery, which it eliminates, there would be a saving in investment equal to the extra 100 kw in rotary converters and step-down transformers at the sub-station, which would be necessary if the storage battery were not there. If there were step-up transformers at the power houses the saving of 100 kw in step-up transformers should also be figured. It may be argued that the storage battery has only a temporary capacity of 100 kw, while additional generating and converting machinery would have a continuous capacity of 100 kw. However, the load on a road running heavy interurban cars is so extremely fluctuating that all that is needed is something to take the peaks of the load, and this the storage battery does admirably. It enables all the generating and converting apparatus to be run at more nearly an economical load, and this, with the smaller investment than would be required if the storage battery were not present.

To illustrate the severe power requirements of modern interurban railroading of the latest type it is only necessary to point to the fact that an 80,000-lb. interurban car, geared for 65 miles per hour, takes considerably more power, both in accelerating and running at full speed, than five-car elevated trains of the weight and speed common on the Chicago or New York elevated roads.

To put the matter briefly, the storage battery replaces much more apparatus, when used in a rotary converter sub-station, than it does when used in a direct-current power station, and the saving in investment thus affected is equivalent to the cost of the apparatus it displaces.

The Esoteric Meaning of Municipal Ownership

The recent convention in New York on Municipal Ownership and Public Franchises serves to call attention again to this subject, which has attracted so much discussion in the past. Papers were read both for and against the proposition and testimony was brought forward as to the success or non-success of this policy abroad. Such evidence, certainly so far as any alleged success is concerned, is, in our opinion, absolutely negatory as the customs and conditions of European countries, particularly as regards suffrage and the character of those who engage in politics, are so different than in America, that a satisfactory parallel cannot be drawn. Whatever may have been the results from municipally operated street railways abroad, whether they have been good, bad or indifferent, it is safe to say that the possibilities which the control of a street railway system would afford to the average politician in this country are enough to make the ordinary citizen shudder.

Now, municipal ownership in this country is all things to all men. Those who worship at its shrine here are a motley collection; ministerial sensation mongers, socialists mild and socialists ferocious, long-haired students of sociology, professional reformers, choleric grumblers, ward heelers, Sunday-school superintendents, bomb-purveying anarchists, college professors, crooked aldermen and miscellaneous theorists. They ally themselves to the common cause for all sorts of motives, from misguided patriotism to grand larceny. They are working in many instances for they know not what, and it is our purpose to throw, if possible, some light on the real issues of the case, to the end that people may know what municipal ownership really implies. One of the main tenets of the faith is that the streets belong to the people and should not be given over to private corporations. Doubtless the streets do belong to the people, but it seems to us that for this very reason the people should not make a foolish use of them. The streets must be used for purposes of transportation, and some one must furnish the means of transportation. This costs good money, which somebody must stand and deliver. Now, we have small sympathy with those who harp upon the risks of such investment, for in the present state of the art a well planned and operated street railway is morally certain to pay, but either public or private enterprise must do the work if it is to be done at all.

Private ownership is a very straightforward proposition, which needs no explanation; but public ownership may mean almost anything. A little study of the municipal ownership programmes is very instructive. One common scheme is to straddle by granting franchises for a limited time, with provision for purchase by the city afterwards. In theory a limited franchise is proper enough, for it is obviously wrong for this generation to tie the hands of the next in matters of civic importance, but the provisions for purchase are usually of the most absurd description from a practical standpoint. They commonly provide for purchase at an arbitrated value of the equipment and property of the company as a going concern. In this last phrase lurks interminable litigation. Surely no one is green enough to suppose that arbitration will not lead to the courts, or that the value of the franchise will not sneak into the assets of the going concern. This question has already come up in relation to municipal electric light plants with most unsatisfactory results to all parties concerned. When any provision for purchase is included in a franchise there are two distinct ways of computing the price. First, the value of the assets may be taken at the cost of reproduction for the epoch considered, i. e., when the franchise expires the price of the equipment is simply its replacement cost then and there. This is a determinable basis, but few have had the hardihood to favor it. The other basis is the capitalization of the net earnings at the current rates for money. This takes into account both the value of the franchise and that of the property, and is determinable with some difficulty. If a road pays legitimate sums for its right of operation and works up its business properly the enhanced value of the franchise certainly demands recognition. Between these two methods of valuation is a bottomless morass of litigation.

But supposing a city by these or any other methods to have compassed its hopes and taken ownership in its street railways, what is it to do with them? Shall it lease them or operate them itself? There have been many who favor the former alternative; but what profits a city to lease its street railway to a private corporation rather than its mere right of way? All the wrangles between cities and public service corporations come from questions of operation, and if the present form of private ownership be bad the proposed one is equally bad. The legitimate deduction from public ownership is public operation, from which may a beneficent Providence deliver us. When a city cannot even keep its police force from open affiliation with criminals of every stripe, what can be expected of its department employees bossed by the same gang? When our friends, with the domes of thought swollen with civic virtue, can suc-

ceed in initiating an era of pure-souled altruism in city politics they will have warrant to advocate municipal street railways. Until that time comes, the farther the average American city steers clear of the adoption of the municipal operation proposition as applied to its transportation system the better for the citizen and the taxpayer.

Looking at the matter in the cold, impartial light of everyday experience, the power behind the throne in all these movements for municipal business enterprises is a poignant desire for new well-springs of plunder. Politics makes strange bed fellows—the frantic prohibitionist and the sordid dive-keeper fall upon each others' necks and vow destruction to high license, and just so, irresponsible virtue and calculating viee would unite to enlarge the already spacious sphere of graft. Ten thousand or more additional heelers in the street railway service would be a welcome reinforcement to the ranks of practical politics, and the purchasing department of a municipal road would be a joy forever. Before political virtue becomes so universal as to permit a municipal street railway to be honestly run, private owners will have been reconstructed far enough to operate only parlor cars with dancing masters for conductors and will give a chromo with every ride. The man who votes to-day for public operation of street railways is helping on the cause of municipal corruption and allying himself, however innocently, with the enemies of pure government.

The Use of Oil as a Fuel

Several times since oil was first discovered in Pennsylvania a keen interest has been awakened in the use of oil for fuel. But the many difficulties encountered in successfully consuming oil for fuel purposes have prevented its use except in a very limited way on steamers of the Caspian Sea, and very lately on a few freighters on the Atlantic and Pacific, on the locomotives of the Southern Pacific Railway and generally in power plants in California. This recent revival of the interest in liquid fuel caused the United States Government a short time ago to appoint a board to make extended tests with different kinds of burners and oil from different sources. Owing to the amount of work to be accomplished and the time necessary to install the apparatus the entire work laid out for the board has not been finished, but the report recently submitted to the public includes fourteen trials, most carefully conducted by impartial expert observers, and furnishes much valuable information.

The experience of the board has been that the evaporative efficieney of all oils is about the same, because the crude oil, though rich in hydrocarbons, contains sulphur, so that, after refining, the calorific power per unit weight is probably not very different from that of the oil in the crude state. Though it has been feared by some that the use of oil might be harmful to the boilers, no ill effects have been noted. It is, however, undoubtedly desirable to have the sulphur removed, especially where steam is used for atomizing, as this prevents the possible formation of sulphurie acid, which would be detrimental to the boiler if present in excess.

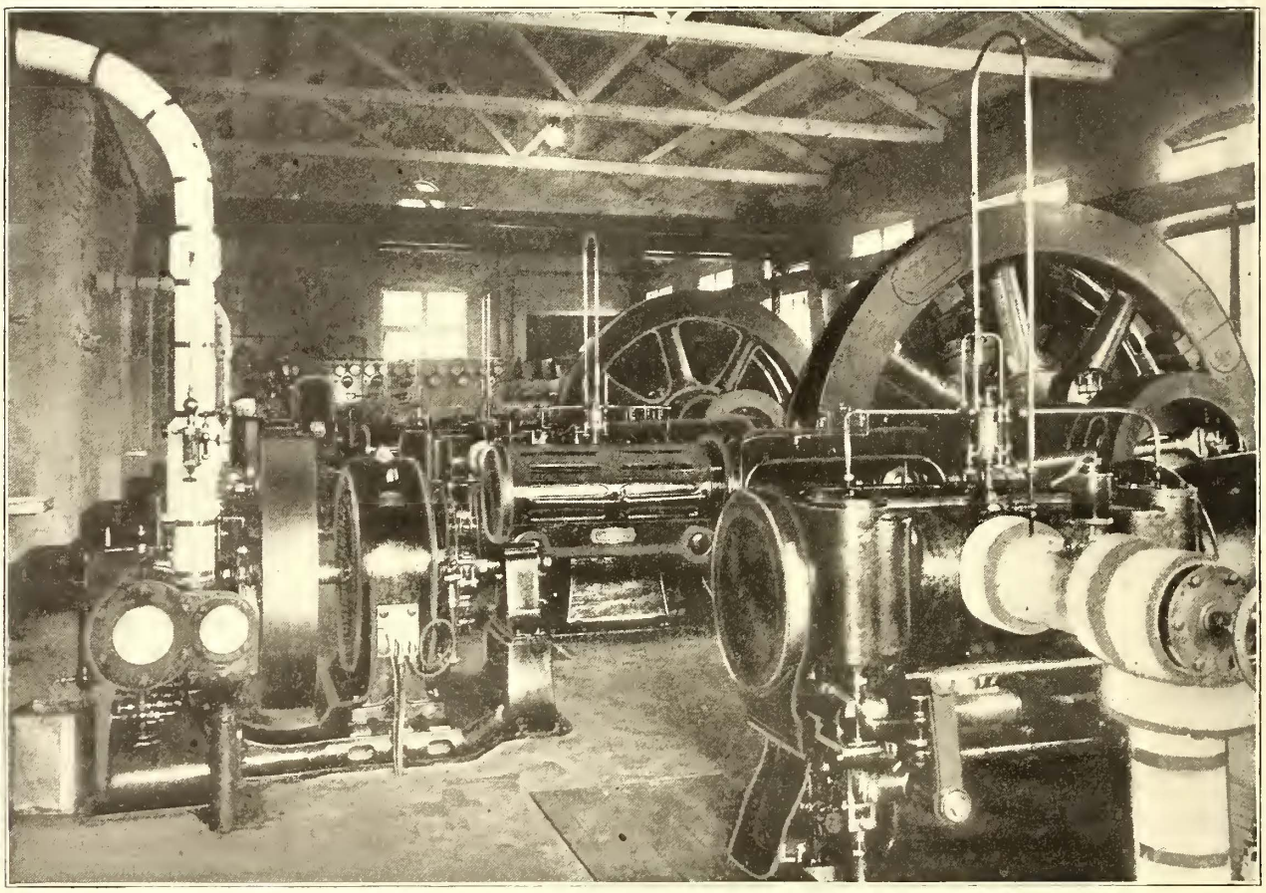
The fact that oil can be very uniformly and economically burned in large quantities has been absolutely proved, as well as the fact that the proper method of securing this end is to convert it and the air necessary for total oxidation into an intimate mixture of hydrocarbon gases and minute particles of carbon. If this is done complete oxidation will take place without the formation of smoke and soot and the deposition of solid carbon in the furnace. Definitely, the question as to the best medium to use for atomizing has not been determined. The tests so far made show beyond doubt that a combination of air and steam with the oil is not desirable, for it is the least economical in the use of steam. Contrary to popular belief, such a combination has a tendency to lower the furnace temperature, though not so much as when steam alone is used for atomizing. The reason for this loss in temperature is accounted for by the fact that the steam used for atomizing is dissociated by and withdraws from the available heat of combustion, exactly the same number of B. T. U. per pound of steam dissociated as is produced by the combination of hydrogen and oxygen when 1 lb. of steam is formed, but because of the escape of a large part of the hydrogen and oxygen up the staek without recombining the stock of available energy is lowered by just that amount. Moreover, the specific heat of steam in this condition is 0.48 against only about 0.24 for the ordinary products of combustion, hence a large loss occurs by virtue of the temperature of the flue gases. It would seem from the experience, so far gained, that when steam is used for spraying, higher pressures and superheating are more efficient than lower pressures. It is questionable, however, whether the superheaters would pay for the extra complieation entailed by them. Nevertheless, with the present interest in superheated steam for engines, it is probable that superheaters will be very widely installed, in whieh case the main superheater could be used for the burner steam.

So far air spraying of oil has shown the best results, but if forced conditions are to prevail it is absolutely neeessary that the air as well as the oil be preheated, in which case it is possible to force the boilers far beyond the limits obtainable when coal is used. With air for the spraying medium it is possible to carry the rate of combustion higher than when steam is used, and while smoke is produced at high rates of combustion in either case, it seems to be more serious with steam. Though the necessity of heating the air and oil, as well as keeping the pressures and temperatures eonstant, cannot be questioned, the best temperature to which the oil should be heated has not been ascertained; it is probably not far from 150 degs. F. If the oil is heated much above this it will tend to deposit earbon, which will clog up the piping and burners and is difficult to remove. An efficient, economical, praetical method of heating the air and oil and one of keeping the pressures and temperatures constant at the burners, independently of each other, is mueh needed, as great difficulty has been experienced from variations of this character, for no method of a practieal character has been devised.

The selection of the best type of burner is by no means settled, and it will, in all probability, take an unlimited amount of pains and a great number of carefully conducted trials before many of the points now in question are solved, but it will be by a process of eliminating those types that are found inefficient that the final result will be reached. One step so far towards this end is that, without doubt, the combined air and steam burner should be dropped, as the extravagant use of steam and the added complications due to its use are not compensated for by any material gain. It is also probable that the type, arrangement and management of the auxiliary machinery will, to a great extent at least, be a factor in the efficiency and success of the installation. Experts only should, therefore, be entrusted with the responsibility of designing the plant, for it is highly probable that a special design of boiler will add much to the efficieney. The general changes in boiler design so far suggested by the trials made are: that the furnace be made longer than is usual with coal, that the calorimetric area be reduced, and the high stack temperatures would indicate that an increase in the heating surface is decidedly desirable.

PROTECTED THIRD-RAIL INTERURBAN ROAD IN PENNSYLVANIA

The Wilkesbarre & Hazleton Railroad, which has just been completed, is one of the most interesting electric railway projects in Pennsylvania, as it is intended to compete with established steam roads in the anthracite coal region for freight as well as passenger business. It is built for high speeds in spite of the mountainous country which it traverses, and it employs a third-rail system, notwithstanding the severe climatic conditions encountered for several months each year. The third rail is protected by a wooden guard, and the contact shoe is of special design to meet the conditions thus presented. It is a modification of the form of equipment used on the experimental track at Schenectady, which was described and illustrated by W. B. Potter in the Street Railway Journal last August. The Wilkesbarre & Hazleton road, therefore, enjoys the distinction of being the first railway in the country to be equipped for commercial operation with a protected third rail. During the construction cars were operated over the several sections as they were completed, and as this period extended through several severe snow and sleet storms without interruption of service, it is confidently anticipated that no trouble will be experienced with the entire road fully equipped for commercial operation.



GENERAL VIEW OF ENGINE ROOM IN MAIN POWER PLANT AT ST. JOHNS

ROUTE SELECTED

As indicated by the name of the company it is proposed to operate an electric line between Wilkesbarre and Hazleton, following as direct a route as the formation of the country permits, and avoiding steep grades as much as possible, in surmounting the difference of 1200 ft. in the altitude of these cities. The district lying between these points is exceedingly rugged, and it comprises some of the most fertile valleys of the State. Strange as it may seem, the region penetrated by this road has heretofore been without any transportation facilities, as the steam roads have followed closely the mining settlements on its outskirts, leaving the agricultural interests entirely neglected. The intercourse between the two cities is large, and at present the means for it are furnished by two steam railroads —the Pennsylvania and the Lehigh Valley. The distance between the railway terminals in the two cities by the railways named is respectively 50.4 miles and 49.6 miles. The Pennsylvania runs four trains a day in each direction, while the Lehigh Valley provides six trains in one direction and five in the other.

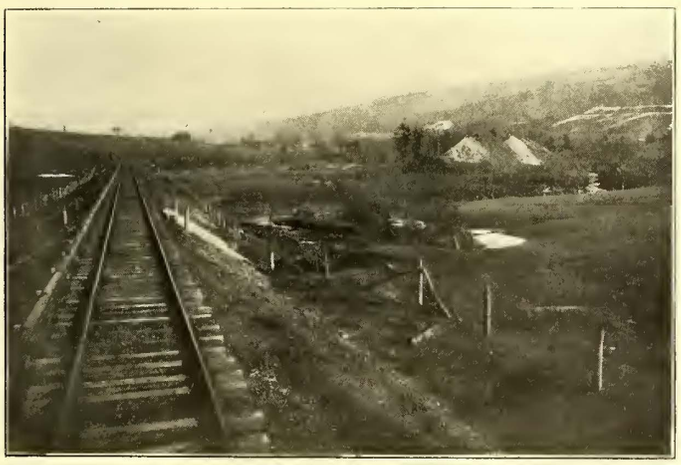
The new electric line is 26.2 miles long between points of junction with the local electric railways in Wilkesbarre and Hazleton, and the total distance between the Court House Square in Wilkesbarre and the terminal at Wyoming Street and Broad Street in Hazleton will be less than 30 miles. By the existing steam roads two hours are required to make the trip between the two cities; at the same average speed the Wilkesbarre & Hazleton Railway would carry passengers in about 70 minutes, but this running time can be materially cut down on the electric line, and it is proposed to operate regular express trains between the terminal points named in one hour. The speed ordinances governing the movement of cars on the streets of the terminal cities leave only 40 minutes of the sixty to cover the distance over private right of way between the two city limits.

The accompanying map shows the relative location of Hazleton and Wilkesbarre, and the routes of the Wilkesbarre & Hazleton Railway, the Pennsylvania Railroad and the Lehigh Valley, as well as the trolley lines in the immediate vicinity of the terminals which will be directly tributary to the new road. It will be seen at a glance that in going from Hazleton to Wilkesbarre the route of the electric railway is the diameter of a circle, of which the combined routes of the Lehigh Valley and the Pennsylvania form the circumference, the Lehigh Valley reaching Wilkesbarre by following the half circle to the right of the new road, while the Pennsylvania follows the half circle to the left of that road. The actual routes of all

three roads are, of course, very devious, but as regards distance the new road, as compared with the steam roads, is relatively shorter than would be the case if the new road were an absolutely straight line coincident with the diameter of a perfect circle, the circumference of which was formed by the two steam roads. Under the circumstances it must be admitted that the new line enjoys many natural advantages, which, in addition to the improved facilities offered in the way of frequency of service and greatly reduced running time, and the economy of electric operation, it is believed, will enable the management to control the greater part of the passenger traffic between the two cities and secure a considerable freight business as well.

The tributary territory to this interurban road is rapidly developing in wealth and population, and it is at present the center of the most important mining, manufacturing and agricultural district in the State.

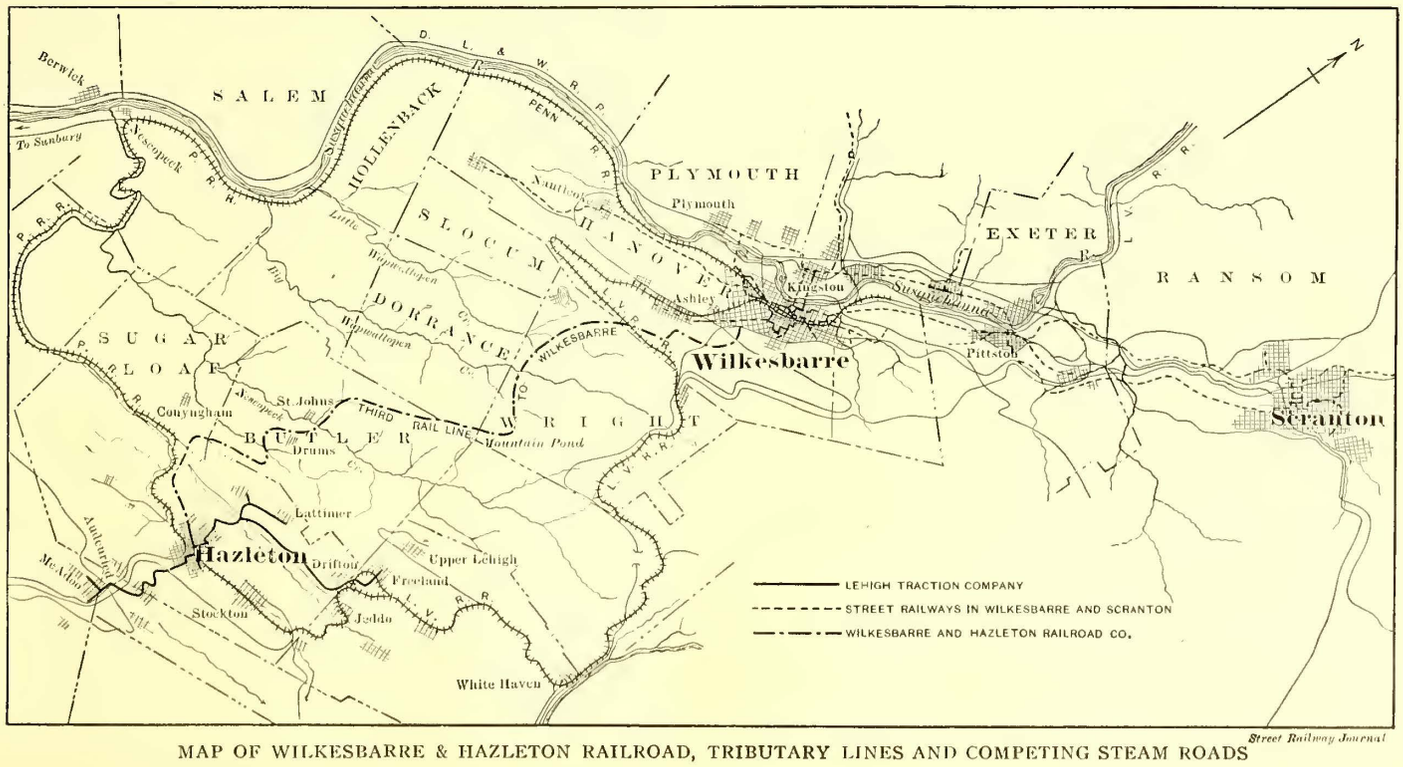
CONTACT RAIL CONSTRUCTION



PASSING JEDDO TUNNEL

CHARACTER OF SERVICE

Wilkesbarre, the northern terminus of the road, is the county seat and commercial center of Luzerne County, which is only exceeded in wealth by two counties in the State of Pennsylvania, namely, those in which Philadelphia and Pittsburg are located. It is in the northern anthracite coal fields, the beautiful Wyoming Valley, which is underlaid with 80 ft. of anthracite coal, and it has, besides, a number of large factories engaged in the manufacture of lace curtains, axles, wire rope, silk, iron and steel. The Wilkesbarre & Wyoming Valley Traction Company owns and operates all the electric railways in the city and valley, which include the local traffic and lines up and down the valley on both sides of the Susquehanna River, comprising a system of 65 miles. These lines pass through and terminate in well-built and densely populated sections of the valley, and they connect at the city of Pittston by two

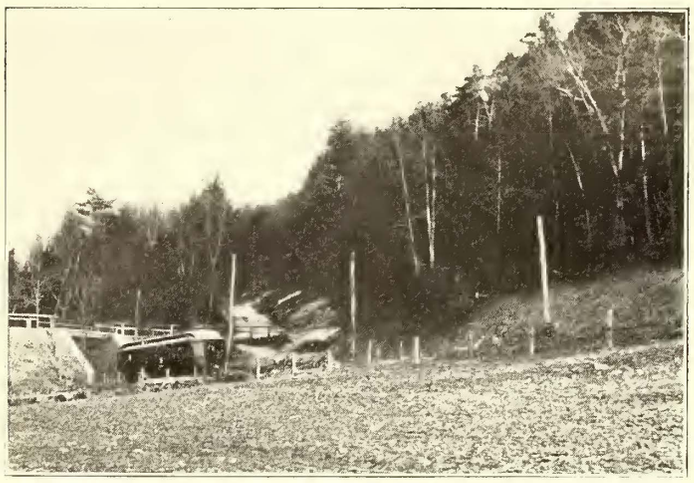


MAP OF WILKESBARRE & HAZLETON RAILROAD, TRIBUTARY LINES AND COMPETING STEAM ROADS

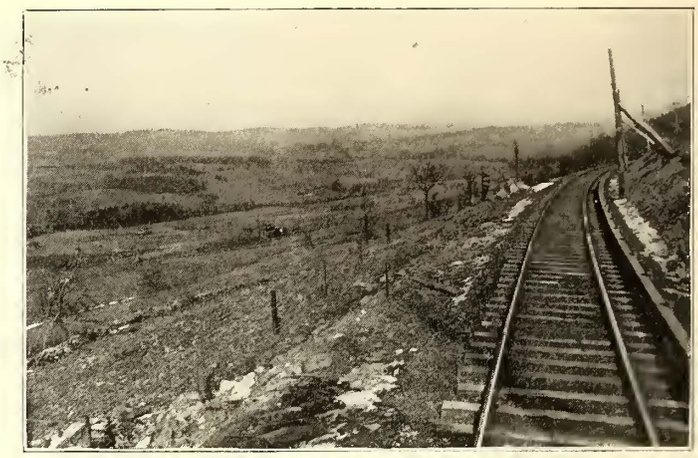
different lines with Scranton and its traction system. At Luzerne there is another connection to a line running to Harvey's Lake, the largest body of water in the State, and one of the most popular resorts. The population served by the Wilkesbarre & Wyoming Valley Traction Company, including the city, is about 200,000. The average number of passengers carried daily is about 35,000, or over 12,000,000 per annum. The equipment of this system includes 123 trolley cars, most of which are large and have double trucks, insuring quick service. The lines of this system converge at the public square in Wilkesbarre, which is the starting point for the line to Hazleton. The Wilkesbarre & Hazleton Railway Company has acquired, by lease, the right to operate its cars over the tracks and to use the terminals of the Wilkesbarre & Wyoming Traction Company, thus giving it unexcelled terminal facilities in the city of Wilkesbarre and connection with the electric lines between Wilkesbarre and Scranton and intermediate towns.

Hazleton, the other terminus of the railway, is the center of the eastern middle coal field, and is surrounded by mining towns. These are reached by the lines of the Lehigh Traction Company, owned by the Wilkesbarre & Hazleton Railway Company. The system includes 22 miles of track, and operates fifty-three cars, which serve a total population of 95,000, the average number of passengers per day being about 7000, or over 2,000,000 annually.

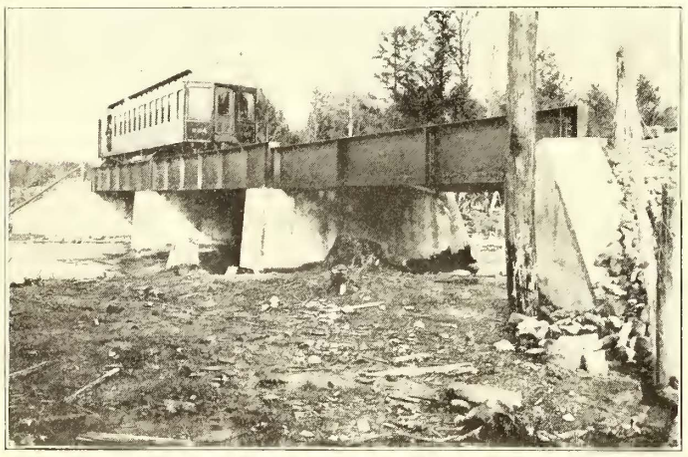
Nine miles from Wilkesbarre is Triangular Lake, a beautiful sheet of water about 300 acres in extent, close to the foot of the mountain and completely surrounded by fine woods. In spite of the present inadequate facilities for reaching this



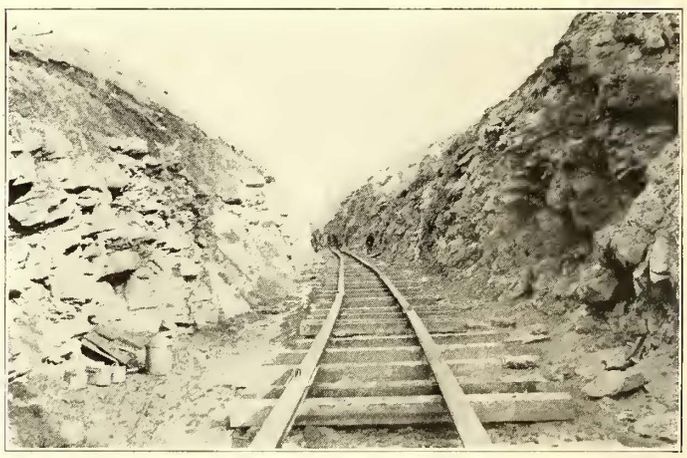
CLIMBING A STEEP GRADE



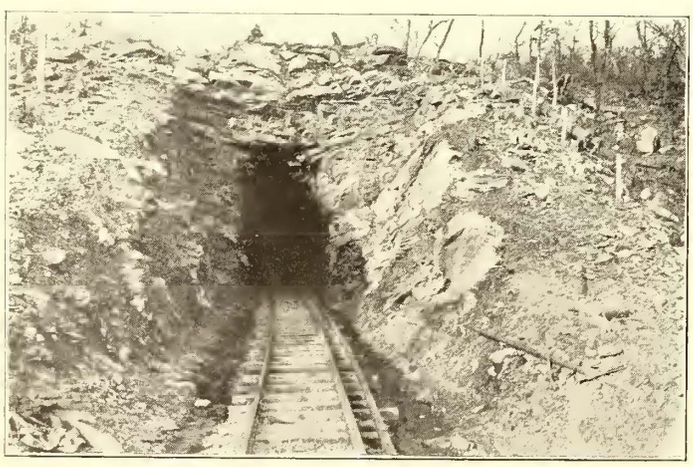
ROAD SKIRTING CONYNGHAM VALLEY



RAILWAY BRIDGE CROSSING BIG NESCOPECK CREEK



PREPARING ROADBED THROUGH ROCK CUT



TUNNEL THROUGH PENOBSCOT MOUNTAIN

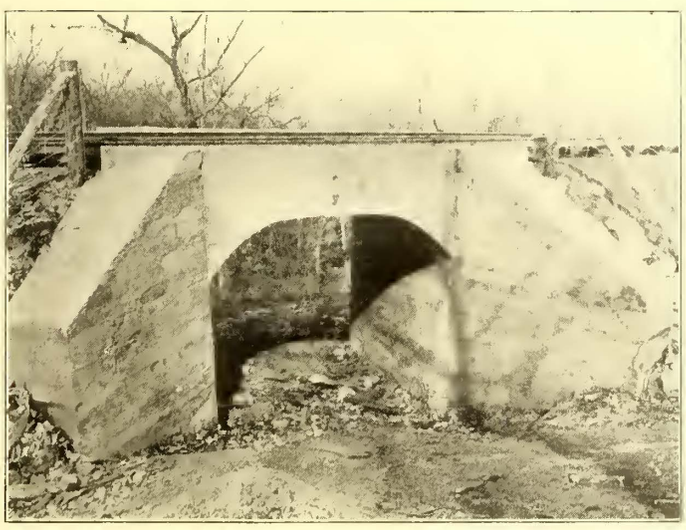
PORTAL OF TUNNEL NEAR WILKESBARRE

charming resort there are already a number of cottages on its shores, and with improved transportation facilities it is bound to become popular for summer homes and recreation grounds. It is the plan of the railroad to establish a picnic grove at Triangular Lake, offering all the inducements of an ideal location to families and excursion parties. The ride over the line of the electric road is through one of the most picturesque sections of the State, and cannot fail to command a large pleasure traffic. The route crosses three valleys, skirts along the sides of two mountains and penetrates a third, and at numerous points presents scenery which is grandly picturesque. Conyngham Valley, as seen from Conyngham Gap, offers a picture of rural beauty, in sharp contrast to the outlook from Nescopeck Mountain. Here is spread a vast tract of wild and rugged country where nature has full sway. Another point of interest is the Jeddo tunnel, near the mouth of which the track passes. This tunnel was constructed by John Markle to drain the G. B. Markle & Company mines at Jeddo, 5 miles away, and it is quite a noted piece of engineering.

A CHARACTERISTIC FILL

In addition to the cities and towns to which additional facilities will thus be offered, there is a considerable population in two farming valleys, Butler and Wapwallopen, which will be traversed by the road.

Besides the passenger traffic to be derived from these sources the road will undoubtedly develop considerable freight business, consisting in the delivery of supplies to the inhabitants of the valley, and in hauling farm products to market. This service is now performed entirely by wagons. The electric road will naturally receive considerable freight from connecting steam roads, including the Lehigh Valley, the Pennsylvania, the Central Railroad of New Jersey, the Delaware & Hudson and the Delaware, Lackawanna & Western. For the present it is proposed to haul freight between midnight and 6 o'clock in the morning, and use steam locomotives for this service, as the system was established under a regular steam railroad charter, which, however, permits electric operation as well. It will be unnecessary by this arrangement to keep the power house in operation during these hours, and it will enable the company to devote all of its initial electrical equipment to passenger and express business during the day. Later, when the freight business warrants, electric locomotives will be employed for this service.



CATTLE WAY

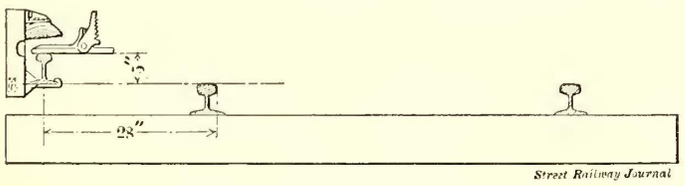
CULVERT AT SUGAR NOTCH RUN

ROADBED CONSTRUCTION

In the construction of the road many interesting engineering problems were encountered. Owing to the character of country traversed and the difference of 1200 ft. in the altitude of the terminal points, it became a serious problem to select a route and establish a line entirely free of heavy grades and sharp curves, but this was successfully accomplished. A private right of way, 60 ft. wide and fenced in on both sides, was acquired, and throughout the entire line there is not a grade exceeding 3 per cent, and only one curve of 18 degs. The grade thus established necessitated some bold engineering, heavy fills, deep rock cuts and the driving of a tunnel 2684 ft. long through Penobscot Mountain, about 600 ft. below the summit and through solid rock. Throughout the entire route there are numerous grades varying from 2 per cent to 3 per cent. The entire elimination of grade crossings was determined upon, in order that high-speed operation might be adopted with safety. This policy made necessary the construction of thirty-three highway-crossing bridges and railroad bridges over streams of

BRIDGE WORK OVER SOLOMON'S GAP

various sizes. All of these structures are of concrete. The roadbed also includes two large bridges of granite masonry, one of the stone arch type and the other of the girder form, supported by high masonry piers. Every feature of the roadbed received close attention, and, as a whole, the line may be said to mark a distinctive advancement among interurban electric properties. The track-rail is a Boston & Albany section, 95 lbs. to the yard, laid on 8-ft. ties, spaced to 24-in. centers. Nine-foot ties are used for every fifth tie, where insulators support

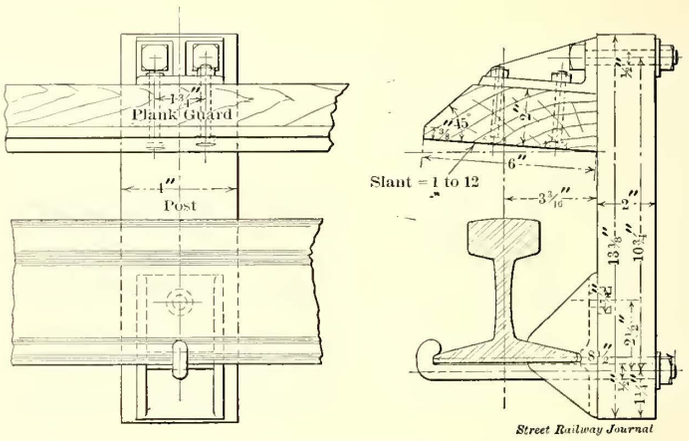


SECTION OF TRACK, SHOWING RELATIVE POSITION OF THIRD RAIL, GUARD AND CONTACT SHOE

the contact rail. At present the ties are laid on a bed of cinders, which will be continued for a year or more, and then a top dressing of broken stone, 10½ ins. high, will be added, the cinders forming a cushion between. In the meantime precautions have been taken to establish a level bed, and as considerable care was exercised in the selection of ties, a uniform structure is maintained. Moreover, the contact rail and track follow the same gage, so that there is no unevenness and no momentary loss of contact because of depressions in the track or divergence of the contact rail. All curves are approached by compounding and are elevated for high speeds. The final elevation of curves will be determined in accordance with the needs as shown by the operations of cars over the line on schedule.

PROTECTED THIRD RAIL

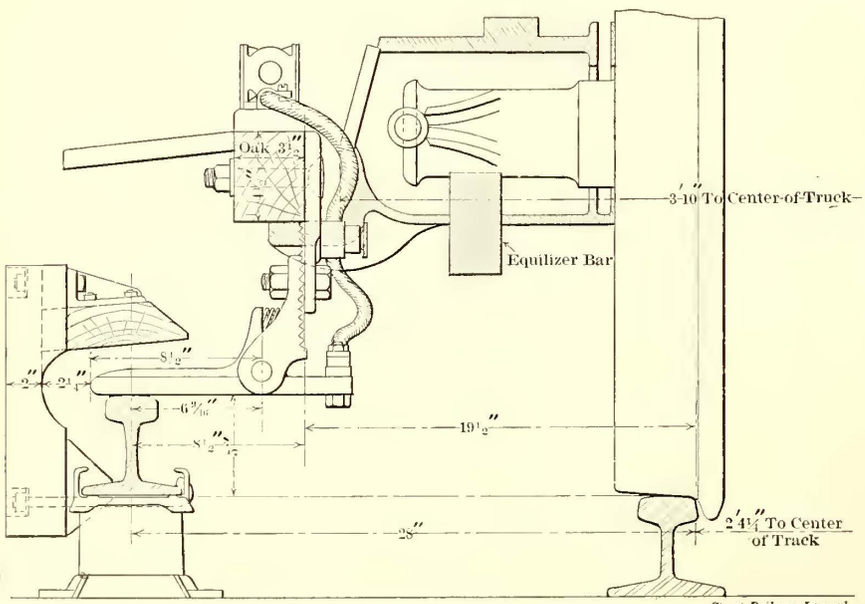
The construction of the contact rail is a departure from common practice up to the present time, as it is protected from sleet and snow by a 2-in. x 6-in. pine plank held directly over the rail. Already this protection has demonstrated its usefulness, for during the severe sleet and snow storms of December the cars operated over the line with perfect ease. The added element of personal safety is a very great factor. The guard plank is supported by oak posts, spaced every 8 ft., and both guard and rail are carried on vitrified clay insulators every 10 ft. To prevent creeping fish-plates are left moderately loose, and an anchoring insulator is placed in each rail midway between joints. The contact rails are 60 ft. long and weigh 80 lbs. to the yard. They are placed 28 ins. away from the gage line,



CONTACT RAIL AND GUARD

and the top of the third rail is 5 ins. above the track rail; in fact, the insulator carrying the contact rail is on a level with the top of the track rail. The contact rail is of special composition and possesses high conductivity.

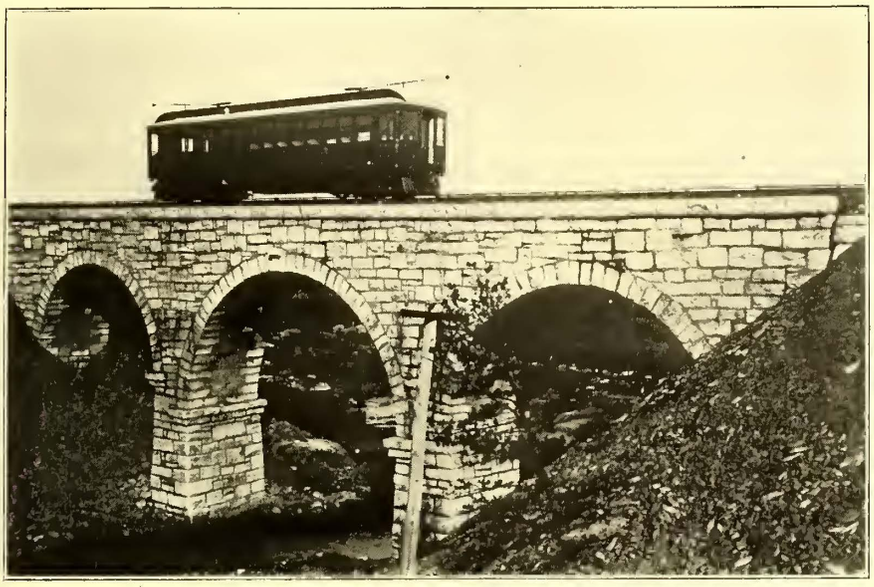
Both contact rails and track rails are bonded with soldered bonds, furnished by the Chase-Shawmut Company. The bonds have been applied for over six months, and the shock due to heavy steam locomotives and freight cars passing over the line during the entire construction period has not thus far produced the least indication of breaking away. The application of the soldered bond necessarily involved a departure from the usual method employed in laying track where protected bonds are used. The soldered bond is fastened under the foot of the rail, and to facilitate the work it became necessary to turn the rail bottom-side up. As the track men had only spiked the rails at center and joints this was easily done by drawing the inside spikes for a length of about twenty rails, depending on the local degree of curvature in the track. The joints were then surfaced, the bond applied, and eight men with a few short bars were enabled to return the rail to its normal position. The spikers in this work followed the bonders rather than the rail-men, thus avoiding delay and keeping the spikers busy.



CONTACT SHOE, GUARD AND RAIL

ROLLING STOCK

The schedule to be inaugurated over this road calls for an hourly express service and a local every hour and a half. Six cars have been provided to perform this work. They are combination coaches built by the J. G. Brill Company, of Philadelphia, and consist of a passenger and a baggage compartment and a toilet room. They are handsomely furnished and are finished in solid mahogany. They are heated by electric heaters furnished by the Consolidated Car Heating Company. The baggage compartment is finished in natural ash and is provided with folding seats for smokers. Loading steps are provided at only one side of each platform. The opposite side is used for a motorman's cab.



STONE ARCH BRIDGE OVER BLACK CREEK

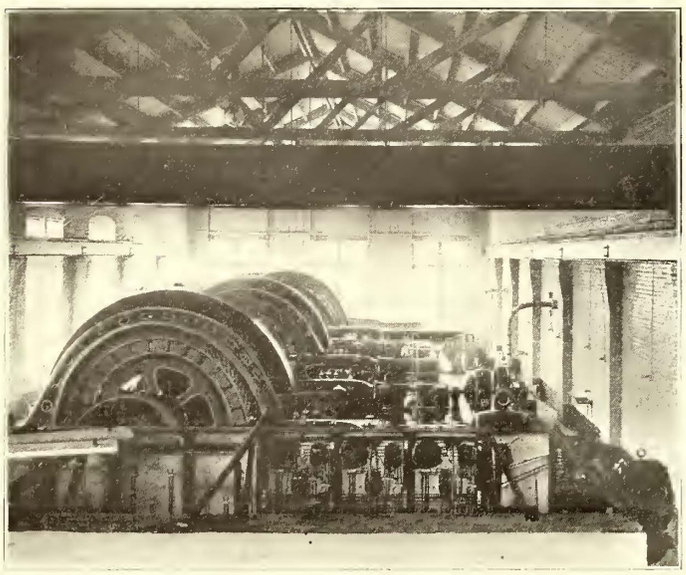
General dimensions of the cars are: Length over end panels, 43 ft., and over platforms, 51 ft.; width over outside sheathing, 9 ft. 6 ins.; height from bottom of sill over roof, 9 ft. 8½ ins.; inside length of passenger compartment, 29 ft. 11 ins.; inside length of baggage compartment, 11 ft. 11½ ins. The cars have been built on lines closely approximating steam practice, and furnishing convincing proof of the advancement that has been made in this particular branch of the service.

Double sliding doors are provided at the passenger end of the cars, and single sliding doors at the baggage end. Each side of the baggage compartment has a 42-in. sliding door. The sliding door in the partition is panelled, not glazed. The vestibule side doors are hinged to the vestibule post next the car body. These doors, when closed, are locked by the close-fitting of the trap-door covering the three risers. Swinging doors leading to trailers have half-drop sash. The motorman's cab in the vestibule has a sliding door to the platform and a drop sash in the side and front windows. The cab is provided with a hinged set. The upper sashes of the car windows are stationary, and are of decorated plate-glass, while the lower sashes may be raised. The interior of the cars are finished in solid mahogany, with pilasters handsomely carved and panels richly inlaid. The head-linings are of three-ply curly birch in natural color and decorated in silver. The passenger compartment has seating capacity for thirty-eight persons. The cane seats are 40 ins. long, and have high reversible backs and mahogany arm rests. The trimmings throughout and basket racks are of solid bronze. The cars are furnished with "Dedenda" gongs, automatic air sand-boxes, M. C. B. couplers, Gould platforms and two-stem spring buffers. The "cow-catchers" at either end are so placed as not to interfere with coupling. Brill No. 27 E-2 trucks, with 36-in. wheels and 6-ft. 6-in. wheel base, are used. The truck frames are 11 ft. 3 ins. long, and the weight of the trucks without motors is 13,000 lbs. A General Electric 66-motor is attached to each of the four axles. The motors are practically the same as those on the Manhattan L, and are governed by the Sprague multiple-unit automatic control, as embodied in the contactor system. The management expects that the traffic will soon warrant the operation of trains of several cars, and for this reason introduced this system of control.

An interesting part of the equipment is the brake system, said to be the most complete ever furnished on any form of rolling stock. This is particularly gratifying to those who hope to see the electric motor become an important factor in long-distance, high-speed and heavy railroading. Experienced steam railroad operators realize that until this feature is fully understood and appreciated, and the electric system is equipped with safety devices for proper operation under steam railroad conditions, it cannot hope for recognition on important lines. Consequently, the evidence thus presented that electric railroad men are giving serious consideration to this problem and have already made such progress is reassuring. In the case of the Wilkes-barre & Hazleton Railway no less than four braking appliances are provided. The outside brakes are operated by two methods, namely, Westinghouse automatic air and a vertical hand-wheel

HEAVY PASSENGER COACH WITH BAGGAGE COMPARTMENT

in the motorman's cab; and the inside brakes also have two systems of control—Westinghouse magnetic and a vertical wheel in the vestibule. The cars are arranged for running in both directions, are adapted for use either singly or in trains, and are equipped for head-end train control. An air signal system is provided whereby the conductor at any part of a long train may signal the operator at the head, as is now done



VIEW OF ENGINE ROOM FROM ABOVE SWITCHBOARD

in steam passenger service. The total weight of a fully-equipped car is 84,000 lbs.

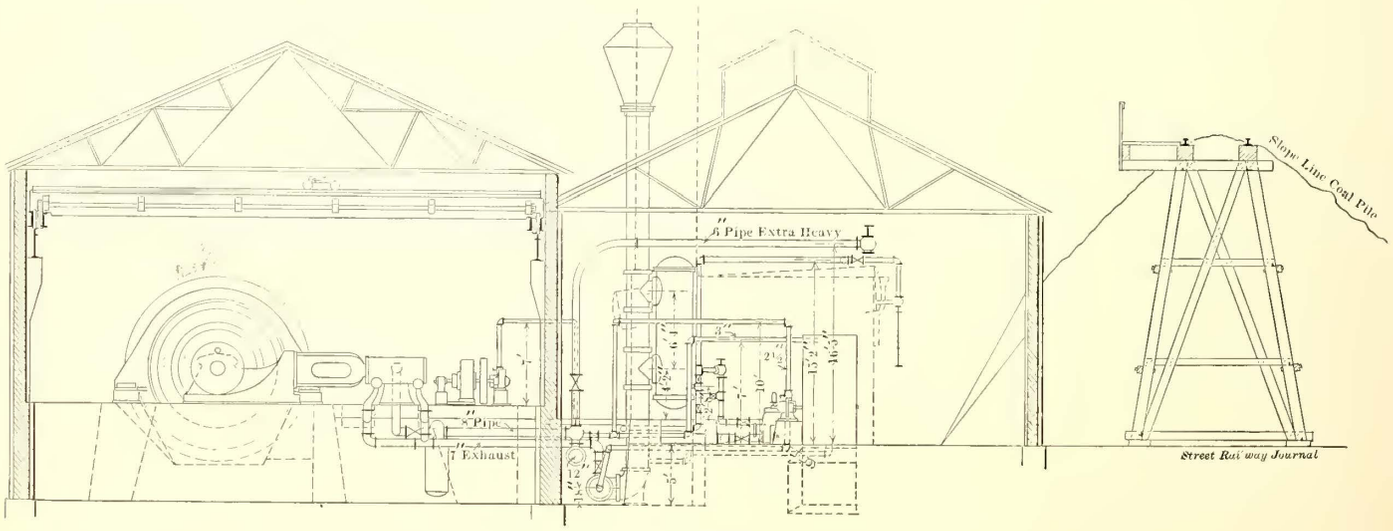
The contact shoes are of special design for use with a protected third rail, and the essential features are illustrated in the accompanying drawings. The design of the contact shoe was worked out by W. B. Potter, of the General Electric Company, and the method of protecting the third rail is, in a general way, similar to that recently erected on the experimental track of the General Electric Company at Schenectady. Trolley poles are also provided on these cars for use on the city traction systems over which they operate, and the switch governing the connections to trolley and shoe is designed to permit the change being made on a grade without losing contact.

POWER PLANT

The power house is located 8.4 miles from the Hazleton end of the line, on the Nescopeck Creek, which supplies suitable water for the boilers. The building is 132 ft. long and 84 ft. wide, and there is a coal trestle at the side. It is a substantial brick structure with steel frame work and cement flooring throughout. It is the purpose of the company to double the present capacity of the power house, and eventually take care of the Hazleton service through sub-stations from this plant. At present one end of the power house is enclosed with an iron sheathing instead of a brick wall, and when the addition is built at this end it will really be an extension along lines already laid down. The general layout is on standard lines, and the unit plan has been adopted throughout. A coal-run deposits coal so that it flows into the boiler room ready for use. Ashes are removed by being dropped into a car which runs on a track beneath the floor in front of the furnaces. The boilers are of the water-tube type, supplied by the Heine Safety Boiler Company, and contain 2600 sq. ft. of heating surface over grates,

POWER HOUSE AT ST. JOHNS

12 ft 3 ins. wide and 7 ft. deep. They are grouped six boilers in a nest, with a steel stack 5 ft. in diameter and 90 ft. high for each pair, resting on the division wall between the boilers. In addition to these stacks a steam-driven blower, capable of developing a 2½-in. forced draught is installed. The boilers operate under 125 lbs. pressure. A Wainright feed-water heater, supplied by the Taunton Locomotive & Manufacturing Company, is used to heat the water supply. The furnaces and grates are designed to burn very fine anthracite coal, and the boilers are set very high to permit the utilization of stokers. The boilers were installed during the coal strike of 1902, and were started up with bituminous coal instead of the fine anthracite for which they were originally intended. The coal used was from the Pennsylvania bituminous coal fields, and was termed a rather smoky burning coal, yet these furnaces consumed it perfectly, and smoke was very rarely seen coming from the stacks, except at such times as the doors were open for the purpose of stoking. The lowest row of tubes is about 6 ft. from the grate and is covered with C-tile brick, providing for the gases a large combustion chamber and permitting them to travel the whole length of the boiler before coming in contact with tubes that cool them to any extent.



SECTION OF POWER HOUSE AND COAL TRESTLE

In a test made on these boilers, using rice anthracite coal

with 22 per cent ash, they developed 40 per cent overload for six hours, with an evaporation of 7.5 lbs. of water from and at 212 degs. F. per pound of coal. During the intermediate four hours of the test the boilers developed approximately 70 per cent overload. The coal burned per hour per square foot of grate was 20.8 lbs. with an average draught of 1.8 ins.

Prior to the making of this test the boilers had been in moderate operation for three or four months, and no special precautions were taken, such as cleaning and blowing out tubes in order that the highest overload capacity might be reached. The makers guaranteed 50 per cent.

The boilers are piped into a 12-in. main header, from which the engines take their supply of steam. The piping, which is extra heavy throughout, is arranged to permit the operation of this plant as three independent units.

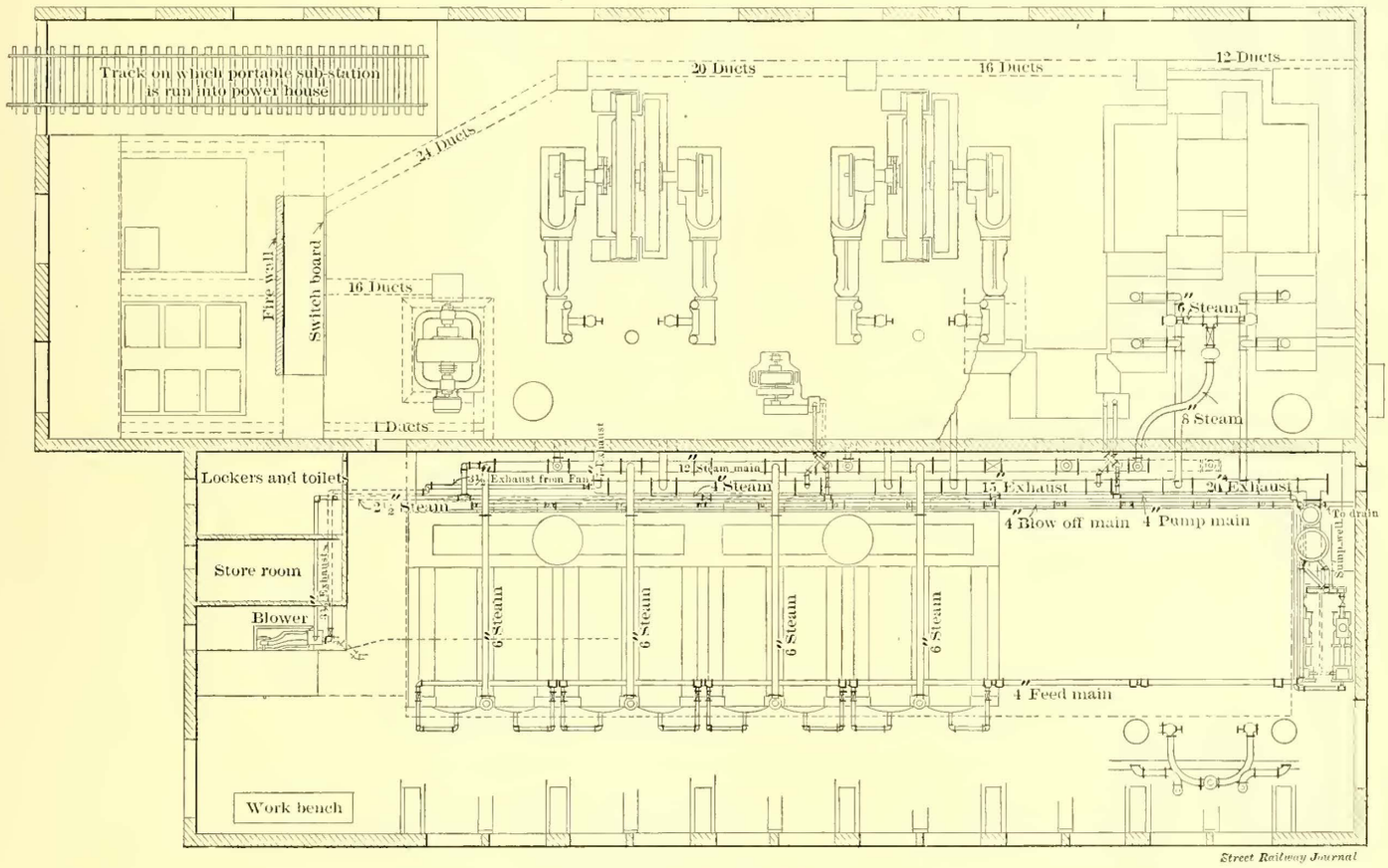
The engines were supplied by C. H. Brown & Company, of Fitchburg, Mass. They consist of three pairs of cross-connected (18 x 36), making 115 r. p. m., and each pair direct-connected to a 400-kw alternator. One pair develops normally 600 ihp. Compounding these engines or condensing the exhaust was not considered advisable in this plant on account of the low cost of fuel and because of the extremely variable load that would be encountered. It was decided, however, to connect two engines, rather than one, to an alternator with cranks 90 degs. apart, in order to obtain a more uniform turning moment for parallel operation. A fly-wheel, 15 ft. in diameter and weighing 60,000 lbs., assists parallel operation and lessens the shock of the engines, when, as often occurs, a 50 per cent overload is suddenly thrown on or off. Their economic performance is 23.9 lbs. of steam per indicated horse-power at full load of 600 ihp.

The two exciter engines (8½ x 9) were supplied by the Harrisburg Foundry & Machine Company. They are operated at 300 r. p. m, and are directly connected to 25-kw shunt-wound generators.

A gravity oiling system furnishes lubricant to all bearings, and an air-blast system is provided for cleaning purposes.

All the electrical apparatus used in the power house and sub-stations is of the Westinghouse type. The alternators are of 400-kw capacity with revolving fields, and are direct connected to the engines. They deliver three-phase current at 390 volts, with 3000 alternations at 115 r. p. m. The generators are connected directly to the bus-bars, without fuse or circuit breaker, and require 115-amp. exciting current at 125 volts. One 400-kw rotary converter, revolving at 500 r. p. m., is now installed in the power house, and a foundation is provided for another. At present it is intended to use the rotary converter in the sub-station car, which is a feature of this installation that will be described in detail later on, to help out the rotary at the power house, as the heaviest demands for current are expected at this point.

This car can be run into the power house on tracks provided for this purpose, as shown in the plan. The rotary converters



PLAN OF POWER HOUSE

in the power house have carbon-break circuit breakers on the direct-current side and fuses in the alternating current leads. They deliver current to the rail at 625 volts. All feeders to the contact rails are protected by tank lightning arresters and choke coils. Two banks of transformers are connected in delta to raise the voltage to 15,000 for transmission over the line, and provision has been made for two more banks. The transformers are of 150-kw capacity and are oil cooled. Fuses are used in the low-tension leads between bus-bar and transformers, and especially designed bayonet switches on the ends of long sticks connect the high-tension side to the transmission line. Long-break circuit breakers and low-equivalent lightning arresters with choke coils are placed in the high-tension line just before it passes out of the power house.

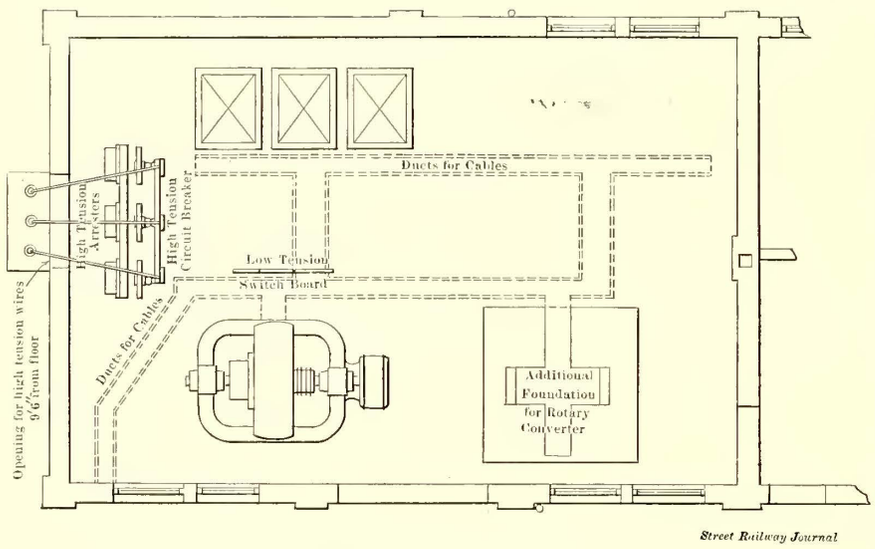
The switchboard is of gray marble and consists at present of nine panels. The two exciters are on one panel, which is equipped with an ammeter for each generator and a voltmeter. Each alternator panel is equipped with an indicating wattmeter, an alternating-current ammeter which can be switched into any phase, a direct-current ammeter in the exciting-current circuit and phasing lamps. A button operates an automatic stop,

which will shut the engines down on a given rise of speed, and a switch controls the engine governor for the purpose of synchronizing or adjusting the load. The two transformer panels are each equipped with three ammeters, which show the current in the transformers. The alternating-current rotary-converter panel is equipped with three ammeters and phasing lamps. The field rheostat operating handle is in this panel. On the direct-current panel is the voltmeter, equalizing switch, together with the circuit breaker and ammeter, which are connected in the negative lead. The feeder panel which supplies the rail in each direction from the power house has circuit breakers and ammeters for each feed.

SUB-STATIONS

In addition to the sub-station at the power house, one permanent sub-station is in service half-way to the Wilkesbarre end of the line. The contact rail between this sub-station and the power house is fed at both ends from rotary converters at these respective points.

The voltage at the Hazleton end of the line, which is 8.4 miles from the power house, will be held up by tying onto the system of the Lehigh Traction Company until the proposed sub-station, already mentioned, shall be provided in the vicinity of Hazleton for the local service as well as the interurban road.

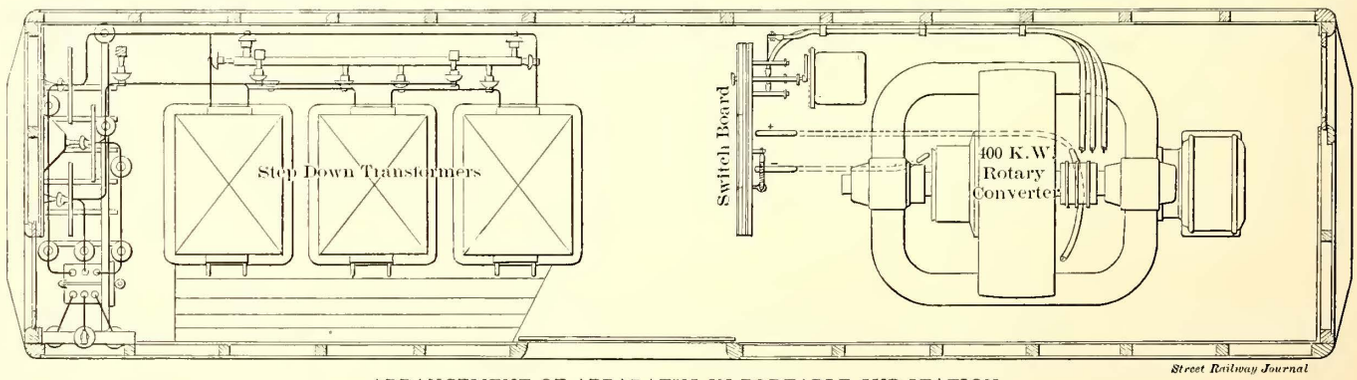


PLAN OF SUB-STATION NO. 1

The sub-station near Wilkesbarre is equipped with one 400-kw rotary converter, one bank of three transformers connected in delta, and a three-panel switchboard, an equipment exactly similar to that in the power house. The transformers in the sub-station, of course, are reversed to step-down the current instead of stepping-up. Provision is made for doubling the equipment when needed. The transformers are connected to the high-tension line by bayonet switches and are protected by low-equivalent lightning arresters with choke coils and by long-break circuit breakers. Tank arresters and choke coils are installed in the feeders. The choke coils on the high-tension lines in the sub-station are of lower capacity than those of the transformer apparatus at the power house. No fuses are used between the low-tension side of the transformers and the switchboard and rotary converter. Attached to the sub-station is a dwelling house for the use of the attendant, and it is expected that one man will be able to perform all the duties of this station, as he will be relieved for a day periodically. The hours will, of course, be long but the work is very light.

SUB-STATION NO. 1

One of the most interesting features of the plant is the portable sub-station, which consists of an equipment similar to that in the permanent sub-station just described. This is installed in a car especially designed for this purpose, so that it may be shifted to any part of the system where the demands are unusually heavy, as, for instance, in the neighborhood of Triangular Lake during the excursion and picnic season. The length of car over sheathing is 36 ft., and the width over posts is 9 ft. 6 ins. The roof can be removed in one piece, like that of a box-car, to permit the placing of large and heavy machinery that can best be handled by cranes. Eight large eye-bolts, set in blocks secured to the rafters and top plate of the monitor deck, facilitate the hoisting process. Every alternate rafter is reinforced with angle-iron, and all parts of the roof are made extra strong to withstand the stress of moving. Brill No. 28 trucks are employed. The rotary converter is placed directly over the forward trucks, and the three transformers at the other end of the car over the rear trucks with the switchboard between. This distribution of equipment leaves ample room, moreover, for the attendant to examine the machinery and move freely about the car, although, of course, no room is wasted. The total weight of the equipment is about 51,000 lbs. The car is not equipped with motors, as it can readily be attached as a



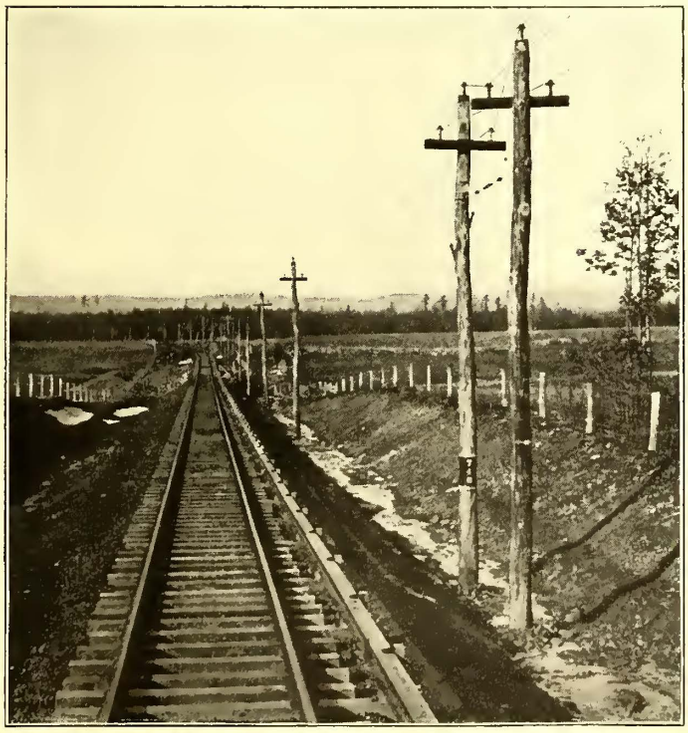
ARRANGEMENT OF APPARATUS IN PORTABLE SUB-STATION

trailer to a regular passenger car and hauled to any part of the line when it is needed. As already mentioned, the apparatus is similar to the equipment in the sub-station, with a slight variation in the connection of the high-tension side of the transformers to the line from those found in the power house and sub-station. In the last the individual leads from a transformer are connected by means of bayonet switches so that a single transformer may be taken out of service by pulling two switches. In this sub-station car sufficient room did not exist to put on the bayonet switches, and the three transformers are supplied with solid connections. It is believed that permanent connections will answer every demand made on the portable plant. The transformer cases are made very high to prevent oil overflowing and running out on the floor, because of the movement of the car. Long poles are provided to hook connection onto the transmission lines at any point alongside of the track. Bayonet switches complete the connection to the car, and an oil break switch furnishes a reliable means of opening or closing the connection between the transformers and the high-tension line.

POLE LINE AND TRACK CONSTRUCTION OVER LONG FILL AND CURVE

HIGH-TENSION TRANSMISSION

The high-tension line runs from the power house to a point north of the Penobscot Mountain, called Riley's Run, a distance of 14 miles. It was desirable to have the poles carrying the transmission line as near the track as possible for telephonic purposes, and yet have ample clearance for passing cars. Accordingly, 12 ft. from center of track was chosen as a line best suited to all conditions. The undulating nature of the ground made it necessary to use poles ranging from 30 ft. to 35 ft. long, in order that the tops should maintain a comparatively straight line, approximately following the line of track. The line consists of three No. 4 B. & S. hard-drawn bare copper wire, forming an equilateral triangle with 30-in. legs and transposed twice, each transposition making one-third turn. The insulators are glass with double petticoats, the outer measuring 7 ins. At the ends of the line, at transportation points and at other places where greater mechanical strength was required, a special type of glass insulator was used. The poles are spaced 100 ft. at curves and 125 ft. on tangents. A locust pin, boiled in paraffine, 7 ins. long, with 2-in. shank, is used. The tops of the poles were bored for the pins, clamped with 7-in. iron bands and gained for cross-arms. The cross-arms are 4½ ins. x 6 ins. x 34 ins., of yellow pine, and secured to the pole by two ⅝-in. bolts.



TRANSPOSITION POLES IN HIGH-TENSION LINE

AUXILIARY EQUIPMENT

A telephone system is installed, which includes a special portable outfit in each car, and plug-in boxes are placed every quarter of a mile along the line. The telephone line is No. 10 hard-drawn copper wire run on wooden brackets, and placed 3 ft. below the cross-arm carrying the high-tension line, transposed to meet requirements. Heavy gongs are placed at each siding in order that cars passing over the line can be reached by signal from the office.

The management has not yet determined upon the block-signal system to be installed. It is the purpose to provide every possible safe-guard for the operation of the road at high speeds without jeoparding life or property of patrons, and a careful investigation of the practical operation of several systems is now being made by the engineers of the company.

President A. Markle, of the Wilkesbarre & Hazleton Railway Company, who developed the project, has given personal attention to the building and equipment of the road. L. B. Stillwell, who is consulting engineer for the company, designed the entire plant, and the road was built under his direction. He was represented during the construction period by J. E. Wallace, the construction engineer. C. A. B. Houck, chief electrician for the traction company, was associated with Mr. Wallace in the work.

ELECTRIC RAILWAY PRACTICE ON THE CONTINENT OF EUROPE

BY HEINRICH VELLGUTH

In the June, 1902, issue of the Street Railway Journal the writed described the electric railway practice of three countries on the Continent of Europe, viz.: Germany, Switzerland and France. While each of these countries has, perhaps, gone farther in electric railway work than any of those whose methods have not been taken up in detail by the writer, many important features of operating practice do exist elsewhere on the Continent of Europe, particularly in Austria, Hungary and Italy. It is the intention in this article briefly to refer to the most interesting developments in electric railway practice in these countries.

AUSTRIA

With Hungary and Germany, Austria was one of the first countries in Europe to introduce electric traction. It was preceded only by Hungary, whose first electric railway, the Buda-Pest conduit road, was opened in July, 1889, and by Germany, whose first road, at Lichterfeld, near Berlin, was put in operation in May, 1881. The first Austrian electric railway was the one between Mödling and Hinterbrühl, near Vienna, and was 5 km in length.

All of these roads, built long before the introduction of American systems in Europe, were equipped by Siemens & Halske; but in those early days European conditions did not require such transit facilities as electricity now supplies, and the necessity for urban transportation in later years stimulated development.

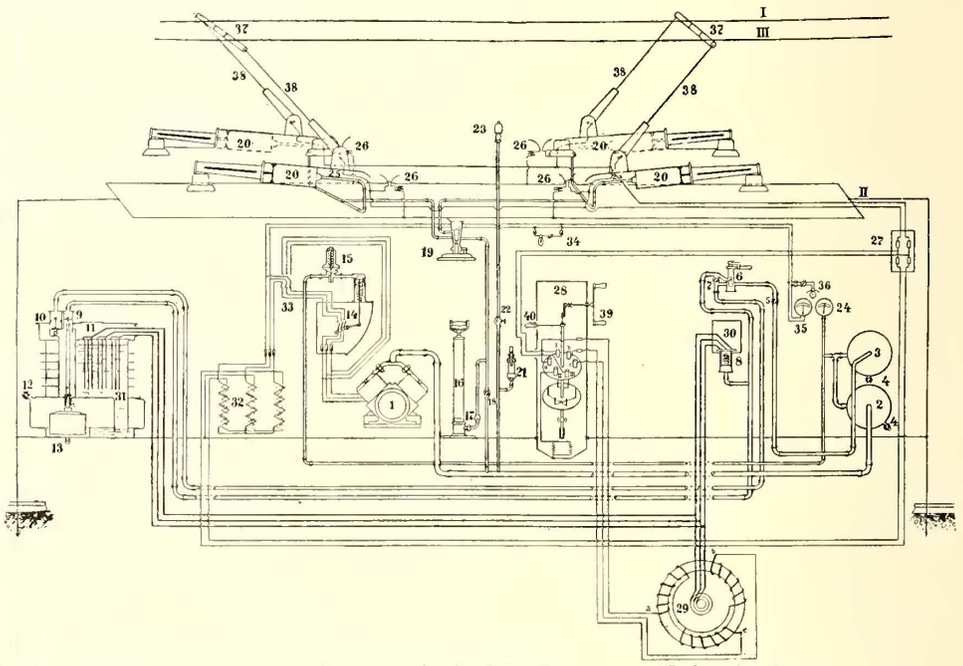
On the Mödling-Hinterbrühl Railway the current was supplied to the car by two slotted gas pipes, one for each polarity, suspended high above the rails. Contact with these pipes was made by means of small contact-shoes, sliding inside the pipe and connected to the car by a flexible conductor. That such a construction may be made durable is illustrated by the fact that a road in Frankfurt, in Germany, built on this plan in 1884, was only replaced by a regular trolley system last year, and a line of this kind is still in operation at Vevey, Switzerland. The pressure used on this pipe road is 350 volts.

In November, 1901, there were twenty-seven separate electrically-operated railways in Austria, with a total length of 332.34 km, as compared with 240.42 km in November, 1900, an increase of 38 per cent.

In November, 1901, the receipts of the roads were 1,592,404 kröner, of which 13,530 kröner were for freight. They carried 12,286,832 passengers and 10,705 tons of freight.

The most extensive railway is naturally located in Vienna, which city will have, after all roads are electrically equipped, 200 km of electric track. Approximately two-thirds of this equipment is now completed. Part of this system is being equipped with the bow trolley system and part with the conduit system. The conduit is located under one of the rails, as at Buda-Pest, and the plow, whose wings can fold in and out, can be raised from or lowered into the slot at any point by the motorman. The road is owned by the city, and is being equipped by Siemens & Halske, who also have the contract for operating the road during the period of conversion.

SECTION BOX ON WOLLERSDORF THREE-PHASE ROAD



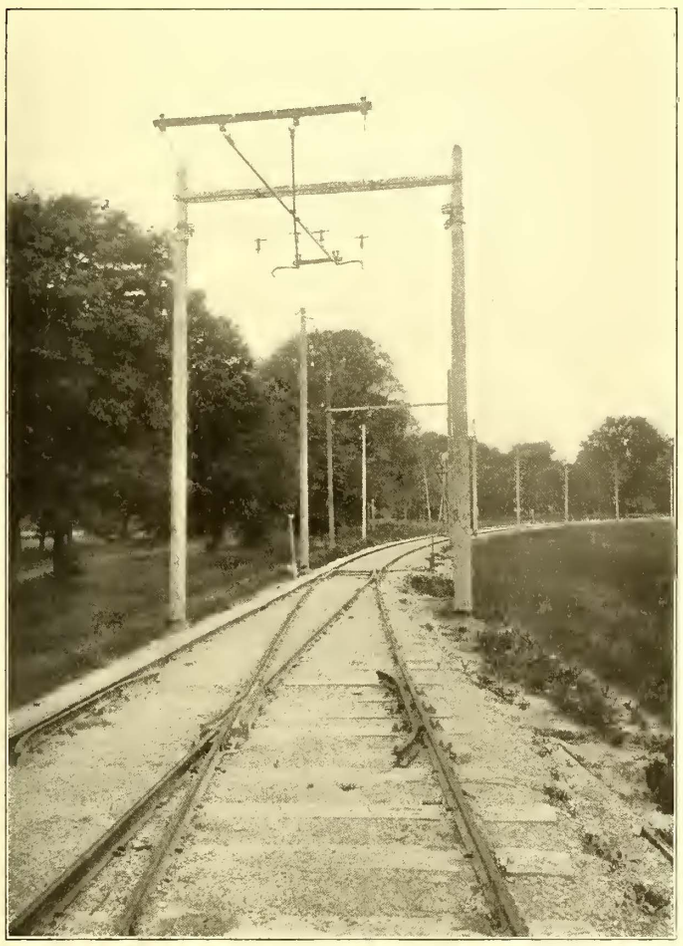
1 air compressor.
2-3 air reservoirs.
4 outlet valves,
5 stop-cock.
6 engineer's valve.
7 throttle valve.
8 air cylinder for circuit-breaker.
9 small valve for operating rheostat.
10 large valve for operating rheostat.
11 top of rheostat.
12 test cock of rheostat.
13 screw stop valve of rheostat.
14 automatic circuit-breaker.
15 regulator for air pressure.
16 hand air compressor.
17 back pressure valve.
18 stop cock.
19 trolley pole valve.
20 trolley pole base.
21 safety valve and indicator.
22 valve for whistle.
23 whistle.
24 pressure gage.
25 connection to trolley base cylinder.
26 lightning arrester.
27 junction box.
28 switch for primary.
29 motor.
30 short-circuiting switch.
31 water rheostat.
32 transformer.
33 quick-break switch.
34 deck lights.
35 voltmeter.
36 head light.
37 current collector.
38 trolley supports.
39 handle for primary switch.
40 handle for reversing switch.

WIRING DIAGRAM ELECTRIC LOCOMOTIVE, WOLLERSDORF

In addition to the electric roads above mentioned there are three other railways in Vienna and vicinity which are worthy of mention. The oldest of these is the Wiener Lokalbahn, which is used for both passenger and freight traffic. It has a length of 39 km, with trackage rights within the city of 3 km. Four and two-axle passenger and freight cars are in use and have a speed, within city limits of 20 km, and on lines which were formerly operated by steam of 45 km per hour. The bow trolley and 550 volts are used on this road, and the equipment was furnished by Schuckert & Company, of Nürnberg. In the city streets the motors are operated in series, and in the outskirts of the city in parallel.

The second of these roads is the "Wiener Stadtbahn," on

which experiments were made with various systems, with the object of replacing steam as a motive power. This road lies just outside of Vienna, forming a sort of semicircle around the city. A 3.8 km section of the road was electrically equipped about three years ago, and has been in operation ever since. The road is owned by the State, and the electrical equipment was furnished by Siemens & Halske. The double-track ex-



THREE-PHASE HIGH-TENSION OVERHEAD CROSSING, BUDA-PEST EXPERIMENTAL RAILWAY

perimental road has two intermediate stations, 700 m apart, an average grade of 0.8 per cent and a maximum grade of 1.8 per cent. The electric trains are run, of course, without interrupting steam traffic. Trains are made up of two or three motor cars and an equal number of trail cars, and the motors are controlled by a system somewhat similar to that used on the Berlin elevated railway, and described in this paper for Jan. 3. The third rail is located between the service rails, and is supported on porcelain or ebonite insulators.

The motors are shunt wound, of 80 hp each, and are mounted directly on the axles. Shunt-wound motors are employed so that they might be used as generators when the train is coasting or running down grade. It has been found that 10 per cent of the power can thus be saved.

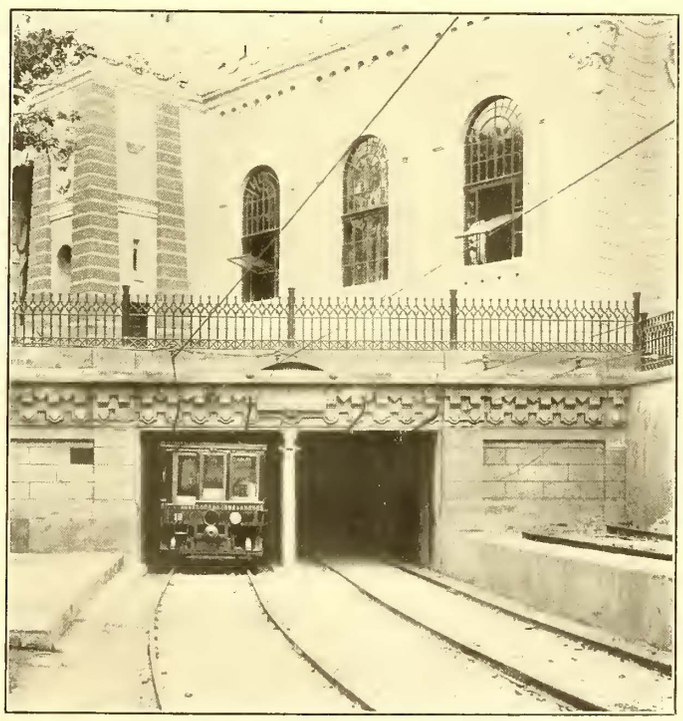
The most modern of the three Vienna roads, having been put in operation in 1902, is a three-phase, high-tension road at Wollersdorf Arsenal, about 50 km from Vienna. This 1.1 km road was built by the Government War Department for the purpose of acquiring information as to the conditions arising from the use of high tensions for railways, and for this reason was much more elaborately equipped than was necessary for so short a line. Alternating current was also used because a 3000-volt, 42-cycle current plant was available. The locomotive is equipped with a 50-hp, 300-volt motor, connected to the axle by gears in the ratio of 1 to 6. Current is taken from the trolley wire by means of two specially designed collectors, one for each direction of travel, the one being lowered when the other is in use. The collectors are attached to trolley poles, and raised or lowered by compressed air cylinders. Special care was exercised in the wiring of the cars. Besides being covered with Okonite insulation the cables are surrounded every 10 cm by porcelain collars, and the whole drawn through well-grounded brass conduit.

The main dimensions of the locomotive are: Length over all, 4180 mm; width, 2200 mm; height, 2095 mm. The wheels are 850 mm in diameter. A diagram of the connections is given on page 354.

The secondary voltage is 300 volts, and liquid starting rheostats are used. The electrical apparatus was supplied by Ganz & Company, of Buda-Pest.

HUNGARY

The majority of the electric railways of Hungary are concentrated around the capital, Buda-Pest, where the first successful conduit electric railway was opened to the public in July, 1889. This road has since been extended and the principal system in the city, the Buda-Pester Strassenbahn Gesellschaft, has also adopted the system with several modifications, among them a change in the form of plow, so as to allow it easily to be removed from the conduit at any point. Contrary to usual European custom the tracks are not laid in the center of the street, but as close as possible to the sidewalk, leaving enough room, of course, for a large vehicle, such as a moving van, to be backed up against the sidewalk. All tracks are situated 3.5 m from the sidewalk, except in the large Ring boulevard, where the distance is 6 m. The distance between track centers is from 3.3 m to 3.6 m, never below 3 m. The smallest radius at curves is 30 m, which is exceptionally large for European conditions. The maximum grades are 5.6 per cent and 5 per cent for a distance of 1500 m. T-rails, weighing 23.6 kg per m, and Haarmann rails with grooves, 35 mm in width and 32 mm in depth, are used. At joints the rails lap

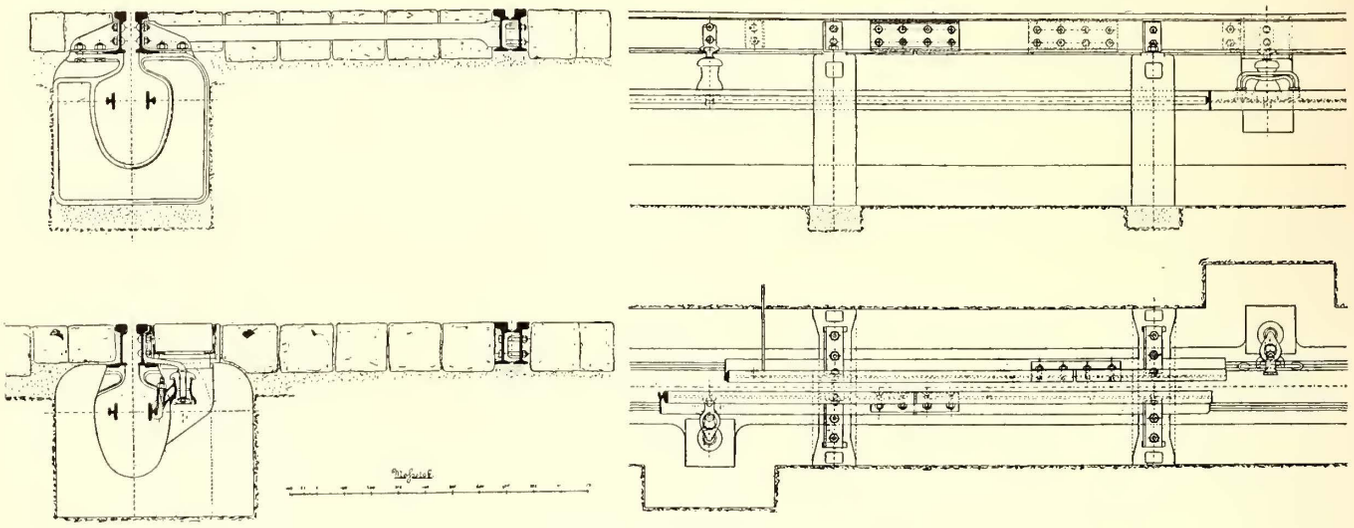


TERMINUS OF UNDERGROUND RAILWAY, BUDA-PEST

600 mm over each other. The Haarmann rail weighs 44 kg per m. It is 155 mm high, and the width of the head is 44 mm. Ties of wood or steel are used with the T-rails, but not with the Haarmann rails, the gage on the latter rail being maintained by means of the tie rods. The conduit has been fully described in these columns, so that a cross and longitudinal section of it only will be given.

Both two-axle and four-axle cars are used, and the managements of both roads look upon the latter very favorably, a somewhat unusual fact in Europe. The Buda-Pest railways are also using chilled iron wheels almost exclusively, instead of the steel-tired wheel so common on other parts of the Continent.

The two roads have their own telephone system. The Strassenbahn Gesellschaft has 12 km of conduit track and 38 km of trolley line, and has in all forty-five telephone stations along its line.



SECTIONS OF UNDERGROUND CONDUIT SYSTEM, BUDA-PEST

One of the most interesting roads in Buda-Pest is the "Franz Josef Underground Railway," the first of its kind to the knowledge of the writer. It is 3.7 km in length, and only comes to the surface at one terminal. Nine depots are located in the tunnel and two above the street level. The gage is 1.435 m, the maximum grade is 2 per cent, the smallest radius 40 m. The tunnel is centrally divided by a set of columns. It is 6 m in width and 2.75 m high. At curves it is 6.8 m wide. The floor and sides are lined with concrete, composed of Portland cement and river sand with some stone. The road is operated by the Buda-Pest Stadtbahn Aktien Gesellschaft. The current is collected by means of a bow contact from two overhead rails, weighing 5 kg per m, attached to the roof of the tunnel. The track, therefore, is not used as a return. The stations are lighted by 100-volt incandescent lamps, three being connected in series. The block system is so arranged that no train can leave a station before the train in front of it has left the station ahead. For this purpose each train is equipped with a device which releases a switch, by means of which a red light shows at the station just left, and a white light at the station in back, indicating that the section is clear. In case there is a breakdown in this system the signals are transmitted by means of telephones, which connect the stations with each other and with the power house.

The rolling stock consists of twenty double-truck cars, 2.35 m in width, each seating twenty-eight persons and having standing room for fourteen. The total length of the car is 11 m. The cars are operated singly, so that with fourteen cars running a two-minute headway is given.

Ten of the cars have one motor on each truck, each of 28 hp normal capacity, and the two truck axles are driven by means of sprocket chains. The other ten cars also have one motor on each truck, but geared to the axle. The complete weight of a car is 15,000 kg.

The total cost of the road, including central station and rolling stock, was estimated in the franchise at 3,600,000 guldens. This small sum was not exceeded. The franchise covers a period of ninety years; in 1940 the city has the right to purchase the road after having given a two-year notice.

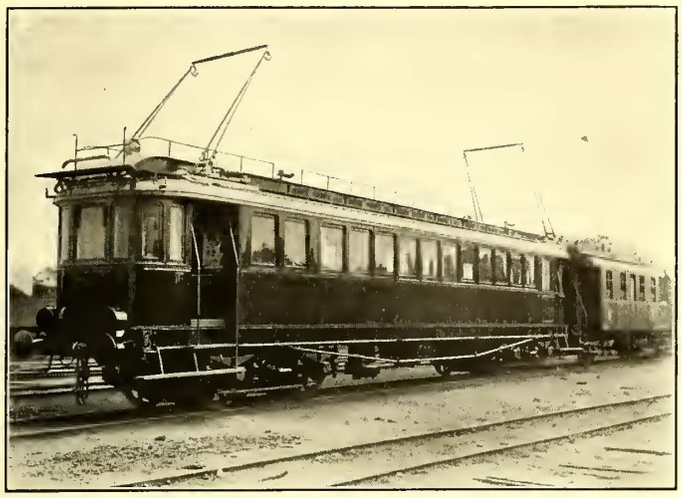
ENTRANCE TO BOTH PLATFORMS OF UNDERGROUND RAILWAY, BUDA-PEST

ENTRANCES TO UNDERGROUND RAILWAY, BUDA-PEST

The lumber industry of Hungary is very extensive, and this has led to the use of electric cars for lumber transportation, old horse cars having been electrically equipped. One such road, 10 km in length, is operated between Maros and Szlatina. A two-truck locomotive, each being equipped with a 16-hp motor, can pull five empty cars up the mountain grade of 60 per cent at a speed of 9 km per hour.

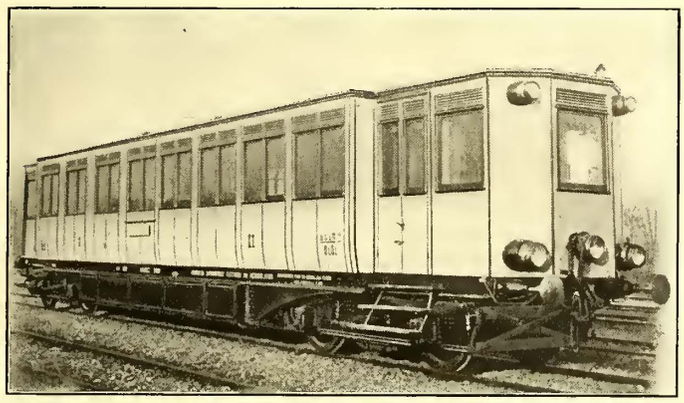
ITALY

Although nearly all the coal in Italy has to be imported from England, and although its inhabitants are engaged in agri-



MOTOR CAR, VALTELINA RAILWAY

cultural more than in industrial pursuits, the country possesses a large number of extensive electric railway systems. This



STORAGE BATTERY CAR ON CONVERTED STEAM LINE BETWEEN MILAN AND MONZA

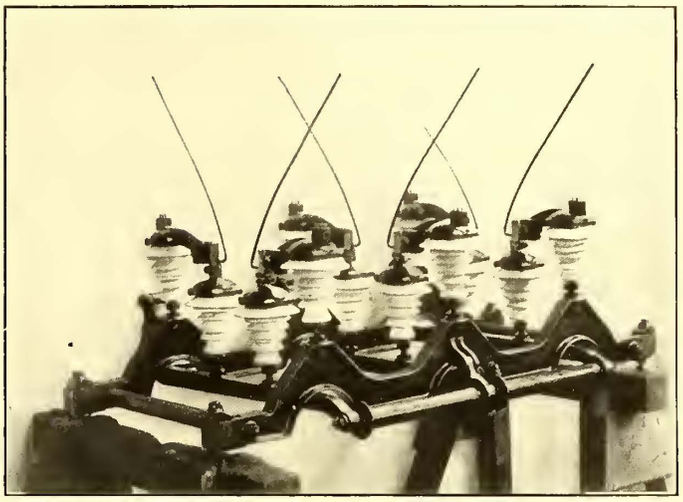
has been due largely to the liberal policy pursued by the government, especially toward the conversion of existing steam lines to electric power, and also to the large amount of available water power

There are no Italian electric street railway statistics, but through the courtesy of the general secretary of the Italian Tramway Association, Monsieur Grand-Moulin, the figures are given in the next column of the principal city installations.

The gage is generally 1.435 m or 1.000 m.

According to the writer's observations the Italian street railways possess but few peculiarities when compared with other European roads, unless it be pointed out that the traffic is far greater in winter than in summer, due to the number of tourists in Italy in winter. In most central stations operated by steam, accumulators are largely used. This is largely explained by the fact that German electrical companies built the roads, and are in many cases owners of them at present.

Another type of road, not included in the table, is the converted steam road with light traffic, operating single accumulator cars or direct-supply trains. The Milan-Monza line, the Milan-Porto Ceresio line and the Valtelina line are instances of roads of this kind, but as they have been frequently referred to in these columns, as well as in other technical papers, no further description will be given.



AUTOMATIC BLOW-OUT, VALTELINA RAILWAY

The views which accompany this article show one of the motor cars on the Valtelina Railway, and one of the automatic blow-outs used on the high-tension circuits, also one of the storage battery cars on the converted Milan-Monza line, and a typical view near Melito on the Naples system.

TABLE SHOWING LENGTH OF PRINCIPAL CITY TRAMWAYS IN ITALY	Operating Length in km, Urban.	Suburban
Societá Romana di Tramways, Rome	40	—
Tramways Neapoletani, Naples	—	43
Tramways Provinciali di Napoli, Naples	—	32
Societá di Tramways di Livorno, Livorno	6	7
Societá Torinese di Tramvie, Turin	53	145
Societá Anomina Elettricitá Alta Italia, Turin	4	13
Societá Edison di Milano, Milan	98	25
Tramways Fiorentini, Firenze	3	108
Societá Tramways Elettrici, Palermo	41	—
Tramvie Varesine, Varese	6	—
Unione Italiana Trams Elettrici, Genoa	61	24
	312	397

Total, 709 km of street railways.

VIEW NEAR MELITO, NAPLES ELECTRIC RAILWAY

DENMARK

The only city in this small country which contains electric railways, worthy of mention, is the capital, Copenhagen. This city has 450,000 inhabitants, and the street railways are operated by two companies, one owning 90 km and the other 20 km of track. The companies are under very strict municipal regulations, and in their franchises are obliged to guarantee certain wages and hours of labor to their employees. The latter are paid from 90 kronen to 135 kronen per month, and are guaranteed a pension after twenty-five years' service, or previous to this time if incapacitated. The hours of labor per day are eleven and every sixth day is a holiday. The city receives 5 per cent of the gross receipts of the road and also requires of the company a certain amount of pavement maintenance.

The Copenhagen authorities have always professed great anxiety over the alleged dangers of electrolysis, and originally accumulator cars only were permitted. No such cars are now in operation, but the city does not permit the use of the rails as a return circuit in the city, and the former accumulator section had to be equipped with double overhead trolleys. Outside of the city limits the single trolley is used, but even here great care has been taken to insure an efficient return circuit, and the rail ends as well as angle plates have been carefully tinned, and a difference of three-fourths of a volt only is permitted in the rails between any two points on the system. The fare charged is 10 ore, which entitles the passenger to a transfer ticket. The current must be bought from the city at 15 ore per kilowatt-hour at the switchboard. The receipts are about 50 ore per car kilometer. The railways were constructed by German firms.

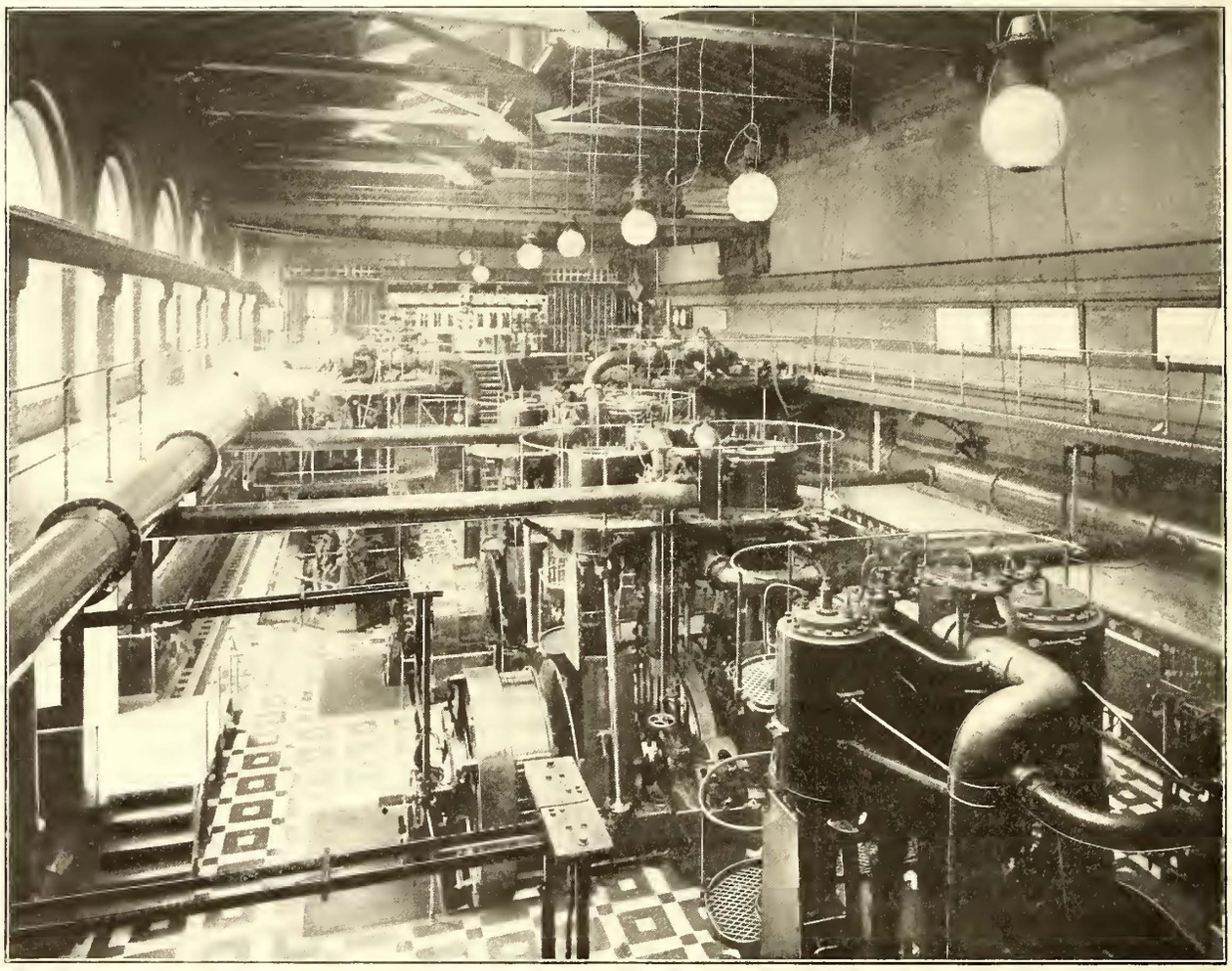
HOLLAND

Mainly on account of its limited industrial development Holland has but few electric railways, a condition which will probably not be materially altered for some time to come. The following are the four systems at present in operation:

(1) A short section, 815 m in length, extending from Aaachen, Germany. It is equipped with the overhead trolley.

(2) The Haarlem Railway, 16.2 km in length, opened in July, 1899. It is the longest road in Holland, and is single track. The gage is 1 m.

(3) The Amsterdam Street Railway, which is 4.8 km in length. It was opened in August, 1900, and has a 1.435-m gage.



MAIN POWER STATION, COPENHAGEN

(4) The railway between the Hague and Scheveningen. It is 10.255 km in length, and has a 1.435-m gage. In summer, when traffic is heavy, the road is operated by storage batteries and in winter by horses.

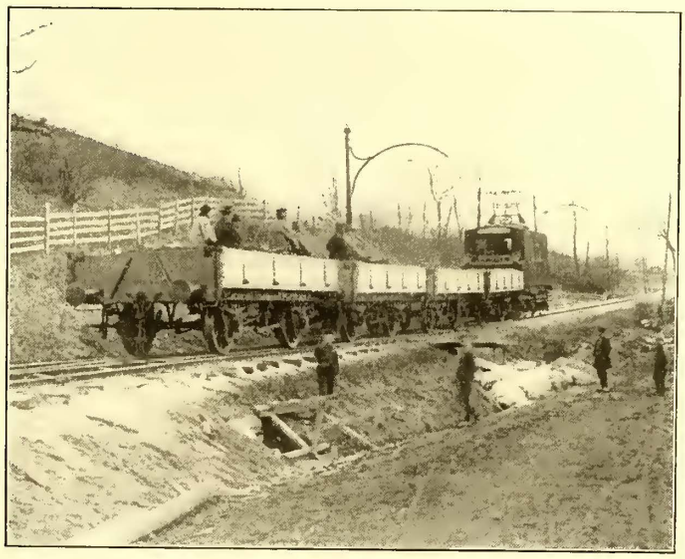
The total length of Holland's electric railways is 32.070 km, of which 12.488 km is double track.

THE REMAINING EUROPEAN COUNTRIES

With the exception of the countries described in this and the previous article no European country can boast of any very extensive street railway system. Belgium has three or four systems in operation, but outside of Brussels none that demand especial consideration. For the Brussels system the reader is referred to an article in this paper for November, 1902. In Sweden and Norway, especially in the latter country, several cities have electric roads, the most remarkable of which is probably the Holmenkollen road near Christiania, where the line was built by the municipality.

Several large cities in Russia are beginning to change the motive power on street railways to electricity, but none possesses any features worthy of mention. Spain and Portugal have both modern electric systems, the former in Barcelona and Madrid as well as in one or two other cities; the latter in Lisbon. As these roads have been made the subject of previous articles they will not be discussed here. Bulgaria, Roumania, Turkey and Gréece, on the other hand, as yet contain nothing of interest to the student of electric railway practice.

SNOW PLOW ON THE KRISTIANA-HOLMENKOLLEN RY., NORWAY



CONVERTED STEAM ROAD BETWEEN HAFSLUND AND SANDESUND, NOAWAY

The Electric Package Company, which handles the package express business on all but one of the electric railways at Cleveland, did a business of nearly $175,000 last year. Owing to the unsettled financial condition of the Everett-Moore syndicate, the company made no special efforts to develop the business, but it is believed that by placing numerous solicitors in the field in the larger towns the business will be more than doubled. As has already been announced in these columns, plans have been completed for a large interurban freight station to be erected on Erie Street, Cleveland, on a site already purchased and tracked, and with this improvement in handling facilities, there will be a large natural increase. Plans are being discussed for handling the produce from the numerous market gardens surrounding the city.

UNITS FOR INDICATING GRADES

BY CARL HERING

Owing to the relatively large number of units in terms of which grades are indicated and measured, confusion is apt to arise and labor is involved in reducing one to the other. It would be very desirable to adopt some one uniform system, and among all those in use the percentage unit seems to be most rational and the simplest to use. Among electric railroad engineers this unit seems to have already become the more usual one. On the continent of Europe the per-mil unit, represented by the sign o/oo, is in general use and is easily converted into per cent, as the figure representing a given rise in per-mil units is exactly ten times that representing that same rise in per cent; or, stated in different terms, the per-mil unit is one-tenth of the per cent unit. In England, as usual when units of measurement are concerned, a very irrational unit is used, namely, the distance in which the rise is unity.

Further confusion arises from the fact that it is seldom stated, even in presumably carefully prepared reference books, whether it is the horizontal or the inclined distance that is meant, in the statement of a grade. When profiles or distances on a map are involved the horizontal distance may generally be assumed to have been meant, thus involving the tangent of the angle. While in formulas for the traction coefficient or when the distances are the actual lengths of the track or road, the inclined or sloping distance is usually implied, thus involving the sine of the angle. A grade of a given per cent, based on horizontal distances, is therefore slightly different from a grade of the same per cent based on inclined distances; the latter is always the larger angle or steeper grade. The difference is, however, generally negligible, as the error is

CONVERSION TABLE FOR GRADES

	For Either Sloping or Horizontal Distances. Sine or Tangent Functions						For Sloping Distances Only. Sine Function				For Horizontal Distances Only. Tangent Functions			
Per Cent. (%) or Feet per 100 Feet	Per Mil (‰) or Millimeters per Meter or Feet per 1000 Feet	Feet Rise per Foot	Feet per Mile	Inches per Mile	Miles per Foot Rise	Feet per Foot Rise	Degrees, Minutes	Sine	Tangent	Equivalent P er Cent. Based on Horizontal Distances	Degrees, Minutes	Tangent	Sine	Equivalent per Cent. Based on Sloping Distances
1	10	0.01	52.8	633.6	0.018 939 40	100.	0° 34'	0.01	0.010 00	1.000	0° 34'	0.01	0.010 00	1.000
2	20	0.02	105.6	1267.2	0.009 469 70	50.	1° 9'	0.02	0.020 00	2.000	1° 9'	0 02	0.020 00	2.000
3	30	0.03	158.4	1900.8	0.006 313 13	33.333 3	1° 43'	0.03	0.030 01	3.001	1° 43'	0.03	0 029 99	2.999
4	40	0.04	211.2	2534.4	0.004 734 85	25.	2° 17'	0.04	0.040 03	4.003	2° 17'	0.04	0.039 97	3.997
5	50	0.05	264.0	3168.0	0.003 787 88	20.	2° 52'	0·05	0.050 06	5 006	2° 52'	0 05	0.049 94	4.994
6	60	0.06	316.8	3801.6	0.003 156 57	16.666 7	3° 26'	0.06	0.060 11	6.011	3° 26'	0.06	0.059 89	5.989
7	70	0.07	369 6	4435 2	0.002 705 63	14.285 7	4° 1'	0.07	0.070 17	7.017	4° 0'	0.07	0.069 83	6.983
8	80	0.08	422.4	5068.8	0.002 367 42	12.5	4° 35'	0.08	0.080 26	8.026	4° 34'	0.08	0.079 75	7.975
9	90	0.09	475.2	5702.4	0.002 104 38	11.111 1	5° 10'	0.09	0.090 37	9.037	5° 9'	0 09	0 089 64	8.964
10	100	0.10	528.0	6336 0	0 001 893 94	10.	5° 44'	0.10	0,100 5	10.05	5° 43'	0.10	0.099 50	9.950
11	110	0.11	580 8	6969.6	0.001 721 76	9.090 91	6° 19'	0.11	0 110 7	11.07	6° 17'	0.11	0.109 3	10 93
12	120	0.12	633.6	7603.2	0.001 578 28	8.333 33	6° 54'	0.12	0.120 9	12.09	6° 51'	0.12	0.119 1	11.91
13	130	0.13	686.4	8236.8	0.001 456 88	7.692 31	7° 28'	0.13	0.131 1	13.11	7° 24'	0.13	0.128 9	12.89
14	140	0.14	739.2	8870.4	0.001 352 81	7.142 86	8° 3'	0·14	0.141 4	14 14	7° 58'	0.14	0.138 6	13.86
15	150	0.15	792.0	9504.0	0.001 262 63	6 666 67	8° 38'	0.15	0.151 7	15.17	8° 32'	0.15	0.148 3	14.83

within 1 per cent for all grades up to 14 per cent, or about 8 degs. Hence, for all but very accurate calculations or exceptionally steep grades it makes no difference which is meant. As a matter of practice the sine is used by many in street railway work while the tangent method is that usually followed by steam railroad engineers.

Another source of confusion is in the incorrect way in which percentage values are not infrequently written. Thus 50 per cent should be written 50 per cent and not .50 per cent, which latter means one-half of 1 per cent, or fifty hundredths of 1 per cent.

The following is a complete set of all the reduction factors for reducing a grade stated in any of the units in use to its per cent value, or the reverse, thus involving only a multiplication and never a division. The relations are strictly proportional and may be used like any other similar reduction factor. Thus a 1 per cent grade, according to this list, is 52.8 ft. rise per mile, hence a 5 per cent grade will be five times this number of feet; or, according to this list, 1 ft. per mile is a 0.018 9 per cent grade, hence 100 ft. per mile will be 100 times this, namely, a 1.89 per cent grade.

The relations between any two units, neither of which are stated in per cent, are readily determined from these reduction factors by reducing both to the same value in per cent.

REDUCTION FACTORS FOR GRADES

The following reduction factors are the same whether the units are based on the sloping or on the horizontal distances:

1 inch per mile	= 0.001 578 28%
1 foot per mile	= 0.018 939 4%
1 o/oo	= 1%
1 per mil.	= 0.1%
1 millimeter per meter	= 0.1%
1 foot per thousand feet	= 0.1%
1 foot per 100 feet	= 1%
1 foot rise per foot	= 100%
1 %	= 633.6 inches per mile.
1 %	= 52.8 feet per mile.
1 %	= 10 o/oo or 10 per mil.
1 %	= 10 millimeters per meter.
1 %	= 10 feet per thousand.
1 %	= 1 foot per 100 feet.
1 %	= 0.01 foot rise per foot.
n miles per foot rise	= $1/n$ feet rise per mile.
"	= $(0.018\,939\,4/n)$ %
n %	= $0.018\,939\,4/n)$ miles per foot rise.
n feet (rise) per mile	= $1/n$ miles per foot rise.
n feet per foot rise	= $1/n$ feet (rise) per foot.
"	= $(100/n)$ %
n %	= $(100/n)$ feet per foot rise.
n foot (rise) per foot	= $1/n$ foot per foot rise.

The following reduction factors are only for units based on the sloping distances:

$n\,\% = \dfrac{100n}{\sqrt{100^2 - n^2}}$ % based on horizontal distances.

n % = 100 × tan.

n degrees rise = (100 sin n) %

n % = number of degrees whose sin is 0.01 n.

If n is the sine of angle, then the rise in % = 100 n.

If n is the rise in %, then the sine = 0.01 n.

If n is the tangent of angle, then the rise in $\% = \dfrac{100\,n}{\sqrt{1 - n^2}}$ Or find from a table the sine corresponding to this tangent, then the rise in % = 100 × sin.

If n is the rise in %, then the tan of the angle $= \dfrac{n}{\sqrt{100^2 - n^2}}$ Or it may be found from a table as that corresponding to sin = 0.01 n.

The following reduction factors are only for units based on the horizontal distances:

$n\,\% = \dfrac{100\,n}{\sqrt{100^2 + n^2}}$ % based on sloping distances.

n % = 100 × sin.

n degrees rise = (100 tan n) %

n % = number of degrees whose tan is 0.01 n.

If n is the tan of angle, then the rise in % = 100 n.

If n is the rise in %, then the tan = 0.01 n.

If n is the sine of angle, then the rise in $\% = \dfrac{100\,n}{\sqrt{1 - n^2}}$ Or find from a table the tangent corresponding to this sine, then the rise in % = 100 × tan.

If n is the rise in %, then the sine of the angle $= \sqrt{\dfrac{n}{100^2 + n^2}}$ Or it may be found from a table as that corresponding to tan = 0.01 n.

Approximate—For small angles and for most engineering calculations concerning grades the sine and the tangent are very nearly equal, hence the simpler of the above formulas will almost always suffice. Up to a 14 per cent grade (about 8 degs.) the error made thereby is less than 1 per cent.

For most purposes the table on page 359 will be found sufficient, it is more convenient than the above reduction factors, as it avoids all calculations. It explains itself. Intermediate values sufficiently accurate for most purposes are found by ordinary interpolations.

STORAGE BATTERY INSTALLATION FOR BORDEAUX

The use of storage batteries as auxiliaries is very extensive abroad, as readers of this paper know, and some of the installations made involve interesting methods of regulation and equipment. Among them may be mentioned that of voltage regulation. The practice of the Bordeaux Tramways Company in this particular will be described.

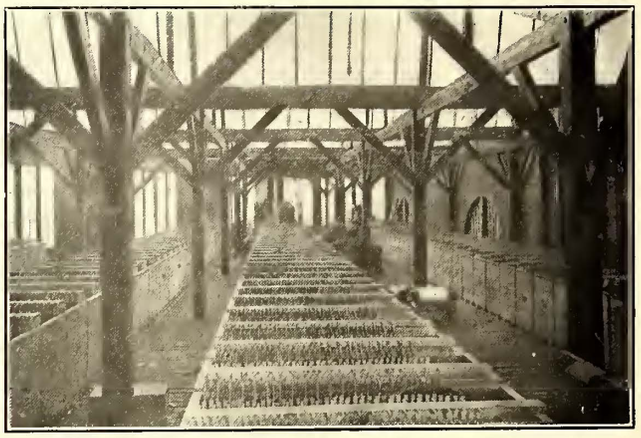


FIG. 1.—UPPER TIER OF BATTERY PLANT

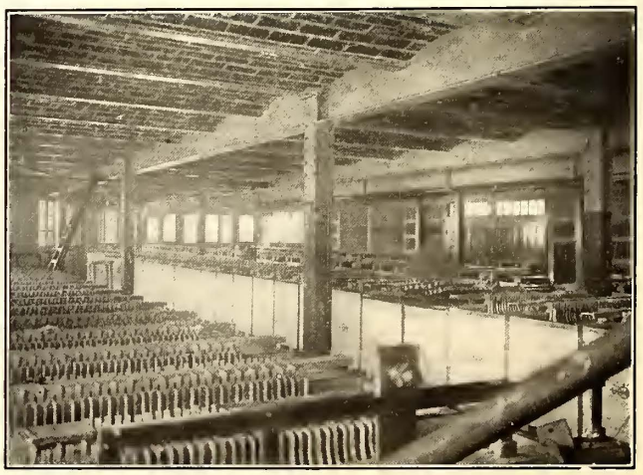


FIG. 2.—LOWER TIER OF BATTERY PLANT

The battery plant of this company is on two tiers, as shown

in Figs. 1 and 2. Fig. 3 shows the storage battery panels of the main station switchboard. The panel to the left is for the booster group, that in the middle is for the generator of the booster group, and that at the right is the main battery panel. From this panel the recording ampere meter has been temporarily removed. Fig. 4 shows the plus (+) end of the battery, with its double cable leading directly to the battery panel. The small wire connected to the second cell of the battery is to give the two volts used for the compounding of the charge and discharge ampere-hour meters. Figs. 5 and 6 show the arrangement of the minus (—) end of the battery. The cell marked a in Fig. 6 is virtually the minus end of the battery, but by the arrangement to be described either cell b or c can be made the final cell; that is, a always forms part of the battery circuit but b or c can be added as desired. Fig. 7 shows the panel used for the manipulation of cells b and c.

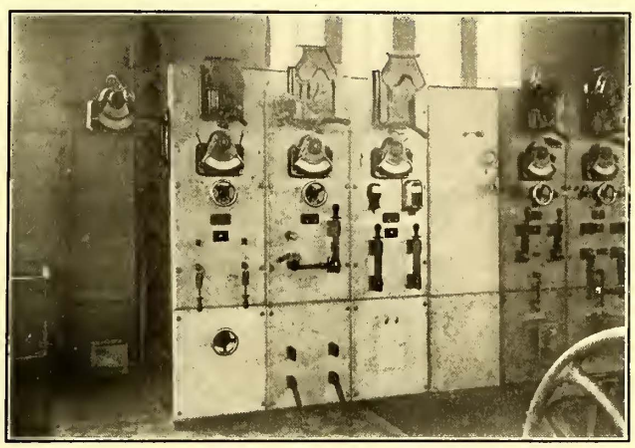


FIG. 3.—BATTERY PANELS ON SWITCHBOARD

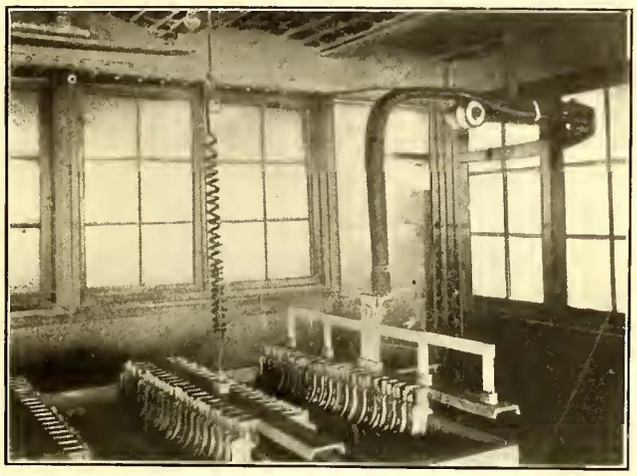
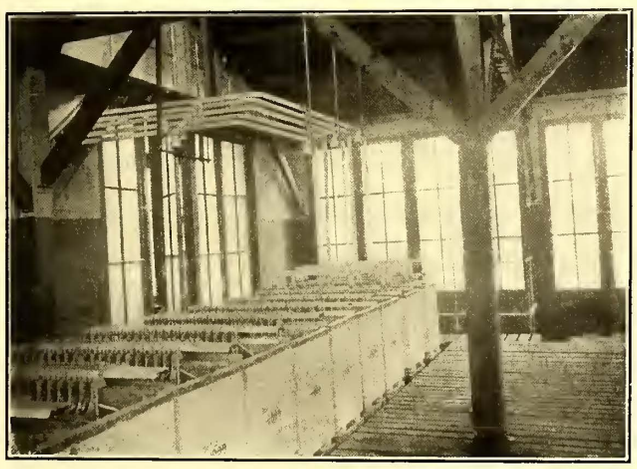
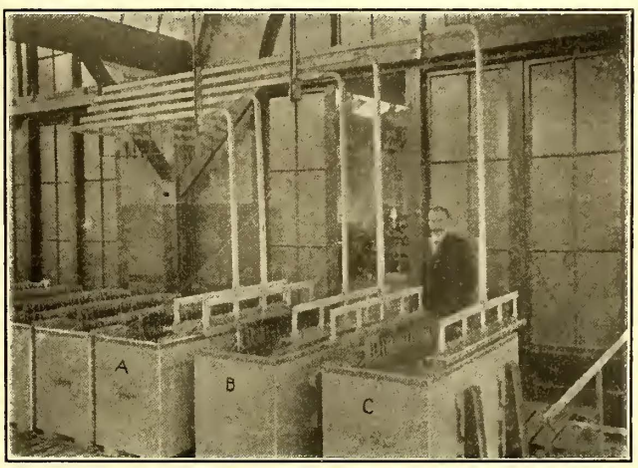


FIG. 4.—PLUS END OF BATTERY





FIGS. 5 AND 6.—MINUS END OF BATTERY AND CONNECTIONS

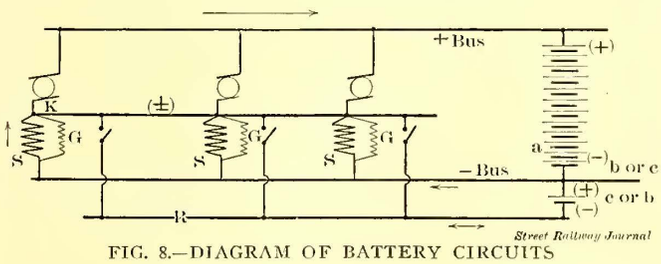


FIG. 8.—DIAGRAM OF BATTERY CIRCUITS

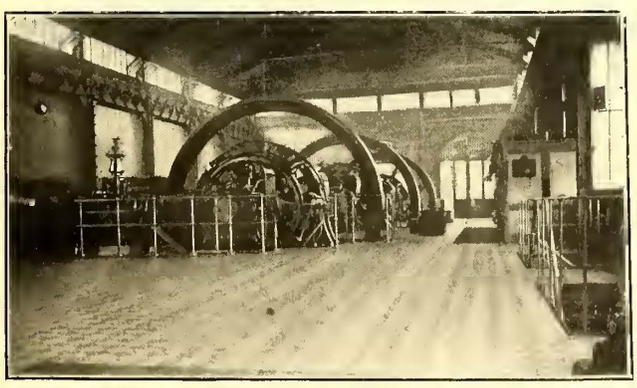


FIG. 9.—INTERIOR OF POWER STATION

When the left-hand is closed above, as shown, cell c is given a special connection around the series coil of the generator, as shown in Fig. 10, while, when the right-hand switch is closed below, cell b forms part of the main battery circuit. The position of cells b and c can be reversed by the manipulation of these two switches, but by a simple locking device on the upper portion of these switches, one cell at least must always be connected in the upper position, i. e., in parallel with the series coil of the generator.

This will be understood better by consideration of Fig. 8, which gives a diagram of the circuits. The connections are the ordinary ones, except that the series and equalizer connections are on the negative side of the generators. S is the series coil of the generator, and G the German silver shunt to this coil for regulation of the compounding. This shunt has a carefully calculated resistance, so that for the average load of a 500-kw generator, that is 750 amps., the differences of the potential across S is as close as possible to 1.8 volts. With a load, therefore, of more than 750 amps. the drop across S will be greater than 1.8 volts, and with less than 750 amps. the drop is less than 1.8 volts. It will also be seen from Fig. 8 that the cell marked

c or b is not in the main battery circuit but is in parallel with the coil marked S. This cell will continue to pass current through S, i. e., in the direction of the dynamo current, as long as the potential across S is less than 1.8 volts. When, however, the load on the generator becomes greater than 750 amps., and

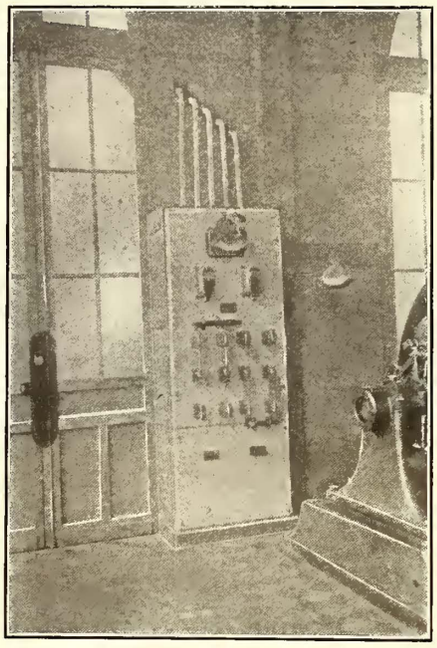


FIG. 7.—END CELL PANEL

when, consequently, the voltage around S is greater than 1.8, the current coming in from the line will encounter less resistance by passing through cell c than through the compound coil, and hence will pass directly to the point K without flowing through S. In other words the cell will charge, and its effect will be to maintain a fixed series excitation and to keep the

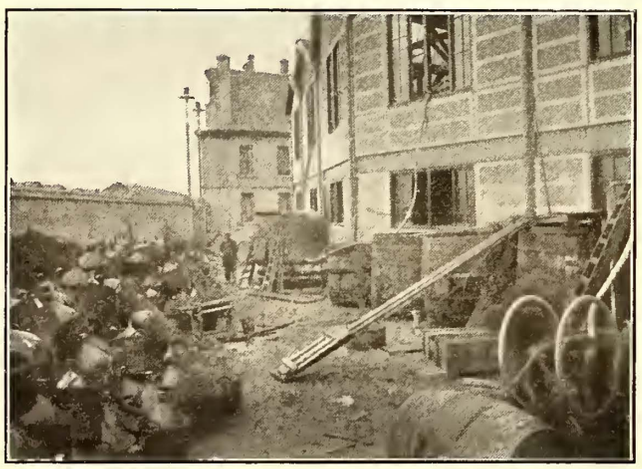


FIG. 10.—MIXING ELECTROLYTE FOR BATTERIES

mean load of the generator at 750 amps. In practice the generators at Bordeaux run at a difference of about 40 amps. between maximum and minimum load, as compared with each other, with the line load varying from 800 amps. to 1800 amps. The arrangement of the cells described is also useful in reducing the shock on the generators caused by line short circuits.

Some difficulty was experienced when the installation was first put in with excessive sparking at the commutators, but this was finally reduced by changing the shunt winding so as to secure a higher excitation from this winding.

Figs. 9 and 10 show respectively the interior of the station of the company, and the method of mixing the electrolyte for the batteries. Sixty-six tons of sulphuric acid and 200 tons of water are mixed at one time for battery purposes in the vats shown.

MODERN SHOPS AND METHODS OF THE CHICAGO CITY RAILWAY COMPANY

The immense new shops and car houses of the Chicago City Railway Company, which have been constructed during the last year, are excellent examples of a liberal expenditure of money and good judgment. These shops and car houses probably represent the most modern ideas as to shop construction and equipment to be found in any large city in the country. In the building and equipment of these shops the company has not hesitated to spend as much money as seemed necessary to produce the best results. The amount spent on them up to Nov. 1, 1902, as given in the Arnold report, was $388,245. The location is such that there is not the usual restriction found in street railway shops, due to the high value of real estate and the necessity of cutting down ground space. The old shops of this company, where the repair work has been done for the last twenty years, are located less than 2 miles from the business district of Chicago. They were in a three-story structure, which, owing to its antiquated design, afforded light only on portions of each floor near the windows. The conditions were decidedly bad for obtaining the best results from the working force, and were similar to those prevailing in many of the older manufacturing establishments to be found in large cities. The new plant follows out the same general policy that is being pursued by the more progressive large manufacturers. It is located in the suburbs, and owing to the fact that the land is not desirable for residence purposes, the cost of real estate was brought to a very reasonable figure, and at the same time it is not in an out of the way place.

LOCATION AND ARRANGEMENT

The site chosen for the new plant is near Auburn Park, a residential district or suburb, about 8½ miles from the downtown center. A tract of land was purchased for shop and car house purposes occupying about two and one-half city blocks, bounded on the north by Seventy-Seventh Street, on the west by Vincennes Road, on the south by Seventy-Eighth Street, and on the east by Wentworth Avenue. The dimensions and shape of this piece of property can be seen by the accompanying plan, Fig. 1. Although adjoining high ground on the west of this particular site was considerably lower than would be desirable for residence purposes; in fact, was practically a swamp previous to its purchase by the company. It is surrounded on all sides by a street railway track, built for the purpose of admitting cars to the shops and car houses. On Vincennes Road is one of the company's street railway lines. Here a third track has been laid on the company's side of the street, so that the whole track which serves the house and shops is independent of the service tracks on Vincennes Road.

The northern part of the tract is set aside for car houses, one of which has already been built. It is one of the most substantial steel and masonry structures ever erected for this purpose. The construction of this car house was described and illustrated in its several stages in the Street Railway Journal of Feb. 8, 1902. The building is divided into six entirely independent apartments, and the proposed structure on the northeast part of the lot will be divided in a similar manner. An alley will be left between the two buildings.

The repair shops comprise a cluster of buildings arranged as seen from the plan, Fig. 1. It is difficult to convey an idea of the magnitude of the plant by photographs, but Figs. 2 and 3, showing the exterior, give some little idea of it. The length of the combined shops along Seventy-Eighth Street is 1050 ft., and they occupy a width of 202 ft. The erection of all these shop buildings was accomplished in about six months. It will be seen from the general arrangement that no transfer tables are employed elsewhere around the property. The track running through the middle of the machine shop and thence east through the blacksmith and frog shops, serves to let cars enter

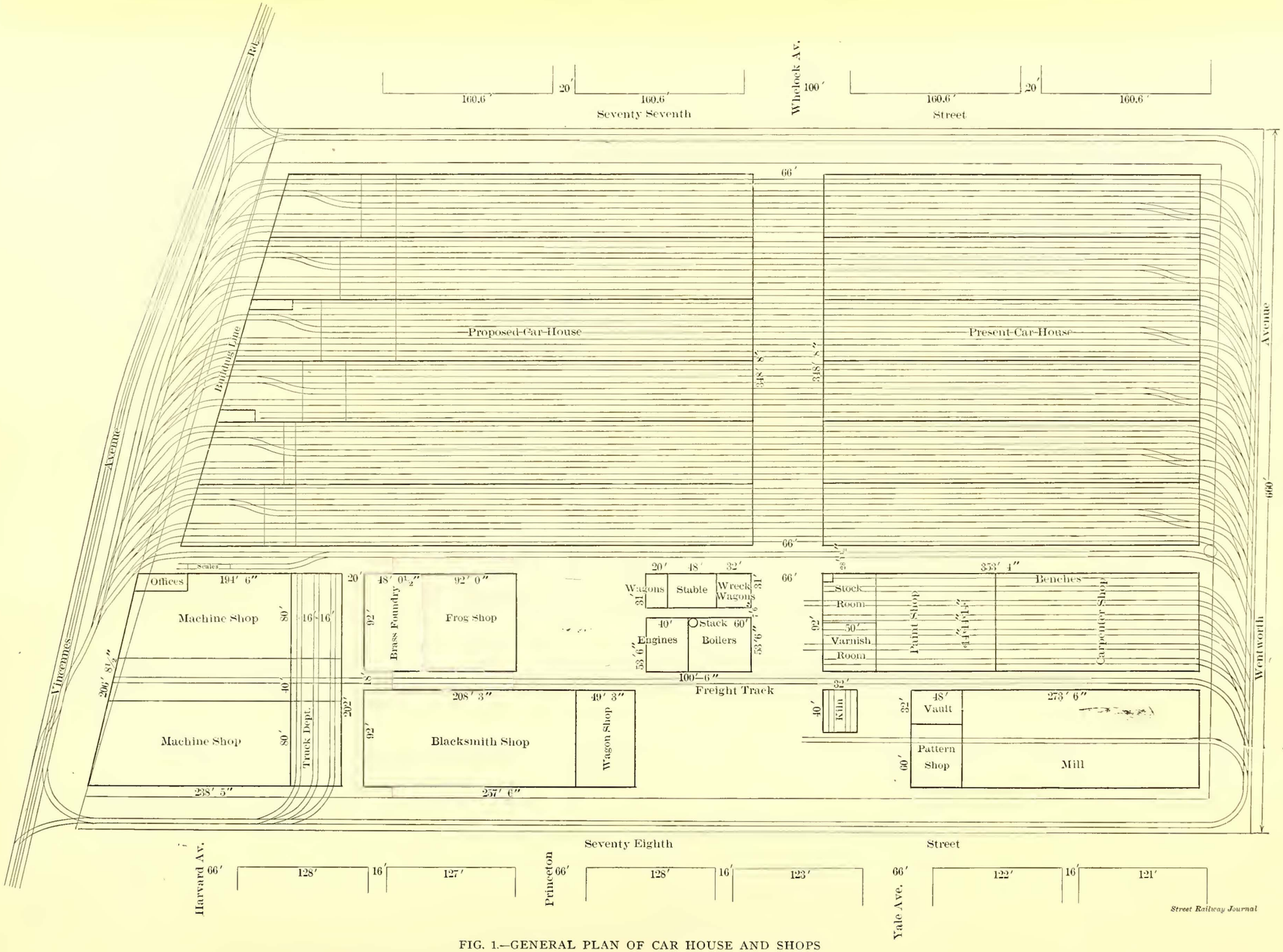


FIG. 1.—GENERAL PLAN OF CAR HOUSE AND SHOPS

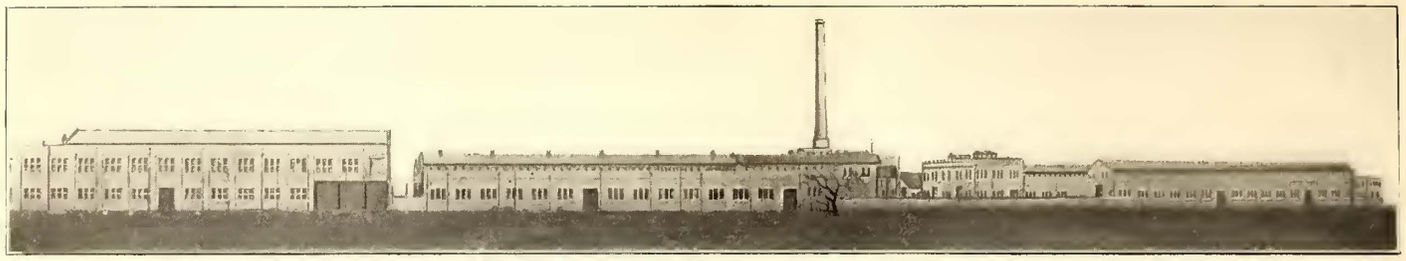


FIG. 2.—EXTERIOR OF PLANT, VIEWED FROM SEVENTY-NINTH STREET

for the distribution and collection of materials. This track is a freight track pure and simple, and is not for the storage or transfer of cars under repair. A track also runs the length of the mill for use in handling material. These freight tracks enter from Wentworth Avenue. Cars sent to the machine shop for truck repairs enter by three tracks from Seventy-Eighth Street at right angles to the freight track serving the machine shop. These three tracks in the machine shop for truck repairs are all provided with pits, the construction of which will be described later. The blacksmith shop and frog shop form practically one building, together with the brass foundry, but the brass foundry is isolated by a fire wall. The freight track passes through the blacksmith and frog shops, Kinnear rolling iron doors being provided for the purpose. The same style of doors is used where the tracks enter the machine shops, and at various other places around these buildings where a fireproof door is wanted. The freight or supply track also delivers coal to the boiler room, which is located adjacent to this track. Automatic coal conveyors, made by the Link Belt Machinery Company, take coal from the dump cars and convey ashes back to the track. The mill contains the wood-working machinery and as much as possible of the carpenter work will also be done in the mill, so that little wood working need be done in the carpenter shop, where the cars are sent in for painting and repairs. In this way the wood dust will be kept away from the car and paint shop. Materials are stored on the second floor of the paint shop. The mill is provided with a fireproof vault, adjoining the pattern shop for the storage of patterns.

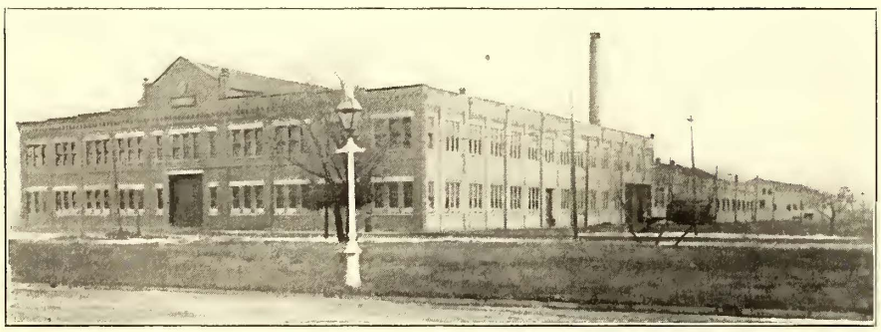


FIG. 3.—EXTERIOR OF MACHINE SHOP IN FOREGROUND

HEATING AND VENTILATION

Heating is accomplished by what is commonly known as indirect radiation, that is, steam radiator coils, located at convenient points around the plant, from which the air is drawn by means of fan blowers and the hot air is distributed to various points by galvanized iron hot-air pipes. There are seven heating coils and fans utilized in this plant. Fig. 6 shows the hot-air pipes as they discharge into the electrical repair department on the second floor of the machine-repair shop building. Fig. 8 shows the hot-air pipes discharging into the pits in the machine-shop building. Fig. 14 is a typical heating fan, driven by a C. C. electric motor through the medium of a Renold silent chain. This chain operates on sprockets somewhat similar to the gear teeth in ordinary gearing, and it is so designed that it does not alter its

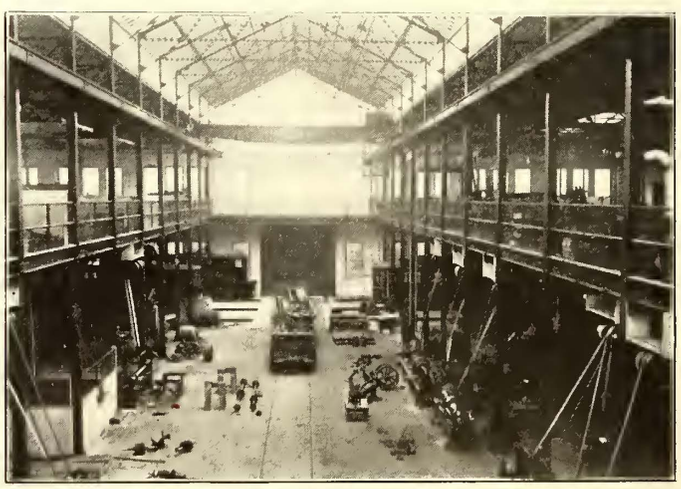


FIG. 5.—GENERAL VIEW OF MACHINE SHOP FROM GALLERY

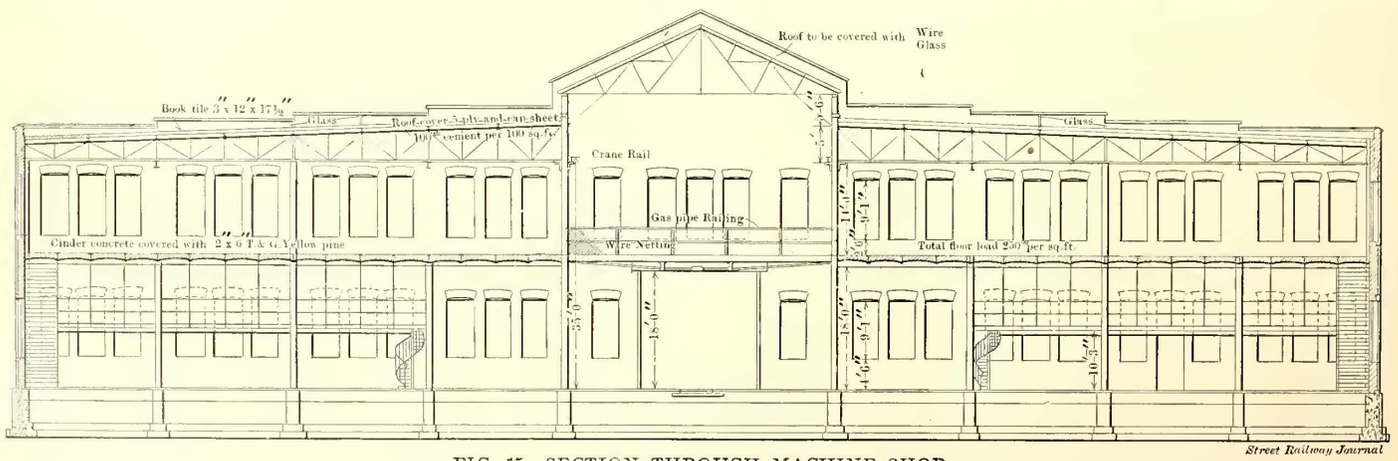


FIG. 15.—SECTION THROUGH MACHINE SHOP

pitch or distance between lengths with wear. The peculiarity of ordinary sprocket chains whereby their pitch is altered with wear has been largely responsible for their failure on heavy machinery. The Renold chain is made upon the principle of

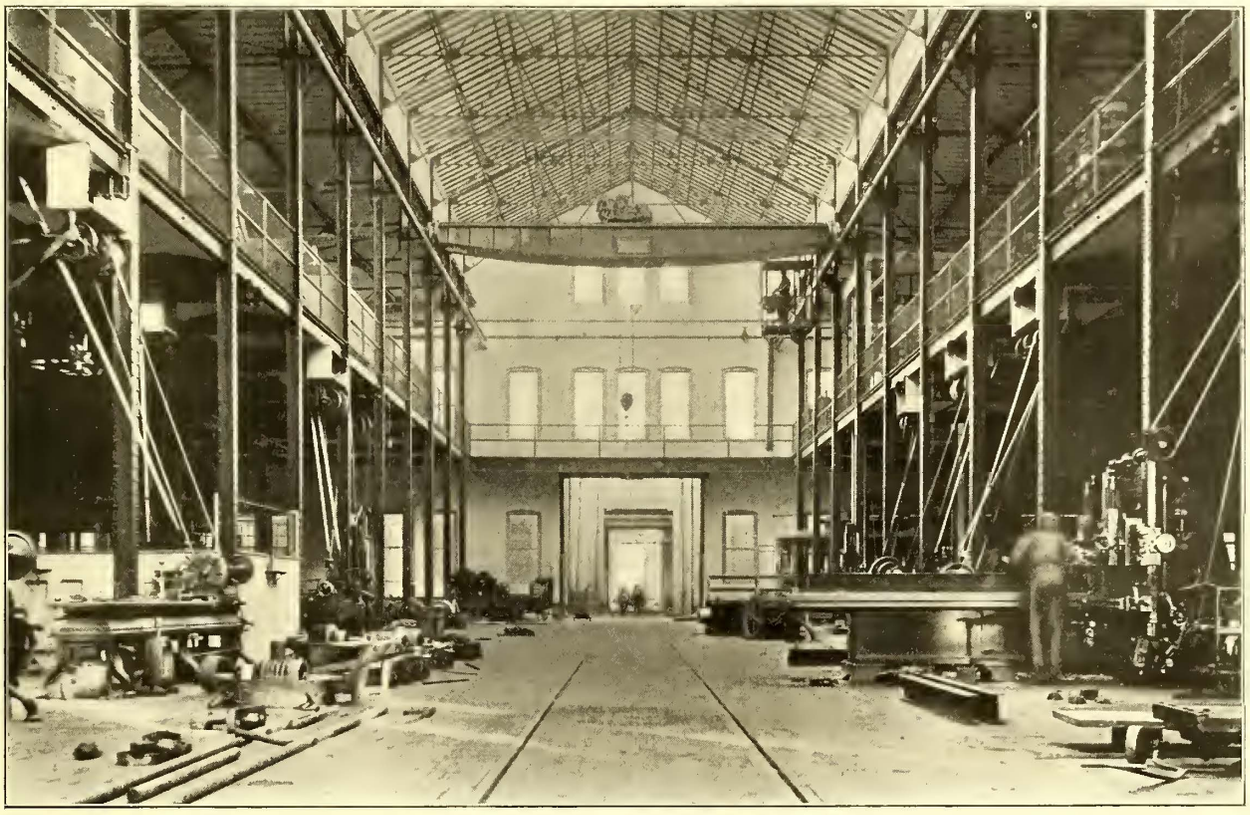


FIG. 4.—CENTRAL BAY OF MACHINE SHOP, SHOWING FREIGHT TRACK AND OVERHEAD TRAVELING CRANE

a link belt, and can be made in any width. Steam for the radiating coils adjacent to the fans is, of course, taken from the several power houses. Fans are supplied by the Buffalo Forge Company.

MACHINE SHOP AND TRUCK REPAIR BUILDING

It is in this building that modern methods are most apparent. The central bay is spanned by a Whiting Foundry Equipment Company traveling crane of 5 tons capacity. The freight track for bringing in and taking out material is directly under the center of this crane, as seen in Figs. 4 and 5. The heavier machine tools are located at each side of the space spanned by the crane so that the crane can deliver heavy pieces to and from these heavier tools. On every second pillar in the center of the machine shop is a push button, whereby the machinists can summon the traveling crane. The man who

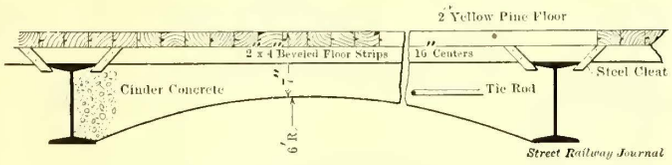


FIG. 17.—SECOND FLOOR OF MACHINE SHOP, AND FLOOR CONSTRUCTION

operates the traveling crane is employed in other work when the crane is not in use. The lighter machine shop equipment is placed in more remote parts of the machine shop.

The use of a center bay, spanned by a traveling crane, saves much labor and delay in the handling of heavy material. As the building is open on all sides and as the center skylights give an excellent light to the central portion, there is no part of the shop that is not well provided with daylight. The wash-bowls, lockers and closets are located on a gallery, half-way between the first and second floors, as can be seen from the drawing, Fig. 15, giving a section through the machine shop building. A number of separate departments are taken care of in the machine shop building. There is the machine proper, and there is also on the first floor the truck repair department. These two departments have separate foremen. In the same building is the motor repair department, which occupies half of the second floor, on the part south of the main bay, while five different lines of work, grouped under another foreman, occupy the other half of the second floor. The electrical repair

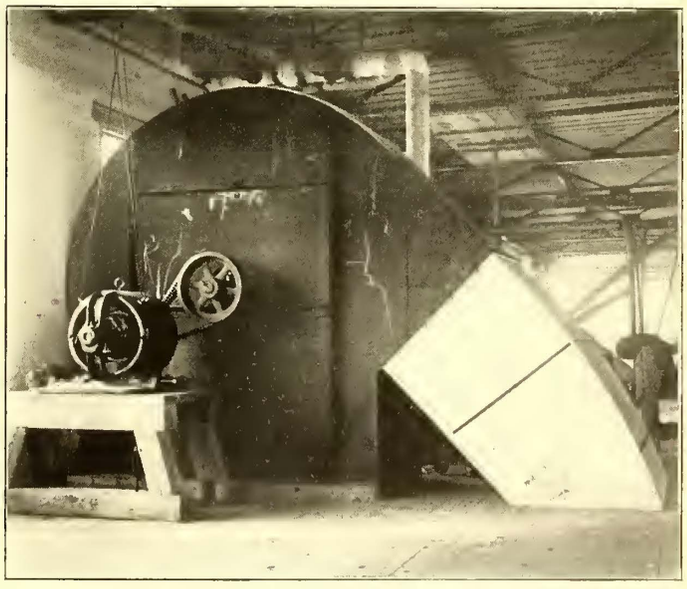


FIG. 14.—MOTOR-DRIVEN HEATING FAN WITH CHAIN GEAR

department takes care of all repairs pertaining to electrical equipment and motors. This department has a storeroom of its own, seen in the background in Fig. 6. The other part of the second floor has the sheet-iron working shop, upholstery department, harness department, broom department and laundry. In the sheet-iron working shop steam fitting is taken

care of in connection with the repair shops. In every department of this machine shop building provision is made for the storage of material connected with that department, so that no time is lost in getting materials from a distant storeroom.

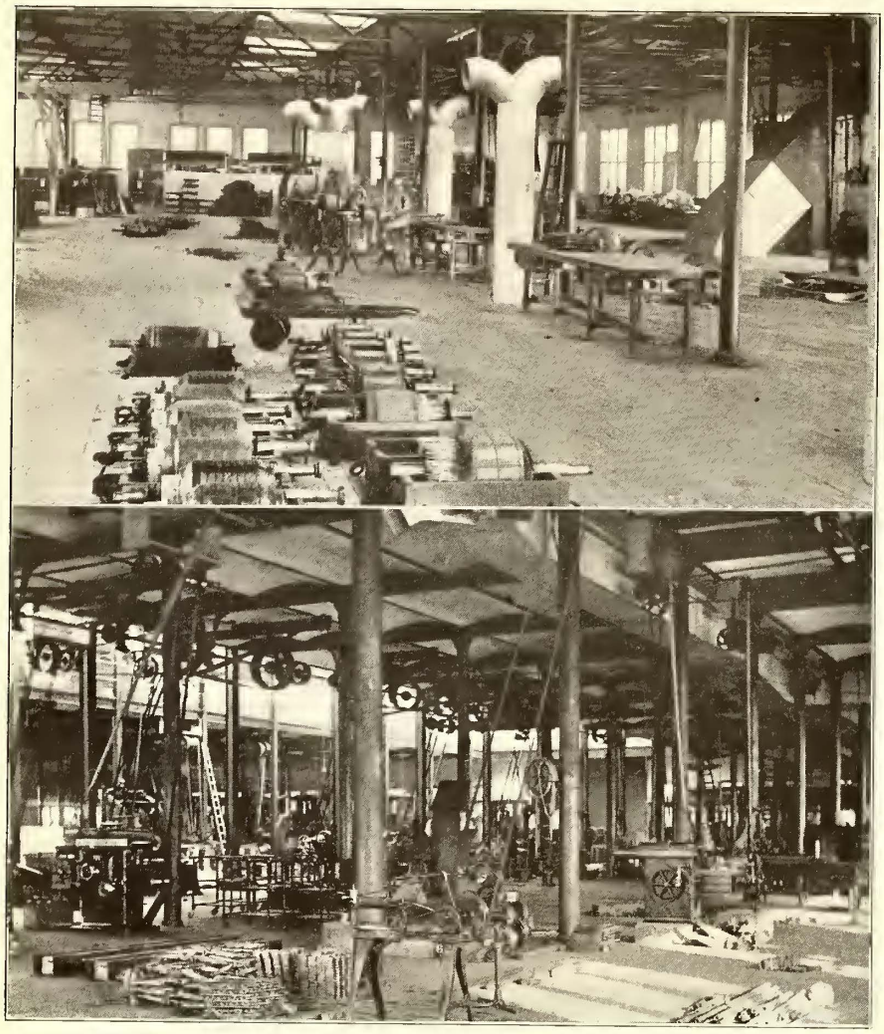


FIG. 6.—ELECTRICAL REPAIR DEPARTMENT, SHOWING HOT-AIR PIPES
FIG. 7.—CORNER OF MACHINE SHOP, SHOWING SMALL TOOLS

MEN EMPLOYED IN MACHINE SHOP BUILDING

In the motor repair department twenty-one persons are employed. In the sheet-iron and pipe fitting department four men, in the broom department three men, in the harness department one man, upholstery department one man. A man in the broom department gives about one-third of his time to the laundry, where all the towels used by the company are washed. This laundry has regular washing and ironing machines, just as any commercial steam laundry. In the machine shop there are twenty-nine machinists and one foreman. On truck repairs there are fifteen men and one foreman.

BLACKSMITH SHOP

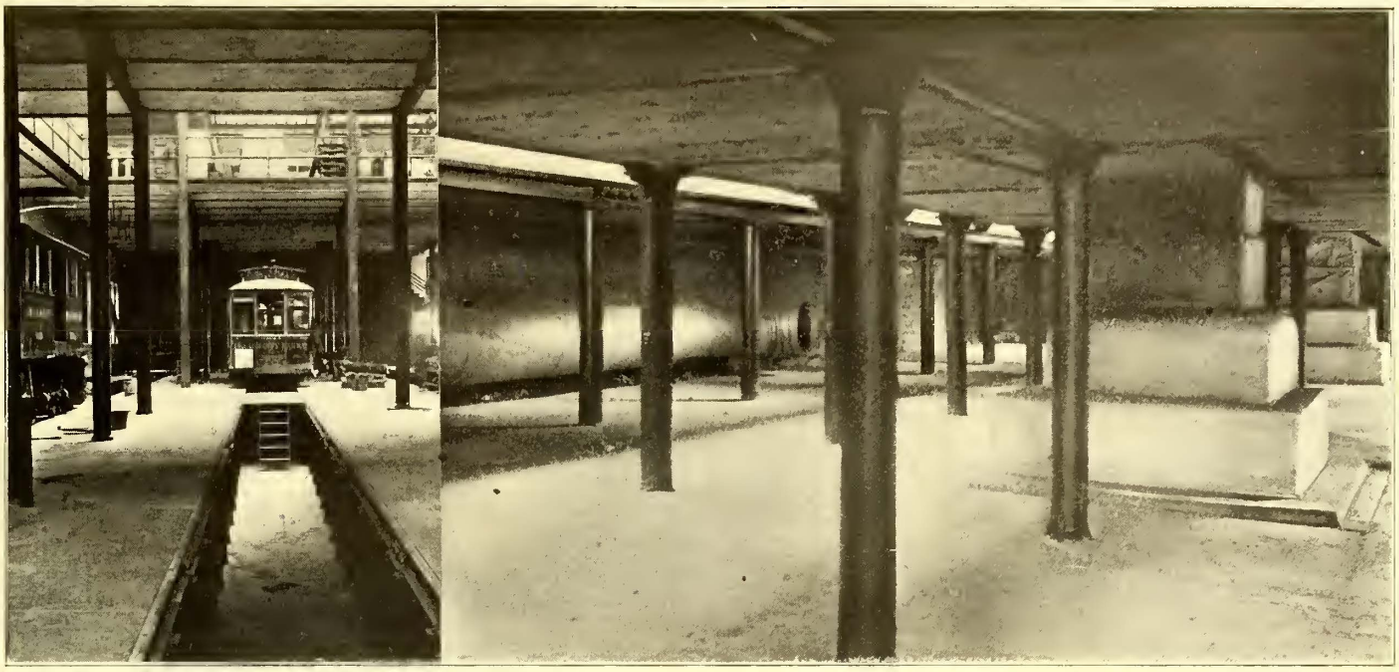
The blacksmith shop and frog shop occupy a building in common. One wing of the blacksmith shop is given to the frog shop. In the future the company will probably undertake more special work construction than it has heretofore, especially as regards crossings with steam railways, of which it has a large number. Such work can easily be performed in the company's own shop now that it has the facilities. Street railway crossings and frogs will probably continue to be purchased from manufacturers, because hardened center work has been found by far the best to withstand street railway traffic, and it is used on all important street railway crossings and special work. Of course, this work is of a nature that cannot be undertaken in the company's own shops. The blacksmith and frog shops have cinder floors. Adjoining the frog shop is the brass foundry. There are twenty men employed in the blacksmith and frog shops, not including four men who give all their attention to cable-car grip repairs. The frog shop is equipped with pneumatic lifts and an overhead track for conveying material from one part of the shop to the other.

BRASS FOUNDRY AND OIL FURNACE

The old and new in brass foundry practice can be seen side by side in Figs. 18 and 19. The new is the Swartz smelting furnace, made by the Hawley Down Draft Furnace Company. This is seen best in Fig. 19. It uses oil for fuel. The furnace is charged with the brass to be melted, and is then revolved on its axis so that the vent or opening through which the products of combustion escape points upward into the hood. Oil and air are admitted into the furnace by the pipes seen in the engravings, and the mixture is lighted. The oil flames are blown down onto the brass to be melted, and thence along the sides of the furnace to the vat. This furnace will hold about 650 lbs. of brass for one melting, and it takes about one hour to melt this. When it is melted the oil and air are shut off and the furnace is turned on its axis until the brass can be poured out of the vent.

This type of furnace, which is being used in nearly all modern brass foundries, effects an economy in several ways, but principally because of the fact that it does not require the expensive crucibles used in the hard coal and coke furnaces of the old style, such as can be seen in the background in Fig. 18. These old style brass furnaces were brought from the old shops, at Twentieth Street, for use when air pressure is not available for operating the oil furnaces, or when for any other reason it is not desirable to run the oil furnaces. It is expected to install more oil furnaces soon. Babbitt metal is also melted in the brass foundry. This company makes it a practice not to bore out or scrape its motor

FIG. 10.—BLACKSMITH SHOP



FIGS. 8 AND 9.—PIT CONSTRUCTION AND HEATING

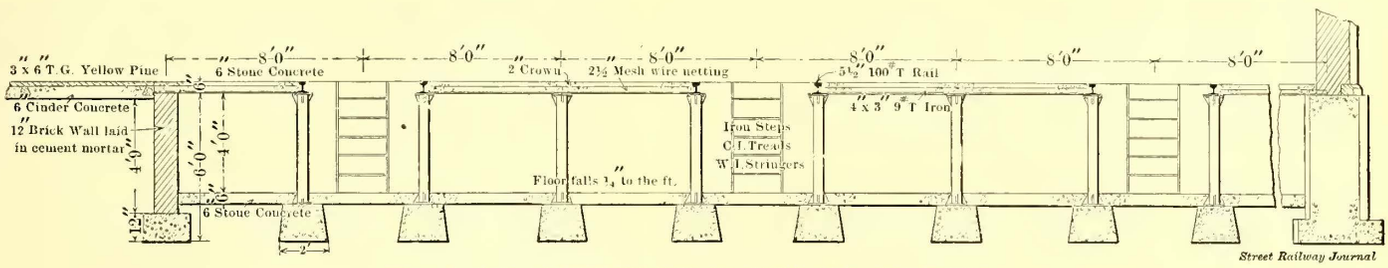


FIG. 16.—PIT CONSTRUCTION OF IRON AND CONCRETE

armature bearings before using, as the ordinary casting is smooth enough, so that boring and scraping are not required.

It is probable that additional oil furnaces will be installed for melting iron, and the company will then make its own brake-shoes from scrap iron.

PIT CONSTRUCTION

The type of pit construction which has been employed, both in the machine shop building and also in the new car house previously mentioned, can be seen in Figs. 8 and 9, which are from photographs, and also in the drawing, Fig. 16, giving the dimensions. The floors are entirely of concrete arches, supported on cast-iron pillars. The columns of the building are supported on concrete pillars. The track rails are of 100-lb. standard T section, and form the girders between which the concrete arches are supported. Tie-rods are run through from the rail of one track to the next, to prevent canting of the pillars and rail under the thrust from the concrete arch floors. A 2½-in. mesh galvanized iron wire netting extends through the concrete. A crown of 1 in. is given to the concrete arch. The standard T-rails are fastened to the tops of the cast-iron columns by special clips. The construction, as illustrated, is the same as that employed in the car storage house except that the distance between the tracks in the car storage house is less and there is no row of cast-iron support columns between the tracks. A single concrete arch spans the space from one track to another without any support except the rails on each side.

MACHINERY USED AND CARS MAINTAINED

In a new shop of this kind it may be worth while to note the machinery which it has been considered wise to install, because such a list shows how far a liberal management of a large street railway property has seen fit to equip its repair shops. In the equipment of any repair shops the question comes up of how much or how little machinery should be purchased in order to get the most economical results. Before enumerating the machinery in the several departments the number of cars

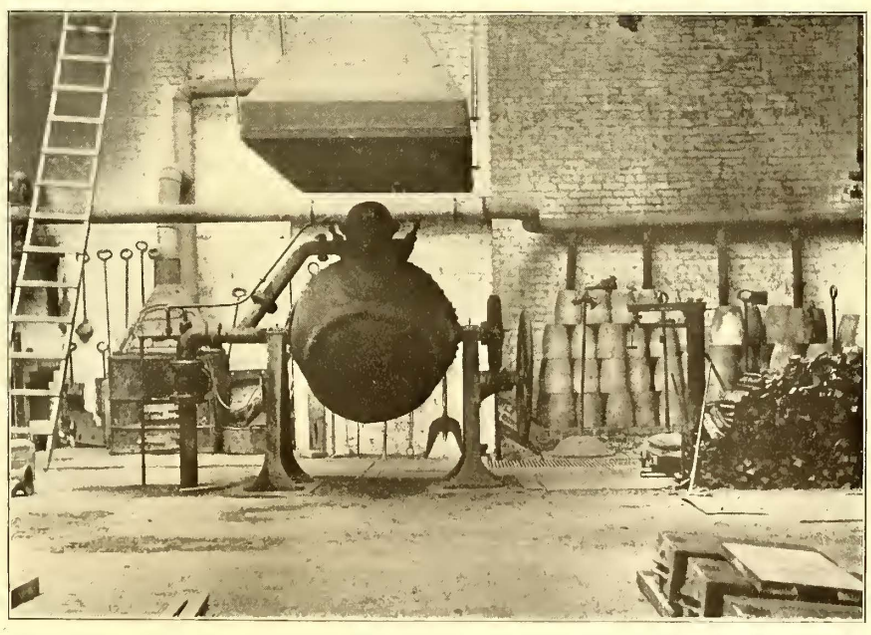


FIG. 18.—THE OLD AND NEW IN BRASS FURNACES

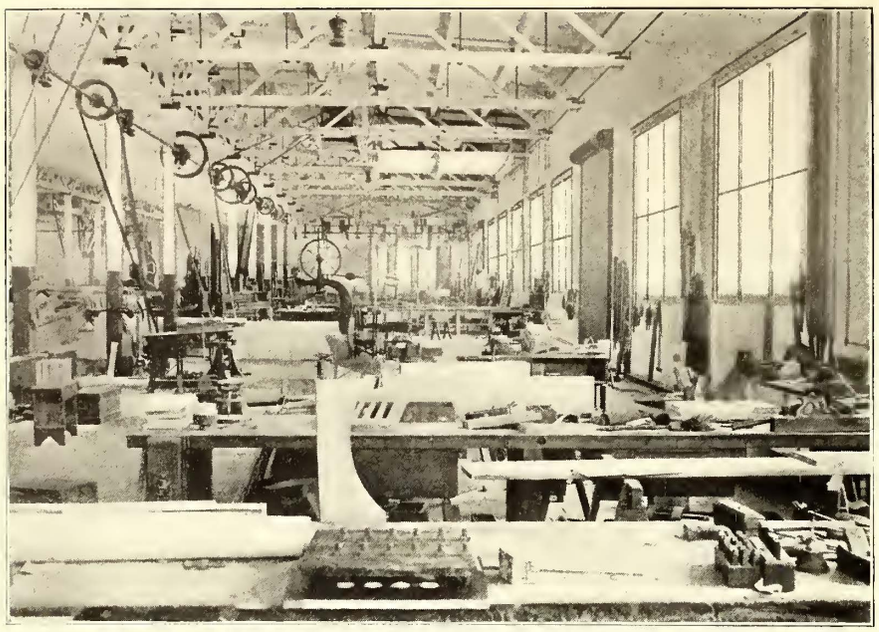


FIG. 12.—WOODWORKING MACHINERY

kept in operation should, of course, be considered. The Chicago City Railway Company operates cars as follows on its maximum schedule:

Electric motor cars	561
Grip cars	183
Trail cars	249
Total	993

The electric motor cars and the cable trail cars are run with open car bodies in summer and closed car bodies in winter, except that about one-fifth of the electric motor cars are of a new cross-seat double-truck type, which can be used in summer by simply lowering the windows. In considering the list of machinery it must be remembered that many more than the present number of cars can be taken care of with the present repair shop equipment, in fact, the whole repair plant has been laid out with a view to a very large future growth in the number of cars to be taken care of. The machinery in the machine shop proper is as follows:

Blaisdell engine lathe, 17-in. swing, 6 ft. 8 ins. between centers.
Fox turret head lathe, 18-in. swing, short centers.
Blaisdell lathe, 20-in. swing, 10 ft. 6 ins. between centers.
Blaisdell lathe, 24-in. swing, 12 ft. between centers.
Pittsburg speed lathe, 14-in. swing, 36 ins. between centers.
Blaisdell lathe, 17-in. swing, 6 ft. 8 ins. between centers.
Blaisdell lathe, 24-in. swing, 12 ft. between centers.
New Hampshire lathe, 34-in. swing, 7 ft. between centers.
Pond Machine Company axle lathe, 7 ft. between centers.
McCabe double spindle lathe, with swings of 28 ins. and 46 ins., 11 ft. between centers.
Flather lathe, 22-in. swing, 6 ft. between centers.
Flather lathe in tool room, 12-in. swing, 36 ins. between centers.
Quint six-spindle drill.
W. E. radial arm gang drill.
Gould & Eberhardt drill press, 37-in. swing.
Drill press, 25-in. table.
Drill press, 24-in. table.
Two drill presses, 20-in. table.
Drill press, 22-in. table.
Six-spindle turret drill press.
Two drill presses, 48-in. table.
Lodge & Davis shaper, 26-in. stroke.
Planer, 6-ft. stroke.
Gray planer, 10-ft. stroke, 44 ins.
Flather back-geared shaper, 26-in. stroke.
Pond car wheel borer, 48-in. swing.
Harrington car wheel borer, 36-in. swing.
Pond car wheel borer, 36-in. swing.
Milling machine.
Acme double-head bolt cutter, 1½ ins.
Single-head bolt cutter, 1½ ins.
Acme six-spindle nut tappen.
Crosby punch press.

The blacksmith and frog shops have machinery as follows:

Hillis & Jones' No. 3 double-throat punch and shears, capacity 1¾-in. hole, through 1¼-in. stock.
Hillis & Jones' 18-in. throat punch and shears.
One Williams-White No. 17 punch, capacity ⅝-in. hole, through ⅝-in. stock, 30-in. throat.
Two Q. & C. rail saws.
Gray frog and switch planer, 36 ins. and 36 ins. x 17-ft. stroke.
Three drill presses.
Eight Buffalo down draft forges.
Ajax forging machine.
Blakesley No. 5 bulldozer.
1500-lb. Bement & Miles steam hammer.
600-lb. Bement & Miles steam hammer.
80-lb. Bradley helve hammer.
40-lb. Bradley helve hammer.
Home-made drop hammer.
Ferguson oil furnace.

In the wood-working mill the following new machinery for the equipment of the new mill was purchased from the S. A. Woods Machine Company, of Boston, Mass.:

30-in. cabinet surfacer and smoother.
27-in. surfacer.
6-in. sash sticker.
Shaper.
Horizontal boring machine.
Vertical boring machine.
Band saw.
Knife grinder.

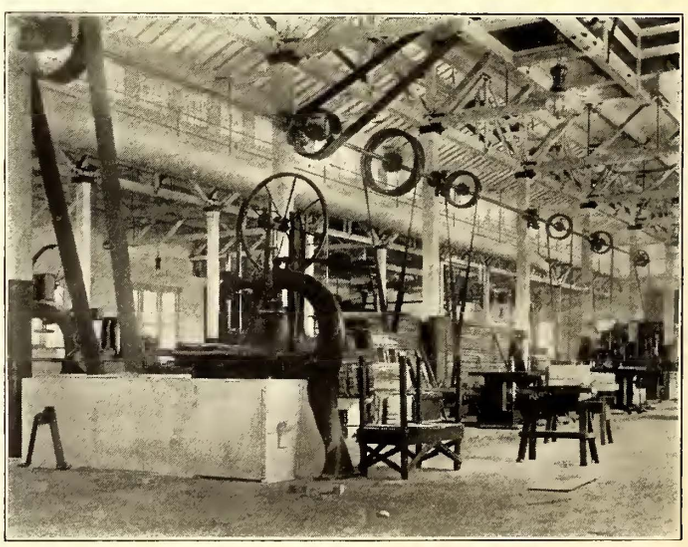


FIG. 13.—MILL

Besides these there is the following apparatus moved from the old shop:

24-in. planer.
7-in. moulding machine.
6-in. moulding machine.
No. 4 self-feeding rip saw.

Swing cut-off saw.
36-in. band saw.
Fay scroll saw.
Two double and trim saws.
Mortising machine.
Tenoning machine.
16-in. joiner.
Shaper.
Carver.
Lathe.
Knife grinder.

ELECTRIC MOTIVE POWER

The power house which furnishes steam for heating also supplies electric current at 550 volts for operating the various shops. The driving is by electric motors throughout. The power house has three Babcock & Wilcox water-tube boilers, rated at 300 hp, equipped with Babcock & Wilcox automatic stokers and "Link Belt" conveyors. The electric generating plant consists of two units of 300 hp. These are Ideal engines, running at 200 r. p. m., direct-connected to Western Electric motor-generators. These units are remarkably smooth in operation. A voltage of 500 was chosen as the pressure at which the shops should be operated, because of the possibility of using for the shops the regular railway current if the shop power house should be shut down, or, on the other hand, using the shop power plant for moving cars at night in case it were possible to shut down the larger power houses. Ordinarily the motors and lights in the shops will not be run on a grounded circuit.

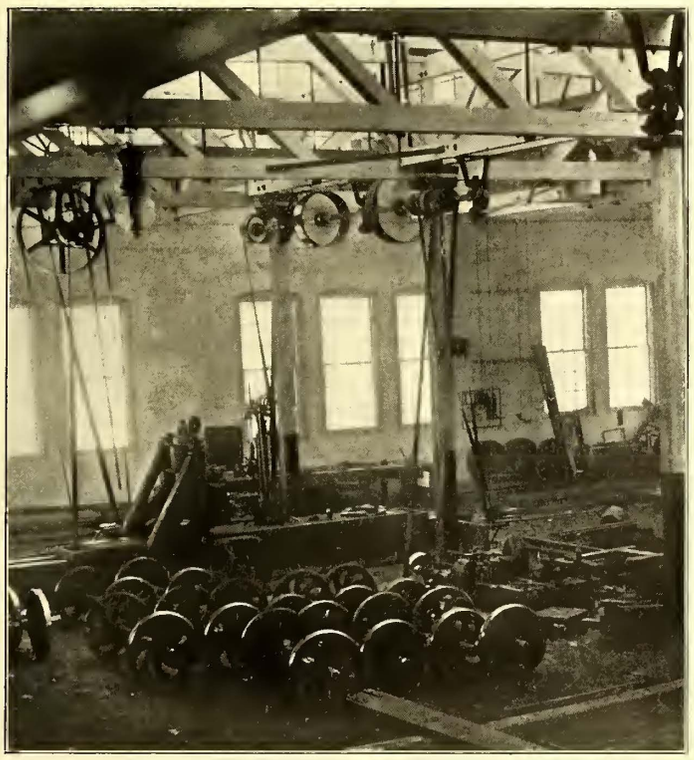


FIG. 11.—FROG SHOP

Shafting in the shops is divided into sections with a motor driving each section independent of the cars. Thus in the machine shop there are three General Electric motors of 35 hp, 30 hp and 25 hp respectively. The motor repair department is driven by an old railway motor, and the departments on the second floor of this building are driven by another similar motor. The blacksmith shop has 35-hp motor-driven blowers, and besides these four car motors in the blacksmith and frog shops. The wood mill has 135-hp and 225-hp motors. There are besides these seven heating fan motors, mentioned in this article, and the common motors, so that, taken altogether, the electrical driving in this shop forms an important installation in itself.

DIVISION OF WORK IN CAR MAINTENANCE

The Chicago City Railway Company divides the maintenance of its rolling stock into four parts, as follows:

(1) Motors, lights and all electrical.
(2) Trucks and tracks.
(3) Car bodies and fittings.
(4) Painting.

SHOP REGULATIONS

Employees of this plant work an average of nine hours a day. The plant has no exits save for cars except through the master mechanic's office or through the employees' door. The car exits are kept closed ordinarily. The employees enter at an office, which is also the weighing office, and a man is kept on duty here. All employees register on an automatic time register clock coming in and going out.

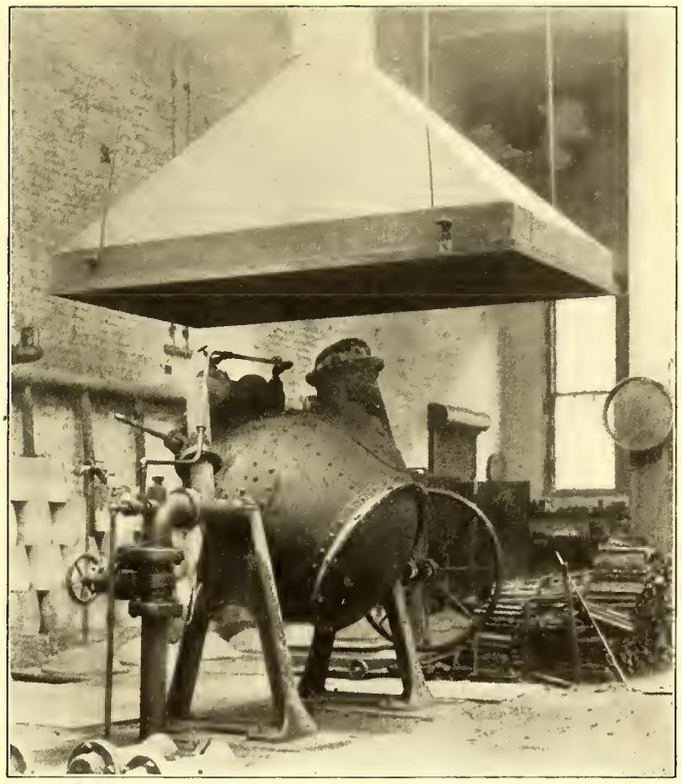


FIG. 19.—OIL-BURNING BRASS FURNACE; CAPACITY, 650 LBS. PER HOUR

The plant is under the charge of M. O'Brien, master mechanic. The design of the plant is, of course, the result of a combination of talent, including that of Captain Robert McCulloch, general manager; Richard McCulloch, assistant general manager; M. O'Brien, master mechanic; H. B. Fleming, superintendent electrical construction; C. E. Lund, civil engineer, and the contractors—W. R. Roberts, steel and iron contractor, and W. R. Crilly, general contractor.

ELECTRIC SERVICE FOR NINTH AVENUE L

The Manhattan Elevated Railway management has begun the operation of electric trains on the Ninth Avenue line, and will extend this service as fast as new cars can be equipped with electrical apparatus. It is probable, however, that the entire system will not be electrically equipped for several months, but it is hoped to abandon steam locomotives by next Fall. The company in the meantime is extending the station platforms so as to admit the loading of six-car trains.

ENGINEERING PRELIMINARIES FOR AN INTERURBAN ELECTRIC RAILWAY—I

BY ERNEST GONZENBACH

In view of the present interest in interurban railway development and engineering the writer submits, as the result of an invitation from the Street Railway Journal, the plans and recommendations embodied in a report on a proposed railway in the Middle West which serves as a good example of many roads now on paper, and which may soon assume tangible form. This article is in no way to be construed as an attempt to generalize and instruct others in the art of railway construction, but is intended to show the way in which certain conditions were to be met in a certain case, together with the reasons which led up to the recommendations and plans therein submitted.

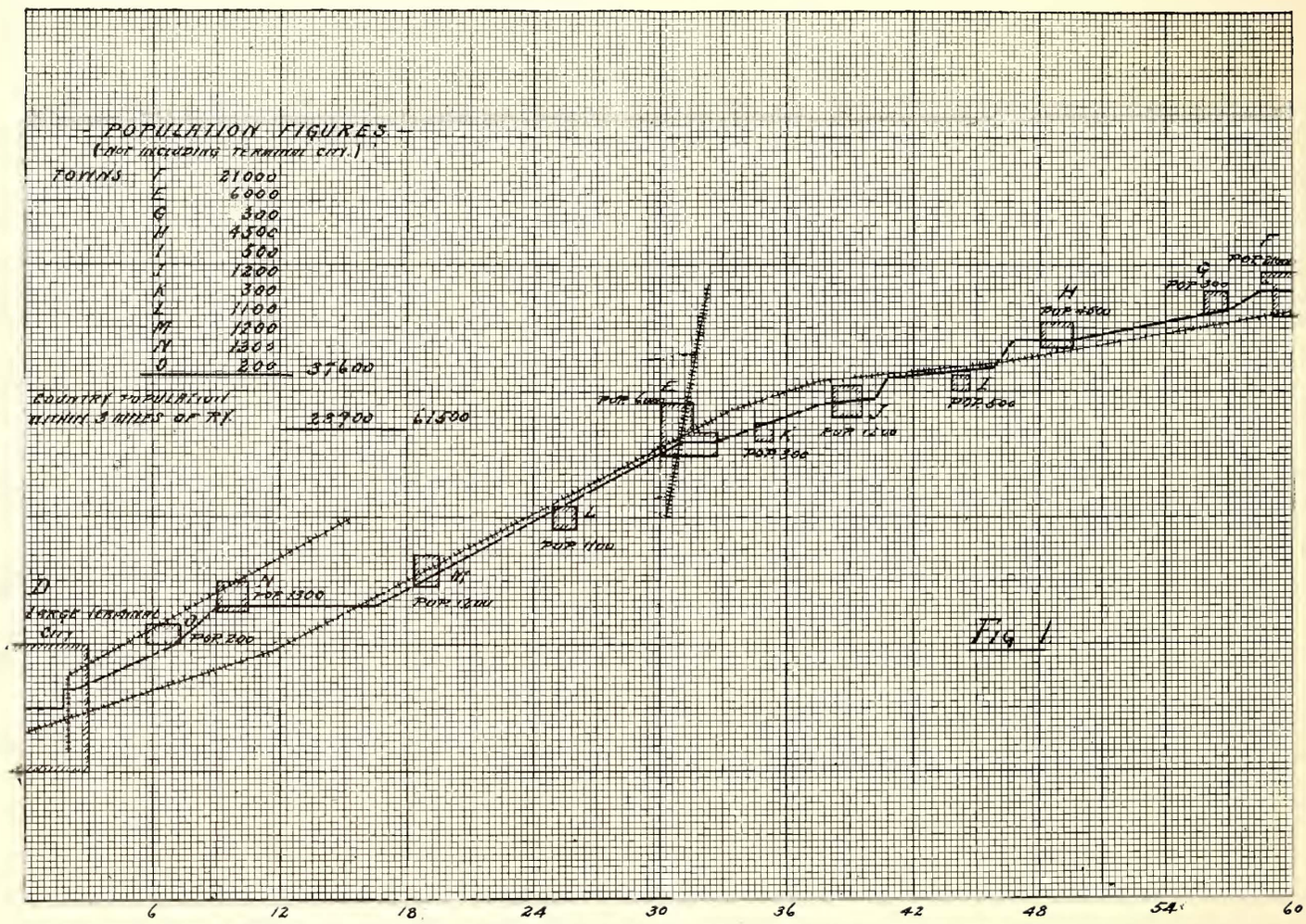


FIG. 1.—MAP OF PROPOSED INTERURBAN RAILWAY

At the time the writer was invited by the promoters to examine and report on the proposed road and its equipment, there had been submitted by one of the large manufacturing companies a proposition to equip the road for high-speed service with four large motors of 125-hp per car, 80-lb. track rail, and 100-lb. third rail, and correspondingly heavy sub-stations, distributing system and power house. The promoters had, furthermore, taken several trips to examine a lately opened high-speed railway with an equipment similar to the one they proposed to install, and there seemed to be a fairly unanimous opinion that the new road should follow the same general lines. As I shall again refer to this road we may designate it for our purpose as the A, B & C Railway. The writer's recommendations differed in many respects from those proposed by the manufacturing company, mostly, however, in the fact that smaller motors and smaller sub-stations and power house equipments were recommended throughout for the reason that, as will be shown below, as good or better service could be given with these smaller equipments than with the larger ones, by a very simple departure from the accepted form of time-table in use on most railways. As a result the total investment per mile of track is very much lower, and the operating costs per car-mile are at the same time reduced.

It is far from the writer's intention to insinuate any tendency on the part of the manufacturing companies to sell heavier equipments than are necessary. Numerous instances are on record where selling companies proposed less expensive equipments than those demanded by the purchaser, and their reputations in this respect are sufficient evidence to the contrary. The present tendency towards extremely heavy equipments for cross-country roads is an outgrowth of elevated and similar practice, where heavy equipments and high acceleration are not only justified but absolutely necessary. The earnings of elevated roads which warrant these heavy investments are never approached, however, by the strictly interurban road, and there are several of the latter now in operation which stagger under the financial burden of the elevated equipment and country road income.

The preliminary step in any electric railway undertaking, therefore, is first to make an accurate and conservative estimate of the income which can be derived from all possible sources of revenue, including passenger and freight receipts, amusement resorts, mail and express and electric lighting and power. This estimate should not be a mere guess, but can be very accurately arrived at by comparison with what other roads are doing. One must carefully choose roads, however, which physically and financially are nearly parallel cases to the proposed road, operate in much the same class of country, industrially considered, and known to be efficiently equipped and

handled. The examples from which to judge need not be numerous if they are carefully chosen. The plans for our example, which we will call the D, E & F Railway, will be developed from the preliminary estimate of income and equipment to the operating details.

ESTIMATED INCOME

A map of the proposed railway, Fig. 1, shows that it would serve a number of small towns, and that it parallels a trunk line railway which gives a very fine, though infrequent, service. The surrounding country is one of the rich farming districts of the West, and F is a large industrial town. There is also considerable industrial activity in most of the towns to the west of F as far as E. From E to D is a farming and dairy country, with little or no industries. The first step now is to get an accurate record of the population. For this purpose census figures only should be used. All of the population of towns along the railway may be counted, and all of the country population within 3 miles of either side of the railway. The result is the population figure which appears on the map and which does not include the population of the terminal city, which cannot be counted because the road will not serve all of its population, and as the percentage served is uncertain, it is advisable to base all comparative figures on a common basis.

Comparing the proposed road carefully with others in operation we find the following roads which operate through nearly the same class of territory. The names of the roads are omitted and initials substituted arbitrarily for obvious reasons:

	Population served	Miles track	Gross receipts per year	Gross receipts per mile track per year	Gross receipts per capita per year	Operating expense
1 G & H.....	150,000	153	753,000	$4,920	$5.02	56%
2 I & J.....	22,600	30	165,000	4,230	7.30	53%
3 K & L.....	49,700	108	464,000	4,285	9.34	54%
4 M & N.....	63,000	58	338,000	5,820	5.37	54%

In view of the fact that these four roads are examples selected because of similarity to the case under discussion, they represent very nearly what earnings may be expected of the D, E & F Railway. The population outside of the terminal city D being 61,600, and assuming the lowest per capita earnings listed $5.02, would give an estimated gross income of 61,600 x 5.02=$309,000.

The average per mile gross receipts for the four roads is $4,815. The D, E & F will have a mileage of sixty-four. On this basis the gross receipts should be 64 x 4815=$308,000.

The average per capita income, adding all gross receipts and dividing by the population of all four roads, is $6.20. Using this as the per capita figure we have 6.20 x 61,600=$381,000. It will, on the whole, however, be safer to use the lowest figure, or about $310,000 as the estimated gross income.

The operating expenses may safely be assumed as 55 per cent of the gross receipts, or $170,000, leaving $140,000 for interest, sinking fund and dividends.

As a matter of fact there is a considerable revenue to be derived from the sale of electric light and power along the line, and the carload freight business should also be attempted. By a vigorous pushing of these items and an exceptionally good passenger service it should not become difficult for a good manager to push the gross income as high as $400,000 per annum. Having now estimated the income, we may proceed to estimate the investment required to produce it.

GENERAL REQUIREMENTS

The road has a length of 62.5 miles from end to end, not including side tracks. As the map shows, for most of its distance it parallels a steam road, which gives a most excellent service, and has express trains between D and F, making the time in one hour and forty minutes, including a stop at E. The fares on the steam road are about 2½ cents per mile, and there are three express trains and five locals in each direction each day. In order to give as good or better service on the electric line it is necessary to provide comfortable, even luxurious, coaches and make as fast time between terminii as the steam railroad does. It is becoming customary, too, to recommend for such service an acceleration of 2 miles per hour per second, a maximum speed of 60 miles to 70 miles per hour, and a schedule speed of from 40 miles to 45 miles per hour, as previously mentioned.

Such a proposition is worth the most careful consideration. It has the advantage that with the schedule speed proposed the fastest time of the steam trains may be equalled and the traffic between local points accommodated at the stame time. Each car becomes an express train, and there is really only one tangible objection which can be urged against such an equipment, namely, its high first and operating cost. The high rate of acceleration and frequent stops demand excessive power, which, in turn, demands heavier apparatus all the way back from the car to the boiler room in the power house. Without question there are places where such an equipment will well repay the extra cost of installing it, but the place for it is hardly in the class of roads of which the D, E & F is an example.

In order to reduce the first cost and at the same time enable a service to be given which shall meet the competition of the steam road, the writer arranged a train schedule of which Fig. 2 is a sample. The number of cars required in service to maintain this schedule, with half-hour headway, is ten as against eight, which would be required were the heavier equipment installed and used. Emphasis must be laid on the last condition because of the roads which have been built and equipped to maintain a schedule speed of 35 miles to 40 miles per hour, with stops averaging 3 miles apart; there is to-day not one which actually is making this schedule speed, not because of inability to attain the maximum speed, but due to the numerous stops. One of these is the A, B & C road referred to, which has cars equipped for such speeds, but whose schedule at present is 28 miles per hour, and there is little prospect of its ever exceeding 34 miles per hour unless a limited service is inaugurated, which, however, is not what the equipment was designed for—this on a road having practically no city or street tracks and entirely on its own right of way. It seems, therefore, that while 40 miles per hour schedule speed is perfectly feasible its practical application and economy on a country road remains yet to be demonstrated, and it should not at present be accepted as sufficient reason for additional investment on a road such as is under discussion, and which has a considerable street mileage.

A little study of train movements, as shown in Fig. 2, shows that there are three classes of service provided for while there are only two classes of trains. The limited trains consist of two cars, but only one of these is a through car. The other car of the train is limited for half the distance, and is then dropped to a local:

1. A "limited" service, making the time between D and F in one hour and fifty minutes, or a schedule speed of 34 miles per hour.

2. A mixed limited service, being a local half the distance and limited the rest of the distance. The time required by one of these cars is two hours and twenty-five minutes.

3. A local service, making the distance, D to F, in three hours, or a schedule speed of 21 miles per hour.

The first or "limited" service will land through passengers at either terminal as quickly as the steam trains. The second class of service is modelled on the suburban time-tables of many steam roads, which run trains "express" part way and "local" the balance of the run. This class of trains should serve a very numerous class of passengers desiring quick time from country points to city. The local trains proper have a two-hour headway, and would naturally get little through traffic, but they serve a very useful purpose in handling the traffic between country points. Moreover, such trains can also take care of the

mail and express business by attaching a regular express car to the local.

It is quite clear that this schedule can only be used when cars are equipped on the multiple-unit system of train control. No railway should be installed in any other way in the present state of the art. The only objections against the system are complicated mechanism and high first cost. The first objection is answered by the fact that cars so equipped are giving less trouble in service than similar ones equipped with hand control. The second objection is formidable, but good things command a high price, and the only remedy is to accept the situation and pay the price demanded, which may be high; yet it is even more expensive to be without it. Better to cut out some of the fancy apparatus in the power house and sub-stations and apply the money saved to purchase of a train-control system. The road, of course, is to be single track, and it will be urged by many

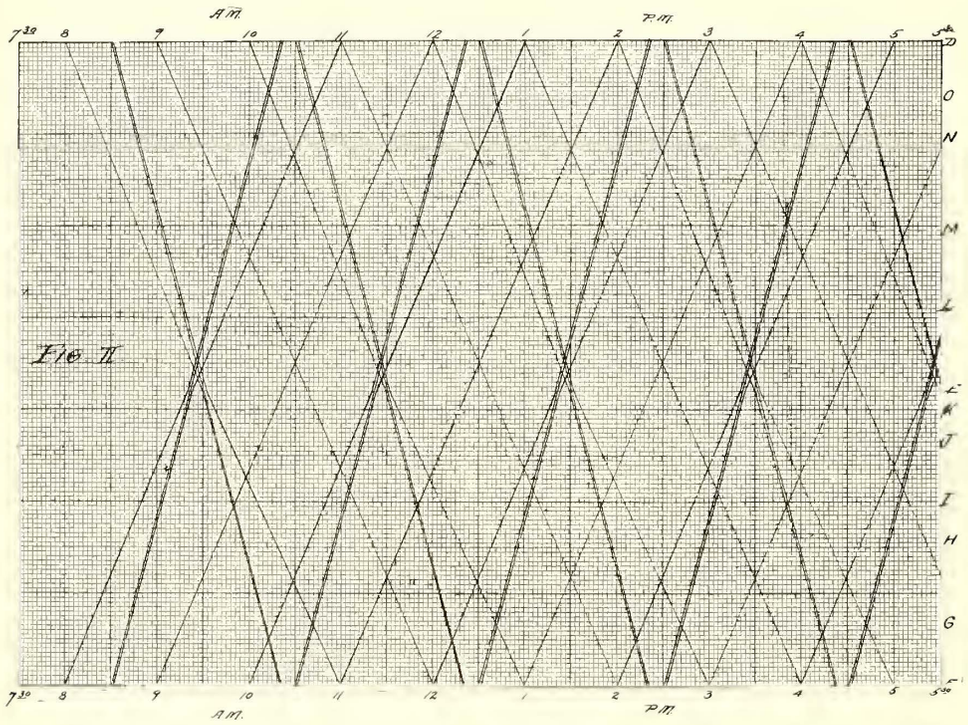


FIG. 2.—TRAIN SCHEDULE FOR TEN CARS UNDER HALF-HOUR HEADWAY

practical railway men that the schedule shown in Fig. 2 is complex and makes too many meeting points at irregular intervals, as compared with a schedule providing half-hourly headway, which would give practically the same class of service with all cars having the same schedule time between terminii. This objection is not quite as formidable as it appears. With half-hourly headway and two hours time, the number of meeting points will be seven, the same as that of the "local" cars in schedule, Fig. 2. The "limited" trains will have only six meeting points and the total number of meets will, therefore, be less. It is true that these meets occur at unequal intervals, and a siding which may be a meeting point on one trip may not be on the next trip of the same car. Considering the amount and various classes of traffic handled on single-track steam roads, such as the Erie, it should not be difficult to apply to the case in hand the methods of despatching which have made it possible in steam practice, especially if the electric road has in addition to a thorough despatching system an automatic block signal system. The latter can now be obtained in the market, and no road should be without such a safeguard, for the advertising effect on the public and the moral effect on employees alone make it a paying investment. It should be noted that a half-hourly headway with single cars is assumed to take care of all the business the road is capable of, and Fig. 2 is designed to operate cars to give a service of approximately the same number of car miles as the half-hour service. In case it were found more desirable to give an hourly headway with single cars, Fig. 2 may be modified similarly, giving "local" service at two-hour intervals and a "limited" service at intervals to suit the traffic. A frequent service up to certain limits seems to be more profitable, however, and if the business warrants it should certainly be adopted.

Another point which may be urged in favor of Fig. 2 schedule is that with the multiple-unit control system "extra" cars need not be sent out on the line, but can simply be attached to a regular car without in any way interfering with its schedule, in fact adding to the maximum possible time of the "regular." There is an absence, therefore, of a demand for the troublesome "extras," which are the cause of probably 80 per cent of the wrecks occurring on both steam and electric roads. The same rule, of course, holds in the case of single cars at equal time intervals, and it is cited here only to show that with the schedule and system recommended the question of "extras" and provision for them cannot be urged against it.

THIRD RAIL VS. TROLLEY

A further point to be decided before details are determined upon is whether the third rail or overhead trolley should be adopted. First cost very often decides this in favor of trolley. The trolley has been so long standardized and has given such universal satisfaction that the third rail is often looked upon with suspicion; it is reported to be dangerous to life, troublesome in freezing weather, expensive, etc. As a matter of fact the third rail as a conductor of current has some disadvantages, notably that of becoming troublesome when coated with ice. This objection is gradually being met and removed, and one may confidently predict that in one or two more winters sufficient experience will have been had entirely to overcome these disadvantages. The trolley itself is not entirely above reproach in this respect.

In the matter of first cost there is often unconscious discrimination, due to the fact that the conductivity of the circuit is lost sight of. One often hears it argued that "we can put up a trolley for $1,500 per mile, and the third rail costs $3,500 per mile, and the trolley poles can be used for the high-tension wires." On closer investigation it usually appears that the speaker has compared a single 000 line or 0000 line or a double 00 trolley having a conductivity equal to about 200,000 circ. mil copper, with a third rail of 70 lbs. to 80 lbs. per yard, which, with low carbon steel, will give a conductivity equal to 1,000,000 circ. mil or over in copper.

The curves shown in Fig. 3 have been prepared to show the difference in first cost between trolley and third rail, and it is interesting to note that the rail is lower in first cost, even down to the smallest sizes. The prices used in making up the costs were those current in October, 1902, plus a 10 per cent margin, and copper was figured at 14 cents per pound, delivered. Single-track bracket construction only was calculated, as it has become standard for interurban railways of the class we are now considering.

The steel for third rail was assumed to be of a grade giving a conductivity 7.5 to 1 as compared with copper. Its cost was estimated at $38 per ton delivered for the larger sizes, and $40 per ton delivered for the smaller sizes. It is to be hoped that with an increasing demand the rail mills will put this low carbon steel on the market at the same price as the standard mixtures. The cost also includes extra length of ties, bonding,

insulators and an allowance for 200 ft. of cable at highway crossings.

The dotted lines compare the costs when a high-tension transmission line is required. The poles must then be considerably higher than when used for trolley purposes only. The high-tension wires should be put out of reach of the trolley pole. For this extra length of poles an increased cost of $3 per pole has been allowed. For the high-tension line forty poles per mile at a cost of $8.50 in place are allowed. The result is shown in dotted curves B and D, Fig. 3. The cost of third rail, plus pole line, is at all points considerably lower than the cost of trolley line carrying high-tension wires.

It so happens that a single No. 00 trolley wire and a 10-lb. per yard soft carbon rail have almost exactly the same conductivity—133,000 circ. mil copper, making allowance for cables, bonds, etc. If the rail could be bought for $40 per ton then the cost per mile of third rail would be $1,065. This includes an allowance for extra length of ties, cost of insulators, bonding, joint plates and provision for 200

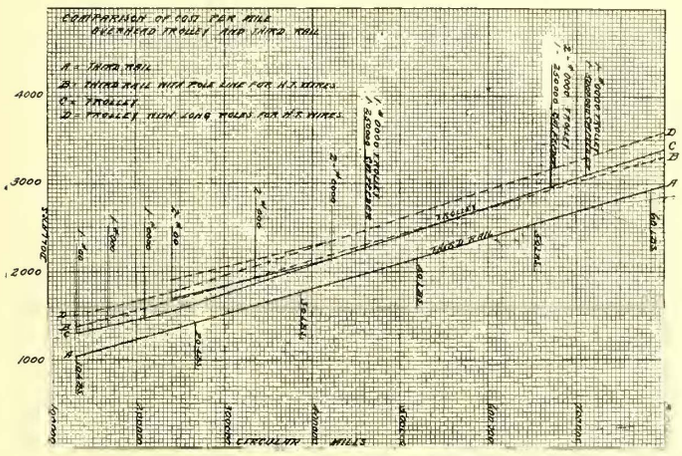


FIG. 3.—DIFFERENCE IN COST BETWEEN TROLLEY AND THIRD RAIL

ft. of cable at highway crossings. The 00 trolley would be $1,308, with copper at 14 cents and material on the same basis. It is not expected that the third rail will be installed in such small sizes, but the comparison serves a useful purpose.

The chief advantage of the third-rail system, however, is its low maintenance cost. It is this feature which warrants its continued increased use, and no doubt will make it advisable for many roads now using trolleys in high-speed service to change to third rail.

Assuming that a service, as shown in Run Sheet, Fig. 2, has been adopted, third rail and train control have been decided upon, and the road is to be built in a manner successfully to compete with the parallel steam line, while at the same time keeping the investment as low as is consistent with permanency, the details of construction are next to be considered.

◆◆◆

The Consolidated Railway & Power Company, of Salt Lake City, has recently completed a car house with a capacity of thirty-five cars to replace one burned down last September. The company is also double tracking considerable of its single-track mileage, and is building a 5-mile extension to Sandy. This fall the company expects to change all of its rolling stock to double-track cars. On Feb. 1 the company raised the wages of employees to 20 cents an hour for the first year, 22½ cents during the second year of employment and 25 cents an hour after the second year. During the Elks Carnival in Salt Lake City recently the cars of the company carried over 100,000 passengers during one day. Eighty cars were in operation during this carnival.

THE EXPERIENCE OF MASSACHUSETTS IN STREET RAILWAYS*

BY LOUIS D. BRANDEIS

The aggregate length of street railway surface lines in Massachusetts, Sept. 30, 1902, was 2086 miles, as compared with 2106 miles of steam railroad lines, not counting in either case second or additional tracks or sidings. Of these street railway lines, 1172 miles have been constructed since Sept. 30, 1895. The average dividend paid on the outstanding capital stock during the year ending Sept. 30, 1902, was 5.23 per cent. It is believed that the street railway mileage in Massachusetts is larger in proportion to area and population than in any other State of the Union, and that the transportation facilities compare favorably with those afforded elsewhere.

The Massachusetts system of street railway surface lines has been developed under a law having these peculiar features: First, a revocable franchise; second, an effective prohibition of stock watering; third, an effective system of franchise taxes.

THE REVOCABLE FRANCHISE

Locations are granted in cities by the Board of Aldermen, and in towns by the Selectmen, subject in each case to the approval of the State Board of Railroad Commissions.† The Aldermen in cities and the Selectmen in towns have likewise the power, subject to the approval of the Railroad Commissioners, to revoke the franchise of any surface street railway at any time after the expiration of one year from its opening for use "if the public necessity and convenience in the use of streets" so require.

While the right to revoke locations has not been frequently exercised (except as an incident to changing routes or alteration of streets), the right of revocation has been fully sustained by the Supreme Court, and is universally recognized in practice. The grant of the location is substantially a license during good behavior. The existence of the right of revocation has proved an effective means of securing to the people proper transportation facilities.

The process by which reasonable demands of the people for better transportation facilities or lower fares are ordinarily secured, is this: A demand is presented in the first instance to the company, not by the local authorities, but by a voluntary committee formed to represent the people. If the company does not yield to the demands of the community thus expressed, there follows a petition to the Railroad Commissioners. The Board gives a public hearing, at which the petitioners and the company are usually represented by counsel. The decision is rendered in the form of a recommendation, for the Railroad Commissioners have little compulsory power. Largely because of the reserved power of revoking locations, such reasonable demands of the local public, if approved by Railroad Commissioners, usually result in immediate compliance on the part of the company with the recommendations of the Board.

A marked instance of the influence of this reserved right of revocation is furnished by the struggle for a 5-cent fare recently conducted by the inhabitants of Roslindale. Roslindale is a station on the Dedham branch of the New York, New Haven & Hartford Railroad, 6½ miles from the heart of the city, in the suburban district of Boston, known as West Roxbury. Around this station is a thickly settled region occupied largely by people of small means. The West End Street Railway system, which is leased to the Boston Elevated Railway Company, does not extend in this direction beyond Forest

* Paper read at National Convention on Municipal Ownership and Public Franchises, New York, Feb. 25, 1903.

† A limited power is vested also in the Railroad Commissioners to grant a location which is required as a connecting link between locations already granted to the same company in two other towns or cities, if the local authorities have failed to grant, or have refused to act upon, the locations applied for for such purpose.

Hills, a station about a mile nearer City Hall. The street railway service beyond Forest Hills throughout West Roxbury, including about 8 miles of lines, is conducted by an independent company known as the Old Colony Street Railway Company.

The inhabitants of Roslindale, although having the double facilities of steam railroad and street railway, believed themselves less favored than other portions of the outlying districts of Boston, because they were denied a 5-cent fare to the heart of the city. The lowest possible fare on the steam railroad is at the rate of 6 6-8 cents. By the street railways the fare is 10 cents, as the passengers have to travel over both the Old Colony and the Boston Elevated-West End system in going to and from the heart of the city. No system of free transfer between the two lines exists.

The effort was made first to secure from the steam road a 5-cent fare to Roslindale, but the Railroad Commissioners refused to recommend the reduction. An application was made to the Boston Elevated Railway Company to extend its surface lines to Roslindale and beyond. This was found to be impossible, because the only available avenue was occupied by the tracks of the Old Colony Street Railway. Application was then made to the Board of Aldermen to have locations of the Old Colony System revoked in order that the same locations might be granted to the West End Company.

The demand for a 5-cent fare, which originated with the residents of Roslindale, had meanwhile spread generally to the inhabitants of the whole of West Roxbury, which extends to a point 10 miles from City Hall. The request for the revocation of the location enjoyed by the Old Colony Street Railway Company, supported by the residents of a large section of the city, became so formidable that the two street railway companies recognized the necessity of yielding to the people's demands. An act was accordingly passed at the 1902 session of the Legislature, by which the Boston Elevated-West End system is authorized to lease all of the line of the Old Colony Company within the limits of the city of Boston. The lease has just been submitted to the Railroad Commissioners for their approval. Thus the people of the whole of West Roxbury will secure the 5-cent fare and through lines to the heart of the city.

PROHIBITION OF STOCK WATERING

The aggregate capital stock of the Massachusetts surface street railways on Sept. 30, 1902, was $47,653,028; the aggregate indebtedness, funded and unfunded, was $55,894,052.67; their aggregate net capital investment was $100,766,796.93; their aggregate net assets were $105,006,087.38; of which $24,120,358 consisted of real estate, machinery and other permanent property, and $20,754,384 of equipment. The cost of construction was $55,130,759. The average construction cost per mile of line, as charged in the accounts, excluding real estate, machinery and equipment, is $26,428.93. This low construction charge (including, as it does, second tracks and sidings) is accounted for by the fact that the locations granted, being revocable, are not treated as an asset in Massachusetts.

The cash capital actually invested in Massachusetts surface street railways is probably in excess of the sum of $100,766,797.93, which appears as the net capital investment; for while the stock of many companies has been, to a slight extent, watered, in spite of the statutory prohibitions, this watering has been more than offset by the large amount of stock issued and sold under the law at a premium, when issued to increase capital.

This substantial prevention of stock watering has been accomplished by means of the following provisions of law:

1. The original authorized capital must be fully paid in in cash at not less than par before any certificate of stock can be legally issued, before the company can be authorized to do business, before the issue of any bonds can be authorized and before any increase of stock can be made. Furthermore, until such payment, directors are made personally liable on all debts and contracts of the company. This provision secures the payment in cash substantially at par of the whole original authorized capital.

2. The issue of all bonds and of any increase of stock in excess of the original capital is limited to such amount as the Railroad Commissioners shall, after a public hearing, determine, will realize the sum which has been properly expended or will be reasonably required by the corporation for proper corporate purposes. No stock can be issued at less than par.

These provisions not only prohibit stock dividends in any form, but actually prevent them. Thus, the Massachusetts electric companies (which control the Old Colony Street Railway Company and the Boston & Northern Street Railway Company) in June, 1902, applied for an issue of $1,250,000 of stock of the former and $2,250,000 of stock of the latter. The Railroad Commissioners authorized an issue only of $948,700 of Old Colony stock and $1,797,300 of Boston & Northern stock, requiring the former to be sold at not less than $110 per share and the latter at not less than $130 per share.

In July, 1902, the Boston Elevated Railway (which, in this respect, is subject to the same provisions of law) applied to the Railroad Commissioners for leave to issue $5,000,000 additional stock to pay for construction, equipment and land damages. The Railroad Commissioners authorized the issue of only $3,300,000 of stock and required the stock to be sold at not less than $155 per share, that being the prevailing market price.

3. No lease, consolidation or sale of any street railway can be made without the approval by the Railroad Commissioners of the terms thereof.

Thus, in 1897, the stockholders and the directors of the West End Street Railway Company and of the Boston Elevated Railway Company voted that the West End Company should lease its system to the elevated for a period of ninety-nine years, on the basis of the payment as rental of 8 per cent on both the common and the preferred stock of the West End Company. The Railroad Commissioners, after a public hearing, refused to approve the lease as voted. The parties, following the suggestions of the Board, subsequently executed a lease by which the term was reduced to less than twenty-five years and the dividend on the West End common stock to 7 per cent. The average dividend which had been paid upon the common stock for nine years prior to the lease was 8.6 per cent; but the Railroad Commissioners refused to approve a rate higher than 7 per cent, because, in the opinion of the Board, the dividends paid by the West End Company prior to that time had exceeded its actual net earnings, making due allowance for depreciation.

THE FRANCHISE TAX

Street railway companies are required to pay, in addition to the ordinary local taxes on real estate and machinery assessable to all owners of property, a so-called franchise tax, which is assessed upon the aggregate market value of its capital stock, less the value of real estate and machinery locally taxed within the Commonwealth. The rate of this tax (which is the same as that assessed upon the franchise of other Massachusetts corporations not enjoying rights in the street) is now $16.18 per thousand. The amount collected on this tax is paid to the municipality in which the tracks of the street railway company are located. If the tracks extend into more than one city or town, the tax is divided among the several municipalities in proportion to the mileage of main track on the public highways in each municipality. The aggregate of such franchise taxes assessed in Massachusetts for the year 1901, including such taxes paid by Boston Elevated Railway Company, was $956,738.69, which is equal to about 1.6 per cent upon the outstanding capital stock of all of the companies, and about 4 per

cent upon their gross earnings from operation. The tax is small, but it is promptly paid. For instance, of the total of these taxes assessed for the year 1901 ($956,738.69) and payable Nov. 1, 1901, there remained unpaid, on Jan. 1, 1902, only $2,224.75.

Provision was made in 1898 for the payment of additional compensation for the use of the streets, by the act which declared that "all operating companies paying dividends in excess of 8 per cent shall pay to the State as franchise tax an amount equal to the excess paid stockholders in dividends over 8 per cent, provided, however, that no tax shall be payable if the aggregate dividends paid to the corporation since its organization do not equal 6 per cent upon its capital stock." No payments have as yet been made under this act.

The act of 1898 also provided for a so-called commutation tax; that is, a specific tax, varying in amount from 1 per cent to 3 per cent of gross earnings per mile, in commutation of the obligations previously existing to keep streets in repair and cleared from snow. Payments are regularly made under this act.

UNDERGROUND AND ELEVATED LINES

In addition to the surface lines, there are in Boston (1) about 1.7 miles of completed underground or subway lines, 1.4 miles are under construction, and provision has also been made for early construction of additional lines; (2) about 6½ miles of completed elevated lines.

All the underground and all the elevated lines are situated in Boston, and form a part of the Boston Elevated-West End Street Railway system. To these underground and elevated lines, exceptional provisions in regard to tenure and the payment of franchise compensation have been attached.

In order to afford proper transportation facilities in Boston it is necessary that most of the important street railway lines should reach the heart of the city. The streets available for railways there are few and narrow.

Prior to 1893 the congestion had become intolerable. Real estate values rendered the widening of streets or the construction of new ones, or the building of an elevated road in this region financially impossible. Besides, the people would not have permitted the disfigurement of that part of the city by the erection of an elevated railway. It was accordingly determined to build the subway. The West End Street Railway Company was given an opportunity to build and own the subway. It refused to do so, partly on the ground that, having but revocable rights in the surface line, the investment would not be prudent. The city was forced to build the subway itself. The act providing for its construction authorized leases to operating companies for a period not exceeding fifty years.

Soon after the passage of the act in 1894, the people realized that a lease of the subway for the full term of fifty years would seriously impair the control by the community of its local transportation system. Public agitation resulted in an amendatory act reducing the limit of any lease of the subway to twenty years. The first subway act provided for the compulsory removal of the surface tracks along the line of the subway on Tremont Street and Boylston Street, for a distance of about a mile, where the greatest congestion prevailed. It was clear that the West End Company would, in order to connect several of its surface lines and maintain possession of the field, be obliged to take a lease of rights in the subway.

In 1896, before the completion of the subway, the West End Company consented to take a lease of the subway for twenty years from its completion, at a rental equal to 4⅞ per cent of the cost of construction—a rental sufficient to pay interest and to provide a sinking fund which will pay for the subway in about thirty-seven years.

In 1897 the promoters of the Boston Elevated Railway Company, having bought an old and impracticable charter from the original owners, secured from the Massachusetts Legislature radical amendments thereto, which rendered the construction of an elevated line financially possible by allowing the elevated line to lease the West End system and use the subway, and also secure the surplus earnings of the surface lines.

The amended charter enabled the company to acquire, so far as the line should be built, within ten years from the date of the act, a substantially permanent franchise in many of the principal streets of a large part of the Boston Metropolitan district, authorized a lease of the West End Railway surface lines, together with the subway, provided for an extension of the subway to connect with the proposed elevated line to Cambridge, and for a tunnel under the harbor to connect with the East Boston surface lines. It contained also provisions protecting the company for a period of twenty-five years from the date of the act from a compulsory reduction of the fares below 5 cents or the imposition of any additional special franchise taxes.

If the locations thus granted to the Elevated Company were all built upon, the Elevated Company would have a substantially completed and independent street railway system, and Boston would necessarily lose, to a great extent, the control which it now enjoys over its transportation lines. But only that portion of the elevated road has been built—about 6½ miles—which it was necessary to construct in order to prevent the lapse of all charter rights. It is not probable that any more will be built except the extension to Cambridge, which the charter also makes obligatory, for heavy land damages render the cost of elevated lines in Boston so great that much additional construction is a financial impossibility.

The construction of the elevated railway was undertaken probably less with a view of promoting rapid transit than for the purpose of capitalizing the surplus earnings of the West End system and of securing, in connection with a long lease of the West End lines, a control of the transportation system of Boston and vicinity. This purpose was frustrated, however, in spite of the exceptional privileges granted to the Elevated Company, by the determined struggle of the people to retain control of the transportation system—a struggle in which they were supported by the Railroad Commissioners and aided by peculiar local conditions which soon made further legislation necessary.

The elevated trains pass for a distance of 1.7 miles through the subway. No elevated line could, by reason of heavy land damages, be built through the heart of the city. The two ends of the elevated road must be connected by some line through the heart of the city, and a subway is the only feasible method.

Before the elevated road was in operation it became evident that an additional subway through the heart of the city would be required, because the existing subway was insufficient to provide for the large and increasing traffic. Upon the opening of the elevated lines and their use of the subway, it was found that the existing subway was not only insufficient, but by reason of numerous curves and because of other features, was not well adapted for use by elevated trains.

In 1900 the construction of an additional subway was petitioned for, and the Boston Elevated Railway Company undertook to secure the right to build that subway and also the Cambridge Street subway at its own expense, and to own them practically in perpetuity, and also to secure an extension of the lease of the existing subway for another term of twenty years—that is, until 1937. This effort of the Elevated Railway Company was vigorously opposed by the people as leading to a surrender by the people of their control of transportation in the Metropolitan district.

After a contest conducted throughout the Legislatures of 1900, 1901 and 1902, the railway company was obliged to yield substantially every point to the demands of the people, and finally assented to the passage of an act which provided for construction of one or more subways by the city, to be leased to the Elevated Railway Company for a term not exceeding

twenty-five years, at a rental of 4½ per cent upon its cost. In this long struggle the Public Franchise League and the Associated Board of Trade took the leading part, on behalf of the people.

Boston has thus, it is believed, established conclusively the policy of retaining control of its transportation system, and also of securing co-operation (although at present but a small one) for the use of its streets by railway corporations. Boston will own all the subways, which are the connecting links in both the elevated and surface systems through the heart of the city. Without these subways no practical elevated system is possible, and no surface system could be successfully operated. So long as Boston retains this ownership and the right to revoke surface locations, the city will control the transportation system and will have power to compel the corporations to pay what may seem from time to time adequate compensation for the use of the streets.

RECENT ATTACKS ON MUNICIPAL OWNERSHIP IN GREAT BRITAIN *

BY ROBERT DONALD

Two statements, frequently met with in discussions on municipal ownership, are intended to cause some alarm among those who take a superficial view. These are the rapid increase of local indebtedness and the steady rise in recent years of local taxation. "Municipal trading," as it is called, is held responsible for both. A misleading comparison is made between the national debt and local debts. Between 1875 and 1900 the national debt decreased £139,966,974, and in the same period the local indebtedness of England increased £201,000,000. This little comparison has been a fruitful cause of misconception. The national debt represents chiefly the cost of wars. Loans are still outstanding for the American War, for the Crimean War and for other wars for which there is absolutely nothing to show. There are few assets to set against the national debt. The assets of municipalities, on the other hand, outweigh their liabilities. The local debt is being paid back within an average period of thirty years, so that it disappears as fast as it is created, as we are just now passing through a period of exceptional activity in local government. Within recent years the whole system of local government in rural districts and in smaller towns has been reformed. Over 35 per cent of outstanding loans are borrowed for undertakings which are of a productive character, and are therefore profitable investments for the community. An increase of debt represented by such assets as water, gas, tramways and electricity undertakings need cause no alarm, and the financial security of municipalities is good, although in consequence of the South African War they have had to pay increased interest in recent years and have not always received all the money they asked, but in this respect English industrial concerns have found themselves in the same position.

TAXATION DECREASED BY MUNICIPAL INDUSTRIES

The developments which have taken place in the functions of local governments, in the advance of sanitation, the progress of education, and the reform in poor law administration are chiefly responsible for the rise in local taxation. At any rate, the extension of municipal ownership is not the cause. On the contrary, the public management of municipal services has been the means of frequently relieving the local rates. The Manchester City Council, for instance, last year had surplus profits amounting to £85,000. During the last five years the surplus profits from its markets, gas, electricity and tramway undertakings used in aid of local taxation amounted to £442,120. In the same period it lowered the charges for water. These surplus profits remain after interest on capital has been paid and payments set aside for a redemption fund. The surplus profits from gas, markets, electric lighting and water undertakings of Bolton during the last five years were £200,465, and Bolton, which is one of the cities which has carried municipalization farthest, having municipal water, gas, electricity works, street railways, slaughter houses, cold stores and ice manufactories, has correspondingly a lower rate in local taxation, although it supports six free libraries, two museums, and art gallery, a technical and engineering school, baths, including Turkish baths, hospitals, etc. The population is about 100,000.

One of the dangers seen in municipal progress is said to be in the large increase of employees it involves. These employees, however, have various interests and are never likely to act as a unit. Their influence in local elections is not yet great, as they do not all live within the town in which they work. Should they become extravagant in their demands, or otherwise to exploit the governing authority, there would be a reaction from which they would be the first to suffer.

MUNICIPAL ACTIVITY

The following table shows the comparative growth of municipal and company undertakings:

	Municipalities †			Companies		
	No.	Capital Expended £	Mileage	No.	Capital Expended £	Mileage
1882-3....	28	2,227,192	170½	113	7,523,635	501
1888-9....	29	2,959,633	243¼	125	10,704,958	706¼
1892-3....	35	3,105,636	274¼	118	10,998,516	686½
1896-7....	42	4,459,488	367¾	117	10,405,622	663½
1897-8....	47	6,116,687	450	116	10,376,282	614
1898-9....	61	8,134,530	519½	108	10,468,692	602½
1899-1900.	70	10,203,604	584¾	107	11,532,284	592¼
1900-1....	99	14,057,664	689½	114	12,741,359	616

While public bodies, at the end of that year (March, 1901), operated only 27 per cent of the total undertakings, they earned 43 per cent of the aggregate net revenue and carried 46 per cent of the total number of passengers conveyed. Since 1901 the greatest development in municipal tramways has taken place, while many of the companies figuring in the above returns have been expropriated.

Almost all the large cities not only own but operate their own tramways. The London County Council is now operating 72½ miles of lines; it is building, or has prepared plans for constructing, over 100 miles of lines; it owns and leases 42 miles north of the Thames. Glasgow municipality owns and operates 103½ miles within the city and in the suburbs. Liverpool has 90 miles. Manchester is building a system to the same extent. Bradford, Leeds, Huddersfield, Sheffield, Newcastle, Dundee, Aberdeen and others now own and operate municipal tramways. Bristol, where a company operates; Edinburgh, where the lines are owned by the city but operated by a company, and Birmingham, where the time for municipalization and workings has only just arrived, are the principal exceptions. In England and Scotland, therefore, companies are, with these exceptions, confined to the smaller towns, and even many of these, such as Dover (population of 41,782), Ayr (population 28,624), Wallasey (population 53,580) and Yarmouth (population 51,250) have successful municipal undertakings.

PRIVATE UNDERTAKINGS SUCCESSFUL

The following table shows that company undertakings have yielded a fair return. Good dividends have been paid whether the municipality constructed the lines as in Manchester, Glasgow and Birmingham, or whether the companies have been

* Abstract of paper read at the National Convention on Municipal Ownership and Public Franchises, New York, Feb. 25, 1903.

† Those owned by municipalities; some are operated by private companies.

allowed the free use of the streets during the currency of their franchise, as in London and other cities. The Dundee Tramways Company was paying 12½ per cent when it was acquired, the Manchester Company 10 per cent, the Leicester company 5 per cent, the Glasgow company 10 per cent, the London company 10 per cent. There is no doubt that, even with horse traction, under the act of 1870, there was scope for enterprising companies to pay a dividend:

	Ratio Working Expense and Receipts Per Cent	Net Revenue Per Mile £	Return on Capital Expenditure Per Cent
1877-8	75	858	5½
1878-9	83	601	4
1879-80	82	624	4
1884-5	75	786	5¼
1889-90	74	856	5¾
1890-1	76	829	5½
1894-5	77	870	5¾
1898-9	75	1,073	6½
1900-1	76	1,100	5¼

DELAY IN ADOPTING ELECTRIC TRACTION

It is frequently stated that the Tramways Act of 1870 not only delayed the introduction of electric traction, but is also responsible for the backward state of the electrical engineering industry in this country. It is pointed out that much of the electric plant now used in England is of American manufacture, and the opponents of municipal ownership blame municipalities for thus injuring British manufacturing industries. These statements, as a matter of fact, are entirely beside the mark. The backward state of electrical engineering in England—the fact that electrical manufacturers were not ready to supply the home market—has nothing to do with municipal ownership. American manufacturers are supplying machinery in all branches of British industry. Every shoe manufactory has to rely on American machinery. The postoffice goes to Chicago for its telephone instruments. The Morgan-Gardiner Company, of the same city, are now equipping hundreds of mines in England with electrical coal cutting machinery. American labor-saving machinery and machine tools are everywhere. They are all of American invention as well as of American manufacture.

When the boom in electric traction came along, the American manufacturers were ready to supply the market; the British manufacturers were not. It was just the same when, a few years ago, American manufacturers anticipated the great boom in cycles and flooded the English market with machines. It did not require great perspicacity to perceive, eight or nine years ago, that in a very short time street railways in British cities would be electrified, whether the municipalities exercised their option to take control or whether the company system continued. The electrical manufacturing engineers did not rise to the occasion. They were not ready to supply the demand. Consequently the first orders for electrical plant had to be sent to America and Germany, and the British manufacturers are still unequal to supply all existing demands.

While tramway legislation is not responsible for the backward state of English engineering enterprise, there is no doubt that it did somewhat retard the introduction of electric traction.

FARES ON AMERICAN AND BRITISH TRAMWAYS

Many comparisons are made between the system of fares on American and British street railways. The American system has been adopted on the Central London Electric Underground Railway, where a uniform 4-cent fare is charged. This line is chiefly used for long-distance traffic. The system which is preferred in England is that of cheap fares for short distances. It will be found, I think, that while America gives many examples of long distances at cheap fares the profit of the street railway companies comes chiefly from the short-distance passenger. For one person who wants to travel a long distance ten want to travel short distances. The long-distance journeys are only performed by people going to and coming from town. Experience has proved that what is most needed in British towns is a low fare for short distances. The average fare in Glasgow is less than 2 cents. The majority of the people travel short distances for 1 cent. The same is the case with the London County Council's Municipal Tramways. Again, on the Metropolitan Underground Railway in London, which has a total distance of 64 miles, while the fares vary from 2 cents to $1.80, the average fare is less than 4 cents—again demonstrating clearly that low fares for short distances suit the English public. It will not be possible to get uniform fares in English towns until that fare is reduced to the minimum coin usually current, viz., ½d., or 1 cent. The prospect is not impossible, as, with the economies which will follow electric traction, the average fare, which is now in a number of cities ¾d., or 1½ cents, may before long be reduced to a universal ½d.

GLASGOW STREET RAILWAYS

The best example of successful operation is to be found in Glasgow. Under the municipality the passengers carried on the street railways have increased in seven years from 57,000,000 to 163,500,000. The revenue from the cars, notwithstanding the great reduction in fares, has increased from 10.26d. to 11.90d. per car-mile. So great, however, were the profits of the undertaking that the corporation have been able to reconstruct the whole of the permanent way out of revenue. It has also set aside large sums for depreciation, and accomplished the feat of keeping the track in perfect condition and of writing down the whole of the horse equipment out of existence—all from the profits of seven years. Early last year, therefore, the Glasgow Corporation were able to start its electric traction system unburdened by any capital expenditure for the old horse car service. Besides laying aside ample reserve funds, the Corporation pays a mileage rate to the city funds, amounting last year to £12,500, on the same basis as the former company did. The capital of the tramways is borrowed for thirty-one years. Two and a half per cent is set aside as a sinking fund and invested at 3 per cent, which will wipe out the loan in that period. New loans incurred are treated in the same way. It is the custom of municipal undertakings—well illustrated in the case of Glasgow—to keep down the capital account, and to draw largely from their revenues for renewals, etc.

IMPROVEMENTS IN SALT LAKE CITY

The Consolidated Railway & Power Company, of Salt Lake City, has laid a considerable amount of 72-lb. Shanghai rail in the business district of the city during the last year. This rail is laid in paved streets by bringing the head of the block close up against the head of the rail on the outside of the track and leaving a space of about 1½ ins. between the rail and the paving on the inside of the track. This construction has proved very satisfactory, and will be used as standard in future city construction. In dirt streets a 60-lb. T-rail is the standard.

The company is now operating a daily service of about sixty cars, and expects to add five or six more cars during the summer. Power is being purchased from the Union Light & Power Company, which has three water-power plants, one at Ogden and two in the Cottonwood Cañon. A fourth plant is being installed at Bear River, and the company is also building a steam plant of from 2000 hp to 3000 hp for reserve purposes in Salt Lake City on the River Jordan. From 1500 hp to 2000 hp is being purchased from this company by the Consolidated Railway & Power Company.

The Consolidated Railway & Power Company has, however, under consideration the construction of a steam plant of its own for future use, to be built in Salt Lake City.

EUROPEAN AND AMERICAN METHODS AND RESULTS COMPARED *

BY ROBERT P. PORTER

Whatever selfish interests first promoted the campaign against municipal trading in Great Britain, the movement is rapidly gaining ground and the attitude of the municipal officials throughout England has undergone a decided change. At first all criticism was treated with singular contempt. We were told it was the work of "disappointed company promoters," "a conspiracy of the Electric Combine," and, finally, the "machinations of the agents of American trusts." The British public is not easily frightened, and with accumulating municipal indebtedness and increasing local taxation the plain every-day ratepayer who has no axe to grind is beginning to ask for an accounting. In response, elaborate tabulated statements and statistical exhibits have been prepared and sent broadcast, some of which are marvels of municipal accounting, and from now on it may fairly be assumed that both municipal trading and municipal socialism in Great Britain have been compelled to assume the defensive. Property owners' and ratepayers' associations are forming all over England, and the United Property Owners' and Ratepayers' Association of Great Britain is assuming national importance. The Industrial Freedom League, an association formed "to free private enterprise from undue interference and from rate-aided competition," is also gaining ground in all parts of the Kingdom, and must continue to increase its influence, as the ratepayers realize the gravity of the abuses creeping into administration of local affairs.

Besides the numerous industries at present being carried on by British municipalities, we find among the powers applied for the manufacture of steam engines, dynamos, gas and electric fittings, and paving materials, cold air storage, ice manufacture, milk supply, concert rooms, shop, saloon and refreshment rooms, hotels, cycle tracks, etc. Tramcar factories have been established, and even a brass foundry to make fittings. Municipal telephones are being undertaken, and a system of universal fire insurance is being discussed. Municipal banks and the issue of municipal bank notes, municipal pawnbroking, municipal bakeries, and even municipal public-houses, have all been seriously suggested. Municipal collieries have been under discussion in the north of England, and the Bradford Corporation has actually proposed to supply coal for retail consumption. To the commonplace duties connected with public health, building regulation, streets, policing, protection from fire, care of parks, we must add all these more intricate businesses.

RAPID INCREASE OF LOCAL DEBT

It is impossible to watch the present mad rush of British municipalities into all sorts of speculative industries without being reminded of the early experiences of some American States which ended in repudiation. Perhaps the most striking fact which the last annual report of the British Local Government Board (1901-2) brings out is the extraordinary rapidity with which the internal debt of the country is increasing. Last year sanction was given to loans amounting in the aggregate to no less than $144,677,465, and the average amount added in each of the last three years has been only just short of $125,000,000. Never before has there been any approach to these figures. In 1891 the sum was $37,021,495, while the average for some years previously had been about $25,000,000 annually. If we go further back, we find that in 1874-75 the entire outstanding debt of British local bodies was just short of $465,000,000, while in 1899-1900 (the latest year for which exact figures are available) the amount was nearly $1,470,000,000, and at the present time it may be roughly reckoned as $1,650,000,000. In 1875 the local debt was about $20 per head of the population. It is now over $50.

During part of this period, between 1880 and 1890, municipal debt in the United States declined from $13.64 to $11.48, and county debts from $2.47 to $2.27 per head of the population. The returns for 1902, so far received by the Census Office, indicate a slight increase per capita of debt between 1890 and 1902, but a decrease when compared with 1880. It will be noted that local indebtedness in the United States is relatively much less per capita than in England. As the figures for the 137 cities, so far tabulated, in 1902 show a decrease from the per capita figure of 1880, the total debt per head of population in the United States in 1902 will probably fall far short of the English figure of 1875.

INDUSTRIES A BURDEN UPON THE RATES

The excuse offered for the enormous increase of local debt in England is that a considerable part of it has been contracted for productive industries, and these estimates range from 35 per cent to 50 per cent. But the profits from many of these concerns, under municipal management, are very small indeed. The only reliable estimate on these profits may be found in a paper which Sir Henry Fowler read as president of the Royal Statistical Society, and showed that on a borrowed capital of $416,895,000, with an average annual income of $44,490,000, upon which only the sum of $405,835 had been set apart for depreciation, or about one-eighth of 1 per cent, there was an average net profit for the five years ended March, 1898, of $1,851,705, or about one-half of 1 per cent on the outstanding debt which the Local Government Board then put at $359,415,000.

It must be very tiresome for the British ratepayer to hear so much about the "profits" of municipal enterprise, when throughout the kingdom year after year surely and steadily the rates are increasing. In England and Wales in 1875 the average amount of rates raised by local authorities was 3s. 3d. in the pounds of valuation, or about $4 per head of population. The rateable value was then $578,230,000. In 1900 it was 4s. 11d. in the pound of valuation, or per head of population about $6.38, while the rateable value had increased to $878,110,000. The sum total raised from rates was in 1875 $95,990,000, but in 1900 it had risen to $203,670,000, being an increase of $107,675,000, or 112 per cent. But whereas in 1875 the grants from imperial taxation were only $8,405,000, in 1900 they amounted to $61,265,000, being an increase of $52,860,000, or 628 per cent. Moreover, while the rateable value of the municipal boroughs was in 1875 $128,565,000, according to the last return in 1897 it had increased to $256,090,000. A table prepared by a competent actuarial correspondent for the "London Times" shows for thirty-five of the principal boroughs of England (1) the total loans raised for remunerative works; (2) the municipal rates actually levied per pound of accessible value; (3) increase or decrease in rates per cent. The figures were given for the years 1886-87 and 1900-01, covering a period of active trading. In three cases only out of the thirty-five have the rates been reduced. It is not contended that absolute deductions can be drawn from these figures, but it is claimed in England by the opponents of municipal trading that the onus of establishing a case for commercial enterprise on the part of municipalities rests with its advocates, and that so far they have failed to do it.

DEPRECIATION NOT PROVIDED FOR

Then, again, the important question of depreciation is left out of account by most of the trading municipalities. They provide for the sinking fund on their debt, but renewals and depreciation of plant are largely neglected, so that it is more than probable that by the time the debts are paid off many of the undertakings will have to be "scrapped."

* Abstract of paper presented at the National Convention on Municipal Ownership and Public Franchises, New York, Feb. 25.

In order to make clear how little provision is made for depreciation beyond the sinking funds, the "Times" has had the following table prepared, showing for the undermentioned municipalities (1) the total capital expenditure on remunerative works; (2) the average net profit or deficit for the three years to 1900-01, after meeting the service of the debt, and (3) the annual average provision for depreciation during ten years:

Corporation	Total Capital Expenditure on Work	Net Average Profit or Deficit After Meeting Service of Debt	Average Annua Provision for Depreciation During Ten Years
	£	£	£
Barrow	453,042	+ 8,798	None
Birkenhead	1,185,786	+ 17,483	15,218
Birmingham	9,315,501	+ 11,243	None
Blackburn	2,087,081	+ 3,947	None
Bolton	2,263,782	+ 35,680	12,597
Bradford	4,965,731	+ 15,332	6,969
Brighton	1,158,355	+ 11,763	4,497 in 1899
Bristol	332,573	— 627	None
Croydon	522,438	+ 6,466	None
Derby	739,612	+ 8,171	None
Halifax	1,837,469	+ 24,053	None
Huddersfield	2,311,554	+ 11,099	4,425
Hull	1,118,140	+ 12,860	340
Leeds	5,070,623	+ 44,546	None
Leicester	2,124,553	+ 40,321	200
Liverpool	8,175,918	+ 117,584	None
Manchester	*15,290,037	— 108,353	None
Northampton	403,440	+ 3,706	None
Nottingham	2,530,588	+ 49,790	2,087
Oldham	1,986,861	+ 14,869	None
Portsmouth	292,390	+ 1,916	None
Rochdale	1,183,855	+ 5,276	None
St. Helens	701,075	+ 9,150	None
Salford	1,415,891	+ 26,041	None
Scarborough (1899-00)	261,887	+ 853	100
Sheffield	4,385,109	+ 21,465	9,384
Southampton	544,137	+ 3,313	None
Stockport	1,098,933	+ 10,054	None
Sunderland	344,656	+ 4,174	None
Swansea	758,563	— 8,906	None
Wolverhampton	490,313	+ 8,782	123
York	129,327	+ 995	None

* Including the loan to the ship canal, which cost upwards of £200,000 per annum in interest, etc.

In commenting on the above table the writer says:

It will be observed that in many cases a provision of 1 per cent for depreciation would more than wipe out the profits and leave substantial deficits. The worst of any figures of this kind is that all manner of important facts and financial juggling may be concealed behind them, and one has great difficulty in getting at the truth.

This is what may be called the "depreciation test," and unless a municipality can meet it fairly and squarely as set forth in the above table as well as the "debt" and "taxation" test, it is of little avail to try and figure out the so-called "profits" of municipal trading.

PRICE OF SECURITIES REDUCED

In an address to the Glasgow Chamber of Commerce Arthur Kay referred to the change in the taste of the investor for municipal loans:

In 1896 Glasgow Irredeemable 3½ per cents stood at 139½; they are now 118. Glasgow 2½ per cents redcemable 1925—40 were 103¾ in 1896; now they are at 86. How's that for the credulous investor who believes in the "unlimited security" put forward by the borrowing Corporation of Glasgow?

Mr. Davies also touches on this phase of the question:

The London County Council, which has the best, because the least burdened of all the municipal securities, has just placed a 3 per cent loan at less than 98½. Another large town recently made an issue of two millions of 3 per cent stock at the price of 94. The public only subscribed for about 10 per cent of the amount offered. There are other indications that several corporations have already felt the pinch of impaired credit. Some of the expedients to which they have been driven are at best questionable.

COMPARISONS SOMETIMES DANGEROUS

Comparisons, if not always odious, are generally dangerous, and when one attempts to make them between two countries like Great Britain and the United States there is always the risk of having all your labor wasted in the general conclusion that perhaps after all English methods suit England best and American methods suit America best. The form of municipal government differs widely in the several geographical divisions of our own country, and this difference is even more accentuated when we come to compare the fundamental laws which govern British municipalities with the State laws under which our own cities are administered. At the best, then, we can only hope to make a few carefully selected comparisons under like conditions that would be of the slightest value. The attempt to do this even might prove disastrous, for there has already been so much quarrelling over details of municipal trading that we are beginning to lose sight of the important principles involved. In short, it will be almost impossible to take up and compare the relative merits of individual enterprises in English cities with those of American cities. Such, of course, would make my paper, in the first place, unreadable; it would start a discussion on details instead of broad principles, and would not aid the convention in reaching conclusions that will be helpful to those who are called upon to vote on the question.

MUNICIPAL STREET RAILWAYS

It is further assumed that the American municipal trader has hardly traveled far enough along the road of municipal socialism to seriously discuss the taking over of the liquor traffic, the bakeries, the supply of milk, the pawnbroking business and the issue of municipal bank notes. Perhaps for the present purposes it may be wise to confine ourselves to the productive industries, the management and control of which lies at the basis of the controversy now so actively waged in England, namely, tramways, gas, electric lighting, telephones and the housing of the working classes. I have purposely omitted the water supply from the above list, because it is so generally regarded in the United States as a legitimate function of municipal administration, and I have repeatedly suggested to my friends on the London County Council the wisdom of purchasing and managing the water supply of the metropolis before they undertake the hundred and one other things of minor importance which can, with proper regulations, be done so much better by private companies.

As by far the largest municipal development in Great Britain just now is in connection with the tramways, it has been deemed advisable to treat this branch of the subject as fully as possible. The last available Board of Trade report on tramways for the year ended March, 1901, show that there were ninety-nine municipal street railways in the country, with a mileage of 700 miles; the capital expenditure upon these was over $70,000,000. The companies had 114 undertakings, with a mileage of 616 miles and a capital expenditure of over $52,500,000. Long before Great Britain is adequately supplied with electrical street railways, the capital account will have increased to $500,000,000.

The change from horse to electric power by the municipalities which have taken over their tramway system has not been carried out with anything like rapidity. Even the most progressive of municipalities and those most enamored of trading projects, dilly-dallied over the problem of conversion for a quite unnecessary period; and in the hands of local authorities the progress of electric traction has been extremely slow. Although their new-found sphere of municipal trading was very attractive, they were at that time extremely cautious about embarking public money in speculative enterprises. When the bold few made the plunge the others followed gradually, according to the fashion of municipalities. There was no inclination to run even the most elementary of risks, and so far as interurban electric lines are concerned, the part which the local authorities have played for many years has been practically nil.

The parochial spirit of municipalities has been evinced in

their dealings with each other, perhaps more strongly than in their relations with companies. Next door neighbors are not always the best friends; and municipalities are in this respect very human. The natural pride of each of them in their municipal achievements has an obverse in the natural jealousy of the achievements of others. There is no necessity to dwell on this well-known aspect of municipal life, but it must, at least, be referred to in order to explain why municipalities have not done much to develop isolated tramway systems into interurban networks. It will be particularly interesting to me to hear how those of my own countrymen who favor municipal ownership regard this sort of playing at modern locomotion. How, with such restrictions as these and such local interference, we could have established the great interurban street railway systems centering in Boston, Chicago, Detroit, Pittsburg and Cleveland, to say nothing of New York and a dozen other cities which will at once suggest themselves, I do not know. Could anything but private enterprise have linked up Minneapolis or St. Paul? I think this phase of municipal ownership deserves special attention, for herein it shows one of its greatest weaknesses.

THE MAINTENANCE OF ELECTRIC CAR BODIES

The regular monthly meeting of the New England Street Railway Club was held in Wesleyan Hall, 36 Bromfield Street, Boston, on Thursday evening, Feb. 26, 1903, with President Farrington in the chair. The subject of the evening was "The Maintenance of Electric Car Bodies," and the principal speaker was Harry Libby, superintendent of car shops of the Boston Elevated Railway Company.

Mr. Libby began by stating that he would endeavor not to confine himself entirely to the woes which confront the car painter, and said that painting bears the same relation to car maintenance as does clothing to the human body. In all cases the painter and builder should co-operate, as the final success and lasting qualities of such work depend very largely upon the proper application of suitable paint and varnish. All parts should be thoroughly coated with lead and oil, as almost all decay of woodwork and rust of metal work can be traced to neglect in painting, and where rusting once starts, it is well nigh impossible to prevent the action from continuing. Occasional renewals of the coating produce a result both economical and pleasing to the eye.

Much has been written and said in regard to the preservation of the rolling stock of steam roads, but the trials of a master painter in charge of a street railway car shop are usually far in excess of those found in steam railroad practice. Most steam road shops have but one body color to handle, which is a far simpler proposition than the electric road, with its different colored routes and numerous pigments required. In the street railway shop the work is at the mercy of the color grinders, but they are greatly needed in these days of push and hustle.

Uniformity of shade for cars of the same route is very important. Even the best colors may be injured by careless handling after selection, and durability and adaptability are points which demand careful consideration. The master painter should be economical and yet at the same time make plenty of careful tests and determine the strength, purity and quality of his materials with as much exactness as possible. The time has passed when a car can be tied up in the shops long enough to give it a painting as thorough and finished as would be given to a carriage.

The object of the painting department is not to produce display or embellishment, for very high-class decorative painting is practically wasted as far as the appreciation of the passengers is concerned. Protection and durability of the rolling stock should always be kept in mind as the prime objects to be sought. Cleanliness and wholesome appearance at minimum cost are also requisites of importance. Cars should not be left long in the shops on a busy road. Elasticity is also highly desirable in paint and varnish, and it is folly to incorporate any elements which produce a hard, brittle surface. Successive repaintings are costly, and it is a waste of time to apply repeated coats in the endeavor to get a coating like that on a private carriage. In preparing to paint the gloss on the first coat should be removed, but it is poor practice to remove 50 per cent of the most valuable material on the car in order to get a smooth surface. Quick drying paint and varnish have no place in a street railway shop. The continuous neat appearance and lasting qualities of the cars more than justify the use of the best paints and pigments which can be obtained.

No rust should be allowed to accumulate, and the woodwork should not be wet or damp. The priming should be mixed with liberal proportions of pure linseed oil, and all holes should then be puttied to more than the level of the work, and then later the work is sandpapered. The knifing coat should be composed of keg lead, dry lead, japan and turpentine. It should be then allowed to dry and set, and the work then should be gone over with a putty knife, then with fine sandpaper, and after that with two coats of color. Most body colors will dry less quickly and become more elastic with the addition of finishing varnish. The car should finally be ornamented with two coats of finishing body varnish, with forty-eight hours allowed between each coat. The effect of touching up cars once in twelve months is very satisfactory. On a large city system like the Boston Elevated the wear and tear of the car bodies is simply enormous, especially in weather abounding in snow and slush. The effect of salt water is bad also. With proper painting as described the car's life can be greatly lengthened. About two weeks are required to finish a car as outlined before.

Street car roofs are usually covered with canvas instead of tin, and if properly cared for will last as long as the car itself. Mr. Libby stated that it was his custom to paint the top side of the roof boards with a coating of white lead and whiting in equal proportions mixed with linseed oil.

In the discussion which followed Mr. Libby's paper, E. E. Potter, of New Bedford, stated that his road purchases cars from the builders, expecting a good painting job throughout, but that after the cars arrive there is often a great deal of trouble with them during the first year. Cars that do not reach the paint shop inside of six months after arrival often present a pitted appearance. Two shop experiences seem to be about right before the car gets down to steady conditions. His custom is to paint every car at least once in twelve months, and he further stated that to his mind the proper handling of cars to be cleaned in car houses was very important.

President Farrington said that the old method of scouring cars in preparation for painting was now a thing of the past. When asked about the washing of cars Mr. Libby stated that his road makes an attempt to use an alkali in a very limited manner. The "sinker" or under panels are sometimes cleaned with soap. Large crystalline splashes of salt water, which are found on the sides of the cars at times require a good, vigorous cleaning. The Boston Elevated shops use a very weak soap, and have tried many kinds, Farr's oil soap and the Columbia Cleaning Compound being tolerably successful. In finishing up a car Mr. Libby said that he uses altogether a finishing varnish with no rubbing whatever.

Mr. Ogden, of the Concord, Maynard & Hudson road, then spoke on the care of car bodies. He advocated the application of a good coat of finishing varnish to a flattened surface. A great deal depends on the painters. If they use turpentine it does not give the glossy finish required. He advised getting down to the first coat after two or three years and then starting over again, putting on a coat of rubbing varnish and after-

wards a coat of finishing varnish. He expressed himself as better satisfied with day work, saying that one can tell what one is getting if the work is carefully followed up from day to day. He had had six cars painted on the contract plan, and after they had been out four or five days it was hard to tell that they had ever been painted. In washing cars the men are provided with soap powder, and they almost always use too much. Frequent washing of cars with cold water and a good bristle brush is as effective as anything. Cars should be gone over at least once a season. About every superintendent has his pet varnish. His own success had been greatest with Babcock Railway Finishing Varnish, although he liked the Murphy varnishes also quite well. City cars have much less chance to dry than those on smaller roads. He advocated two weeks or three weeks drying if possible.

Mr. Potter asked what success the Elevated had had with the use of ammonia instead of torches and knives, when it became necessary to paint old box cars. Mr. Libby replied that his road had tried about all the paint and varnish removers now on the market, and that he knew of nothing better than the torch for the work. Mr. Libby further said that his cars were extensively rubbed down with dry curled hair, and that the idea of providing a high mirror-like surface for painting had long been discarded. Only his window sashes are rubbed with pumice. Only one coat of paint is usually applied to open cars, and the actual time to paint, revarnish and touch up a car in the paint shop is but seven or eight days. Usually sashes are cherry, and cherry is a bad wood to hold varnish, and gives much trouble. The only preventive to keep water out of a car which he uses is a good oil putty and glass tightly jammed down, in with its moulding. Seats are cleaned with soap and running water, and scrubbed by hand, pumice being used also.

Paul Winsor, of the Boston Elevated, then spoke of the difficulties met in trying to keep the elevated cars clean. Inasmuch as the cars are in the subway during about half the time they are out on the road, and are subjected to extraordinary wear and tear, dirt and brake-shoe dust, the management had found it absolutely impossible to attempt to clean the outsides of the cars, except at prohibitive expense, and it had been found cheaper to spend $25 when the car goes into the paint shop to be touched up than to try to clean it otherwise.

Mr. Libby then stated that he always advocated opaque colors, and not of the richest shades, as the expense and trouble necessary to retouch a transparent color was much greater than with the opaque.

President Farrington said that he had seen men spend an entire hour trying to match lakes and carmines in cars. Although such colors look well on the streets they are very troublesome in this respect.

Mr. Libby does not revarnish head linings.

Mr. McMillan, master painter of the Worcester Consolidated Street Railway Company, was then introduced. He said that if a new car can be taken six or eight months after arrival and given one coat of varnish in the paint shop, and then once a year another coat, it can be carried along for a great many years. He has used two coats of finishing varnish for fifteen or twenty years. On carriage work, rubbing varnish is, of course, used, but the service of a private carriage scarcely averages one hour a day against eighteen hours per day and eight months in the year of a street car. The finishing varnish used should have lasting qualities. He advised steering as clear of ammonia as one would of the small-pox. He satisfies the insurance people when using a torch to burn off varnish and paint by following it up with a blanket.

President Farrington then said that the Lynn & Boston road uses the torch in all their car work, and that the paint needs to be as dry as possible. He knew of little or nothing better than raw linseed oil with lead. Mr. Libby said that the brass and metal work of the elevated cars was taken out in order to facilitate getting around the various parts of the car, and to remove the bright, glittering marks which distracted the painter's attention.

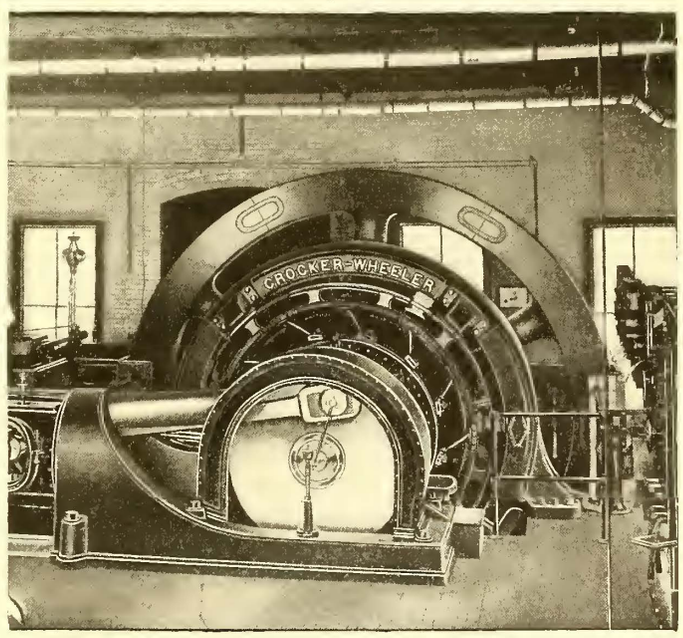
Mr. Henderson, of the Newton lines, then gave some personal reminiscences of the troubles he had had with unsatisfactory painters in the earlier days of the work. On one job he found that the man had used fish oil instead of linseed oil, with sorry looking results. He considered the new cars running between Auburndale and the Boston Subway to be models in appearance, and said that no part of the maintenance of cars appealed to him as strongly as did the painting. The directors of the Boston Suburban took great pride in the appearance of their cars. He had found success with the Atlas primer, and believed that the best quality in materials always paid.

In answer to a question whether anyone had used a gas and air blow-pipe in removing paint and varnish, instead of a gasolene torch, President Farrington and Mr. McMillan stated that it did not give as good a flame, was not as easy to handle, on account of its being at the end of a hose connection, and was more expensive in regard to cost of materials and time. One man with a gasolene torch could do better and quicker work, and great trouble and delay occurs if the small hole in the gas burner becomes plugged or stopped up.

A vote of thanks was then extended to Mr. Libby and the meeting adjourned.

CROCKER-WHEELER RAILWAY GENERATORS

The development and extension of electric railways has called for a special type of generator to meet the requirements of this service. The machine operates at fairly high voltage, and must give a steady, reliable supply of current under sudden



NEW RAILWAY GENERATOR

and varying fluctuations in load. It is of importance, therefore, that the machine be so designed as to accommodate the rapid changes in current output without altering the field to such an extent as to change the point of commutation. It is by this means that sparking is prevented and the machine will operate quietly without requiring shifting of the brushes with change of load.

The Crocker-Wheeler Company, which has for many years

maintained a reputation for building only the best in electrieal apparatus, has recently gone into the railway field, and during the past few months has shipped generators to the following roads among others: Washington&Canonsburg Railroad Company, Washington County, Pa., two 400-kw units; Lake Construction Company, Thornton, Pa., two 400-kw units; Steubenville Traction & Light Company, Steubenville, Ohio, one 250-kw units and one 400-kw units; Tennis Construction Company, Pennsylvania, two 300-kw units; Vandegrift Construction Company, Philadelphia, three 300-kw units and one 200-kw units; Erie Rapid Transit Railroad Company, Harbor Creek, Pa., one 200-kw units, and the Philadelphia & Lehigh Valley Traction Company, Quakertown, Pa., one 200-kw units.

The magnet frame of the Crocker-Wheeler generator is of an internally flanged section, which serves to increase the rigidity of the frame, protect the field eoils and gives a neatly rounded appearance to the outside. A feature of all these generators is the large air gap, which is claimed to be especially desirable for the reason that it tends to reduce field distortion with rapid changes in armature current, and will permit a slight displacing of position of the armature without bringing it too close to the poles on one side to cause undue magnetie attraction. In the large generators, particularly where the engine foundations are apt to settle and throw the shaft out of alignment, a slight displacing of a narrow air gap will cause such a strong magnetic pull as greatly to increase the unbalanced condition.

With the field coils which the company has recently put on machines of 200 kw and over, a division of the shunt field into two or possibly three units is secured, each separately taped and varnished. This affords good protection to the separate sections, and wooden blocking between each assists in the ventilation.

The brush rigging in these machines is simple and accomplishes its purpose without requiring more than occasional attention. The current is carried from brush to the rocker ring by means of four sets of copper leaves, which relieve the helical spring from any such duty, and, therefore, prevents its overheating and loss of temper.

These generators are built in sizes from 150 kw to 1000 kw.

THREE TYPES OF LONG CARS

The accompanying engravings show three types of long cars recently built by the St. Louis Car Company for different sections of the eountry. They illustrate the modern tendency toward a straight-sided car of dimensions approximating those of steam railroad cars but possessing minor differenees depending upon the use to whieh they are to be put or the faney of the eustomer.

Fig. 1 shows a double-truek car, of whieh five have reeently been built for the Los Angeles Traetion Company. The main

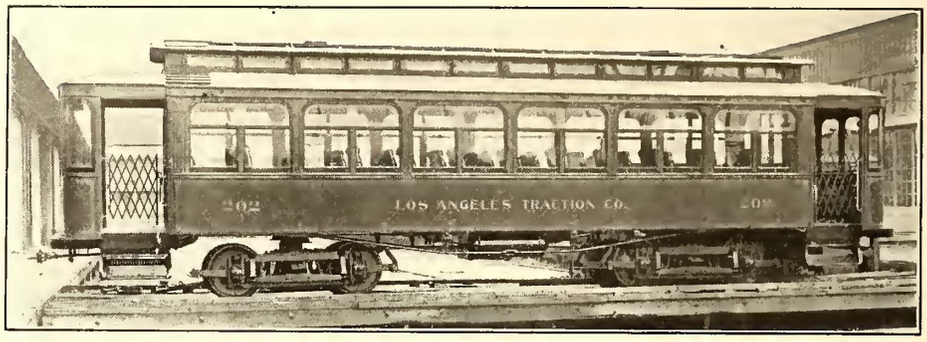


FIG. 1.—DOUBLE-TRUCK CAR FOR LOS ANGELES

dimensions of this car are as follows: Length over body, 34 ft.; length over all, 45 ft.; extreme width, 8 ft. 10 ins.; height of car body, 9 ft. 4 ins. The ear is one of the handsomest interurban cars ever built. The windows are of especial design with double sash and are plate-glass throughout. The interior finish is of Tobasco mahogany, finished in handsome inlaid work.

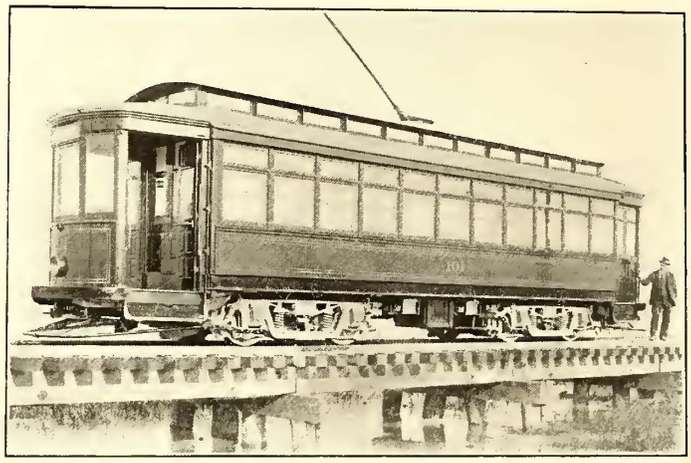


FIG. 2.—SEMI-CONVERTIBLE CAR FOR KANSAS CITY

The car is fitted with twenty-six seats with extra high roll-top backs upholstered in green plush and is mounted on Brill-27 trucks.

The second engraving shows a ear recently built for the Metropolitan Street Railway Company, of Kansas City, and is of the semi-convertible type. The main dimensions of this car are: Length of body, 30 ft. 7 ins.; length over all, 42 ft. 1 in.; width over belt rails, 8 ft. 6 ins.; height of ear body, 9 ft. 8 ins. The interior finish of this car is in white oak, and it is equipped with twenty-two walk-over seats. Twenty-five cars of this type have recently been shipped to Kansas City.

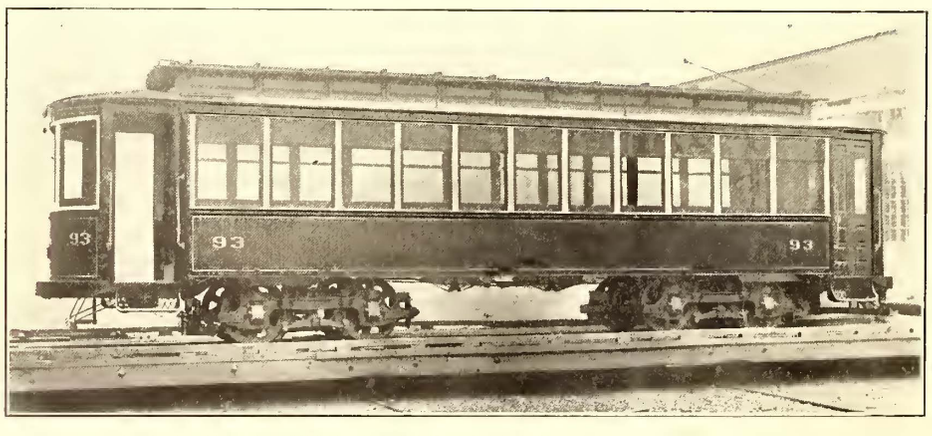


FIG. 3.—MASSACHUSETTS ELECTRIC SEMI-CONVERTIBLE TYPE

Fig. 3 shows a car not greatly differing in general construction from that just described, but of different dimensions and finish. It is one of fifty-two cars recently built for the Massachusetts Electrie Companies, of Boston. This car has a body length of 30 ft. and a length over bumpers of 40 ft. 4 ins. The interior finish is in eherry, and the car is equipped with twenty cross-seats upholstered in plush. The car, as shown, is mounted on St. Louis Car Company's No. 37 trueks.

COMBINATION CARS FOR INTERURBAN SERVICE

These cars were made by the John Stephenson Company, at Elizabeth, N. J., for the Punxsutawney Passenger Street Railway Company, and give a good example of the standard interurban cars turned out by these manufacturers. The type shown is semi-convertible, serving the requirements for both summer and winter traffic with a single equipment. The windows are made extra large and are separated, as shown, into two parts, the upper sash going into the roof and the lower sash dropping into the sides of the car when open. The car body is 36 ft. 2 ins. long, and the total length over dash is 45 ft. 2 ins. The width of the car at the sash rail is 8 ft. 6 ins.

COMBINATION CAR FOR PUNXSUTAWNEY STREET RAILWAY

About one-third of the car is occupied by a baggage compartment, separated from the passenger compartment by a glazed partition containing a single sliding door. The doors at the end of the car are double, as are also the vestibule doors, the latter being hinged together at the center and folding back against the side of the vestibule. The baggage compartment has a single sliding door on the side, and is also provided with a safety chain so that in summer this door may be left open. The baggage compartment is provided with folding seats and may be used by smokers if desired. There are fourteen walk-over seats in the passenger compartment. The interior is handsomely finished in mahogany with bronze trimming.

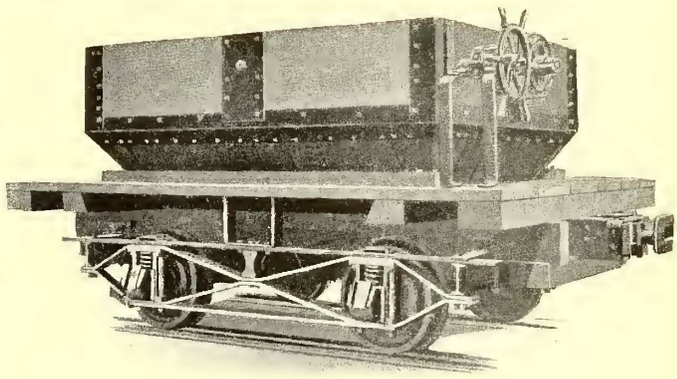
The general appearance and construction of the car is along standard steam railroad lines. It has straight sides and steam-car roof extending completely over the vestibules. Two ash grab handles are provided at each vestibule door to assist passengers in mounting and descending the two steps which reach the vestibule floor. The trucks are made by the John Stephenson Company, and are the standard No. 8 type, with 6-ft. 9-in. wheel base. This truck is of special design for high-speed work under heavy cars. The air-brake equipment is supplied by the Westinghouse Traction Brake Company, and employs axle-driven compressors for filling the reservoirs. As will be seen from the illustration, the trolley board runs the entire length of the car. There will be a trolley pole at each end when the cars are placed in operation.

CINDER FLOORS AND CAR VARNISH

The Chicago & Joliet Electric Railway Company, which operates the local lines in Joliet and the interurban line between Joliet and Chicago, has abandoned the use of soft coal cinders or ashes as a top dressing for the floors of car storage sheds. F. E. Fisher, general manager, states that it was formerly the practice of this company, as of many others, to put a cinder floor in the portions of the car house used for the storage of cars. It was found that in a car house with such a floor there was an unaccountable depreciation in the paint and varnish on new cars in one winter. It was concluded that the drippings from the wet cars coming into the car house caused fumes to rise from the cinders, which attacked the varnish. In its new car house this company has, therefore, put a top dressing of fine limestone on the floor of the storage house, and no such trouble has been experienced as was formerly found with the cinder floors.

HOPPER AND BOTTOM DUMP CARS

The accompanying illustration shows a type of hopper or bottom-dump car which is being introduced for ballast work on interurban electric railroads. Provision is made for opening the dumping doors at the bottom either lengthwise or crosswise, as may be desired. The car is built of white oak, and all corners are reinforced both on the outside and inside with heavy steel plate angles. The hopper on the inside of the car is lined 12 ins. deep with 3-16-in. steel plate, and the inside of the doors is also covered with similar material. The car has



DUMP CAR FOR INTERURBAN ELECTRIC RAILWAY CONSTRUCTION

diamond-frame steel running gear with two cross girths of 6-in. I-beams. The draft timbers are clipped to the I-beams and end sills to make them rigid, and the bed is bolted to the framework of the car, which is made of 5-in. x 9-in. timber. The doors are operated by chains fastened to a heavy steel rod crossing the car and manipulated by geared sprocket wheels. Solid plate-chilled face wheels, 24 ins. in diameter, are pressed on hammered iron axles 4½ ins. round, with bronzed brass journals 3½ ins. x 7 ins. The car is furnished with brakes when desired. The dimensions are: Box, 96 ins. long by 76 ins. wide by 55 ins. deep; height, from rail to draw-bar, 27 ins.; door, 19 ins. x 55 ins. The capacity of the car is 6 cu. yds.

This car was designed by the Kilbourne & Jacobs Manufacturing Company, of Columbus.

NEW CARS FOR THE PENNSYLVANIA REGION

The Tamaqua & Lansford Street Railway Company, within the last few weeks, has added four combination passenger and smoking cars, built by the J. G. Brill Company, of Philadelphia. The cities of Tamaqua and Lansford are important points, situated in the heart of the anthracite region, a region which has a large and growing population and affording an excellent field for operations on a large scale, which the street railway company is not slow in developing. The line is about 20 miles long, and is being extended 9 miles to Mauch Chunck, another busy center.

The cars make an imposing appearance with their steam-car roof, twin windows and straight sides. They are mounted on

PASSENGER COACH WITH SMOKING COMPARTMENT

27-G trucks, with a four-motor equipment, and are capable of making 30 miles an hour. These trucks have spring link-suspended semi-elliptic equalizers, which, it is claimed, ride very smoothly and take curves without shock or lurch, even with large and heavy car bodies. The general dimensions of the cars are: Length over end panels, 34 ft. 5 ins.; length over crown pieces and vestibules, 43 ft. 10 ins.; width over sills, 8 ft. 4 ins.; bottom of sill over top of deck, 9 ft. 4½ ins.; and over trolley board, 9 ft. 7½ ins. The side and end sills are 4½ ins. x 8 ins.; the center crossings, 4½ ins. x 5½ ins. The corner posts are 3¾ ins. thick, and the side posts 3 ins. All the car lines, with the exception of those next the ends, have steel car lines sandwiched between the wood. Between the compartments there is a partition of hard wood, with windows and a single sliding door. The smoking compartment is 11 ft. 10½ ins., and contains eight double seats. The passenger compartment is seated for thirty-two, a total for the car of forty-eight. The top sashes of the windows extends across two lower sashes, bringing the windows together in pairs for ornamental effect. This does not detract from the strength of the sides, as the alternate posts are heavier than usual, to make up for the lighter posts which go behind the glass of the upper sashes. The lower sashes drop into wall pockets, and when down the opening is closed by a cap. The interiors are finished in mahogany, with ceilings of birch. Folding doors and gates are provided at both sides of the vestibules, and single steps are used, as the cars are carried low on this type of truck. The bodies have high-strain rods as well as substantial trusses; the platform timbers are reinforced with angle-iron, and in every particular the cars are stanchly built and capable of high speeds and heavy loads.

In a large part of the special work used abroad the grooved rail is made shallower at the junction point of the crossing than at other places. The result is that when the cars reach a crossing the wheels run on their flanges over the crossing and there is not the same amount of pounding as when the groove is made the same depth at all points.

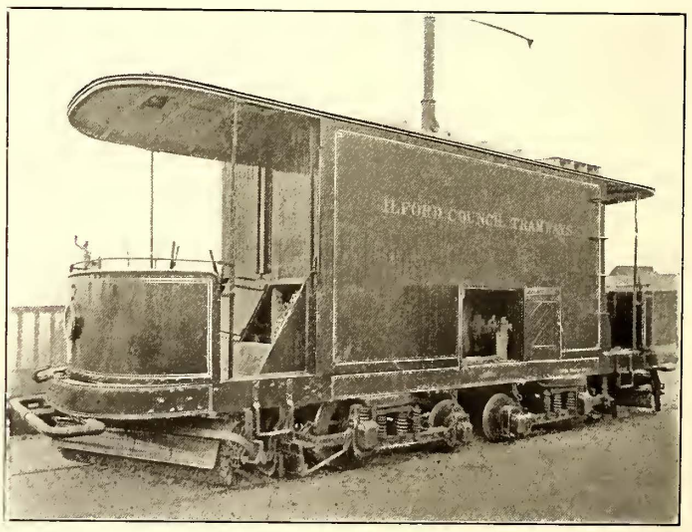
COMBINATION SWEEPER AND SPRINKLER

The accompanying illustration shows a combined sprinkling car and sweeper which has recently been built for the Ilford Corporation Tramways, in England, by the British Electric Car Company, of London and Manchester. It consists of an 1800-gal. tank, on a solid one-piece frame of 9-in. x 3-in. channel, and mounted on two maximum traction trucks. It has two electrically-driven rotary brushes, one at each end, and in addition to these it is fitted with two sprinkler pipes of the ordinary type, pipes for watering the grooves of the rails, groove cleaners and track brushes.

The car is equipped with three General Electric 54-motors, two for ordinary driving and one for driving the brushes. The two traction motors are, of course, controlled in the ordinary way, the third motor is operated by a separate and independent controller from the platform, and is concealed under the tank in the body of the car. It operates a diagonal cross-shaft set parallel to the brushes, on which clutch gear (also operated from the platform) is so arranged that either front or rear brush may be set in motion at varying speeds, in a forward or reverse rotation, at will.

The rotating brushes are driven by chain and sprocket gearing from the diagonal shaft, one reduction being introduced to keep down the speed of the brushes. They are of ample size to allow for wear, and are capable of being raised from the road or lowered by means of a lever on each platform. They may be set at any height from the track by means of a quadrant arrangement similar to that on a railway signal lever, and can be lifted clear of the road altogether if desired.

The tank is constructed of ¼-in. boiler plates, and is filled



TRACK SWEEPER AND SPRINKLER

inside with two baffle plates to prevent the water surging. The tank is sheeted outside with ½-in. match-boarding. The usual dash headlights are carried, and in addition a couple of canopy lamps at each end to light up the platforms.

Generally this combined water-car and sweeper is a most efficient machine, and though when running with the brushes going and a full tank the current consumption appears to be high, still it is considerably lower than would be that of two separate cars, one for sprinkling and one for sweeping. The whole can be operated by a crew of two men, and here again a saving is effected by combining the functions of two separate cars in one machine.

LONDON LETTER

(From Our Regular Correspondent.)

It might be interesting in view of the early opening of Parliament to make a short summary showing the progress of the underground tubes in London for the solution of the transportation problem in this city. First of all there are the three tubes now in use. The oldest of these is the City & South London Railway, which runs from Clapham Common to the "Angel" at Islington. Next in order is the Waterloo & City Railway, a short underground line from the Bank to the Waterloo terminus of the London & South Western Railway, and, thirdly, there is the Central London Railway, commonly called the "Twopenny Tube," which runs from the Bank to Shepherd's Bush. These are the three lines which are now in daily service, and the next to be considered are those which are in actual construction. Of these the Baker Street & Waterloo has been longest in progress. This is to connect the Waterloo terminus of the London & South Western Railway with Paddington, and will afterward be continued from Waterloo to St. George's Circus. Next comes the Great Northern & City Railway, a full description of which was published in this journal a few months ago. It is almost completed and runs from Finsbury Park to the Bank. As the third section of these tubes the following are enumerated collectively as authorized, though on some of them considerable work has already been done. Brompton & Piccadilly Circus Railway, which was authorized by acts of 1897, 1899 and 1902, is a railway connecting the vast southwestern residential quarters of London, such as Earl's Court, South Kensington, etc., with the west end of London at Piccadilly Circus, and also communicating with another authorized tube, the Great Northern & Strand Railway, which in the meantime has been authorized by acts of 1899 and 1902, and is to run from Finsbury Park to a point in the Strand near the law courts. These two railways will be connected by a short tube from Piccadilly Circus to the Great Northern & Strand Railway, and the former will be connected at Earl's Court with the Metropolitan District Railway at Gloucester Road and South Kensington stations, with the Metropolitan and the District Railway at Piccadilly Circus, with the Baker Street & Waterloo Railway at Cranbourne Street, with the Charing Cross, Euston & Hampstead Railway, and at King's Cross and Finsbury Park stations with the Great Northern Railway. The third authorized railway is the Charing Cross, Euston & Hampstead Railway, which was authorized by acts of 1893 to 1900 and 1902, on which work is in progress. This railway will be connected with the Brompton & Piccadilly Circus Railway at Cranbourne Street, and with the old District Underground Railway at Charing Cross, making a much-needed connection between the West End and the northwestern suburbs, Kentish Town, Highgate & Hampstead, with a probable continuation to Edgware, which has already been authorized. There is also in existence an act for an underground tube for a railway called the City & Brixton Railway, though nothing much has been done for this line, and there seems to be little necessity for it. The Metropolitan District Railway has also got an act for a deep level electric, which will be worked in connection with the Brompton & Piccadilly Circus tube, and there is another railway called the North Western London Railway, which, by an act of 1899, is empowered to complete an underground tube railway from the Marble Arch at Hyde Park, to Cricklewood, though nothing has been done with regard to this line yet. A number of bills have been promoted in the session of 1903 as follows: The City & South London Railway, the oldest underground railway tube, is again promoting its scheme (which was thrown out last year) for continuing its railway from the "Angel" to Euston, which would make it even considerably more valuable than it now is. The Central London Railway is also promoting its bill (which also was thrown out last year) to complete its circle from Shepherd's Bush back toward the city by way of Knightsbridge, Piccadilly, the Strand and Cannon Street, though naturally this scheme will enter into strong competition with the Brompton & Piccadilly Circus line. There is also a strong bill being promoted called the North-East London Railway, which is now the only tube scheme promoted for the extensive northeastern suburbs of London, and which is intended to connect the city to these suburbs by way of Stoke Newington, Stamford Hill, Tottenham and Southgate, and would join the District Railway deep level scheme at the Mansion House. This railway has also to construct a branch line to Leyton, Walthamstow, and Waltham Abbey. There are other minor bills, such as the City & Crystal Palace, the Paddington, Victoria & Kennington, the Clapham Junction & Marble Arch, and the Marble Arch & Victoria, but these are not of much importance, and will either be abandoned or be embodied in the schemes promoted by the larger lines. It might be said in conclusion that of the works in progress on the authorized railways, the Baker Street & Waterloo, the Brompton & Piccadilly Circus Railway, with its connections to the Brompton & Great Northern & Strand Railway, the Charing Cross, Euston & Hampstead, and the various metropolitan district railways are all included in what is now known as the Yerkes group.

The announcement has just been made that the Royal Commission has been appointed by the King, composed of the following members:

Sir David Miller Barbour, K.C.S.I., K.C.M.G., chairman.
The Earl Cawdor.
The Viscount Cobham.
The Lord Ribblesdale.
The Right Hon. Sir Joseph Cockfield Dimsdale, Bart., K.C.V.O., M.P.
Sir John Poynder Dickson-Poynder, Bart., D.S.O., M.P.
Sir Robert Threshie Reid, G.C.M.G., K.C., M.P.
Sir Francis John Stephens Hopwood, K.C.B., C.M.G., permanent secretary to the Board of Trade.
Sir John Wolfe Barry, K.C.B., F.R.S.
Sir George Christopher Trout Bartley, K.C.B., M.P.
Charles S. Murdoch, Esq., C.B.
Felix Schuster, Esq.
George Gibb, Esq.
Lynden Livingston Macassey, B.A., B.Sc., barrister-at-law, will act as secretary.

So far as can be discovered at present this will practically put a stop to all tube promotion in Parliament for this year, as it is well known that Royal Commissions take time to work. The result will practically be that aside from the three tubes in existence, and the Great Northern & City Railway which is approaching completion, all of which are entirely independent tubes, Mr. Yerkes will be left in complete control of the situation for the present, as he has already been granted permission to proceed with all his schemes, some of which are already well advanced toward completion. Other plans which have been promoted by other people will for the present have to be left out until the labors of the Royal Commission are completed. In addition, of course, to the solution of the underground problem this Royal Commission will also have to consider the relationship between underground railways and the surface traffic. The whole of the tramways situated in London will also come under their special consideration together with the omnibus and motor traffic. No doubt the task will be a long and arduous one and will most probably delay further progress in London transportation problems for some time, though it is to be hoped that distinct benefits in the future will accrue.

The London County Council in a recent report stated that the work of reconstructing for electric traction from Westminister to Tooting of their tramway system is nearly completed, and that it expects within a few months that the temporary power house and sub-stations will be in working order. It hopes to have the tramways in operation by the end of April next, but judging from experience it is probable that the service will not be in operation until about June 1.

The highways committee has also taken into consideration the question of allowing advertisements of new electrical cars. It seems that the net receipts for the year 1901 and 1902 amounted to £8,500, and the committee is naturally loathe to give up a benefit of this kind. It fully appreciates, however, the disadvantages of allowing advertisements to be plastered all over cars, and it recommends that in the new cars advertisements will only be allowed on the boards around the top and the inside of the ventilators over the windows.

It is interesting in these days of electric traction to read a report by the directors of the London Road Car Company, who, during the last half year, were able to show a balance at the credit of revenue account, being profits on the half year's working of £18,573. After making the usual charge for £3,000 interest on debenture stock, and other sums to depreciation, etc., amounting to about £700, the directors recommend a dividend at the rate of 5 per cent per annum and a bonus at the rate of 1 per cent per annum, £4,680 is transferred to the General Reserve Fund, bringing it up to £46,700, and the remainder, £3,945, is carried forward to the next half year. The statistics are also interesting, as they now have 5321 horses in stock, and 455 cars at work daily. The number of passengers carried during six months was 36,504,894, and the weekly average traffic receipts per car amount to £17 2s. 2d., while the weekly average expenditure per car amounted to £16 6s. 6d. This is the best report that the directors have been able to place before their stockholders for some time.

The Great Northern & City Railway Company has now practically completed the permanent way in both tunnels. Rail-laying is being proceeded with at Drayton Park Station, and the signalling is practically finished, except at Drayton Park. The Moorgate Street and Essex Road stations are up to roof-level, and Drayton Park is practically finished. Preparations are being made for commencing work on the Lothbury Station and Highbury. They could work the line from Drayton Park to Moorgate Street as a section within the next three or four months, but after serious consideration the directors found it would not be advantageous to do so. They are working in cordial co-operation with the Great Northern Railway

Company. The extension to the Bank is almost as important as that to Finsbury Park, but the directors are determined that the opening of the lines should not be contingent upon the completion of that section. As soon as Finsbury Park Station, under the Great Northern Railway, is finished, it is proposed to open the line from Finsbury Park to Moorgate Street. The Finsbury Park extension will be completed by the end of the year, and that to Lothbury by September, 1904.

On Sunday morning, Jan. 25, at 10 o'clock, all the employees of the Brighton Corporation Tramways met to present a testimonial to T. B. Holliday, the engineer and manager, as a token of their regard and esteem for him. This took the shape of a handsome illuminated address, mounted in a massive carved oak frame, also a heavily chased silver cigar case, together with a set of silver articles for the tea table for Mrs. Holliday.

Speaking recently at a meeting of the shareholders of the London, Chatham & Dover Railway Company, Mr. J. Staats Forbes, the chairman, touched upon the provisions of a bill to be brought before Parliament in the coming session to authorize the managing committee to work the railways by electrical power. There was no doubt that all companies must be prepared to face the question of electrical traction over portions of their lines. Within an area of some miles round London, in the course of a short time, they would see electricity playing a very important part.

The council of the Incorporated Municipal Electrical Association has appointed a Parliamentary committee (in accordance with the resolutions set forth in the last annual report), consisting of the following gentlemen: The president, ex-officio; Mr. Alderman Pearson, Hon. Solicitor; Messrs. H. Faraday Proctor, E. T. Ruthven-Murray, A. S. Giles, F. A. Newington, V. A. H. M'Cowen and John F. C. Snell. It has been arranged that these gentlemen shall deal with matters concerning different districts divided as follows: Metropolitan and southeastern, southwestern, northwestern, northeastern, Scotland, Ireland. The object the committee has in view is to obtain, record and tabulate information which is likely to be of use either to the association as a body, or to its members, more especially on the following points: (1) Parliamentary bills (municipal and private), (2) Local Government Board or Board of Trade inquiries, (3) light railways, and (4) decisions of civil courts in re tramways, electricity supply, overcrowding of cars, accidents, etc. It is believed that by carefully selecting and tabulating the data sent in, and by making periodical reports information of great value will be available as a source of reference for members of the association seeking precedents of conditions affecting, or liable to affect, their own undertaking, whether electricity supply, tramways or telephone.

The Halifax tramways committee have resolved to recommend that an agreement be entered into with James Killingsworth, of Bradford, granting him the exclusive right for the term of five years of carrying parcels on every tramway running in the borough system, Mr. Killingsworth to pay £150 for the year, and an advance of £50 per annum on that sum for the remainder of the term.

The report of the directors of the London United Tramways (1901), Limited, with accounts covering the year 1902, makes a highly satisfactory showing. The gross receipts amounted to £222,256, of which £101,318 was secured as net revenue, enabling the payment of a dividend on the ordinary shares of 8 per cent for the year, leaving £4,257 to be carried forward. The total number of passengers carried during the year over the 6 miles of route at present open for traffic was 36,209,737. It is announced that during the past few months arrangements have been made for working the tramways in friendly relations with the Underground Electric Railways of London, Limited, the company which controls the Metropolitan District, the Great Northern, Piccadilly & Brompton, the Baker Street & Waterloo, and the Charing Cross, Euston & Hampstead Railways, in pursuance of which it is intended that all the allied railway companies and the Tramways Company shall issue through tickets over the respective systems. It is also announced that Mr. C. T. Yerkes has been appointed chairman of the London United Tramways Company, though Mr. J. Clifton Robinson will still continue as managing director.

The tenders recently received by the North-Eastern Railway for the electrification of about 37 miles of double track near Newcastle-on-Tyne has now been considered. The company have, as reported last month, accepted the tender of the British Thomson-Houston Company for the electrical equipment of motor coaches and trailer coaches on the multiple-unit system, and the laying of the third rail, bonding and low-tension feeders, and have now accepted that of the British Westinghouse Electric and Manufacturing Company for the supply and erection of high and low-tension switchboards, rotary converters, static transformers, and all sub-station equipment.

The transformation of the Huddersfield Corporation Tramways from steam to electric haulage is now practically complete. The work of conversion was begun about four and a half years ago, under the general supervision of the borough engineer (Mr. K. F. Campbell), and has been carried out within the period of time estimated. Thirty-six miles of track have been laid or relaid, and all the overhead equipment necessary newly erected.

The eighth annual convention of the Incorporated Municipal Electrical Association will be held at Sunderland, on July 15, 16, 17 and 18. On Wednesday morning there will be a reception of the president and members of the Incorporated Municipal Electrical Association by the Mayor of Sunderland at 10 o'clock, followed by a general meeting, at which the president will give his address, and papers will be read and discussed. In the afternoon visits to the electricity stations and tramway car sheds, and shipyards and engine works on the Wear will be made. On Thursday morning there will be a reception of the association by the Mayor of Newcastle at Newcastle, at 10 o'clock, followed by a general meeting for the reading and discussion of papers. In the afternoon visits will be made to the corporation's tramway power house; Tyneside Power Company's station, Wallsend, and various works electrically equipped. On Friday morning a general meeting for the reading and discussion of papers will be held at Middlesbrough, and in the afternoon visits to various places of electrical interest in Middlesbrough and Stockton will be made. On Saturday the annual general business meeting will be held in Sunderland in the morning.

The promoters of the Nottinghamshire and Derbyshire tramways have deposited the estimates prepared by their engineer, Mr. Alfred Dickinson, of Birmingham, showing the cost of constructing these tramways, as set out in the bill deposited for next session. The aggregate cost of the whole scheme is put down at £408,015, of which sum £360,541 will be spent upon the construction of the proposed 79 miles of tramways. The balance will be spent on road widenings, which are estimated to cost £46,526, and upon land for generating station, car sheds, and depots, which are estimated to cost £947. The capital of the company is to be £750,000, with the right to borrow a further £250,000.

The report of the directors of the Edinburgh and District Tramways Company (limited) discloses a profit for last year of £3,756 15s. 8d., as compared with a loss in the previous year of £19,528 11s. 1d. The total receipts were £204,970 10s. 7d., and the total expenses, including corporation charges, £77,879 19s. 8d., amounted to £201,213 4s. 11d. After making provision for the rent up to Dec. 31 last, and also for the interest on the debentures, etc., there remains a balance of £122, 15s. at the credit of the net revenue account.

Mr. Harry Richardson, A.U.I.E.E., of Newcastle, has been appointed electrical engineer for the city in place of Mr. W. H. Tittensor, who was appointed to the charge of the corporation works at Preston. For nearly two years Mr. Richardson has had charge of the erection and construction of the Newcastle-on-Tyne tramway undertaking under Mr. A. E. Le Rossignol.

The Halifax tramways committee have decided, by a majority, not to carry out the proposed construction of a "lift" or incline tramway at Salterhebble at a cost of £12,000.

In two of the tramway bills to be discussed in the coming session powers are asked to authorize the use of electric cars in the districts of Stroud, Gloucestershire, and Rochester, Kent, worked by the overhead system, but without rails. The cars will be connected to the trolley wire by a flexible cable, and would be steered in the road like any other vehicle.

The contractor has made a beginning with the laying of the rails for the Houghton-le-Spring & District Tramways system, which is intended to carry goods as well as passengers. The main line will start at Grangetown, Sunderland, and pass through Ryhope, Ryhope Colliery, Tunstall, New Silkworth, East Herrington, New Herrington, Philadelphia, Newbottle, Houghton-le-Spring, Hetton-le-Hole, Easington Lane, on to Easington, and there will be branch lines from New Silkworth to Sunderland, near Low Barnes, from New Herrington and Philadelphia to Penshaw Station, and from Houghton-le-Spring to Fence Houses, a total length of about 20 miles and embracing a population of about 60,000, exclusive of the Borough of Sunderland with its population of 150,000, thereby affording direct communication with the borough and the popular sea resorts of Roker and Ryhope. It is proposed to extend the line from Penshaw Station across the River Wear to Washington, Usworth, and along the New Road to the Felling, and thereby affording communication with Gateshead and Newcastle. It is intended to construct the tramways on the overhead system. The engineers are Messrs. D. Balfour & Son, civil engineers, and Messrs. Handcock and Dykes, electrical engineers, both of Newcastle-on-Tyne and London.

At a meeting of the electric power and lighting committee of the Liverpool Corporation, the resignation, owing to ill-health, was received of Mr. A. Bromley Holmes, city electrical engineer. The

resignation was accepted and the committee recommended Mr. Holmes' appointment as consulting electrical engineer, at a salary of £1,000, his former salary being £1,800. It was also decided to recommend the appointment as resident electrical engineer of Mr. A. Clough, Mr. Holmes' deputy, and that his salary be increased from £700 to £800 a year.

The highways committee have given Messrs. P. & W. Maclellan & Company, of Glasgow, the contract for 2775 tons of track rails, 1470 tons of slot rails, and 705 tons of conductor tees, etc., their tender amounting to £33,876. The firm propose, and the committee have agreed to permit them, to obtain the bolts and nuts from Messrs. Ibbotson & Brothers, of Sheffield, while the rails, etc., will be obtained from the Société Anonyme des Acieries d'Angleur, Belgium, who are the sub-contractors under a contract of a similar character accepted in March last.

Mr. James Fisher, brother of Mr. Peter Fisher, manager of the Dundee Corporation Tramways, has been appointed traffic superintendent of the tramway system in Kirkcaldy. Mr. Fisher, who was an inspector in Dundee, has a thorough knowledge of the work, and Kirkcaldy must be congratulated on securing his services.

At the fifteenth ordinary general meeting of the Central London Railway after the usual reports referred to elsewhere had been presented the chairman stated that the subject of the ventilation of the tunnel was receiving the most serious consideration, and that the very best scientific advice had been called on. A huge electric fan is being established at Shepherd's Bush, by which it is proposed to exhaust the air in the tunnel during the few hours when the railway is shut down at night, the doors leading to the several stations being closed at that time. In addition the company intends putting in a plant at the Bank station, and at that point force air into the dead end, where the trains are shunted, as this is naturally the place where the foulest air exists. The company has installed four additional lifts at the Shepherd's Bush station, as the traffic was altogethe rtoo great for the plant that had been installed.

An interesting decision was rendered recently by Sir Richard Harrington and jury in Birmingham in which the City of Birmingham Tramways Company, Limited, had to pay damages amounting to about £33 for the value of a trap, which had been smashed when traveling along the route of their line. It was contended that the paving-stones were from 2 ins. to 2½ ins. above the level of the track, and that the wheels of the trap jammed in the groove that was made, thereby breaking the axles and causing the damage. The decision was rendered according to Sec. 25 of the Tramways Act, which obliges tramway companies to lay and maintain the tramways in such a manner that the uppermost surface of the rails should be on a level with the road.

The St. Pancras Council has again decided against the innovation of tramways in Tottenham Court Road, it being urged that tramways would spoil the trade in the locality and spoil the looks of what is now "a magnificent avenue." There appears no doubt but that tramways in the north of London are a great boon to the working classes, and it seems an absurd thing that the St. Pancras Council should prevent the existing tramways crossing Euston Road and going down Tottenham Court Road to Holborn, which would enhance their value to the public enormously. Tottenham Court Road is a wide street, and could well accommodate these tramways.

The half yearly meeting of the shareholders of the Liverpool Overhead Railway recently took place when it was intimated by Sir William B. Forwood that arrangements were all but completed by which their railway would shortly be connected with the Lancashier and Yorkshire Railway at Seaforth. A bill is also being deposited by the Cheshire lines for the purpose of connecting their system at St. Michael's with the overhead railway, and a bill has also been deposited for the purpose of making a line from the Seaforth Sands station to Sefton, and there to join the Southport and Cheshire line extension. Should these bills be passed and the construction done a loop line will be established round Liverpool which would naturally enhance the value of the railway to a large extent.

The formal opening ceremony of the Rotherham Corporation Tramways took place this month with considerable ceremony, three double-deck cars having been decorated for the occasion. The total length of the route is about 8 miles, and the contracts which the committee have accepted for the tramcars, wire, overhead work, cables, rolling stock, engines, dynamos, etc., together with the cost of the car sheds, amounts to a little over £100,488. The rails weigh 89½ lbs. per yard, and were made by Walter Scott, Limited, of the Leeds Steel Works. The points and crossings have been supplied by Hadfield & Company, of Sheffield, and are of that company's patent manganese cast steel. The Roeblings furnished the wires used for the overhead work, and the trolley poles have been supplied by Stewarts & Lloyd, of Glasgow and Birmingham. The cables are by Glover & Company, of Manchester, the cars by Dick, Kerr & Company, with Brill trucks, and the wheels, which have been guaranteed to run 55,000 miles, are by John Baker & Company, of Rotherham. The cars are of the double-deck type, weighing 8½ tons and seating fifty-four passengers, and of the single-deck type, weighing 7½ tons and accommodating twenty-eight passengers.

Recently mention was made that the London County Council had given Dick, Kerr & Company a contract for about 11 miles of conduit work, and that roughly the same amount had also been given to J. G. White & Company. Dick, Kerr & Company have kindly furnished a few further particulars relating to their half of the contract. The contract includes relaying the horse lines in the Old Kent Road, New Cross Road and Greenwich Road, as a conduit tramway with double-track throughout, excepting a short length in London Street, which, owing to the difficulties in widening, will still have to remain single track. It also embraces equipping the conduits with conductor rails, etc., for working the cars by electricity, and the special track work at the junction of the tramway in Queen's road, Camberwell, and at the junction of New Cross Road with the Lewisham High Road and Blackheath Road, along which tramways will be constructed at a later date. Provision is also made for joining the tramways in South Street to those in the Greenwich High Road, when that section is converted. Junctions have to be left for three existing car depots at Bowles Road, Leo Street and Old Woolwich Road, and for a new depot, which is to be built east of New Cross Gate. The total mileage length amounts to nearly 11 miles, and has to be completed by September 1, 1903. The total estimated value of the work is £102,066 2s. 11d., and is to be of similar construction to that adopted on the lines of the Westminster Bridge to Tooting. The whole work is to be carried out to the plans and specifications of Maurice Fitzmaurice, chief engineer to the London County Council. The special track work at the junctions will be made by the Lorain Steel Company, and laid by the principal contractors. Special arrangements have been made for altering the bridges which cross the Surrey Canal and the London & Brighton and South-Eastern Railway Company, at New Cross and London Street, to allow of a sufficient depth in the ground for the construction of the conduit. In connection with the first contract given by the London County Council for electrification of their lines, Dick, Kerr & Company have already delivered forty-five cars and part of the large 1500-kw generators for the temporary Loughborough power house. It took eighteen horses to draw the huge armature across London, weighing, as it did, 26 tons.

A. C. S.

STREET RAILWAYS IN NEW HAMPSHIRE

The report of the Railroad Commissioners of New Hampshire shows that street railway construction proceeded rapidly during the year. The mileage of the State is now 226 miles, as against 138 miles July 1, 1901, and the capitalization, exclusive of current liabilities, has been increased from $2,964,339 to $5,659,083.

During the year the Concord & Manchester, the Berlin, the Hudson, Pelham & Salem, the Portsmouth & Exeter, the Haverhill, Plaistow & Newton, the Haverhill & Plaistow and the Seabrook & Hampton Beach Railways were completed and placed in operation. The Claremont Street Railway, the Dover & Eliot Street Railway and the extension of the Keene Street Railway to Swanzey were partially built. The Manchester & Haverhill and the Newport & Sunapee Railways, which were authorized to issue stock and bonds, have done nothing toward completing their roads.

An examination of the returns of the companies shows that only one, the Manchester Street Railway, which serves a population of 65,000, showed a divisible income from operation of 6 per cent on the par value of its stock, which was only 3 per cent on the cost to the present owners. The Exeter, Hampton & Amesbury Company paid a 3 per cent dividend, amounting to $8,250, but its divisible income was only $6,450. No other company paid dividends. The Chester & Derry Company returned a surplus of $448.88 for the year, or a little more than one-third of 1 per cent on its stock; the Concord Company a surplus of $726.28, or less than 1 per cent; Keene Company a surplus of $1,221.66 upon a capital of $24,256; the Portsmouth Company, with no debt and no taxes to pay, a surplus of $4,696.98, or less than 1 per cent on its cost, which was $470,583.11; and the Laconia Company failed to meet its operating expenses and fixed charges by $1,904.65. In concluding, the Railroad Commissioners say: "All the populous centers of our State are now supplied with electric roads, and the building of the future, if in new territory, must be in the country districts. The great bulk of the patronage of the roads we have is that of pleasure-seekers, and is secured by large outlays for casinos, theaters, parks and other attractions, the use of which is necessarily confined to the summer season. We have but one city

large enough to support an electric railway used exclusively for business purposes, and the car receipts in that are to a great extent from pleasure travel, without which it could not pay a dividend."

THE CONVENTION OF MUNICIPAL OWNERSHIP AND PUBLIC FRANCHISES

This convention, which was held last week at the Reform Club in New York, was concluded Feb. 27. As already announced in these columns, papers were read both for and against municipal ownership of companies operating under public franchises. The sessions on Feb. 25 were devoted to a general discussion of the topic and to the subject of transportation; those on Feb. 26 to gas and electric lighting, water and telephones. The taxation and regulation of companies was the subject of the papers delivered on Feb. 27.

Three papers read at the meeting on Wednesday, i. e., those of Messrs. Porter, Brandeis and Donald, are printed elsewhere in this issue. Another speaker was C. R. Bellamy, of the Liverpool Corporation Tramways; that city took over the local system in 1897. Electric traction was adopted throughout the system and other improvements were made. The carrying capacity was doubled. This table was quoted to show the results:

	1897	1902	Percentage increase
Passengers	58,409,084	109,335,585	184.66
Mileage	6,013,180	11,790,815	96.08
Receipts	$1,395,552	$2,431,320	74.25

A unit fare of 1 penny had been established, carrying a passenger an average distance of 2 1-3 miles. The length of the system is 101 miles. The population of Liverpool is about 750,000. Mr. Bellamy continued: "The gain to the traveling public during last year amounted to £320,000 (or $1,536,000) as a result of lower fares. The employees gained £40,000 (or $192,000), with free uniform clothing. Notwithstanding these important concessions, the gross profits amounted to 9½ per cent, after maintaining the rolling stock, permanent way and machinery in the highest state of efficiency. Six per cent of this amount has gone to interest and sinking fund, 2½ per cent to a general reserve or depreciation fund and the remainder, amounting to £25,000 (or $120,000), transferred to the relief of the local taxes."

An interesting paper from Charles T. Yerkes, of London, was also read. It will be published in an early issue of this paper.

Edward M. Shepard, counsel to the Rapid Transit Commission in New York and late candidate for Mayor, then reviewed the history of rapid transit in New York since 1891. The feature of the contracts with the Belmont-McDonald subway syndicate, he said, were that they protected the city from all possibility of loss. He added:

"Those who criticise the commission for having granted too long a lease to the contractor in the case of the present tunnel must remember that until three years ago not one financier dared to undertake the construction of such a subway. It is no secret I tell you when I say that I, as counsel for the Rapid Transit Commission, consulted with the Vanderbilts, the Goulds and many others. Without exception they said the plan was impossible."

After making his estimate of what the contract has proved to be worth, which he thought was between $30,000,000 and $50,000,000, Mr. Shepard explained that since that proof had come it was easier for the city to get advantageous terms in building its tunnels. The Brooklyn extension had shown this.

"We are committed to municipal construction," said the speaker. "Undoubtedly it will be our course in future. I've no doubt that the terms of future leases to contractors will be abridged. For my part, I see no reason why we should not have one soon with a twenty-year limit instead of the fifty and thirty-five-year terms of the Manhattan-Bronx and Brooklyn contracts."

He compared the building of tunnels with the building of court houses or reservoirs. The city in each case let the contract for construction because it was more economical than to do the work itself.

"There has been a public misapprehension about the city's powers," he said. "The city does not abdicate its rights, even during the time it leases the underground road to the builder. During the fifty or thirty-five years it will control absolutely the conditions of the road's operation. If the contractor fails to come up to requirements in every detail the city can even take over the control of the line. The contracts provide how the road shall be operated down to the minutest particular."

Mr. Shepard said he was not prepared to say the time was ripe for American municipalities to buy, build and run their railroads from the start. He considered New York's present form of municipal ownership adequate.

The speakers on Feb. 26 included J. B. Cahoon, secretary and ex-president of the National Electric Light Association; Edw. B. Ellicott, of Chicago; U. N. Bethell, general superintendent of the New York Telephone Company; William R. Hill, ex-president of the American Water Works Association, and Hon. J. De Witt Warner.

On Feb. 28, Professor E. R. A. Seligman, of Columbia University, cited the Michigan method as the best one to measure franchise values.

"That method is this," he said. "Subtract the value of the physical tangible property from the value of the corporation's securities and you have the franchise value. If you can't get at the value of the securities, then take the total gross earnings plus the total income from other sources and deduct 5 per cent of the tangible property plus the operation expenses and then capitalize the remainder at 7 per cent and call it the value of the company's non-physical property or franchise."

Wheeler H. Peckham said there was no difference between taxing income and capital; that no matter how a street railway company might be taxed, the real fact was that the passengers in the cars paid the taxes. When a company pays so much in dividends that its stockholders received more interest than that which other capital similarly invested pays it is a disgrace to the city and State.

Before the franchise tax discussion the convention listened to Dr. Charlton T. Lewis on the subject of "How Should Public Service Corporations Be Controlled?" The speaker attacked the wave of municipal socialism that has swept over Great Britain and said the great public utility corporations were the best agents for the management of such utilities.

WORK ON PENNSYLVANIA TUNNEL BEGUN

Actual work on the North River section of the great Pennsylvania tunnel was begun in New York Feb. 25, when a gang of workmen started to tear down some old tenements and warehouses at the foot of West Thirty-Second Street. The first board was ripped off in the presence of Chief Engineer Charles M. Jacobs, of the North River Division; Alfred Noble, who is in charge of the East River tunnel, and the members of their staffs. A shaft will be sunk as soon as the ground is cleared. The North River section extends from a point in the center of the North River to the site of the terminal station at Seventh and Eighth Avenues and Thirty-Second to Thirty-Fourth Streets, New York. For the sinking of the shaft the plant of an iron works, besides several small buildings, will be razed. The shaft, upon which work has just been begun, will extend down to the level of the tunnel, and then the work will be pushed west under the river and east under the city to connect with other sections. There are four of these—one extending from the terminal east to a point under the center of the East River, one on Long Island and one in New Jersey, besides the one which is now under construction.

In the annual report of President Cassatt, of the Pennsylvania Railroad Company, prominence is given the plans for the building of the tunnel through New York and the establishing of a station in this city, together with the important connections secured by this project. This is really the first definite official statement of the plans since the granting of the franchise. The route is outlined as follows:

The tunnel extension into New York commences at a point on your United New Jersey Railroad about a mile east of Newark, whence a double-track road will be constructed by the Pennsylvania, New Jersey and New York Railroad Company on an elevated line to Weehawken, and thence by tunnel under Bergen Hill and the North River to a connection on the boundary line between the States of New York and New Jersey, with the line of the Pennsylvania, New York and Long Island Railroad. The latter company is to complete the line from that point under the North River, the city of New York, the East River and Long Island City, to a junction with your Long Island Railroad near Thompson Avenue in that city. It will also make connection with the New York Connecting Railroad, and through it with the New York, New Haven & Hartford Railroad, and thus provide an all-rail passenger route between your system and New England.

The provisions of the franchise covering the privileges extended the company and the compensation exacted are related in detail and include the construction.

First—Of a railway consisting of two double-track lines, starting from adjacent points under the Hudson River, on the line between the States of New York and New Jersey, and running eastwardly through New York City, one under Thirty-First Street and the other under Thirty-Second Street, and thence under the East River and Long Island City to a surface terminus near Thompson Avenue in that city.

Second—The construction of a terminal station between Thirty-First and Thirty-Second Streets and Seventh and Ninth Avenues, in New York, and

for that purpose the closing and occupancy of Thirty-Second Street between the avenues named.

Third—The construction of a third double-track railway from this terminal station under Thirty-Third Street and to and under the East River to the terminus near Thompson Avenue.

Fourth—The construction of additional tracks on Thirty-First, Thirty-Second and Thirty-Third Streets necessary for the operation of the railway and station.

Fifth—The occupancy of ground under Thirty-Third Street and east and west of Fourth Avenue for a local station.

Sixth—The maintenance and operation of the necessary cables, wires and conduits under and along the route of the railway for power, heating, light and other necessary purposes.

Seventh—The right to use private property, lawfully acquired, for its corporate purposes in connection with the construction and operation of the tunnel, and

Eighth—The right to maintain and operate the railroad in perpetuity.

ATTORNEY-GENERAL OF WISCONSIN SAYS RAILROAD COMMISSIONER HAS POWER TO INQUIRE INTO RAILROAD AFFAIRS

In an opinion holding that electric railways are required to report to the State Railroad Commissioner the same as steam roads, Attorney-General Sturdevant, of Wisconsin, interprets the statute giving the commissioner certain powers to inquire into the affairs of railroad companies in general. The commissioner asked the Attorney-General if section 1795 of the statutes of 1898, which requires that "all railroad corporations hereafter organized shall within ten days after beginning operations as a common carrier, give notice in writing to the Railroad Commissioner of the name of the company, date of beginning its business as a carrier, names of terminals and the names and residences of the principal officers," applied to electric railways. In holding that it did the Attorney-General, in his opinion, says: "A railroad company doing business as a common carrier is certainly within the words of the statute, and the words 'railroad corporations' certainly include a railroad operated by electric power, as well as one operated by steam power. The evident object of section 1795, in requiring reports from railroad companies, is to give the commissioner information of the business operations of railroad companies in order that he may perform his duties under the statute with reference to such companies. The State is also interested in these electric railways, for the reason that they pay license fees to the corporations through which they run under the provisions of chapter 354, laws of 1899, and the State receives a portion of these license fees."

ANNUAL REPORT OF THE TWIN CITY RAPID TRANSIT COMPANY

The report of the Twin City Rapid Transit Company, of Minneapolis, for the year ended Dec. 31, 1902, has just been made public. President Lowry, of the company, in presenting the report, calls attention to the present properties controlled by the company and points out their fine physical condition, and says that in order to meet the growth of the property steps have been taken to provide additional power facilities. According to Mr. Lowry, the new power plant, for which plans have been drawn, is expected to be fully completed during 1904.

The report shows that the gross earnings for the year were $3,612,211, an increase of 13.81 per cent over 1901, and that the net earnings were $1,982,041.34, an increase of 12.71 per cent over 1901. The company has operated the property, including taxes, for 49.30 per cent of the gross earnings, as compared with 48.35 per cent for the preceding year. The increase in operating expenses over the previous year is largely due to increase in wages and abnormal cost of fuel, the increase in wages alone adding 2 per cent to the operating expense.

After paying all fixed charges and 7 per cent dividends on the preferred stock, there is a balance in the net income of $1,060,324, being 7.06 per cent upon the common stock, as compared with 5.87 per cent for the previous year.

From this surplus, four quarterly dividends of 1¼ per cent each, amounting to $769,262, or 5 per cent, have been declared on the common stock, leaving a balance of $291,061, which has been passed to the surplus account.

The company has sold $1,501,000 of its common stock to its stockholders at par, said stock carrying with it the dividend for the last quarter of the year. The proceeds from the sale of this stock have been partly used to pay the cost of improvements to the properties during the current year, and the balance will be used toward paying for improvements the ensuing year.

On May 1 the company cancelled $20,000 of the remaining $250,000 7 per cent first mortgage bonds of the Minneapolis Street Railway Company, redeeming them in cash.

The following are detailed statements of the operations of the company for the fiscal year ending Dec. 31, 1902:

MONTHLY STATEMENT OF GROSS EARNINGS—1902

	Passenger Earnings	Miscellaneous Earnings	Total Earnings
January	$270,485	$1,673	$272,159
February	243,140	1,631	244,780
March	277,575	1,808	279,382
April	261,456	1,787	263,243
May	295,152	1,839	296,991
June	308,131	1,752	309,884
July	335,716	1,737	337,452
August	321,842	-,692	323,534
September	337,965	1,704	339,669
October	302,634	1,682	304,317
November	307,756	1,712	309,468
December	329,686	1,645	331,331
	$3,591,548	$20,662	$3,612,210

STATEMENT OF RECEIPTS AND EXPENDITURES—1902

RECEIPTS

Passenger earnings	$3,591,549
Miscellaneous earnings	20,662
Total earnings	$3,612,211

EXPENSES

Maintenance of way and structures	$83,135
Maintenance of equipment	196,521
Operation of power plant	269,224
Car service	745,771
General expense	153,706
Legal expense	23,000
Injuries and damages	138,445
Insurance	20,365
Total operating	$1,630,170
Net earnings from operation	1,982,041
Interest on debt and taxes	711,717
Surplus applicable to dividends	$1,270,324
Dividends preferred stock	$210,000
Dividends common stock	769,262
Total dividends	$979,263
Transferred to general surplus account	$291,061
Per cent total operating (including taxes) to total earnings	49.3

GENERAL BALANCE SHEET—DECEMBER 31, 1902

RESOURCES

Roadway, equipment, real estate, buildings, machinery, tools and securities in treasury.		$32,989,594
Current assets		350,197
Notes and accounts receivable	$32,349	
Cash in banks	646,072	
Stores—materials and supplies	171,776	
		$33,839,791

LIABILITIES

Capital stock		$19,511,000
Common stock	$16,511,000	
Preferred stock	3,000,000	
Funded debt		10,868,000
Minneapolis Street Railway Company	4,080,000	
The St. Paul City Railway Company	4,388,000	
Minneapolis & St. Paul Suburban Railway Company	500,000	
Consolidated 5 per cent mortgage bonds	1,000,000	
Current liabilities		469,445
Unpaid vouchers and accounts	55,762	
Interest accrued and not due	207,296	
Dividend common stock, payable Feb. 15, 1903	206,387	
Income account, surplus		2,991,346
		$33,839,791

STATEMENT OF FUNDED DEBT—JANUARY 1, 1903

BONDS

	Total Debt	Annual Interest
Minneapolis Street Railway Company—		
First mortgage, 7 per cent, due 1910	$230,000	$16,100
Second mortgage, 6 per cent, due 1913	600,000	36,000
First consolidated mortgage, 5 per cent, due 1919	4,150,000	207,500
	$4,980,000	$259,600
The St. Paul City Railway Company—		
First mortgage, 6 per cent, due 1932-34	680,000	$40,800
Cable consolidated mortgage, 5 per cent, due 1937	3,708,000	185,400
	$4,388,000	$226,200
Minneapolis & St. Paul Suburban Railway Company—		
First mortgage, 5 per cent, due 1924	$500,000	$25,000
Minneapolis Street Railway Company and the St. Paul City Railway Company—		
Consolidated mortgage, 5 per cent, due 1911	$1,000,000	$50,000
Total	$10,868,000	$560,800

TRACK MILEAGE AND PASSENGER EARNINGS PER MILE

Total miles single track	38.12
Total miles double track	98.29
Total miles special track	17.85
Total miles all track reduced to single	252.55
Total miles street occupied by track	136.41
Gross passenger earnings per mile single tracks	$14,221.14
Gross passenger earnings per mile streets occupied by track	26,329.07
Gross passenger earnings	3,591,548.55

STATISTICAL STATEMENT

	1902	1901	1900	1899
Gross earnings	$3,612,210.88	$3,173,975.85	$2,839,355.78	$2,522,793.85
Operating expenses	1,630,169.54	1,415,451.70	1,304,689.11	1,156,972.37
Net earnings	1,982,041.34	1,758,524.15	1,534,666.67	1,365,821.48
Rev. passengers carried	71,830,971	63,009,957	56,284,102	49,526,845
Transfers redeemed	17,789,105	15,587,858	13,909,535	12,983,112
Operating, per ct. earnings	49.30	48.35	49.16	48.71
Per cent on preferred stock earned and paid	7.00	7.00	7.00	7.00
Per cent on common stock earned	7.06	5.87	4.70	3.66
Per cent on common stock paid	5.00	4.00	3.00	2.50

REPORTS OF THE UNITED RAILWAYS OF BALTIMORE

The annual meeting of the United Railways & Electric Company, of Baltimore, Md., was held Feb. 25. Directors and officers were elected as follows: J. M. Hood, president; George C. Jenkins, first vice-president; William A. House, second vice-president and general manager; H. C. McJilton, secretary and treasurer; N. E. Stubbs, auditor; E. L. Bartlett, H. Crawford Black, Alexander Brown, General John M. Hood, George C. Jenkins, Seymour Mandelbaum, Wesley M. Oler, H. A. Parr, J. B. Ramsay, Douglas H. Thomas and General Francis E. Waters, directors.

The report of the company for the year ended Dec. 31, 1902, was presented by President Hood. It shows that the gross earnings were $5,041,275; operating expenses, $2,252,133; earnings in excess of operating expenses, $2,789,142; fixed charges, including franchise and other taxes and interest on income bonds, $2,637,115; amount carried to surplus from railway operations, $152,027; dividend from lighting company, $53,405; total credited to surplus for the year, $205,432; previously credited, $128,007, or a total surplus to date of $333,439.

As compared with 1901, there was an increase of $344,645 in revenue and an increase of $58,958 in operating expenses, making a gain of $285,687 in operating results. There was, however, an increase of $144,113 in fixed charges and interest, so that the actual net increase was $141,574. To this should be added $31,739, representing increased dividend from the lighting company, so that the net increase from all sources was $173,313.

The report says in part: "The increase in fixed charges of $144,113 was mainly due to an increase in franchise and other taxes of $45,864 and of $98,215 in interest on first 4 per cent bonds issued and loans made in connection with construction of Carroll Park shops, new boiler house and equipment, new machinery for Pratt Street power house and the 105 double-truck convertible cars purchased for the Ellicott City and York, Frederick & Belair road lines in 1901, none of the interest upon which became a fixed charge until 1902.

"When the advances made by this company to the Baltimore, Sparrows Point & Chesapeake Railway Company have been repaid this company will not only be able to liquidate all floating indebtedness, including all contractural liabilities, but have a cash surplus in its treasury.

"The number of car miles run was 24,056,973, an increase of 726,681 miles. The total number of revenue passengers carried was 101,746,407, an increase of 6,704,460 passengers.

"The number of transfers used was 39,363,604, an increase of 4,021,070. The average earnings per car mile were 20 96-100 cents, and the cost of service 9 36-100 cents. The percentage of operating expenses to gross earnings was 44 67-100 per cent, a reduction of 2 3-100 per cent from 1901.

"On Aug. 13 your company gave to the Continental Trust Company an option on its 40,000 shares (the entire common stock) of the United Electric Light & Power Company, conditioned upon acceptance by Nov. 15 and payment of the consideration, $904,237.39, by Jan. 15, the terms having all been complied with, the property was duly transferred on the latter date, Jan. 15, 1903.

"The nearly 40,000,000 transfers issued during the year should be taken as the best evidence that the public has been greatly benefited by the consolidation of lines, which has rendered the offering of the transfer privilege and the availing of it on such an extended scale possible.

"The facilities afforded by the company enter into the daily life of almost the entire population of our city and surrounding country, and as the nearly $70,000,000 of securities of the company are held by our own people it will be seen that, in round figures, not only do they receive back the $2,600,000 of fixed charges, but likewise the major part of the $2,200,000 disbursed by the company for labor and material used in its operations, while as yet no return has come to the stockholders, the real owners of the property."

The consolidated general balance sheet of the company as of Dec. 31, 1902, shows:

CONSOLIDATED GENERAL BALANCE SHEET OF THE UNITED RAILWAYS & ELECTRIC COMPANY OF DEC. 31, 1902

ASSETS

Cost of road, equipment and real estate		$64,498,929
Investments—		
Stocks and bonds of other companies owned and controlled by the United Railways & Electric Company of Baltimore		2,697,212
Current Assets—		
Cash	$100,737	
Bills and accounts receivable	1,064,611	
Supplies and coal on hand	181,814	
		1,347,162
		$68,543,303

LIABILITIES

Capital Stock—		
Common	$15,000,000	
Preferred	65,306	
		$15,065,306
Funded Debt—		
Convertible 5 % 1906	$527,000	
First mortgage 5 % 1911	2,000,000	
Certificate of indebtedness 4½% 1911	500,000	
First mortgage 6 % 1912	41,000	
B. C. & E. M. 5 % 1916	500,000	
C. & S. 5 % 1922	3,000,000	
First mortgage 5 % 1929	1,500,000	
Consolidated mortgage 5 % 1932	659,000	
E. & I. 5 % 1932	600,000	
L. R. E. 5 % 1942	1,000,000	
N. B. 5 % 1942	1,750,000	
B. & N. 5 % 1947	139,000	
First consolidated 4 % 1949	25,231,000	
Income 4 % 1949	13,934,694	
		$51,381,694
Current Liabilities—		
Accounts payable	$146,650	
Outstanding tickets and transfers	8,875	
*Bills payable	1,047,855	
Accrued interest	426,213	
Accrued park tax	86,605	
Accrued interest on income bonds and dividend on preferred stock	46,667	
		$1,762,865
Surplus		$333,438
		$68,543,303

* Since the preparation of the above statement $904,237.59, received from sale of stock of the Lighting Company, has been applied to the payment of floating debt.

IMPORTANT RULINGS BY THE RAILROAD COMMISSIONERS OF MASSACHUSETTS

The Railroad Commissioners of Massaehusetts have issued an important order on the petition of the Hartford & Worcester Street Railway Company for approval of loeations and authority to construct over private land.

It seems that the Hartford & Woreester Company obtained locations in Wales, Holland, Brimfield, Sturbridge and Leicester whieh became valid without action by the board, having been accepted before the law went into effect to make street railway locations subject to the supervision of the Railroad Commissioners. Subsequently it became apparent that owing to the heavy grades and sharp curves in portions of the highways in which these loeations were granted a railway could not be operated over them safely. For this reason it is now proposed to build the railway for a part of the route upon private property, and to carry out this purpose certain other locations rendered necessary by this change in plan have been obtained. Under the legislation of last winter these later locations cannot become valid without a eertificate from the board that they are eonsistent with public interest.

The Woreester & Southbridge Street Railway, an established line between Woreester and Southbridge over a eircuitous route, is opposing the construction of the Hartford & Worcester Railway, and contended, among other things, that the Hartford & Woreester Company had no standing at present before the board; that the locations serve no useful purpose and are parts of a railway project which as a whole involves needless capitalization, and that the locations are neither original locations nor valid amendments or alterations of loeations.

On all of these counts the commissioners find for the Hartford & Worcester Company. In regard to constructing over private land, the commissioners rule as follows:

"The petitioner also asks authority to build over private land in Leicester. In this, as in other towns in which such authority has been given, construetion for a considerable distance over private lands is in the interest of safe operation. We therefore find that public necessity and convenience demand the construction of the railway over private lands in the town of Leicester. This is stated to be for the purpose of avoiding undesirable grades and curves, but the authority is granted with a stipulation that on approaching a public street or way to be crossed at the same level the car shall come to a full stop within 100 feet, and that in crossing the speed shall not exceed 4 miles an hour, and that suitable signs shall be maintained at each such crossing."

Announcement has been made that the case is to be carried to the courts by the Worcester & Southbridge Company.

On the question of approving locations granted by the Selectmen of Southboro to the Boston & Worcester Street Railway and the petition of the company for a grant of connecting locations in Southboro, the Railroad Commissioners of Massachusetts have issued one of the most important rulings of the year.

The Boston & Worcester Street Railway, now building under special charter between Boston and Worcester, for the better conduct of the enterprise, decided to abandon its original purpose in Southboro and leave the streets in that town for a route over private lands. In connection with this change in plan it became necessary to obtain locations across several highways. The Selectmen of Southboro, after protracted hearings, declined to grant crossings at grade over the Parkerville, Central and Cemetery roads, so-called, as requested by the company, but required the railway to pass under these ways. The Selectmen sought the approval of the locations before the Railroad Commissioners, while the company, on the other hand, having refused to accept the locations, presented a petition to the Railroad Commissioners for a connecting location under section 11, chapter 112, Revised Laws.

The contention of the company was that the railway should cross these highways at grade, as that method of construction involved the least cost and gives the best grade for operation. The Selectmen and others remonstrated against this as unsafe and contrary to the best public policy.

In their annual report of 1902 the Railroad Commissioners said that the electric car, "moving over private land or a way of its own, aproaches a highway under practically like conditions with the railroad train. When such crossings can be avoided at an expense not too burdensome this should be done. It is better to pay the cost of safe construction at the outset than to meet the greater cost of changes in the future." The Railroad Commissioners said, in ruling on the petition, that they found no reason to change the views thus stated in their annual report, it following that unless the expense of carrying the railway over or under these highways is disproportionate, crossings at grade must be denied, and that the dangers of construction at grade at these points, though considerable, is not sueh as to make it an unreasonable requirement, in view of the eharacter of the serviee which the company proposes to perform. Their ruling is that one overhead and two underneath crossings are to be constructed.

THE FRANCHISE TAX SUIT IN NEW YORK

Attorney-General Cunneen, of New York, is preparing his brief from whieh he will argue before the Court of Appeals the appeal of the State from the decision of the appellate division, third department, in declaring eertain provisions of the special franchise tax law to be unconstitutional. Charles A. Collin, one of the leading attorneys representing the corporations, was in Albany on Feb. 28 to see Mr. Cunneen, and informed him that the corporations are about ready to present their side of the case.

The Court of Appeals will adjourn this week until late in March, and it is probable that during the week a representative of the Attorney-General and one for the corporations will appear before the court to request the fixing of a date for the hearing of the appeal. If a simple notice of argument was given the cases would go over, under the rules of the court, until January, 1904. The probability is that the court will fix some day of the first week of its next session for the hearing of the appeal.

As not less than two weeks will be required to reach a decision and write such opinions as may be necessary to express the views of the court, a final determination of this litigation cannot be had before the middle of April. It is known that Governor Odell is anxious to have this question decided in time for the passage of such legislation as may be required to remedy any unconstitutional features of the law and to provide in some proper manner for the taxation of special franchises.

It is understood that the five attorneys who represented the corporations in the case before the appellate division in presenting the arguments for their side before the Court of Appeals will each argue one of the questions involved. These questions will inelude, first, the right of the Legislature to classify special franchises as real estate; second, a question of a conflict of the franehise tax act with the home-rule provision of the State constitution; third, its violation of the section of the Federal eonstitution governing the inviolability of eontracts; fourth, the failure of the State Board of Tax Commissioners to separate the value of the intangible from that of the tangible property constituting the franchise; fifth, the failure of the board to assess separately the various franchises operated by each corporation, and, sixth, special questions local to the individual corporations concerned.

PRACTICAL ENGINEERING AT LEHIGH UNIVERSITY

Dr. W. S. Franklin, head of the electrical engineering department of Lehigh University, and Professor William Esty have introduced this year as part of the electrical engineering course at that university a series of lectures on practical topics by practicing engineers. Among the lecturers secured this year are W. C. Gotshall, of New York, who is delivering a course on "Preliminary Engineering and Development for Electric Railway Enterprises," and C. O. Mailloux, whose topic is "Electric Light Wiring." Mr. Mailloux has also recently delivered a lecture on "Some of the Factors Bearing on the Success and Career of the Consulting Engineer." The university is to be congratulated on having secured lectures from engineers of the standing of Messrs. Gotshall and Mailloux and also for having established such an important adjunct to a university training in electrical engineering.

QUESTION OF STATE SUPERVISION IN MICHIGAN

The Michigan Legislature has under consideration a bill to bring electric railways under the jurisdiction and control of the Commissioner of Railroads to the same extent and in the same manner as steam roads are now controlled. At the present time the only control exercised by the State over these companies is in regard to their crossing with steam roads, all such crossings being subject to the approval of the Commissioner of Railroads.

Objection to this plan of supervision is raised by the farmer members of the Legislature, who claim that, inasmuch as cities are allowed full control over the street railways, that justice would demand that townships should have the same privilege, as these roads are of necessity very largely local in their nature and business. Their contention is that the local authorities are abundantly able to regulate and control them without any interference on the part of Stae authority.

The electric railway men are somewhat divided upon the ques-

tion, but all agree that if they are to be subjected to additional regulation they should also be granted additional rights and privileges and should be allowed the same rights and privileges in the matter of the condemnation of property for the construction of their lines as are now given to their competitors, the steam railroads.

40,000-VOLT TRANSMISSION PLANT IN ITALY

The Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, has recently received an order which, both for its importance and for the special circumstances pertaining to it, seem worthy of a few remarks. The order alluded to embraces the exploitation of the water power of the Caffaro River and its transformation into electrical energy. The Caffaro River has its spring on the Alps, which form the frontier between Italy and Tyrol, and discharges its waters into the Chiesa River.

The complete installation is calculated for a total output of 15,000 hp, measured at the turbine shafts, and comprises two separate power stations. The up-stream station, which will be built later on, will supply 5,000 hp, while the hydro-electric power station going to be erected now and situate within the Italian township of Bageline will make some 10,000 hp available. In both central stations, which after erection shall work in series, the three-phase current of 9000-volt 42 cycles taken from the generator terminals will be transformed up to 40,000 volts.

The current of 40,000-volt tension is transmitted to Brescia, some 40 km distant, where it is partly used for power and light distribution in the province of Brescia and partly for operating large electro-chemical works.

The down-stream station, which is now in course of construction, commands a water power of 4000 liters per second, with a head of 254 meters, which corresponds to an effective turbine output of 10,160 hp.

The upper-water channel has a length of 4500 meters and passes three tunnels, one of which is 2300 meters long.

In the down-stream central station five hydro-electric groups of a capacity of 2500 hp each will be installed. Each group consists of a turbine which is directly coupled to a three-phase generator and makes 315 r. p. m. Besides these large groups there will also be two smaller turbines erected of 160 hp output each and with a speed of 600 r. p. m., they are coupled each to an exciter generator. One exciter suffices for four three-phase generators, so that the other exciter, as well as the fifth hydro-electric group, serve as a reserve.

The three-phase generators are calculated for absorbing 2500 hp with a power factor of 0.75, and will have an output of 2340 k. v. a. The three-phase current generated by them has, as stated above, a voltage of 9000 and a frequency of 42 cycles.

Five step-up transformers, each of 2340 k. v. a., will bring the pressure of the current up to 40,000 volts, which, after transmission of the current, is by an even number of step-down transformers transformed down to the working pressure.

This installation may call for special interest as being the first plant in Europe that makes use of a high-pressure current of 40,000 volts and transformers with a capacity exceeding 2000 kw.

FOREIGN TECHNICAL PUBLICATIONS

Science Abstracts will be presented in a different form hereafter, the most important change being in the division of the contents into two parts, sections A and B. The latter includes steam plants, gas and oil engines, electrical engineering and apparatus and electrical distribution, traction and lighting. The American Physical Society is now joined with the Institute of Electrical Engineering and the Physical Society of London in the direction of the publication, and has elected Professor E. H. Hall, of Harvard University, its representative on the publishing committee. The American Institute of Lighting is also co-operating with the committee, it is announced.

The Engineering Digest, a new publication which proposes to be a useful ally to existing engineering periodicals, is announced by D. N. Dunlop & Company, of Effingham House, Arundel Street, Strand, London, W. C. It will be a 6-penny weekly index and review of contemporary engineering literature and a survey of the principal technical press of Great Britain, America and Europe. This weekly index and digest will supply a short expert summary indicating the purpose and character of each article, the author's name, the length of the matter and the name and price of the periodical in which it is published. Certain original features, such as the Man of the Week, the Book of the Week, a digest of new Catalogues and Trade Publications, a Buyer's Encyclopedia, a section devoted to matters bearing on Business System and Organization, and a Commercial Information Bureau will be added.

The Universal Electrical Directory for 1903 has just been published by Alabaster, Gatehouse & Company, of London. It contains the names of the members of the electrical and kindred industries throughout the world. The book has been most thoroughly revised. The British alphabetical section now comprises 11,080 distinct names, the continental section 9405, the United States 7040 and the colonial 3465, aggregating 30,990. For simplicity and facility of reference it is divided into four groups, namely, British, Continental, United States and Colonial, which are again sub-divided into alphabetical and classified sections. In addition to the names incorporated in the present issue, much financial information is given, the telephonic addresses and local telephone numbers are given and the pages added to the work are eighty-one in number as compared with that of 1902, making in all about 1350 pages entirely of directory matter. The lists of central stations in the United Kingdom and colonies have again been considerably added to. and the engineer's name, system of distribution and the voltage has been included.

BRITISH RAILWAY OFFICIALS TO STUDY AMERICAN METHODS

Important conferences between the consulting engineers of all railroads in Great Britain were held in London last week, with the object of deciding on a uniform scheme for electric equipment, whereby the rolling stock and electric motors of the various companies will be able to travel indiscriminately on all the lines.

Six officials of the traffic and engineering departments of the London & North-Western Railroad sailed for New York on the White Star Line steamer Oceanic (which left Liverpool Feb. 25) to make a further study of American methods.

PERSONAL MENTION

MR. A. F. WALTER has resigned as general superintendent of the Michigan Traction Company, of Kalamazoo, Mich., owing to ill-health.

MR. C. S. DARRACH was apointed on Feb. 1 freight agent and car accountant of the St. Louis & Belleville Electric Railway Company to succeed Mr. R. L. Rausch, who had resigned.

MR. G. L. ESTABROOK was recently elected secretary and treasurer of the St. Louis & Suburban Railway Company and Mr. T. W. Gregory assistant secretary and treasurer of the company.

CAPTAIN JOSEPH M. DICKEY, of Newburg, N. Y., has assumed the duties of his new position as a member of the State Board of Railroad Commissioners. The board has reorganized by electing Colonel George W. Dunn chairman to succeed Colonel Cole.

MR. P. W. DAVIES, formerly secretary of the British Electric Traction Company, Ltd., and Mr. Thomas G. Hansen, also of the British Electric Traction Company, and formerly of the Clevcland Electric Company and the Northern Ohio Traction Company, have formed a new company to be entitled The Railways and Tramways Inspection Company, with offices in London. The company will act in an advisory capacity to existing tramway enterprises.

MR. CHARLES S. POWELL, who has been associated with the Westinghouse electrical interests since 1893, and who for the last six years has been manager of the Cleveland office of the Westinghouse Electric & Manufacturing Company, has changed the scene of his activities from the United States to Europe. He has been appointed assistant manager of the British Westinghouse Electric & Manufacturing Company, Ltd., and has already entered upon the duties of his new position. Mr. Powell's headquarters are in the Westinghouse building, Norfolk Street, Strand, London, W. C.

MR. J. J. SULLIVAN has been elected president of the American Railways Company to fill the vacancy caused by the death of Mr. Samuel G. De Coursey, and Mr. C. L. S. Tingley has been elected a director of the company to succeed Mr. De Coursey. Mr. Tingley has also been elected second vice-president of the company and Mr. Walter W. Perkins has been elected secretary and treasurer of the company, vice Mr. C. L. S. Tingley. Mr. Frank J. Pryor, Jr., has been elected comptroller and assistant treasurer of the company. Mr. Sullivan has become president of the company, with the distinct understanding that it is only temporary and that he is at liberty to retire at any time.

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* Comparison is made with 1900 because in 1901 the earnings were abnormal on account of the Pan-American Exposition. *b* Exposition opened Dec. 1 *c* Including Cleveland & Southern and Norwalk Gas & Electric Co. *d* Including Rapid Ry. system and Sandwich, Windsor & Amherstburg Ry. Co.

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O.						
Northern Ohio Tr. Co.	1 m., Jan. '03	58,787	34,843	23,944	20,966	2,978
	1 " " '02	48,287	29,184	19,103	12,750	6,353
	6 " June '02	318,937	185,362	133,575	77,556	56,018
	6 " " '01	268,967	164,458	104,510	63,494	41,016
	12 " Dec. '02	745,044	410,793	334,251	155,068	179,183
	12 " " '01	617,011	350,845	266,166	136,162	130,004
ALBANY, N. Y.						
United Traction Co.	1 m., Jan. '03	129,782	87,455	42,327	23,778	18,548
	1 " " '02	118,979	89,126	29,853	21,963	7,890
BINGHAMTON, N. Y.						
Binghamton St. Ry. Co.	1 m., Jan. '03	16,287	11,586	4,701	------	------
	1 " " '02	14,873	10,599	4,273	------	------
	7 " " '03	132,904	75,052	57,852	------	------
	7 " " '02	128,262	66,643	61,619	------	------
BOSTON, MASS.						
Boston Elev. Ry. Co.	12 m., Sept. '02	11,321,030	7,862,571	3,458,458	2,836,560	621,898
	12 " " '01	10,869,496	7,336,597	3,532,899	2,896,359	636,539
Massachusetts Elec. Cos	12 m., Sept. '02	6,090,168	3,827,372	2,262,796	1,391,239	871,557
	12 " " '01	5,778,133	3,915,486	1,862,648	937,206	925,442
BROOKLYN, N. Y.						
Brooklyn R. T. Co.	1 m., Dec. '02	1,076,193	655,896	420,296	------	------
	1 " " '01	1,038,158	686,623	351,536	------	------
	6 " " '02	6,836,370	3,785,175	2,051,194	------	------
	6 " " '01	6,513,239	4,083,729	2,429,510	------	------
	12 " June '02	12,789,705	*8952214	3,837,490	------	------
	12 " " '01	12,101,198	*7970635	4,130,563	------	------
BUFFALO, N. Y.						
International Tr. Co.	1 m., Jan. '03	291,490	166,051	125,440	129,195	+3,756
	1 " " '02	256,595	152,560	104,034	124,866	+20,831
	7 " " '03	2,215,180	1,165,706	1,049,475	903,750	145,724
	7 " " '02	1,813,652	875,350	938,301	*889,294	49,007
CHARLESTON, S. C.						
Charleston Consol'ted Ry. Gas & El. Co.	1 m., Dec. '02	45,872	29,364	16,508	12,605	3,903
	1 " " '01	*b* 60,092	29,957	30,134	12,673	17,461
	10 " " '02	524,654	312,584	212,069	125,921	86,148
	10 " " '01	427,174	267,941	159,233	128,092	31,141
CHICAGO, ILL.						
Chicago & Milwaukee Elec. Ry. Co.	1 m., Jan. '03	12,035	6,571	5,465	------	------
	1 " " '02	10,954	5,873	5,081	------	------
	12 " " '02	190,110	79,364	110,746	------	------
	12 " " '01	171,172	74,015	97,157	------	------
CLEVELAND, O.						
Eastern Ohio Traction Co.	1 m., Oct. '02	17,365	10,142	7,224	6,033	1,190
	10 " " '02	161,071	89,603	71,468	54,574	16,894
Cleveland, Elyria & Western	1 m., *c* Jan. '03	26,949	19,615	7,334	------	------
	1 " *c* " '02	18,760	12,983	5,778	------	------
	12 " " '02	300,846	171,074	129,771	64,250	65,521
	12 " " '01	249,260	136,865	112,394	57,023	55,371
Cleveland, Painesville & Eastern	1 m., Dec. '02	12,473	8,435	4,038	------	------
	1 " " '01	11,920	6,681	5,239	------	------
	12 " " '02	189,187	105,670	83,518	74,552	8,966
	12 " " '01	164,971	87,102	77,869	71,296	6,573
COVINGTON, KY.						
Cincinnati, Newport & Covington Ry. Co.	1 m. Dec. '02	100,587	53,950	46,638	23,886	22,752
	1 " " '01	69,803	42,175	27,628	16,223	11,405
	12 " " '02	1,103,995	610,444	493,551	255,873	237,677
	12 " " '01	819,266	485,264	333,942	188,362	145,580
DETROIT, MICH.						
Detroit United Ry.	1 m., Jan. '03	284,641	170,949	113,693	70,188	43,505
	1 " " '02	251,084	147,724	108,360	64,216	44,144
	12 " *d* " '03	321,145	*195,938	125,207	81,157	44,051
Detroit and Port Huron Shore Line (Rapid Ry. System)	1 m., Nov. '02	32,117	*21,187	10,930	------	------
	1 " " '01	27,979	*17,446	10,533	------	------
	5 " " '02	204,644	*117,364	87,280	------	------
	5 " " '01	184,935	*99,350	85,585	------	------
DULUTH, MINN.						
Duluth-Superior Tr.	1 m., Dec. '02	48,769	28,699	20,070	10,054	10,016
	1 " " '01	40,541	25,042	15,499	9,212	6,287
	12 " " '02	538,031	288,373	249,658	116,275	133,382
	12 " " '01	453,704	251,315	202,389	109,967	92,422
ELGIN, ILL.						
Elgin, Aurora & Southern Tr.	1 m., Jan. '03	33,254	21,301	11,953	8,333	3,619
	1 " " '02	29,075	17,537	11,537	8,333	3,204
	12 " " '02	410,431	243,653	166,778	100,000	66,778
	12 " " '01	361,665	206,005	155,660	100,000	55,660
FINDLAY, O.						
Toledo, Bowl'g Green & Southern Traction Co.	1 m., Nov. '02	24,289	13,173	11,116	1,991	9,126
	1 " " '01	15,833	11,067	4,766	635	4,130
	7 " " '02	142,108	76,228	65,880	28,989	36,890
	7 " " '01	105,329	67,679	37,649	20,752	16,898
HAMILTON, O.						
The Cincinnati, Dayton & Toledo Trac. Co.	1 m., Jan. '03	32,693	22,689	10,003	15,915	+5,912
	1 " " '02	28,577	17,212	11,365	16,410	+5,045
	8 " " '03	335,361	178,724	156,637	129,775	26,862
LONDON, ONT.						
London St. Ry Co.	1 m. Jan. '03	12,133	8,591	3,541	2,205	1,336
	1 " " '02	10,118	7,079	3,039	2,249	790
	12 " " '02	154,704	93,248	61,456	25,983	35,473
	12 " " '01	141,846	84,557	57,289	23,835	33,454
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co.	1 " Jan. '03	244,469	129,402	115,067	71,098	43,969
	1 " " '02	214,884	106,532	108,352	65,402	42,950
	12 " " '02	2,776,293	1,286,035	1,490,258	803,546	686,713
	12 " " '01	2,442,342	1,185,534	1,256,808	755,139	501,669
MINNEAPOLIS, MINN.						
Twin City R. T. Co.	1 m., Jan. '03	311,837	148,575	163,262	78,400	84,862
	1 " " '02	272,158	132,419	139,739	76,017	63,722
	12 " " '02	3,612,211	1,630,170	1,982,041	711,718	1,270,324
	12 " " '01	3,173,976	1,415,452	1,758,524	666,637	1,091,886
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., Jan. '03	172,143	110,611	61,532	16,516	45,016
	1 " " '02	155,030	100,538	54,491	15,094	39,396
	4 " " '03	703,788	424,576	279,213	65,990	213,222
	4 " " '02	634,199	387,846	246,353	59,630	186,723
NEW YORK CITY.						
Manhattan Ry. Co.	12 m., Sept. '02	11,583,546	5,545,395	6,038,151	2,712,089	3,326,062
	12 " " '01	10,455,872	5,328,649	5,127,223	2,683,132	2,444,091
OLEAN, N. Y.						
Olean St. Ry. Co.	1 m., Jan. '03	5,557	3,236	2,321	1,942	379
	1 " " '02	3,947	2,480	1,467	1,738	+271
	7 " " '03	42,940	22,283	19,657	10,243	9,414
	7 " " '02	34,460	16,441	18,020	10,051	7,969
PEEKSKILL, N. Y.						
Peekskill Lighting & R. R. Co	1 m., Oct. '02	9,023	5,706	3,317	2,083	1,234
	4 " " '02	37,696	21,586	16,110	8,333	7,777
	12 " June '02	86,795	*56,392	30,402	23,125	7,277
PHILADELPHIA, PA.						
Union Traction Co.	12 m., June '02	14,118,159	6,402,338	7,715,820	*6637781	1,078,038
	12 " " '01	13,431,681	5,836,186	7,595,494	*6734328	861,266
American Railways	1 m., Jan. '03	89,890	------	------	------	------
	1 " " '02	78,736	------	------	------	------
	7 " " '03	729,816	------	------	------	------
	7 " " '02	579,946	------	------	------	------
	12 " June '02	1,009,509	------	------	------	------
	12 " " '01	844,298	------	------	------	------
PUEBLO, COL.						
Pueblo & Suburban Traction & Lt. Co.	1 m., Dec. '02	40,583	20,249	20,334	11,249	9,085
	1 " " '03	26,780	13,501	13,279	4,050	9,229
	" " '03	38,521	*31,310	7,211	------	------
ROCHESTER, N. Y.						
Rochester Ry.	1 m., Jan. '03	101,634	54,242	47,392	25,586	21,806
	1 " " '02	91,221	50,853	40,368	24,848	15,520
	12 " " '02	1,107,738	576,922	530,816	302,061	228,754
	12 " " '01	1,022,009	589,199	432,810	301,138	131,671
SYRACUSE, N. Y.						
Syracuse R. T. Co.	1 m., Jan. '03	64,357	36,536	27,820	19,025	8,795
	1 " " '02	58,819	32,890	25,928	19,025	6,903
	7 " " '03	436,096	239,604	196,486	133,175	63,311
	7 " " '02	405,489	221,177	184,312	133,121	51,192
TOLEDO, O.						
Toledo Ry. & Lt. Co.	1 m., Jan. '03	125,494	62,397	63,097	39,458	23,639
	1 " " '02	113,178	57,767	55,410	37,828	17,583
	12 " " '02	1,459,091	*726,779	732,312	------	------
	12 " " '01	1,311,084	*636,407	674,677	------	------
Lake Shore Elec. Ry. Co.	1 m., Nov. '02	42,540	30,982	11,558	------	------
	1 " " '01	27,778	20 064	7,714	------	------
NEW BRIGHTON, S. I.	11 " " '02	416,390	275,693	140,697	------	------
	11 " " '01	329,376	217,518	111,858	------	------
Richmond Light & R. R. Co., formerly Staten Island Elec. Ry.	3 m., Sept. '02	73 687	43,950	29,737	18,950	10,807
	3 " " '01	80,197	42,103	38,094	27,221	10,873
YOUNGSTOWN, O.						
Youngstown - Sharon Ry. & Lt. Co.	1 m., Dec. '02	47,857	*24,729	23,129	------	------
	12 " " '02	444,986	*244,972	200,014	------	------

NEWS OF THE WEEK

CONSTRUCTION NOTES

TEXARKANA, ARK.—The first electric car in Texarkana was placed in operation Feb. 13. Work is progressing rapidly on the lines being built here, and it is promised that 5 miles of line will be in operation by April 1.

SACRAMENTO, CAL.—The Sacramento Electric Railway Company is building a repair shop adjoining its car houses at Twenty-Ninth and U Streets.

WATSONVILLE, CAL.—The Watsonville Transportation Company has been incorporated, with a capital stock of $1,000,000, to build an electric railway from Watsonville to Monterey Bay, a distance of 5 miles. F. A. Kilburn, R. W. Eaton and H. H. Main are among the incorporators of the company.

LOS ANGELES, CAL.—It is reported that during the last thirty days surveyors have been busy along the foothills between Pasadena and Monrovia with a view to an electric railway that may eventually reach as far east of Monrovia as Pomena, running through Lamanda Park, Sierra Madre, Santa Anita, North Arcadia, Monrovia and Duarte. The length of the proposed route is from 10 miles to 20 miles. It looks as if the project might be in opposition to the Pacific Electric Railway Company, which even now has its line quite built to Monrovia from Los Angeles. About two years ago the Stebbins-Conenwett Company, a Monrovia corporation, secured through private property nearly a complete right of way for an electric railway between Monrovia and Pasadena, and acting with the company was the Pasadena Business Men's Protective Association. But when the franchise was bid for under the Broughton act, the Huntington-Hellman syndicate stepped in and secured a double franchise through Monrovia for $8,000, whereupon the Stebbins-Conenwett scheme was dropped for the time being. Now that recent surveys have again been made along the foothills gives rise to the belief that the old plan has been revived, inasmuch as the Huntington-Hellman line as built does not touch intermediate foothill points.

WINDSOR LOCKS, CONN.—The Windsor Locks & Rainbow Street Railway Company, which secured a charter from the General Assembly in 1901, has filed a certificate of organization. Henry A. Huntington has been elected president, and Frank E. Healy, secretary. The corporation is authorized to build a street railway from Windsor across the town of Windsor Locks to Suffield. Its capital stock is $100,000, and it is authorized to carry freight as well as passengers.

WASHINGTON, D. C.—The Washington, Alexandria & Mount Vernon Railway Company has decided to construct a double track for its line from the Four-Mile power house to Alexandria, and contracts for the work will be awarded within a few weeks. The proposed improvement will be pushed as rapidly as possible to provide for the increased summer business resulting from large parties of tourists already scheduled. More equipment has already been purchased and two large cars of modern design have been ordered for immediate delivery. These cars will be placed in service between Washington and Mount Vernon, and the summer schedule, which takes effect in May, will be given additional trains between Washington and Alexandria. The double track between Washington and the Four-Mile power house has been completed and the track facilities at the power house are now undergoing extensive improvements.

BOISE, IDAHO.—The Intermountain Electric Company has begun work on its proposed electric railway system here.

BELLEVILLE, ILL.—The City Council is to act at once on the petition of the Belleville Interurban Electric Railroad Company for a franchise for an electric railway in this city. The company proposes to build lines from different points in St. Clair County to East St. Louis.

BLOOMINGTON, ILL.—It is said that practically all the right of way has been secured for the proposed electric railway between Bloomington and Decatur. It will be necessary to bring condemnation proceedings in a number of cases.

QUINCY, ILL.—E. H. Arnold, chief engineer of the Quincy & Western Illinois Electric Railway Company, has opened offices in the Wells Building, and the announcement is made that final arrangements are to be made at once for building the company's proposed lines. Bracey, Howard & Company have the contract for building.

WOODLAWN, ILL.—The Southern Illinois Electric Railroad is the name of the new electric railway to be constructed through Woodlawn from Belleville to Evensville, Ind., in the spring. Hon. John R. Piercy, of Mount Vernon, is the promoter of the enterprise.

DECATUR, ILL.—W. L. Shellabarger, secretary of the Decatur Traction Company, admits that interests identified with the Decatur Company are interested in the plan to build an electric railway from Decatur to Springfield. The right of way that was completed by the Everett-Moore syndicate between Riverton and Niantic has been secured. According to Mr. Schallerbarger, only a few preliminary details remain to be closed before actual work is begun on the line.

VANDALIA, ILL.—The St. Louis, Vandalia & Eastern Electric Railway Company has just been incorporated, with a capital stock of $50,000. The incorporators of the company are: William M. Folger, Charles G. Sonneman and George D. Steinhauer.

TERRE HAUTE, IND.—Representatives of Stone & Webster, of Boston, owners of the Terre Haute Electric Company, are in Terre Haute to arrange the engineering details for building the proposed electric lines from West Terre Haute to the Wabash River and from Terre Haute to Clinton. The road will ultimately cross the river to Paris, Ill.

HOBART, IND.—The City Council has granted a franchise to the Hobart & Western Electric Railway Company. The company plans to build a double-track third-rail line from Valparaiso to Chicago via this city. Samuel A. Wright, of Chicago, is president.

DANVILLE, IND.—W. F. Churchman and Everett Wagoner, prominent bankers and chief incorporators of the Indianapolis, Danville & Rockville Electric Railway, made a tour of inspection of the proposed route a few days ago, and now announce that the line will be constructed at once. Estimates of the cost of construction are now being prepared. It is decided to build the power house at Danville. This line will open up an important field and will reach toward the coal fields. It is now believed it will ultimately connect with the Coal Belt Road, building from the Sullivan fields, and afford the latter a direct route into Indianapolis.

INDIANAPOLIS, IND.—The following bills affecting interurban lines have been introduced in the Legislature: Permitting interurban companies to charge 12½ per cent of amount of pounds of baggage being allowed on one ticket; permitting interurban or electric lines to be incorporated under a special railway law, thereby removing them from the incorporation requirements of steam roads; requiring interurban lines to employ train despatchers, and requiring interurban lines to fence their tracks and construct cattle-guards.

SHELBYVILLE, IND.—The Indianapolis, Shelbyville & Southeastern Traction Company has decided to extend its lines from Shelbyville through Greensburg to Batesville.

GREENFIELD, IND.—The Indianapolis & Eastern Traction Company is making important improvements at its power house at Charlottsville. A large amount of new machinery is being installed.

RUSHVILLE, IND.—A large power house will be erected here on a site selected by Charles L. Henry, president of the Indianapolis-Cincinnati Traction Company. The building, when equipped, will cost $200,000. President Henry's office is in Indianapolis.

CLINTON, IA.—The Iowa & Illinois Interurban Railway Company has perfected its organization, electing the following officers: George D. McDaid, of Clinton, president; George W. Bawden, of Davenport, vice-president; Frank Ellis, of Clinton, secretary; Garrett E. Lamb, of Clinton, treasurer; Thos. J. Wilcox, of Clinton, general manager; the officers and R. B. McCoy and E. A. Ferrin, of Philadelphia, comprise the board of directors. The contract for building the company's proposed lines is held by Pepper & Register, of Philadelphia, and the announcement is made that construction work is to be begun at once.

COVINGTON, KY.—J. C. Ernst, of the South Covington & Cincinnati Street Railway, announces that the Evergreen and Fort Thomas lines are to be connected and operated as a belt line.

LOUISVILLE, KY.—The Fiscal Court has adopted a resolution providing for the sale of a franchise for an electric railway to Valley Station and Riverview. The upset price is 500 per mile, and the road will have to use about 5 miles of the county highway. It is said that a company is being organized to bid in the franchise. Officials of the Louisville Railway Company are quoted as denying that the company will bid for the franchise.

ALGIERS, LA.—There is to be introduced in the Council at its next session an ordinance providing for the sale of a street railway franchise here. It is understood that an Eastern syndicate will bid in the grant.

BOSTON, MASS.—The Boston Transit Commission has decided to carry the East Boston tunnel beneath the Scollay Square station of the present Boston subway. The present floor of the Scollay Square platform will become the tunnel roof, and a system of stairs will connect the two structures. There will be a tunnel station at this point, and the two tracks will probably run through the center, with broad platforms on both sides, as is planned for the old State House station, and then continue on through the square under Court Street to Bowdoin Square. The details of the section from the old State House to Scollay Square have not yet been worked out. The old State House is now completely undermined and is resting on temporary supports. The excavation is nearly completed around it to the full depth of the station. Work on the lower section of State Street is progressing rapidly, and two gangs of 130 men each are employed in operating the construction shield night and day. About 300 ft. are completed from the shaft opposite the Custom House down toward Atlantic Avenue. This section has 400 ft. remaining. Gow & Foss will soon begin work on the station at the junction of State Street and Atlantic Avenue. Already one of the side walls of this station has been built by the Boston Tunnel Construction Company, which is boring the tunnel under the harbor. There will be three stations on the Boston end of the tunnel proper, one at State Street and Atlantic Avenue, another in the old State House and a third at Scollay Square. It is undecided as to what will be built on the other side of Scollay Square, as the plans for rapid transit between Boston and Cambridge are not yet matured.

WORCESTER, MASS.—For the solution of the proposition of the Boston & Worcester Street Railway Company to cross at grade the Boston & Albany Railroad tracks, the railroad has submitted a plan for carrying the street railway tracks over the railroad tracks on a trestle. The estimated cost is $7,000. The street railway company is asking the Legislature for permission to cross at grade.