Street Railway Journal

VOL. XXI. NEW YORK, SATURDAY, MAY 2, 1903 No. 18

PUBLISHED EVERY SATURDAY BY THE
McGRAW PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, ENGINEERING BUILDING, 114 LIBERTY STREET.

BRANCH OFFICES:
Chicago: Monadnock Block.
Philadelphia: 929 Chestnut Street.
Cleveland: Cuyahoga Building.
London: Hastings House, Norfolk Street, Strand.

Cable Address, "Stryjourn, New York,"—Lieber's Code used.

TERMS OF SUBSCRIPTION

In the United States, Canada and Mexico.....$4.00 per annum
Single copies, first issue of each month, 25 cents; other issues, 10 cents.

To all Countries outside of the United States, Canada and Mexico.... { $6.00 / £1-5s / M 25 / Fr. 31

Single copies, first issue of each month, 40 cents; other issues, 15 cents.

Subscriptions payable in advance, by check or money order. Remittances for foreign subscriptions may be made through our European office.

Entered as second-class matter at the New York Post Office.

EDITORIAL NOTICE

Street railway news, and all information regarding changes of officers, new equipments, extensions, financial changes and new enterprises will be greatly appreciated for use in these columns.

All matter intended for publication must be received at our office not later than Tuesday morning of each week, in order to secure insertion in the current issue.

Address all communications to

THE STREET RAILWAY JOURNAL,
114 Liberty Street, New York.

Master Mechanics' Meeting

The newly-formed association of railway master mechanics and electricians is now assured a successful meeting at Saratoga in conjunction with the parent organization, and, judging from the enthusiasm displayed by those who have been actively engaged in the preliminary work, the movement to give increased prominence to the mechanical department of electric railway organization is recognized by the management of the properties that have been approached as an important step that should be commended and encouraged.

Up to the present time the master mechanics and the electricians of street railway properties have remained in the background, and it is quite probable that these conditions would continue indefinitely had it not been for the development of suburban service, and then the building of interurban lines, for which standards had to be adopted entirely different from those which have been followed heretofore. More than mere modification of old methods was needed to meet the new conditions; indeed, the departure in some instances was as radical as any made in the transformation from horse cars to trolley, and it was in the solution of problems thus presented that the mechanical department proved its importance in electric railroading to-day.

The new organization will have a tendency to develop still further capacity and invention in this branch of the service, and it will give opportunities for those engaged in this work to meet and discuss methods and devices employed on their respective systems. In time the new association should wield great influence in electric railroading, as conditions favorable to its growing importance are arising every day with the extension of the interurban field of operation.

The Saratoga meeting will have several excellent papers, and the discussions of these topics will doubtless prove valuable and interesting, but the influence of this gathering should not be measurable by these contributions alone, important though they may be, but the practical results growing out of this convention should be of much greater moment. The master mechanics now have an opportunity to meet and discuss subjects in which they are interested and to gain valuable information from those engaged in similar work on other roads, and the results should be of great benefit to the industry generally as well as the individual members and the properties they represent. There are great probabilities in this organization, and it remains wholly with the master mechanics themselves to determine whether they shall take advantage of these opportunities.

Some Problems in Hygiene

The recent experiments of the air in the London "Tuppenny Tubes" sets one a-thinking on the various questions of ventilation that arise in rapid transit systems. It is inevitable that when heavy traffic is crowded into an underground space the ventilation should leave much to be desired, but the London results make one somewhat anxious about the results in this Metropolis, where the traffic conditions are on the whole much more severe than in London, and the underground run per passenger will be longer. To be sure we shall not here deal with a deep tunnel of the London variety, while on the other hand the piston effect of the trains in the close-fitting tubes will be absent, and ventilation here must be purely artificial. In the London experiments it was found that the station elevators presented the worst conditions, while in the tunnel itself the air gradually righted itself to a considerable extent during the night. It is tolerably obvious that the tunnel space can be kept in fairly good condition by a proper system of fans.

We do not remember that the conditions in the Boston Subway have been investigated with any care, but the general impression made on patrons is that the air is kept in pretty good condition. In this instance the cars, both surface and elevated, make the major part of their runs in the open air, so that they can be taken care of by ordinary methods of ventilation. When, however, the cars are most or all of the time in the tunnel itself it is far from an easy matter to keep the air in the cars in even tolerably good condition, and ways and means for doing this are well worth consideration. Closed and heated cars cannot be crowded for several hours at a time without getting into a state of nastiness that is not pleasant to contemplate, to say nothing of the danger to health involved.

We have no desire to emulate a certain old lady of our acquaintance who always spread newspapers over the seat in any public conveyance before sitting down, but a census of microbes in the air of even a closed surface car, toward the close of the rush hours, would not be a cheerful subject of study. It would seem as though, from a hygienic standpoint, it would be desirable to introduce a systematic plan for ventilation of the cars on any underground line. The ordinary process of opening the roof ventilators or even the windows cannot be continuously

applied without violent protest on the part of the passengers. Would it not be possible to "blow off" the cars on an underground line at frequent intervals through the day, while at the termini, so as to change the air thoroughly and quickly? Estimating the cubical contents of a car at about 2500 cu. ft., it would be entirely possible to run, say, a four-car train under an exhaust hood, with its doors opposite air flues of equal area, and to blow it out in say two minutes if such haste were necessary. Certainly a very modest blowing outfit would enable the foul air to be cleared out and replaced by fresh air several times a day, and the effect would be most striking. It is quite impossible to air-out cars by natural draft without taking considerable time for it, but under forced draft the work can be very quickly done. An edict of the Board of Health against spitting in street cars produced a most salutary effect, but it certainly is at least as bad to have the air befouled as the floor, and there is no remedy available but ventilation and plenty of it. Bad air will not leave merely upon a polite invitation—it must be shown the door and kicked out. We hope the lesson of the London underground will not be wasted here.

Reformers Who Sell Short

The result of the investigation which is now being conducted in the New York courts to determine whether Mr. Amory is a "notorious person" has been an interesting one in more particulars than one, as those who have followed the summary of the investigation in this paper will have discovered. It has already been shown that well-known bear operators in Wall Street were closely connected with the alleged investigation into the finances of the Metropolitan Street Railway Company, and that considerable sums of money were made by selling the stock short as a result of tips furnished as to the time at which the alleged disclosures would be made public. The publication of the correspondence between those making the attack and those who were profiting by it has intensified the feeling in leading financial circles against tactics of this kind, and has solidified the sentiment which has always been favorable to the Metropolitan Street Railway Company. It has often been said that modern business is built up almost entirely on credit, so that any unjust attack on the credit of any company or individual has as direct an injury to person or corporation attacked as has the destruction of any other kind of property. This is particularly true in Wall Street matters, owing to the fact that the investors are proverbially timid and are often willing to sacrifice their stock in a company at the first rumor of suspicion against its stability or good faith.. Fortunately, the standing of the Metropolitan Street Railway Company and its backers is so high that the final announcement of the alleged discrepancy in its accounts caused practically no change in the quotations of its stock. Another reason was undoubtedly the offer promptly made by the management, upon publication of the charges, to open all of its books to the district attorney, with whom the charges had been filed, in order to allow him to make a thorough examination of the accounts of the company. While this might be perfectly practical with the Metropolitan Company and, perhaps, justifiable, we think that companies should have a means of defense against attacks of this kind other than that of being obliged to disclose all their details of operation to the public. Such an obligation will often give competitors information which they have no right to obtain, and in many cases would work a direct injury. The exhaustive report made by three independent public accountants of the accounts of the company and published in this issue is a complete refutation of the charges brought against the company.

The Power of Railroad Commissioners

An interesting decision and one very significant of the tendency to grant enlarged powers to State governing boards, such as railroad commissioners, has recently been rendered by the Supreme Court of Connecticut. The conditions under which the case was brought to the court were briefly as follows:

The street railway companies in Connecticut are obliged by law to do a certain amount of paving in the streets through which their tracks run. The Hartford Street Railway Company, acting under this law, applied to the city authorities for permission to replace certain asphalt pavement in the city of Hartford with creo-resinate wood paving. As the city authorities refused to grant this permission the railway company took an appeal to the Board of Railroad Commissioners, which, after investigating the proposal, "permitted and directed" the railway company to lay the paving between certain designated points in order to test its practicability and efficiency. The city authorities took an appeal from this action of the Commissioners to the courts, claiming that the Commissioners had no authority in the premises, but, according to the opinion just rendered, it is held that under the statutes the Railroad Commissioners are the supreme authority in matters of this kind.

The decision has naturally evoked a great deal of discussion in Connecticut and is the subject of considerable adverse criticism on the part of the city authorities, who claim that such a decision defeats home government and takes the streets away from the control of the citizens. This is undoubtedly true to a certain extent, but we believe that the interests of the greater number of people will be better conserved by the regulation of all such matters by a State Commission. It may have been proper, when street railway companies confined their operations within the limits of one city, to make the authorities of that city the judges of what is required. But at present there is hardly a street railway in the country whose lines lie within the boundaries of one city. All of them serve suburban territory as well, and many of them connect a large number of different cities, towns and villages. It is certain, therefore, that questions will arise which vitally affect large numbers of people who will not be represented if problems of this kind are settled by the authorities of the municipality in which they arise.

The question is one which, of course, depends entirely on State statute, so that however important this decision is in Connecticut it will not affect roads outside of that State. The tendency is and will be, however, in all States to increase the powers of State boards in matters of this kind. At present there are hardly two States in the country in which the railroad laws are uniform. As is well known, in the New England States and in New York the boards of railroad commissioners have considerable authority over street railways, but in many other States practically all questions are settled by the local authorities, and in some States the permission of every abutting property owner to the construction of the new line must be obtained. The diversity in practice as regards street railway questions is perhaps illustrated in no better way than in the tribunal to which is left the adjustment of such questions as grade crossings with steam railroad companies in case of dispute. This would seem to be an eminently proper question for adjudication by railroad commissioners, but in some States, as for instance New Jersey, these questions are settled by the Chancellor, while in Indiana it is the State Auditor, who is designated by the statute as the authority whose rulings must govern.

Estimating Earnings of Projected Interurban Lines

The first question that comes up when a new interurban electric railway is projected is whether the population to be served is sufficient to make the enterprise profitable. Before this can be answered we must determine what proportion of the total population reached can be assumed to be probable patrons under prevailing conditions. The minimum paying population per mile is constantly being decreased as a result of larger experience. Seven years ago capitalists hesitated about investing in interurban enterprises serving populations which we now know by experience to be sufficient to make gilt-edge propositions. Every year these roads are entering less populous territory, and yet the results do not show where an absolute limit is reached.

We have been asked many times what constitutes a sufficient tributary population to justify an interurban road, and have likewise put this question to many engineers who have been active in interurban work. The answer is almost invariably the same, namely, that every case has features peculiar to itself which make comparisons very difficult. A very serious difficulty is encountered, moreover, in the fact that the gross receipts of interuran companies are withheld in a great many cases from the public, so that it is not always possible to reach conclusions of much practical value, because of lack of information regarding the full annual earnings of the properties which it is proposed to take as guides.

The assumption should not be drawn from this statement that the wisest plan in estimating the earnings of a proposed road is to select an existing road in another State with a distribution of population along its route approximately the same as that on the road under discussion, and then blindly accept its earnings as those which will be secured on those of the proposed road. The industrial character, wealth per capita and traveling proclivities of the persons in the territory traversed all affect the rides per capita, and these would have to be determined before any reliable conclusions could be obtained. Differences as high as 25 per cent have been noticed between two closely corresponding properties in adjacent States, due only, so far as can be seen, to differences in the riding habit and occupations of the population. Whatever errors there may be, therefore, in basing probable earnings on averages, they will, in most cases, be less than if single examples are taken as the sole guide in determinations of this character. The safest way is to combine the two methods, that of general averages and that of specific comparisons, and apply the results with that judgment which only comes through long experience in considering statistics of this kind.

It is also necessary to classify interurban roads under several distinct heads, not the least important of which should consider their geographical location. For example, in Eastern Massachusetts towns are close together, the right of way is largely over highways, the schedule speed is slow, and these roads belong to a class distinctly different from the high-speed interurban lines of the Middle West, which operate over private right of way at steam-railroad speed, and serve an entirely different kind of territory. In this discussion we will consider more particularly the latter class, since it is in the great Middle West that high-speed interurban building is most active, and at present, at least, holds out the greatest promise.

High-speed interurbans may again be divided into two classes, namely, lines radiating from a large city terminal, such as Detroit, Cleveland or Indianapolis, and those which connect a number of moderate-sized towns and villages, in which there is no great preponderance of population at any one point. In calculating population tributary to a road radiating from a large city it is not customary to include all of the population of this large terminal; otherwise a road with scarcely any population outside of the large city would make a magnificent showing in population per mile of track. The effect on the traffic of having a large city as one terminal has not been thoroughly determined except that we know that the size of the city is some form of reverse function of the rides per capita, and that the traffic to any particular interurban lines from a terminal city with a population of about 100,000 is almost as large as one much greater, that is at this point, the curve representing rides per capita would tend to become asymptotic to the axis of population. Below that figure the curve tends to rise, that is the total traffic from a city is more nearly proportional to its population. Roads serving moderate-sized towns can generally be fairly compared with each other by counting in all of the population and villages touched by the line.

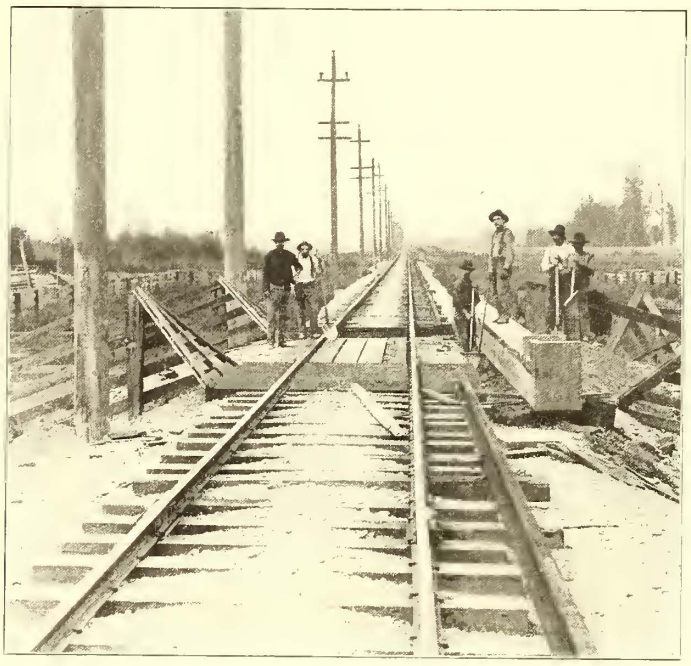
Another feature which is likely to produce confusion in making comparisons is the manner of obtaining the population along the line. One man would take the 1900 census, and count only the population of the incorporated towns and villages directly reached by the road; another might take the population of the towns and villages along the route and add to it all the rural population within 5 miles or 10 miles on either side, together with the population along lines immediately connecting with the projected road. In the latter case a handsome showing would be made in the prospectus, and the actual population increased enormously. Now, any of these methods is all right, provided the population figures are obtained in the same way for all the roads included in the comparison made, and all the facts clearly set forth. The enthusiastic promoter in some cases, however, is likely to forget to include in the population of the roads which he is citing as examples anything but the 1900 census of the towns actually touched, while on his proposed road everything is included.

So far this discussion has covered mainly the work preliminary to actual comparison with existing operating statistics, and it is perhaps unsafe to proceed farther to attempt to formulate rules where it is admittedly dangerous to generalize, but there are a few operating results obtainable from several prosperous and well-managed roads radiating from large centers, which may safely be depended upon as typical of their class. Gross earnings per mile of track per year are reported on these at $10 per capita of population, based on the latest census report in the incorporated towns and villages along the lines. There are some roads with a population of 300 per mile or less, which are doing much better than $10 per capita, and there are many more with larger population earning less than $10 per capita. It is a notable fact that the less the population per mile of track the greater the earnings per capita; in other words, a system operating through a number of large towns will not secure as much business from each and every person in those places as it will from those in smaller towns. If it were not for this fact the limit of profitable interurban building would be reached much sooner than it is. If the earnings of a large number of interurban electric railway companies were available curves could no doubt be plotted showing the relation between receipts per capita and population per mile of track. Such curves would show higher receipts per capita as the population per mile of track decreased. Just what this relation is no one can say at the present time without more statistics upon which to base conclusions.

THE SEATTLE-TACOMA INTERURBAN RAILWAY

BY HOWARD S. KNOWLTON

Among the cities of the great Northwest which attract the student of progressive civilization, Seattle and Tacoma offer many features of interest. Situated on the borders of Puget Sound, in a region famed for its superb scenery, with the mag-



LOOKING NORTH FROM THOMAS

nificent Cascade range of mountains on the east and the Olympic Mountains on the west, these two cities enjoy the commercial advantages of quick and easy communication with the Far East, as they are terminii of the long American transcontinental routes of the Great Northern and Northern Pacific Railways. At the same time the vast forests of the State of Washington constitute the foundation of a great lumber business, while coal and valuable mineral deposits are found about equally distributed in the neighborhood.

Seattle, the metropolis of the State, is located on the eastern shore of Puget Sound, and has a fine deep water harbor, large manfactures of lumber, shingles and machinery and an important trade in lumber, hops and fish, salmon fishing being a leading branch of industry in the State. Its population by the census of 1900 was 80,671, and it has long been known as one of the objective points of Klondike gold prospectors on their way to Nome and the farthermost regions of Alaska. It has also the reputation of being a thoroughly alive and energetic Western city. The electric car lines of the city are about 87½ miles in total length, and are operated by the Seattle Electric Company, which also carries on the electric lighting business of the city. The population served by these lines is estimated at the present time at 115,000.

Tacoma, likewise, is an enterprising and progressive city, beautifully located on the southeast shore of Puget Sound, and surrounded by extremely level and fertile valley lands, especially adapted to agricultural pursuits. It is also a great lumber town, carries on a large ocean traffic to the Orient, has numerous manufacturing establishments and is the great wheat port of the State. Over 1,000,000 tons of coal were taken from the mines within 40 miles of Seattle and Tacoma in the year 1898, and shipbuilding, fruit growing and grazing are rapidly growing industries on Puget Sound.

As residential cities both Seattle and Tacoma enjoy magnificent scenic advantages. The Cascade Mountains lie about 50 miles to the eastward, and from elevated points in either city fine views of the range abound, extending from Mt. Baker (10,719 ft. altitude) on the north to the mighty ice-capped dome of Mt. Rainier, or Tacoma (14,526 ft. high), on the south. On the west lies the Sound, with its 2000 miles of shore line and numerous islands and tributary rivers, while the sunsets on the Olympic Mountains are said to be almost unrivalled in splendor.

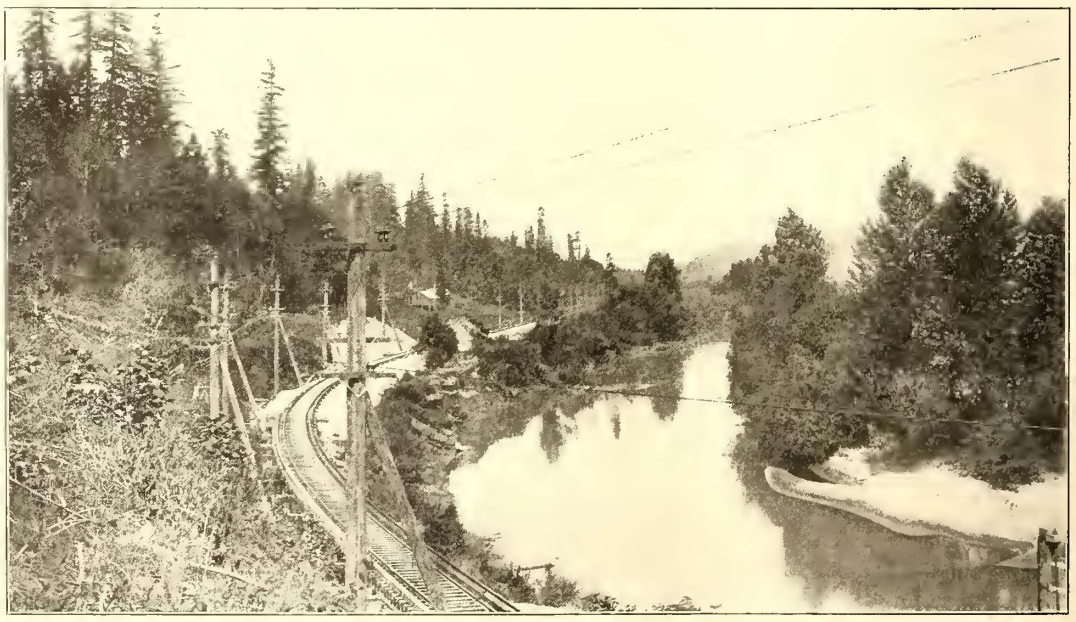
ELECTRIC RAILWAY SYSTEM

The electric railway business of both cities is now under the controlling management of the firm of Stone & Webster, of Boston. The Tacoma lines are operated by the Tacoma Railway & Power Company, those in Seattle by the Seattle Electric Railway Company, while the two cities are connected by the Seattle-Tacoma Interurban Railway.

This interurban railway was opened for traffic on Sept. 25, 1902, and in its equipment and similarity to steam railway standards of practice in roadbed, track and right of way, it is one of the most interesting high-speed electric third-rail systems in the United States. It was built under the direction of Stone & Webster, and its distinctive features constitute the chief subject matter of this article.

The population tributary to the interurban line is estimated at about 180,000, on the basis of the growth of the cities of Seattle and Tacoma since 1900, together with the population along the line itself, which is probably about 35,000.

The track runs for the most part through quite level country,



WHITE RIVER, LOOKING NORTH

the maximum interurban grade being 2 per cent. Many long tangents abound, and from Renton Junction to Auburn the route is practically a level air line for over 11 miles, and being a private right of way, with superb roadbed and track, it is specially adapted to speeds of from 50 miles to 60 miles per hour. The line runs on an average about 3 miles inland from the Puget Sound coast. Drawbridges have been built where the track crosses the Duwamish River and White River, be-

tween Race Track and Renton Junction, and fixed bridges are found at the White River crossing near Kent, and the Puyallup River crossing at Tacoma city line, and at Bay Street, Tacoma.

The principal stopping points and distances from Seattle, as shown on the company's time-table, are shown in Table I:

TABLE I.

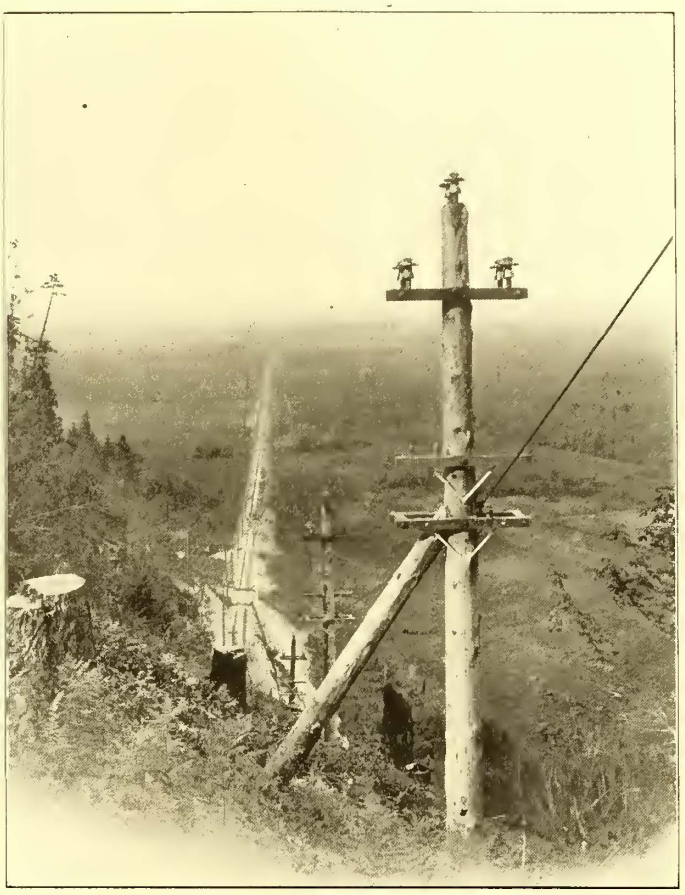
Stations	Distance from Seattle Miles	Running time from Seattle Minutes
Seattle	0	0
Connecticut Street	0.2	3
Argo	3.2	12
Georgetown	3.8	15
Denny	5.1	20
Race Track	6.1	25
Riverside	8.01	29
Foster	9.1	31
Black River	10.2	33
Renton Junction	10.7	35
Orillia	12.5	39
O'Briens	14.6	43
Kent	16.7	46
Thomas	18.5	49
Christopher	19.5	52
Auburn	21.8	57
Farrow	23.03	60
Bluffs	25.1	63
Edgewood	27.2	70
Milton	29.3	77
Bay Street	34.3	85
Tacoma	36.3	100

RIGHT OF WAY

The clearing for the right of way extends on the average 50 ft. each side of the center line of track. Earth excavations were generally 16 ft. wide at grade, and the side slopes of excavation were made standard, at a ratio or one horizontal to one vertical. As far as possible no excavation was made within 4 ft. of the right of way limits or right of way fence. Rock cuts were made 16 ft. wide at bottom as far as possible, with slopes

ONE MILE SOUTH OF SUMMIT, LOOKING SOUTH

of 1 to 6, and all rock cuts were excavated to a depth of 1 ft. below grade. Embankments were made 14 ft. wide at grade, with side slopes 1½ horizontal to 1 vertical, with bermes not less than 4 ft. in width between embankment slopes. Log culverts were made of straight, green logs, from which all bark was first removed, the logs being not less than 10 ins. in diameter at their small ends. As far as possible each log extends the entire length of the culvert. The joints of all drain and culvert pipes were stopped with mortar composed of one part Portland cement to three parts sand. Log and timber cribs were constructed from logs varying from 10 ins to 18 ins. in diameter, and all riprap stone placed for the protection of the



A LONG STRETCH OF STRAIGHT TRACK

slope of embankments, or about the foundation or ends of culverts, was required to have a volume of at least 1 cu. ft.

FENCING

The entire private right of way is fenced in, the posts being of cedar, sawed or split square, and measuring at least 6 ins. on each side, their length being about 7 ft. 6 ins.; gate posts measure at least 8 ins. on a side, and are 11 ft. in length. The fence posts are set 8 ft. apart on centers along the fence with the bottoms 2½ ft. in the ground. The bottoms of gate posts are at least 4 ft. in the ground. The minimum dimensions of boards are: Length, 16 ft.; width, 6 ins.; thickness, 1 in. They are of fir, and there are five tiers of boards.

TRACK

The track is laid out as carefully as though the road was to be operated by steam locomotives. Cross-ties number at least 2816 to the mile. The service rails are 70-lb. A. S. C. E. section, in 30-ft. lengths. The gage is 4 ft. 8½ ins. on straight lines. The spreading of gage on curves is shown in Table II:

TABLE II.

Degree of Curve	Add to gage of track Inches	Degree of Curve	Add to gage of track Inches
2	⅛	8	½
4	¼	10	⅝
6	⅜		

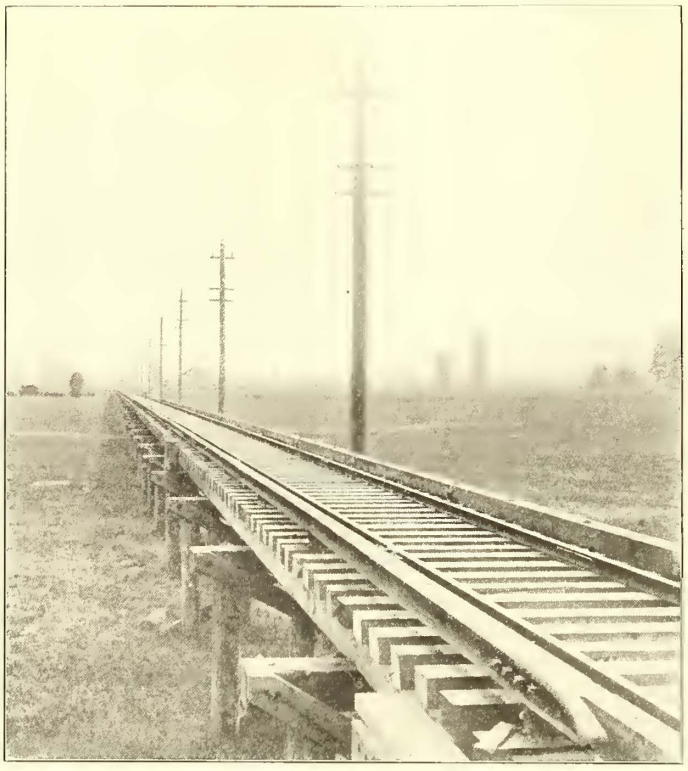
This increase of gage is accompanied by the superelevation of the outer rail shown in Table III:

TABLE III.

Degree of Curve deg. min.	Superelevation Inches	Degree of Curve deg. min.	Superelevation Inches
0 30	⅜	4	3¼
1	11-16	4 30	3⅝
1 30	1 3-16	5	4
2	1⅝	6	4 13-16
2 30	2	7	5⅝
3	2 7-16	8	6 7-16
3 30	2 13-16		

The superelevation tapers out in 5 ft. per degree of curvature.

Ties are 7 ft. 6 ins. long, 8 ins. wide and 6 ins. thick, the material being Washington fir. There are four spikes to each



TRESTLE CONSTRUCTION

tie, two inside and two outside the rail, staggered to avoid splitting the tie, and the two inside spikes are driven in the same edge of tie so as to keep the ties at right angles to the track. Spikes were driven not over 4 ins. from center to center on a line parallel with the rail. The rails were laid to break joints, not more than 1 ft. variation, centering joint at the middle of the opposite rail being allowed. The allowance made for expansion and contraction of rails is shown in Table IV:

Joints on or within 4 ft. of cattle guards, open culverts and road crossings were avoided wherever possible. At road and farm crossings the planking is placed 2½ ins. from the gage side of the rails, the ends and edges of the plank nearest the rail being bevelled. Weber joints are used.

THIRD RAIL

The third or contact rail weighs 100 lbs. per yard, and is located with its central vertical axis 21 7-32 ins. from the gage line of the service rail and at the outside of the track. It is laid in 30-ft. length, and is supported by reconstructed granite insulators, furnished by the General Electric Company. The top of the insulator brings the rail base 6 ins. above the ties, and the insulators weigh about 25 lbs., and are fitted with a malleable iron cap and base. These insulators are located 10 ft. apart, or practically every fifth tie, which is lengthened to 9 ft., in order to provide proper support. At breaks in the third rail the contact-shoe approach tapers in a gradual curve to a thickness of 1 in., the distance required being 6 ft. from the joint of the approach section with the main line of third rail. The proper curvature is accomplished in 5 ft., and one insulator is the only support required aside from the joint. The third rail is bonded with a Chase-Shawmut 750,000 circ. mil. "Clark" bond at each joint. The service rails are bonded with a similar Chase-Shawmut connection of 500,000-circ. mil. capacity. These bonds are soldered to the rail and are too well known to require any extended description.

TABLE IV.

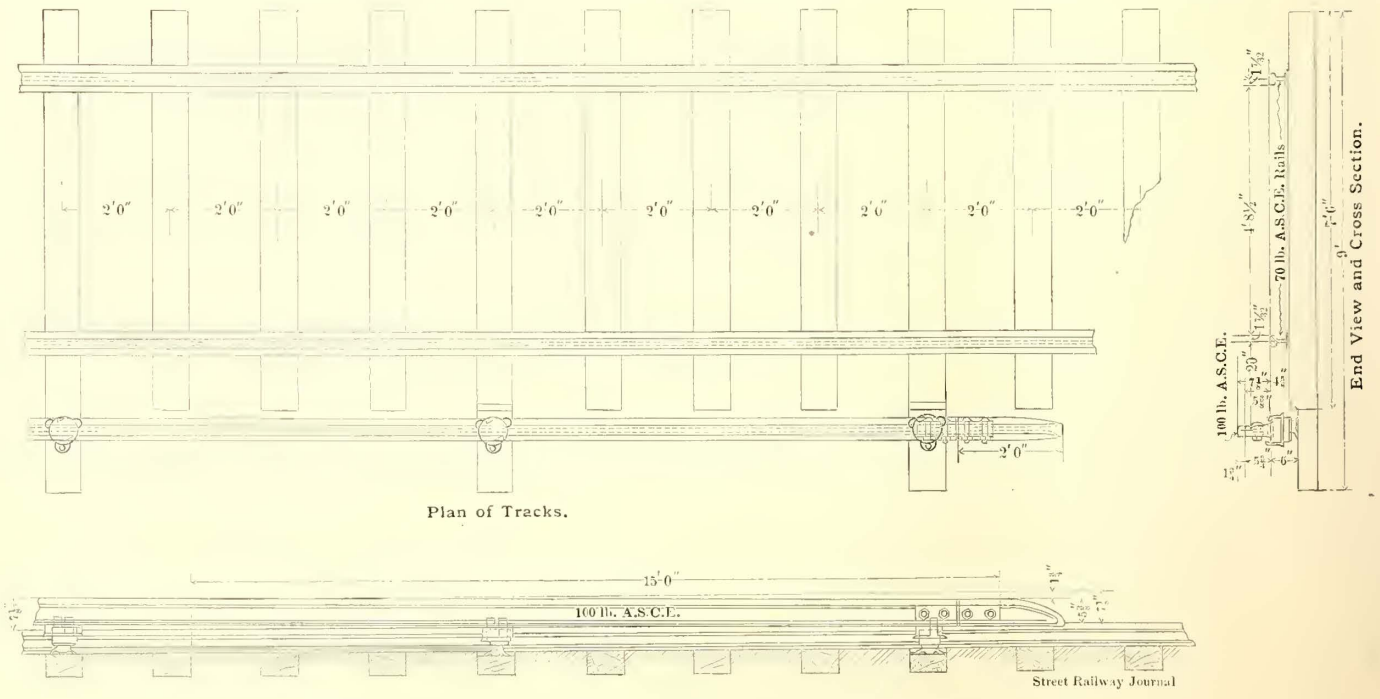
Degrees Fahrenheit	Allowance Inches	Degrees Fahrenheit	Allowance Inches
80	1-16	50	¼
70	⅛	40	5-16
60	3-16	30	⅜

SPLICE BARS AND FEEEDERS

All the track rails are drilled for splice bars as follows:

End of rail to center of first hole 3 15-16 inches
Center of first hole to center of second hole, 5 inches.
Diameter of holes, 1 inch.
Base of rail to center of holes, 2 3-64 inches.

The drilling of the contact or third rail is: First hole, 2⅜ ins. from end of rail; second hole, 5 ins. further; third hole, 5 ins. further than the second. The center line of all holes is 2 65-128 ins. above the bottom of the rail, while all holes are



PLAN AND SECTIONS OF TRACK, SHOWING POSITION OF THIRD RAIL

1¼ ins. diameter. Only the first hole from the end of the rail is used for the splice bar.

The third rail is laid only upon the private right of way, No. 00 trolley being used in Seattle, Tacoma and on the county road and highway. At farm and road crossings it is discon-

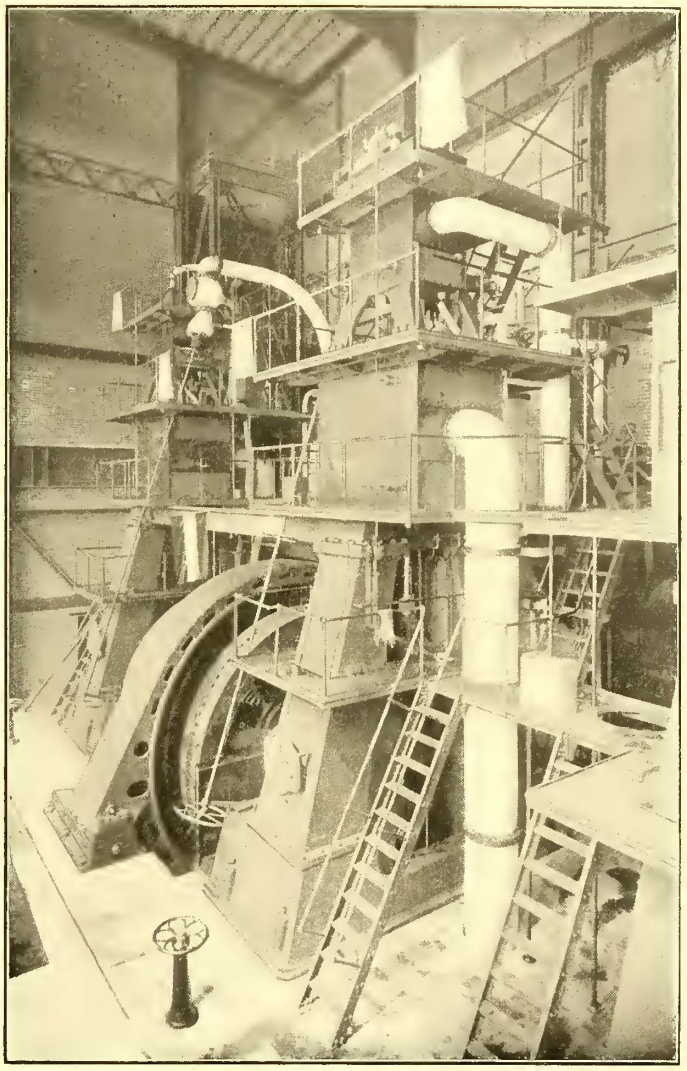
tinued, the cables being carried beneath the crossing in conduit or trench. Generally the length of a two-car train is sufficient to span the gap between successive sections of the third rail, in case the cars should become stopped on the crossing.

POWER STATION

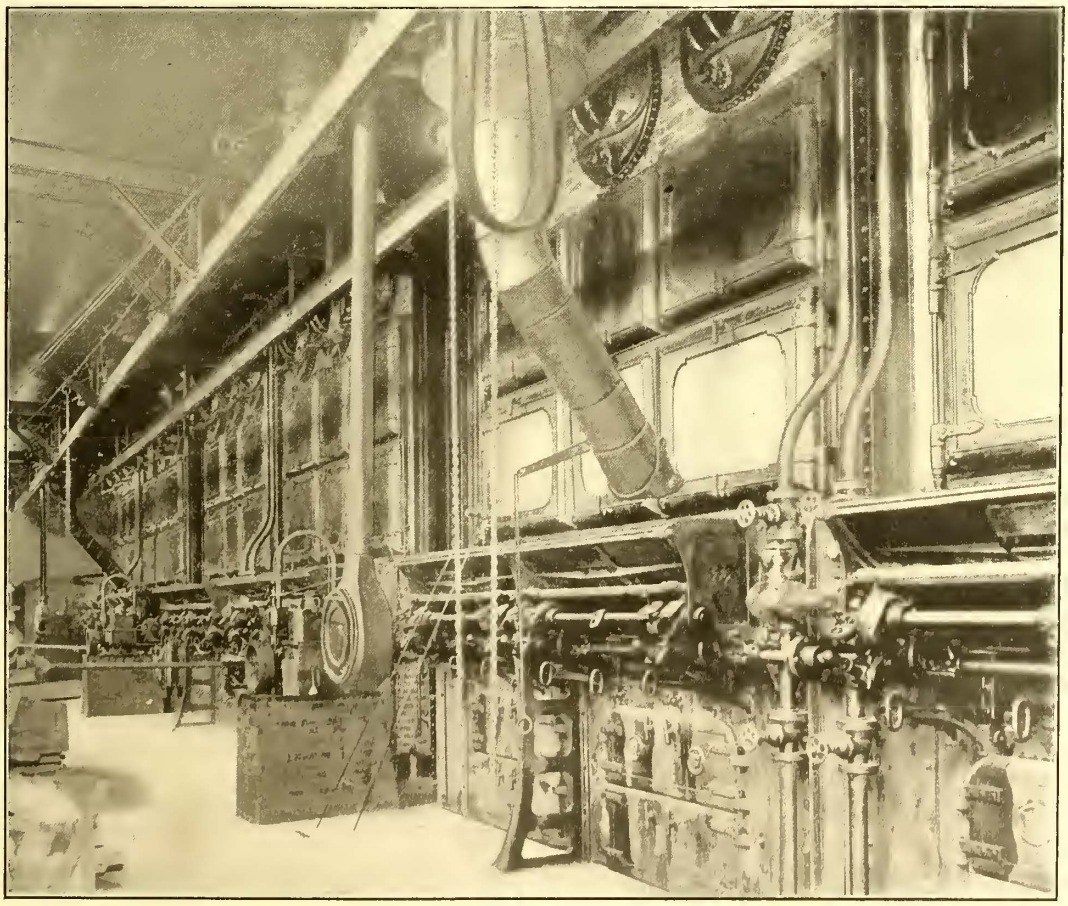
The power for operating the interurban railway is distributed at three sub-stations on the line, located respectively at Georgetown, Kent and Milton. A high-tension transmission line, operated at about 25,000 volts, extends from a step-up transformer station located at Massachusetts Street, Seattle, through to "Station A" in Tacoma. The Massachusetts Street station in Seattle is connected with the Post Street station of the Seattle Electric Company by a two-phase circuit, composed of four No. 0000 Brown & Sharpe copper cables. These cables are connected to the 2200-volt alternating-current bus-bars of the Post Street station, which station is the main generating plant of the Seattle Company. The interurban road is at present operated by water-power, the Park Street station serving as a relay plant. This latter plant is steam driven, the generating units being two 1600-kw Westinghouse direct-connected, 2200-volt, two-phase alternators, having an overload capacity of 50 per cent for four hours. These machines are of 60 cycle frequency, and are each driven by a 2500-hp McIntosh & Seymour vertical marine type cross-compound condensing engine of 2500-hp rating, cylinders 23-in. and 48-in. diameter by 42-in. stroke, speed 120 r. p. m.

The steam generating plant is composed of six 500-hp Aultman & Taylor "horizontal" water-tube boilers, operated at 160 lbs. per square inch steam pressure, and fed by Roney mechanical stokers. A Holly gravity drip system is also in use, and the condensers are of Wheeler admiralty design, surface type.

The Post Street station supplies current at three 500-kw Westinghouse 60-cycle, two-phase, 360 r. p. m., 250-volt direct-connected rotary converters for power and lighting service, and also to five 500-kw Westinghouse railway rotaries, running 400 r. p. m., three-phase at 550 volts full load. Each rotary is supplied with alternating current by two 300-kw transformers. The exciter set for the alternators is a steam-driven unit, being a 75-kw, 250-volt Westinghouse set, making 290 r. p. m. A 40-ton Brown hand crane is operated over the engines, a 20-ton Brown hand crane over the rotaries, and a 12-ton Whiting hand crane over the transformers.



GENERATING UNIT



BOILER ROOM

The switchboards are located on the main floor and on a gallery back of the rotary converters. Direct current for the trolley lines of the Seattle Electric Company is supplied by the railway rotaries above mentioned.

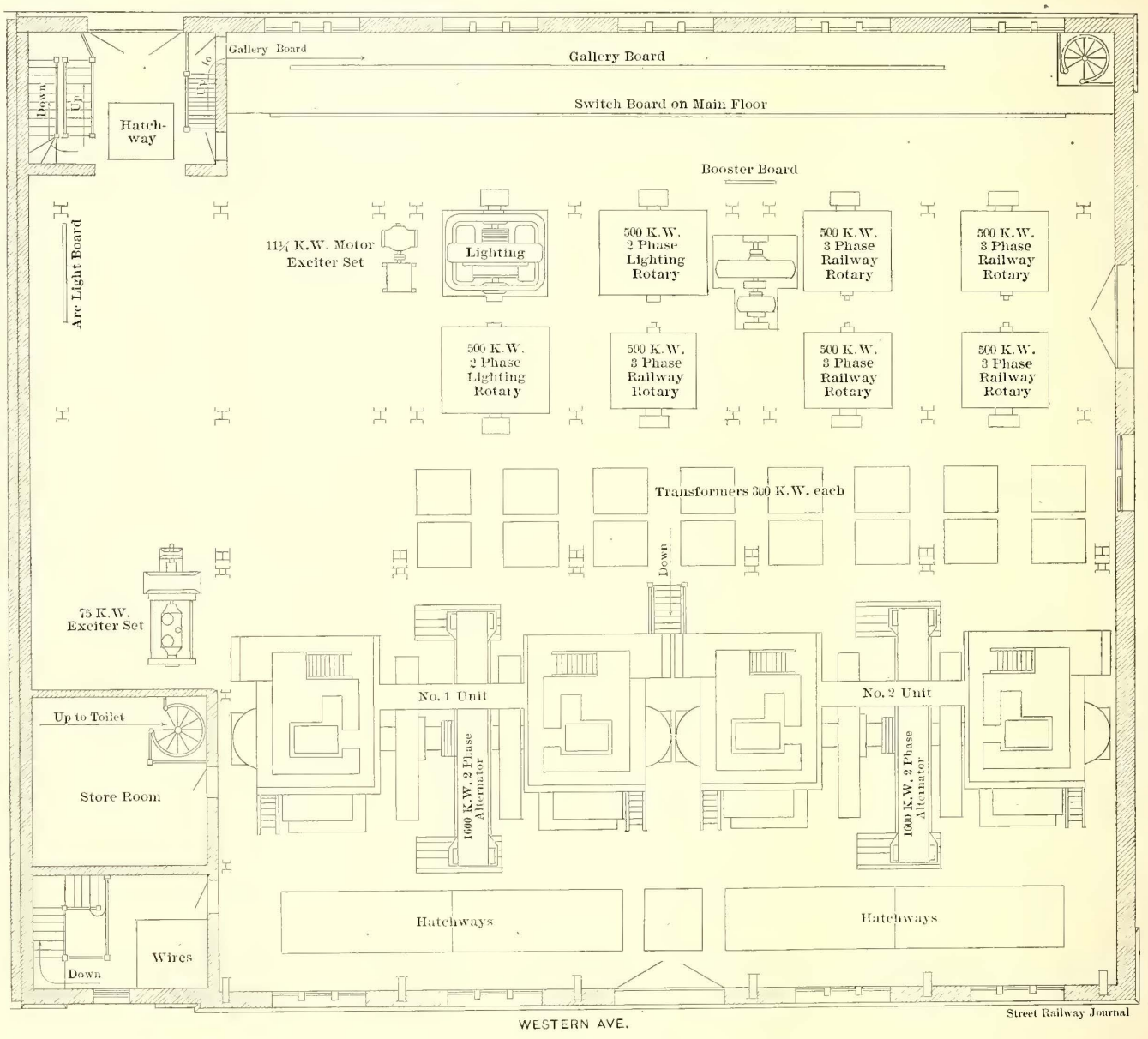
BATTERIES

There is also a railway battery in this station, built and installed by the Electric Storage Battery Company. This battery is composed of 278 cells of "type-G" elements. Each cell has 23 plates in the tank. The full load voltage of

the battery is 578, and the discharge capacity is 880 amps., at the one-hour rate. The battery room is 69 ft. 10½ ins. long, 42 ft. 4 ins. wide and 10 ft. 6 ins. in height. The battery discharges and is charged through a General Electric motor-driven differential booster, the motor being a 4-pole, 53-hp, 600-volt, 600 r. p. m. machine, direct connected to a 6-pole, 33-kw, 50-120-volt, generator. The battery is designed to float upon the direct current station bus-bars at average load, the rotaries supplying the current for the surface lines of cars. When the load exceeds the average the differential winding of the booster causes the battery to discharge and take up the fluctuations by the over-

STEP-UP TRANSFORMER STATION

The step-up transformer station at Massachusetts Street, Seattle, is located on the tide flats, and is a substantial brick building built upon piles, two stories in height, and rectangular in shape. It is about 60 ft. long, 30 ft. wide and 43 ft. 6 ins. high above the floor line. It is amply lighted by three rows of windows, the larger ones being 7 ft. 1 in. high, 2 ft. 6 ins. wide, and the smaller 3 ft. high by 2 ft. 6 ins. wide. There are twenty-seven large windows and twelve small ones. The roof is flat, and in five-ply tar and gravel, and is surrounded by a galvanized iron coping. The second floor is 17 ft. above the first. A door,



PLAN OF POWER STATION

powering action of the series fields upon the shunt field coils. When the load is below the average the booster shunt field is in predominance, and the rotaries, therefore, charge the batteries. Owing to the fact that this booster is designed to operate in connection with five 500-kw rotaries its series field design was unusually difficult, and the terminals had to be supported on a special terminal board located on the floor beneath the main rotary room.

The battery and booster switchboard is located near the booster, and is composed of two panels, with the usual complement of switches and instruments. The coal supply of the station is, in the main, obtained from the company's mine at Renton, and condensing water is obtained from the Seattle harbor through a long suction pipe.

12 ft. high and 8 ft. wide, serves as admission for heavy apparatus to the transformer room. In this station the 2200-volt wires from Post Street station enter the building over a support held up by brackets 6 ft. on centers, the wires being spaced 12 ins. apart.

These wires enter the building at the second-story and pass down through the floor to 2200-volt oil switches, and thence to the primary windings of the two 500-kw step-up transformers. These transformers are located on the first floor of the building, and are of General Electric make, being of the usual water-cooled type, designed to transform 2200-volt, two-phase current to 25,000-volt three-phase. The full load primary current is 227 amps. and the secondary current is 20 amps., the ratio of transformation being 11.35 to 1. Each transformer re-

quires 400 gals. of oil, and 3½ gals. of water per minute are needed for cooling purposes.

Each transformer consists of a set of flat primary and secondary coils, placed vertically and surrounded by a built-up steel core, the coils being so placed as to admit the free circulation of oil between them, which acts not only as an insulator but also as a cooling medium by conveying heat from the interior portions of the transformer to the tank by natural circulation. The coils and core are enclosed in a boiler iron tank, the base and cover being cast-iron. The water circulation pipe is placed in the oil in the upper part of the tank over the core and surrounding the ends of the windings. The core is built up of steel laminations, carefully annealed and insulated from each other, to reduce eddy current losses. The primary and secondary coils are wound flat, each with one turn per layer for suitable ventilation. The primary and secondary leads are brought out at the top of the transformer through suitable bushings. Each transformer has an overload capacity of 50 per cent for two hours without undue heating. The full load efficiency is 97.8 per cent, and the quarter load efficiency 93.5 per cent. The height of each transformer over all is about 110 inches, the floor space 68 ins, x 38 ins., and the weight, without oil, 12,700 lbs. The oil weighs 3200 lbs., making the total weight of the transformer per kilowatt of capacity 31.8 lbs. The floor space per kilowatt capacity is nearly 5.2 sq. ins.

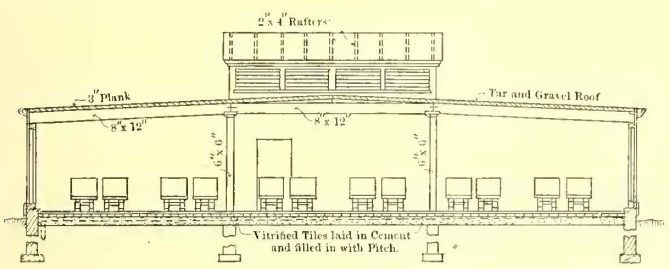
Each of the 500-kw transformers is provided with four taps, giving voltages of 2000, 2050, 2100, 2150 and 2200, by means of which the secondary connection can be adopted to the voltage received from the line and the high-tension voltage maintained at 25,000. The transformers will also stand a voltage of 27,500 on the high-tension side, which would be the result of an application of 2200 volts to the 2000-volt low tension tap.

From the transformers the high-tension wires, which are No. 1 Brown & Sharpe copper, three-phase, pass directly to the General Electric 25,000-volt automatic oil switches, on the same floor, and thence to the jack switches located in the second story, after which they leave the building through a high-tension wire shelter bushed by glass plates, and thence to the transmission line. Space has been provided in the step-up sub-station for six additional 500-kw transformers in the future.

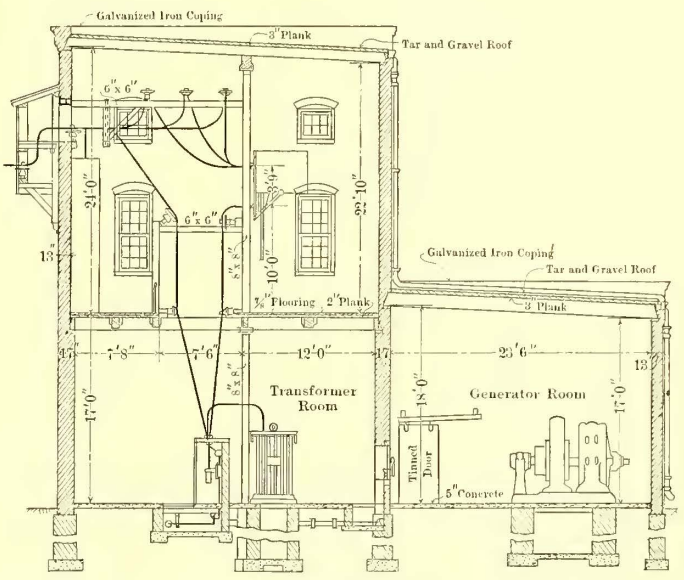
The switchboard for the step-up station consists of two 1000-kw, 25,000-volt transformer panels, each containing horizontal edgewise ammeters, overload and time limit relays, operating levers for three single-pole, single-throw, 27,500-volt automatic oil switches current transformers, 2500-volt single-throw automatic oil switches, potential transformers, lightning arrester switches, etc. The lines are provided with lightning arresters and switches, while the ground connection is made by a No. 1 bare stranded copper wire attached to a copper ground plate.

All the interurban sub-stations were designed for ultimate operation at potentials up to 50,000 volts, and the spacing of apparatus and high-tension circuits was laid out with this in view.

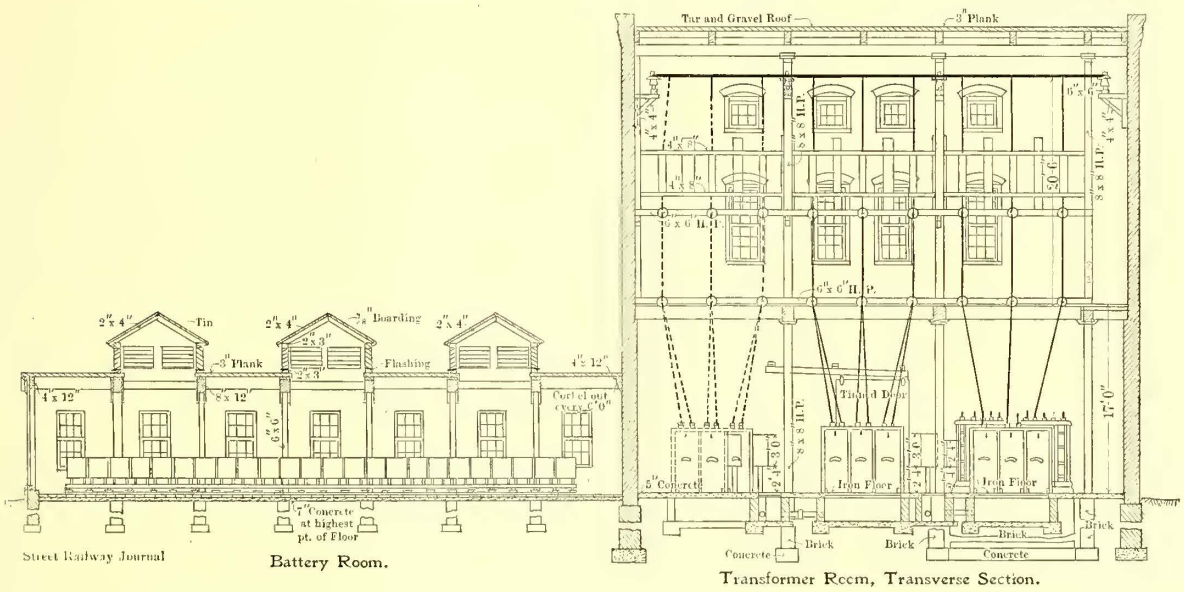
The step-up transformer station measures 57 ft. x 27 ft. inside the transformer and oil-switch room on the first floor, which is an allowance of about .39 sq. ft. per kilowatt of ultimate capacity. A second three-phase transmission line can easily be run out of the building should future circumstances require its addition.



Cross Section of Battery Room.



Cross Section.



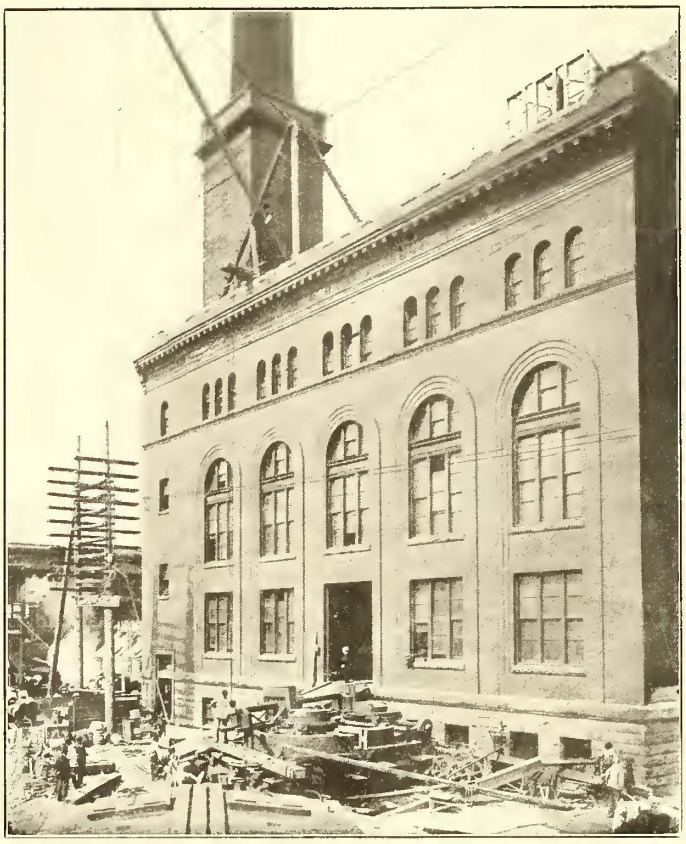
Battery Room.

Transformer Room, Transverse Section.

SECTIONS OF STEP-UP TRANSFORMER STATION

The 2200-volt oil switch barriers are each 5 ft. long and 3 ft. wide, while the 25,000-volt oil switches require each a floor space 7 ft. 4 ins. x 3 ft.

The transformer station is also provided with a work bench 8 ft. long and 30 ins. wide, and access to the second floor is obtained by a spiral stairway of twenty-five risers. A large



EXTERIOR OF POWER STATION

opening for the passage of wires from the first into the second story runs nearly the entire length of the station, its width being 7 ft. 6 ins. There is a basement in the building about 5 ft. in the clear below the first floor. One man per shift is all the attendance required.

SUB-STATIONS

The first sub-station reached after leaving Massachusetts Street station is at Valley Street, Georgetown. The building is of brick, and is divided into three parts—a transformer room two stories high, a generator room and a battery room. These three sections of the building adjoin an old car house, which is to be used by the Seattle Electric Company. Foundations for transformers, oil switches, trenches and pits are of hard-burned square edge brick, gravel concrete being used for footing courses. These foundation walls, as well as those for machinery, are stopped at a point 5 ins. below the floor line, and finished out with broken stone concrete to match the concrete floor and bonded into it.

Over the entire area of generator and transformer rooms, except those portions occupied by machinery or switches, is laid a concrete floor 5 ins. thick, composed of broken stone concrete 4 ins. thick, and a finished surface 1 in. thick, composed of one part Portland cement and one part clean, sharp sand. In pits a gravel concrete floor bonded into footing courses and surfaced with cement is provided. All ducts in floors are laid in concrete. The battery room floor is also laid with concrete, 7 ins. thick at the ridge, and sloping uniformly at a rate of 1 in. in 10 ft. to gutters at either end of the room. On top of the concrete is a finished floor of vitrified shale tile, set in clear cement grout for about half its thickness, the remaining portion of the joint being filled with pitch poured in from the top.

The high-tension wires enter the station through the pipes approximately 4 ft. in diameter.

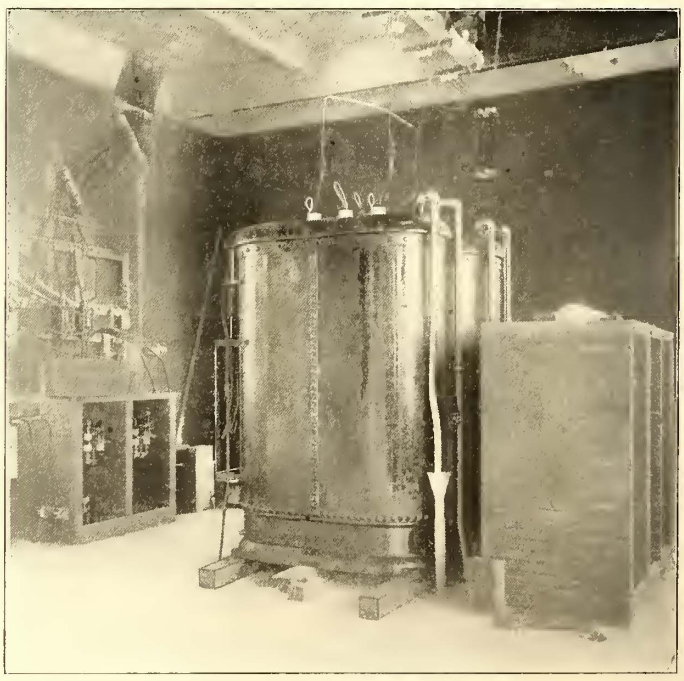
All timber framing which carries high-tension wiring is firmly anchored where it extends into the walls, and where such timbers are supported on uprights they are fastened with wrought iron clips or angles cut to the proper size. Brackets for bus-wires are framed and bolted together and fastened to the wall with through bolts with heavy washers outside. All bolts used in framing timber are provided with washers under heads and nuts.

All roofs are covered with the best five-ply composition tar and gravel roofing. The battery room walls are carefully sheathed, and large ventilators are provided for the exit of the acid fumes. This room is carefully separated from the room containing electrical machinery, and every precaution has been observed to prevent the acid fumes from getting into the motor generator, transformers and wiring.

Each of the interurban sub-stations is provided with a 300-kw motor generator set, a storage battery, differential booster, switchboard and transformers.

GEORGETOWN BATTERY ROOM

The Georgetown battery room is in external dimensions 66 ft. 5½ ins. long by 43 ft. 11 ins. wide, and has a maximum clear head room of about 9 ft. It contains a battery of 288 cells of the Electric Storage Battery Company's type-"G" elements, there being seventeen plates in each tank. The maximum capacity of each tank is twenty-three plates, and the full load rating of the battery under present conditions is 640 amps. at the hour rate of discharge, the average voltage being 600 on the basis of 2.08 volts per cell. The ultimate capacity of the battery when the tanks are filled with twenty-three plates is 880 amps. at the hour rate. The differential booster occupies a floor space 9 ft. 7⅛ ins. x 6 ft. 6 ins., and operates in precisely the same manner as that in the Post Street station of the



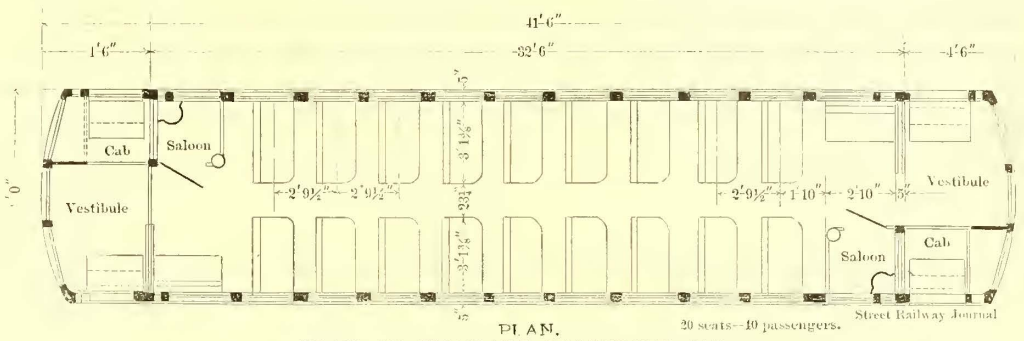
TRANSFORMERS IN SUB-STATION

Seattle Electric Company. It is located in the motor generator room.

MOTOR GENERATOR ROOM

The motor generator room is 43 ft. 11 ins. long by 24 ft. 3 ins. wide externally, and also contains a General Electric type M. P., 8-pole, 300-kw, 450 r. p. m., 600-volt direct-current compound-wound railway generator, direct coupled to a General Electric 450-hp, 2200-volt, two-phase, 60-cycle induction motor. Each induction motor has sixteen poles and a full load

efficiency of 92.5 per cent at 90 per cent power factor. The direct-current generator has an efficiency of 93 per cent between full load and 50 per cent overload. The rotor of the induction motor weighs 5500 lbs., and the stator 12,500 lbs., while the set weighs 53,000 lbs., or about 177 lbs. per kilowatt. The floor space occupied by the set is about 80¾ sq. ft., the foundation layout being practically 9 ft. 6 ins. x 8 ft. 6 ins. This gives about 39 sq. ins. per kilowatt.



PLAN OF STANDARD PASSENGER CAR

TRANSFORMER ROOM

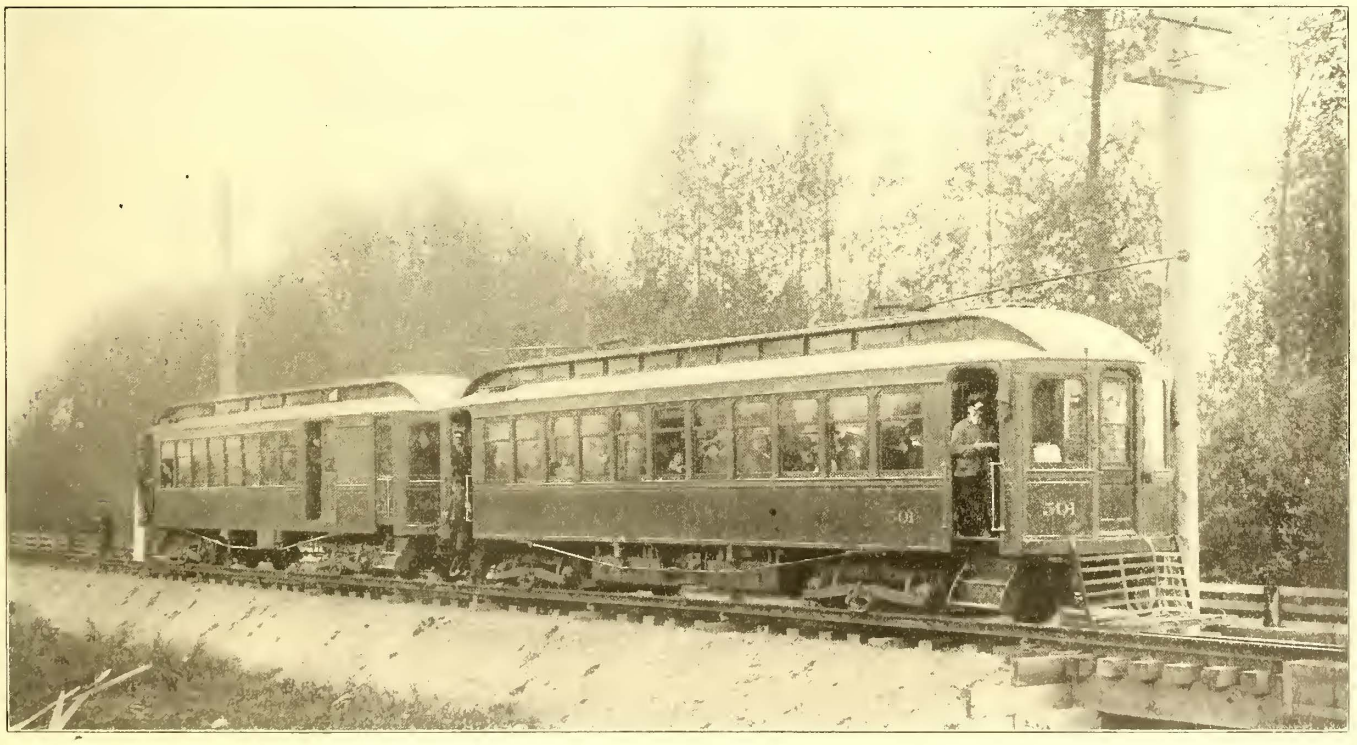
The transformer room at the end of the building is 46 ft. 6 ins. long by 30 ft. wide outside. Its first story contains two General Electric 180-kw, 25,000-2200-volt, 60-cycle oil-cooled three-phase two-phase step-down transformers, which convert the high-tension line current into a two-phase lower-tension current, adapted for the use of the induction motor-generator set. These transformers are of sufficient capacity, allowing for power factor, to supply one motor generator set when driving the generator at its 50 per cent overload for two hours without undue heating. Each transformer weighs, without oil, 10,500 lbs., the oil adding 2400 lbs. to make a total of 12,900 lbs., or 72 lbs. per kilowatt. The floor space occupied by each is about 62 ins. x 51 ins., and the height over all is 100 ins. The full load efficiency is 97 per cent.

TRANSFORMER CONNECTIONS

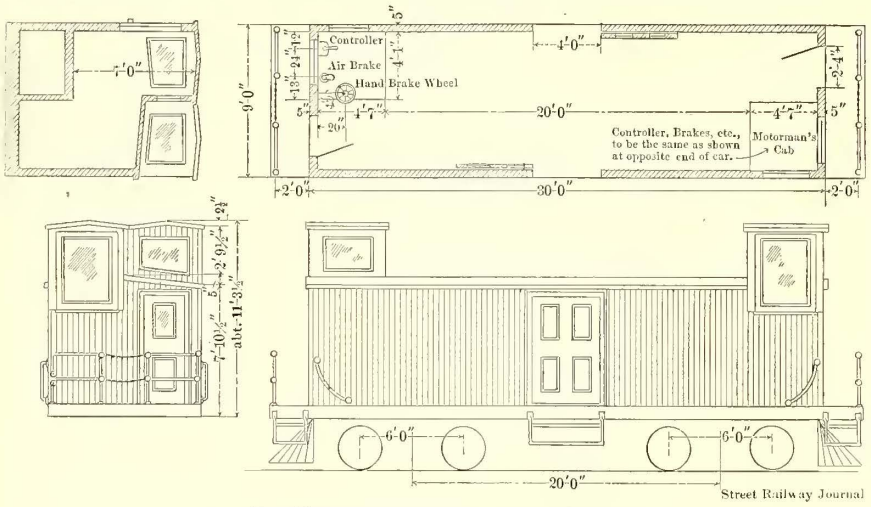
On the upper floor of the transformer room the high-tension line wires enter the building by the wire shelter, and pass across lightning arresters to high-tension jack switches mounted in cells on the wall. They then drop vertically into the first story, where they pass into single-pole, single-throw General Electric 27,500-volt automatic oil switches, encased in cells. Thence they pass to the transformers. The secondaries of the transformers are connected to the induction motor generator set by a two-phase circuit of No. 2 copper wire, passing through a double-pole, double-throw motor-starting switch, which starts the induction motor by its connection with half-voltage taps on the transformers. From the direct-current generator the negative main cable passes to the generator panel in the switchboard, the size being 800,000 circ. mil, triple braided, waterproof. The field wire is No. 10 rubber covered. The positive cable, also of 800,000-circ. mil capacity, goes directly to the positive bus and feeder panels of the railway system. The high-tension line is also arranged to pass through another set of automatic oil switches behind the transformers, so that in normal operation the sub-station is simply connected in multiple on the transmission line, and if desired all stations to the southward can be cut off and supplied from either Tacoma or by the Snoqualmie Falls Power Company's lines at Kent, where a connection is made with the interurban transmission line in case of need.

SWITCHBOARD

The switchboard is located between the differential booster and the Valley Street wall in the motor-generator room. The automatic high-tension oil switches are arranged for remote control by levers passing beneath the floor of the transformer room, and terminating in the walls, where projecting handles enable the switches to be operated by hand. The switchboard contains one 2000-kw, 25,000-volt line panel, containing the operating mechanism of the high-tension automatic oil switches, voltmeter, time-limit relay, current and potential transformers and indicating lamps. There is also an induction motor panel containing an overload relay, operating levers for the high-tension oil switches, current transformers and lamps,


INTERURBAN PASSENGER TRAIN

and a 2200-volt starting panel containing a double-pole, double-throw switch. The generator panel is of 300-kw rating, and contains one 1200-2000-amp. General Electric form "K" circuit breaker, one 1000-amp. Thomson illuminated dial ammeter, one 600-amp., 600-volt Thomson recording wattmeter, one single-pole, single-throw, 1200-amp. quick break main switch, a 100-amp. lighting switch, voltmeter and potential receptacles,



PLANS OF ELECTRIC LOCOMOTIVE

field rheostat mounting, etc. The positive and equalizer switches are each single-pole, single-throw, of quick break, 1200 amps. capacity.

OTHER SUB-STATIONS

The sub-stations following that at Georgetown are at Kent and Milton. They each contain the same capacity in motor generators, boosters and transformers, and are laid out in many respects along the lines of the Georgetown sub-station.

The battery room at Kent is 99 ft. 4 ins. x 54 ft. 7 ins., outside dimensions, the generator room is 34 ft. long by 24 ft. 7 ins. wide, and the transformer room is 46 ft. 6 ins. long by 30 ft. wide. At Milton the generator and transformer rooms are of the same dimensions as at Kent, and the battery room is 54 ft. 7 ins. long by 51 ft. 10 ins. wide. The Milton and Kent batteries each are composed of 288 cells, type-"G" elements, but the Kent battery is a duplicate of that at Georgetown, whereas the present installation of plates in the Milton outfit is but fifteen per element, giving an hour rating of 560 amps. The ulti mate capacity is twenty-three plates, however, as in the other batteries.

TRANSMISSION LINE

The transmission line is built up on red cedar poles, 40 ft. to 45 ft. long, spaced 110 ft. to 120 ft. apart. The transmission wires are spaced on a 42-in. equilateral triangle, and the line can be operated at 60,000 volts if desired. A telephone arm is placed before transmission arm, and is arranged to contain four standard insulators from 12 ins. to 18 ins. on centers. This arm is 4 ft. 2 ins. long and its ends are 3¼ ins. x 4¼ ins. Two feet below this arm is a feeder-arm, 5 ft. 3 ins. long and 4 ins. x 5 ins. wide, capable of carrying four insulators, 17 ins., 21 ins. and 17 ins. on centers. Both telephone and feeder arms are firmly braced and secured to the pole by ⅝-in. bolts. The high-tension cross-arm was boiled in paraffine before being installed. The pins which support the high-tension insulators are of eucalyptus, 16⅞ ins. long, and 2¾ ins. in maximum diameter. They are round and are threaded at the top for a distance of 2⅛ ins., to receive the insulator, the thread tapering from a diameter of 1¼ ins. to 1½ ins. The transmission insulators are Locke "No. 318," chocolate-colored porcelain, 10½ ins. in diameter, guaranteed to withstand a test of 120,000 volts, and to work continuously at 60,000. They are provided with eaves to carry drip water away from the cross-arm.

The size of wire used between the Massachusetts Street step-up station and Race Track is No. 1 Brown & Sharpe copper, while from Race Track to Milton the line is No. 4. Between Milton and Tacoma the size is not standardized, several Brown & Sharpe sections being used in the circuits. At station "A" of the Tacoma Railway & Power Company are located two 500-kw step-up transformers similar in all respects to those at Massachusetts Street, Seattle.

TROLLEY WIRE

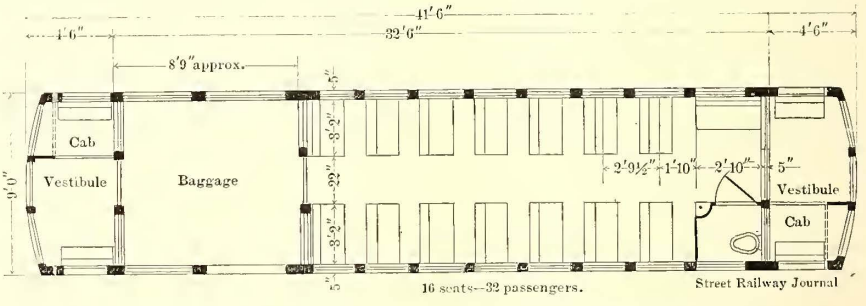
The trolley wire is No. 00 Brown & Sharpe. From the Seattle line to Race Track a 500,000-circ. mil feeder is run as supplementary to the trolley. From Georgetown to Kent a 350,000-circ. mil feeder is run, tapping to the third rail at frequent points, and from Kent to Milton a 350,000-circ. mil feeder supplements the third rail. The branch line to Renton from Renton Junction, about 2 miles, is equipped with third rail and two 350,000-circ. mil feeders. The crossing connections of the third rail are made by 500,000-circ. mil cable. These connections are covered by 2½-in. standard wrought iron pipe. The third rail section switches are 600 amps., Anderson make. At road crossings poles are guyed by 7-16-in. seven-strand galvanized wire.

FURTHER POWER PLANS

Further power plants are now being built on the White and Puyallup Rivers, the enterprises being directed by Stone & Webster. The interurban will undoubtedly receive power from these in the near future.

ROLLING STOCK

The rolling stock of the road consists of five combination passenger and baggage cars, four of which are motor cars and one a trailer, and ten standard passenger cars, four of which are motors and six are trail cars, all made by the J. G. Brill Company, of Philadelphia. The length of the motor car bodies



PLAN OF COMBINATION BAGGAGE AND PASSENGER CAR

over the platform crown pieces is 41 ft. 6 ins., and the width at the sill, including panels, is 9 ft. The height inside is 9 ft. The windows are eleven in number in straight passenger cars and eight in combination cars, arched, with double sash. The platform lengths are 4 ft. 6 ins. The side sills are of yellow pine and are reinforced with heavy iron plates, the end sills and center cross joints being of white oak.

The corner posts of the body framing are 4¾ ins. thick, the side posts 3¾ ins. thick, with a ⅝-in. rod through the center. The roofs are of monitor-deck pattern running the full length of the car body. They are strengthened with concealed steel rafters ⅝ in. thick. Each car is provided with three steps. On each platform is a hand brake to supplement the air brake equipment. Van Dorn automatic couplers are used. Ham sand boxes and "Dedenda" gongs and Hale & Kilburn seats are

used. The steps are fitted with Mason universal safety tread, about 3 ins. wide, and the cars have Westinghouse automatic air brakes with independent motor-driven compressor pumps.

Two sets of wrecking tools, consisting of saw, axe, hammer and crow-bar are provided for each car, one being set in a locker with a glazed door near the end of the car, and one set under the car in an emergency tool box, including replacing frog and ratchet jack. Dull Mexican mahogany finish is employed in the cars.

In combination cars one end is fitted with a baggage compartment, 8 ft. 9¼ ins. long, with a sliding door on each side. The minimum distance from the track to the bottom of the sill is 37¼ ins., which allows a minimum clearance of 3½ ins. above the top of the motors.

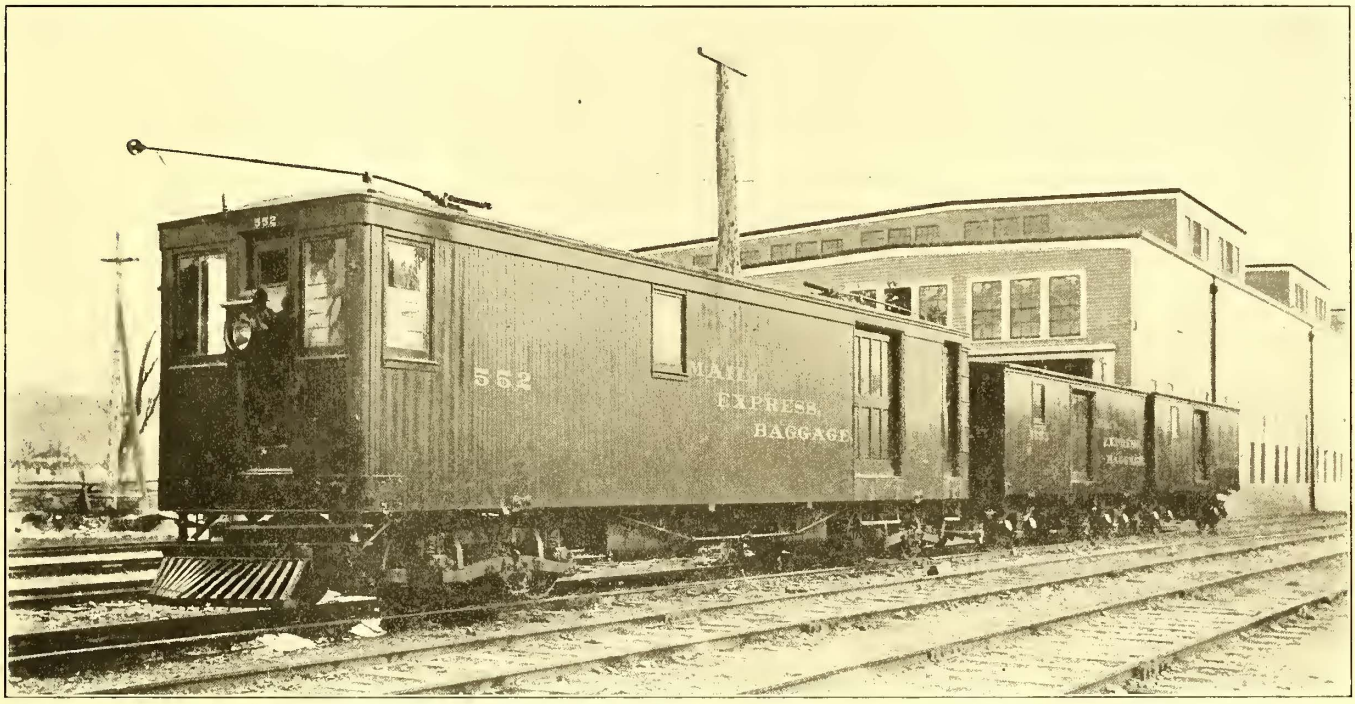
All trailer car bodies are similar to the motor car bodies and thereby being adapted to operation by multiple-unit control when desired. Each four-motor equipment, with a gear ratio of 1.54, fifty-seven-tooth gear and thirty-seven-tooth pinion, is guaranteed to propel a 50-ton train consisting of a 30-ton motor car and a 20-ton trailer at 56 m. p. h. on a level with 33-in. wheels at 550 volts.

WEIGHTS

The motor cars weigh 30 tons empty, and the trail cars 16 tons, the total train weight with full-seated load being 51 tons and 54 tons with standing load.

ELECTRIC LOCOMOTIVES

The freight equipment is composed of an electric locomotive, operated by four General Electric "66" motors, gear ratio 3.94, and has the capacity to haul a 275-ton trailing load at a speed



ELECTRIC LOCOMOTIVE AND TRAIN OF FREIGHT CARS

so designed that they may be converted into motor cars when desired. The bell cords are designed to make a continuous train line if it is needed.

TRUCKS

The motor cars are mounted on extra heavy Brill No. 27-E trucks, having chilled cast-iron double-plate wheels, 33-in. diameter, 3½-in. tread and 1-in. flange. The wheel base is 6 ft. The trucks weigh approximately 9000 lbs. each, and are duplicates, except wheels, of those of the Brooklyn Elevated. The axles are 6½ ins. in the gear fit, 6 ins. in motor linings, with 4¼-in. x 8-in. journals.

The support for the third-rail shoe consists of a cross piece of wood fastened to lugs cast on the boxes, and is designed for a third rail located with center line 21 7-32 ins. from the gage line of the bearing rail, and with top of rail 7⅛ ins. above top of bearing rail.

The axles of the trailer trucks are 4¾ ins. in diameter, and the journals 3¾ ins. in diameter. The wheels are 33 ins. diameter like the motor trucks, and the wheel base is 5 ft. Brake-shoes for the motor trucks are mounted inside the wheels and those for the trail trucks on the outside of the wheels. An additional safety chain is attached to the under side of each draw-bar. The trucks of both motor and trail cars are adapted to a maximum speed of 65 m. p. h.

MOTORS

All the equipments used in passenger service are equipped with four General Electric "66" motors, with type-M control, of about 12 m. p. h. on the level. The motors are connected permanently, two in series, the series pairs being thrown in multiple for full speed running. Recently wiring the equipments for 25 m. p. h. maximum instead of 12 by throwing all four motors in multiple has been considered. In this case air would be blown through the motors, either by a special fan motor or by natural draft with the covers open. It is also planned to operate express cars equipped with four General Electric "66" motors, gear ratio 1.54.

It was found that the passenger equipments made too high a speed in the Seattle streets, so a commutating switch has been installed, which permits operation with all four motors in series.

CAR HOUSE AND GENERAL OFFICES

The principal car house of the road is located at Kent, and is a wooden structure one-story high, with a capacity of sixteen cars. The repair shops are closely connected with the car house and have a capacity of twelve cars.

The general operating offices of the road are located at Kent in the second story of the passenger and freight station. On the ground floor is the general waiting room and ticket office, and a large express and baggage room with a freight track running into the center of the building between platforms. The train despatcher's office is located in the second story. In addition to the offices of the superintendent and clerks there are special rooms for trainmen, containing beds, lockers, billiard table, reading facilities, etc., with a suite of rooms

dining room, kitchen and bedrooms—for the use of the station agent and his family. These have a private entrance from the station platform. The company's buildings are heated from a steam plant installed in the car house.

FARES AND SPEEDS

The minimum schedule time between Seattle and Tacoma is about one and one-quarter hours for express trains and one and one-half for local trains. The fare one way is 50 cents, a round trip costing 75 cents.

OFFICERS

The operation of the road is under the immediate charge of W. S. Dimmock, of the Tacoma Railway & Power Company; the superintendent of the interurban being L. C. Bradley, and the trainmaster, E. W. Mason. A large part of the electrical construction in the field was carried on under the general oversight of D. P. Robinson, assistant general manager of the Seattle Electric Company, and the engineering of the road was planned and directed by Messrs. Stone & Webster, of Boston, the general managers.

DOUBLE-DECK CARS IN GREAT BRITAIN

It is a somewhat remarkable fact that although double-deck cars have gone out of use entirely in the United States and almost entirely on the Continent of Europe, they still remain popular in Great Britain. It is true that there are still a few double-deck cars in Paris, Milan, and perhaps one or two other cities in Italy, but one could visit every city in France, except Paris, and every important city in Belgium, Germany, Austria and Switzerland and see nothing but the single-deck car.

The Street Railway Journal recently made an investigation into the causes of this popularity of double-deck cars among the prominent English railroad managers, and found that there was a unanimity of opinion among the tramway managers in the largest cities that double-deck cars will remain in favor in that country, although admitting that the different conditions in the United States would prevent the double-deck car from giving satisfactory service there. A few of these opinions are quoted below:

A. Baker, general manager of the London County Council Tramways, states that he believes that "single deckers will never supersede the top-seated car in the United Kingdom. In the first place they do not carry as many passengers, and to equal the carrying capacity of a top-seat car they would have to be of such length as to render them impracticable. It must be remembered that in the United Kingdom the number of passengers allowed to be carried is generally limited by the number of seats provided, while in America a car is never full while there is anything above the wheels to be seen. No one can deny that single-deck cars have one great advantage. They can be loaded and unloaded at the terminal points very much more quickly than the top-seat cars. A better time schedule can be maintained, inasmuch as there is no waiting while passengers ascend or descend the stairs. This feature in itself far outweighs some of its disadvantages, as doubtless our American cousins are well aware. On my visit to America last year I came to the conclusion, after giving the matter careful consideration, and having regard to weather conditions, the single-deck car is the right thing for America, but for this country the top decker cannot be improved upon."

J. B. Hamilton, general manager of the Leeds City Tramways, considers that "the reason that double-deck cars are used so extensively in Great Britain is that the variations of temperature are not so extreme in this country as they are in America or in the central portions of the Continent, and passengers, except in the very extreme cold of winter, are quite able to sit on the outsides of cars for the distance which they ride. This distance, owing to the operation of the graded fare, will not average so long as it does in America, where the effect of a uniform fare is to discourage short-distance riding. Then again, the fact that these cars came as successors to horse cars, which were practically all double deckers, has had its effect in determining the wish of the people to continue the use of a vehicle which will permit of smoking freely on the outside. The experiment which was made of having single-deck cars in Glasgow at the very first failed, I think, largely because it was opposed to the usual custom of having a seat on the outside. The narrow, crowded streets of many of the principal cities in Britain are no doubt well served by the adoption of double deckers, as they economize space in the street, a double number of passengers being handled per lineal yard of line. One other reason for the use of double-deck cars is that passengers, as a rule, are not allowed to stand on the platforms, and this has no doubt had its effect in determining what is now an universal custom."

William M. Murphy, general manager of the Dublin Tramways, made several trips to America and the Continent before deciding between single and double-deck cars. After full consideration, however, he selected the double-deck car, and has had no reason to regret this decision. He believes that double-deck cars "possess the great advantage that with a small increase of weight the seating capacity is more than doubled, while riding outside is very agreeable, affording the passengers an extended view of the town or country which they do not obtain from the single-deck cars. One of the objections raised to the top-seat car is that it takes more time to unload and fill again at the end of the journey. I do not find that the difference in time is appreciable. I think that these cars would be in general use all over the world but that the climates of most countries have long spells of extreme heat and extreme cold, when no one would desire to ride outside. There is not a single day in an average English summer when a parasol will not be sufficient to protect a passenger from being inconvenienced by the heat of the sun, and there are very few days in winter, except when it rains, that people of fair constitution cannot enjoy a ride and smoke outside. More than twenty years ago I tried single-deck covered cars with open sides for summer service, but they were taken off after a very short experience. They are all right as open cars without a roof. While the roof afforded protection from a shower it caused a draught, which on all but exceptionally hot days sets half the passengers sneezing before they proceeded very far. I am convinced that the double decker has come to stay. I think that a car of moderate dimensions to seat about twenty-four passengers inside will be found the most suitable size for ordinary street traffic.

This opinion is also coincided in by J. Clifton Robinson, of the London United Tramways Company, who states that in spite of the austerity of the British climate on occasions, there is a strong public opinion in favor of outside travel, such as does not seem to prevail anywhere else in the world.

The Liverpool Corporation Tramways was another to go carefully into the subject of single and double-deck cars. According to C. R. Bellamy, general manager of that system, the corporation considered it desirable to make a practical test. As a result the following cars were put in service:

Fifteen typical modern single-deck cars, American type, purchased from the J. G. Brill Company.

Fifteen Continental trains, consisting of single-deck motor and a single-deck trailer, obtained through Messrs. Busch & Company, Hamburg.

Twelve double-deck cars, obtained through the British Thomson-Houston Company, Ltd.; five through the Brush Electrical Engineering Company and ten through Messrs. Dick, Kerr & Company.

The following statement indicates the weight, length, seating capacity and energy used of the five types of car:

Type of Car	Weight	Length Over All	Seating Capacity			Kw. Hours per Car Mile
			Inside	Outside	Total	
American	25,365 lbs.	33′ 6½″	40	--	40	1.25
German { Motor	16,280 "	27′ 6″	20	--	38	1.6
German { Trailer	8,220 "	25′ 2″	18	--		
Double deck ordinary	18,920 "	27′ 1¾″	22	28	50	0.87
Double deck, L'pool type staircase	20,160 "	27′ 4″	22	34	56	0.9
Double deck, L'pool type, top cover	21,210 "	27′ 4″	22	42	64	

It will be seen that in point of weight, total passenger accommodation and energy used, the figures are all in favor of the double-deck car.

It was originally urged against the upper-deck car that it would be much delayed owing to the time occupied by passengers in descending the stairs. To meet this difficulty Mr. Bellamy devised a reversed stairway for electric cars, which is now largely adopted throughout the country. It can be used with the utmost safety when the car is traveling at any rate of speed, and passengers are required to descend to the lower platform before the order is given to stop. Some interesting statistics of the number of days during which the top seats are desirable for riding purposes have been compiled by Mr. Bellamy. He says in regard to them:

"I have taken from the meteorological report the days during the past year on which the rainfall exceeded .05 of an inch, and which could be described as in any way wet, and the days upon which the temperature was below 35 degs., and could be described as cold. I find that under the first heading there are seventy-four, and under the second thirty-two, and that four of these are concurrent days, giving a total of 106, or 29 per cent of the traffic year, when outside traveling could be regarded as inconvenient. On the other hand I have taken out the number of days when the temperature was 50 degs. or over, when outside traveling would be undoubtedly preferred, and find that they total 173, or nearly half of the whole year. For the remaining eighty-six days, nearly one-fourth of the year, that are dry, with the temperature over 35 degs., the outside seats are very largely occupied. It must be borne in mind that the outside accommodation is much greater than inside, forty-two against twenty-two, and with our climate I have demonstrated that it is practicable to use a collapsable covering for the upper deck of the cars, which renders them available during the whole of the year. With the advance of sanitary knowledge among the people there is an undoubted growth in favor of outside traveling, and at times of epidemic sickness a considerable section of the public will only ride outside.

"The provision of the upper deck deals also most satisfactorily with the smoking difficulty. The single-deck car, unless it is run round a loop at the termini, must, on alternate journeys, have the smoking compartment ahead, when great annoyance is caused to the rear non-smoking passengers. With the upper deck the difficulty is entirely overcome, as smoking is only permitted behind the trolley standard. Taking the matter of revenue earning capacity to first cost, which, after meeting the public requirements, must remain the principal question, the double-deck car certainly leads the way."

There is no doubt that the more equable temperature in Great Britain accounts in large measure for the popularity of the double-deck cars in that country, but it is also true that the average rainfall is considerably greater in America than in Great Britain. This may seem surprising to those to whom the "moist climate" of England has been a long-cherished tradition, but the American rains make up in severity what they lack in continuity. This fact constitutes an additional objection to double-deck cars in the United States. Outside riding during a slight drizzle is not very objectionable to many persons when suitably clad in rainproof coats, as a glance at the upper decks of the cars in most British cities during a "Scotch mist" will indicate. If, however, these same passengers were exposed to a downpour or cloudburst, such as is not infrequent in many American cities during any except the three winter months, the conditions would be quite different.

The rainfall in different cities varies quite considerably, but an examination of the accompanying table will show that it is less in London than in any of the other six cities selected for the purposes of comparison; and that even Glasgow, with its traditional wet weather, has an average rainfall extending throughout the year considerably less than New York, and only slightly more than Philadelphia, Washington or St. Louis. The American figures are taken from the official reports of the United States Weather Bureau, and the British from the records of the Royal Meteorological Office. A table of average temperatures by months for the same cities is also appended.

When these differences in character and quantity of rainfall are added to those of temperature it is easy to understand why, for those reasons alone, the double-deck car would be unsuitable for the United States. In fact their practical use would be confined to a small portion only of the year, while their inconveniences, in the way of delaying traffic, would be considerable. They were tried and abandoned during horse car days in Philadelphia, Washington, Pittsburg and other cities.

In spite of the fact that the managers of most of the largest tramway companies in Great Britain advocate double-deck cars, there is no doubt that there is a growing tendency, certainly among the smaller British towns, toward the use of single-deck cars, especially combination cars, such as are known in America as the California type. Among the cities which are using this car are Wolverhampton, Rothsay, Southport, Gateshead and Sunderland, while a considerable number of others are using the standard closed car, either single or double truck, similar to the standard American car. The chief advantage of the single-deck car is that it can be loaded and unloaded much more quickly, and as the tramway systems develop and the traffic becomes more dense it is thought by many that the single-deck car will come into somewhat more general use.

One other point remains to be considered, and that is the wear on the track. The double-deck cars in Britain are almost exclusively of the single-truck type, with a 6-ft. or 6½-ft. wheel base. With the 1-in. grooved rail used generally, and with the 30-ft. and 35-ft. curves, which are common, there is undoubtedly an excessive amount of flange wear on both wheel and rail. The increased weight per wheel of a loaded double-truck car must have a detrimental effect on the rail-joints.

Table Showing Average Monthly Temperature (in degrees Fahr.) in Several British and American Cities.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
London *	38.7	40.3	42.7	48.3	53.6	60.2	63.5	62.8	58 2	49.9	44.2	39.6
Glasgow *	38.3	39.0	40 4	45.0	50 0	55.8	57.9	59 2	53.2	46.7	42.2	38.6
New York †	31 5	25 6	38.6	49.4	58.6	71.4	78.1	75.6	68.4	56.0	39.7	34.4
Philadelphia †	33.1	27.2	41.8	50.1	60.5	72 6	79.2	76.9	69.5	57.1	41.2	35.9
Washington †	34.1	29.8	45.0	50.6	62 5	72.4	79.8	76.0	67.4	55.6	40.6	34.8
Chicago †	26.0	17 0	34.0	45.0	54.1	69.1	77.4	71.6	64.3	55.4	37.6	24.0
St. Louis †	37.2	31.0	44.8	54.4	66.2	80.6	87.4	80.0	71.8	61.8	44.0	30.2

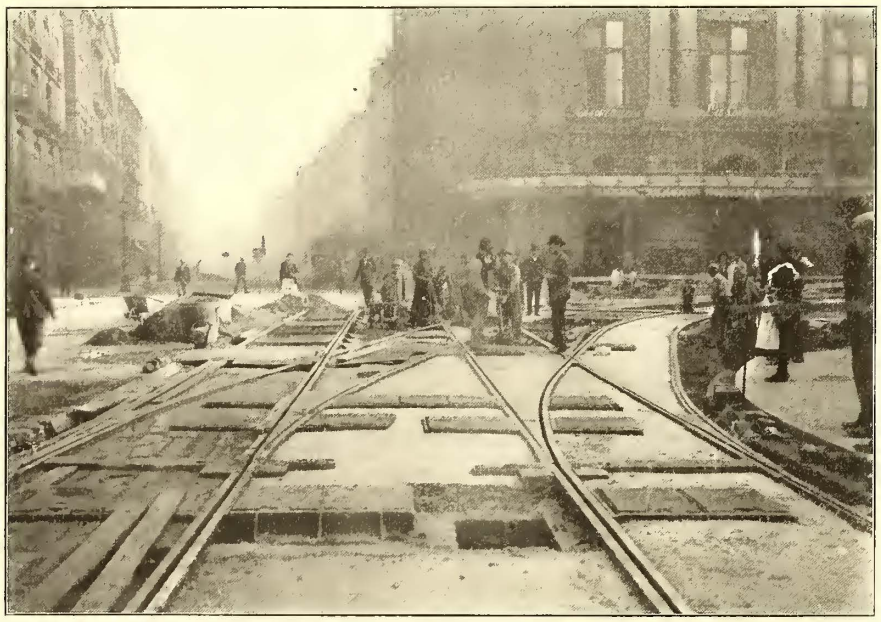
Table Showing Average Monthly Rainfall (in Inches) in Several British and American Cities

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
London *	2.01	1.69	1.49	1.65	1.69	1.93	2.27	2.30	2.28	2.70	2.29	2.15	24.45
Glasgow *	3.85	3.20	2.42	2.12	2.44	2.84	3.34	3.99	3.77	3.78	3.79	4.23	39.57
New York †	3.65	3.88	4.03	3.17	4.04	3.57	4.57	3.89	2.67	3.28	3.96	3.11	43.02
Philadelphia †	3.10	3 37	3.31	3.05	4.11	2.52	3.59	3.95	3.09	2.04	3.59	3.03	39.35
Washington †	3 10	3.91	3.21	3.34	3.88	3.44	3.79	3 14	2.81	2.22	2.57	3.06	38 47
Chicago †	1.99	2.32	2.14	1.71	3.14	3 68	3 09	2.45	3 01	1.42	2.47	1.92	29.64
St. Louis †	1.92	2.87	3.89	3.87	5.28	3.24	4.09	1.46	2.07	1.80	2.85	2.19	35.53

* Ave age for 30 years, 1871–1900, reported by Royal Meteorological Office. † Average for 10 years, 1892–1901, reported by U. S Weather Bureau.

CONDUIT CONSTRUCTION IN BRUSSELS

In the September, 1902, issue of this paper a description was published of the Brussels tramways and of the underground conduit system which has been adopted in that city. This conduit, as is common in European cities, is laid on one side of the track and forms one of the track rails, the flange of the wheel running in the slot of the conduit.



VIEW OF PARTIALLY COMPLETED WORK

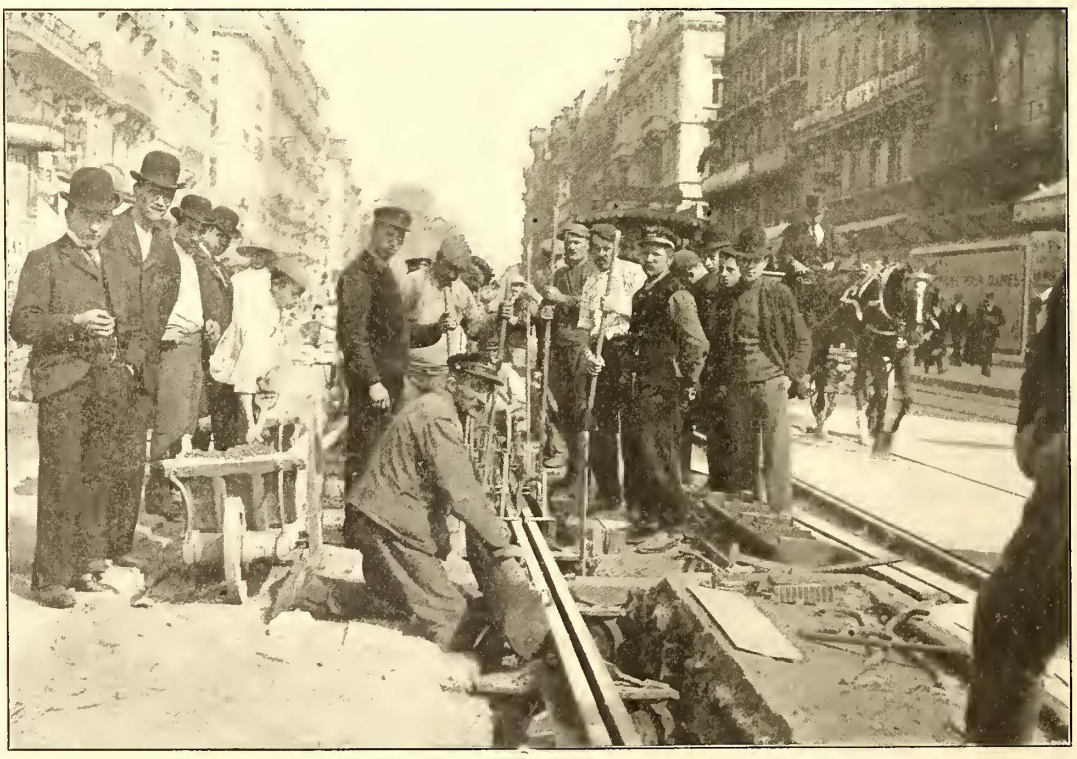
One of the accompanying views shows the method of laying the conduit, and as it differs from that originally followed some particulars of it will be of interest. The method is practically the same in principle as that followed in New York city, but as the conduit is laid at the side instead of in the middle of the track there are necessarily some points of difference.

The original plan was to excavate a trench for the entire width occupied by the conduit, or by the two conduits in case of a double-track road. The bottom of this trench was then laid with concrete, and after this had set the yokes were placed in position and held in place by cement. After this the slot rails were laid on the yokes and aligned. This always occupied considerable time, as any slight displacement of the yokes threw out the alignment of the slot rails. When this work was accomplished, however, the conduit was built up by means of concrete blocks prepared in advance, or by brick, or else by means of concrete tamped into place around moulds. The construction was then allowed to set, after which the earth was tamped in around the conduit and the paving was laid.

This method of construction involved the removal of a considerable amount of earth, the opening of the street for four or five weeks and difficulty in aligning the rails. Moreover, during this time it was necessary to keep along the line of work a quantity of earth in order to replace it around the conduit. This created an obstruction on the street as well as a considerable disarrangement of the tramway service, as both tracks were usually open at the same time.

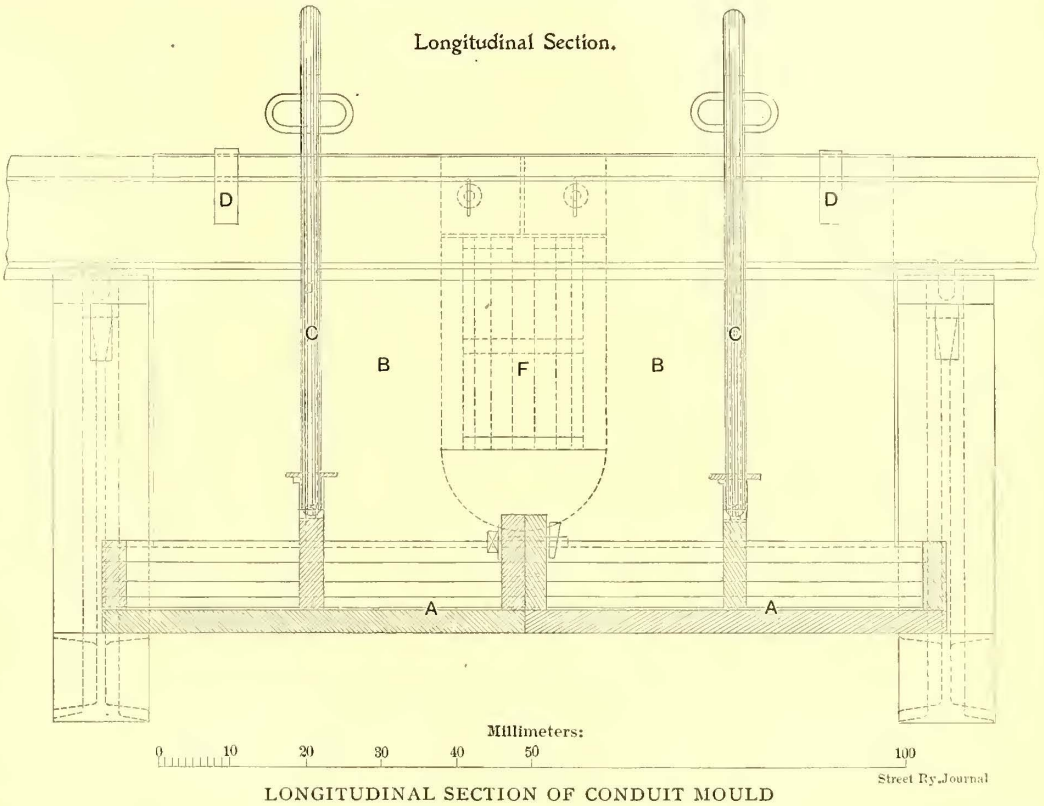
The new method followed avoids practically all of these difficulties, and as only one conduit is laid at a time, one track and half of the street is still free for tramway and vehicle traffic.

A trench is first constructed of exactly the dimensions which will be taken by the completed conduit, so that the quantity of earth removed is a minimum and it can immediately be carted away. The yokes are placed 1.25 m, about 5 ft. apart, and niches are carefully cut in the trench at exactly the points required to accommodate these yokes; the yokes are then put in place. After this has been done wooden timbers are placed across the trench to support the slot rails, and at such a height that when the slot rails are placed on them they will rest on the yokes, and will be in their proper future position. On these timbers are mounted cast-iron clamps, which are of just the right shape to fit the base of the slot rails. The rails themselves are then set in these clamps, after which they are held together on top by means of a T-shaped clamp which embraces the heads of the rails and fits into a mortise in the lower clamp. In this way the proper position of the rails is secured in an exact manner, and it is only necessary to align and level them, which is easily done by adjusting the position of the wooden timbers. In other words, the track is aligned by means of the slot rails, which is the end desired, and the rest of the structure is made to conform to it. The next process is to attach the yokes to the slot rails, which is done by means of four bolts. The brace rods connecting the web of the slot rails with the yokes are then put in place. The only work now remaining to be done is to build up the conduit proper.

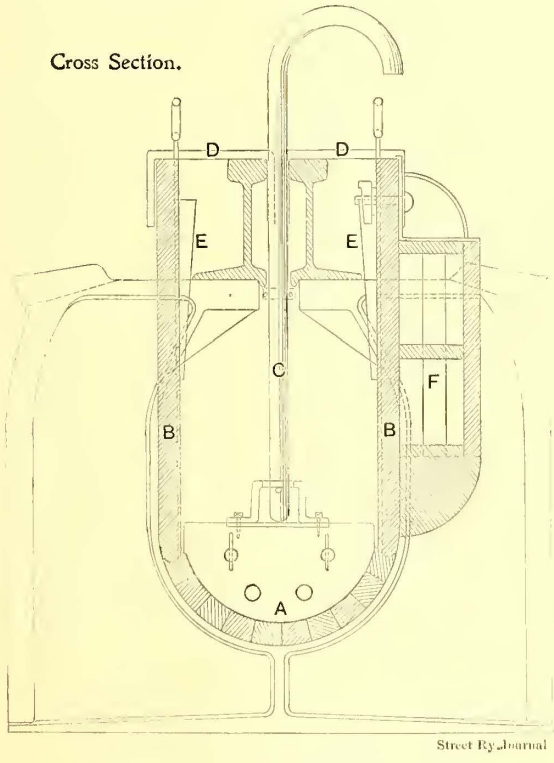


INSERTING MOULDS IN TRENCH

As has already been said, the outside section of the trench serves as the exterior mould of the concrete. The interior mould is illustrated herewith. It consists of three parts, a semi-circular piece made of wood and marked A., and two vertical pieces marked B. This mould, as shown in the longitudinal section, is made in two parts held together by bolts and pins so that it can easily be taken apart and removed from the conduit after the concrete has been packed in place. The mould is fitted with two long, upright handles provided with a flexible joint, by means of which they can be straightened out against the lowest surface of the rail. The handles also serve to shove along the mould from one part of the conduit to another as the work progresses. To prevent the lower piece from wedging against the vertical pieces and to secure a good joint between the parts the lower part is made slightly less than half of the arc of the circle. The vertical pieces, B, are also of wood, and are held in position at the top by the brace B, and in vertical position by the wooden wedges E. No bolts are used, so that the mould can be put together in position or taken apart in less than a minute. The conduit used is made of one part of Portland cement with three parts of sand and five parts of broken stone. The concrete is first



LONGITUDINAL SECTION OF CONDUIT MOULD



CROSS SECTION OF CONDUIT MOULD

tamped under the yokes and then around the sides of the mould. The tampers used for this purpose are of wood, shod with steel and weigh about 3 kg (6½ lbs.).

The insulators are placed every 5 m, and are set in small recesses left in the concrete. These recesses are obtained by fitting against the upright pieces of the mould a small wooden secondary mould marked F. The bearing for the brace holding the insulator is obtained by placing it in the concrete at the time of tamping by means of clamps of the proper form, and which are afterwards removed.

In this way a concrete body of great density, well set in the soil, is obtained. After the tamping is finished the cross ties are removed and the top of the conduit is covered with steel plates intended to distribute the weight of the pavement evenly on the conduit. The only work remaining is then the installation of the secondary rail, which is placed in the usual way, and the paving.

The time of accomplishing this work depends upon various circumstances, but averages about five days in streets paved with blocks and about double that in streets paved with asphalt, for the reason that time has to be allowed for the concrete to set before tamping down the asphalt.

The work of reconstruction of the Brussels lines was commenced in May and was finished late in the year. They will be put in operation as soon as the new power station is completed, which will be during 1903.

The third line of cars from suburban lines outside the system of the Boston Elevated Railway Company to run into the Park Street subway station has been placed in service. The route is from Natick, Mass., over the Newton Street Railway Company's tracks, via Washington Street and Commonwealth Avenue, Newton, and Commonwealth Avenue, Beacon Street and Boylston Street, Boston. This gives a through car from Natick to Park Street every half hour. The Newton Company has been running cars between Park Street, Waltham and Auburndale by a similar arrangement for some weeks.

One of the plans of the Boston & Worcester people is to bid for the contract to transport the Boston companies of the State militia from the camp ground to Boston next June. The brigade will break camp June 24, and the South Framingham power house of the railway company is directly opposite the camp ground. Although it will take more time to carry the troops to Boston by trolley instead of by steam road, the line will land them in the center of the city rather than at the foot of Summer Street.

THE WINDING UP OF THE EVERETT-MOORE SYNDICATE

The recent financing and the removal of the receivership of the Lake Shore Electric Railway practically marked the closing of the last problem to be solved in the rehabilitation of the electric railway properties of the famous Everett-Moore syndicate, of Cleveland. But the prediction freely made in the early stages of the embarrassment, to the effect that a few months would see the syndicate on its feet in shape to carry out its projects and to assume its former position in the front rank of the financial giants of the country, seems at present improbable of realization. The gentlemen identified with the syndicate are unquestionably still very wealthy men, but they can hardly regain the prestige they have lost or gather together again the vast group of properties that have been, to a large extent, disrupted during the past year.

As a matter of fact no less person than Mr. Moore has made the statement that in the future the heads of the syndicate will work as individuals, and that while they are bound to be more or less allied through friendship and their mutual interests, there will be no more concerted action to the extent of the endorsement of paper as a syndicate. Mr. Everett will devote his attention to the development of the properties in which he is interested, since his forte has always been in the operating rather than the financing of projects, while Mr. Moore will devote his chief attention to the banking business. He is a banker by profession, and is interested in several leading Cleveland institutions besides being a member of the Boston banking firm of Moore, Baker & Company.

To those who have watched the growth of the Everett-Moore syndicate since its inception, and have had a chance to know the important services which they rendered to the advancement of the electric railway industry in general, it is a matter of deep regret that their plans should have been blasted just at a time when they were about to complete solid foundations for structures that promised to eclipse anything in their lines of work.

Jan. 1, 1902, saw the Everett-Moore syndicate in control of the most remarkable groups of electric railway properties and independent telephone system this country has ever seen.

The traction system included something like 1500 miles of electric railways in operation, with several hundred miles of road under construction and projected, while the independent telephone properties included the control of thirty or more leading exchanges in Ohio and Michigan, linked together by the most important independent long-distance system in the country, connecting nearly 400 exchanges with about 9000 miles of toll lines.

The electric railway properties that were absolutely controlled by the Everett-Moore syndicate are detailed herewith:

Name	Capital Stock	Miles of Track	Annual Earnings, 1901
Cleveland Electric Railway..	$13,000,000	136	$2,296,889
Detroit United Railway.....	12,500,000	380	2,919,171
Toledo Railway & Light.....	12,000,000	102	1,311,084
Lake Shore Elec. Railway...	6,000,000	160	358,180
Northern Ohio Traction Co..	2,500,000	95	617,011
Cleve., Painesville & East'n..	1,500,000	38	164,971
Dt. & Pt. Huron Shore Line.	2,000,000	108	327,148
Toledo & Maumee Valley...	300,000	15	.....
London Street Railway.....	450,000	28	141,846

It had under construction the Detroit & Toledo Shore Line, the Scioto Valley Traction Company, the Cleveland, Painesville & Ashtabula Railway, and the Illinois Central Traction Company. It was also heavily interested in the Aurora, Elgin & Chicago, the Washington & Baltimore, the Miami & Erie Canal, the Cleveland & Eastern, the Cleveland & Chagrin Falls, the Chagrin Falls & Eastern, the Wheeling Traction Company and probably a number of other properties.

The history of this great group of properties is interesting. Henry A. Everett started as an office boy with the East Cleveland Railway, of which his father, Dr. Everett, was founder and president, and he inherited the control of this property. Also interested in the East Cleveland road was Charles Wason, who has since become identified with all Everett-Moore propositions. In 1892 a number of Cleveland lines were consolidated into the Cleveland Electric Railway, and later Mr. Everett obtained control and became president of the system. In 1892 Mr. Everett supervised the electrification of the Toronto, Can., horse car lines, and later did similar service for the Montreal and London, Ont., lines. He became manager and a large stockholder in these properties, and retained control of the Toronto and Montreal lines until 1900, when he disposed of his interests, because they were too far away from his chief field of action.

In 1894 Mr. Everett secured a franchise in Detroit, which finally resulted in gaining control for himself and his associates of all the Detroit city lines, which were consolidated under the present title of the Detroit United Railway. In 1895 Messrs. Everett, Wason and others built their first suburban line, from Cleveland to Painesville. Soon after they obtained a controlling interest in the Akron, Bedford & Cleveland line, which was later merged into the Northern Ohio Traction Company, through the purchase of the Akron city lines with suburban lines to Cuyahuga Falls, Kent and Barberton. About the same time Mr. Everett became interested in the Lorain & Cleveland line, which was owned largely by Barney Mahler, who has since been a leading member of the syndicate.

In 1900 came the formation of the Everett-Moore syndicate and the launching of a systematic campaign for the upbuilding of an immense electric railway system as well as an independent telephone system; Mr. Everett having become interested in the telephone movement through the purchases of the franchises in Cleveland of the crippled Home Telephone Company. Edward W. Moore, who from a clerkship had worked himself to the secretary-treasurership of a prominent bank in which Mr. Everett was interested, was invited to become the active financial man of the group.

The years 1900 and 1901 saw the remarkable development of the plans of the syndicate, which for a time threatened to absorb all the leading traction and telephone properties in the Central West. The controlling interest in the Toledo city lines was obtained at low figures, and the Toledo Railways & Light Company was formed, including all the electric railway and lighting properties in the city. The Toledo, Fremont & Norwalk Railway was purchased and work was immediately started to connect it with the Lorain & Cleveland Railway, to form a through line from Cleveland to Toledo. Incidentally the Sandusky city lines and lighting plant, the Sandusky & Interurban and the Sandusky, Norwalk & Southern Railway were absorbed, and the whole merged into the Lake Shore Electric Railway. The Canton-Akron and the Canton-Massillon interurban lines, together with the city lines of both the latter towns were absorbed and merged into the Northern Ohio Traction Company. The Toledo & Maumee Valley Railway was purchased and later its stock was absorbed by the Toledo Railway & Light Company. The Toledo & Monroe Railway was acquired to prevent its being extended to Detroit, and thus make competition for the Detroit & Toledo Shore Line, which the syndicate had partially completed between Toledo and Detroit; it was the intention to have consolidated the Toledo & Monroe with the other road, thus making a double track line; one track was to have been for freight and the other for fast passenger traffic.

The most gigantic acquisition was the purchase of five of the six interurban lines radiating from Detroit, a total of nearly 300 miles. The remaining Detroit line would doubtless have been absorbed, as negotiations were still on when the crash came. They were merged into the Detroit United Railway, as was also the Sandwich, Windsor & Amherstburgh, on the

Canadian side, opposite Detroit, including also the lighting system of Windsor, making the Detroit United one of the largest systems in the country.

To lend prestige to these companies Messrs, Everett and Moore acquired stock and became directors in the Cleveland & Eastern and the Cleveland & Chagrin Falls lines, since consolidated into the Eastern Ohio Traction Company. This nominally extended the syndicate properties from Youngstown, Ohio, to Port Huron, Mich., traffic arrangements having been made to reach the former city.

The plans made by the syndicate for developing these properties have been touched on from time to time in the columns of the STREET RAILWAY JOURNAL, but they are worthy of review. It was proposed eventually to form a controlling company to have a capital stock of something like $100,000,000, and to control all the railway properties under one head, as had already been accomplished in the telephone field through the Federal Telephone Company. This was to have been accomplished by first merging the properties into groups, the Detroit United system being the first step in this direction. It was planned to effect great economies through the standardization of equipment and the purchase of supplies and material in large quantities. The Everett-Moore Managers' Association was formed, and considerable work was actually accomplished in the standardization of city cars; about 200 city cars were purchased and are now in use in Cleveland, Toledo, Detroit and Akron. A standard "Everett-Moore Red" was adopted as finish for interurban roads and a standard yellow for city cars, and they are still in use on the majority of the roads. A standard for numbering cars was also adopted. The central purchasing department, with Charles Wason at the head, made many heavy purchases of material while it was in operation. It was the plan to eventually centralize power stations and to effect the economies resultant from generating current in large quantities. A tract of coal lands, located near Massillon, was to have been purchased, and fuel was to have been handled at night over the syndicate's own lines. Repair shops were to be centralized, and while this point was denied, it was undoubtedly part of the plans for the future to build all their own cars. The freight traffic was to have been developed by an interchange of business and it was the plan to handle heavy freight during the night. Great attention was to have been paid to developing summer traffic, and there was to have been a chain of parks and places of amusement, all under syndicate management, and with attractions that were to make regular circuits of the various resorts. The lighting business was also to receive considerable attention, and the syndicate was quietly at work securing franchises in all of the towns touched by its lines. There were official predictions that a very short time would see limited trains in operation from Pittsburg to Detroit and other points, with parlor and sleeping cars.

Reasons almost without number have been assigned for the Everett-Moore embarrassment. In fact it was a complication of circumstances, but it can be summed up in the single sentence: "Lack of capital." It is not within the writer's province to criticise those who are still millionaires through their own efforts, but undoubtedly had the syndicate confined itself to either line of enterprise—electric railways or telephones—there never would have been any occasion for writing this article. And as a matter of fact it is extremely questionable if the embarrassment might not have been averted had the syndicate kept its money strictly in these enterprises alone. As it was the Everett-Moore people figured in enterprises without number. They were stockholders in numerous banks in Cleveland and vicinity and in the East. They were among the largest owners of real estate in Cleveland, and controlled several office buildings, a theater, a hotel and several apartment houses, besides being interested in two or three realty companies operating in the neighborhood of Cleveland. It has been said that they would buy anything that was offered cheap enough, providing the sellers would take part or all payment in Everett-Moore securities.

The earlier propositions were all financed in Cleveland, and they aided in acquiring for the Forest City the reputation of being the greatest traction and independent telephone center in the country. There was a local pride in building and owning these properties, and as the majority of propositions were successful, or appeared promising, the securities were eagerly taken up by all classes of people. Gradually the movement spread until Everett-Moore securities permeated the business interests of the entire State, and they were looked upon as first-class investments. Cleveland banks and later the smaller institutions throughout all the cities and villages of the district loaned money to the syndicate, as well as to individuals on the syndicate securities and on notes endorsed by the syndicate. Finally there came a time when Cleveland institutions were no longer strong enough to float the huge propositions, and at the time of the Detroit United deal the syndicate turned to New York capitalists with a $30,000,000 bond issue. This was finally put through at a reduced figure after many trying vicissitudes. Propositions were then presented for the sale of bonds on the Lake Shore Electric Railway and the Detroit & Toledo Shore Line, and at the same time the syndicate attempted to raise money on a block of telephone securities. It is generally believed that it was this telephone proposition that proved the "straw that broke the camel's back." Independent telephone securities were not fully appreciated by the moneyed interests of the East, and while it may or may not be true that the American Bell Telephone Company brought pressure to bear and thought to stifle with one blow the lusty independent giant that was developing with tremendous strides in the Central West, the fact remains that the telephone proposition hung fire for many months, and was presented under several different plans, among them the collateral trust plan, which, for a time, seemed likely to prove successful. The wonderful growth of the telephone properties astonished even the promoters themselves, and in nearly every exchange they were forced to make extensions at once, in some cases before they were fairly started. This fact incurred heavy debts for the Reserve Construction Company, the telephone construction company of the syndicate, causing the telephone supply people to press their claims.

At the same time Cleveland banks that held Everett-Moore paper had been drained of much of their ready cash through heavy loans in building operations, through heavy losses suffered by Cleveland people in taking care of margins on Amalgamated Copper stocks, a security which was held extensively in Cleveland, and through the general depression prevailing at the time.

The crash came on Jan. 2, 1902, when the Reserve Construction Company was forced into a receiver's hands. On the same day it was announced that the Everett-Moore syndicate had placed its entire affairs in the hands of a coterie of Cleveland bankers, who would attempt to arrange with all creditors for an extension of eighteen months. It was stated that this action had been taken with the full consent of the members of the syndicate, and that it was deemed the wisest move in order to preserve the equities of the securities owned by the public at large and held by the banks on loans.

During the next few days event followed event in rapid succession. The Eastern bond buyers withdrew from their agreements to take the Lake Shore Electric and the Detroit & Toledo Shore Line securities, and these roads were forced into the hands of receivers, the latter being wholly tied up. The Toledo & Monroe Railway reverted to its former owners owing to the failure of the Detroit & Toledo line. The effect on Cleveland and vicinity was tremendous. Everett-Moore securities had so permeated the entire commercial and banking fabric of the

district that the situation may almost be described as appalling. There were runs on three banks, in which the syndicate was interested, and one of them failed as the indirect result. Several small banks in neighboring towns were seriously embarrassed, and one or two went out of business. The syndicate securities, and in fact all traction securities, which had been declining for several weeks past, owing to tight money, suffered a decided slump, but to the credit of the good sense of Clevelanders there was not the panic that might have been expected, and within a very short time a reaction took place, caused by the demand for many of the securities at the prevailing low prices. Confidence was restored to a large degree as soon as it was seen that the individual properties, which were in good shape, could not be involved, and a great many people seized the opportunity of making good investments. The wisdom of this, so far as the traction securities are concerned, is amply demonstrated in the quotations of the stocks of the leading roads presented herewith. The first column represents the figures soon after the embarrassment, the second column the high quotations during September, 1902, when the bull movement reached its climax, and the third, the present quotations, which are considered very low owing to the general decline in all stocks:

	January, 1902	September, 1902	April, 1903
Cleveland Electric Railway.....	69¾	92¼	80
Cleveland, Painesville & Eastern.....	33⅛	35	*a*
Detroit United Railway.....	56½	95¼	85
Toledo Railway & Light Company....	20	40	33
Lake Shore El. (common).....	10	22½	14
Lake Shore El. (preferred).....	45	61	53
Northern Ohio Traction (common)...	20	70	*b*
Northern Ohio Traction (preferred)..	80	98	..

a No recent sales recorded on Cleveland Exchange. *b* Company reorganized with larger capital.

The work of adjusting the affairs of the syndicate was a herculean task. Within a very short time creditors, to the amount of nearly $12,000,000, had filed their claims, and with but one or two exceptions agreed to the eighteen months' extensions. Then the bankers' committee announced that it was open for proposals on the various properties. And they came thick and fast. The affairs of each of the various properties were placed in the hands of sub-committees, whose duty it was either to refinance them or arrange for the sale of the Everett-Moore interests. After careful investigation the bankers committee announced that the majority of traction propositions were in good shape, and that they would not be disposed of at up-set prices. Bargain hunters were disappointed, and the wisdom of this decision was soon made apparent, for the longer the committee held off the better figures it was enabled to command through the return of the public confidence in the soundness of the propositions. The first important transaction was made February 15, when 43,000 shares of Cleveland Electric Railway at 80, and 5000 shares of Cleveland City Railway at 105 were sold to a syndicate headed by Horace Andrews. The syndicate's equities in these sales were said to have been nearly three-quarters of a million, and the money went a long way towards taking care of pressing obligations.

There was a touch of the pathetic in the sale of the Big Consolidated, the foundation of Henry Everett's career, especially in view of the fact that the supremacy passed into the hands of one whom Mr. Everett had twice before vanquished in contests for control. Numerous proposals were considered for leasing the Detroit and Toledo systems, but they fell through. An offer of 75 for the entire capital stock of the Detroit United failed, because a sufficient number of shares could not be obtained to make the plan operative. Finally large blocks of the Everett-Moore holdings were sold to brokers in various centers, who, in turn, placed them on the market. In this way the stock was widely scattered, and it is understood that something like 22,000 shares out of the 30,000 shares owned by the syndicate were disposed of at between 70 and 78. By retaining 8000 shares it is believed that the members of the syndicate are still the largest individual stockholders in this property, and through the interests held by their friends are still theoretically in control. An offer of 20 was declined for the 80,000 shares of syndicate's Toledo Railways & Light stock, and 40,000 shares were disposed of through brokers at an average of about $22.50 per share. This sale was a magnificent deal for the syndicate, for the stock is said to have cost them only about $7 to $9, and they were still enabled to retain the control. In the Northern Ohio Traction Company the syndicate owned 6244 shares of the 10,000 preferred, and 14,080 shares of the 25,000 common stock. A proposition was received to sell the entire property at 37½ for the common, and 87½ for the preferred, but the minority stockholders declined to sell, and the syndicate's portion of the preferred stock was finally sold at $80. The wisdom in holding the common is apparent when the above table of quotations is referred to. Through its common stock the syndicate still retains control of the Northern Ohio Traction. An option was given on the London Street Railway but this fell through and the syndicate remains in control of a very valuable property. The syndicate's interest in the Aurora, Elgin & Chicago was sold for $200,000. Its 60 per cent interest in the underwriting of the Scotio Valley Traction Company was sold to Columbus and Cincinnati people, who are now finishing the road. The franchises and right of way for the Cleveland, Painesville & Ashtabula were sold to Cleveland parties for $65,000, and the road is now being completed. Through failure to complete the purchase of the Canton-Akron and Canton-Massillon lines these roads reverted back to Tucker, Anthony & Company, of Boston, from whom they had been purchased. A large amount of valuable real estate was disposed of early in the game; one piece adjoining the Electric Building, on which it was proposed to erect another office building, selling at $110,000. A large amount of Eastern and local bank stock was also disposed of, among this being 15,000 shares of Dime Bank, which brought 150.

To provide for much needed improvements the Northern Ohio Traction Company was reorganized into the Northern Ohio Traction & Light Company. The capital stock was increased from $2,500,000 to $7,500,000, of which $6,500,000 was issued. The road is now showing wonderful increases in earnings, and it is well able to take care of this increased load; the new stock is at present worth considerably more than the old common was a year ago.

The greatest obstacle encountered by the bankers' committee was the refinancing of the Detroit & Toledo Shore Line and the Lake Shore Electric Railway. Efforts to merge the former into the Detroit United failed, and after many controversies the property was finally sold to the Grand Trunk for use as a steam line. The electrical apparatus was sold to the Toledo & Monroe for its extension to Detroit. The syndicate netted its investment and interest and the creditors are to be paid in bonds guaranteed by the steam company. The Lake Shore Electric refinancing proved even more perplexing. Eastern bankers declined to touch the securities, and a syndicate of Cleveland banks finally agreed to buy them, but they required that the receivership be first lifted. It was arranged to accomplish this through the sale of a new issue of $1,500,000 preferred stock, which was to be taken by the old preferred stockholders at 60. Many of these stockholders objected, in view of the fact that the preferred stock was selling at a considerably lower figure. For many weeks the plan was held up, and it was feared that property would have to be foreclosed. Finally the Everett-Moore syndicate removed the deadlock by taking 9000 shares of the preferred. In Cleveland financial circles this move is looked upon as an extremely magnanimous one, since the syndicate, being the largest creditor of the road, could have foreclosed the property and could probably have bought it in at a low figure. The receivership was removed April 1, and the road is being placed in first class shape. While the syndicate owns the majority of the Lake Shore stock the control is vested,

for the next five years, in the hands of the syndicate of Cleveland banks that purchased the bonds.

The adjustment of the affairs of the telephone properties presents a difficult proposition, but by reason of the rapidly increasing earnings of these properties the problem is daily becoming easier, and it is believed matters will soon be adjusted. The largest creditors practically control the management of these properties, and it is probable that some of them will be disposed of. The Federal interest in seven or eight exchanges has already been sold.

The effects of the Everett-Moore embarrasment were widespread and in a measure disastrous. The promotion of electric railways in Ohio and adjoining States was practically stifled for many months, and many propositions that had been partially financed and were under way, were tied up through the bankers withdrawing their support. Many roads that were planning extensions and improvements put aside their tools and waited developments. Material men who attempted to sell electric railway supplies in Ohio during the summer of 1902 have painful recollections of the truth of these statements. But there is another phase to the situation; it taught would-be promoters that electric railroads could not be built without capital, and it practically wiped out a cloud of wild-cat projects that threatened to throw into disrepute plans for building these latest harbingers of a higher stage of civilization. The outcome has demonstrated beyond a question of a doubt that well located and well designed electric railway properties are among the safest investments known to modern financiers, and there are hundreds of wealthy men in Cleveland and the Central West who made their fortunes by investing in Everett-Moore and other traction securities in the early days of the syndicate's difficulties.

CONNECTING TRENTON, N. J., AND DOYLESTOWN AND EASTON, PA.

The New Jersey & Pennsylvania Traction Company's extension from Yardley to Newtown, Pa., is expected to be in operation early in June. Two cars have been ordered from the Brill Company, of Philadelphia, for delivery by May 1. Another car will follow shortly after and others as they are needed. The general specifications call for a car 37 ft. over bumpers, equipped with four 40-hp motors, Christensen air brakes, cross-seats, enclosed vestibules, etc. They will be built largely from special plans evolved by General Manager Barry, of the New Jersey & Pennsylvania Company, and will weigh about 20 tons net. The road will run entirely over private right of way from Yardley to Newtown, Pa., and there will be less than 1 mile of the 7 miles between Newtown and Yardley where the grades will exceed 2 per cent. There will be two short sections of 4 per cent grade and two of 3 per cent. A 30-ft. right of way has been purchased. The 12 miles from the center of Trenton to Newtown will be covered in about 40 minutes, and the fare will be 15 cents for the entire distance. The completion of this line will afford connections between Trenton, N. J., and Doylestown, Pa., 26 miles, and through to Easton, Pa., with the completion of the Philadelphia & Easton Railway Company, between Doylestown and Easton.

On Feb. 10 a disastrous fire occurred in the borough of Mornington, New Zealand, by which the power station and car house of the Mornington Tramway Company were destroyed. The loss is estimated by Mr. Eunson, general manager of the Mornington Tramway Company, at about £10,000. The insurance carried on the property was £5,735. The road was operated by cable and was built in 1883. Negotiations are pending for the purchase of the road by the local authorities, and it is possible that these negotiations will be hastened by the fire. In this case electricity will probably be used.

NOTES ON THE VALTELLINA 20,000-VOLT THREE-PHASE RAILWAY IN ITALY*

BY WILLIAM J. HAMMER

About two years ago I had the pleasure of visiting the works of Messrs. Ganz & Company, in Buda-Pest, Hungary, and through the courtesy of Director Otto F. Blathy, I was given facilities to study the company's 20,000-volt three-phase system for operating electric railroads. In September last I embraced the opportunity of visiting the generating plant and railroad equipment in Northern Italy.

For nearly two years Ganz & Company have been installing this plant, and it was officially started up Sept. 4, 1902; and this firm and the Societá della Rete Adriatica, for whom the work was carried out, are to be congratulated upon the pluck and perseverance they have shown in grappling with the well-nigh insuperable difficulties they have had to contend with, and the very able manner in which they have carried out this stupendous undertaking. It represents the most important and interesting electric railway installation in the world, and it is, indeed, remarkable that so little attention has been given by engineers, especially in this country, to this important and successful effort to establish long-distance electric railroading under steam railroad conditions.

I visited the railway early in September, 1902, almost simultaneously with the starting up of the road, and spent some days traveling over the entire line; and, although the Lecco-Colico section was not being electrically operated at the time of my visit, all the rest of the road was; and I can bear testimony to the remarkable success of the operation of the road, which compared very favorably in smoothness and reliability of running, in starting and stopping, etc., with any road I am familiar with, either here or abroad; and I am informed that the company already has under contemplation the equipment of the road from Lecco to Milan in addition to the 72 miles already in operation.

This railway system has until recently been operated by steam, and is known as the Lecco-Sondrio and Chiavenna Line. Enormous difficulties have been met with in the installation of this plant, not so much in the employment of the initial voltage of 20,000 volts, but in dealing with the difficulties of the road-bed, which, as in all Italian roads, is execrable; also by reason of the length of the line, the problems in freight and passenger haulage, the very large number of tunnels the road had to pass through, the high winds and freshets in the mountain streams, and the difficulties in electrically equipping a standard gage road of 72 miles in length during the time that it was being constantly operated as a steam road.

The power house represents about 7400 hp, with facilities for increasing this when necessary. The plan consists of three 2000-hp Shuckert three-phase alternators of the revolving field type, supplying 20,000 volts at 15 cycles; these are direct connected to three turbines supplied from a raceway between 2 miles and 3 mile in length, sections of which are open cuts through the rock, and other sections being through tunnels. The water is carried to the head stock 90 ft. above the station and delivered at the rate of 35 cubic meters per second.

At the time of my visit but one alternator was being used, and it was claimed that this could be made sufficient to operate the entire road, and the engineers have been surprised to find they would have such a very large reserve of power above all present requirements.

The power plant is placed at Morbegno, 9½ miles from Colico, or 15½ miles from Sondrio.

The three-phase current of 20,000 volts is connected directly to the primary line, which supplies nine sub-stations equipped

*From a lecture delivered before the Franklin Institute, Philadelphia, Feb. 12, 1903.

with ten 300-kw. Ganz transformers and the necessary switches, arresters and motor-driven ventilating devices for the transformers. At these sub-stations the current is stepped down to 3000 volts; these stations furnishing current to the

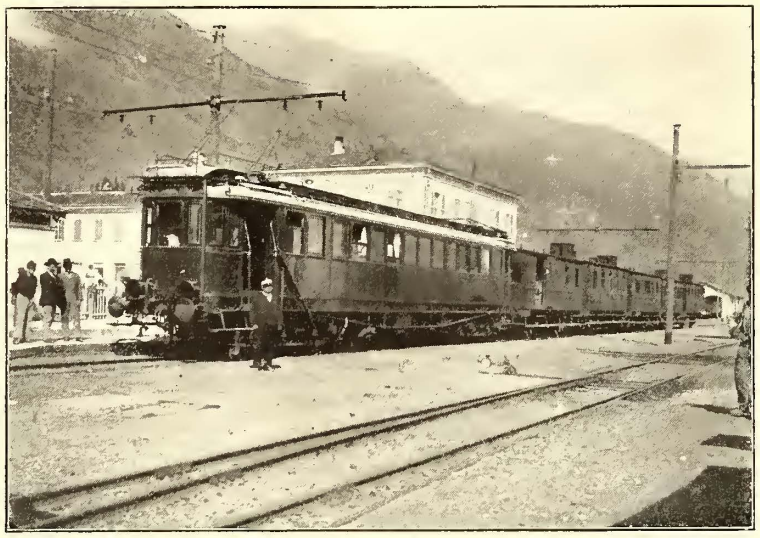


FIG. 1.—EXPRESS PASSENGER TRAIN, VALTELLINA 20,000-VOLT, THREE-PHASE RAILROAD

eleven independent sections of the overhead trolley line—each about 6 miles in length. Each of these circuits is equipped with fuses. The two overhead trolley wires, each 8 mm in diameter, represent two of the phases and the track the third. The line insulators have five petticoats, decreasing in size from top to bottom, and are made of porcelain. The poles are of wood, but eventually will be replaced by steel poles. The line wire, which is of copper, is 7 mm in diameter, and was doubly insulated and flexibly suspended.

The high-tension 20,000 feeders were carried over or around all tunnels, some thirty-two in number, but the 3000-volt trolley wire passed through all tunnels, being supported from the roof at a height of 4.80 m. Especial privileges were accorded by the government for placing these circuits below the regulation height of 6 m, where they passed through the tunnels, and it was found necessary to replace the lateral suspension by a longitudinal suspension, owing to strains originally breaking the supporting devices. The increase of speed over that employed in operating the road by steam necessitated the changing of the pitch of the road, and also necessitated altering the trolley circuit to prevent the trolleys striking the tunnel sides. There are seventeen regular stations and eight extra stopping places. The stations are supplied with incandescent lighting from the railroad power plant at Morbegno through suitable transformers.

Passenger and freight traffic is operated independently. The types of these cars are shown in the accompanying illustrations, Figs. 1 and 2. At the time of my inspection they had ten passenger trains and two freight, and were expecting, in addition, three more passenger and two more freight trains.

The freight locomotives are approximately 700 hp, employing four motors, and are capable of hauling 500 tons on the level at a speed of 19 m. p. h.

The passenger locomotives are also equipped with four primary motors, operated in parallel, each weighing about 3½ tons, and representing 300 hp. The schedule speed is about 37½ m. p. h. on the level, and about half that on the grade. The cars of the express trains carry fifty passengers, and the local cars each sixty-four passengers.

The trolleys, which take the 3000-volt current direct to the motors, consist of two copper rollers, each 16 ins. long and having a diameter of 3¼ ins. These rollers are mounted in the same axial line and have steel ball-bearings. These bearings, however, do not have any current passing through them, it having been found in all trolleys with ball-bearings that the passage of the current through them soon pitted and roughened the surfaces. To the left and right of these pairs of rollers are copper cones about 8 ins. long, rigidly attached to the trolley support. The base of the trolley is supported on the top of the car, and has a long horizontal hinge, and the trolley is connected to the piston of an air cylinder supplied by the air brake apparatus on the train, so that the trolley can be readily raised and lowered —a dash-pot preventing jar.

Each of the primary or high-tension motors has its trolley with double rollers. The current is taken from the two rollers by collecting brushes running in contact with graphite collars, against which they are held by spiral springs. The current is taken from these trolleys by highly insulated wires inside of grounded metallic tubing, 3000 volts being supplied direct to the motor. Each car is mounted on two four-wheel trucks, and is equipped with two "primary" and two "secondary" induction motors, there being in all four motors of 150 hp each.

The rotors each weigh about 1½ tons. The air gap is only between 4 mm and 5 mm.

In starting up a train or climbing up a grade the motors are connected in "cascade," or, in other words, while the 3000-volt current is direct connected to the stationary windings of the "primary" motors the windings of their "rotors," which are designed for 300 volts, are connected to the stationary wind-

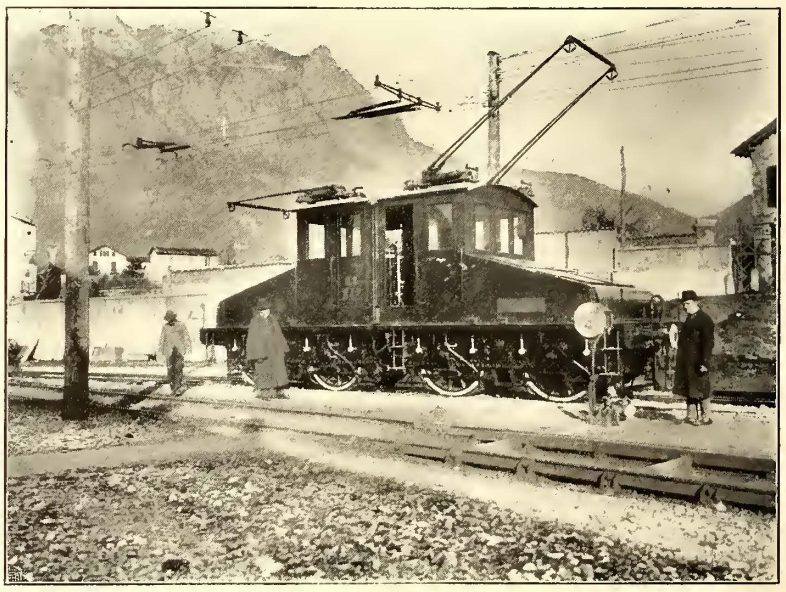


FIG. 2.—FREIGHT LOCOMOTIVE, VALTELLINA 20,000-VOLT, THREE-PHASE RAILROAD

ings of the "secondary" motors, while their "rotors" are in turn connected to a fluid resistance. This arrangement gives a speed of about 18½ m. p. h. The controller is thrown to but two positions—i. e., half-speed and full-speed.

When the handle of the controller (shown in Fig. 4) is thrown to the second or full-speed position the stationary fields of the two "primary" motors are then thrown directly on the line, and their rotors are connected to the fluid resistances, which are slowly cut out of the circuit. In the meantime the "secondary" motors have been cut out of the circuit. This full-speed arrangement gives approximately 37½ m. p. h.

The controllers at each end of the car are connected mechanically, and the high-tension switches are connected electrically. A special device renders it impossible for any one

to open the boxes containing the high-tension switching apparatus until a key has been removed from the trolley device; and this key cannot be removed until the trolley has been lowered and the circuit thus opened, rendering it perfectly safe.

A high-tension switch carrying the 3000-volt primary current is shown in Fig. 3, and consists of a horizontal iron plate pivoted on a vertical shaft ending in a rack which engages a pinion worked by a crank. The plate is raised by turning the hand crank—this plate having six porcelain-backed bolts with steatite heads mounted on the upper side.

The collecting current circuit is connected to three copper sockets sunk in porcelain insulators, the cables to the three motors being similarly connected to three sockets. All of the

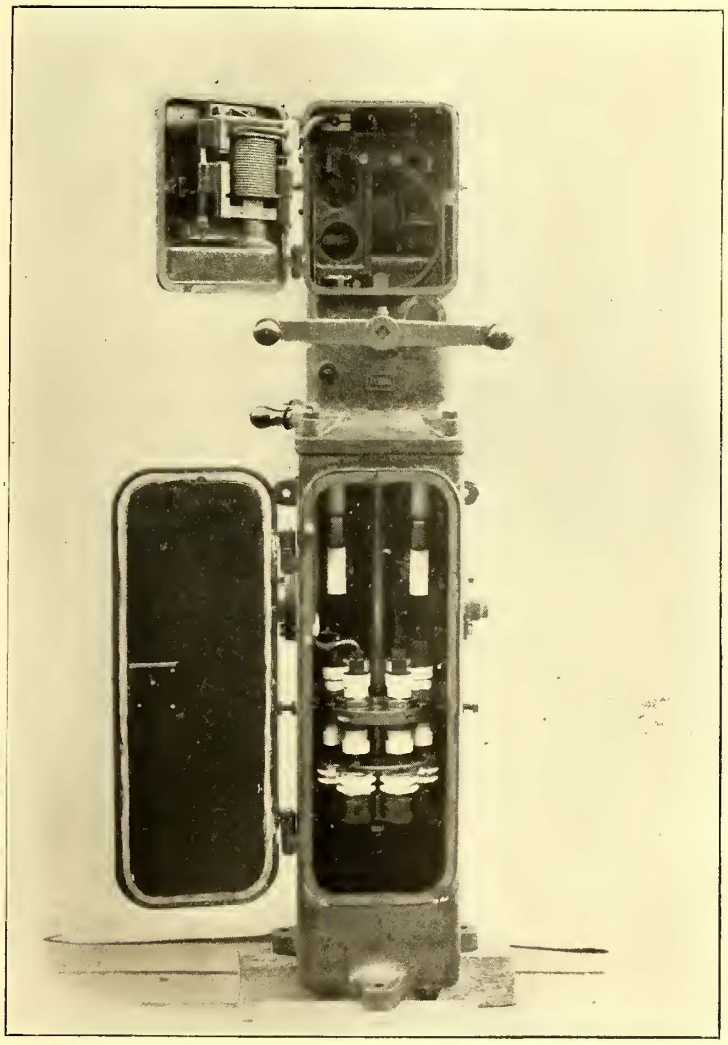


FIG. 3.—PRIMARY OR MAIN-LINE SWITCH (3000-VOLT)

six sockets are directly above the plates, which are raised by the crank. The insertion of the bolts into the sockets establishes a perfect connection, and on their withdrawal a rarefication of the air is produced, which to some extent prevents the formation of an arc, which is further assisted by the steatite heads.

Reversal of the current to the motors may be effected by rotating the lower switch-plate on its vertical axis. A relay placed in the return circuit to the rails causes a cutting off of the current to the motors by lowering the switch-plate should a safe limit be exceeded. A special device is also provided in case of the potential falling, due to a break in the line, by means of which device the 3000-volt trolley circuit is grounded.

The arrangement employed on this line is such that it is impossible for two trains to move upon the same section of track in the same direction at the same time,as each train leaves the section behind it dead, re-establishing the circuit as soon as it has passed into the next block.

The signalling system employed, when set against an approaching train, at the same time cuts off the current from that particular section until the train is given the right of way.

The brakes on the train are also automatically applied the

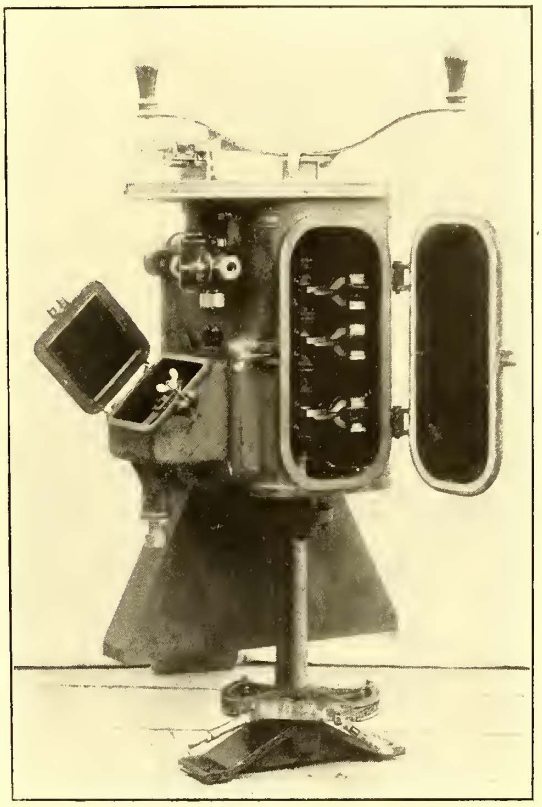


FIG. 4.—CONTROLLER, VALTELLINA RAILROAD

moment the train endeavors to enter a section over which the preceding train has the right of way.

During the entire time of operating this road but one accident has occurred, and that due to a workman forcing the door of the high-tension box open, and thus somewhat severely burning his arm.

The wires of both the field and rotor windings pass longitudinally through insulated tubes in the iron. The ends of the winding are insulated by mica and protected by plates or caps bolted on, and the windings are all invisible. The motors are direct-connected to the axles. By this I mean no gearing is employed. The axle of the rotor is hollow, the internal diameter being 8 ins., and is lined with brass. The car axle, which has a diameter of 4 ins., passes through this hollow axle.

The circuits to the three collecting rings pass through grooves in the rotor shaft, and the rotor shaft and car wheel are flexibly connected, thus preventing jarring and vibrating. The smoothness with which these trains were started and stopped is remarkable.

At one end of the rotor is a driving flange which is connected to the driving wheel on that side of the motor through two links, one of which acts by thrust and the other by tension, the two stresses being of equal magnitude; at the other end of the rotor the three collector rings, upon which rest the three carbon block brushes supplying current to the rotor.

A 100-volt three-phase motor is supplied with current through an 8-kw transformer connected to the line, and is used for compressing the air for the air brakes, for raising and lowering the fluid in the resistance boxes, and for raising and lowering the trolleys and automatically operating the high-tension switches.

A circuit from the same transformer supplies current for lighting the train. It was found that the low periodicity of 15

per second caused such noticeable fluctuation in the light of the ordinary incandescent lamp, that three-phase or three-filament lamps were made by both the Cruto and Ganz Companies for this purpose, and are being very successfully employed. I saw lamps of both of these types tested on the circuit, and the three-phase lamps were remarkably steady, while the others were not.

The liquid rheostat employed on these cars is very ingenious, and has given very satisfactory service. It is a three-phase rheostat, and consists of an iron box with three wings to it, from the top of which depend three separate cylinders. Inside of each cylinder are two sets of iron plates which are rounded at the lower extremity, and vary in length. The alternate plates are connected in pairs, the current entering by one plate and leaving by the other; the sets being attached to the three phases of the low-tension roller circuits, which have

The operations described are repeated in securing acceleration from half to full speed, and in securing retardation from full to half speed, at which time the motors operate in "cascade," as already described.

The Arcioni three-phase recording wattmeter, manufactured by Camillo Olivetti, of Ivrea, Italy, is employed to register the entire output of the Morbegno plant. This wattmeter, I found, is being used extensively in various high-tension plants throughout Europe, and is giving very great satisfaction. I know of no instrument for this class of work which has given as satisfactory results. No oil switches are employed in this plant, ropes being used to pull the levers attached to the high-tension switches overhead; and to these are attached Siemen's horned lightning arresters.

I was informed that no lightning has ever entered the station, and the protection is doubtless due to the very interesting light-

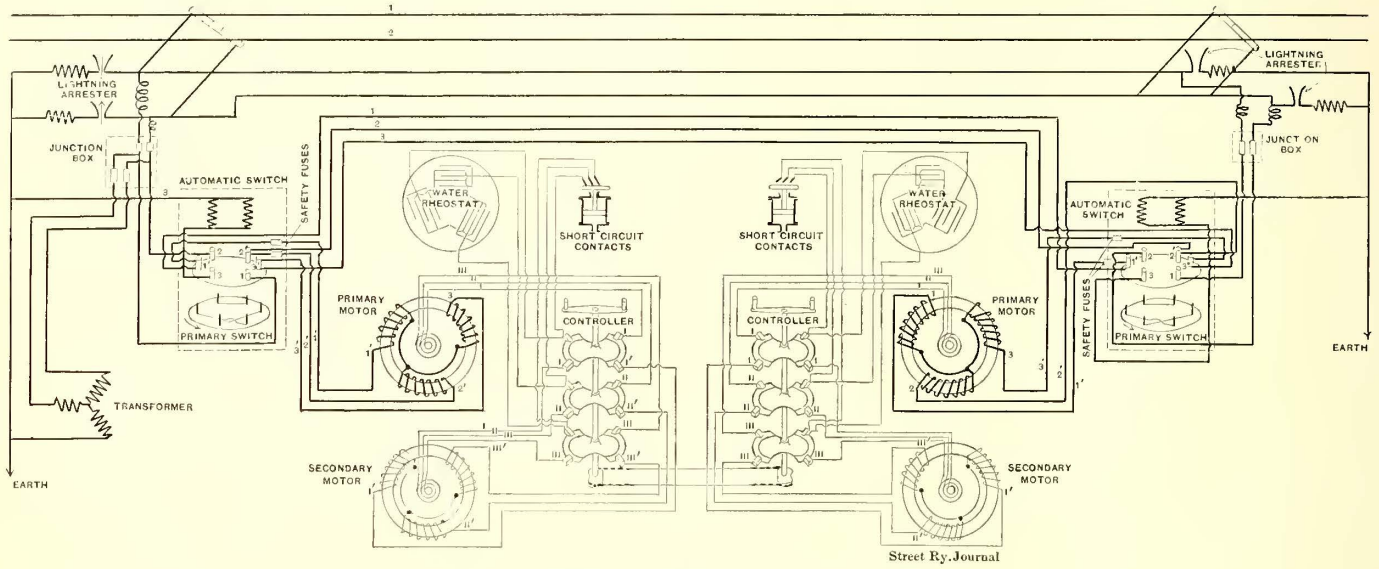


FIG. 5.—WIRING PLAN OF MOTOR CAR

a potential of only 300 volts. A cooling device is attached to these rheostats.

The solution employed is sodium carbonate contained in the lower portion of the outer case. The upper portion of this outer case is supplied with compressed air, which, on being supplied to the case, in a greater or less degree, allows the solution to rise in the three cylinders. In rising, the liquid comes in contact with the iron plates, one after another, thus cutting the resistance out of the circuit to a greater or less degree, dependent upon the height of the solution. This plan, it will be readily seen, is much simpler and far preferable to the raising of the plates out of the liquid. The device is the result of extensive experimentation, and permits the motor-driving torque to be kept constant during acceleration. The entire height through which the solution passes is less than a foot.

The exhaust valve is the lift type of valve, normally kept open by a spiral spring, and the valve for operating the rheostat is compound-wound, having several openings through it. On being operated the compound valve first opens a clear way for the compressed air to the cylinder and to the top of the piston, which compresses the spiral spring of the exhaust valve already referred to, and closes this exhaust valve. The air then slowly passes through a small throttled aperture, admitting the air to the outside of the resistance box casing at a low pressure.

When half speed has been attained, the motion of the trolley lever, when thrown to full speed, causes the air-cock to close the throttling aperture, opening another aperture, and thus relieving the air above the upper surface of the exhaust valve piston, permitting the compression spring of this valve to instantly open, it thus throwing in instantly the whole resistance.

ning arrester. Three jets of water are thrown into the air, each jet coming within a short distance of a tap taken from one of the three-phase lines of the high-tension circuit. Any lightning disturbance passing over the line will jump across the intervening air space, and pass through the water to the ground. The device is most simple, and thus far has proved very effective.

In preparing the data on this most interesting engineering development, I am very much indebted to Director Otto F. Blathy and Mr. Kando, chief engineer, to whom the success of this system is largely due, and to Lello Pontecorvo, one of the engineers of the Ganz Company, in charge of the work, who very courteously took me over the road, through the power house, etc., and furnished me with many of the engineering details. The illustrations which I have presented are from photographs made by myself, and from photographs and drawings furnished by the Ganz Company.

The right of Ohio interurban roads to acquire property by condemnation proceedings has again been demonstrated in a recent suit brought by the Cincinnati, Milford & Loveland Traction Company to condemn a right of way. The attorney for the property owner set up the demurrer that the company had been incorporated as a "street" or "electric" railroad, doing interurban business, and that to have the right to condemn it should have been incorporated as an "interurban" road. The court held that all railroads operating outside of municipal corporations and between cities and villages with motive power other than that furnished by animals have the right to condemn right of way along the highways and through private property outside of municipal corporations.

NOTES ON PIPE FITTING

BY W. H. RIPLEY

The screwed-flange style of steam piping connection will probably continue to be most generally used, because of the considerably higher cost of the various other styles of joint. A concession to the popular belief that a threaded joint must leak is found in the survival of the caulking recess at the back of the flange. This recess is seldom made use of except that it is sometimes filled with lead or copper wire in an attempt to stop the blowing along the threads that is common in high-pressure work of the ordinary character.

High-pressure steam, blowing along threads, will quickly cut them away until blowing occurs all around the pipe, which may result, as the writer has seen it do, in the pipe pulling out of the flange. Vibration of the line, or the shock of a body of water passing through, may complete this destruction without warning.

It is a common saying among pipe fitters that three or four threads will hold a pipe. This belief is founded on the assumption that the cross-sectional area of the bases of three threads is sufficient to resist, in shear, any stress to which the pipe will be subjected. The practical result from this reckless assumption is that most pipe fitters run a flange on until the pipe edge is within three or four threads of the face of the flange and stop. In fact it is laid down as a rule in some handbooks that the pipe should never be run through to the face of the flange. If the threads are good on both flange and pipe, and the tapers of both happen to agree throughout, this may give a tight joint at first, but it soon begins to leak when subjected to vibration under pressure. Probably the leaky member is then taken down and peened. This pounding of the pipe is injurious to the end fibres, and seldom results in permanent tightness, as the steam always has access to the threads at the end of the pipe.

The following procedure is one which, with careful erecting, will give joints that are permanently tight:

(1) The threading of the pipe end should be carried back slightly more than the threaded depth of the flange, care being taken to have the tapers of the two agree throughout.

(2) The pipe should be run through the flange practically "to refusal."

(3) Flange and pipe end should be faced off together.

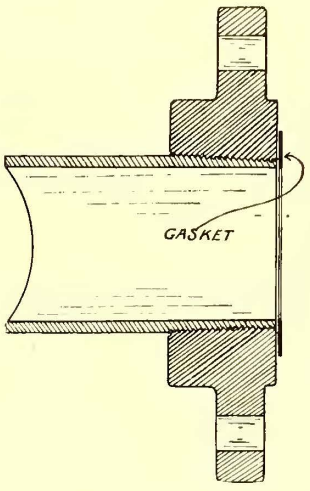
The gasket should be of such size as will cover the joint between the pipe end and the flange.

The best form of flange for use with 140 lbs. pressure, or above, is the one with raised bearing face, as this form gives a certain amount of flexibility in approaching the faces, is easiest to adjust the gasket on, and makes possible a good distribution of the bolt tension. It also has the advantage over a plain flange face, that it is easier to give it a bevel, if necessary, to fit any special situation.

Steel flanges are capable of giving better distribution of bolt pressure than iron, as they are somewhat lighter and more flexible for the same pressures. They are liable, however, to be "dished" by unskillful handling.

The tightness and permanence of a high-pressure steam line depend much more on the skill of the fitters than upon the style or quality of its materials. Frequently we find an old line of standard weight pipe and fittings that has operated for years without giving trouble. As soon as we attempt to remove parts or disturb it in any way it begins to fail. The writer once saw a line of this description in process of removal. Fitters would remove a couple of lengths during the day, and the following night a couple more lengths would go to pieces, so that a large part of the work of removal was done by the line itself. Under the influence of vibration and local expansion and contraction, this old line had gradually adjusted itself to all the various stresses and strains of its daily work. These adjustments, extending from boiler nozzle to engine throttle, were disturbed by the removal of one member of the structure, and rapid destruction overtook the rest.

It is well when rebuilding old steam plants to go to considerable expense and inconvenience rather than attempt to make additions or subtractions about the old piping. It should not be connected into the new system even at the same steam pressure, and certainly not by a reducing valve connection to higher pressure mains. It will always be found possible, although sometimes involving extra expense, to operate new boilers and a new steam line as an independent plant. New boilers will stand forcing, and the general scheme should be to replace as much as possible of the old plant before any of it is removed. In order to have a new piping job as free as possible from unnecessary stresses, it should be given every facility for adjusting its position when first put under pressure. The first tightening of bolts should not be carried any farther than is possible with a short leverage, say about 1½ ft., on the wrench, the final tightening being done while piping is hot, though, preferably, not under full gate of steam.



PIPE FLANGE AND GASKET

The tendency of a bend is to straighten out when under pressure. The writer has seen an 8-in. U bend, divided at the middle, straighten up at the middle flanges with a report like a gun, when steam was turned into it. It is quite obvious that flanges should be brought together with stress on as many bolts as possible, yet, unless watched, many steam fitters will draw up each bolt in succession as tight as possible.

The use of graphite on bolts is quite common. It is usual to mix it with oil and apply with a brush. This mixture will bake hard in use, and will make it almost impossible to remove the nut. A better way to use graphite is to polish the threads with the finest size, using a shoe brush and no oil.

It is a cheap precaution to wash out each fitting and length of pipe before erection, as sand will collect under the valve gates and travel into the engine. Every piece of pipe should be looked through for possible obstructions. The writer once found a cast-iron center in a 14-in. bend, held in place by four set screws—an effective projectile with 160 lbs. steam pressure behind it!

Inspection of fittings should be made with the aid of a narrow cape chisel, a 2-lb. hammer, several files and some stiff wire. A clean open gas hole in a flange may be unobjectionable if it does not involve two bolt holes or extend into the wall of the fitting. Sandy spots and cold shuts, however, should be thoroughly explored with a wire and chisel, to determine the extent of the defect and the character of the metal. If the iron is weldable at the spot it is quite likely to be good inside. Anchors should be examined by filing off some of the boss and noting the character of the union between anchor and metal.

Cast-iron fittings should always be submitted to the inspector unpainted. The writer once found a gas hole, neatly filled with 2 lbs. of babbitt, in the flange of a beautifully filled and painted elbow.

The stockholders of the Honolulu Rapid Transit & Land Company, of Honolulu, Hawaii, have approved the proposed purchase of the rights and property of the Hawaiian Tramway Company.

WATTMETERS ON EUROPEAN CARS

Several of the Continental street railway companies are employing wattmeters on the cars to measure the amount of current taken by the motorman, and are offering rewards to their motormen for an economical use of current. The Magdeburg Tramway Company is one which has adopted this practice. This company equipped two cars with wattmeters, July, 1901, without the knowledge of the motormen, and different motormen were assigned to these cars to see whether there was any important difference between them in current consumption. The results were so startling that the company decided to introduce wattmeters in a more general way. It was not considered necessary to equip all of the cars with wattmeters, but forty-two were purchased for the total equipment of 130 cars, and all the cars were arranged so that the meters could be changed from one car to another so as to test each motorman for about one-third of his time. The cost of making this installation was as follows:

Forty-two meters, at 145 M. ($38.50) each	6,090.00 M., or	$1,522.00
Alterations to 130 motor cars for mounting wattmeters	552.50 M., or	138.12
Repair apparatus for wattmeters consisting of:		
Liquid resistance for 50 amps.	47.50 M., or	11.88
Switchboard with volt and ammeters for 600 volts and 100 amps.	480.00 M., or	120.00
Miscellaneous repair tools, including a lathe and drill	400.00 M., or	100.00
	7,570.00 M., or	$1,892.00

The cars are of three different types, viz., ninety-seven single-truck cars, weighing 8.2 tonnes (18,000 lbs.) each; thirteen single-truck cars, weighing 9.38 tonnes (20,600 lbs.) each; twenty double-truck cars, weighing 10.82 tonnes (23.800 lbs.) each.

The readings on the wattmeter are taken by the depot superintendent each morning before the motor car is put in service, and each time the crews are changed, and reported to the head office, where the amount of power used is compared and the relative efficiency of the different men is determined. The basis of comparison used is the tonne-kilometer or ton mile. As the amount of power required varies not only with the type of car used, but also with the line on which the car is run, it was necessary to adopt certain formulæ or constants by which the final figures could be computed. This was done by obtaining averages for the different sized cars and for the different lines. For instance, it was found that on a certain route the average consumption per car was as follows:

For the first type of car mentioned 48.29 watt-hours per tonne kilometer (70.24 watt-hours per ton mile).

For the second type of car mentioned 45.71 watt-hours per tonne kilometer (66.49 watt-hours per ton mile).

For the third type of car mentioned 37.72 watt-hours per tonne kilometer (54.86 watt-hours per ton mile).

The cars are reduced to a given basis, therefore, by taking the second type as the standard, and subtracting 5.35 per cent from the readings obtained with first type of car, and by adding 21.18 per cent to the readings obtained with the third type of cars.

The same plan was followed with different lines, as it was found that the lines varied from 44.851 to 46.592 watt-hours per tonne kilometer. Readings on the different lines are therefore reduced to a common basis by adding or subtracting from the readings given by the wattmeters the proper percentage. When this is done it is an easy matter to make a direct comparison of the efficiency of the different motormen. The men are then classified according to their records during each quarter, and the twenty-five motormen who make the poorest showing and who average about 15 per cent of the total number are warned. If a man receives three warnings he is either discharged or his wages are cut down.

On the other hand, prizes are offered to the thirty-five motormen (about 21 per cent in number) who show the best results. This practice has sensibly cut down the output demand from the station, as shown by the following table of watt-hours per tonne-kilometer for unloaded cars during 1901:

First quarter	67.086
Second quarter	59.495
Third quarter	56.128
Fourth quarter	62.260
Average for the year	61.242

The method of computing the prizes to be awarded is as follows: The expense of conducting the system including the interest and cost of renewals of the wattmeters, is first deducted from the saving effected. This cost is estimated as follows:

Twenty per cent of the original cost for interest and renewal account	378.50 M., or $94.62
Cost of repairs	121.50 M., or 30.37
Increase in clerical force as a result of the system	450.00 M., or 112.50
Total	950.00 M., or $287.50

After making this deduction 10 per cent of the money saving effected by the system was last year distributed as prizes among the thirty-five conductors mentioned. The amount given each motorman was proportioned to his record, the lowest was 5 marks ($1.25), and the highest was 78 marks ($19.50).

Thomson wattmeters are used. They are placed under the seats, and by means of a small door can be read from the outside of the car. They are calculated for 100 amps. 500 volts, and a great deal of care has been taken to flexibly suspend them so that they are not affected by the jolting of the car. The armature is very light, and a considerable amount of iron is used to give a strong magnetic field. The wattmeters are dismounted every four weeks or six weeks, cleaned, repaired and calibrated with the aid of a rheostat.

The result of the introduction of this system, which has been in use since April 1, 1902, has been very satisfactory. The average reduction in current has been as follows: During the second quarter of 1902, 51.62 watt-hours per car kilometer; during the third quarter of 1902, 47.14 watt-hours per car kilometer.

The net economy realized, after the deductions for cost of operation mentioned above and the prizes to the motormen, was as follows, estimating the cost of power at 9 pf., or 2¼ cents per kilowatt-hour:

Second quarter of 1902	7,128.86 M., or	$1,782.22
Third quarter of 1902	8,955.95 M., or	2,238.99

PRACTICE AT RHEIMS

The Rheims Tramways Company has also been experimenting with wattmeters and has been giving prizes for the most efficient operation of cars. It combines this practice, however, with that of giving prizes based on the number of passengers carried by the cars, and divides both prizes equally among the motormen and conductors, so that each will have an interest in making a good record. It is argued that the conductor can assist the motorman in saving current by not compelling him to make unnecessary stops; at the same time it is thought advisable to couple the prize for economy of current with one based on the number of passengers carried so that the motorman will not run by passengers in order to better his current-consumption record.

The prize based on receipts is one-tenth of the receipts above 40 centimes per car kilometer (12.8 cents per car mile), and is awarded every three months from the records of the previous quarter. The motormen receive half of the amount while the conductors divide the other half proportionately to their receipts.

The prizes for economy of current are distributed to the employees each year and as follows:

300 francs ($60) for an average consumption of 465 watt-hours per car-kilometer, or 744 watt-hours per car-mile.
600 francs ($120) for an average consumption of 455 watt-hours per car-kilometer, or 728 watt-hours per car-mile.
1,000 francs ($200) for an average consumption of 445 watt-hours per car-kilometer, or 708 watt-hours per car-mile.
1,600 francs ($320) for an average consumption of 435 watt-hours per car-kilometer, or 692 watt-hours per car-mile.
2,500 francs ($500) for an average consumption of 425 watt-hours per car-kilometer, or 676 watt-hours per car-mile.

The number of motormen employed is fifty in winter and sixty in summer. The cars weigh empty 7 tons each.

Half of the prize for economy of current is divided equally among all of the conductors, the other half is divided among the motormen proportionally to a coefficient based on their individual records of consumption. The average consumption for each quarter is first obtained by taking the total consumption of the cars, as given by the wattmeter at the station, and dividing this sum by the total number of car kilometers. The efficiency of each motorman is then determined as follows:

The company has six cars equipped with Thomson wattmeters, and the motormen take turns in running them, one day with each of these cars. The consumption during these days is recorded. At the end of the quarter, therefore, each motorman has operated a registering car for a number of times, and the average for the figures obtained is taken as his efficiency coefficient. It is found that this practice with the registering car is an excellent thing, as it teaches the men the proper way of economizing power. By the plan followed also it will be noticed that each man is also interested in saving current whether he is running a car equipped with wattmeters or not, as the bonus for the entire force depends on the total consumption. It is found in practice that a wasteful motorman will consequently be the subject of remonstrances and complaints from both motormen and conductors. The company considers it indispensible to interest the conductors in the economy of current and the motormen in the subject of gross receipts.

The results show a very large difference in the consumption of current between the motormen with the same car on the same line, ranging from 425 watt-hours to 675 watt-hours per car kilometer.

The Union Internationale de Tramways et de Chemins de Fer d'Intérêt local has prepared a full account of the practice of both of these companies, with the blanks used by the Magdeburg Company, and is sending copies to the members of the association.

PAINTING SPECIFICATIONS

BY H. ARNOLD FRENCH

In drawing up specifications for new cars for street railway equipment the matter of painting seems sometimes to attract but passing notice, judging from the little space allowed for the details of this portion of the contract.

The smallest detail is seldom omitted in the arrangement of the wood and iron specifications in order that the prospective cars may be made symmetrical and strong, and yet it often happens that no adequate provision is made to insure their protection with proper paint. It is generally decreed that "this part is to have two good coats of paint," or "to be followed by three coats of good varnish." Such instructions, however, signify nothing and only give the contractor very liberal scope within which he can fulfill this part of the contract, and yet use some very poor material. This is owing to the fact that paint can be produced by compounding unsuitable ingredients and still be good of its kind.

A contractor cannot reasonably be expected to furnish expensive paint material when he can apparently produce as good work by using cheaper material unless he specifically agrees to use the better quality. If the details of the painting part of a contract are carelessly left incomplete a railway company can have no grounds for complaint if in the course of a few months the painting proves to be unsatisfactory. It is quite plain to see that this neglect will offer an inducement to bidders who would take the contract at a low figure, knowing all the time that this would present a vulnerable point of attack for making good the anticipated loss.

It would certainly cause a manager some anxiety when the arrangement of the specifications was in progress if he could only foresee the possibilities of subsequent losses incurred by the oxidizing of iron parts, the decomposition of unprotected wood, interrupted electrical arrangements—to say nothing of the loss made possible by the cars being prematurely taken out of service to rectify the results of an inadvertently constructed contract; nor would it guarantee the best results to specifically state in a contract that Green's paint and Copal's varnish were to be used if more definite demands were not added. A glance into Copal's varnish catalogue would show that ten or more grades were listed therein, ranging in price from $5 to 50 cents per gallon. Any one of these varnishes could be used in this case without any violation of the contract whatever. In all probability the contractor would not be so unwise as to use either the 50-cent or 70-cent grades on the exterior of cars, their presence would be too apparent; but it is fair to presume that for business reasons he would not be likely to furnish the most expensive quality, which, by the way, is the most economical for street cars. The grade of Copal's varnish required should be explicitly stated in the contract—presumably it would be the grade used in the repair shop. The failure to furnish this particular grade would doubtless be detected by the company's master painter, owing to his familiarity with its action when applied to the cars. The same caution should be exercised in regard to all paint material specified in the contract, and by following it closely satisfactory results may be expected.

If the painting specifications submitted by ten master carpenters, located in widely separated parts of the country, were brought together they would probably represent a unique collection, remarkable chiefly for their dissimilarity; and yet this diversity would not seem so strange after all if the cause is explained. It would not in every respect be a complication of opinions, but the results of tests and experiments made in their several localities. Climatic conditions, nature of the soil, and the proximity of salt water, are conditions which would have different chemical effects upon paint and varnish. This necessarily requires that gums, pigments and vehicles should be assembled in proportions suitable to the existing conditions. For instance, it is reasonable to suppose that a varnish containing an excess of oil would withstand the influence of an alkaline soil, which exists in parts of the West, longer than a varnish with less oil in it. A varnish that would do good service in Chicago might not do so well in New York or Boston. To secure the best results paint material and the method of its application must be accommodated to the section of the country where it is to be used, and this cannot be accomplished except by local testing and experimenting.

In view of these facts a standard method of car painting, such as has been suggested and recommended by a committee appointed by the American Street Railway Association at Detroit last October, is obviously impracticable. Supposing that car painting specifications are copied entirely from this standard—as no doubt will be done by some managers who never consult the master painter in the matter—what would be the result? This scheme might work satisfactorily in Worcester, but some other method might give better results in New

Orleans. This country is a large one, and the introduction of any particular method of car painting with the expectation of its becoming popular throughout this vast territory must meet with indifferent success.

A wise manager could do no better than to allow the master painter to be the judge of what material and what methods of application are essential for their particular locality. The painter is from experience best fitted for this work, and should be required to draw up all of the painting specifications for prospective new cars. This places the responsibility where it belongs, and in the event of any question arising subsequently on account of inferior painting on new cars received he will be in a position to answer it intelligently.

THE FRANCHISE CONDITIONS OF THE TORONTO RAILWAY COMPANY

The franchise conditions and results secured by the street railway system in Toronto, Canada, are so frequently cited in this country as examples to copy or avoid, when franchise conditions are considered, that a brief summary of the actual conditions under which the Toronto Railway Company operates will be of interest.

The Toronto Railway Company was organized in September, 1891, by George W. Keily and William McKenzie, of Toronto; Henry A. Everett, of Cleveland, and Chauncey C. Woodworth, of Rochester, to take over from the city of Toronto the operation of its strect railway system. A short time previous to the organization of the company the city of Toronto had come into possession, through the expiration of the franchise of the Toronto Street Railway Company, of its property. This franchise was granted in 1861 for thirty years, and provided that upon its expiration the city could assume ownership of its property upon payment of its value, to be determined by arbitration. At the time of taking over the road was being operated by horse-power, and included 68.71 miles of track, laid with 25-lb. and 30-lb. rail, ninety single-horse box cars, fifty-six single-horse open cars, ninety-nine 'buses, forty sleighs, 1372 horses, several pieces of real estate with buildings. For this property the arbitrators awarded the Toronto Street Railway Company the sum of $1,453,788.

The tender of Messrs. Keily, McKenzie and Everett in behalf of the Toronto Railway Company, which was accepted by the city of Toronto, was only one of several which were submitted. The principal provisions were as follows:

The Toronto Railway Company took over all the property formerly belonging to the Toronto Street Railway Company at its cost to the city, and also agreed to pay the cost price of any extensions made during the time the property was owned by the city.

It has the exclusive privilege (with the exception of one or two streets which were then occupied by another company) of all street railway operation in the city for a period of thirty years. Sunday operation was prohibited until approved by a popular vote, that has since been obtained. At the end of the thirty years the city can take over the property at an appraised value.

The Toronto Railway Company pays the city $800 a year per mile of single track, and $1,600 per mile of double track. This is called a pavement tax, and is paid in lieu of all paving between rails or tracks.

The company also pays to the city, on all gross receipts up to $1,000,000, 8 per cent; between $1,000,000 and $1,500,000, 10 per cent; between $1,500,000 and $2,000,000, 12 per cent; between $2,000,000 and $3,000,000, 15 per cent; on all over $3,000,000, 20 per cent.

The fares provided for are as follows: Cash fares, 5 cents, good all day, except after midnight; tickets, 25 for $1.00, good all day, except after midnight; tickets, 6 for 25 cents, good all day, except after midnight; tickets, 8 for 25 cents, good only between the time when cars begin running to 8 a. m., and between 5 p. m. and 6.30 p. m.; tickets, 7 for 25 cents, good only on Sunday and at the hours at which the 8-for-25-cent tickets are valid; tickets, 10 for 25 cents, good only for children under nine years of age (infants in arms carried free) and for school children between 8 a. m. and 5 p. m. on school days.

Fares on cars after midnight are 10 cents.

Every passenger whether paying a ticket or cash fare is entitled to a transfer for a continuous journey to any point on the line.

No employee shall work more than ten hours a day or sixty hours a week, or more than six days a week, and no adult employee shall be paid less than 15 cents an hour.

The earnings, operating expenses and passengers carried by the company during the last ten years is shown by the accompanying table:

The report for the year ending Dec. 31, 1902, shows that the amount paid to the city during that time was $255,551.07, of which $220,188 was the gross receipts and pavement charge, and $14,846 was a personal tax. This was made up of $13,046, the local rate on real estate and buildings, and $1,800 on rails, poles and wires.

At the beginning of the company's franchise the only taxes it was called upon to pay, in addition to the percentage on receipts and the "pavement charge," were the school taxes, which were especially included in the franchise, and the ordinary tax levied against the company's real estate. After several years the city commenced to assess the company's rails, poles and wires. This assessment the company contended the city had no right to demand, but in 1897 the courts decided that the rails, poles and wires were assessable as real estate. Accordingly since that date the company has paid the general tax rate on this property, which for the year 1902 was assessed at $91,000, or about $1,000 per mile of single track. This assessment was upon a basis of what has been termed "scrap value." The company also paid a provincial tax of $4,748.

In 1898 the company paid for the first time taxes upon its power house plant, and has continued to pay taxes on this property.

Under the amendment to the assessment law in 1902 the assessment on rails, poles and wires has been increased to $6,300 per mile.

THE TORONTO RAILWAY COMPANY; STATISTICAL STATEMENT, YEARS 1893-1902.

Comparative Statement.	1902.	1901.	1900.	1899.	1898.	1897.	1896.	1895.	1894.	1893.
Gross earnings	$1,834,908.37	$1,661,017.50	$1,501,001.28	$1,333,542.44	$1,210,618.24	$1,077,612.53	$997,272.20	$992,800.88	$958,370.74	$900,232.59
Operating expenses	1,015,361.32	857,612.19	775,980.82	650,324.55	578,857.26	525,801.25	507,760.31	489,914.76	517,707.53	537,597.15
Net earnings	819,547.05	803,405.40	725,020.46	683,277.89	631,760.98	551,811.28	489,512.97	502,886.04	440,663.21	362,635.44
Passengers carried	44,437,678	39,848,087	36,061,867	31,826,940	28,710,388	25,271,314	23,537,911	23,353,228	22,609,388	21,215,010
Transfers	15,974,220	13,750,038	12,570,704	10,538,279	9,287,239	8,169,022	7,354,895	7,257,572	7,438,171	8,477,147
Percentage of Operating expenses to earnings	55.3	51.6	51.0	48.8	47.4	48.8	50.9	49.3	54.0	59.07

During the year 1902 the following passengers were carried under the respective rates:

Cash fares at 5 cents	8,902,532
Tickets at 4 1-6 cents	21,167,190
Tickets at 4 cents	3,928,678
Tickets at 3⅛ cents	8,104,512
Tickets at 3 4-7 cents	1,371,727
Tickets at 2½ cents	765,740

The Cleveland Stock Exchange is distributing a valuable manual containing complete financial information concerning all the large corporations controlled by Cleveland people. It indicates that no less than forty traction properties in various portions of our country are owned or controlled by Cleveland people. The securities of the majority of these roads are listed on the Cleveland Stock Exchange. The book was published by the Finance Publishing Company.

ECONOMICAL AND SAFE LIMITS IN THE SIZE OF CENTRAL STATIONS *

BY H. A. LARDNER

In this day of gigantic engineering enterprises one would be very conservative indeed if he placed any limit on the possible size of modern central stations. From the plans for extending some of the well-known plants, the engineers of the companies owning them apparently think they have not reached the limit either from the point of economy or of safety. I shall certainly not attempt to place any limits on the size of power stations, for each case must naturally be considered as a separate problem. However, I may call attention to some of the considerations which induce companies to erect large stations, and give an opinion of the objections and disadvantages which attend their operation.

TERRITORY TO BE SERVED

If the territory is large and the system is to serve several villages or small cities with power for lighting or for railway purposes, one large station located conveniently for coal and water has a decided advantage, owing to economy in labor, lower cost of fuel, water and first cost.

Frequently the business in the individual towns would not be large enough to permit of an independent plant in each, and any risk of interruption to service is put up with because it is the best kind of service that such a community can support.

In fact, until the class of territory approaches that of our largest cities the question of lower first cost and economy of operation must in general rule; for the size of station is not large enough to minimize those advantages or to demand the advantages of a service supplied by several stations, harmoniously designed and operated.

When the territory becomes similar to New York, Chicago, Brooklyn, Boston, etc., the large station has many claims for consideration. As the central stations now built in this class of territory are so much larger than those which have been erected elsewhere, we may confine our discussion to stations for the larger cities.

SIZE OF UNIT FOR MOST ECONOMICAL OPERATION AND FLOOR SPACE

From the compilation of C. D. Gray in the journal of the Franklin Institute, October, 1901, I give the results of tests on compound Corliss condensing engines. The best results published, and one near the average, are given for several different sizes:

Pressure	Vac.	I.H.P.	Steam	Authority
155		1950	12.5	Thurston; Science, Oct. 1, 1897.
150	26.9	1713	12.3	Barrus; "Engine Tests."
123	25.6	1592	13.5	Thurston; A. S. M. E., 15-839.
133	25.2	1539	14.1	Barrus; "Engine Tests."
126	27.0	1107	14.1	Barrus; "Engine Tests."
120		1018	13.3	Barrus; A. S. M. E., 15-839.
117		1001	16.3	Sibley Journal, 8-393.
151		997	12.8	Barrus; A. S. M. E., 14-1340.
112		709	15.1	Stone & Webster; S.R.J.,Aug.,1898.
144	25.2	741	13.2	Barrus; "Engine Tests."
159	25.4	595	12.7	Dean; A. S. M. E., 16-169.
90		548	13.5	Thurston; Elec. World, Jan. 5, 1901.

It will thus be seen that under proper conditions of design and operation, very good comparative results can be secured with units much smaller than those installed in the large stations in New York.

The published guarantees for the steam consumption are as follows in these stations:

Station	Pressure	Vac.	I.H.P.	Steam
The New York Edison	175	27	5500	12.5
Manhattan Railway	150	26	8000	13.0
Metropolitan Street Railway	160		4500	13.14

That part of the cost of labor for engine operation, which varies with the size, amounts to but a small portion of the total operating expenses; and although the larger the unit the smaller the item becomes per horse-power-hour it is relatively of little importance except in very small units.

The question of floor space required for reciprocating engines of different sizes demands the largest units practicable.

The vertical space required by an engine is provided more cheaply than the floor space, and as the requirements are of three dimensions the floor area should not increase proportionally with the size of the unit. Again, the aisle space must be practically the same for engines differing in size by large percentages.

In spite of these facts the floor space in engine rooms per horse-power appears to be affected more by the type of engine used and the judgment of the designer than by the size of the unit. The Edison station with engines of 5500 hp, normal rating, require only about one-third of a square foot per horse-power, and the Metropolitan, with 4500-hp units, one-half of a square foot per horse-power against the 8000-units in the Manhattan station, with an area of .55 of a square foot per horse-power.

It therefore appears that economy of operation and in floor space may be made entirely too much of in discussing the advantages of large units, although with similar design and type of machinery the large units undoubtedly have some advantages, provided the station is large enough to require a sufficient number of units to permit of economical loading.

The following table will give some published data about the engines in the New York Edison, Manhattan Railway and Metropolitan stations:

Engines	Metropolitan	Manhattan	Edison
Number	11	8	8 installed 16 ultimate
H. P. each normal rating	4,500	8,000	5,500
H. P. each maximum rating	6,600	12,500	8,000
Aggregate rated H. P.	49,500	64,000	88,000
Aggregate maximum H. P.	72,600	100,000	128,000

From the large number of units we may assume that these are the largest machines the manufacturers cared to produce.

Larger engines have been built for use aboard ocean liners, and as conditions are in many ways much more severe aboard ship than on land, it should be possible to have still larger units if central station engineers really demanded them.

The turbine has decided advantages over reciprocating engines for driving many classes of electrical machines, as it gives ideal conditions for the parallel operation of alternators and synchronous apparatus on account of its uniformity of angular velocity. It is well known that many difficulties in the operation of 60-cycle apparatus disappear when the supply of power is from water-wheels, and if the steam turbines are to help us in this respect it will be a great point in their favor.

Due to the high speed at which turbines are operated, direct-current machines seem to be ruled out on account of commutator troubles.

Perhaps the greatest advantage of the turbine is its economy of floor space. The following table gives the principal dimensions of some of the sizes which are now being built:

CURTIS TURBINES AND GENERATORS

Size kw	Height ft. ins.	Diameter ft. ins.	Floor Space sq. ft.	R.P.M.
500	12 2	7 8	46.2	1,800
1,500	16 10	10	78.5	900
3,000	22	14	154	600
5,000	27	14 10	175	500

*Abstract of a paper read at the meeting of the American Institute of Electrical Engineers, New York, April 24, 1903.

WESTINGHOUSE-PARSONS TURBINES AND GENERATORS

Size kw	Height ft. ins.	Dimensions ft.	Floor Space sq. ft.
400	7 6	19 × 5	95
1,000	8	43 × 8	344
5,500	15	50 × 12	600

For comparison the following is the floor space required by the vertical cross-compound condensing engines of a well-known maker. The figures include the space required for an alternating-current generator between the frames:

Size kw	Dimensions ft.	Floor Space sq. ft.	R.P.M.
500	15 × 22	330	120
1,000	21 × 24	504	110
1,500	22 × 28	616	100
2,500	23 × 32	736	90
3,000	23 × 34	782	75

The height would in all sizes exceed that of a similar size of vertical turbine.

The steam consumption guaranteed for the above-mentioned Curtiss turbines are attractive, especially at light loads. The figures are given in dry steam per kilowatt-hour and for purposes of comparison with results per indicated horse-power they have been reduced by assuming an efficiency for generator and turbine of 85:

Size	Pressure	Vacuum	Lbs. of Steam per kw-hour Full Load	Half Load	Lbs. per I.H.P. Full Load
500	150	28	20½	23	13
1,500	150	28	20½	22	13
3,000	150	28	20½	21.5	13
5,000	150	28	20½	21	13

I believe that the cost of labor for engine operation will be considerably cheapened with the turbine, and this and the other advantages shown should greatly reduce the necessity for very large units. If, therefore, steam turbines are to make the operation of smaller stations (with a suitable number of units to handle the load economically) equal in efficiency to some of the largest plants now installed, it will be advantageous in many cases to install several stations in place of one, and secure all the saving in distribution and safety against shut-downs that go with such an arrangement.

ADVANTAGES AND DISADVANTAGES OF LARGE CENTRAL STATIONS

The advantages may be summed up from what has been previously said, and consist mainly of the following:

The location of the station on the one most suitable site for the coal and water supply.

The reduction of floor space by the use of large units.

The economy of fuel secured by the use of large generators and engines.

The economy of labor and general superintendence secured by the use of large units in one building.

The saving in first cost effected by the installation of a large station with large units.

The economy of operation secured by serving many sections of a city with different hours of maximum demand from one station, due to the better load factor obtained.

The installation of a large station presupposes supplying a very large territory from one source, and in order that the coal and water supply may be convenient the chosen location is generally much further from the load than when it is divided among several plants. This involves a greater expense for a distribution system, although this may be minimized by the installation of high potential current or by local conditions.

The economy of floor space by the use of large units will always be an important consideration where land is valuable, but the economy in this direction with the steam turbine may lead the designer of the future to give less consideration to this point.

The added economy of fuel, labor and general supervision in large units will also be reduced somewhat even with the large turbine units, and the first cost of the machines themselves will undoubtedly decrease per unit capacity with increase of size. However, the reduction in cost of turbine generator installation from the prices now paid for generators and slow-speed reciprocating engines should be considerable and permit smaller units than are now feasible. This will undoubtedly be true after development charges have been cared for.

It is a question whether there is any saving in the first cost in the installation of very large stations, except in prime movers and generators. The construction of double and triple-decked boiler rooms, long coal-handling apparatus and coal pockets high above the ground, involves heavy expenditures without compensating advantages. It is probable in the case of some large stations in this city that they could have been built to half their capacity as cheaply per unit as to the ultimate size. The size of the units in either case would probably have been the same.

The principal disadvantage of the very large station is the danger to a system if the disabling of the station leaves the company without a source of power or takes away a larger portion of its supply than can be cared for by overloading the remaining plants. It is with this point in view that I have attempted to bring out all the points which make smaller stations worthy of more consideration than they frequently get.

The stations in this city are wonderful examples of good design in all features which tend to make them reliable and free from dangers of serious break-down and interruption of service. Nevertheless, I do not believe that there has been a single station built, and I do not look to see one, which is free from weak points capable of causing interruptions.

The recent break-down at the station of the Niagara Falls Power Company is an instance in point, and while such occurrences have been rare, the one in question left Buffalo without Niagara power for twenty-four hours, and the Niagara Falls district was without power for nearly two days.

SAFETY DEVICES IN CENTRAL STATIONS AND SUB-STATIONS *

BY PHILIP TORCHIO

In this connection no attempt has been made to deal with the feature of mechanical reliability of the generating systems, though it is as important for the mechanical equipment to be safe and reliable as it is for the electrical equipment to be so. In fact, the general principle of sub-division and independence of different generating units may be considered to find its application throughout—from coal supply at the boilers, through the mechanical and electrical equipment at station and transmitting lines, to the receiving sub-stations.

Proceeding from the generating station to the transmission line and receiving sub-stations, we find the following characteristic features more or less generally adopted or considered desirable from the aspect of reliability of service. Some of the safeguards given in the list appear perhaps as unnecessary and expensive refinements, and probably they would be so for a large number of cases where continuity of service may not be considered absolutely essential. In a large situation, for instance, the lighting and power of a large city, the conditions are different; and if for these conditions safety cannot be obtained in any other manner these refinements become of paramount importance.

*Abstract of a paper read at the meeting of the American Institute of Electrical Engineers, New York, April 24, 1903.

GENERATING STATION

1. Installation of storage battery on field exciter bus at generating station.

2. Equipment of reverse current relays and circuit breakers on exciter generators.

3. Equipment of overload relays with time limit and circuit breakers on motors of motor-generator exciter sets.

4. Separation and mechanical protection of generator leads of different generators. Also proper insulation and protection against capacity discharges of cable leads.

5. Connection of each generator to bus-bars by means of two oil switches in series, preferably arranged to close independently and open at the same instant.

6. Sub-division of bus-bars, in different sections, enabling operation of generators in different groups. Also selector switches on each generator, enabling the same to be operated on at least two sections of bus-bars.

7. Tie connections between different sections of bus-bars, enabling us to make, if desired, combinations of different sections or even one common bus-bar.

8. Overload and reverse current relays on generator switches, these being connected to signal lamps until they have proven their reliability for actual tripping of main switches.

9. Selector switches on feeders providing means of connecting each feeder to at least two sections of bus-bars.

10. Duplication of oil switches on each feeder circuit, preferably arranged to close independently and open at same time.

11. Overload relays on each feeder, with a variable time limit, in inverse proportion to the amount of current.

12. Separation of all wiring and busses inside the station by means of ducts, fireproof septums and grooves in walls, and proper protection against capacity discharges, by the use of good glass or porcelain insulators.

13. In connection with very high voltage step-up transformers, provide low-tension synchronizing busses for generators and switches on the low-tension side of step-up transformers, thereby avoiding synchronizing on the high-tension side of transformers, or closing of high-tension switches on dead transformers.

14. Avoid installation of single-pole main switches for each leg of the circuit, and also synchronizing with one-pole switch closed and synchronizing transformer across the gap of the other pole switch.

TRANSMISSION LINE

15. Duplication of transmitting lines to important centers of distribution, selecting if possible different subway routes or independent transmission lines.

16. Mounting of suitable end boxes on ends of cables at all terminals. Also possible equipment of spark arresters on each end of underground cables.

17. Protection of underground cables in ducts by the use of good fireproof material.

18. Protection of cables in manholes, using preferably separate manholes for high-tension cables, with asbestos or iron covers on each cable, etc.

19. Protection of lead sheath of cables against electrolysis, either by laying cables in vitrified ducts and rubber cushioned racks in manholes, thereby making the cable insulated from ground along its route, or laying heavy bare copper wires along the route of cables and connecting solidly to their lead covers in each manhole, these wires providing a secure metallic path for the current, which leaves the cable sheaths to return to the grounded bus at the railway station via the wires suitably connected to the railway return feeders.

20. Protection of transmitting and receiving stations operating overhead transmitting lines by improved lightning arresters.

21. Grounding of neutral of three-phase transmission lines for very high voltages. (General practice in the California transmission plants.) In the case of very high voltages, this grounding seems a necessity.

22. Possibly grounding of neutral for lower voltages and underground cables. (This is done in several places, as for instance, in Chicago, on the 2200-volt, three-phase, 4-wire, 60-cycle system, as well as on the 9000-volt, three-phase, 25-cycle star-connected system.) From the point of view of reducing strains on insulation, this grounding of neutral seems unnecessary for moderate voltages, though it could be made use of for locating accidental grounds on the system, and in indicating and eventually disconnecting the affected feeder, which would be troublesome to locate on a system without grounded neutral and operating several feeders from same bus-bars.

23. Avoid operation of high-tension lines at different frequencies when lines are mounted on same pole line. This to avoid doubling of strain on insulators when two wires of different lines become crossed.

SUB-STATIONS

24. Separate lines entering sub-stations should preferably be operated independently, laying out independent high-tension busses and transforming apparatus on each line, the transformed current being delivered either to a common set of bus-bars or to independent sets of bus-bars, if the service will allow of this sub-division. In rotary sub-stations, while the rotaries operate in parallel on the direct-current side, they can be fed from independent high-tension lines not operated in synchronism. This allows feeding each sub-station from different groups of generators at the generating station, or even from different generating stations. In the case of alternating current stations with transformers feeding into a common secondary set of bus-bars, the primary lines must necessarily be operated in parallel, and therefore from same bus-bars at the generating station. This prevents us from attaining the advantages of duplicate lines and independent sources of supply, as in the case of rotary sub-stations. For this reason, in alternating-current systems of secondary distribution, as extensively used in water-power plants, the adoption of independent groups of generators and independent feeding lines to important centers of distribution is not common. In important cases it may be advantageous to sub-divide the customers' supply on different circuits fed from independent lines and transformers operated from different sources of supply. The New York Edison Company operates at present the generators at its Waterside station in two independent groups, and whenever a sub-station has more than one rotary converter in service the several rotaries are divided among different feeders, fed from different groups of generators at the generating station. The rotary converters being operated in parallel on the direct-current side, the distribution of loads between different feeders and consequently between groups of generators is easily and perfectly accomplished. This distribution is regulated by the system operator at the station, who instructs each sub-station how to sub-divide the loads among the rotaries. The system is laid out to still further sub-divide the groups of generators, if the further addition of generators will make it desirable.

25. Receiving lines should be equipped with oil switches and overload relays with variable time limit in inverse proportion to amount of current. When more than one line is feeding a common high-tension bus or independent transforming apparatus operating in parallel on the low-tension side (for instance, rotary converters), each line should also be equipped with reverse current relays, with variable time limit in inverse proportion to the amount of current, the time limit for these relays being a fraction of the time for the overload relay. Reverse current relays without time limit are too sensitive to momentary irregularities on high-tension system and cause trouble on this account.

26. Inside the sub-stations all high-tension wiring and construction should be laid out along the same lines mentioned in case of generating station. Also, the low-tension apparatus and connections should be properly laid out, avoiding crowding and crossing of cables, keeping cables of different polarities separate, and protecting them by means of ducts, septums and pipes as much as possible.

26a. On very high voltage receiving stations the closing of high-tension switches on transformers subjects them to heavy strains, which can, in most cases, be avoided by making alive the transformer from the low-tension side, if the common bus-bars are already fed from another set of transformers. In case of a single set of transformers, it may be advisable to leave the high-tension side of transformer closed all the time, especially in water-power plants.

27. For protection of lines from overloads or short circuits on transforming apparatus of large capacities, oil switches with overload relays should be considered preferable to high-tension fuses. The switches should be of proper capacity and should be equipped with locking relays for overloads, exceeding the safe breaking capacity to avoid blowing up the oil switch. The breaking capacity of an oil switch will to a great extent depend not only on the character of load but also on the amount of power back of the short circuit.

28. Compound-wound rotary converters and eventually also plain shunt-wound rotary converters operated in parallel on a common direct-current bus should be protected by some speed limit device to trip the alternating-current and direct-current circuit breakers on the rotary, when speed exceeds the normal by a certain fixed percentage.

29. It is desirable to protect the direct-current side of all rotary converters with circuit breakers to operate in connection with the speed limit device above mentioned, and also in connection with a reverse current relay on the direct-current side of the rotary. This reverse current relay should be equipped with a variable time element in inverse proportion to the amount of reverse current; direct-current overload relays seem to be unnecessary.

30. All relays at different points of the system and their time elements must be properly adjusted, to operate the different circuit breakers in the proper order, so that if a trouble is once cleared by the opening of certain circuit breakers, the other relays reset themselves in the normal position, leaving the rest of the system in operation.

31. Emergency connections between different generating stations are considered desirable and have found favor in connecting different water-power plants and also in connecting large generating stations in the same city as in New York.

32. Of first importance in a lighting situation in a large city is the equipment of storage batteries at every sub-station. One large New York company, for instance, has installed or under contract twenty-two 8000-amp-hour, 135-volt batteries, and more may be installed in the future.

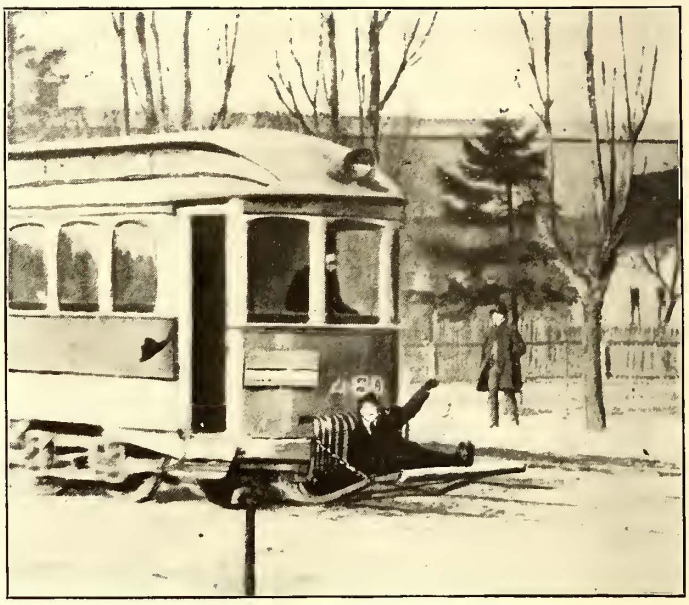
33. In closing this list of safeguards it may be added that in all high-tension work great care should be used in applying tests to the apparatus, especially in making insulation tests on generators, cables, line and transforming apparatus. Break-down tests can be made on samples, but it is unwise to strain unnecessarily the insulation of the complete plant near the break-down point. Close inspection of the installation will finally give more satisfactory results than loose inspection and severe tests.

Omaha is threatened with a street car strike. On April 24 the president of the union of the employees was discharged by the company because of an accident in which he was implicated. The union insists that its president was discharged because of his connection with the union and has demanded his reinstatement.

CAR FENDER TESTS

The accompanying cut is a reproduction of a photograph taken at a test of the Eclipse car fender on the lines of the Cleveland City Railway Company on Feb. 5, 1903. The car was going at the rate of 12 miles an hour when the man was struck by the fender and picked up absolutely uninjured. At the time of the trial the fender had been operating on the line for a month. After two more months knocking about the fender was purposely bumped into wagons and other obstructions in order to test its durability, and it was found to have received no material damage from the severe tests to which it was put during this three months' trial.

At Wilmington, Del., on Feb. 12, a similar demonstration was made. Men in the employ of the street railway company



CAR FENDER ON CLEVELAND RAILWAY

were picked up uninjured while the car was going at full speed. At Norfolk, Va., March 19, another demonstration was made and at this trial a man was picked up uninjured with the car going at the rate of 18 m. p. h. A similar demonstration will be made at Toledo, and the company claims to have arrangements made with the railway companies in several of the larger cities, where similar tests will be made. The Eclipse Car Fender Company, of Cleveland, Ohio, manufactures this fender.

The platform of the fender stands at an angle of 45 degs., with a hollow rubber hose 4 ins. in diameter, stretched across the lower end, which rides about 3 ins. from the ground, but can be adjusted either higher or lower if desired. Any person on the track in front of the car will be struck about the ankles first by this tube or hose. This blow takes up the first jar, knocking the man's feet and legs from under him and giving him somewhat the momentum of the car, dropping the weight of the body back against the platform. The platform, which swings on a pivot, immediately falls back, bringing the front end with the roll on about 20 ins. above the ground, while the rear end is about 6 ins. to 8 ins. lower, thus forming a basket from which a man cannot get out without assistance. The back guard is made of spring steel, with 8 ins. to 10 ins. play, and if the car is going at great speed the man's body will strike against that, but cannot be bounced forward onto the track again, because of the basket shape which the platform of the fender has assumed, as the platform becomes locked after assuming this basket shape. The fender is all that is desired in simplicity of construction, as there are no springs and levers to rust and get out of order. The fender is always in position and does not require any action on the part of the motorman to operate.

BAGGAGE CAR FOR INTERURBAN RAILWAY

One of the most important steps taken by the management of the Columbus, Delaware & Marion Electric Railway is the provision just made for hauling baggage. Up to the present time the company has not catered to this class of trade, but now it is prepared to furnish a complete system of interurban service. It has added to its equipment, which was fully described in the STREET RAILWAY JOURNAL of March 21, several baggage cars of the type shown in the accompanying cut. These coaches, which were built by the G. C. Kuhlman Car Company, are 53 ft. over all, and comprise one continuous

BAGGAGE CAR FOR COLUMBUS, DELAWARE & MARION RAILWAY

room, as there are no divisions for motorman in the interior. The exterior of the coach is made to resemble a passenger coach as nearly as possible. The bottom construction is of the heaviest type, having two intermediate sills constructed of 6-in. I-beams, extending from buffer to buffer, each sill being reinforced with heavy T-iron. The buffers are continuous and are faced with regular V-sheeting, placed vertically. The inside of the car is sheeted with yellow pine beaded ceiling, ⅞ in. thick, placed horizontally and neatly painted. There are four undertrusses under each car, and four windows on each side of car body, arranged to drop. They are covered on the inside with iron rods made in frames. The cars are mounted on Peckham M. C. B. trucks, with four Westinghouse 75-hp motors, General Electric double-end type M controllers, double-end Christensen air brakes, and No. 3 Van Dorn draw-bar. These cars are painted Pullman color and are lettered in gold leaf.

BOATS FOR STREET RAILWAY PARKS

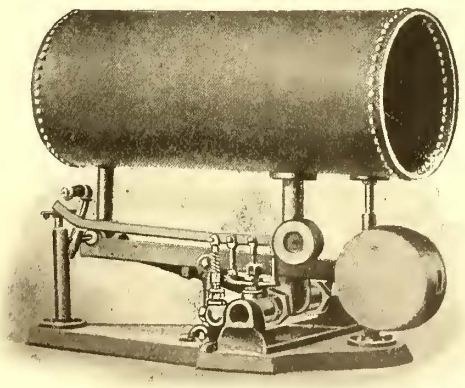
Nearly every street railway park contains a body of water on which it is usual to have boats for hire. It is for this reason that any radical improvements in rowboats has a practical value to the operating railway manager. The boat illustrated

METAL BOAT FOR PARKS

in this connection is built of steel plates, laid on a frame or skeleton of wood. The keel is not fastened on the outside of the metal covering but is on the inside of the boat, where it is protected and where it can add to the stiffness. The top rail and seat rests of the boat are also of wood. The steel is stamped out of a few large plates, and is put through a special process which protects it from rusting. The ends of the boat are fitted with air chambers so that the boat will float if overturned. The chief claims for the construction are that it is more durable, handsome and safe than wooden boats. These boats are built by W. H. Mullins, of Salem, Ohio.

NEW FORM FOR MOREHEAD TRAP

Several changes have been made in the form and construction of the Morehead trap, illustrated herewith. A cast-iron base has been substituted for the wooden platform previously used. The drum or tank is now counter balanced by a lever and weight having its fulcrum attached to the base. The weight of the water exerts a leverage in starting the tank to tilt over, and vice versa, the counter balancing weight has a powerful leverage to bring the tank back to its normal condition when the water is discharged. The slight change made in the construction of the vent to the trap has overcome the necessity for the equalizing pipe, which was formerly on the outside of the drum. An improvement has been made in the seat and disc of the steam valve, reducing the possibility of destruction and wear. The American Blower Company, of Detroit, manufactures this device.



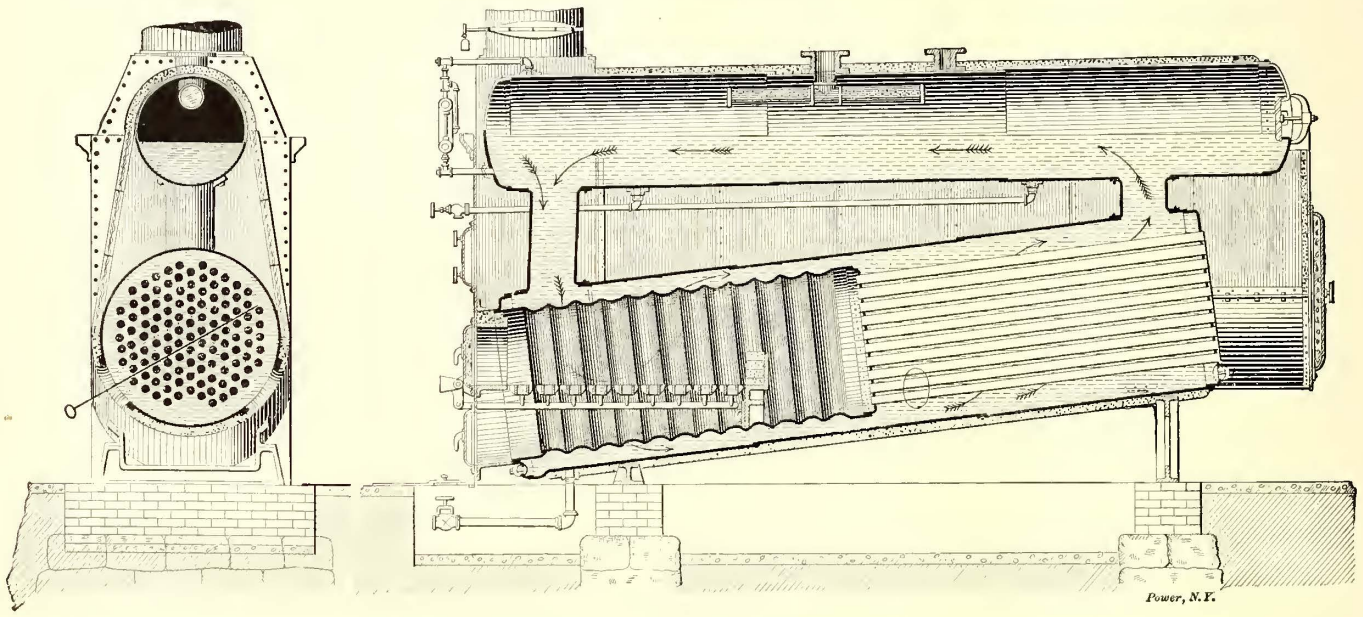
RETURN TRAP

After several conferences the wage differences between the Youngstown & Sharon Railway Company and its employees have been adjusted. The men asked for an advance of 5 cents an hour, but a compromise was effected on 3 cents, and the company abolished its bonus system, under which employees running six months without accident received 1 cent an hour additional. On the interurban line the new scale is 21 cents first six months, 22 cents for second six months, and 23 cents thereafter. On the local lines the scale is 20, 21 and 22 cents. The agreement is for one year.

THE ROBB-MUMFORD INTERNALLY FIRED BOILER

This boiler, though new to the American market, has been manufactured extensively for several years in Canada, and has been used for almost all purposes with all kinds of water and fuel. It consists of two cylindrical shells, the lower one containing a cylindrical furnace and tubes and the upper forming a steam and water drum, the two being connected by two necks or circulating pipes. The lower shell has an incline of about 1 in. to the foot from the horizontal, for the purpose of promoting circulation and draught. A steel casing, stiffened by angle-irons and lined with asbestos air cell blocks, forms the rear smoke box and return smoke flue between the lower and upper shells, the upper half of the steam drum and bottom of the lower shell being also covered by non-conducting material.

The furnace is of the well-known "Fox" or "Morrison" corrugated type, without joints, providing for expansion and contraction and requiring no staying. The heads of the steam drum are spherical, and the tube sheets are stayed by the tubes, baffle plate, which is placed back of the front neck, and blow-off outlet is provided at that point. Another pocket for the deposit of sediment is provided underneath the furnace with a blow-off, so there are practically two mud-drums providing for the deposit and removal of sediment before the in-flowing water reaches the hot surfaces of the furnace and tubes, where scale would be formed. It is found by experience in using impure water that it is easy to keep the boiler clean by the regular use of the blow-off cocks, and the usual washing out through the hand-holes at the front and back of the lower shell and through the manhole in the upper drum. In addition, there are two large hand-holes in the shell at the rear of the furnace for cleaning between the tubes, the tubes being spaced in parallel diagonal rows, so that a bar may be passed through every row of tubes at the rear of the furnace, where scale will form, if at all. Owing to the rapid circulation of water around the upper part of the furnace and tubes it is found scale will not form except at the lower part of the boiler. In cases where exceptionally bad water is used the furnace and tubes are bolted



SECTIONS OF INTERNALLY FIRED BOILER

and as every part of the boiler is cylindrical except the tube sheets, no staying is required. The gases, after leaving the furnace, pass through the tubes and return between the lower and upper shells to the outlet at the front of the boiler.

The furnace being of large diameter and highest at the back, with considerable space beyond the grate surface, is favorable to good combustion. The tubes are short, direct and proportioned to give the correct area, in order that they may all be filled with hot gases. Most of the soot is carried through the tubes and deposited in the rear smoke box, so that all the heating surfaces, furnace, tubes and return flue between the upper and lower drum, are very effective.

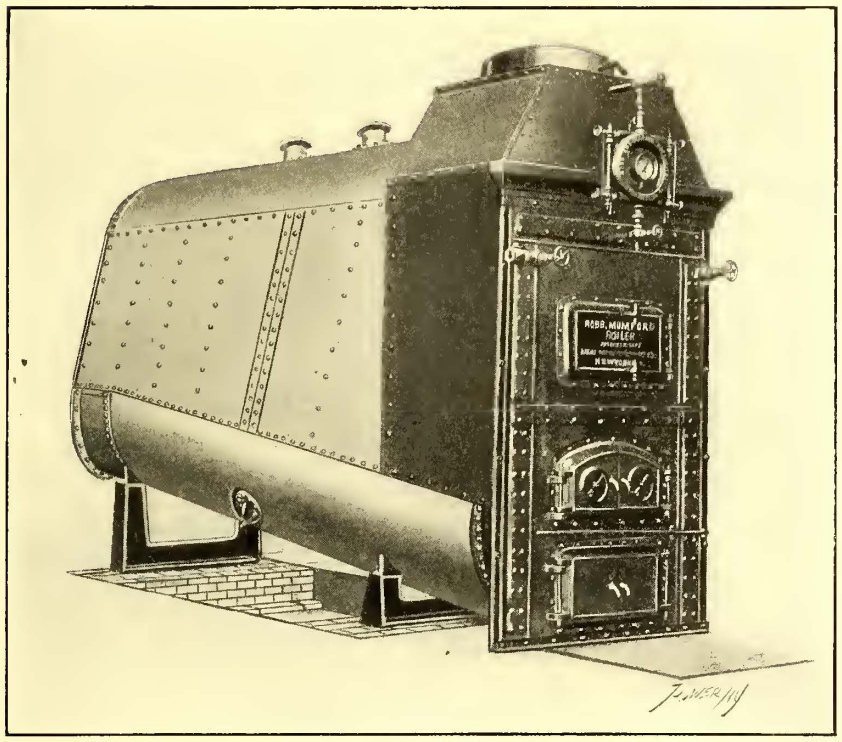
The circulation of water inside the boiler is around the furnace and tubes, up the rear neck into the steam and water drum, where the steam is released, the water passing along the upper drum towards the front and down the front neck. A semi-circular baffle plate, which is placed about half-way around the furnace, causes the down-flowing water to circulate to the lowest part of the shell under the furnace.

It will be seen by reference to the sectional cuts that the feed-water enters the rear part of the upper drum, where it meets the current of hot water flowing towards the front, so that as it passes towards the front the temperature is raised to that of the steam and water in the boiler, and an opportunity is given to drop any sediment or solvent impurities on the bottom of the upper drum, particularly in the pocket formed by a in, so that by removing a row of bolts passing through the front ring and an exterior angle-iron ring, and another row through the rear tube sheet and ring the entire furnace and tubes may be removed for inspection and cleaning.

It is claimed for this boiler that it has the advantage of the Scotch Marine and similar types of internally fired boilers, without the large diameter of shell, thick plates and expensive combustion chamber, giving the light weight, small floor space and good circulation of the best boilers of the sectional or water-tube type, but avoiding the large number of hand-holes and joints usually necessary in boilers of this type. As the fire-box is internal, surrounded entirely by water, there is no loss of heat, either by radiation or air leakage, and the expensive repairs incident to brick setting is entirely avoided. It is interesting to note in this connection that ex-Chief Engineer Isherwood, of the United States Navy, in discussing a paper on water-tube boilers at a meeting of mechanical engineers at New York, May 9, 1894, estimated the difference in economy between water-tube and internally-fired boilers, due to the fundamental differences in construction, at about 10 per cent in favor of the latter type.

The manufacturers of the Robb-Mumford boiler claim that the best results in steam generation are obtained by having a rather small grate surface, strong draught and a thick fire; or, in other words, a high rate of combustion per square foot of grate, and they claim that the practice of furnishing a large

grate surface, as is frequently done in boilers of the externally-fired type, to increase the capacity of the boiler, is opposed to good economy; because (1) if more coal is burned than the heating surface of the boiler is calculated for the gases will escape too hot, and (2) when the boiler is worked at a less capacity the grate surface is so large that the fire may not be properly distributed over the whole grate, and is liable to have thin or dead spots through which cold air may pass, causing waste and imperfect combustion.



SIDE VIEW OF BOILER

As this boiler consists practically of two steam and water drums similar to those used in water-tube boilers and constructed entirely of steel plate without stays, it is claimed to be equally as safe as the best of that type. A battery of 1000 hp occupies a space of about 32 ft. in width by 23 ft. in depth, and 14.25 ft. in height, each unit is entirely distinct and may be completely isolated for cleaning, inspection or repairs.

The manufacturers for the United States are the Robb-Mumford Boiler Company, Inc., with offices in New York and Boston.

NEW COMBINATION OHMMETERS

The accompanying illustration shows a new form of ohmmeter which is being placed on the market by Machado & Roller, the licensees under the Hanchett and Sage patents. As will be seen, this differs from the old form in having added a galvanometer and an induction coil. Two switches are also provided, with whose aid either the telephone receiver or the galvanometer may be used as current detecter at will and the other, which applies either direct current from the batteries or alternating current from the secondary of the induction coil, at will.

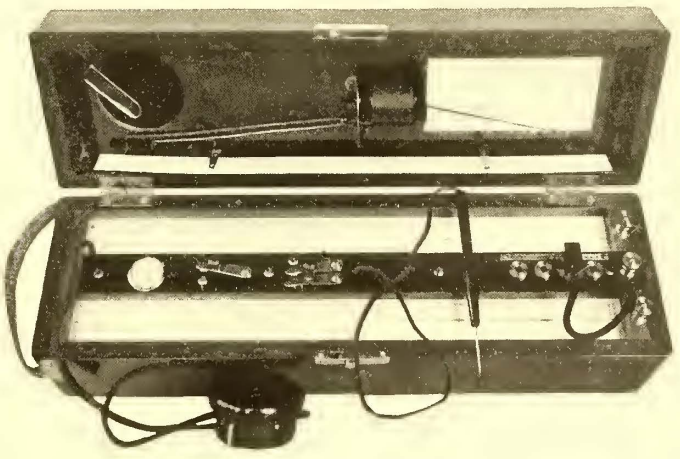
The galvanometer is of the D'Arsonval form, unaffected by external magnetic influences, well balanced so that care in levelling is not required and of a sensibility even superior to that of the telephone receiver. It is, of course, also unnecessary to place the meter in any particular meridian in order to bring the galvanometer needle to zero.

The galvanometer is a valuable adjunct in that it enables the set to be used where there is too much noise to make the employment of the telephone receiver possible, and further gives a means of working from a false zero in making the Murray test. The induction coil makes it possible to compare capacities and inductances and to measure the resistance of electrolytes or the internal resistance of batteries. It also comes in when locating faults on lines where an electromotive force exists at the fault, as, for instance, in a submarine cable, where one or more conductors are grounded or both open and grounded. By keeping the telephone receiver circuit closed the E. M. F. at a fault of this kind causes a continuous current to flow, which does not affect the telephone receiver, the alternating current from the induction coil of the instrument alone being effective for use in obtaining balance.

The number of cells of battery has not been reduced and the over all dimensions have not been increased, while the weight is only about a pound more than that of the original form of apparatus.

It is claimed that tests that have recently been made under the most severe service conditions show this form of meter to be superior in every way to a bridge and galvanometer for the location of faults.

The old form of this ohmmeter is said to be very popular among street railway men for testing out the conditions of car equipments. Systematic tests made on the resistance of car wiring circuits with the controllers placed on successive notches quickly show any tendency toward the development of faults, and plain resistance measurements made on meter-field coils often save from the scrap heap ones that might otherwise be condemned or show as defective some which as far as appearances go are in good condition. It is thought that the new form will answer still better, as car houses are often too noisy to allow of the most accurate results with the telephone receiver alone.

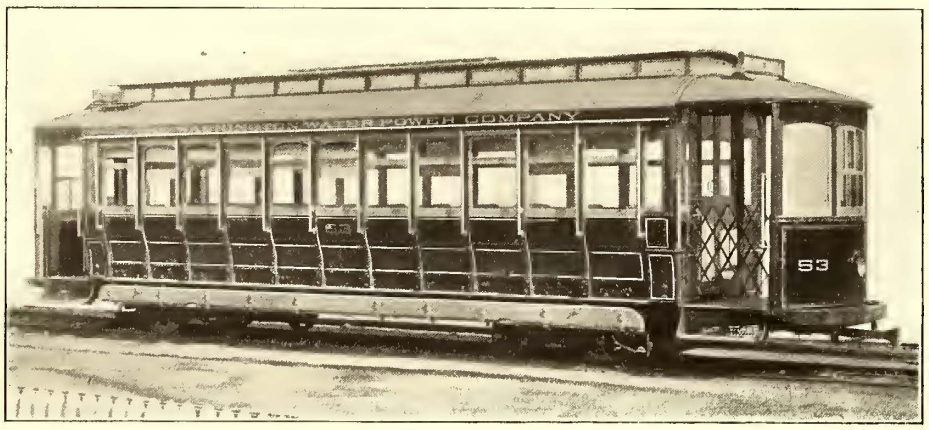


COMBINATION OHMMETER

No longer are the private electric railway cars to be confined to the presidents and other officers of street railways, for a report from North Adams, Mass., which there is no reason to doubt, says that a wealthy resident of the Berkshire district, having first made the necessary arrangements with the street railway companies in that part of Massachusetts, is to have built for his own private use the costliest trolley car in the United States.

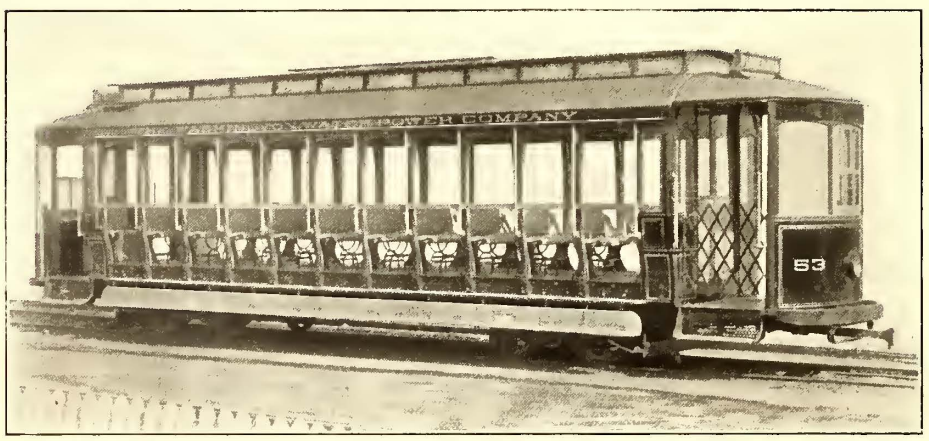
A NOVEL COMBINATION

Within the past few weeks the J. G. Brill Company has shipped to the Washington Water-Power Company, of Spokane, Wash., sixteen cars, which are a combination of the builders' patented convertible and "Narragansett" types. Some four years ago, when the Brill Company first commenced to build this form of convertible car, the Washington Water-Power Company recognized its suitability to conditions found in Spokane, and bought the second car that was built. It was



NARRAGANSETT CAR CLOSED

decided to give it a thorough trial to determine the wearing qualities of the movable parts, the structural strength of the whole car, the capacity to retain heat and keep out the water in wet weather and to note whether the public regarded it favorably. So well did the car answer every requirement that several months ago the company decided to place the above



NARRAGANSETT CAR OPEN

order. In some respects the climatic conditions in Washington may not be as severe as in other parts of the country; but during the time this car has been in service the temperature has been as low as 12 degs. below zero; nevertheless, according to the management, the car was comfortably warmed by the use of four electric heaters. The adaptation of the "Narragansett" type of sills and steps to the convertible design was suggested by the builders. The object was two-fold: obtaining easier and quicker ingress and egress, and adding to the longitudinal strength of the cars. This type overcomes two objections to long open cars, namely, too high steps in the case of a single-step car, and too extreme width when double steps were used. The "Narragansett" design comprises Z-bar sills with the upper step on the sill, thereby utilizing space ordinarily occupied by the timber sill. The Spokane cars are mounted on Eureka maximum traction trucks, which carry the cars low, and with the double steps the cars are easy and safe to enter or leave. It will be readily seen that this combination of type is also suited for use with trucks having equal sized wheels and equipped with four motors per car.

The general dimensions of the cars are: Length over end panels, 30 ft. 5½ ins.; length over vestibules, 40 ft. 9½ ins.; from end panels over vestibules, 5 ft. 2 ins.; width over Z-bar sills, 7 ft. 8¾ ins.; width over posts at belt, 7 ft. 11¼ ins. The Z-bar sills are 8 ins. x 6 ins. x 4 ins., and end sills of oak 4¾ ins. x 8 ins.; double corner posts and vestibule posts, 3¾ ins. thick, and the side posts, 3⅜ ins., with a sweep of 3½ ins. The seats are Brill patented reversible, 34 ins. long. Aisle width is 20¼ ins. At the diagonal corners are sand-boxes, the covers of which are mounted with spring cane to form corner seats. The vestibules are fitted with drop sash. The double-sash windows and flexible double-sheet metal panels slide in all metal grooves into the roof pockets, and are in nowise different from the standard convertible type of the builders.

PAPERS FOR THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

Walter Mower, secretary of the American Railway Mechanical & Electrical Association, reports the membership of this organization as growing finely since the organization at Cleveland in February. One good example of the hearty endorsement this organization is receiving from the large companies is the application of the Boston Elevated Railway Company for active membership, accompanied by payment for nine associate and twenty-seven junior memberships for various members of its staff.

Part of the programme which will be held at Saratoga, N. Y., Sept. 1, 2, 3 and 4, has been arranged. The convention is to be held at the same time and place as the American Street Railway Association convention.

The papers which have been already arranged for are as follows:

"Care and Maintenance of Car Bodies," by C. F. Baker, superintendent motive power and machinery, Boston Elevated Railway Company.

"Improvements in Motors," by E. W. Olds, superintendent rolling stock, the Milwaukee Electric Railway & Light Company.

"The Type 'M' Control," W. O. Mundy, master mechanic, St. Louis Transit Company.

"Use and Abuse of Controlling Mechanism," by D. F. Carver, chief engineer Cleveland Electric Railway Company.

The Tri-City Railway Company, of Davenport, Ia., has announced to its employees that after June 1 the wages of the 225 trainmen, including conductors, motormen and brakemen, will be materially advanced. After that date the scale of wages will be 18 cents an hour for the first year men; 19 cents an hour for the second year men and 20 cents an hour for all trainmen who have been continuously in the employ of the company for two or more years. The above advance makes the third one in as many years, making, all told, an advance of about 34 per cent. About 75 per cent of the employees of the company are old hands.

GENERAL ELECTRIC REPORT

The annual report of the General Electric Company for the year ending Jan. 31, 1903, was issued April 20, and shows a profit of $10,277,169 (including a profit of $973,649 upon securities sold), and, after deducting all general and miscellaneous expenses and allowances for depreciation, losses and writing off $386,875 from patent account, and $1,908,324.11 from factory plants and machinery. Deducting $44,331.17, interest on debentures, $1 613 879 82 for deductions from patent account, the balance $8,618,958.17.

The sales of the company have increased enormously during the past year, as shown by the following statement:

Year Ending Jan. 31	Amount Billed	Orders Received	Yearly increase of Orders Received—Per Cent
1899	$15,679,430	$17,431,327	21.8
1900	22,379,463	26,323,626	51.1
1901	28,783,275	27,969,541	6.3
1902	32,338,036	34,350,840	22.7
1903	36,685,598	39,944,454	16.4

The orders received included:
Generators and rotary converters, capacity over 590,000 kw.
Railway motors, more than 11,000, capacity over 490,000 hp.
Transformers, capacity over 475,000 kw.
Stationary motors, more than 16,000.
Arc lamps, more than 80,000.

RAILWAY ORDERS

Referring to the railway orders the report says:

"During the year we have delivered most of the motors and control equipments ordered by the Manhattan Elevated Railway, of New York city. The electrical equipment of that road is now very nearly completed. Its electrical operation has been a complete success with the exception of a few days in December, 1902, when a sleet storm was encountered for which the road was unprepared. The equipment had not progressed sufficiently to include proper facilities for coping with sleet. This was the cause of such difficulties as were encountered, and no blame was attached to the motors or control. During the two days of the storm the road carried 1,105,296 passengers as against 1,059,167 passengers carried during the two corresponding days of the previous year. This fact is sufficient refutation of the exaggerated reports indicating that the Manhattan Railway was out of service for a considerable portion of these two days.

NEW YORK SUBWAY

"After months of investigation, competitive tests and trials, in which the superiority of our control system was conclusively proven, the Interborough Rapid Transit Company awarded to the General Electric Company the contract for all of the control equipments of its cars.

MULTIPLE UNIT CONTROL

"The demands of modern transportation in the matter of schedule speeds, power required and flexibility of movement have resulted in the development of a new method of control known as the 'multiple unit' system, in which two or more of the cars in a train are each equipped with motors and controllers, and, in addition, with master switches and controlling lines, so that they may be operated either individually or in train combinations of any required length, with or without other cars which are not equipped with motors, and all may be controlled by the master controller on any car. This system is in direct contrast with the locomotive system, where all of the power is concentrated in the locomotive. The multiple unit control is the most important recent development in electric traction work, making possible the use of electric motors in urban rapid transit and standard steam railroad service in such manner as to secure rapid acceleration and quick service which results cannot be obtained with a locomotive.

"By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple unit control. This system, now known as the Sprague-General Electric System, is in successful operation on many roads. The following is a list of roads which have been equipped with or have contracted for this system of control:

NAME	LOCATION	No. of Cars
Manhattan Ry. Co.	New York City	900
Aurora, Elgin & Chicago Ry.	Chicago, Ill	38
Houghton County Ry. Co.	Houghton, Mich	8
Boston & Maine Ry. Co.	(Con'd & Man'ster Div.) N. H.	12
Chicago, Burlington & Quincy Ry.	(Deadwood & L. C. Div.)	3
Canton & Akron Ry.	Canton, O.	10
Columbus, Buckeye L. & Newark Ry.	Columbus, O.	9
Columbus, Delaware & Marion Ry.	Columbus, O.	14
Columbus, London & Springfield Ry.	Columbus, O.	11
Detroit & Chicago Ry.	Detroit, Mich	10
Denver & Northwestern Ry.	Denver, Col.	5
International Ry.	Buffalo, N. Y.	36
Central London Ry	London, England	64
Great Northern & City Ry.	London, England	35
Chemin de Fer de L'Ouest, France	France	2
Mediterranean Ry. Co.	(Gallarate Division)	2
Lake Shore Electric Ry.	Toledo, O.	28
Northwestern Elevated Ry.	Chicago, Ill.	67
Seattle & Tacoma Interurban Ry.	Seattle, Wash.	10
Fonda, Johnstown & Gloversville Ry.	Gloversville, N. Y.	8
Schenectady Ry. Co.	Schenectady, N. Y.	22
Athens & Piraeus Ry.	Greece	1
Prussian Government Ry.	(Anhalt Suburban Division)	19
Interborough Rapid Transit Co.	New York	340
Boston & Worcester Electric Ry.	Worcester, Mass.	36
Milwaukee Electric Ry. Co.	Milwaukee, Wis.	25
Baltimore & Ohio R. R. Co.	Baltimore, Md.	4
South Side Elevated Ry. Co.	Chicago, Ill.	150
Boston Elevated Ry. Co.	Boston, Mass.	156
Wilkesbarre & Hazleton Ry.	Wilkesbarre, Pa.	6
North Eastern Ry.	England	50
Total number of roads		31
Total number of cars		2081

RAILWAY MOTORS

"The report of June 28, 1897, states: 'Since the organization of the company, in 1892, we have sold 30,912 railway motors, having a total capacity of 795,120 hp.' Since that date we have sold 54,344 motors, having a total capacity of 2,304,986 hp. The grand total of railway motor sales in the past eleven years is 85,256 motors, having a total capacity of 3,100,106 hp. These motors are in operation in all parts of the world."

MANUFACTURING

Expenditures aggregating about $2,500,000, exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery; all required to take care of the increased business, and in 1903 the factory floor space was 3,000,000 sq. ft., and the factory employees 18,000.

ENGINEERING

Engineering work of the past year has been largely devoted to the development of established lines of apparatus. The number and variety of useful applications of electrical machinery have kept pace with the increased volume of our business. Standard apparatus has been improved in quality and efficiency, and considerable special apparatus has been designed and manufactured to meet novel conditions.

The distance to which electricity has been delivered has been largely increased and many new long-distance plants have been installed, using pressures of from 60,000 volts to 80,000 volts and delivering power at distance of from 50 miles to 150 miles. A notable instance is that of the transmission of 6000 hp from the falls of the Cauvery River, 90 miles to the Kolar gold fields in Mysore, India. The entire transmitting and receiving machinery of this plant, as well as the transmission line, was constructed by the company. The plant was started last year and has continued in most successful operation. Six of the eleven 5000-hp generators for the new power station at Niagara Falls have been put in operation and are highly successful. It is interesting to note that the size and voltage of generators and transformers used in connection with long-distance transmission have greatly increased. The company has in successful operation transformers of over 50,000 volts, and have orders for others to be used at 80,000 volts.

The demand for direct-current generators of large size, 2000 kw and over, has fallen off. This has been due to the increasing use of alternating current in the generating station and its conversion, where needed, into direct current at sub-stations through the medium of rotary converters. This system has now become standard for all large undertakings in this country, and is being rapidly introduced abroad. Its great economy and flexibility has undoubtedly contributed largely to the successful and extended use of electricity for all purposes. It is interesting to note that the capacity of some of these sub-stations is much greater than that of the largest generating stations that were in existence a few years ago.

BALANCE SHEET

ASSETS

Cash	$ 3,632,556.17
Stocks and bonds	12,682,214.63
Real estate (other than factory plants)	431,455.98
Notes and accounts receivable	12,816,607.04
Work in progress	1,769,456.49
Merchandise inventories	11,561,216.72
Factory plants	5,000,000.00
Patents, franchises and good will	2,000,000.00
	$49,893,507.03

LIABILITIES

5 per cent gold coupon debentures	$99,000.00
3½ per cent gold coupon debentures	2,049,400.00
Accrued interest on debentures	825.00
Accounts payable	1,378,960.42
Unclaimed dividends	1,886.29
Capital stock	41,880,733.33
Surplus	4,482,701.99
	$49,893,507.03

PROFIT AND LOSS ACCOUNT

EXPENSES

Cost of sales	$28,844,881.40
Interest on debentures	44,331.17
Profit for the current year	10,232,837.99
	$39,122,050.56
Deduction from patent account for expenditures incurred chiefly in acquiring the patents of the Sprague Electric Company	$ 1,613,879.82
Dividends paid in cash	2,677,263.50
Stock issued in restoring percentage of reduction made in 1898	16,746,133.33
Surplus at Jan. 31, 1903, carried forward to next year	4,482,701.99
	$25,519,978.64

EARNINGS

Sales	$36,685,598.00
Royalties and sundry profits	814,958.66
Dividends and interest received on stocks and bonds owned	393,961.49
Interest and discount	253,882.67
Profit on sales of stocks and bonds	973,649.74
	$39,122,050.56
Surplus brought over from last year	15,287,140.65
Profit for the year ending Jan. 31, 1903	10,232,837.99
	$25,519,978.64

PARIS LETTER

(From Our Regular Correspondent.)

Public interest in Paris continues to manifest itself around the Metropolitan undertakings. It will be remembered that the line No. 1, running from Vincennes to the Etoile, will form a large loop with line No. 2, running under the outer boulevards on the right bank, which will be entirely completed in one month, when the section of line No. 2, cutting line No. 1 at the Place de la Nation, will be opened for public service. The station at the latter place will form the main car depot. The tunnel is doubled, and four parallel tracks run for a distance of 1200 meters, under which distance are built pits to facilitate inspection and cleaning of equipments.

Line No. 2 will have a total length of 12 km, 11 km of which are in actual operation. A six-minute train service is arranged for, and the number and length of trains will be augmented, giving a three-minute service, soon after the last stage of the work is completed. The schedule time for the whole distance of 12 km is forty minutes. An interesting and unusual feature of this line is contained in the Anvers-Bagnolet section, just opened for service. On a length of 1800 meters the Metropolitan trains run either on a level or above ground. This was made necessary owing to the passage over a canal and important railway lines encountered at this point.

Meanwhile the Compagnie Generale des Omnibus is making a stubborn fight for public favor, and is using steam traction and trailer cars on the line running parallel to line No. 2. The open trailer cars have been well received by the public, and the service will be increased in the near future.

Nevertheless, the Omnibus Company is beginning to recognize that its future sphere of action will be in connection with the services to be organized between any two points not served by the yet incomplete Metropolitan. However complete the Metropolitan line will be, it will be seen that in a large city there is always room for surface traction. Thus a new omnibus line has been introduced joining the Gare du Nord and the Gare des Invalides, two very busy centers, which are yet unserved by any completed line of the Metropolitan.

The tramway and omnibus companies are still clamoring for graded fares giving them the right to charge acording to the distance traveled. They still state that the old system of 3 and 6 cents within the city limits has ceased to be profitable, especially when taken in conjunction with the use of an accumulator or conduit system of traction. They wish naturally to use the trolley line, which appears to be the only remedy for their troubles. The solution is watched with considerable interest.

Another aspect which has to be taken into account in Paris is the use of horses for war reserve purposes. The cab and omnibus companies are naturally liable to be called upon in case of mobilization to hold at disposition of the government a certain number of horses. The attention of the authorities has been directed to the fact that the number of animals of burden is on the decrease in all districts of Paris. The following figures will show this decrease:

Horses in Paris in 1901	96,868
Horses in Paris in 1902	91,976
Horses in Paris in 1903	90,926

Thus the effective cavalry reserve has decreased in two years by about 6000 units, which would be serious on a war footing. The decrease is mainly due to the action of the General Omnibus Company, which has made a reduction of 2822 horses of its stud, due to the Metropolitan competition. On the other hand, the cabs and small carriages have slightly increased during this period, that is, by about 300 horses.

In further reference to the question of fares of the tramway companies, which has been urged above all by the so-called "tramways de penetration," it has been stated that the East and West Paris line threatened to stop their service immediately owing to the decision of the tramway and omnibus committee, from which it would appear that sectional fares are not to be permitted, nor will the fare be increased, although just as this letter is being mailed some temporary concessions have been made. The West Paris line has, it appears, made a loss for the first six months of 1902 of something like f. 194,000, which is 25 per cent more than its receipts for the same period. It is estimated that with a concession for an increase of fares and the introduction of the trolley, this loss would disappear and a profit of the same or greater amount take its place. In fact, the company's estimate that the economy to be realized by the use of trolley in place of accumulators would amount to f. 222,500 annually.

A few words will be well said regarding the actual state of construction of the Metropolitan. It will have been gathered from the preceding that the line No. 1 and the part of line No. 2 now in operation have been complete successes, and the same can be well predicted regarding the other lines now being constructed. The following figures were kindly given us by Mr. Bienvenue, chief engineer of the construction department of the Metropolitan, and will speak for themselves concerning the magnitude of the work in hand for this scheme: Fifteen contracts have been given out for the No. 4 line, running from Porte d'Orléans to Clignancourt, which has been commenced, and for line No. 3, now well under way. At the end of January last over 4500 workmen were employed on construction, and there are more than this to-day. This number of men represents the men actually under the orders of the city engineers building the Metropolitan. As a matter of fact, this figure would be greatly augmented by taking into account the number of men employed by the Metropolitan Company for portions of the line in operation.

In 1902 the total amount expended in construction work was f. 25,000 per day. The daily expenditure in 1902 was f. 70,000, and this will be increased to f. 85,000 per day during the present year. The total expenditure to date on the Metropolitan has been over f. 75,000,000. It is estimated that to complete the work the city of Paris must borrow the sum of f. 170,000,000.

On line No. 2, by reason of the overhead construction and the canal and railways to be crossed, no less than 11,000 tons of metal, exclusive of rails, were employed, and 18,000 tons of sand and 12,000 tons of earth used for the embankments.

One of the interesting points in connection with the southern exterior line is the passage under the Sceaux Railway station. The line under the exterior boulevards is at a great depth at this point, while the level of line No. 4 is, for certain reasons, quite close to the surface, and, in fact, on a level with the line at Sceaux station. It will be remembered that line No. 4 is the intersecting line running directly north and south of the city, and will be referred to directly. The line No. 4 is connected with the Denfert Rochereau station, which station is posed on two cantilever constructions which it has been found necessary to further strengthen, by reason of the Metropolitan tunnel arriving at this point.

After long and hot debate it has been decided that the Institute shall not be disturbed and another route under the Seine has been chosen for the Metropolitan. The favored street is the Rue Danton, and the Seine will be crossed by passing under the St. Michel station of the Orleans Railway. The construction of the entire line is being rapidly pushed forward; the loans necessary will soon be passed by the Chamber of Deputies. It is considered that this line will be second in importance only to line No. 1 running from Porte Maillot to Vincennes. Line No. 4 will include in its route four of the principal railway stations of Paris, Gare du Nord, Gare de l'Est, Gare de Montparnasse and Gare de Sceaux. The line will be entirely underground, and will contain some twenty-two stations over a distance of 11½ km. The speed scheduled

will allow the distance to be run in thirty-five or forty minutes. The total estimated cost of this line is f. 31,500,000. It is hoped to open the line for public service about the end of 1904 or the commencement of 1905. The line has already been commenced as far as tunnel construction is concerned.

A recent legal decision has just been given affecting tramway interests. At Cannes a tramway company found it desirable to install a stub track in a certain street, so that cars could be held there pending the arrival of a car from another direction. The abutting property owners claimed damages for the space occupied in the street, and their contention has been upheld by the Conseil d'Etat.

The Antwerp-Brussels railway scheme has again come to the fore in a scheme proposed by Mr. Mullender. It consists of a double track of standard gage in a tunnel in one straight line with a total length of 42 km. The height of the tunnel would be 6 meters, and ventilation would be assured by 420 chimneys of a meter diameter each, fitted with an electric exhaust fan, the chimneys being situated at every 100 meters. The speed of the trains would be 120 km. an hour, covering the 42 km. in twenty-two minutes. A ten-minute train schedule would be arranged with twelve motor cars of a seating capacity of thirty.

The expenses of construction are estimated at f. 38,532,000, working out at f. 916 the meter. Two and a half years are asked for construction. A concession of ninety years has been asked for with purchase by the State (optional) after fifteen years' operation.

LONDON LETTER

(From Our Regular Correspondent.)

C. R. Bellamy, general manager of the Liverpool Corporation Tramways, on his return from his trip to New York, where he went recently at the invitation of the National Convention on Municipal Ownership, has been presented by the employees of the tramway department a handsome silver tea and coffee service and also a diamond pendant for Mrs. Bellamy. The presentation was made by Alderman Petrie, who, in making the presentation, stated that the Liverpool tramways owed much of the energy, ability and skill to Mr. Bellamy. Mr. Bellamy in accepting the gifts referred to his visit to America and stated that he considered Liverpool very much ahead of America in the matter of proper provision for passenger accommodation on tramway cars. Mr. Bellamy will doubtless ere long present a full report to the Tramways Committee regarding his visit to New York, which will be awaited with considerable interest.

Progress is being made with the electrification of the North Eastern Railway Company's branch line near Newcastle and most of the contracts for the complete electrical equipment have been let. A short portion of the third rail to be used has already been laid for experimental purposes by the British Thomson Houston Company, which has also the contract for the rolling stock, including fifty motor cars and fifty trailer cars. It has now been decided by the Newcastle Electric Power Supply Company, from whose main power station at Neptune Bank, Wallsend, it was originally intended to take power to build a new power plant, as Neptune Bank is already working up to its full capacity. This new power house is being erected on a site on the Tyne side adjoining the ship building yard of Messrs. Swan & Hunter. It is expected that this year 20,000 hp will be installed there and all the arrangements are being carried out by C. H. Merz, who is the consulting engineer to the Newcastle Electric Power Supply Company, and also consulting electrical engineer to the North Eastern Railway Company. Babcock & Wilcox have already received the order for the boilers, superheaters, stokers, pumps, economizers, fans, steam pipes, etc., for this plant. The coal will be brought into the house above the boilers by means of a siding from the railway, and all will be handled automatically.

The London United Tramways Company has just opened another important extension to its system by means of which many of the most picturesque spots in the Thames Valley will be brought within easy access. This extension is what is known as the Hampton Court loop, by means of which the gates of Hampton Court Palace are reached. Two routes are available, one by Twickenham through the town of Hampton, and the other by way of Teddington and Hampton Wick. It is now possible to travel from Shepherd's Bush to Hampton Court for 6d. A new car depot and sub-station have been erected at Fulwell, where accommodation has been made for 200 cars. It is interesting to note that the King had to be approached with regard to the improved facilities for reaching Hampton Court, as a slice of Bushey Park was necessary and was graciously accorded by His Majesty. The new lines were opened recently, C. T. Yerkes performing the ceremony. Garrick's Villa at Hampton, which has recently been acquired by the London United Tramways Company, was used for the luncheon ceremony, where the usual speeches of a congratulatory character were made. Needless to say that the regular service since the formal opening has been patronized to an enormous degree, and on the recent Easter holidays the company was almost overwhelmed by the numbers of passengers desiring to take this open-air route through such attractive scenery.

An official confirmation has been issued that the Prince of Wales has consented to open the new London County Council Tramways in London on Friday, May 15. His Royal Highness will be accompanied by the Princess of Wales, and it is proposed to invite the London members of Parliament, the mayors and aldermen of all the London boroughs and other public men. It has been arranged that their Royal Highnesses will enter the first electric car and ride to the terminus at Tooting and back to Westminster Bridge. In connecting with these tramways it has been decided to adopt the queue system at Blackfriars, and barricades are to be erected there which will serve to assist a staff of officials in preventing the struggling which at present takes place to enter the cars at this point. Preparatory to the opening of this system a regular course of tuition has been given to many of the county councils horse drivers, and many of these have successfully passed.

Preparatory to the formal opening of the system by the Prince of Wales on May 15, it is interesting to note that trials of the new electric cars on the conduit system have recently been made in the early morning after midnight. It is most satisfactory to note that these trials were perfectly successful, and the cars ran from end to end of the route without a single hitch. As this is practically the first long conduit system in England (with the exception of Bournemouth, which was opened only a few months ago) the result must have been extremely gratifying to the London County Council, Messrs. J. G. White & Company, the contractors for the whole of the conduit work, and also to Dick, Kerr & Company, Ltd., who furnished all the electric cars with their complete electric equipments. It would thus appear that everything will be in perfect order by May 15, when the South London will have an electrical tramway system thoroughly up to date, as good, if not better, than any electrical system in the world, as the work has been most thoroughly done in truly British manner.

The Brush Electrical Engineering Company's annual report this year is particularly interesting from certain statements which were made by the chairman, Lord Vaux, of Harrowden. The financial results of the year have shown a marked improvement and a 6 per cent dividend has been declared on the preference shares, £5,000 placed to reserve and a balance of £11,086 carried forward. The net profit for the year was £24,186 after deducting general charges, maintenance, interest on debenture stock and £6,500 placed to depreciation reserve fund. The interesting statement, however, which was made was with regard to some new types of work which the Brush Company proposes to enter into this year. They have been for some time experimenting in the manufacture of steam turbines and now feel that these machines are probably destined to play an important part in the future of electrical engineering undertakings. They have taken a license to manufacture steam turbines under the Parsons patent. It may be remembered also that the Brush Company has manufactured reciprocating engines in the past, but this work was recently discontinued. It is now also announced that they have designed an excellent type of vertical reciprocating high-speed steam engine suitable either for compound or triple expansion and for two or three cranks. They have already built one of this type of 500 hp which has already been in regular daily work for over six months. The directors have also decided to add polyphase generators to their line of manufactures, as it is evident to the board that such machines are absolutely necessary to keep pace with the progress of electrical work both for railways and power distribution.

With regard to the various underground enterprises before the House of Commons at present, the committee has passed the preamble to the City & South London Railway bill, by which powers are requested for extending the existing tube from the "Angel" to the London & North Western Railway terminus at Euston, and also to take over the powers already granted by Parliament to make a tube from Brixton to the city. The City & North Eastern Suburban Electric Railway bill, by which it is proposed to run a tube from the Monument to the North Eastern suburbs, is also making progress in committee, though meeting with strenuous opposition from the Great Eastern Railway, the North London Railway and the London County Council, though many statements have been made before the committee proving that the railway accommodation to these suburbs is totally inadequate. There is little to be said about the various other tube schemes, as they seem to have

received all the privileges which they had been desirous of securing. In the meantime the Royal Commission is investigating the whole problem, and most of the new schemes will probably be held up until some decision is arrived at by the Commission.

The one interesting feature, perhaps, in regard to the underground situation is the delivery by the Brush Electrical Engineering Company of two experimental trains which have been built for the Metropolitan District Railway Company, and which are now being used at South Harrow. These trains will be illustrated in an early issue, and here it will be sufficient to say that one has been equipped by the British Thomson-Houston Company, and the other by the British Westinghouse Company. The cars are of the long type used on the Central London Railway, and which has come to be considered as the representative American. The seats are all placed longitudinally along the sides with a broad corridor running down the middle, and in addition to the doors at either end of the cars with platform gates, as on the Central London, the District cars have also side doors in the middle, which, however, do not open outwards, but slide, handles being provided so that they can be worked either from the inside or from the station platforms. As has already been stated, it is the intention of the Metropolitan District Railway to keep these cars in regular service on the Harrow Branch for about a year, when it is expected the whole Inner Circle will be ready for equipment. During that time a complete system of experiments will be made and much valuable information secured, and these trains will also form a valuable educational feature for the employees.

The London County Council has just placed a contract for 200 tram cars, with the British Westinghouse Company, at a price of £118,980, which is about £12,000 cheaper than what the London County Council had to pay for a similar number last time. Only about £5,000 of this amount will be expended upon work which will have to be secured abroad, and with this exception all the work will be done in England.

The London County Council has given notice that it will issue £5,000,000 3 per cent stock for the purpose of paying off the bills, many of which are for tramway electrification. The highways committee reports that their experience with all night car service has led them to believe that they meet the requirements of the public, and that there is need for them to be maintained. The receipts show no surplus over expenses, but the committee is convinced that these night cars are of great convenience and intend maintaining them. The London County Council has again failed to get powers to place tramways on the Thames embankment, this time by only one vote. The London County Council has also recently had a set-back from the House of Commons, which placed its veto upon the proposal in the bill to permit borough councils to undertake the supply of electrical fittings. In refusing this request Sir F. Banbury stated that if such trading were allowed he did not know where it would be possible to draw the line, and that they might come to a state of things in which the country would be run by municipalities.

The City of Wolverhampton is much exercised at present on the subject of tramways, and as to the question whether the Lorain system of surface contact which has now been in operation for about a year will be taken over by the corporation or not. It will be remembered that this system was installed conditionally by the Lorain Company on the understanding that if it was not found to be successful it would be removed and the corporation permitted to instal the overhead system or any other system which might be selected. A report has now been prepared by C. E. C. Shawfield, the borough electrical and tramways engineer, which, while it admits that the cars have been running successfully, claims that it is considerably more expensive to operate and more expensive to instal. The committee has not given out this report nor has it published its decision in the matter, but it will naturally be one of great interest, not only to Wolverhampton but to electrical engineers in general. It would appear from what has been published of the report that it is not a question of ability to operate the system, as that seems to have been thoroughly established but the financial aspect, which is receiving the most severe investigation.

Last month saw the inauguration of a through system of cars from Liverpool to Bolton, labelled Liverpool, Prescot, St. Helens and Bolton. This system is controlled by the South Lancashire Tramways Company, which has Parliamentary powers to construct 115 miles of electric tramway, and will eventually link up Manchester and Liverpool and upwards of thirty towns and districts in the neighborhood. About 32 miles of the system are already in operation, and the opening of the through system of tramways from Liverpool to Bolton served for an opening ceremony of considerable importance. The route commences in Liverpool at the Pier Head and the procession of cars on the opening day proceeded by Water Street, Castle Street, Lord Street and Lime Street, into the London Road, and thence to Greenfields. The route passes by way of Knotty Ash and so on to Prescot, where is situated the factory of the British Insulated & Helsby Cable Company, with which the Atherton brothers, who are practically responsible for this railway, are associated. The route then passes through Ashton-in-Makerfield, Hindley, Atherton and so on to Bolton. At Atherton, a town named after the brothers who conceived the scheme, is a central power house; and here a stop was made for the purpose of examining the generating plant. Luncheon was served at the Town Hall of Bolton, at which Sir John Willcox presided. One of the important features of this route will be the carrying of merchandise in addition to passengers.

The Manchester Corporation, by opening the remaining routes upon the Oldham Road, Ashton New Road and Ashton Old Road, has completed the work of substituting electric traction for the old system of horse tramways begun in July, 1900. The first electric car was run on the Cheetham Hill route about eighteen months ago. There are now 140 miles of track under the control of the department, and about 400 cars are in daily use. By means of the new routes passengers will be able to travel quickly and comfortably from the center of Manchester to the boundaries of Oldham and Ashton, where connections will be established with the tramways of those two boroughs. It is hoped that in the near future the Manchester cars will be allowed to enter both towns, and negotiations with this object in view are already in progress with the authorities concerned.

The first provincial conference of the Municipal Tramway Managers' Association was held at the Leeds Town Hall recently, under the presidency of Mr. John Young, of Glasgow. Some twenty managers of municipal tramways attended. It was resolved to widen the basis and extend the scope of the association by admitting members of municipal tramways committees to membership, and to alter the title of the society to that of the Municipal Tramways Association. Among the matters discussed was the question of limiting compensation for personal injury in the case of tramway accidents to £25. It was decided to hold the annual meeting in Glasgow during July.

At a recent joint meeting of the Tramway Committee of the Perth Town Council and the Perth Tramway directors, a settlement with regard to the purchase of the tramways was reached, £21,000 being fixed upon as the figure for the basis of negotiations. At a subsequent meeting of the Town Council the agreement between the Tramways Committe and the directors was ratified, and the Corporation Tramway Provisional Order will now be unopposed.

The inauguration of the new electric tramways for Chester took place recently without public ceremony or function to celebrate the event. The first car, which was driven by the manager of the tramways (Mr. Jno. Gardner), left the tramway yard at 8 o'clock with a full load of passengers, there being eager anxiety displayed by a large number of persons to have the first ride and to obtain possession of the first tickets punched.

Arrangements are practically completed for the construction of a light electric railway by the Glamorgan County Council between Morriston and Pontardawe, a distance of 5½ miles, and the working thereof by the South Wales Electrical Power Distribution Company. The Council proposed to widen the road at certain points, to lay the tracks and also to put in the electrical equipment, and to lease the line for a sum which will be equivalent to their contribution to the sinking fund and interest, which will probably amount to something like 5 per cent on the capital expenditure.

The committee of the Portsmouth Corporation Tramways accepted the tender of Mr. Coltherup for the construction of new workshops and offices to the designs of E. Rotter, under whose supervision the work will be carried out. The amount of the contract is £8,150. The new buildings which are to be situated at North End, will, together with the large car shed already erected there, complete the depot.

The Portsdown & Horndean Light Railway, which was opened on March 2, has already earned such good traffics that the company have ordered additional cars.

The new Aberdeen Corporation Electricity Works at Dee Village were formally opened by the Town Council paying a visit of inspection. The party included Lord Provost Walker, the magistrates and Town Council members of the Harbour Board, and a number of the town's officials. The works are of imposing appearance, and there is ample room for further extension. The visitors were conducted over the station by Mr. George Kemp, convener of the Gas and Electricity Committee, and Mr. J. A. Bell, city electrical engineer, and had an opportunity of examining the fine plant and machinery, which, along with the building, has entailed an outlay of nearly £80,000.

The Southsea Corporation appears to have got themselves into rather a peculiar condition. A year ago they secured an order to extend their present lines, but soon after got the surface-contact bee in their bonnet and members of the Council have visited Wolverhampton, London and Paris for the purpose of investigation. After repeated meetings of the committee, at which the claims of nearly every surface-contact system were thoroughly gone into, it has occurred to the Council to consult the company which at present operates the tramways. They now find that the company holds the keynote to the whole situation, and by their contract the lease of the new lines must be made to them, and that any new lines which the Corporation construct must be to the company's reasonable satisfaction. The company now holds that surface contact is not reasonably satisfying, that it was not in contemplation when the agreement was drawn up, and it flatly refuses to consider anything but the overhead equipment. As things are, the town stands to-day in exactly the same position in which it stood when the order was obtained in May, 1902.

A. C. S.

METROPOLITAN REPLY TO CHARGES

The Metropolitan Street Railway Company, of New York, has mailed to its stockholders a reply to the accusations of falsified accounts against the company made recently.

The statement is prefaced with a note from Mr. Vreeland to the effect that in view of "the wide publication of misleading and injurious statements regarding the financial affairs of the company," he had asked Stephen Little, Farquhar J. MacRae, and Haskins & Sells, certified public accountants, to make an investigation and submit a report that could be presented to the stockholders." This report is given in full below:

THE ACCOUNTANTS' REPORT

We submit herewith in detail our report upon the memorandum you have handed us. We have considered the subdivisions contained therein in their numerical order, retaining in each case the caption that appears in the memorandum.

NO. I.

"Cash disbursements for new construction, etc., wrongly reported."

The allegation under this headline is in effect that during certain specified years the cash disbursements for new construction and equipment were reported to the Railroad Commissioners as amounting to $35,413,421.85 in the company's cash statement, while in the company's general balance sheet they were said to amount during the same period to only $25,355,572.76.

The figures stated by the persons who prepared this memorandum are incorrect. The sum reported in the general balance sheet for the period stated was $25,705,572.76, but the difference, for the purpose of this inquiry, is immaterial.

The question which this comparison seeks to raise is: What became of the missing $10,000,000? The answer is that there is no missing $10,000,000, and that the comparison is mistaken, misleading, and contrary to all principles of accounting. The company's statement of cash disbursements represents obligations paid during the specified period, while the increase in the amount charged to the construction and equipment account, as shown on the balance sheet, represents obligations incurred. The two things are obviously so different that any attempt to compare them is preposterous and conveys no meaning whatever.

The reference to loans and investments and to the difference between the cash statements and the balance sheets in respect of these, is met by the same answer. We repeat that there is no occasion to reconcile the cash statement with the balance sheet, nor is any inference whatever to be drawn from the fact that they do not agree. To base a charge of corporate mismanagement upon the fact that a disagreement does exist is simply absurd.

NO. II.

"False balance of $3,000,000 due from lessor companies carried forward from 1901 to 1902."

The suggestion made under this heading is that because your company reported to the Railroad Commission (Report of 1901, page 1072), "amount due from lessor companies June 30, 1901, $2,245,598.78," and the next year reported (page 1109) "balance due from lessor companies June 30, 1901, $5,245,598.78," it follows that a false balance was stated, amounting to $3,000,000. This interference is entirely unwarranted. The transaction embodied in these two reports was simply this—$3,000,000 had been paid by the lessor companies to the Metropolitan in notes on account of additions and betterments made by the Metropolitan Company upon their respective lines, and the notes falling due, were not paid by the lessor companies, but were taken up by the Metropolitan Company. Thereupon the $3,000,000 of indebtedness to the Metropolitan Company represented by the notes were, of course, charged back to the lessor companies' accounts on the Metropolitan Company's books.

NOS. III., IV., V., VI.

(III.) "In relation to the Second Avenue Railroad Company;" (IV.) "Repeated charges for same construction work on certain leased lines;" (V.) "Excessive charge for reconstruction on the Thirty-Fourth Street Crosstown Railway Company;" (VI.) "Neglect to report in detail cost of new construction year by year."

The points raised under these headings relate mainly to the cost of construction work, and are merely expressions of opinion that this cost was excessive.

We shall not undertake to discuss that question, as to which certainly no one is qualified to form an opinion who does not know of his own knowledge all of the physical conditions under which a given piece of road was built.

In making out the allegation that this cost of construction was too great, it is claimed that evidence of double charging exists in the reports your company has made to the Railroad Commission. Certain items reported as the cost of constructing a certain road during a given year are pointed out, and attention is then called to the statement in the same report that the road is in operation. Thereafter a further increased item, stated in respect of a subsequent year is cited, and, recalling that the road was said to be in operation, it is assumed that this state of the accounts implies a double charge. There is no ground for such an assumption. The work of construction is not necessarily nor often completed when the road is put into operation. On the contrary, it goes on for months, even years, and any charge for that road in the report of a given year means only the cost of such mileage as was constructed and accounted for during that year.

Another mistaken assumption of a similar kind appears under the above captions. Observing in the annual reports amounts therein stated to be expended during the year reported upon, and observing also the length of the road therein stated, it is assumed that the charge applies to the entire mileage so reported. But it is not so. The charge made represents the cost of such work as has been actually done and accounted for at the time the report is made. Subsequent charges refer to subsequent work, and all such charges added together are the cost of the entire mileage of the road. An illustration of the manner in which the author of this memorandum has continually imposed upon himself in the examination of your annual reports appears in the criticism that "the enormous sums carried by your company year by year since 1898 under the head of "New construction on lines owned and leased to be distributed" (reaching a total of more than $22,000,000 in 1901) would permit of an apparently easy way for falsification of accounts and for misappropriation of funds." On the contrary, an undistributed account would be the very last place in which anybody would undertake to conceal false accounts or misappropriated funds. Every such item must reach its final destination and be fully accounted for, and it is by no means remarkable that the Metropolitan Company, during the period of its sudden and wonderful expansion, should have had a very large open account. The remark that "no necessity existed for such an account," disqualifies anyone who makes it from discussing the accounts of the Metropolitan Road. Your company was building for the account of many subsidiary companies, and the best way to keep its construction account intelligently and with accuracy was the way in which it was kept; namely, by holding it together until the work was completed, and then apportioning the amount to the different properties to which it appertained.

NO. VII.

"Excessive charge for engineering and superintendence on the Central Park, North and East River Railroad Company."

Under this headline attention is called to an entry in the company's report of 1902 of $322,340.45 expended for engineering and superintendence, and adding thereto some other items, it is made to appear that the charge for this service upon a mile and a half of double-track road was $341,731.39. It appears that the company's report in respect to this charge did contain a clerical error, and that $290,000 of the $322,340.45 should have been charged to track and roadway and electric line construction. This, of course, does not affect the aggregate charge to construction and equipment, as both of these amounts were included in such aggregate.

The item of $9,693.97 stated by the company to be incurred in connection with the organization or construction of the property is properly classified by the company, regardless of the date of the road's organization, and, being an item of "legal expense," it is in

accordance with the provision of the Street Railway Accountants' Association of America relating to classification, and this memorandum in declaring it to be "an entirely improper charge" speaks in violation of the authority it cites.

"Excessive claims for the value of investments credited in the company's general balance sheets."

It is here contended that the valuation placed by the company upon its pledged and unpledged securities "is far in excess of the actual valuation," and the conclusion is reached that, as you have issued a certain amount of Metropolitan stock for these investments, on which stock you pay 7 per cent dividends, "the company is paying out annually $1,400,000 to receive in return $300,000," because "the company's income from these investments, as its own annual reports prove, is but $300,000 a year." This is wholly mistaken. The annual reports prove nothing of the kind. They prove that the Metropolitan Company derives that much income in the shape of interest and dividends from these securities. But as lessee or owner of these properties it derives from them also all their net returns over and above their regular dividends, to say nothing of the value of each property to the Metropolitan system as a whole. The false assumption shown above renders this criticism absurd.

Moreover, as a matter of correct accounting, these investments should be held on your books at cost, irrespective of their par or market value. No corporation of this character would undertake to write up or down the value of its investments to agree with the fluctuations of the market.

NO. IX.

"Lease by the Metropolitan Street Railway Company to the Interurban Street Railway Company."

There seems to be no foundation for the statement that the sum of $23,000,000 to be paid to the Metropolitan Company by the Interurban Company under the agreement of lease, was to be used for any other purposes than those mentioned in the Metropolitan Company's circular of Feb. 14, 1902. The auditor of the company certifies that on Feb. 1, 1902, the floating debt of the Metropolitan Company was $10,648,972.81, of which $6,432,800.46 represented the cost of the Third Avenue stock, and that substantially all of the balance had been incurred in the extension of the electrical system to Metropolitan lines. It seems to be conceded that approximately $12,000,000 would be required to extend the electrical system to the Metropolitan lines which were operated by horse cars at the time the Interurban lease took effect, so that it follows that the sum of $23,000,000 was to be expended in paying the debt incurred in or occasioned by the purchase of the Third Avenue stock and in defraying the expense of extending the electrical system.

The suggestion that the Interurban transaction provided for the general purposes of the Metropolitan Company $5,804,000 of the new refunding bonds simply because that happens to be the difference between $54,000,000, the amount of these bonds reserved for refunding purposes, and $48,196,000, the amount of the underlying bonds, is entirely met by the provision of the mortgage (which seems to have been overlooked in the memorandum) to the effect that these $5,804,000 of bonds cannot, prior to Jan. 1, 1920, be used for any other than refunding purposes. It is simply the usual condition of a refunding mortgage to provide for the premiums upon underlying bonds bearing high rates of interest.

The creation of a separate mortgage of $3,000,000 by the Central Crosstown Company is fully explained by your statement that as the Metropolitan Company owns only about three-fourth of the capital stock of the Central Crosstown Company and does not control that company's line by lease, it was clearly to the interest of the Metropolitan Company that the Central Crosstown Company should procure by the sale of its own bonds the necessary funds to provide for the conversion of its system to electricity, thus placing upon the minority stockholders their proportionate share of the cost of such conversion.

Your treasurer informs us that the Interurban Company has paid to the Metropolitan Company, under the agreement of lease, the sum of $16,549,000. From this sum the floating debt existing at the time of the lease has been paid in full and the construction expenditures subsequently incurred have been more than provided for.

NO. X.

"Alleged payment of large sums of money by lessor companies."

Under this heading it is pointed out that, following the stereotyped forms adopted by the Railroad Commission, you have represented that certain amounts of money were paid to the Metropolitan Company by certain lessor companies during certain years, and no account of such payments being found in the reports of those companies, it is alleged that no such payments were made. The transactions to which these items refer are similar in principle to the transactions mentioned in Article II. of this report. The lessor companies gave to the Metropolitan not cash, but notes on account. It is ridiculous to accuse the Metropolitan Company of having availed itself of the printed form of the report of the Railroad Commissioners" to charge its treasury with something which it never received.

The claims of the Metropolitan Company against its lessor companies, which in this memorandum are said to amount to $13,180,339.63, and of which it is alleged that they "seem to be totally unfounded," represent a debt for improvements and betterments constructed by the Metropolitan Company upon its leased properties. The extent to which they are "founded" would no doubt be realized by any lessor company that undertook to break its lease.

NO. XI.

"Excessive charge for new construction in the year 1902."

The matters which are undertaken to be criticised under the headline above are not susceptible of intelligent discussion from entries in official reports. Whether or not a road costs too much in the absence of thorough and detailed knowledge of all the physical conditions under which it was built is the merest guesswork. In the memorandum many inferences of excessive cost are based upon the difference between obligations reported as paid and obligations reported as incurred, and, of course, there is absolutely no basis for such inferences. Inferences of excessive cost are also based upon the disposition of construction charges which occurred in 1902 at the time the Metropolitan property was leased to the Interurban. These charges had been, therefore, undisturbed. They related to work previously done, and the memorandum makes the mistake of assuming that they related only to the work reported as under way in 1902.

No ground for questioning the correctness of the company's reports or the propriety of the charges made in its construction accounts is to be found in the fact that the sums reported as having been expended for construction in a given year appear to be large as compared with the amount of work done in that year, when it is understood that the sums so reported do not necessarily, nor often, apply only to the work so reported.

NO. XII.

"Difference in balance sheets and income account as reported on March 31, 1902, to the New York Stock Exchange and to the Railroad Commissioners."

Under this heading attention is called to certain differences between a report of your company's affairs rendered to the Railroad Commissioners as of March 31, 1902, and another report rendered to the Stock Exchange, as of the same date. The fact is, however, that although these two reports were made as of the same date, the report to the Railroad Commissioners, being only a quarterly report, was considered tentative in character and did not include the general construction account, which is reported only at the end of each fiscal year, while the balance sheet submitted to the Stock Exchange, which was not prepared until late in the month of July, was intended to be full and complete. Furthermore, in the interim the lease of the Metropolitan to the Interurban had gone into effect as of April 1, 1902, so that the statement made to the Stock Exchange necessarily included many adjustments which had not been made when the report to the Railroad Commission was prepared. It was necessary that these adjustments should be made to refer back to the period anterior to the date of the lease. The item of cash referred to in the memorandum was a construction fund belonging to the Third Avenue Railroad Company, and its omission from the Stock Exchange report was properly made in view of the fact that it was not a part of the funds of the Metropolitan Street Railway Company.

The memorandum concludes with a reference to the statement of the income account made by the company to the Stock Exchange, and to the statement made to the Railroad Commission as of the same date, and finding many differences therein, states that they "call for a clear explanation in detail." With this we do not agree, as the differences are sufficiently explained by the fact that to the Railroad Commission the company was reporting the operations of the lines which it directly operated, whereas to the Stock Exchange it was reporting the operations of its entire system, which included a considerable mileage operated by subsidiary companies, who by law make their own reports to the Railroad Commission.

Stephen Little,
Farquhar J. MacRae
Haskins & Sells,
Certified Public Accountants.

MAY FIGHT CHICAGO RECEIVERSHIPS

A motion is likely to be made on the part of the stockholders of the North and West Chicago Street Railway Companies that the three receivers be removed so far as they affect directly the affairs of these underlying companies, on the ground that they are not insolvent. The stockholders declare they are at a loss to explain how the underlying companies could be declared insolvent because of the failure of the Union Traction Company to meet notes or interest guaranteed. A general reorganization of the Union Traction interests into a new company, back of which will be J. Pierpont Morgan, is said to be in prospect. A decision by the Federal courts on the validity of the rights claimed by the Union Traction Company under the so-called ninety-nine-year act is to be sought.

The protective committee which has been acting for some of the stockholders of the Chicago Union Traction Company, the North Chicago Street Railway Company, and the West Chicago Street Railway Company, has issued a circular to the stockholders to the effect that the appointment of receivers for these companies, just made in the United States Court at Chicago, was required by the State of the controversy between these corporations and the municipality of Chicago, and that it is believed that a satisfactory solution of the questions involved will be facilitated by these receiverships. The protective committee urges stockholders to hasten the deposit of their holdings, the time for which will expire on May 2 next.

NEW FRENCH ELECTRICAL COMPANY

A new company has just been organized in Paris with the title L'Industrie Internationale by interests which are identical with those of Robert W. Blackwell & Co., Ltd., of London. The company has been incorporated with a paid-up capital stock of 450,000 francs, and will take over the present business in France of Robert W. Blackwell & Company, together with the offices, stores and stock in Paris belonging to that company. The directors of the company are: B. Hunting Howell, president; Eugene Estavard, general manager; Max Duchanoy, Edgar R. James, Robert W. Blackwell, and Lucien Rousseau, secretary. Of these gentlemen, Messrs. Estavard and Rousseau have been connected with the business of R. W. Blackwell & Company, in France, for a long time past. Max Duchanoy is prominent in Parisian financial circles and was largely instrumental in the late consolidation of the lighting companies in Paris. Messrs. Howell, James and Blackwell are managing directors of R. W. Blackwell & Company, Ltd., of London.

The company has taken offices at 20 Rue St. Georges and will commence business May 1. The company will carry in stock a large supply of all kinds of electrical railway supplies, and has recently acquired the leases of the factory and store rooms of the Dunlop Tire Company, in Paris, which will insure storage and handling facilities of the very best from every point of view. The new company was organized owing to the rapidly increasing business of Blackwell & Company in France, and it is believed that a concern of this kind incorporated, as this is, under French law, and with its headquarters in Paris will be better able to carry out contracts in France than a foreign concern. Practically all of the capital stock of the company has been subscribed by the present shareholders in R. W. Blackwell & Company, Ltd.

SENATOR CLARK BUYS LOS ANGELES TROLLEY LINE

All the property and rights of the Los Angeles Traction Company, of Los Angeles, Cal., have been purchased by Senator W. A. Clark and his associates for a sum that approximates $2,000,000. The first payment of $100,000 was made on April 18 to bind the bargain. It will be remembered that it is Senator Clark who wants a blanket franchise covering 82 miles of the streets of Los Angeles, promising a 3-cent fare. The purchase of the Traction property affords an important nucleus for the new system.

Senator Clark is president of the San Pedro, Los Angeles & Salt Lake Railroad, and his recent close alliance with the Union Pacific, consequent upon his purchase of the Oregon Short Line and acquisition by lease for ninety-nine years of terminal facilities in Salt Lake City, has led many to suppose that, in entering the electric railway field in Los Angeles and interurban territory he is backed by President E. H. Harriman, of the Southern Pacific. Such a syndicate would compete with Henry E. Huntington for supremacy in the electric railway traffic of Southern California, on the theory that steam traffic in that section is seriously menaced by the interurban electric railway. Thus, it seems a battle royal has begun in California between electricity and steam.

POWER DEVELOPMENT IN CONNECTICUT

Details are announced of the plan for the development of power on the Housatonic River, in Connecticut, for the generation of power for electric lighting, railway and manufacturing purposes. As previously stated in the STREET RAILWAY JOURNAL, the work will be carried out by the New Milford Power Company, and will result in the abandonment by the Connecticut Railway & Power Company of a number of its steam plants. Reducing considerably the cost of power, the construction of the new plant is expected to give a new impetus to the construction of new electric railway extensions in the territory to be served by it.

Two large plants are to be built, and a 15-ft. dam is to be constructed across the Housatonic River at the head of Bull's Falls. A canal 11,000 ft. in length will convey the water to a large reservoir, whence a 13-ft. steel flume will be built to one of the power houses to be located at Bull's Bridge. The Bull's Bridge plant will have an initial capacity of 6000 kw. The equipment will consist of six 1000-kw generators of General Electric build. They will be revolving field, three-phase, 60-cycle machines to operate at 400 r. p. m. These generators will be direct-connected to special high-head turbines of 1850-hp capacity each. The turbine contract has been secured by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The machinery will generate at 1150 volts and step up to 33,000 volts.

The other plant is to be situated at Gaylordsville, about 4 miles below the Bull's Bridge power house, with which it will be run in parallel. The capacity of the Gaylordsville plant will be 3000 kw. The working head will be 33 ft. The contracts for the equipment have not yet been awarded. A double transmission line will be built almost straight across to Waterbury, a distance of 26 miles. At Waterbury, where the major portion of the power will be used, the Connecticut Railway & Lighting Company will construct a large receiving station for the distribution of power to operate its extensive railway, lighting and power interests. The station will take care of 6000 kw and will be equipped with four 550-kw railway rotary converters and four 300-kw rotary converters for lighting use. The remainder will be utilized for arc lighting and general power purposes. All the rotary converters will be of six-phase, 60-cycle type, and will be of General Electric Company's manufacture. From Waterbury the transmission line will be continued to New Britain, 18 miles distant, by way of Southington. In the vicinity of Southington a transforming station will be built in which three General Electric six-phase, 60-cycle railway rotary converters will be installed for the purpose of operating the Meriden, Southington & Compounce Tramway Company and other lines controlled by the Connecticut Railway & Lighting Company in the locality. At New Britain a station is to be built which will be equipped with three railway rotary converters, six-phase, 60-cycle, of 300-kw capacity each, of General Electric type, also similar machinery to handle 1500 kw for light and power purposes. The transmission line will be built by the New Milford Company. The contracts for wire, etc., have not yet been determined. The company has the contract for supplying power to the Connecticut Railway & Lighting Company for a period of thirty years. The power is to be delivered at the step-down transformers at all the latter concern's plants. The contracts for the rotaries and other equipment for the transforming stations are let by the Connecticut Company.

A NEW HEADLIGHT ADJUSTER

On April 17 George F. Chapman, of Marlborough, Mass., took a party of street railway men on an especially arranged trolley trip between Waltham and Hudson, Mass., for the purpose of demonstrating the value and utility of his new headlight adjuster. This device is unique in its construction, application and use on suburban and interurban roads. Briefly described, it is an attachment to the axle of the front truck, reaching forward to the headlight, and adjusting the latter so that its rays are constantly kept on the track, especially while going around a curve. When the car strikes the curve the headlight is immediately deflected so that it not only lights the curve but the track ahead. The deflection of the rays of light is gradual, yet absolutely positive and certain.

The value of a positive device of this kind on high-speed interurban and suburban roads, especially single-track lines, can readily be seen. It enables the motorman to clearly distinguish any object on the track ahead for at least a hundred yards.

The car, on the trial trip left Waltham shortly after 7 o'clock, and the value of the shifting light was soon demonstrated as the car swung around the curves on the line. Where they were gradual the light followed them perfectly, and if they were sharp the bright beam swept across the track, lighting it for its entire width

and giving a clear view of everything ahead for a long distance. At present there are three of the cars of the Lexington & Boston line equipped with the adjusters, and Superintendent Green, who was one of the party, said that they were only waiting till they could get the devices to put on all the cars of the line. He regarded it as an essential part of their equipment.

All of the party seemed much pleased with the performance of the device, and many favorable expressions were heard concerning it. When the car reached Concord, Superintendent J. W. Ogden, of the Concord, Maynard & Hudson Street Railway, joined the party, and he was accompanied by Charles H. Persons, vice-president of the same company. On reaching Maynard the party change to the parlor car "Concord" and continued the trip to Hudson.

Arrangements are now being made to manufacture these adjusters in Marlborough.

VIOLENCE IN THE ILLINOIS LEGISLATURE

There were witnessed last week in the Illinois Legislature scenes of violence that have been described as surpassing the wildest scenes of the Austrian Reichsrath. Thursday, April 23, was the day on which the turbulent disturbances occurred. The Mueller bill, which provides for municipal ownership, was before the House, and the Speaker, John H. Miller, through what is said to have been his unwarranted use of the gavel in opposing the advancement of the bill, has been charged with precipitating disorder. The members mobbed the Speaker's platform in a general fist fight, and when they had done the interior of the legislative chamber is said to have resembled, in a measure, the track of a tornado, so general was the wreckage of chairs and desks. The Speaker, as an explanation of the extraordinary actions on his part, late on Thursday, formally made charges that attempts had been made to bribe him. On Friday, April 24, the House, by a vote of 72 to 60 declared "no confidence" in the Speaker, and appointed a committee to investigate the charges and report on Tuesday, April 28.

PERSONAL MENTION

MR. B. F. O'MARE, of Terre Haute, Ind., has been appointed superintendent of the Northern Texas Traction Company, to succeed Mr. J. W. Renfro, recently elected Street Commissioner by the City Council.

MR. THOMAS N. McCARTER has resigned as Attorney General of New Jersey to become president of the new company that is to be organized to consolidate the street railway and lighting interests of Northern New Jersey.

MR. CHARLES L. MURRAY has been appointed superintendent of the Elmira & Seneca Lake Railway Company to succeed Mr. E. W. Alexander. Mr. Murray was formerly assistant superintendent of the Buffalo & Depew Railway Company.

MR. HENRY A. EVERETT, head of the Everett-Moore syndicate, has returned from an extended vacation trip through the South. Mr. Everett will devote his attention during the next few months to a settlement of the telephone troubles of the syndicate.

MR. GEORGE C. EWING, of Boston, Mass., was recently in New York on a business trip. Mr. Ewing is now located in the Board of Trade Building in Boston, and is Eastern agent for a number of the leading manufacturers of heavy street railway apparatus.

MR. J. W. HOLMAN, recently of "The Engineering and Mining Journal," and Mr. G. W. Scott, recently of the "Mining and Scientific Press," have purchased the "Western Mining World," of Chicago, and after May 1 it will be known as the "Mining World."

MR. GEORGE S. PATTON has been appointed land agent of the Pacific Electric Railway Company, at Los Angeles, Cal., reporting to General Manager Epes Randolph. Mr. Patton has the personal approval of President H. E. Huntington, who has also made him general manager of the Los Angeles Land Company and the Huntington Land and Improvement Company.

MR. C. D. EMMONS, who for the last two years has been general superintendent of the Lafayette Street Railway, of Lafayette, Ind., has been appointed general superintendent of electrical construction of the Fort Wayne Traction Company, and general superintendent of all the lines in which Messrs. James & Charles Murdock are interested. These embrace the system at Logansport, Richmond and other Indiana towns.

MR. JAMES R. M'CARDELL, of Trenton, N. J., died April 22, after an illness which had confined him to his room for nearly nine months. Mr. McCardell was born in Trenton forty-four years ago, and learned the trade of woodworker with Mr. Richard Sutphin, who formerly conducted an extensive carriage and wagon works in that city, and in 1885 engaged in business for himself with Mr. C. H. West, who had also learned the trade of carriage blacksmith with Mr. Sutphin. In 1886 the firm of McCardell & West purchased the works of Mr. Richard Sutphin and built up an extensive business in Trenton and the surrounding towns. In 1891 the firm was reorganized, Mr. M. J. McDonald purchasing an interest and the firm name being changed to McCardell, West & Company. In 1898 Mr. West retired from the firm, disposing of his interest to his partners, and the firm name was changed to J. R. McCardell & Company. The business grew rapidly, and the firm entered the electric field, furnishing the Trenton trolley wagon used on electric railways, which was invented and developed by members of this firm. Mr. McCardell was widely known among electric railway managers.

MR. ROBERT E. LEE, retiring superintendent of the Washington Railway & Electric Company, of Washington, D. C., was tendered a reception Monday, April 20, by the officers and employees of the company at the building occupied by the Employees' Relief Association on E. Street. A varied vaudeville entertainment had been arranged, in the course of which General George H. Harries, vice-president of the company, traced Mr. Lee's connection with the company. In closing his speech General Harries paid a glowing tribute to Mr. Lee, and then crowned his laudatory remarks by presenting Mr. Lee with a solid silver service of colonial design, a chest of silver knives, forks, spoons, etc., and a handsome bouquet for Mrs. Lee on behalf of the relief association. The silver service was appropriately engraved and was of handsome design. General Harries also presented Mr. Lee with a handsome gold watch charm set with diamonds. Mr. Lee made a brief response, in which he said that the greater part of his success was due to the manner in which the men worked with him for the betterment of the company's property. He expressed regret at leaving. Mr. Lee, as previously stated in the Street Railway Journal, has accepted the position of superintendent of the Cincinnati Traction Company.

MR. A. O. KITTREDGE, president of the Account, Audit & Assurance Company, of New York, and a frequent contributor to the columns of this paper, died suddenly in Boston March 23. Mr. Kittredge was known as an authority on accounting, and represented the Street Railway Journal at several of the early meetings of the Street Railway Accountants' Association of America. He was most assiduous in whatever he undertook, and was not only an indefatigable worker, but one who was never satisfied with his work unless it represented the best possible result from the materials at hand. Mr. Kittredge was born in Dayton, Ohio, in 1848 and commenced his business life as bookkeeper in a stove foundry in that city. While engaged in this work he originated and put into practical use what was probably the first card ledger ever used. A little later he went into the sheet metal business in Salem, Ohio, and while engaged in this work issued the "Manual of Sheet Metal Architectural Work." In 1874 to '78 he published "The Sheet Metal Builder." In the latter year he sold the paper to David Williams, publisher of "The Metal Worker" and "The Iron Age," but continued for several years to be a contributor to Mr. Williams' periodicals. In 1886, he began the publication of a monthly periodical devoted to business accounting and called "The Office." In 1890 the paper was purchased by Mr. Williams and its name changed to "Business, the Office Paper," but with Mr. Kittredge as editor. In 1896 he decided to devote his entire attention to the accounting profession, and in 1898 formed the Account, Audit & Assurance Company, of which he remained president until his death. His balance-sheet accounting system, which is applicable to all lines of business, and which, as adapted to street railway accounting, was described in the Street Railway Journal of January, 1899, has been adopted by a large number of important manufacturing, mining and other companies. In 1900 Mr. Kittredge was appointed Professor of the Theory and Practice of Accounts, in the School of Commerce, Accounts & Finance, of New York University. In the same year he was largely instrumental in forming, and was elected secretary of, the American Institute of Bank Clerks. This institute has some 6000 members and publishes a semi-monthly bulletin, of which Mr. Kittredge was editor. The articles by Mr. Kittredge which have been published in the Street Railway Journal include: "Theory of Reserve and Suspense Accounts," "An Ideal System of Street Railway Accounts," "The Voucher System of Bookkeeping," "Accounts of Materials in Store," "Open Questions before the Committee on a Standard System of Accounting," and "Notes and Comments on the Accountants' Conventions," from 1897 to 1901.

A MODERN ENGLISH ENGINEERING PLANT

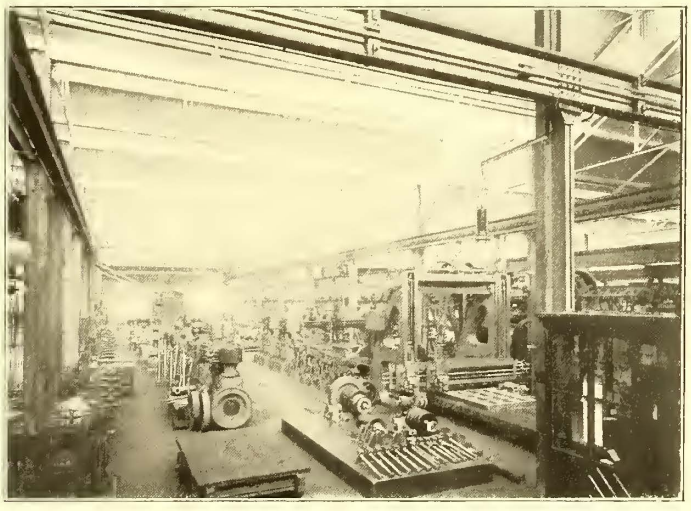
The plant of W. H. Allen, Son & Company, Ltd., known as the Queen's Engineering Works, is situated on the western side of the main line of the Midland Railway Company at Bedford, England, and covers 4 acres, with 6 acres adjoining for further extensions. The works have been especially equipped for the manufacture of very high-class electrical machinery, as well as centrifugal pumping engines, air-pumping machinery, and machinery for large central stations comprising engines and dynamos, motors, condensing plants and Edwards air pumps. The company employs 800 men, and has introduced American methods and some of the latest American machine tools during the last few years.

The company has installed a complete generating plant, in which its own apparatus is largely used. Four Babcock & Wilcox steam boilers are installed to carry 300 lbs. of steam, 200 lbs. to 210 lbs. being the daily working pressure. This, however, can be increased when it is required to carry out several tests at the same time. Two of the boilers are capable of raising 5000 lbs. of steam per hour, and the remaining two 6000 lbs. of steam per hour. A separate siding has been arranged so that the coal can be brought alongside the bunkers. The boilers are fitted with a special apparatus in the drums for softening the water, owing to the Bedford town supply being of a very hard character. At the back of the boilers is fitted a large feed-water heating apparatus and deteriorizer, the heat for which is obtained from the waste steam from the steaming bed. The boilers are run in parallel, and the main steam pipe is taken to the testing bed, as well as to the engine room, so that the steam pressure can be maintained constant, notwithstanding the great fluctuation in load owing to the intermittent work on the steaming bed. The engine room is placed alongside the boiler house, and contains three units, two 160-kw sets and one 100 kw of the company's manufacture, the dynamos being compound wound for 250 volts. A condensing plant has been provided, consisting of a surface condenser of 750 sq. ft., with Edwards air pump and centrifugal circulating pump. Cooling apparatus is placed alongside the power house, consisting of a tower, and special aparatus for separating the oil from the exhaust steam was added.

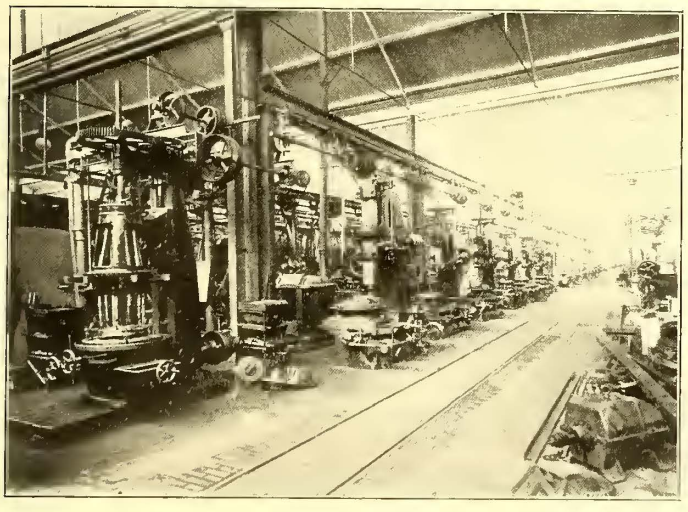
The testing bay contains a plant which is capable of testing engines up to 1000 hp. Very complete records are taken of every steam trial, both of engines as well as condensing plants.

The steam consumption measuring plant is entirely separate, and consists of a surface condenser of 1400 sq. ft. and two sets of Edwards air pumps delivering directly into two large measuring tanks. A standard clock and barometer is placed alongside these tanks. The company has erected a complete potentiometer for checking the instruments used, and is set up for use with a D'Arsonval reflecting galvanometer. A Craven traveler is provided over the test bay capable of lifting 10 tons. It is electrically driven by the company's latest standard motors.

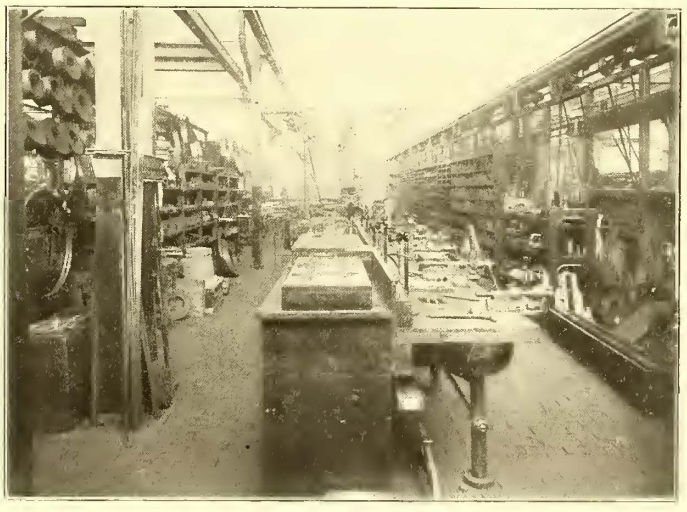
DYNAMO DEPARTMENT



ERECTING SECTION



MACHINE SHOP



TOOL SHOP

American practice has been adopted in dividing into separate departments the construction of the several parts of engines. Formerly one erector and a gang of men fitted a complete engine together, but the new arrangement has been found much more satisfactory.

In the heavy machine shop the largest machine tools in the works are arranged, including a planing machine of Armstrong, Whitworth & Company's make, 8 ft. 3 ins. square, with a 16-ft. stroke, and another planing machine made by the Pond Machine Tool Works at Plainfield, N. J., which is a rapid-moving machine, cutting cast-iron at a speed of 26 ft. per minute. Both these machines are driven by separate motors. Niles and Bullard boring machines, the former of 90-in. and the latter of 62-in. diameter, and a crank lathe made at the Pond Machine Tool Works for turning three-throw engine crankshafts, are conspicuous features of the equipment.

The department for medium sized machine tools contains a fine equipment, including several drilling, tapping, cutting, boring and grinding machines. A complete set of boring machines of

American make are grouped together to operate upon circular work, and the American system of boring, roughing, reamering and sizing is freely adopted.

A separate department is given to the milling machines.

It is worth noting that with the exception of the Jones & Lamson type of machine the majority of machine tools are driven by means of friction clutches fitted directly onto the main driving shafts.

The company has given much attention to the equipment of a thoroughly up-to-date tool room. The limit system of gages is used exclusively throughout the works. Three distinct gages are provided in the limit system—(1) for articles required to be finished by grinding; (2) those which are to be used as running fits, and (3) those which are required for driving fits. The tool room is fitted up with the necessary machines for the manufacture of the gages and the up-keep of the milling cutters

The machine shops generally are provided with ample means of lifting apparatus, three 10-ton electric travelers and one 15-ton electric traveler being in use. The whole of the electrical equipment has been carried out by the company.

The dynamo shop is situated in the northwest corner of the main building. A prominent object upon entering is a cylindrical vacuum chamber of the type rapidly coming into vogue for the purpose of extracting the moisture from armatures and field magnet coils without the use of such temperatures as are otherwise required. The inside of the chamber is heated by means of a coil of steam pipes arranged round the inside of the cylinder. The chamber is closed by means of an air-tight door at one end, and the air is extracted by means of an air pump driven by a small steam engine. A low-pressure, very little short of a complete vacuum, is soon attained, and evaporation of moisture proceeds rapidly. Near the drying chamber are the standards for supporting the armatures during winding. For the winding of field magnet coils special machines, each driven by a small motor, are in use. The wire is fed from a drum over a series of pulleys onto a bobbin, the feeding apparatus being provided with a horizontal traverse motion, actuated by spur gearing, which can be altered so that the horizontal movement of the wire during one revolution corresponds with its thickness, the turns being thus automatically made to lie close together. The number of turns is registered by means of a counter

Much time is saved in taping the shaped armature coils and bars by the use of several special taping machines. The bar to be taped is passed through the middle of a revolving ring at one point in the circumference of which is fixed a coil of tape, made to circle round the bar, which is passed along by hand as each portion is covered.

The iron foundry is situated in the north end of the fitting shop, and consists of two bays, 60 ft. wide by 260 ft. long. The cupolas are on the eastern side of the foundry, the large one melting 15 tons and the small one 10 tons per hour. The blowers are driven by an electric motor.

The brass foundry consists of two bays each 30 ft. wide, and is arranged to make the largest pump castings required for the British Admiralty, which at the present moment entails castings weighing about 30 cwt. Six pot furnaces are provided, as well as one large air furnace. The brass foundry alone turns out nearly 2 tons of castings per week.

The pattern shop is a large building, lofty and airy, which is 40 ft. wide by 160 ft. long. It is electrically driven.

At the northern end of the works is situated a pond for cooling the circulating water from the condensing plants used in connection with steam trials on the testing bay. This is fitted with two large weirs.

The testing machine is an important feature, the cast-iron, steel and gun metal being tested daily to insure the best material.

The company for several years has taken a great interest in the training of pupils, and has set aside a department for this purpose employing a demonstrator, who not only assists in solving difficult problems connected with the work, but also guides them as to the literature of allied subjects, so that they may be able to read in their spare time and attain a deeper knowledge of their work. Lectures are given every Monday evening on various subjects. The pupils are also in constant touch with the directors, who endeavor to exercise a useful control in their welfare generally.

Judge Philips has rendered a decision against the Cleveland City Railway Company in the suit brought by the Robinsons, who owned a block of stock in the old Superior Street cable line, and who claimed that they did not receive their share of the stock in the Cleveland City Railway when the transfer was effected. The judgment will amount to $175,000, and there are a number of similar suits in the courts. The case will probably be appealed by the company.

STEAM FEARFUL OF ELECTRICITY

The City Council of Los Angeles, Cal., sold two important franchses to the Pacific Electric Railway Company on April 13 for $7,500. They grant the privilege of a third-rail for standard gage purposes down one of the principal streets of the city. One franchise, covering two blocks from Seventh to Ninth Streets on Main Street, was bought for $7,000; the other, also covering two blocks from First and Los Angeles Streets to Main Street, thence south on Main Street to Second Street, brought $2,500. Of great strategic importance to the Pacific Electric Railway Company are these two franchises. Together with a franchise granted in 1897, under which the company asserts the right to lay a third rail on Main Street from Second to Seventh Streets, the two franchises just acquired will enable all of the broad-gage interurban lines of the Huntington-Hellman syndicate to reach the big depot now building at the corner of Sixth and Main Streets. Under the charter system of direct legislation the franchise ordinances will not go into effect for thirty days after their approval by the Mayor and during that time they will be subject to a referendary vote. Meantime the company will be permitted to lay its rails at once, provided it will guarantee to remove them if a referendary petition is filed within the thirty days. The coming visit of the President is urging the matter.

Surprise is expressed that Senator W. A. Clark and his associates, who back the 3-cent, 82-mile blanket franchise application, did not make the Huntington-Hellman syndicate pay more for the short franchise that are so valuable to the interurban system. The existing roadbed is narrow-gage, and as only two franchises can be granted on the same street, a failure to secure the concessions would have severely crippled the plans of Mr. Huntington. On the other hand, however, the proponents of the 3-cent franchise stoutly maintain that they are acting in good faith in proposing to construct a new city system. The Main Street franchises are not essential to this system, and any attempt to outbid Mr. Huntington would have strengthened the popular belief that the steam roads—Southern Pacific and Santa Fe lines—are trying to obstruct and prevent an extension of the electric railway lines of Los Angeles County.

A representative of Senator Clark states that the total number of persons interested in the 3-cent proposition is in excess of twenty, among whom are Senator Thomas Kearns, of Utah, mining millionaire and railway builder; Richard Kerens, of St. Louis, millionaire railway operator, and W. A. Elkins, of Philadelphia, the millionaire street railway promoter. Nevertheless, it is positively stated by Mr. Huntington that these prominent financial interests are named simply to hide the person of the real opponent, E. H. Harriman, of the Southern Pacific, who is said to deplore the extent to which the Huntington electric railway system has begun to cut into the steam passenger traffic of Southern California.

As to such an affiliation, however, Senator Clark will have nothing to say.

CHICAGO & MILWAUKEE ELECTRIC RAILWAY IMPROVEMENTS

The Chicago & Milwaukee Electric Railway Company is making a number of improvements and additions to its power house and sub-station equipment, and it is proposed to increase the service on the line, making a ten-minute headway, instead of twenty minutes as heretofore. The power-house equipment now includes two alternating-current generators of 250 kw and 550 kw and two direct-current machines of 225 kw and 300 kw. These machines are connected to 1000-hp and 600-hp tandem compound engines, the 300-kw direct-current and 550 alternating-current being driven by the 1000-hp machine, and the 250-kw alternating and 225-kw direct current by the 600-hp engine, by the Arnold system. Alternating current at 5500 volts is transmitted from the main power house at Highwood to two sub-stations at Winnetka and North Chicago, while the direct-current is utilized for the line between Winnetka and Evanston. It is the purpose of the company to adopt 11,000 volts in its transmission system ultimately, and the plans have been made with this in view. Additional equipment is being furnished the sub-stations. The two 125-kw three-phase rotary converters at Winnetka will be supplemented by a 500-kw six-phase rotary with the necessary changes in the switchboard. At present there is a 125-kw rotary converter at the North Chicago sub-station and a new 300-kw machine will be installed there, together with a 25-kw differential booster. It is also proposed to put on a number of extra cars and to change the equipment of the present cars from two to four 50-hp motors. The work is being done by the Arnold Electric Power Station Company, of Chicago.

TABLE OF OPERATING STATISTICS

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

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O.						
Northern Ohio Tr. Co.	1 m., Mar. '03	61,609	35,361	26,248	21,083	5,164
	1 " " '02	51,264	29,620	21,584	16 667	4,917
	3 " " '03	175,097	102,618	72,479	63,275	9,203
	3 " " '02	141,134	86,335	54,799	46,084	8,715
ALBANY, N. Y.						
United Traction Co.	1 m., Mar. '03	129,877	85,761	44,115	24,512	19,603
	1 " " '02	115,652	86,131	29,5 1	23,453	6,067
	3 " " '03	370,503	252.869	126,632	72,550	54,083
	3 " " '02	347,337	257,766	89,661	69,203	20,357
BINGHAMTON, N. Y.						
Binghamton St. Ry. Co.	1 m., Mar. '03	16,975	9,794	7,181	------	------
	1 " " '02	14,610	9,174	5,536	------	------
	9 " " '03	165,381	95,333	70,048	48,245	21,802
	9 " " '02	155,621	85,026	70,595	48,498	22,096
BUFFALO, N. Y.						
International Tr. Co.	1 m., Mar. '03	295,916	170,294	125,622	130 862	† 5,240
	1 " " '02	260,730	152,984	107,746	124,587	† 16,841
	3 " " '03	859,473	49 · 908	364,565	378,303	† 13,738
	3 " " '02	748,069	438,464	309,604	373,631	† 64,027
CHICAGO, ILL.						
Chicago & Milwaukee Elec. Ry. Co.	1 m., Mar. '03	13,355	6,317	7,038	------	------
	1 " " '02	11,215	6,185	5,030	------	------
	3 " " '03	36,035	18,705	17,330	------	------
	3 " " '02	31,692	17,705	13,987	------	------
Cleveland & Southwestern Traction	1 m., Mar. '03	31,547	18,624	12,922	------	------
	1 " " '02	22,071	12,654	9,416	------	------
	3 " " '03	83,730	55,698	28,032	------	------
	3 " " '02	57,084	37,831	19,253	------	------
Cleveland, Painesville & Eastern	1 m., Mar. '03	14,359	8,951	5,409	------	------
	1 " " '02	13,609	7,626	5,975	------	------
	3 " " '03	38,039	24,803	13,235	------	------
	3 " " '02	33,863	21,083	12,779	------	------
DETROIT, MICH.						
Detroit United Ry.	1 m., Mar. '03	330,667	195.325	135,342	82,533	52,809
	1 " " '02	305,421	174 673	130,748	76,627	54,121
	3 " " '03	936,010	568,369	367,641	243,253	124 388
	3 " " '02	856,010	498,354	357,656	227,103	130,553
DULUTH, MINN.						
Duluth-Superior Tr.	1 m., Feb. '03	39,747	26,924	12,824	10,161	2,662
	1 " " '02	33,419	20,780	12,639	9,563	3,077
	2 " " '03	83,435	55,837	27,598	20 340	7,257
	2 " " '02	70,121	43,939	26,182	19,228	6,954
ELGIN, ILL.						
Elgin, Aurora & Southern Tr.	1 m., Mar. '03	37 824	19,973	12,851	10,633	2,218
	1 " " '02	30,535	18,598	11,937	10,300	1,637
	3 " " '03	96 101	60,192	35,908	31,899	4,009
	3 " " '02	87,826	53,540	34,286	31,050	3,236
FINDLAY, O.						
Toledo, Bowl'g Green & Southern Traction Co.	1 m., Mar. '03	22,434	13,138	9,296	------	------
	1 " " '02	19 145	9,258	9,887	------	------
	3 " " '03	61,237	40,477	20,761	------	------
	3 " " '02	51,511	29,090	22,422	------	------
HAMILTON, O.						
The Cincinnati, Dayton & Toledo Trac. Co.	1 m., Mar. '03	37,851	23,243	14,608	15,967	† 1,359
	1 " " '02	33,540	18,285	15,255	16,635	† 1,380
	10 " " '03	404,052	224,585	179,467	161,640	17,827
ITHACA, N. Y.						
Ithaca St. Ry. Co.	3 m., Mar. '03	23,592	13 966	9,627	5,518	4,109
	3 " " '02	23,028	20,452	2,577	5,735	† 3,158

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
LONDON, ONT.						
London St. Ry Co.	1 m. Mar. '03	11,534	7,599	3 935	2,230	1,705
	1 " " '02	10,233	6,691	2,542	2,313	1,230
	10 " " '03	34,383	23 874	10,509	6,355	4,153
	10 " " '02	29,246	20,328	8,918	6,560	2,357
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co.	1m., Mar. '03	237,361	125,614	111,751	70,714	41,036
	1 " " '02	216,642	101 063	115,579	65,69	49,881
	3 " " '03	700,740	370,368	330,372	209,900	120,472
	3 " " '02	627,500	302,122	325,378	193,793	131.585
MINNEAPOLIS, MINN.						
Twin City R. T. Co.	1 m., Mar. '03	319,556	153,304	166,252	50,900	105,382
	1 " " '02	279 388	127,960	151,42	58,516	9 2,906
	3 " " '03	913, 9)	442,329	471 666	182,699	288 966
	3 " " '02	796 321	380,651	415,670	175,549	240,120
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., Mar. '03	171,902	118,677	53,225	18,43	34 793
	1 " " '02	156,856	103,846	53 09	16,176	36,854
	6 " " '03	1,017,491	652,056	365,43	100,13	265 297
	6 " " '02	924,720	595,607	329,113	90,387	238,726
OAKLAND, CAL.						
Oakland Transit Consolidation Co.	1 m., Feb. '03	76,412	44,097	32,31	------	------
	1 " " '02	63,374	44,072	19,302	------	------
OLEAN, N. Y.						
Olean St. Ry. Co.	1 m , Feb. '03	5,316	2,859	2,457	1.942	516
	1 " " '02	3,281	2,760	521	1,146	† 625
	8 " " '03	47,256	25,142	22,114	12,187	9,928
	8 " " '02	37,741	19,201	18,540	11,197	7,344
PEEKSKILL, N. Y.						
Peekskill Lighting & R. R. Co	3 m., Mar. '03	22,888	* 15,770	7,138	6 250	888
	9 " " '03	79,434	* 49,567	29,867	18,750	11,117
PHILADELPHIA, PA.						
American Railways.	1 m., Mar. '03	92,838	------	------	------	------
	2 " " '02	83,502	------	------	------	------
	9 " " '03	964,456	------	------	------	------
	9 " " '02	731,044	------	------	------	------
PUEBLO, COL.						
Pueblo & Suburban Traction & Lt. Co.	1 m., Feb. '03	31,988	31,932	3,057	------	------
	2 " " '03	73,509	63,242	10,268	------	------
ROCHESTER, N. Y.						
Rochester Ry.	1 m., Mar. '03	100,457	53,520	46,936	25,451	21,486
	1 " " '02	92,114	47,823	44,292	24,854	19,437
SYRACUSE, N. Y.						
Syracuse R. T. Co.	1 m., Mar. '03	63,352	36,098	27,254	19,025	8,229
	1 " " '02	60,253	33,607	26,646	19,025	7,621
	9 " " '03	558,437	309,976	248,461	171,225	77,236
	9 " " '02	518,644	285,559	233,085	171,171	61,914
TOLEDO, O.						
Toledo Rys. & Lt. Co.	1 m., Mar. '03	127,012	65,452	61,560	40,715	20,845
	1 " " '02	111,174	53,151	58,023	37,833	20,190
	3 " " '03	367 654	188,964	178,690	119,738	58,952
	3 " " '02	325,238	163,442	161,796	113,494	48,302
YOUNGSTOWN, O.						
Youngstown - Sharon Ry. & Lt. Co.	3 m., Mar. '03	120,164	* 77 423	42,740	------	------
	12 " " '02	444,986	*244,972	200,014	------	------

NEWS OF THE WEEK

CONSTRUCTION NOTES

SANTA CRUZ, CAL.—The City Council has granted Fred W. Swanton a franchise to operate an electric railway on Pacific Avenue from Lincoln Street to the lower plaza, where it will connect with the electric road that is being constructed to Capitola.

VISALIA, CAL.—The supervisors have adopted the ordinance granting John Hays Hammond and Harold Wheeler a franchise for an electric railway.

HANFORD, CAL.—Louis M. Cole has received a franchise for the electric railway in Kings County. The franchise provides that construction work must commence within six months, and that the road must be completed within two years.

BERKELEY, CAL.—The Pacific Improvement Company is formulating plans for the construction of an electric railway along the sides of the Berkeley Hills.

PALO ALTO, CAL.—John F. Parkinson has petitioned the City Council for a franchise to construct an electric railway in this city.

STOCKTON, CAL.—H. H. Griffiths has applied for franchises for an electric railway along the Cherokee lane and the Sacramento road.

NORWICH, CONN.—A resolution incorporating the Norwich, Mystic & Westerly Street Railway Company has passed the General Assembly. The company is authorized to construct an electric railway in Norwich, Preston, Ledyard, Stonington and North Stonington, and provision is made for an extension into Rhode Island. The capital stock of the company is $700,000.

WASHINGTON, D. C.—The East Washington Heights Traction Company has been granted a franchise for its proposed electric railway on Pennsylvania Avenue southeast, from the terminus of the Capital Traction Company's line.

WASHINGTON, D. C.—A certificate of the incorporation of the United States Lighting & Traction Company of the District of Columbia has been filed in the office of the Recorder of Deeds. The capital stock is $2,000,000 and the incorporators are: Edward White, W. A. White, W. I. Francis, of Washington, D. C.; Herbert L. Stillman, of West Acton, Mass.; Thomas W. Bickwell, of Providence, R. I.. The officers are: Mr. Bickwell, president; Mr. Stillman, treasurer; Mr. Francis, secretary.

WASHINGTON, D. C.—John R. McLean and his associates have at last closed the deal for the purchase of the Great Falls & Old Dominion Electric Railroad. The announcement is made on authority that the company will build a line from the Virginia end of the Aqueduct Bridge to Great Falls as soon as the bridge has been repaired by the District government and its superstructure altered to allow laying of tracks for the railway. The following board of directors has been chosen to represent the new interests in control: John R. McLean, R. D. Weaver, R. H. Goldsborough, George G. Boteler, Nathan B. Scott, Colin H. Livington and William F. Hart.

MONMOUTH, ILL.—Articles of incorporation have been filed by the Illinois Union Railway Traction Company, with capital stock $500,000. The company proposes to construct a system of interurban electric roads north from Monmouth to Aledo, Rock Island and Muscatine, and from Monmouth south to Roseville, Macomb, Hamilton and Keokuk. The incorporators and first board of directors are: P. E. Elting, of Macomb, Ill.; W. H. Beaver, of Abingdon, Ill.; John W. Andrews, of New York, and W. W. McCullough, W. B. Young and S. S. Hallam, of Monmouth.

INDIANAPOLIS, IND.—The Indianapolis & Martinsville Rapid Transit Company's line has been placed in operation. The road is built entirely over a private right of way, which is enclosed with a woven wire fence. The ties are standard and the rails are seventy pounds to the yard. The large power house is located on a bluff on the edge of Mooresville, where convenient access is had to the water of White Lick Creek. There are ten cars at present on the line, besides a number of freight and ballast cars. The directors of the company are: Charles Finley Smith, John H. Holliday, Americus C. Dailey, Harry S. New, Gavin L. Payne, H. M. Foltz and E. M. Smith.

KOKOMO, IND.—The Kokomo Street Railway & Electric Light plant has become the property of the Kokomo, Marion & Western Traction Company. The contract has been let for the construction of the road from this city to Marion. A certificate has been filed with the Secretary of State, increasing the capital stock of the traction company from $100,000 to $1,000,000. The officers of the traction company are as follows: George J. Marott, president; L. J. Kirkpatrick, vice-president; T. C. McReynolds, secretary; G. E. Brunner, treasurer; L. J. Kirkpatrick, general attorney; George J. Marott, M. W. Choate, L. J. Kirkpatrick, T. C. McReynolds, G. E. Brunner, Lee Hall, of Marion, and R. F. Cummins, of Bluffton, directors.

WICHITA, KAN.—The findings of the experts employed to report on the feasibility of building an electric railway from Wichita to Arkansas City have been reported to the Wichita Interurban Railroad, which has the road in contemplation. It has been decided formally to charter a company to build the road, and to go ahead with the details. A. H. Barnes, of Oxford, and A. L. Barner and S. C. Barnett, of Belle Plaine, have been added to the board of directors of the company.

WESTFIELD, MASS.—The Woronoco Street Railway Company is planning to increase the equipment of its power house in Westfield to provide power for the operation of its line now being built to Holyoke. The company will also add to its rolling stock. Owing to a low bridge they must pass under, cars of a special design will be required.

NORTH ADAMS, MASS.—The Hoosac Valley Street Railway Company has been given a franchise to build an extension on the east side of the Hoosac River from Adams to North Adams.

PITTSFIELD, MASS.—The Berkshire Street Railway Company will add a large tract of land to its amusement park at Berkshire, which is now being laid out by a landscape gardner, Thomas McClune, of Hartford, Conn. There is a small mountain included in the property and Rocky Mountain burros are to be provided for carrying passengers to an observatory at the top.

NORTH ADAMS, MASS.—The Hoosac Valley Street Railway Company will begin at once the extension of its line from Briggsville to Clarksburg.

WESTON, MASS.—The Railroad Commissioners have issued an order approving "as consistent with public interests" the locations within the town granted Dec. 13 and April 11 by the Selectmen of Weston to the Newton Street Railway Company. In this case three roads were endeavoring to get practically the same location. The matter came before the board originally on the petition of the Concord, Maynard & Hudson Company, which wanted an extension of franchise into the town. The Waltham Street Railway Company opposed this on the ground that it was about to ask the same privilege, and believed that it could give better service, and the Newton Company was also opposed, as the Selectmen had already granted it a location. The Selectmen told the board that it considered the Newton Company's plans better for the town and the board now has approved their decision.

FALL RIVER, MASS.—The Secretaries of the States of Massachusetts and Rhode Island have forwarded to Abraham Manchester, of Adamsville, R. I., notice that a charter is issued for the proposed electric railway which will be built to connect with the Old Colony system at the Stafford Road terminus, Fall River, and run to Adamsville, Westport Point, across the bridge to Horseneck, thence to Russell's Mills, taking in various shore resorts, a distance of 22 miles, and connecting with the Union Street Railway in New Bedford at Bliss Corners. A survey will begin at once. A meeting for organization is to be held the latter part of this month. Among the more prominent promoters of the road are Abraham Manchester, of Adamsville; J. C. McKenzie, of Fall River; Pardon Cornell, of Little Compton, and Gifford Cornell, of Westport.

MELROSE, MASS.—The Melrose Aldermen have finally agreed on terms for granting a franchise to the Boston & Northern Street Railway Company for laying double tracks from the Wakefield town line to Porter Street, in Melrose.

TOPSFIELD, MASS.—The notices of the incorporation of the Haverhill, Danvers & Ipswich Street Railway Company are being advertised. The company is to build an electric railway from Boxford through Groveland, Georgetown, Rowley, Ipswich and Topsfield, a terminus, and to connect with the Essex County Street Railway at Bixby's corner, in the westerly part of the town of Ipswich in the county of Essex, thence in an easterly direction to the Boston & Maine Railroad crossing near the railroad station in Ipswich, a terminus. Its length will be 20 miles. Joseph N. Green, of Boston; Charles M. Perley, of Ipswich; Alphonso T. Merrill, of Topsfield, are interested.

WHITINSVILLE, MASS.—A petition is now before the Selectmen of Northbridge to grant permission to the Worcester & Blackstone Valley Street Railroad Company to extend its tracks in the village of Whitinsville. The company wishes to extend its present tracks to Douglass and Manchaug, 7 miles beyond the present terminus in Whitinsville. This will give these two towns direct connection with Worcester. The cars of the Worcester & Blackstone Valley Street Railroad Company will pass over the tracks of the Linwood Street Railroad Company for a distance of 1500 ft.

CUMBERLAND, MD.—The County Commissioners have granted a franchise to the Luke, Westernport & Keyser Railway Company, recently incorporated, to use the county roads from Luke to McCoole, Md. The construction of the line provides for a bridge across the Potomac River, one-half of the cost of which is to be borne by the railway company and the other half by the county. Work must begin within fifteen months.

EASTON, MD.—The Eastern Shore Improvement Company is said to be considering the advisability of building an electric railway to connect Cambridge Ferry, Easton, and Love Point.

MUSKEGON, MICH.—The work of surveying the right of way for the new interurban from Grand Rapids to Hart has begun. F. A. Nims is the local promoter.

SAULT STE MARIE, MICH.—The Street Railway Company is making surveys for an extension to Algonquin.

HIBBING, MINN.—The Mesaba Electric Railway Company seeks a franchise through this city.

ST. LOUIS, MO.—The St. Louis & Suburban Railway Company has succeeded in replacing the equipment destroyed in the recent fire, and has begun running a line of the new cars from Sixth and Locust Streets to Forest Park, the end of the line being at the Union Avenue entrance to the park. This line will enable persons who desire to visit the World's Fair Grounds to ride within a short distance of the main entrance. The company has also put some new cars on Union Avenue, between Bridge Road and Forest Park. The equipment on the main line is complete. The service over the Sarah Street line to Benton, Webster, Kirkwood and Meramec highlands has been fully restored, so far as the number of the cars is concerned, and, within a short period, the new cars will also be put upon that line. The service of the O'Fallon Park line is also fully restored, and the cars from O'Fallon Park around the downtown loop are now running more frequently than ever. The tracks of the Suburban have been overhauled, many of them being entirely new. The roadbed has also been put in splendid condition.

ALAMAGORDO, N. M.—Alamagordo Street Railway Company has been organized with $50,000 capital stock, to build and operate a street railway and electric light system. Arthur P. Jordan, William Hodge and Thaddeus H. Llayford, of Alamagordo, are interested.

GREAT FALLS, MONT.—John D. Ryan and his associates have been granted a twenty-five-year franchise for the construction of an electric railway here.