Street Railway Journal

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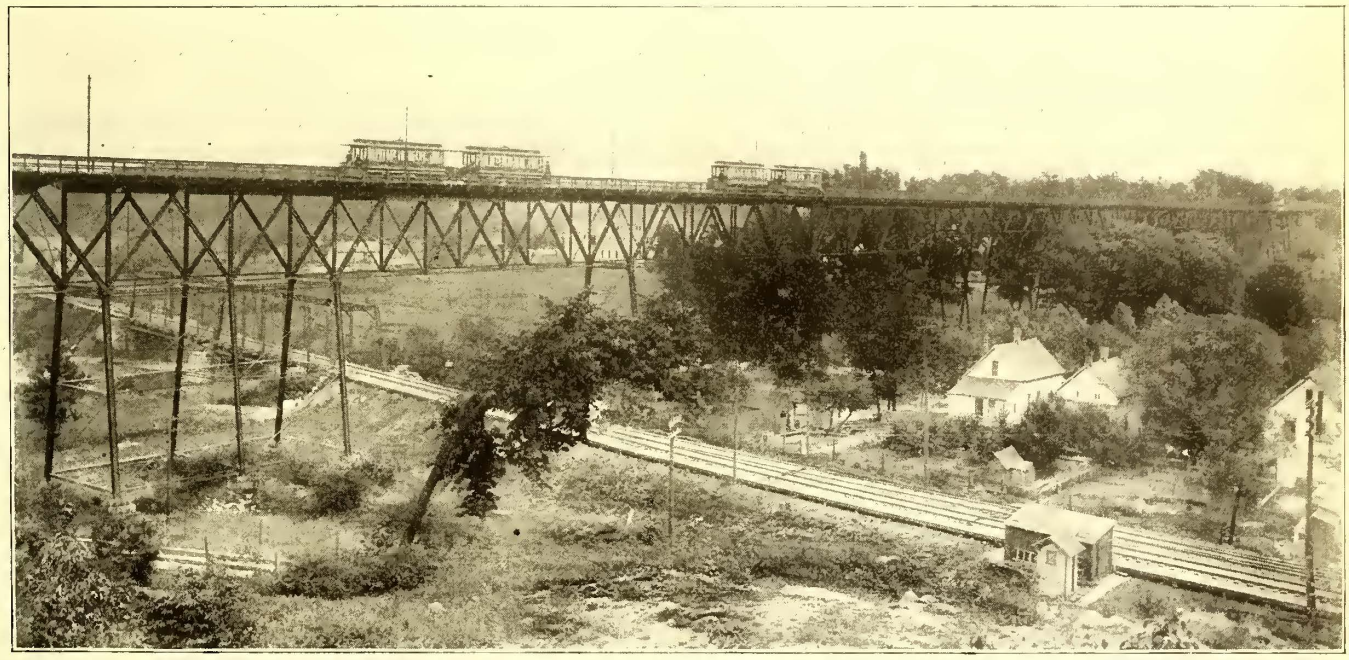
THE ELECTRIC RAILWAY SYSTEM OF MILWAUKEE AND EASTERN WISCONSIN

U. JUN 3 1899 S. PATENT OFFICE.

In the State of Wisconsin and counties of Milwaukee, Waukesha, Racine and Kenosha lies an electric railway system remarkable in many respects, and the recent development of which is little known to the "outside world." Its nucleus is the city railway system of Milwaukee, which is a consolidation, effected in 1891-2, of several smaller lines until then in independent operation. Additions have been made by the purchase of existing lines and the building of new ones, until now the system reaches out 7 miles to Whitefish Bay on the north; 25 miles to Waukesha Beach on the west, and nearly 35 miles to Kenosha on the south. A dozen cities and villages, with an aggregate population exceeding 350,000, are served by the 225 miles of track which at present comprise this system—a trackage which places this among the half-dozen great properties of the country.



VIADUCT AT WAUWATOSA—MILWAUKEE STREET RAILWAY SYSTEM

This is not all. The plans of the present management are broad and comprehensive, and include the immediate construction of a line extending from the southern terminus of the present system through to Chicago, connecting there with the Chicago city system; while on the west and north it is intended to push the lines rapidly onward through the beautiful lake district, in which are thousands of summer homes of Chicago, St. Louis and Milwaukee business men.

For financial and business reasons this entire system centering in Milwaukee is operated by two separate companies, the Milwaukee Electric Railway & Light Company, which owns the city lines and does the city and commercial electric lighting, and the Milwaukee Light, Heat & Traction Company, which owns all the interurban lines, and also has electric lighting departments in several of the cities reached by its railway lines. The entire capital stock of the Milwaukee Light, Heat & Traction Company is in the treasury of the Milwaukee Electric Railway & Light Company, and a controlling interest in the stock of the latter is owned by the North American Company, of New York, which also owns a controlling interest in the Cincinnati Edison Electric Company. In practice the two Milwaukee companies are operated as one, although their accounts are kept entirely separate.

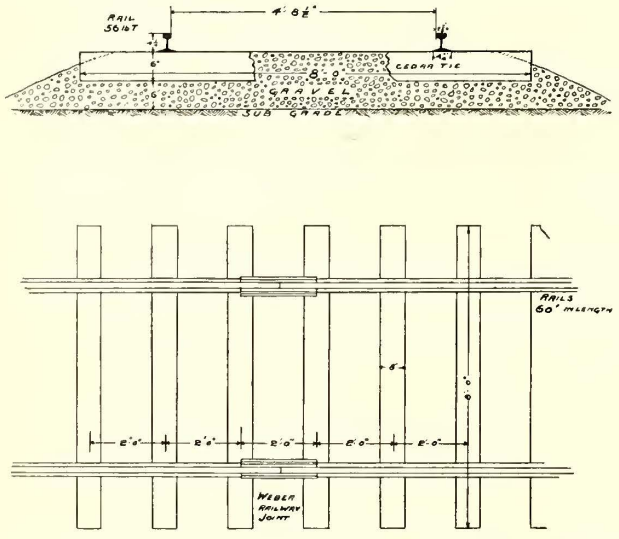
RAILWAY FARES AND LIGHTING CHARGES

Within the city limits of Milwaukee a uniform 5-cent fare is charged, and transfers are given freely for a continuous trip. Outside the limits the rates vary from 10 to 60 cents single fare, and 50 per cent is added for the round trip. The fare from Milwaukee to Racine, for example, is 40 cents single trip, 60 cents round trip; from Milwaukee to Kenosha it is 60 cents single trip and 90 cents round trip; from Milwaukee to Waukesha Beach it is 50 cents single trip, 75 cents round trip; and from Milwaukee to Whitefish Bay it is 10 cents single trip, 15 cents round trip. The rate for a private car from Milwaukee to Waukesha Beach is $25 round trip, each car seating fifty passengers,

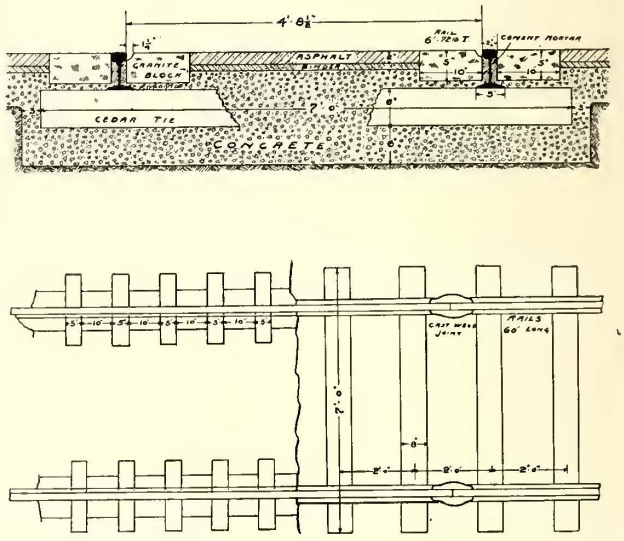
and the city rates for private cars vary from $5 for the short single-truck car to $15 for the magnificent illuminated car "Marguerite," the rates being based on a three-hour run, with an extra charge for each additional hour.

The charges for lighting are as follows:

For direct current low tension power for lighting circuits, 20 cents per 1000 watt hours, subject to 25 per cent discount for incandescent lamp use up to 125,000 watt hours per month, and 50 per cent discount above that figure. Current for electric motors is charged for at the rate of 10 cents per thousand watt hours, subject to discounts ranging from 5 per cent for use of 100,000 to 200,000 watt hours per month to 50 per cent for use of 1,000,000 watt hours per month. Minimum charges are, of course, provided for by special schedule.



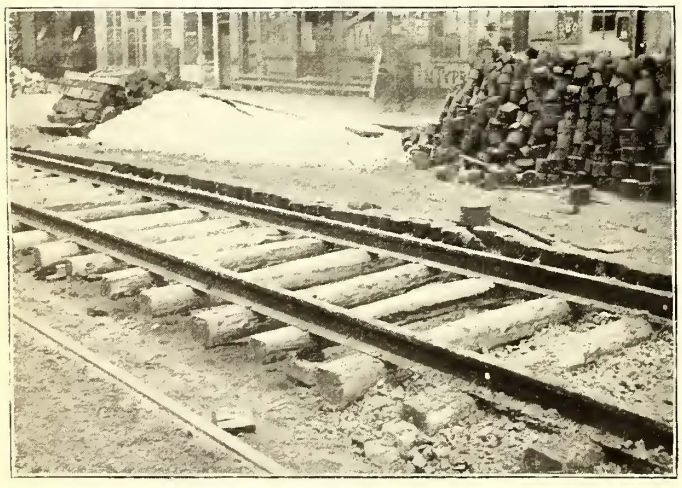
STANDARD TRACK CONSTRUCTION FOR INTERURBAN LINES



STANDARD TRACK CONSTRUCTION AS APPLIED TO ASPHALT PAVING

ROADBED

The traffic earning power of a combined urban and interurban system of this kind is largely dependent on speed of transit in competition with other transportation agencies, and high car speeds are possible only when track and roadbed are in first-class condition, and the lines are reasonably straight. These facts have been fully appreciated by the present management, and the work of straightening the interurban lines and improving the roadbed has been steadily going on for the past two years, and large sums of money have been expended in securing private rights of way to cut off curves, reduce distances between population centers and decrease running time. Other large sums have been spent in grading and leveling roadbed and improving alignment and surface of track, to the end of approaching more nearly to steam railroad standards. Within the city limits a large amount of old chair rail construction has been replaced by heavy T rail sections, laid directly on ties, and in several of the best paved streets, such as Grand Avenue, a concrete foundation is being put under the ties, the whole forming a solid, massive construction, difficult to improve upon.



T RAIL TRACK CONSTRUCTION ON GRAND AVENUE

The standard city roadbed construction is shown on this page, and an illustration is also given of the new work now going on in Grand Avenue. The company is fortunate in being able to use T rail in both city and interurban work, the Milwaukee pavements being such that this can be done without difficulty. The standard rail for city work is a 6-in. 72-lb. Shanghai section, rolled in 60-ft. lengths. Recent purchases have been made of the Johnson Company and the Pennsylvania Steel Company. It is laid on oak ties 6 ins. x 8 ins. x 7 ft., set 2 ft. apart on centers. In pavements which have a concrete foundation the ties are placed on a 6-in. bed of concrete, and on other streets broken stone ballast is used.

About two years ago the first experiments in cast welding joints were made by the Falk Company, and on track which was then so poor that without these improvements its immediate replacement would have been necessary. Today this track is even better than when the joints were put in, in many places having been worn to better surface, and it is believed that the rail was given five or six years' additional life by use of the cast welded joints. By the end of this year all the joints within the city limits, over 40,000 in number, will be cast welded. The original work was done by the Falk Company, whose methods and processes are well known and have proven satisfactory in Milwaukee. Later contracts, however, have been awarded to the Milwaukee Rail Joint & Welding Company, which will, by the end of this year, have installed over 25,000 joints. Their process is somewhat different from that of the Falk Company. A casing or jacket, formed of two L-shaped pieces of rolled steel, is placed under and at the side of the joint and is temporarily fastened to the rail by clamps. The metal is then poured round the joint inside this jacket, after which the clamps are taken off and the jacket remains in position, giving additional strength to the cast iron which it incloses. This company has also successfully placed its joints on exposed rails in the interurban track between Milwaukee and South Milwaukee,

although the full results of this work have not as yet been demonstrated by long time tests. Slip joints are provided, as shown herewith, every 500 ft., and the contraction and expansion of the track has been found to amount to about 1¼ ins. per 100 ft. of track, so that at the slip joints the rails are sometimes 6 ins. apart.

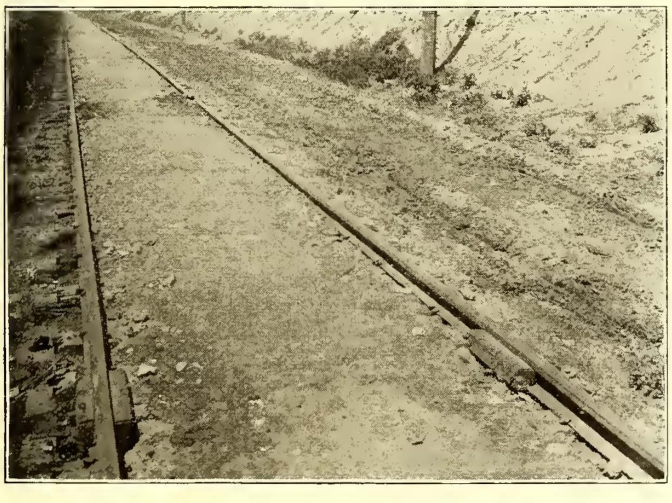
The standard suburban roadbed construction consists of a 56-lb. T rail 4¼ ins. high, rolled in 60-ft. lengths, laid

CURVE CONSTRUCTION WITH FIG. 8 TROLLEY WIRE

on broken stone or gravel ballast with Weber joints. The Weber joints have, so far, given entire satisfaction, and after a year of service the rail ends are firm in position, without the slightest depression.

The company makes its own special work, and its shops have turned out a number of extremely complicated pieces. The frogs and crossings are re-enforced by strips of hardened steel let into recesses and pinned in position. These can be easily replaced when worn out.

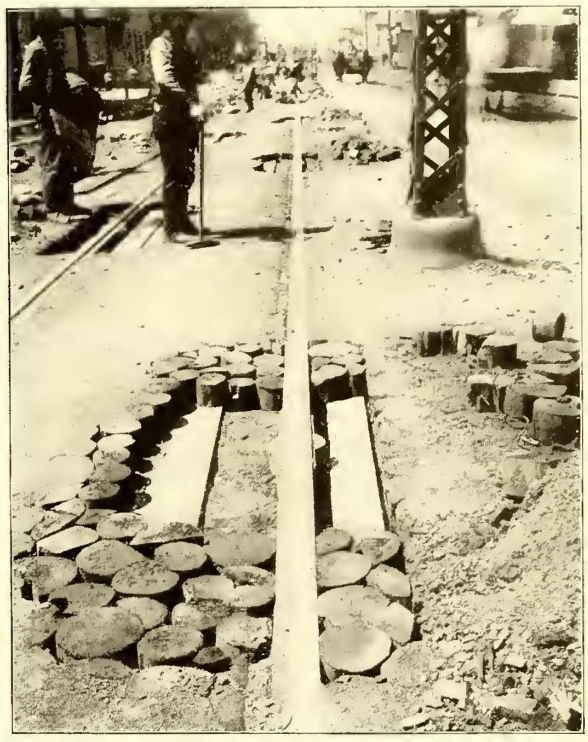
On the line to Wauwatosa, recently purchased from a company which formerly operated a dummy line upon it, is a fine and costly viaduct, crossing the valley of the Me-



CAST WELD STEEL JOINT IN EXPOSED TRACK

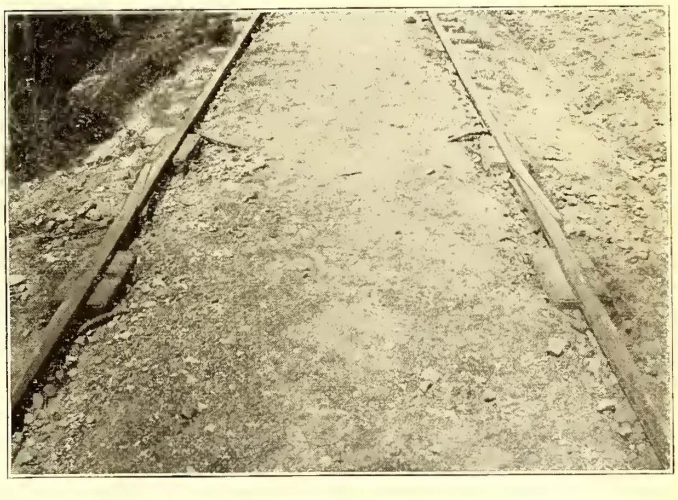
nominee River and the tracks of the Chicago, Milwaukee & St. Paul Railroad. Another viaduct, 1075 ft. in length, having between its termini a transition curve of approximately 125 ft. radius, is now being constructed between the grounds of the Calvary Cemetery and those of the Soldiers' Home, near the Menominee River viaduct. At about the center of the new viaduct will be an elevated station to be used by visitors to both the cemetery and the Soldiers' Home, and upon its completion it will be part of a new through line to Waukesha Beach, on which the time of transit from the center of the city will be considerably less than at present. By improvements of this kind the system is being greatly strengthened and the future traffic earning capacity increased.

The greatest attention is given to the maintenance of roadbed. Handcar inspection of all the high speed lines is made every morning, and necessary realignment, surfacing and improvement of joints and special work are at-



STEEL JACKETED, CAST WELD RAIL JOINTS IN CITY TRACK

tended to without the slightest delay. The city track is constantly under inspection by men employed for that purpose, who have, however, other work to do, such as



SPLIT JOINT IN EXPOSED TRACK

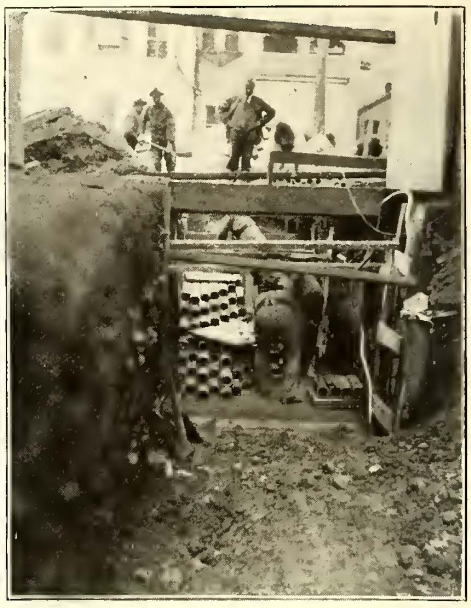
greasing curves, sanding the track, etc., and at least once a week the superintendent goes over all the interurban and most of the city lines in his "office car." The importance of this constant and rigid inspection may be judged from the fact that speeds of 45 miles per hour or more on certain portions of the interurban lines are of daily occurrence.

OVERHEAD AND UNDERGROUND CONSTRUCTION

During the last two years almost the entire mileage of overhead line work has been rebuilt with new and strong

material throughout. The 000 "Fig. 8 trolley wire" is the company's standard, and is giving absolute satisfaction in all respects, the report of its value being, indeed, quite enthusiastic. The chief disadvantages which have in other places been urged against this type of trolley wire, namely, the difficulty of supporting it satisfactorily, and of running

STANDARD CITY CARS

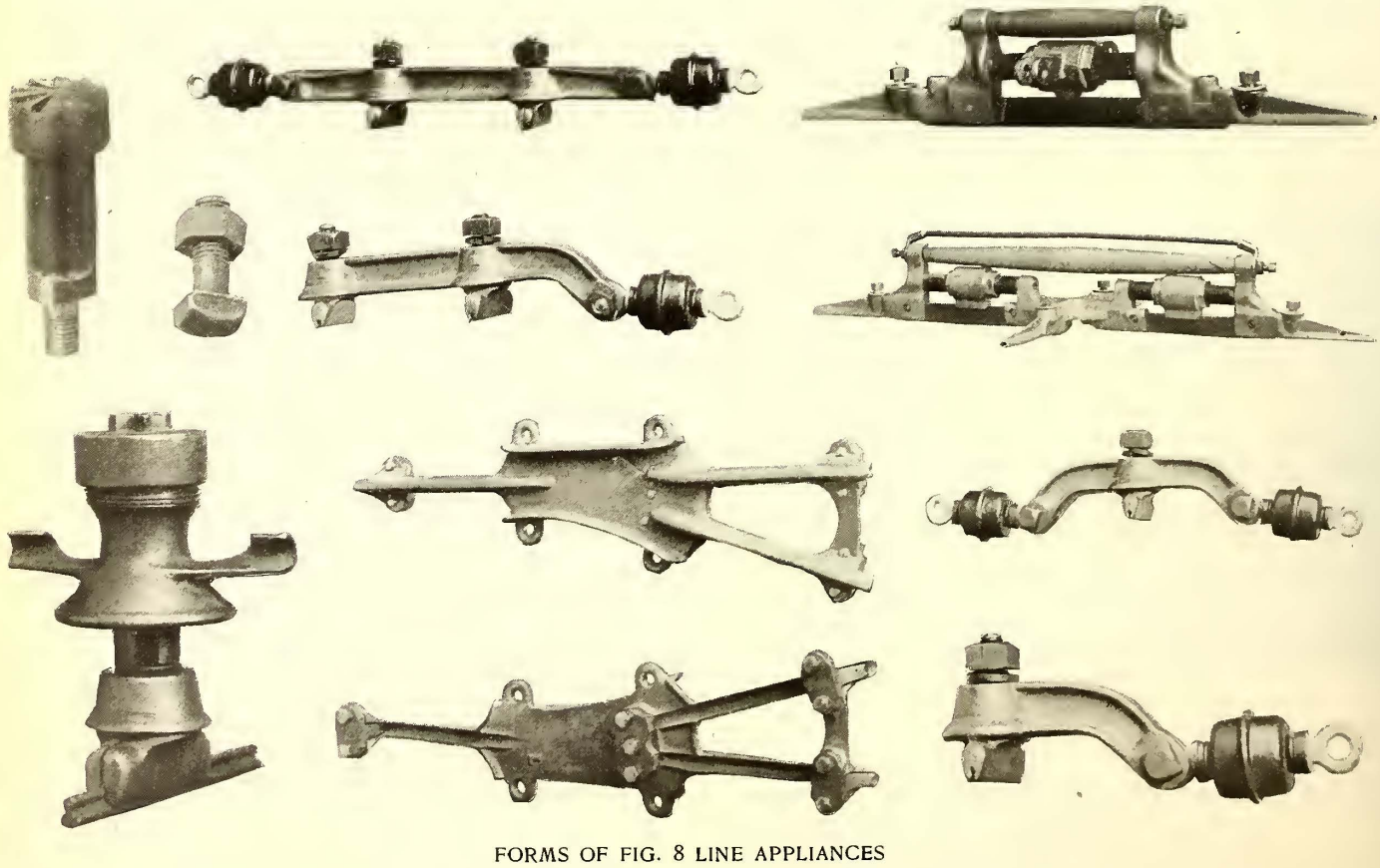


100 DUCT CONDUIT NEAR STATION

good curves, and the large section required, are not regarded as important by the Milwaukee management.

A special clip, devised by the company's engineers in conjunction with those of the Electrical Railway Equipment Company of Cincinnati, is used for supporting this Fig. 8 wire. It seems to have entirely overcome all obstacles to the use of this wire, and some of the finest curves and straight line work to be seen in any city (see page 341) are to be found in Milwaukee. A large section of trolley wire means, of course, the cheapest possible reinforcement of the feeder system, as there is no charge for insulation. The great advantage of the Fig. 8 wire is, of course, the doing away with sparking at the clips, by reason of the fact that a perfectly clear path for the trolley is obtained.

In other respects the company has taken great pains in developing a complete line of overhead appliances. These are manufactured by the Electric Railway Equipment Company. Anderson & Johns' insulation is the foundation for this material, and bronze is the metal employed. Illustrations of some of the special appliances used are shown herewith. They are solidly and well constructed, and so carefully have all details been designed that trouble from broken trolley wire is now very rarely experienced.



FORMS OF FIG. 8 LINE APPLIANCES

A large number of center poles are used, but are not liked by either the company or the public, and the span wire construction is preferred in all cases. Iron poles are used generally within the city limits, and wooden poles outside. Many of the iron poles are "lattice" construction, but the heavy tubular pole is preferred as being stronger, more durable and less costly to keep in good condition.

The overhead construction is carefully and regularly inspected for wear, broken span wires and defective insulation. For this purpose the repair and inspection car and the patrol wagon are used, shown on page 350, and are fitted up with all tools required for quick repairs.

STATION AT WEST PARK

The underground feeder system is installed in the business district of Milwaukee. Camp vitrified brick conduits are used, and recent purchases of feed wire have been made from the Standard Underground Cable Company.

OFFICE BUILDING OVER LIGHTING STATION

STORES, YARDS, AND CONSTRUCTION FACILITIES

The company's plans for new construction have been, and are, so extensive that the construction work has been organized most carefully, and purchases of material and supplies made and arranged for on a large scale. The company owns a 10-acre gravel pit near Waukesha, from which all its grading material is obtained, and contracts have recently been closed with a large blast furnace near its yards by which the slag and other furnace refuse can be obtained in any desired quantity for surfacing of track. Ties, paving stone and other material are always on hand in quantity, and the company was fortunate in purchasing a large tonnage of rails and track material before the recent advance in prices.

For the purpose of storing this construction material and facilitating its receipt by rail and water, the purchase of a 5-acre swamp abutting the tracks of the St. Paul and the Chicago & North Western railroads on one side and the Kinnickinnic River on the other was made some time ago, and has since been piled and filled in so as to form an extensive and very valuable piece of real estate. Arrangements have just been made by which the company's street railway tracks in the vicinity are connected with a loop line in this yard, and a branch from the St. Paul and North Western tracks also enters the yard.

Construction work is facilitated by a large equipment of work cars, which the company is permitted to use on the city tracks, as well as the interurban, and which, of course, greatly reduces the cost of transportation of material.

The company's storerooms at the Kinnickinnic car house, near its yards, are among the most extensive to be found in any street railway system of the country. The inventories show that there are now on hand about $125,000 worth of "live" material and supplies, most of it purchased before the recent large advance in prices. The stores are most neatly and systematically arranged.

WORK TRAIN ON GRAND AVENUE

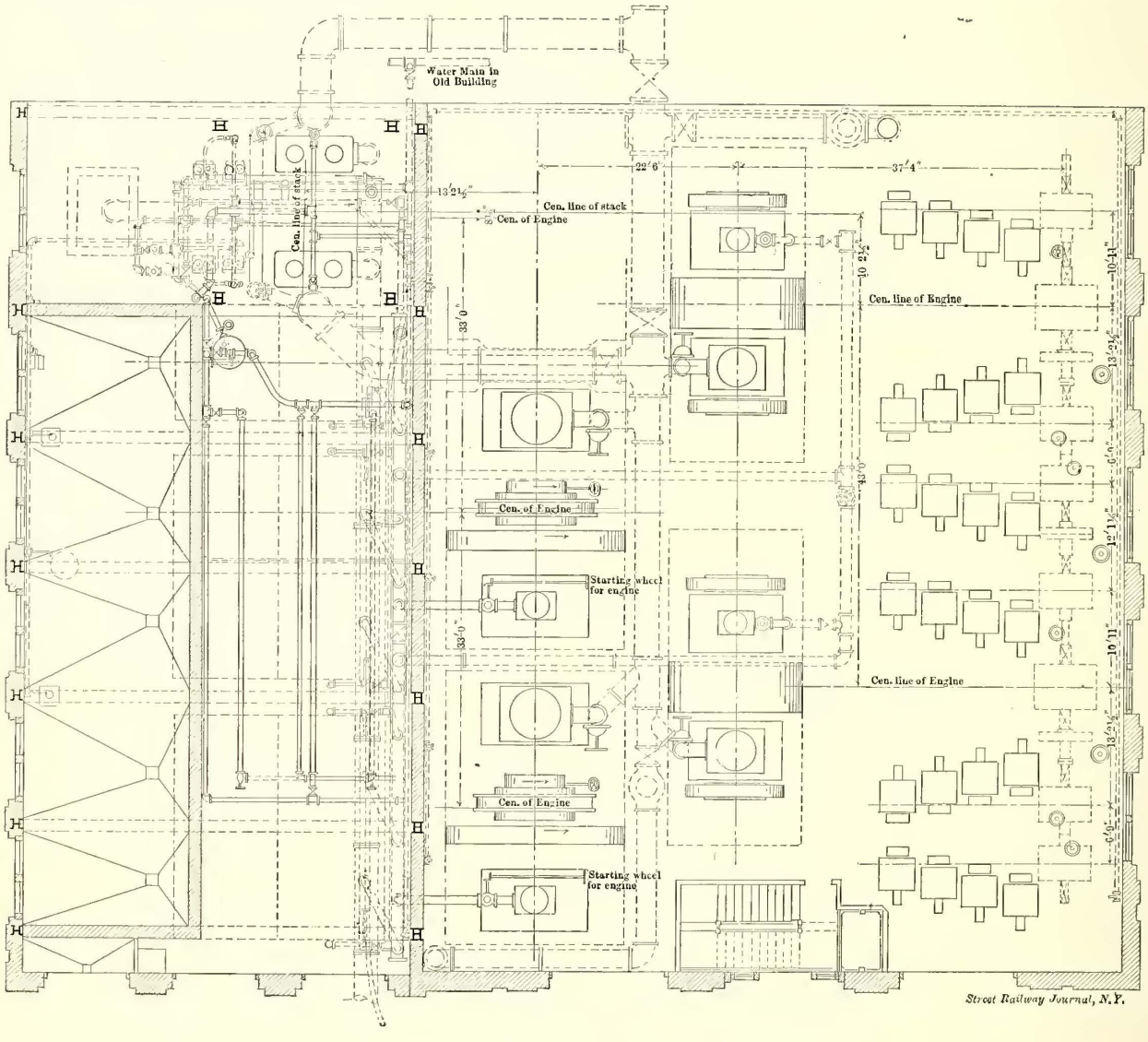
POWER STATIONS

The railway and lighting system is now being operated from seven power stations, large and small, two of which are merely held in reserve to provide for breakdowns elsewhere. It is probable that several of these stations will disappear as soon as the large new station now building is completed. Three-phase transmission will come into extensive use a little later. The main station, both old and new, is located on River Street, on the banks of the Milwaukee River, in the very heart of the city. Three stations, bought from other companies which are now consolidated with the present one, are found within the Milwaukee city limits. The fifth station is at Racine, the sixth at Waukesha, and the seventh at Wauwatosa. The relative capacities of these stations are as follows:

	Railway.	Lighting.
River Street station	2250 kw.	1120 kw.
Racine station	875	167
Waukesha station	600	...
Eleventh and Wells Street station (reserve)	400	...
Wauwatosa station (reserve)	130	150
Badger station	... Approx.	1000
Broadway station	...	1115
Total capacity	4255 kw.	3552 kw.

The River Street station was built in 1891, and was one of the first large railway power stations in Ameriea. Its equipment is now out of date, though it is giving fair satisfaction, and the company is building a large new power station in the plot adjoining the present one, the intention being that after completion of the new station the old will be demolished and its place taken by an extension of the new.

The present equipment in the old station consists of eighteen Galloway boilers, with coal and ash conveyors, made by Link Belt Engineering Company, and eight triple expansion marine type engines, of which five are each direct connected to two 200-kw. Edison multipolar railway generators, and three are connected each to two



PLAN OF NEW POWER STATION, SHOWING PIPING

100-kw. multipolar Edison three-wire lighting generators. These engines were designed by the Edison General Electric Company, and several of them were manufactured by Filer & Stowell Company, of Milwaukee. There is also in the station one Allis vertical compound engine, direct connected to two 200-kw. Edison lighting generators; one McIntosh & Seymour engine, belted to two 60-kw. Edison bipolar lighting generators; one triple expansion engine, direct connected to two 50-kw. Edison generators, which were formerly lighting machines, but have now been rewound for railway booster service; and one McIntosh & Seymour horizontal tandem compound engine, belted to one 150-kw. Edison bipolar railway generator. The Edison multipolar generators are all of the end-bearing commutator type, with side-bearing brushes, and the armatures serve as flywheels. They were originally somewhat too light in construction to stand the strains of railway service; but have been so altered as to be fairly satisfactory and efficient machines, and no serious electrical troubles have ever been developed in them. The present station cannot be called economical, however, as the cost of power production slightly exceeds one cent per kw. hour, of which about $.0066 is for fuel, and it is expected that the new River Street station will reduce this cost of production fully one-half.

The new station, of which plan and elevation is given herewith, will contain five Edgemoor water-tube boilers, with Green traveling chain grates; McCaslin coal conveying machinery; one Green economizer; two 1400-h.p. and two 1100-h.p. Allis engines; four 1050 and four 400-kw. General Electric generators; twenty 100-light Brush arc machines, and the usual steam and electric auxiliary apparatus.

The furnaces will be fed from large hoppers, located near the top of the boilers, and which are filled in turn from bunkers of from 1500 to 2000 tons capacity, supported on strong iron pillars above the boilers. The conveying apparatus will be used in combination with steam shovels for filling these bunkers from boats or cars, and will also handle the ashes. The conveyors are of the McCaslin overlapping gravity bucket conveyor type, and are manufactured by John A. Mead & Co., of New York. They handle both coal and ashes, and the buckets overlap, so that no filler is required except an ordinary chute.

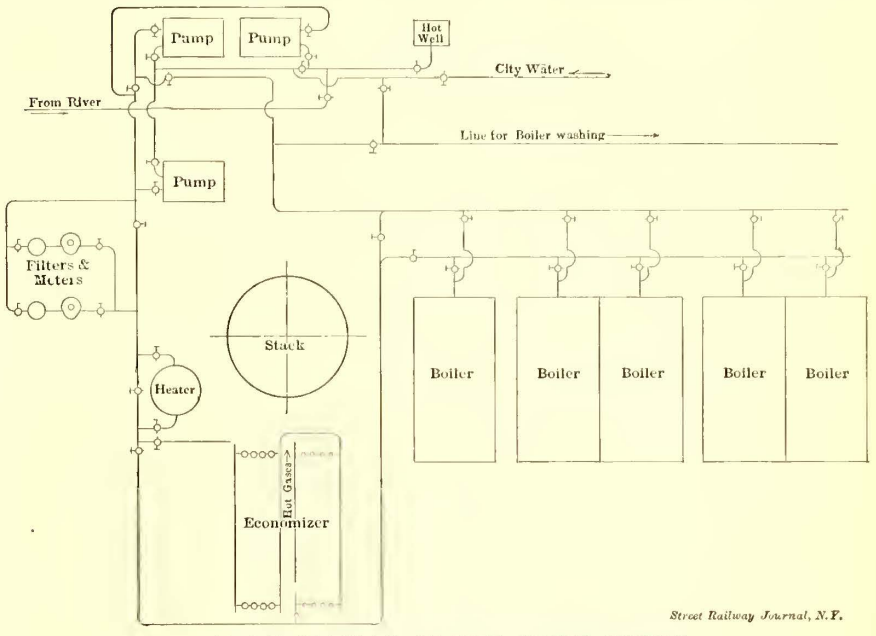
Both buckets and links are of malleable iron. The coal will pass from the bunkers, through the hoppers, direct to the traveling chain grates. These are made by the Green Engineering Company, of Chicago, and it is guaranteed that the grates will burn from 18 lbs. to 36 lbs. of coal per sq. ft., and will prevent the formation of smoke.

The boilers, made by the Edgemoor Iron Works, of Edgemoor, Del., have each 233 18-ft. lap-welded tubes, 4 ins. in diameter, and three 34½-in. drums. They are to carry 160 lbs. steam pressure, and are guaranteed to evaporate 10½ lbs. of water from and at 212 degs. with less than 2 per cent moisture under ordinary conditions of running, when coal having not less than 13,000 B. T. U. is used, with ¾-in. (water column) draft, and when boiler is operated at not less than 750 h.p. Centennial standard. The guarantee also covers 11 lbs. under proper test conditions. The total capacity of the five boilers working together is guaranteed to be not less than 4100 h.p., Centennial standard. The Green Engineering Company, of Chicago, will install the boilers.

The Green economizer is composed of 768 tubes, in 128 sections, ranged in four groups of 32 sections each. Each section contains six tubes, 9 ft. long and 4 9-16 ins. in external diameter. These tubes are connected top and bottom to headers. The scrapers are to be operated by a 220-volt 4-h.p. electric motor. It is guaranteed that the average fuel burned shall be 12 per cent less when the feed water from the hot well is put through the economizer than when the economizer is not used, it being understood that the boilers are running at full-rated capacity.

The stack is of steel, brick lined, and will be about 200 ft. high and 16 ft. internal diameter in the clear. Its capacity is about 22,000 to 25,000 h.p.

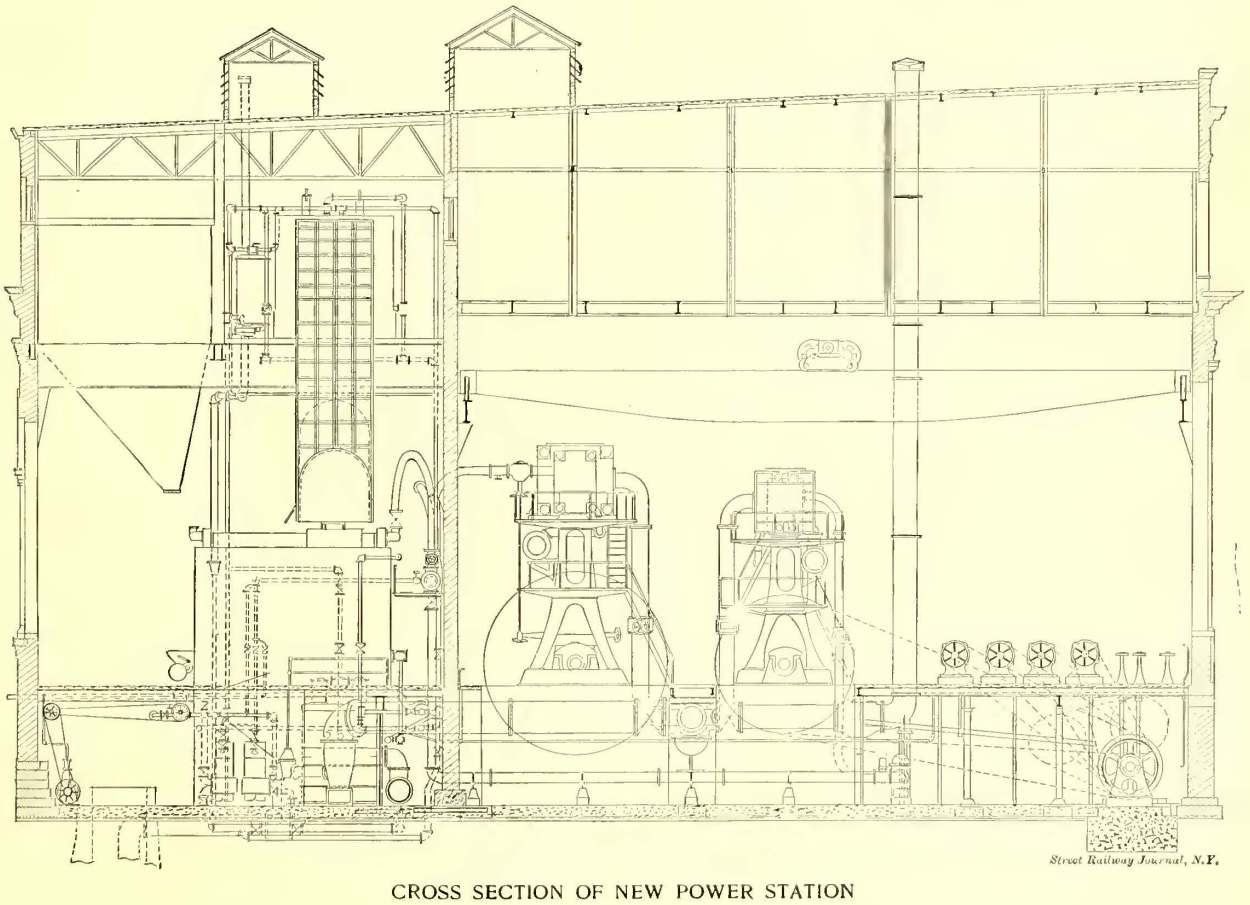
There are two duplex vertical Blake pumps, of the standard Admiralty type, and two Blake condensers of the same size and type as those used on the Kaiser Wilhelm der Grosse.



GENERAL DIAGRAM OF FEED-WATER SYSTEM

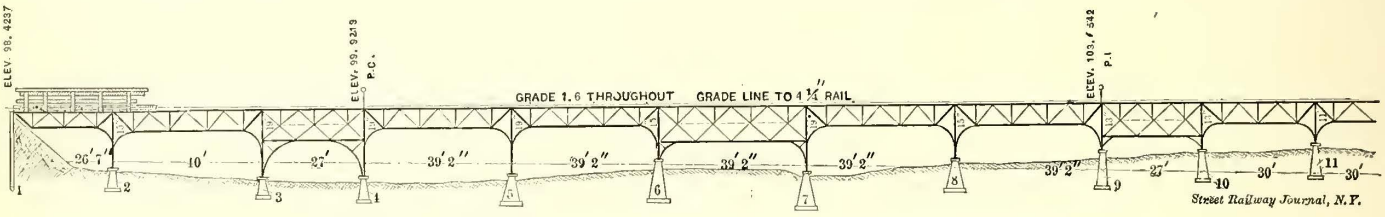
In the engine room is a 30-ton 80-ft. span electric crane, with three motors, built by Pawling & Harnischfeger, of Milwaukee.

Both railway and lighting engines are built by the E. P. Allis Company, of Milwaukee, and are of the cross-com-



CROSS SECTION OF NEW POWER STATION

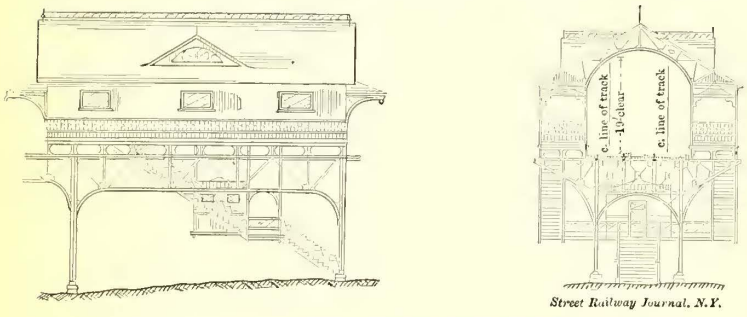
pound vertical type, with Reynolds-Corliss valve gearing. The railway engines have cylinders 28 ins. and 60 ins. x 48 ins., and are guaranteed to indicate 1400 h.p. at the point of highest steam economy, and 2400 h.p. at maximum load, with a boiler pressure of 150 lbs. and a vacuum of 26 ins. These engines run at 80 r.p.m., and it is guaranteed that the regulation shall be such that the minimum



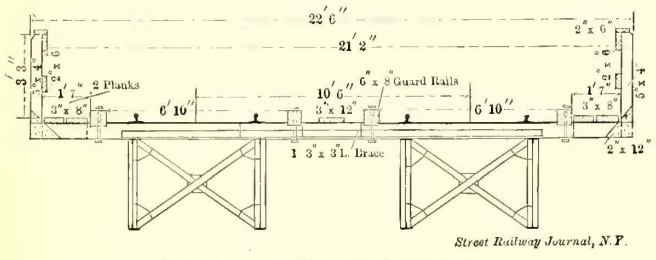
PORTION OF DOUBLE TRACK VIADUCT—CALVARY CEMETERY EXTENSION

speed shall not be less than 79 revolutions and the maximum 83. The flywheel is 20 ft. in diameter, and weighs 120,000 lbs. The cylinders are not steam jacketed, but the receiver is equipped with reheating coils fed by live steam. The valves are placed in the cylinder head, by which arrangement the clearance is reduced to about 1½ per cent on the low pressure cylinder, and nearly that on the high. It is guaranteed that when running under uniform load of 1400 i.h.p., with 150 lbs. pressure at the throttle, with 26-in. vacuum in exhaust pipe, and at 80 r.p.m., the engines will consume but 13½ lbs. of dry steam per i.h.p.

The lighting engines will run at 120 r.p.m., will indicate



SECTION OF SIDE ELEVATION OF VIADUCT STATION



CROSS SECTION OF VIADUCT

1100 h.p. at highest economy and 1600 h.p. maximum, and the speed will not be below 118 nor more than 123 r.p.m. with any variation of load. The cylinders are 22 ins. and 46 ins. x 42 ins., and the flywheel is 15 ft. in diameter, weighs 35 tons, and has a face 60 ins. wide, grooved for rope driving. An economy of 13½ lbs. is also guaranteed for the lighting engines under conditions similar to those just stated.

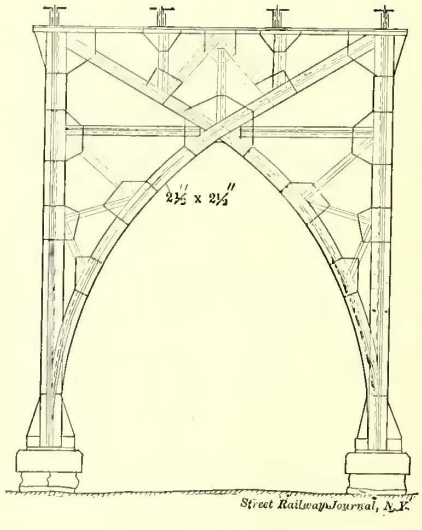
The railway generators, built by the General Electric Company, are of their "M.P.14" type; are rated at 1050 kw. or 1755 amps. at from 500 to 575 volts, and are direct connected to their engines. It is guaranteed by the makers that after ten hours' run at normal full load the temperature rise will not exceed 40 degs. C., and that after one hour run at a load 50 per cent above the normal full load, immediately following the ten-hour run at normal load, the temperature shall not exceed 50 degs. C. above the surrounding air. It is also guaranteed that a load 50 per cent above the normal can be carried without sparking at, or moving of, the brushes. The commercial efficiency at full load is to be 95 per cent, and at half load 94 per cent.

The twenty 100-light Brush arc machines, built by the General Electric Company, which are to be installed in this station form part of an order for sixty of the same type given by Mr. Beggs for use in Cincinnati and Milwaukee, this being the largest single order for arc light machines ever placed. The arrangement of these generators and of the counter shafting and rope drives by which they are run is clearly shown in the plan and cross sectional views herewith.

There will be in the station an immense marble switchboard built by the General Electric Company, arranged for forty-eight arc light circuits and forty-eight machines, and for all other railway and lighting circuits.

CAR HOUSES AND OTHER BUILDINGS

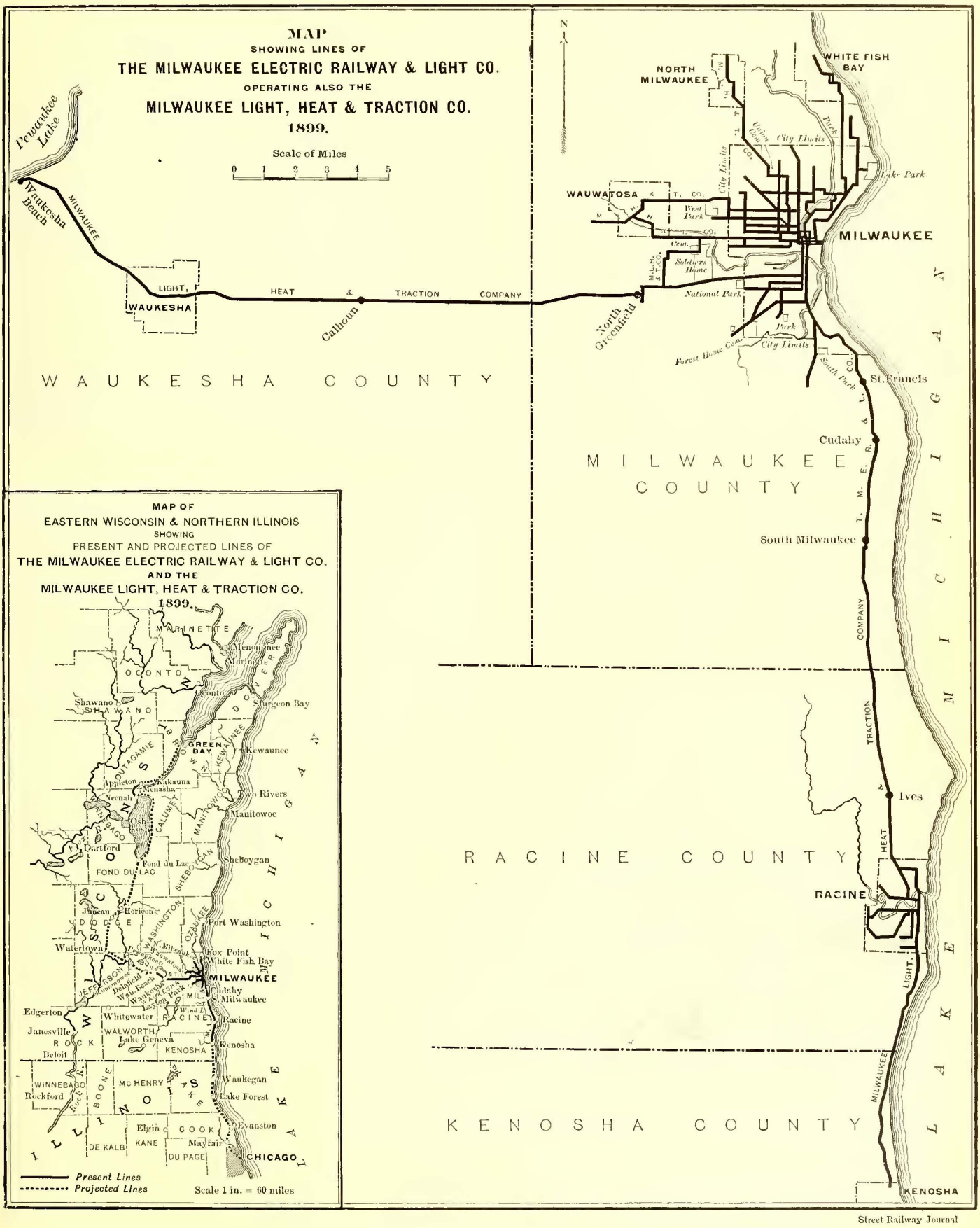
The company owns a number of car houses, located at various points upon the line, and an office building directly over one of the lighting stations recently purchased. For the purpose of facilitating car movement, especially at



TYPE OF BENT

times of sudden rain or snow storms, when the patrons are driven quickly to the cars, an option has been secured on a valuable piece of ground, 320 ft. x 240 ft., in the heart of the city, on which it is proposed to put up a building which will have a variety of uses. The ground floor will be the loop line terminal for practically all the east and west lines of the city, and three floors will be given up to car storage, with special means for quickly putting cars into service below. The company's offices will also be in this building, and there will be ample space devoted to the uses of the employees, in the way of gymnasia, library, reading rooms, meeting rooms, instruction rooms, etc.

The principal shop, the Kinnickinnic car house, is fitted up for the performance of all necessary repairs of rolling stock and power station equipment. Here also are to be found the foundry and the shops for the manufacture of



Street Railway Journal

MAP SHOWING ELECTRIC RAILWAY SYSTEM OF THE MILWAUKEE ELECTRIC RAILWAY AND LIGHT CO.

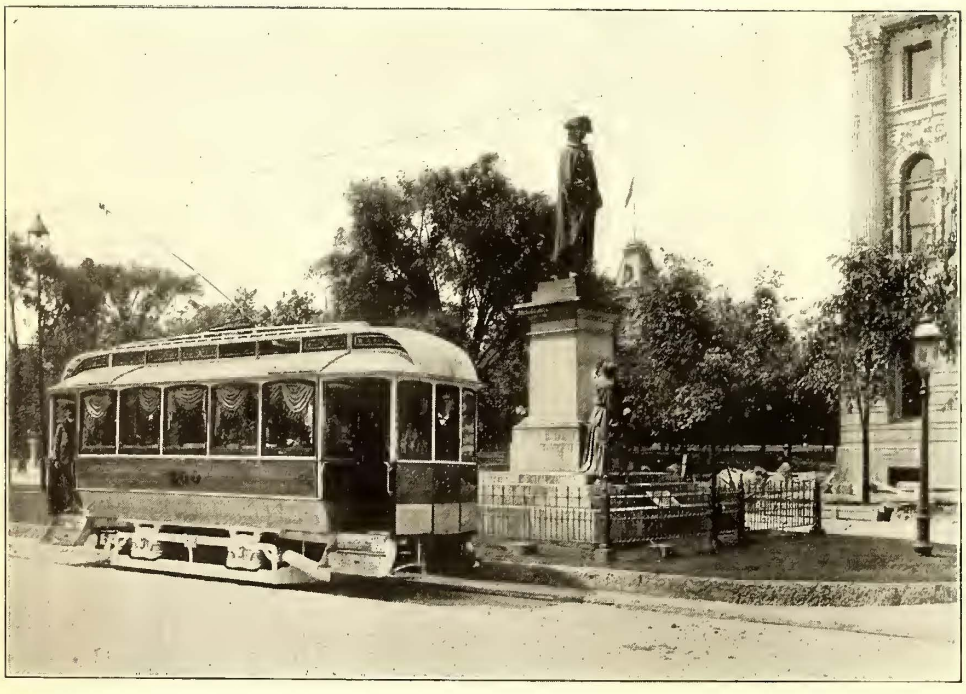
special work, as well as the storerooms, while, as before-stated, the large construction yards belonging to the company are close by, crossing the tracks of the two large railroads entering Milwaukee.

CAR EQUIPMENT

The standard cars of the Milwaukee Electric Railway & Light Company in its city service, and of the Milwaukee Heat, Light & Traction Company in the suburban and interurban service are so unusually sightly, comfortable and attractive to the riding population that a somewhat extended description of their characteristics is well worth while. The color scheme is nearly the same as the Broadway Metropolitan cars in New York—colors which always give a bright appearance to the cars in the streets. Inside, the finish and trimmings throughout are in quartered oak, and cane-bottomed cross-seats with center aisles—a seating plan always popular with the public—are combined with large windows, so that an excellent combination summer and winter car is obtained. The car interior finished in this way, without elaborate over-ornamentation, has a particularly *clean* look, and the whole aspect is decidedly pleasing.

The double-truck interurban cars of this general type were built by the Barney & Smith Company, of Dayton, and the St. Louis Car Company. The length over corner posts is 29 ft., and over bumpers is 41 ft. The width over all is 8 ft. 5 ins. The height from top of rail to bottom of sill, loaded, is 2 ft. 6 ins., and the inside height from floor to roof is 8 ft. 2 ins. The center and main side sills are of heart Southern pine, and a ½-in. iron plate, 5 ins. wide, furnishes additional strength to the side sills. The end sills and all cross and trap-door framing are of white oak, and posts, rails, rafters, etc., are of straight-grained white ash.

There are eighteen reversible and four stationary seats



PARLOR CAR

in the car, all made by the Hale & Kilburn Manufacturing Company, of Philadelphia. The curtains are made by the E. T. Burrowes Company. The car trimmings are of solid bronze, and folding iron gates are used on platforms. Electric push buttons summon the conductor.

The International double register is the company's standard, and is believed by the management to be the simplest and most durable in the market. The city cars are heated in the winter by coal stoves, and the interurban cars have the Baker hot water heater. In these long interurban runs it is not considered wise to run the risk of losing power and freezing passengers.

The cars are lighted by four two-light clusters and two platform lights, with a switch for an electric headlight.

INTERIOR OF OFFICE CAR

On the long-run interurban cars electric arc headlights are used. These have done much to reduce night accidents, and are considered by the management to be one of the most important equipment features of the modern interurban road, in spite of their wastefulness in the use of current. These headlights take about 5 amps. of current, and over 80 per cent of the power must be used in the dead resistances, but it is believed that power is the cheapest thing found in electric railroading, while accidents are among the dearest from every point of view. The arc headlight is really a searchlight, and by its use the track and road are lighted up for about a quarter of a mile in advance of the car, making accidents as rare as in daytime.

In addition to the Barney & Smith and St. Louis cars, which are, as above stated, the company's standard at present, we find also in service twenty Brill cars on the National Avenue line and a large number of short cars of different makes, some of which have been, and are being, rebuilt for continued service, but most of which will be replaced by new purchases in the near future.

There is no question in the opinion of the management as to the great advantage of double-truck over single-truck cars in both city and interurban service. They are held to be easier on track and more attractive to passengers, and while taking more power to operate, it is not believed that the cost of power per passenger carried is greater, while the transportation cost is, of course, reduced. Moreover, by means of these cars a longer headway can be maintained without public dissatisfaction, for overcrowding is less likely to occur.

After a series of elaborate and most carefully conducted

tests, it has been decided to equip these cars, both city and interurban, with four G. E. 1000 motors as a standard. The advantages of this equipment lie chiefly in the greater traction obtainable and the much more rapid acceleration, by which means higher schedules of speed are possible. The tests have shown that the power consumption in such an equipment is less than where two motors of equal or greater aggregate power are used, and experience has shown that repairs of the four-motor equipment are less than of the two-motor, in spite of the duplication of apparatus. This is a surprising and very interesting result, but certainly appears to be borne out by the repair figures for 1898, which show an expenditure of only $.0038 per car mile for repairs of electrical equipment—an extremely low figure.

Recent purchases of trucks have been of the Barney & Smith "H" type and the St. Louis Car Company's trucks, but no permanent standards have been established. The wheels are furnished by the Terre Haute Car Wheel Company, are 33 ins. in diameter, weigh about 385 lbs. each, and are guaranteed for about 40,000 miles of serviceable running, which guarantee has been maintained. The axles are of hammered iron, 4 ins. in diameter.

The Waukesha and Wauwatosa interurban cars are equipped with the Christensen automatic air brakes, with

SPECIAL EXCURSION CAR

independent motor compressor, and the highest satisfaction has been expressed by the management at the work of these air brakes, which are considered essential in the high-speed interurban work, of which there is so much around Milwaukee.

A number of parlor cars, nicely fitted up for excursions, are in service, and one car, "Marguerite," is especially ornate, being lined on the outside with incandescent lamps, and lending itself well to decoration. The superintendent has fitted up a special office car, with which inspection of the lines is, as before stated, carried on regularly, while, at the same time, considerable office work can be accomplished by means of the stenographer and typewriter who accompanies him on his trip.

There are several emergency and patrol wagons located at several points in the city. These wagons are kept ready for immediate call in exactly the same way as is done by the fire department, harnesses being suspended in such a manner that the horses can be immediately put into position and the wagons run out of the house with but a few seconds delay. On a recent inspection trip a patrol wagon was called by telephone at a point one-half a mile away from its house, and it arrived on the ground in less than 2¼ minutes after telephone connection was made.

For the purpose of providing against blockades from breakdowns on the road each motorman is given a toolbox, which is numbered with his badge, and for which he is responsible. This box is equipped with all the tools necessary for above repairs on the road. While it is not the company's purpose to allow the motormen to do anything except emergency work on the cars, they are given

STANDARD INTERURBAN CAR

a training sufficient, it is believed, to enable them to get their cars into the station under ordinary conditions.

The construction cars have already been referred to, and an illustration of one is given on the following page.

The snow equipment is somewhat extensive, and is strong enough to grapple with any storms which may visit Milwaukee; in fact, there have been some fine records made in dealing with heavy storms which have blocked railroad travel while the electric cars have been able to run.

It is found from the company's books that the entire cost of maintaining the rolling stock in 1898 was $.0091 per car mile, of which $.0022 was expended for car bodies, $.0017 on trucks, $.0038 on electrical equipments, and

INTERIOR OF STANDARD CAR

$.0014 on superintendence, tools and miscellaneous expenditures. These are extremely low figures, in spite of the fact that the rolling stock has been kept up in first-class condition without the slightest depreciation.

CAR SERVICE

The average speed schedules of the city of Milwaukee are somewhat high, being from 8 to 9 miles per hour on an average, while on the suburban and interurban lines

PATROL WAGON

they are 20 miles per hour. The run from the center of Milwaukee to Waukesha, a distance of 20 miles, is regularly made in fifty-five minutes, and has been made in forty-five minutes. These are high figures in view of the fact that several miles of the distance lie in the city proper, with considerable local traffic, while there are numerous curves and detours on the line which have not yet been gotten rid of. Two Waukesha cars regularly make nineteen half-trips a day, or 380 miles each, this being one of the highest electric car day records to be found in this country.

The greatest care and attention is given to the securing of punctuality in the operation of the entire system. Each of the lines, city as well as suburban, has several time points, and the motorman is called strictly to account if he falls more than a minute behind time at any of these points. Results have shown to the management that this element of punctuality is most important in obtaining traffic, and goes far to offset a slight increase in the time interval between cars, since it is less important for the would-be rider to get a car at the moment he steps upon the street than it is to know that if he steps upon the street at a particular moment he will get his car. Largely owing to an increase in speed, gradually brought about in the last two years, the present management has succeeded in giving a superior service to the public with a less number of car trips and car miles, so that the earnings per car mile have been materially increased without a corresponding increase in expenses, and this is one of the potent causes for the large financial improvement in the properties.

An hourly service is maintained between Milwaukee and Waukesha, Whitefish Bay and Racine-Kenosha; a half-hourly between Milwaukee and South Milwaukee; and a fifteen-minute alternate service on two lines between Milwaukee and Wauwatosa. In the city the cars are run on a time interval of from six to ten minutes.

There is on this system a most complete private telephone system, and all of the dispatching business on the interurban lines is conducted by telephone. At the present time more than fifty points on the system are connected with the central office by telephone, and the number will be largely increased in the near future. On arriving at switches, or other meeting points, instructions are sought for and received by each conductor over the telephone, and a notation of the call and of the instructions given is made on a large sheet in the dispatcher's office, where also is made a record of every kind of trouble reported on the system, including accidents (even of the most trivial character), breakdowns, failures to make time, etc. This feature of operation is to be still further improved and extended in the near future, but is already efficient and satisfactory.

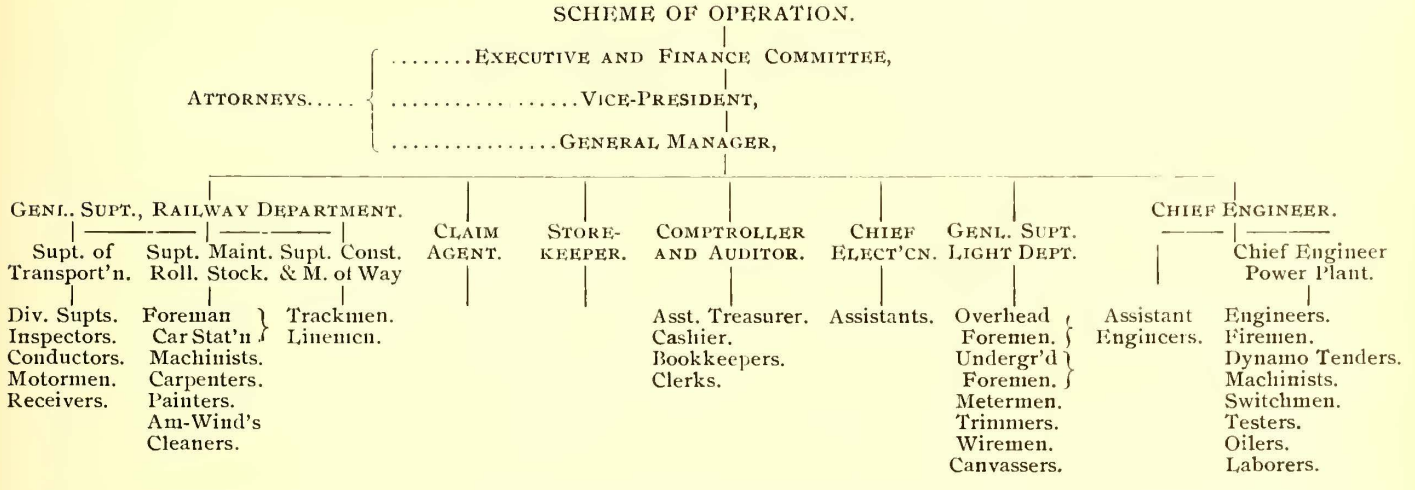
The company has regularly in its service a surgeon, whose duty is to drive immediately upon call to any point in the system where an accident may have occurred, and to render every assistance in his power to the injured person. This course is dictated not only by humanity, but by wise economy, since it is almost always possible to obtain a truthful statement of the accident immediately after its occurrence, while after several days' delay garbled or deceptive accounts are not infrequent. As a matter of fact, the company's disbursements for injury are small, in spite of the high speeds maintained by the cars, the regular fund, amounting to 3 per cent of the gross earnings, which has been set aside for the past two or three years, proving so far sufficient to take care of all disbursements on this account.

RACINE–KENOSHA CAR

INSPECTION AND REPAIR CAR

ORGANIZATION

The company's scheme of organization is clearly shown in the accompanying diagram.



The executive and finance committee consists of Charles W. Wetmore, chairman; William Nelson Cromwell, of the law firm of Sullivan & Cromwell, and George R. Sheldon, all of New York.

Henry C. Payne, the company's vice-president, has been connected with the property ever since the original purchase of the constituent companies by Henry Villard and the North American Company in 1891-2. He is one of the ablest and most influential men in the State of Wisconsin, and his influence and assistance have been of inestimable value to the company. Mr. Payne was president of the American Street Railway Association in 1893-4.

The responsible executive head of the company is its general manager, John I. Beggs, to whose skillful and aggressive work the great improvement in the physical and financial condition of the property during the last three years is largely due. Mr. Beggs' reputation as a successful manager of corporate enterprises, particularly in the field of electric lighting and the manufacturing of electric apparatus, is established by numerous successes and no failures during the past twenty years; but it was reserved for Milwaukee to prove that in the larger field of electric railroading even greater success would be achieved. His policy is broad and far reaching, as has been indicated at several points in the previous discussion, and it is not too much to say that one of the most valuable lighting and railway properties in the West is now being developed by him, and will eventually reach proportions far larger than at present.

The comptroller and auditor, H. C. Mackay, is in charge of the accounting department. The company's accounting system closely follows the standard of the Street Railway Accountants' Association of America, although greater detail in many of the accounts is required by the general manager. Owing to the rapid development of the system, and especially to the recent purchases of important interurban lines, the accounting system in its details is still in a formative condition.

The general superintendent of the railway department, T. E. Mitten, has been with the company for five years, and is in direct charge, under General Manager Beggs, of the operation of the railway lines.

The chief engineer, Chester P. Wilson, was formerly general manager of the Sioux City Traction Company.

The company's chief electrician is O. M. Rau, who is now acting as general superintendent of the light department.

In the month of April there were 1673 employees on the company's payrolls, of whom 84 were in the general office, 709 in the transportation department, 305 in the maintenance departments, 106 in the power stations, 83 in the lighting department, and 386 in the construction department.

FINANCIAL RESULTS

It has before been stated that remarkable changes have been made during the three years of the present management in the financial and operating statistics of the Milwaukee property. The real character of these changes can best be seen by an examination of the comparative statistics of operation expressed in "per car mile" and "per passenger" figures. The following results are for the railway department of the Milwaukee Electric Railway & Light Company only, it being impossible to obtain a similar comparison for the Milwaukee Light, Heat & Traction Company on account of the recent purchases of its most important properties:

GENERAL FINANCIAL STATEMENT.

	per car mile.		
	1896.	1897.	1898.
Total receipts, all sources	$.1547	$.1857	$.2074
Operating expenses, actual disbursements	.1047	.1063	.1108
Earnings from operation	.0500	.0794	.0966
Reserves and taxes	.0309	.0256	.0477
Net income applicable to return on investment	.0191	.0538	.0489
Interest on funded and floating debt	.0340	.0405	.0413
Surplus for stock	.0149*	.0133	.0076

*Deficit.

	per passenger carried.		
	1896.	1897.	1898.
Total receipts, all sources	$.0493	$.0504	$.0496
Operating expenses, actual disbursements	.0334	.0289	.0265
Earnings from operation	.0159	.0215	.0231
Reserves and taxes	.0099	.0069	.0114
Net income applicable to return on investment	.0060	.0146	.0117
Interest on funded and floating debt	.0108	.0110	.0099
Surplus for stock	.0048*	.0036	.0018

*Deficit.

OPERATING EXPENSES IN DETAIL.

	per car mile.		
	1896.	1897.	1898.
General expense	$.0136	$.0164	$.0199
Conducting transportation	.0724	.0673	0702
Maintenance, way and structures	.0064	.0116	0116
Maintenance, rolling stock	.0123	.0110	.0091
Total	$.1047	$.1063	$.1108

	per cent to total op. ex.		
	1896.	1897.	1898.
General expenses	13.00	15.42	17.91
Conducting transportation	69.10	63.26	63.41
Maintenance, way and structures	16.10	10.94	10.46
Maintenance, rolling stock	11.80	10.38	8.22

The most remarkable feature of the above statement is found in the 33 per cent increase in total receipts per car mile, and in the fact that the earnings from operation per car mile have been nearly doubled in the three-year period. Surplus for stock is affected largely by the amount set aside for "reserves and taxes," and as the company's practice in this respect is remarkably conservative and most admirable in conception, an explanation of the meaning of "reserves" is in order.

DEPRECIATION AND OTHER RESERVES

For the first six or seven years of operation depreciation in operating expenses was overlooked and neglected in the scheme of finance, and nothing was set aside to take care of the "deferred operation expenses," which come when track and equipment are worn out, and large sums of money have to be put into the property in order to replace them. In many cases in American street railway practice the investment or capital account has to furnish these sums of money, which are, nevertheless, operating expenses pure and simple, and a measure of the "depreciation" which has taken place during the previous operating period. European practice is, on the contrary, very rigid in requiring all railway and manufacturing companies to take from their operating expenses every year a certain amount to cover depreciation before declaring dividends to stockholders.

Two or three years ago the Milwaukee company awoke to the realization of the mistake which had been made in not providing a reserve fund for depreciation, and it was decided to immediately reorganize the finances on a far more conservative basis. The plan adopted was as follows:

Fifteen thousand dollars is set aside each month as a reserve fund for depreciation of railway plant, and $2,000 for depreciation of lighting plant. At the same time 3 per cent of the gross earnings of the railway and 1 per cent of the gross earnings of the lighting departments are set into a reserve fund to provide for injuries and damages arising in the operation of the property. In an "insurance fund" is placed an amount large enough to provide not only for actual disbursements in insurance premiums, but also for a surplus which it is intended shall take care of the uninsured losses from fire. A certain percentage of the gross earnings is also set aside for legal expenses, and, finally, $10,000 per month is passed into the fund for amortization of franchises, which expire about twenty-five years hence. The theory of this last item is that in case the company's franchises are not renewed at their expiration there is likely to be realized a large loss of capital, unless such a fund as this be provided in order that the investors may receive their principal, dollar for dollar.

All of these moneys taken out of the earnings in the way above stated are credited on the books to their respective ledger accounts, and are actually represented in the cash, bank, or otherwise liquid assets of the company. The sum of these accounts appears in the general statement in the item of "reserve and taxes" as in the above tables, and is a direct deduction from "earnings from operation."

If, now, it becomes necessary to replace twenty-five worn out cars, or to rebuild 5 or 10 miles of worn out track, the money for this is taken out of the bank, cash, or liquid accounts, and is charged directly to the reserve fund for depreciation. Small renewal expenditures arising in the current operation of the property and not involving the actual purchase of new rolling stock or bulk material, are charged directly to operating expenses as a current disbursement, and not to this reserve fund. Insurance and general expenses paid out are, however, charged to their respective funds, as these funds are established, not only for the purpose of gradually accumulating a reserve, but also as a bookkeeping method for pro rating the annual disbursement for these accounts evenly upon the twelve monthly statements. Taxes are dealt with in a similar manner and as an "accrued" obligation.

It is not intended that the depreciation fund shall ever contain large sums of money, but, on the contrary, most of the money is actually expended each year in the purchase of new rolling stock and replacement of track. Such a fund, however, has the effect of evening up expenditures over a series of years and taking out of the earnings that proportion which ought to be given over to maintaining the property in good condition, so that its actual value shall be always equal to its book value.

In the light of this discussion the following final figures will be interesting as a gauge of the financial results of the Milwaukee property during the past three years.

	per cent op. ex. to gross receipts.		
	1896.	1897.	1898.
Per cent op. ex. (actual disbursements) to gross receipts	67.7	57.2	53.4
Per cent op. ex., reserves and taxes, to gross receipts	87.7	71.0	76.4

The figures heretofore given appertain, as stated, to the street railway department only of the Milwaukee Electric Railway & Light Company. Its lighting department is, however, by no means unimportant, but in proportion to the investment therein contributes largely to the net revenues of the company. The surplus left for stock after paying the operating expenses, reserves and taxes, and the interest on its own investment, amounted in 1898 to nearly 40 per cent of the company's total surplus for stock. It is not probable, however that this high percentage can be long maintained for the railway earnings, gross and net, will doubtless increase far more rapidly than the lighting.

All in all, this great Milwaukee system has had the benefit of an operating and financial management of the most admirable character—a management which, if continued, can hardly fail to give it rank among the most substantial and valuable street railway properties in the world.

Accident Cases in Australia

The following is clipped from the legal department of the "West Australian" of March 17, 1899, and shows how railroad accident cases are treated in that country, where, it would seem, it is a serious offense for a man to get in the way of a locomotive:

Infraction of Railway By-Law.—Thomas Hodgins was charged with driving a horse and buggy across the railway when a train was approaching. Mr. Purkiss appeared for the Railway Department, and defendant was undefended. An engine driver said that defendant drove across the line in front of a train, the engine of which witness was driving, on the 1st inst. The engine struck the hind wheel of defendant's buggy and capsized and smashed it. The horse broke away, and defendant, unhurt, got up and ran after it, but the horse got into a cattle pit. When spoken to by witness, defendant admitted having tried to get across, as he thought he had time to get over, and his horse shied. Defendant said that he was driving an unruly horse at the time, and was afraid he could not pull him in, and that he would run into the train. He thought the only chance he had of saving his own life and that of the horse was to try and get across the line. He tried at first to pull the horse up. He got nearly across, when the engine struck the back wheels and defendant was thrown 10 ft. He was cut and shaken, but got up to try and catch the horse, which ran into a cattle pit and got its sinews cut. He considered the crossing dangerous. Defendant was fined 20s. and costs, in default one month's imprisonment with hard labor.

Letter Boxes on Cars

An interesting experiment is now being tried by the Hartford Street Railway Company, of equipping a number of its electric cars with ordinary drop boxes for the receipt of letters. These boxes are attached to one side of the rear vestibule of the car, so that they are protected from collision with passing vehicles or other accident. The public is invited to use these letter boxes for depositing their mail, and no charge is made by the railway company to the government for carrying these letters. All the cars of the company start from the center of the city, which is directly opposite the post office, and when they arrive at that point the boxes are emptied by the postal authorities. As the cars always wait a minute or two at this point, they are not detained by the process; neither has there been a material delay in receiving letters on the road from persons wishing to mail letters.

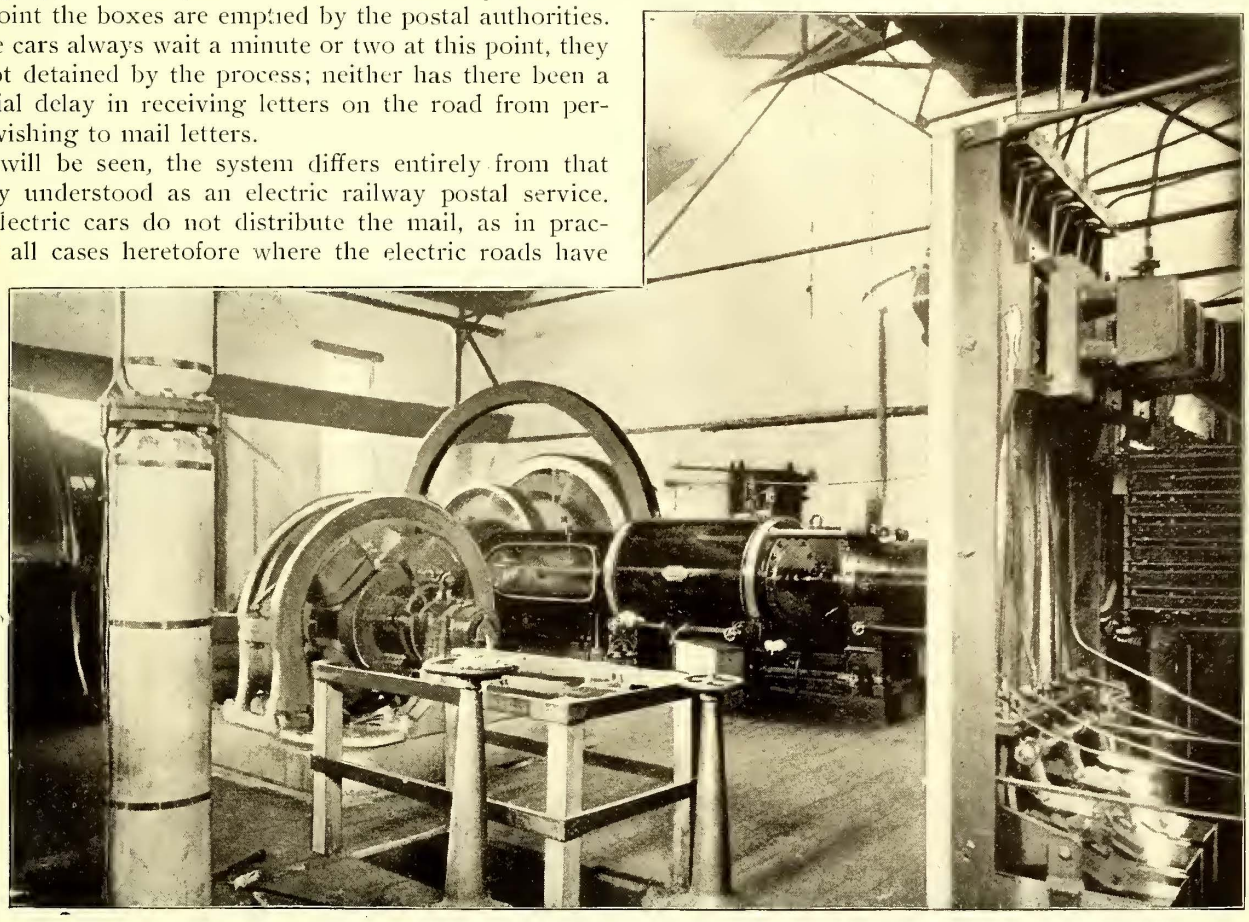
As will be seen, the system differs entirely from that usually understood as an electric railway postal service. The electric cars do not distribute the mail, as in practically all cases heretofore where the electric roads have acted in connection with the postal service, but assist in collecting the mail. The advantage to the railway company is principally in offering a convenience to the public, especially to its patrons, and the manager of the company, N. McD. Crawford, reports that so far there has been no drawback to the plan.

The system has proved most popular in Hartford, and has been well patronized. It was put in operation on a half-hourly schedule on April 1, when it was thought that only fourteen boxes were required to perform the service. F. P. Furlong, General Post Master of Hartford, who originated the idea, said recently to the STREET RAILWAY JOURNAL that during the first fifteen days of April there were received through this source 9310 letters; during the last fifteen days, 12,899; making a total for the month of 22,209 letters, which included quite a few special delivery letters.

For the postal department the system presents very many advantageous features. Much earlier connections are made with outgoing mails, by reason of the frequency of the service, and it relieves, in a measure, the congestion in the mailing division, by reason of bringing smaller quantities of mail into the office at frequent intervals.

Three Phase Transmission for Railway Service Near Philadelphia

The increase in the number and extent of suburban electric railways near Philadelphia has kept pace with that surrounding other large cities in this country, and Philadelphia is now connected electrically with Wilmington on the south and Westchester on the west, while the extension of roads to the north is being carried on rapidly. These roads make connections in the outskirts of the city with the system of the Union Traction Company of Philadelphia, but the suburban cars do not run into the center of the city, as in some instances, over the tracks of the city company.



INTERIOR OF MAIN POWER STATION—WESTCHESTER TRACTION COMPANY

Among the lines in operation that of the Philadelphia & Westchester Traction Company is, from an electrical standpoint, probably the most interesting, on account of the use of the three-phase current for power distribution. The line is 20 miles in length, and extends from the corner of Sixty-third and Market Streets, Philadelphia, in almost a direct line along the turnpike, which is controlled by the company, to the Borough of Westchester, which has a population of 15,000. The region traversed is a rich and rolling farming territory, and crosses a series of six ridges and valleys, with grades of from 4 to 6 per cent on each side, some of the grades being over 3500 ft. long. Eight miles of this line, or that from the eastern terminus to Newton Square, were built in 1894, but the old track has been completely reconstructed.

The track is rock ballasted for the entire length, and east of Newton Square is a 58-lb. T rail, furnished by William Wharton, Jr., & Co., with tongue switches, mates and frogs of manganese steel. The ties are 5 ins. x 7 ins. x 7 ft., laid 2-ft. centers. No. 0 trolley wire, with the General Electric overhead material is used. West of Newtown

Square 58-lb. Johnson T rails in 60-ft. lengths are used, laid on oak and chestnut ties of the size already mentioned. The trolley wire on this section is a No. 0000, and double for the entire distance, as no feeders are employed. The overhead material is of the General Electric and McCallum type. Within the Borough of Westchester a 9-in. Johnson girder rail in 6-ft. lengths is used, on 6-in. x 8-in. x 8-ft. oak ties. Mayer & Englund 0000 protected bonds are used throughout. The Ramsey block-signal system is used.

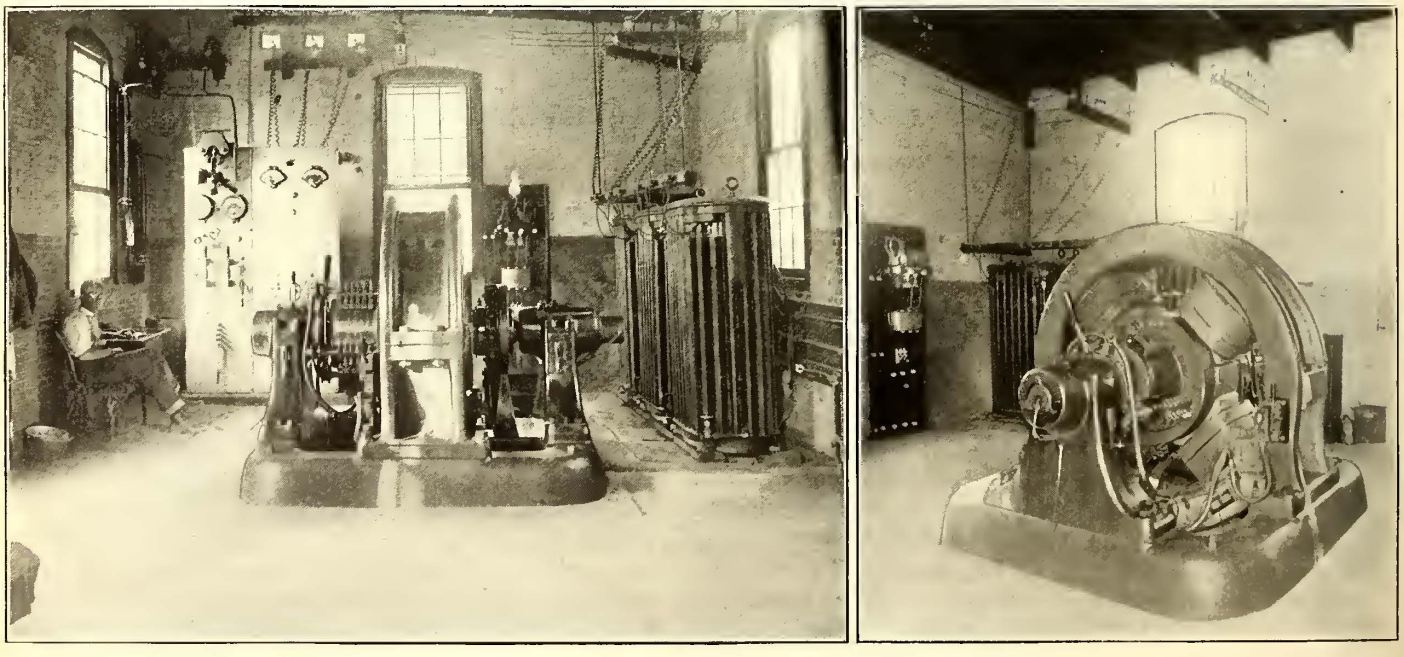
The main power station is at Llanarch, 2¼ miles from the eastern terminal. It is of red brick on rubble stone foundations, and measures 100 ft. x 52 ft. 5 ins. The roof trusses are of steel, supported by steel columns, which also carry the crane girders. The boiler room is 44 ft. x 51 ft., and 20 ft. high, and contains three Pierpont water-tube boilers of 200 h.p. each. These boilers are fed by two No. 10 Sellers injectors, and burn bituminous coal.

The engine room is 52 ft. 5 ins. x 51 ft., and contains two Harrisburg Ideal compound condensing engines, 17 ins. and 28 ins. x 42-in. stroke, each directly connected to a G. E. 400-kw. generator, with a speed of 100 r.p.m. In the basement each engine is connected with a single cylinder air pump and jet condenser, 12 ins. and 16 ins. x 18 ins., manufactured by the Snow Steam Pump Company, which also supplied the steam pump, which is 10 ins. x 5 ins. x 10 ins. In the engine room is also a 15-ton Sellers crane, operated from the main floor. The switchboard is of the standard type of the General Electric Company, with two generator and four feeder panels.

In addition to this machinery, which supplies current to the line from the eastern terminus to Newtown Square, there is also a 250-kw. General Electric rotary converter, taking current from the main bus bar. This converter is of the T C-4-250-750 type, supplying 380 volts on the alternating side and 550 volts on the direct current side, and is run inverted; that is, the direct current side is used as a motor, while current is taken from the alternating side at 25 cycles per second. In the station are also three 90-kw. step-up transformers of 380 volts primary and 6600 volts secondary current connected with the alternating current side of the inverted rotary.

The substation is located at Ridley Creek, is of brick, and measures 19 ft. 6 ins. x 32 ft. It is 10¾ miles from the power station, with which it is connected by three No. 4 wires carried on porcelain insulators. These were supplied by Mayer & Englund, manufactured by Fred M. Locke, and are carried on white pine cross-arms, on pins spaced 12 ins. apart. After passing the lightning arresters, which are of the G. E. A type, the current passes through aluminum fuses, thence to the oil switches on the switchboard, and thence to three oil-insulated 90-kw. transformers, by which it is reduced to 380 volts. At this

EXTERIOR OF ROTARY CONVERTER SUBSTATION

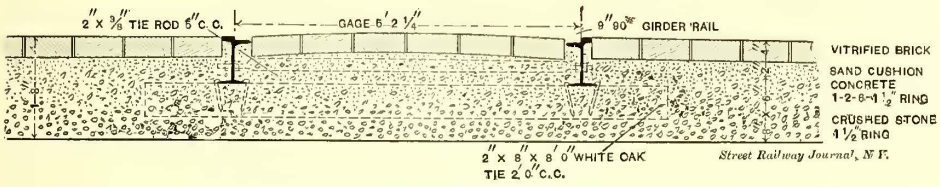


INTERIOR OF ROTARY CONVERTER SUBSTATION AT RIDLEY CREEK

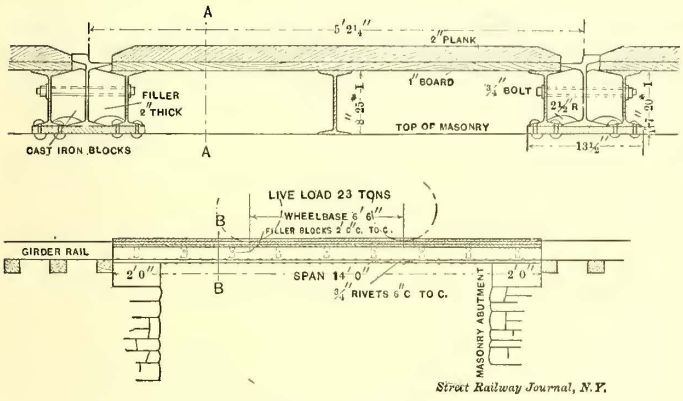
voltage it is taken to the alternating side of the rotary, while from the direct current side a current of 550 volts is supplied to the trolley wire.

Each rotary converter is supplied with a centrifugal governor operated from the extended shaft of the machines. This governor is set so as to throw the circuit breaker on the switchboard, in case the limiting speed, which is about 30 per cent above normal, is reached. The governor consists of two weights, which are thrown out as the speed increases, and when in operation make contact on two rings, which are connected to an auxiliary trip coil on the circuit breaker. On the other side of the machine is placed an end-play device which is in connection with a make and break circuit, which energizes coils and causes a magnetic pull on the armature, thus giving it a to and fro motion in the bearings. The motor for accomplishing this is of the induction class, 4-1/16-750-80 type.

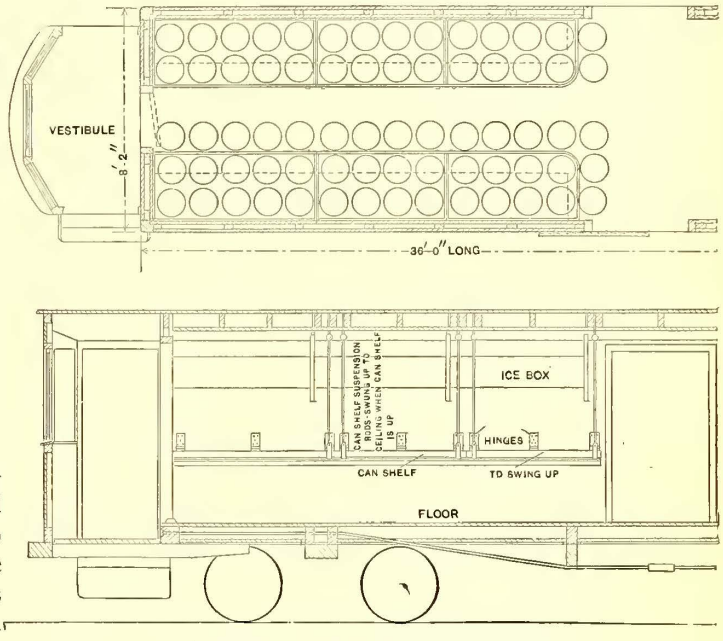
In starting the alternating current system, the rotary converter in the main station at Llanarch is first



SECTION OF TRACK CONSTRUCTION IN WESTCHESTER



14-FT. SPAN BRIDGE OVER PENNSYLVANIA R. R.



SECTION AND PLAN OF MILK CAR

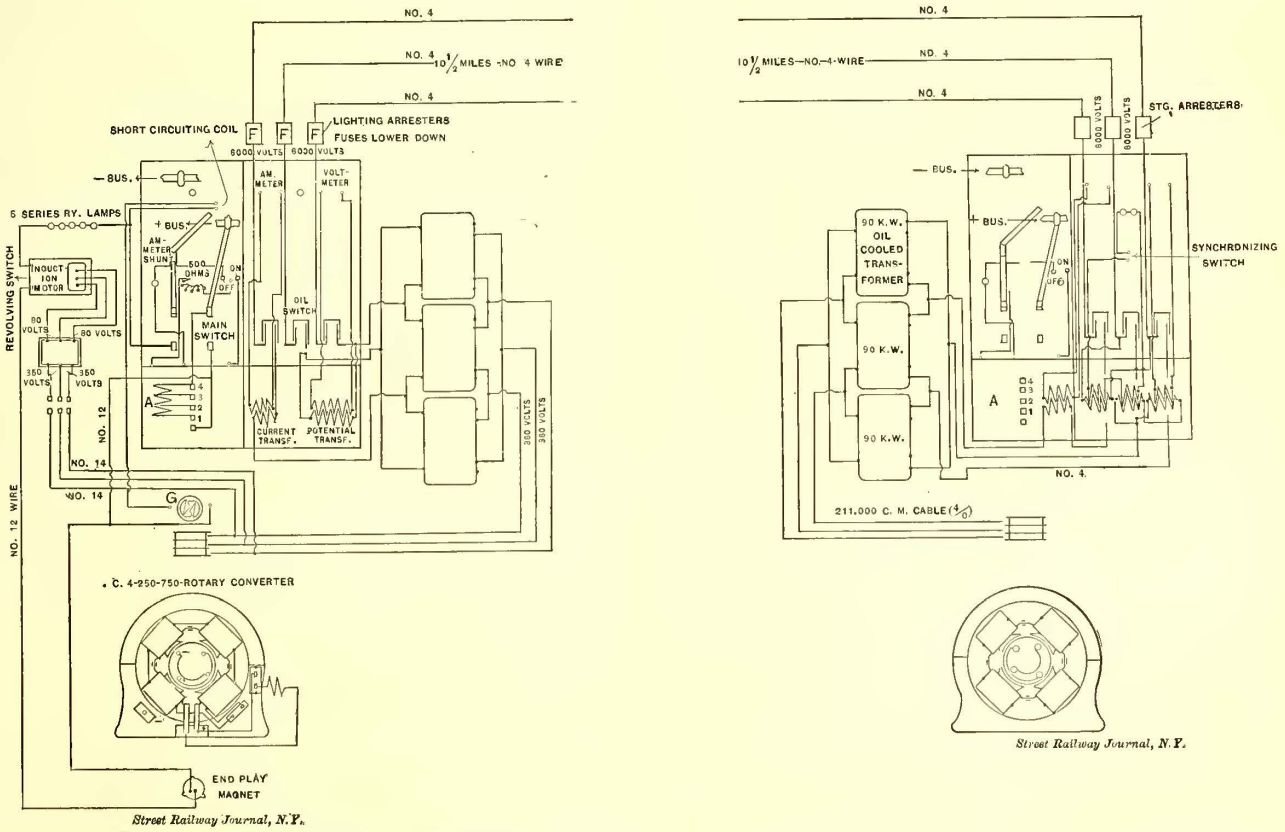


DIAGRAM OF THREE-PHASE CONNECTIONS AT MAIN AND SUB-STATION

run as an ordinary direct current motor, after which that in the substation is started as an alternating synchronous motor from the alternating side. The amount of current necessary to start this machine is about its full load. The voltage on the direct current side of the rotary converter in the substation is practically the same as that in the main station. This voltage rises, along with the compounding of the large 400-kw. generators, in the main station as the load goes on.

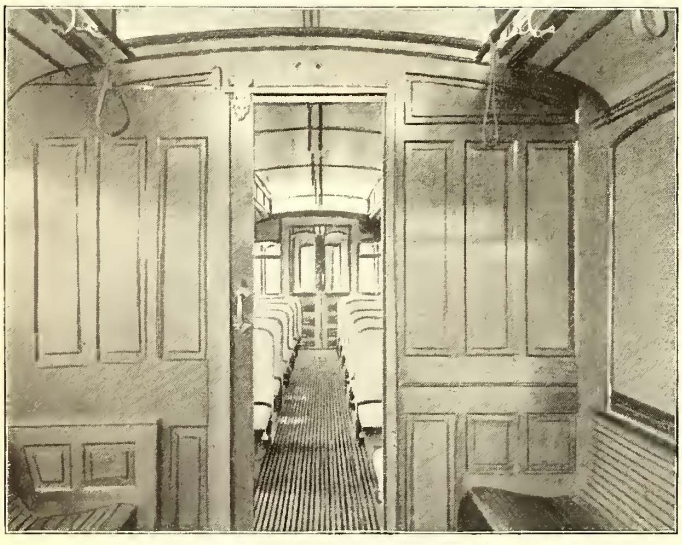
For its rolling stock the company has fifteen ten-bench open cars, made by the Lamokin Car Works, mounted on Brill 21 E trucks, and equipped with Westinghouse No. 38 motors; six small box-cars, built by Brill, and six long closed cars, with smoking compartment, built by Jackson & Sharp. These latter, the latest addition to the company's rolling stock, are 29 ft. 6 ins. in frame, 39 ft. over all and 40 ft. over bumpers. They measure 7 ft. 6 ins. wide over sills, and 8 ft. 2 ins. wide over belt rail, allowing 34-in. seats on each side of the aisle, giving a very wide aisle space.

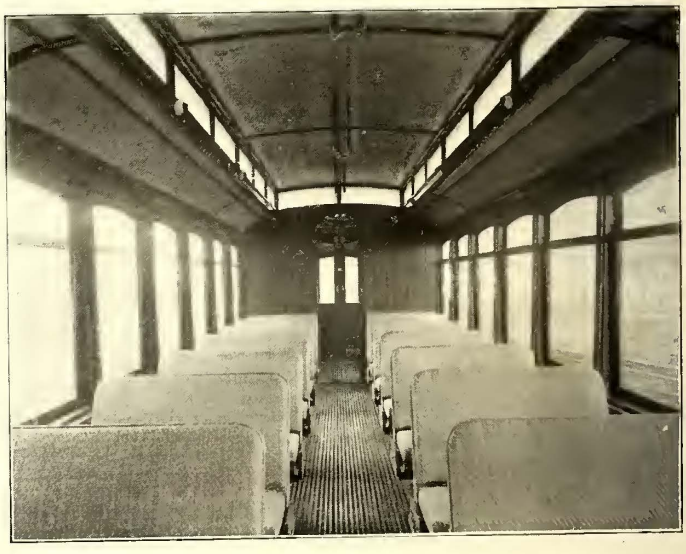
The interior finish of the cars is quartered oak, with white birch veneer ceilings, handsomely decorated. Between the second and third windows is placed a bulkhead, or partition, dividing the car into two compartments. The main compartment, or passenger room, is fitted with Hale & Kilburn's walkover seats, upholstered in rattan. In the smoking-room end of the car side seats of slats of the usual type are placed, giving a seating capacity of four on each side, or eight in all, making the total seating capacity of the car forty passengers. The sashes are double and fitted with polished plate glass; the upper light is permanent. The lower sash is made to drop into the side of the car below the belt rail. The lights in the deck are bevel-edge with chipped center, and the glass in the end doors are also bevel-edge, of plate. The end doors of the cars are double, mounted on contra-twist door hangers. The curtains are fitted with Burrowes Climax fixtures. The cars are fitted with especially long platforms, being 5 ft. 3 ins. over all, detachable canopies and vestibule fronts. The outside is painted Tuscan red, and striped and numbered in gold leaf, and lettered in aluminum leaf, which give very handsome effect. The cars are mounted on Peckham 14 A trucks, and are equipped with Westinghouse No. 49 motors and Christensen air brakes. The cars are equipped with New Haven registers and Johns heaters.

A large proportion of the company's business is the carrying of freight and merchandise, of which the transportation of milk forms a considerable item. To accommodate this service the company has recently put on a new milk car of the form illustrated on the preceding page.

The line is especially built for high speed, and it is the intention of the company to run the 20 miles in one hour and fifteen minutes. There is no direct steam railroad connection between the terminals of the electric road, and it is thought that considerable through business can be secured, as well as a considerable excursion business in the summer. To encourage the regular passenger business, especially on rainy and cold days, the company will build waiting stations at regular points along the line, and they will be lighted and heated by electricity.

VIEW ALONG LINE





INTERIOR VIEWS OF DOUBLE TRUCK CAR

The officers of the Philadelphia & West Chester Traction Company are: President, A. Merritt Taylor; secretary, C. Russell Hinchman; treasurer, Nathan Sellers; electrical engineer, Joseph W. Silliman; superintendent, J. H. Gibson.

The general contractors were Pepper & Register.

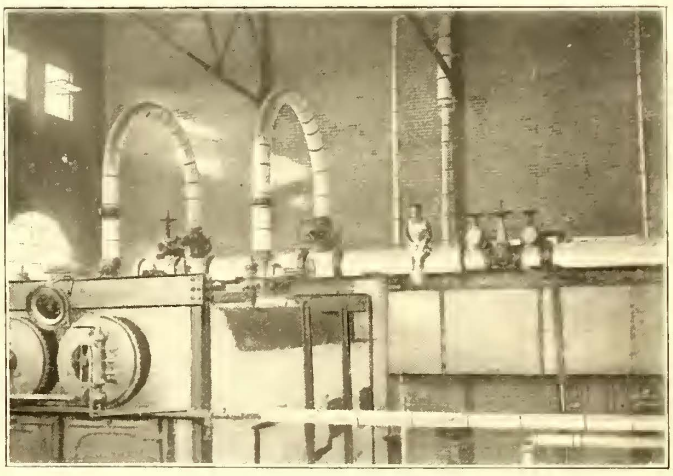
For making inspection and running repairs such as should be made in car-houses, it is a safe rule to have one man to seven cars. From paper at the Boston Convention, 1898.

An Interesting Cross Country Electric Road

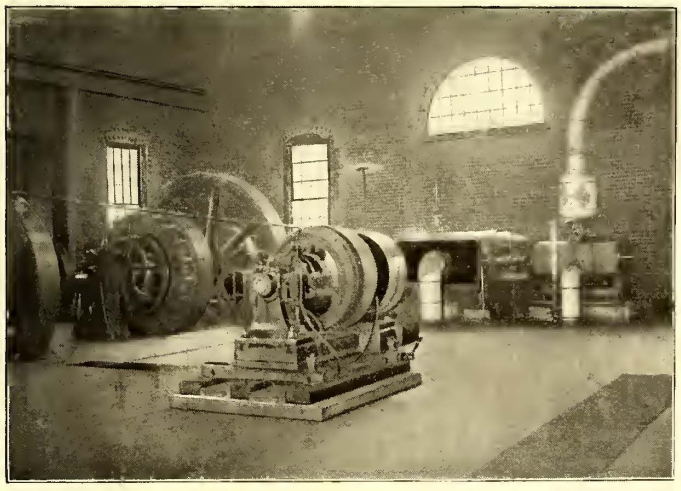
The Dayton & Western Traction Company, of Dayton, Ohio, in which some of the principal stockholders of the City Railway Company, of Dayton, are interested, is operating an important electric railway extending from Dayton to Eaton, a distance of 25 miles. The line extends through a thickly settled region, chiefly devoted to farming, and containing a number of small villages and towns, notably New Lebanon, Johnsville and West Alexandria. The Dayton terminus is at the Post Office. After leaving the Dayton city line it follows the National Pike all the way to Eaton, and in a distance of 22 miles after leaving the city tracks it has only one slight curve, near the Soldiers' Home. The subgrade of the track, wherever possible, was kept about on a grade with the highway, thus keeping the track high and dry. The maximum grade on the line is 4 per cent, coming out of Dayton. There is also a long grade about 6 miles in length, of 3.85 per cent for 2600 ft. and 3.5 per cent for 1700 ft.

There are nineteen steel bridges on the line, of various lengths, from 10 ft. to 154 ft. They are all built alongside

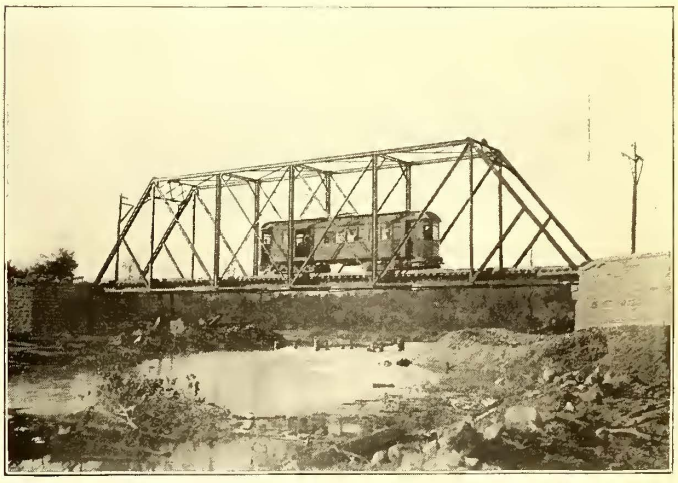
EXTERIOR OF POWER STATION



VIEW OVER BOILERS



INTERIOR OF STATION



120-FT. SPAN TRUSS BRIDGE AT BANTA'S CREEK

WOODEN TRUSS BRIDGE

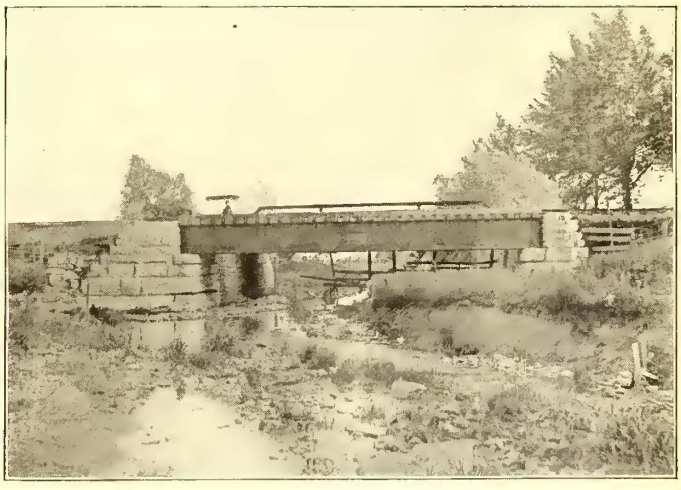


PLATE GIRDER BRIDGE

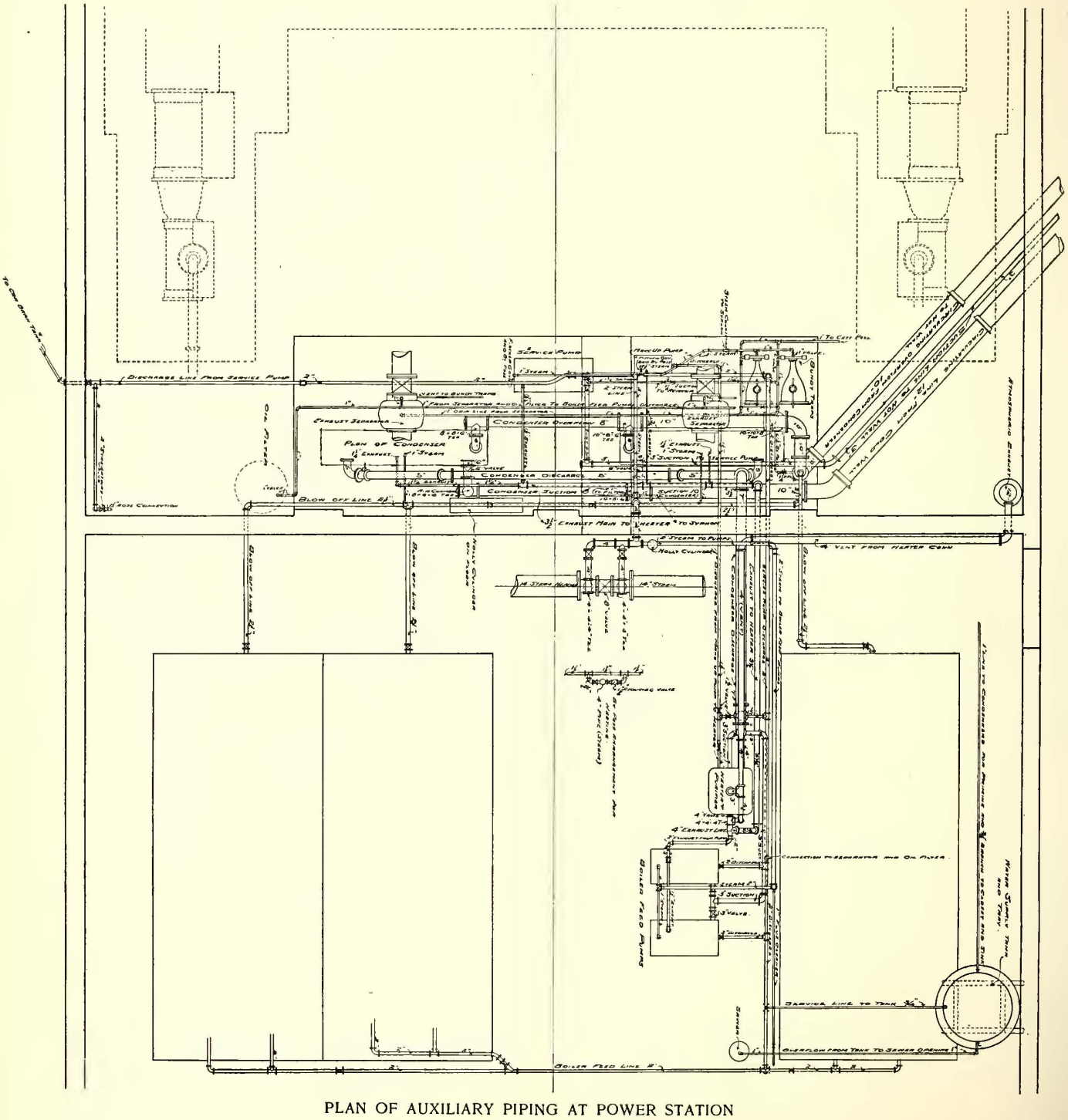
of the county highway bridges, and have independent abutments. They are all of the deck girder construction, with the exception of one through truss span over Banta's Forks, 118 ft. span. The bridges were furnished and erected by the King Bridge Company, Cleveland.

The ties are principally of white oak, with about 20 per cent chestnut, and were 5 ins. x 7 ins. x 7 ft. 6 ins. The rails are the A. S. C. E. standard, 70-lb. T, 60-ft. lengths, furnished by the Johnson Company. Seven-inch rails were used in West Alexandria, and 6-in. girder in Eaton. The track is ballasted throughout with 6 ins. of gravel underneath the ties, sloping 12 ins. outside the ties. The switches are 200 ft. in the clear, and these, with all other special work, were furnished by the Cleveland Frog & Crossing Company. The line crosses the Cincinnati & Northern at West Alexandria, and the Panhandle at Eaton. Derailers are provided at both crossings.

The trolley wire consists of two No. 00 wires, and there are six 300,000 cir. m. feeders of bare wire. There is also a complete telephone system, with boxes at numerous intervals along the road, and telephones in the power house and office and on the cars.

The road has no competition, there being no direct steam road communication between Dayton and any point on the traction line.

The company is at present operating four passenger cars and two combination cars, and transports both freight and passengers. The fare for the entire trip is 45 cents, or 75 cents for the round trip. The charges for freight are 25 cents minimum for packages, with the regular charge of 10 cents per 100 lbs. for light freight, but special rates are given for bulky loads, such as household goods, and the line is enjoying a very liberal patronage in both the freight and passenger departments. Long eight-wheel cars, with cross seats, are employed. The cars were built by the G. C. Kuhlman Company, of Cleveland, and are

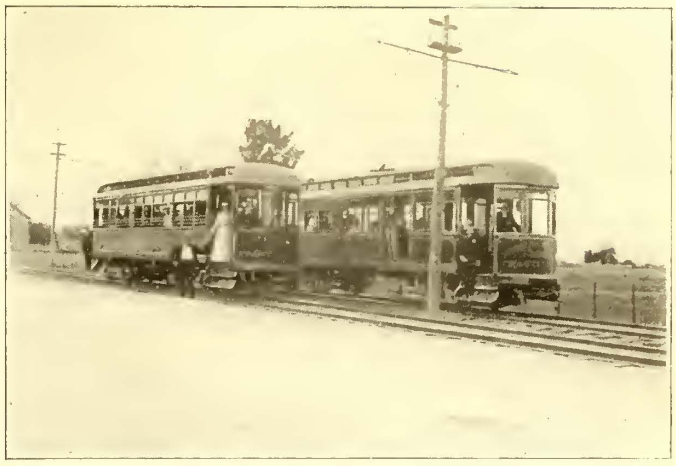


PLAN OF AUXILIARY PIPING AT POWER STATION

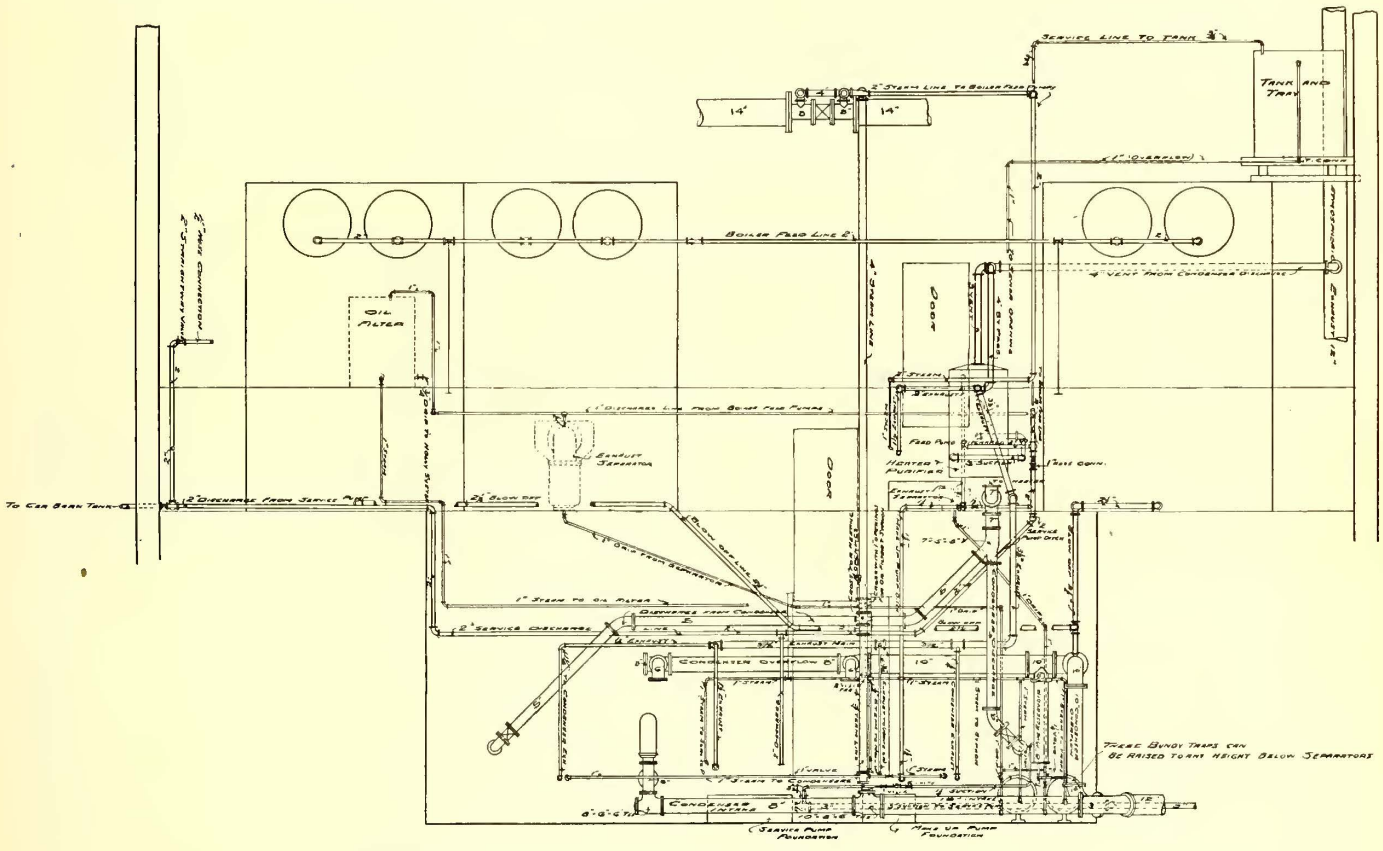
mounted on extra strong Peckham trucks, with two General Electric motors, and with electrical brakes of the General Electric type.

The station was located at West Alexandria, 17 miles from the eastern terminus. This site was selected because it was the only point between the termini where the line crossed a steam railroad, and where coal could be obtained without hauling it over the electric road. It was also the best site for water, as there was no location toward the middle of the road where water was obtainable. It was also thought probable that at some time there might be an extension or addition to the western portion of the line, in which case the power house would be at the center of gravity of the system.

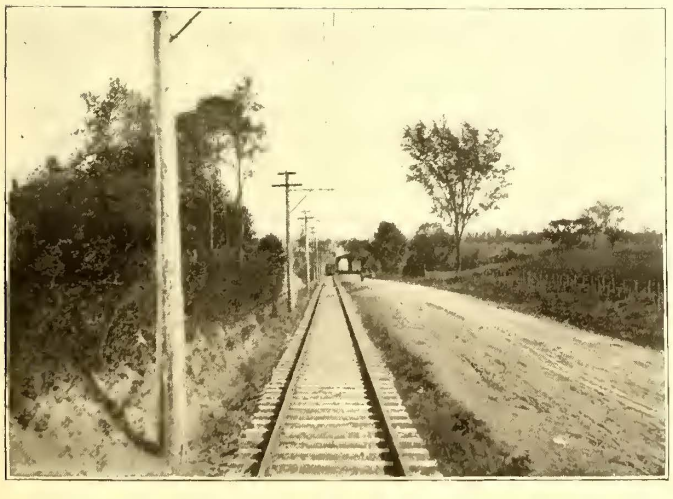
The station building is of brick and is located on the top of a bluff about 1200 ft. from Twin Creek, and about 32 ft. above the level of the creek. The bottom land lying between the creek and the foot of the bluff rises gradually toward the bluff until at the power house it is about 18 ft.



PASSENGER AND COMBINATION CAR



SIDE ELEVATION OF AUXILIARY PIPING AT POWER STATION



VIEW AT TOP OF 3.8 PER CENT GRADE 2600 FT. LONG

below the top of the bluff. Underlying the soil on the bottomland is a bed of gravel, and sufficient water to operate the condensing plant is obtained without the expense of a large pipe line to the creek by driving two wells, about 16 ft. in diameter and 18 ft. deep.

The power equipment consists of two 250-h.p. Buckeye engines, each of which is directly coupled to a Siemens & Halske 250-kw. generator. The engines are tandem compounds, with cylinders 15 ins. and 28 ins. x 30 ins. The units are placed parallel to each other, and the shafts of the generators are extended and coupled with friction clutch with a belt pulley. From this pulley is run a booster, which is placed on a line with the engines, so that it can be driven when one or both of the generators are in service. The booster is rated at 75 kw., and raises the voltage from 600 to 800 volts. It is connected to the line 8 miles from the station. The engine room is provided with an overhead traveling crane, which was manufactured

by the Cleveland Punch & Shear Company, of Cleveland, Ohio.

The steam is generated in two Babcock & Wilcox boilers of 250 h.p. each, and the auxiliary equipment consists of Wheeler condensers and air pump. The coal is delivered directly into the boiler room from freight cars by sidings that connect with the neighboring railroad lines. The operating office of the company is located in one corner of the car house, which adjoins the power station.

The entire engineering for the system was done by E. P. Roberts & Co. and the Osborn Company. In addition to the inspection on the ground, the structural steel was inspected at the mills for the tracks, bridges and structural work in the power house and for the boilers. The contractors for the line were the Chase Construction Company, for the overhead material the Ohio Brass Company, and the line arresters the Garton Company. The engravings for the article are from photographs taken by J. B. Crankshaw, electrical engineer of the road.

VIEW ON DAYTON & WESTERN RAILWAY

The officers of the company are: President, J. E. Lowes; secretary and superintendent, J. E. Feight; treasurer, Oscar Sheppard; general manager, Valentine Winters, and electrical engineer, J. B. Crankshaw.

Labor Saving Devices in Cincinnati Repair Shops

About a year ago the extensive new repair shops of the Cincinnati Street Railway Company were described in the Street Railway Journal. They have been found amply adequate for the purposes for which they were designed, as well as most conveniently arranged. During a recent visit to these shops of a representative of this paper a number of labor saving devices and other interesting features were noticed.

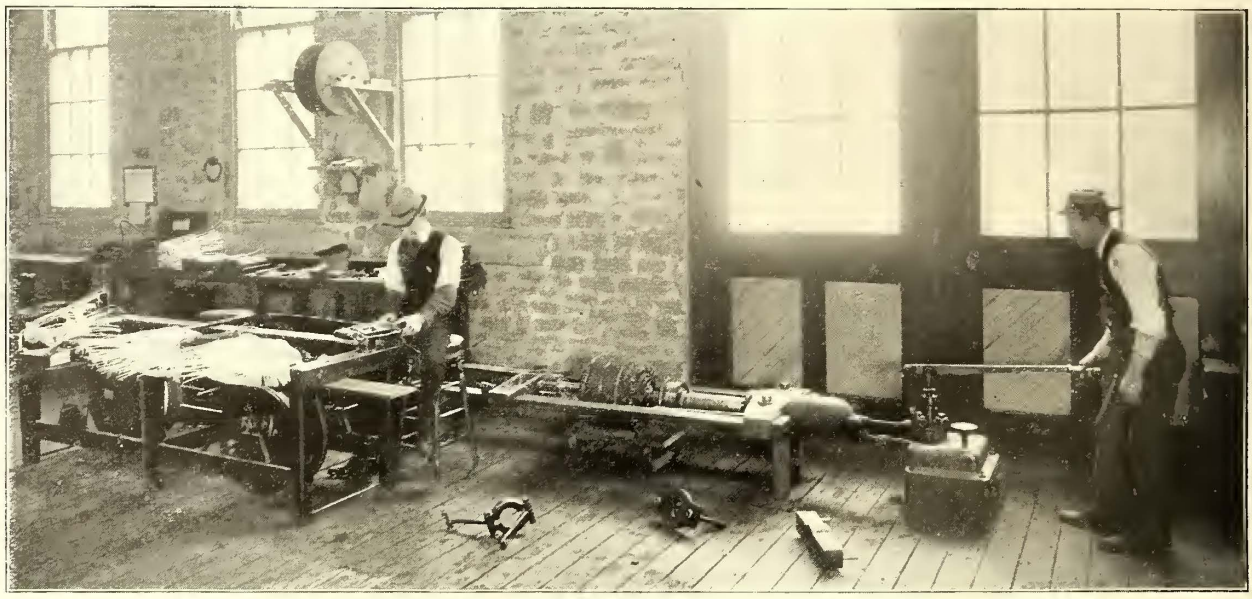


FIG. 1.—MAKING COILS AND PRESSING ON COMMUTATORS, CINCINNATI

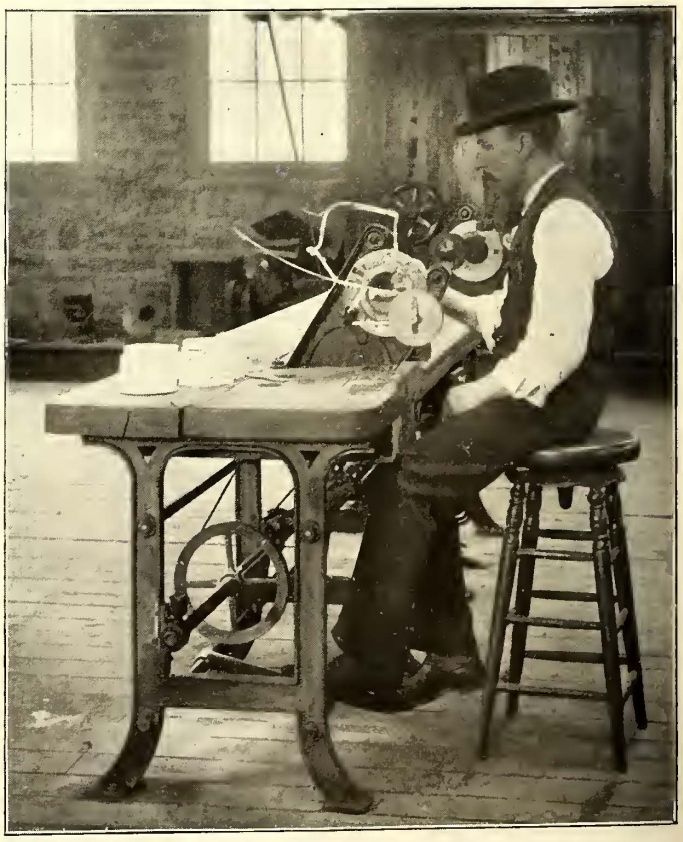


FIG. 2.—COIL TAPING MACHINE

In the motor repair department five hands only are employed. These are mostly boys or young men, who work under the direction of an expert repair man, and it will

be noted that this is an exceedingly small force for a railway of the size of the Cincinnati Street Railway Company, especially since it is the practice of the company to wind and tape all its own coils and fields and make all its own commutators. The latter are cast in the brass foundry of the company, of pure copper from the scrap trolley wire that is melted up.

Fig. 1 illustrates some of the forms on which the armature coils are made. In this same engraving is shown a home-made hydraulic press, which is employed for pressing on or taking off the commutators from the armature shaft. This press is operated by a hand lever, as shown in the illustration.

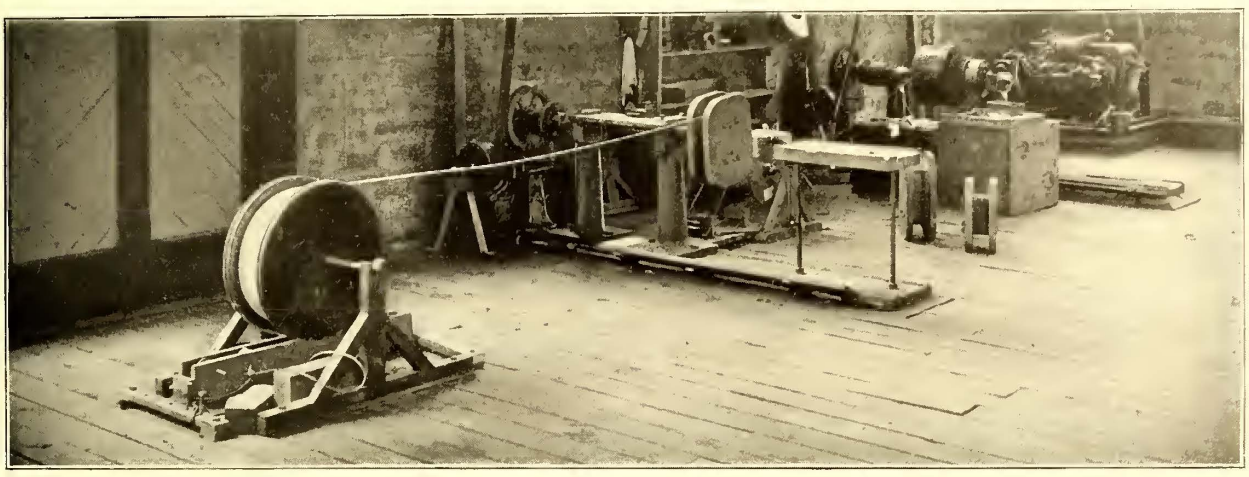


FIG. 3.—LATHES FOR WINDING FIELD COILS AND PLACING BINDING WIRE ON ARMATURES

Fig. 2 shows the coil taping machine, by means of which armature coils are taped very rapidly. This consists of two rings, one operated outside the other by means of a belt which is actuated by foot power, and which causes the ring carrying the spool of tape to revolve. Both the inner, or stationary, ring and the revolving ring are provided with slots which, when brought into conjunction, admit of placing one side of the coil within the ring. As the ring revolves the tape is paid out from the reel which carries it, and which has a governing spring that adjusts the tension. By this device coils can be taped very much faster than by hand. The shops are provided with two of these machines, and a large number of coils are taped up in advance, ready for service, and are stored in the stock room.

Fig. 3 illustrates the method of winding the field coils, which is done on a wooden form. In the same figure is shown a similar device for placing the binding wire on the armatures. These are each operated by power from a belt connecting with an overhead shaft, and the mandril is revolved through the medium of a friction clutch and a worm gear. The clutch is thrown in or out of operation by means of a lever operated by a long pedal, as shown. By this means the mechanism may be started or stopped at the will of the operator. These devices, as well as other shop tools, are operated by power from an electric motor, also shown in Fig. 3.

Four types of motors are employed on the cars of this system, according to the character of the grades and of the cars. They are the G. E. 800 type, the G. E. 1000, the G. E. 1200 and G. E. No. 58, and for testing the armatures of the four different types the device shown in Fig. 4 is used. It consists of a jack shaft driven by belt from a D 62 type of generator that has been transformed into a motor. It will be noted that the cases and fields of four different types of motors are geared to the jack shaft, and are kept in position, the armatures being placed in or removed by means of an overhead hand-hoist. In connection with this testing apparatus is a nest of incandescent lamps, which are cut in and out according to the tension of the current required in the testing.

For treating field coils and armatures Monarch asphalt paint is employed. This paint, when properly baked, proves to be as durable and as satisfactory as to insulating properties as any of the materials that the company has tried.

It is the practice to provide two sets of carbon motor brushes for each car motor, and the same for the generators in the different stations. The brushes for the motors are put in service every other day in summer and every three days in winter, and as soon as removed are placed in a pan of sperm oil, in which they are kept until again put in use. The brushes are all numbered and lettered, and are used on the same commutators. By this practice a long life is gotten from the brushes, two sets lasting a year. The practice also adds 100 per cent to the life of the commutator, some of which run for three years. They never require to be sandpapered or touched, but always run smoothly, with a gloss on the surface.

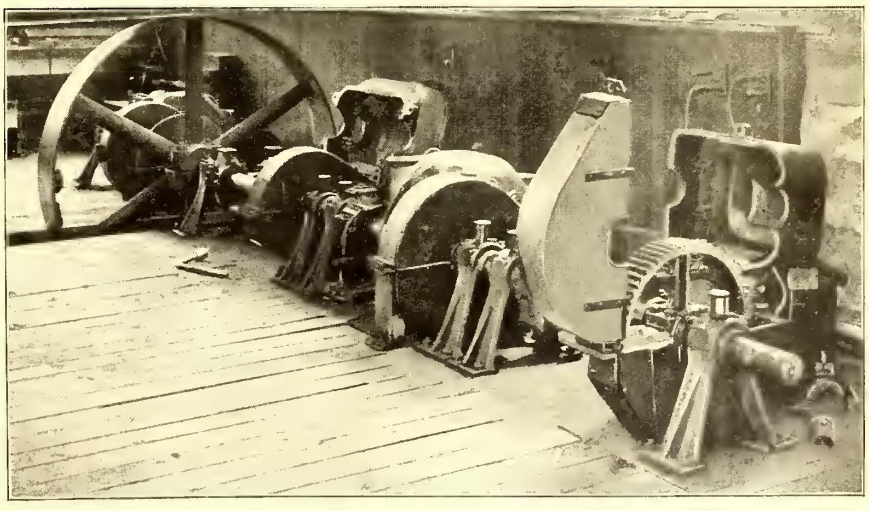


FIG. 4.—APPARATUS FOR TESTING ARMATURES

Power for operating the different departments of the

repair shop is derived from motors which are made over from the old D 62 type of generators formerly employed. Quite a number of these are employed, and have proved very satisfactory. There are besides twenty small-power motors employed about the shops and the different car houses of the system.

The company manufactures its own trolley wheels, the blanks being cast in their own brass foundry. They are turned on a specially designed turret lathe, the cutting tool of which works automatically and turns the sides and grooves at one operation. The lathe is operated by an unskilled workman, who receives only $1 a day, but is able to turn up and finish 125 wheels a day. The wheels are cast from a mixture consisting of eight parts of copper to one of tin.

The company employs bronze bearings for armature journals in preference to babbitt, as it was found frequently that the babbitt would squeeze out from the shell and allow the armature to come down in contact with the fields, and in case of excessive heat would melt.

The Present Status of Electric Welding of Rails

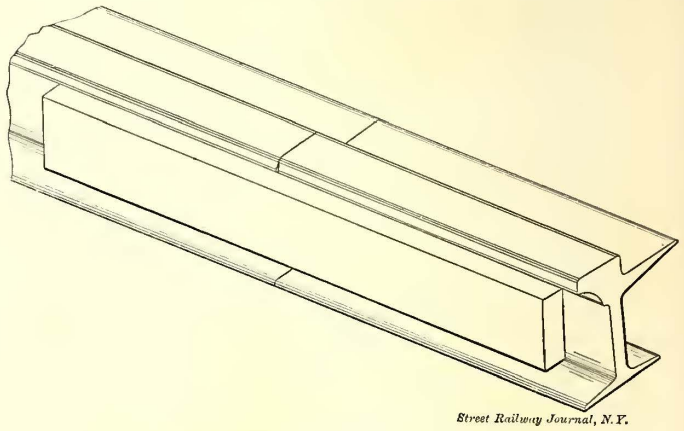
BY H. F. A. KLEINSCHMIDT

It will be remembered that in the early welding of rails, as carried on by the Johnson Company, peculiar indications of a change in the nature of the steel were observed. These were attributed for a long time to the electric current. Until the nature of the apparent change could be understood, the company withdrew from the field and entered upon an exhaustive series of experiments. Various methods of heat treatment after the weld was made were tried and discarded. Finally the writer, in endeavoring to prevent the spread of heat after the weld is made, discovered a very simple process which entirely overcomes any change in structure of the steel, and produces a weld of the greatest toughness and strength. This process consists in making a weld from a boss on a bar, instead of from a flat bar. As the boss is the only portion of the bar which comes in contact with the rail, all the heat is concentrated at that point. As soon as a welding heat is reached the current is cut off, and, simultaneously, a heavy pressure is exerted directly over the weld and artificial means provided for hastening its cooling while under pressure. The comparatively cold portions of the bar surrounding the boss prevent the more plastic metal from spreading, and the heavy pressure so confines it that in cooling there is no chance of coarse crystallization. In other words, the effect is exactly the same as hammering or working the steel.

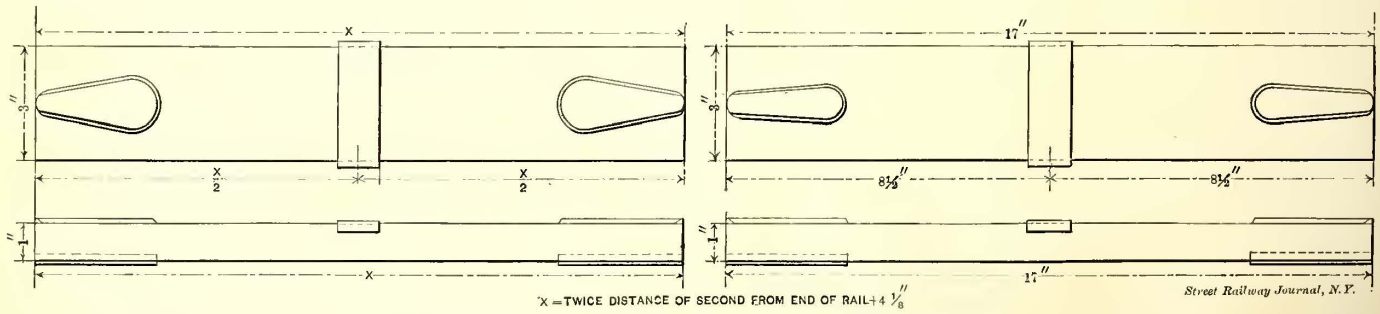
The results obtained experimentally by the Lorain Steel Company have been amply borne out by practice. Even with a strain of 350,000 lbs., we have never succeeded in shearing off a weld made in this way. On making a joint we use a bar 1 in. x 3 ins., having three bosses, as shown in the accompanying diagrams, and weld one bar to each side of the rail web. Bosses of an ovoid shape are used when old rails having punched holes are to be welded. The boss then covers the hole, welds it up completely, and thus removes the danger of old fractures at this point. Holes beyond the bars are reamed. The center weld is made first, then the end welds. The bars, when cooling, exert a powerful force to bring the rail ends together, making a perfectly tight joint.

In 1897 a little over a mile of track was welded in Johnstown. After a severe cold spell during the first winter one break occurred through an old bolt hole beyond the welded bars. No further breaks have occurred on this track. Last summer 10 miles of track were welded for the Nassau Electric Railway Company, at Brooklyn. Some of the joints had eight-hole splice bars, and others twelve-hole. In all cases the second hole on the top row was welded over by the end bosses, the bars being placed close under the head of the 9-in. rails. In the twelve-hole punching the holes beyond and directly under the end of the bars were reamed out, our experiments having shown that a punched rail, on account of minute fractures, is very much weaker than a drilled rail. Although the Brooklyn track was welded during the hottest weather, the number of breaks have only been one out of 180 joints, or a trifle over 0.5 per cent. In no case did a rail with the eight-hole punching break. The fractures all occurred through the holes beyond the bars, thus showing that the reaming had not removed all the fractures in every case. With new rails, having no holes, or rails in which the holes are drilled instead of punched, it is confidently believed a break will be an extremely rare occurrence. The fact that no fractures occurred until after severe cold weather set in proves conclusively that they were due entirely to the tensile strain to which the rails were subjected by contraction due to low temperature, and that the old trouble has been entirely overcome.

The experimental stage of the electrically welded rail joint is passed. In electric welded joints we are as sure



ISOMETRIC DIAGRAM OF JOINT



X = TWICE DISTANCE OF SECOND FROM END OF RAIL + 4 1/8"

BAR FOR PUNCHED OR DRILLED RAILS

BAR FOR RAILS WITH PLAIN ENDS

of our product to-day as in any field of production. With a given size of bar we produce a joint of certain strength and a uniformity of product as perfect as can be obtained.

The ultimate success of the process is due to the indomitable perseverence of Mr. A. J. Moxham, and to his faith that this method offered advantages superior to any form of joint, and that the field to be occupied has hitherto been unfilled.

For electric roads using their rails as a ground return it has manifest advantages. The cost, especially for the 9-in. girder rails which are now coming into almost universal use, is less than for any other form of so-called welded joint. As a bond it offers the only perfect method of reducing electrolysis to a minimum. The intimate union of steel to steel, and the increased carrying capacity due to the bars at the joints, make the joint the place of least resistance. An electrically welded track is of lower resistance than the rail itself.

There is no obstruction to paving, as the flat bar offers as good a surface for paving against as the rail web itself. Ties are not disturbed, as it is not necessary to go below the rail flange in making the joint. A continuous rail joint should last as long as the rail itself, and its wearing qualities should be the same. By our process the head of the rail is heated but slightly, thus avoiding the danger of annealing the rail head and softening it, which is apt to be the case where the whole rail is raised to a red heat when forming the joint.

In the apparatus used at present in this work we have made very few changes. A 75-kw. booster has been added, which permits good welding, even with a voltage as low as 300, and a sand blast apparatus has replaced the old method of cleaning the rails.

The Lorain Steel Company has started upon the electric welding of 50 miles of track in Buffalo, upon the system outlined above. Of this length about 25 miles will be of 60-ft. 9-in. rails, with ends left blank for the style of joint adopted.

Speed Tests on the Cleveland-Lorain Railway

In the last issue of the STREET RAILWAY JOURNAL some results secured in the power station of the Cleveland-Lorain Railway Company were published, under the heading "Analysis of the Operation of an Interurban Railway." Through the courtesy of E. P. Roberts & Co., engineers of that line, the STREET RAILWAY JOURNAL is able to give in this issue some additional statistics upon the speeds secured during trial runs and in regular service. The figures are particularly interesting, from the fact that the line is a high-speed electric road, with practically no grades and few curves. The cars with which the tests were made, the results of which are given, were equipped with four G. E. 57 motors, with gear ratio 1 to 5.7. Each car was mounted on two Brill No. 27 trucks, equipped with 33-in. wheels.

Table I. shows the result of four acceleration tests made in the same direction, with the same car, from the same point, and with the same motorman. The car weighed 23 tons, and the speed per hour given is the average speed between the 10-sec. readings.

Table II. shows four tests with three cars differently

TABLE I.—SPEED TEST WITH SPECIAL CAR.

No. of Car.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds		50 Seconds.		60 Seconds.	
			Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour,	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
1.....	23	1	9.1	133	20.0	426	20.8	877	37.7	1,430	43.2	2,064	44.0	2,724
1.....	23	"	9.5	138	21.8	455	....	....	...	1,520	42.4	2,146	46.7	2,830
1.....	23	"	10.1	148	21.0	457	31.7	922	35.3	1,449	39.9	2,034	....	....
1.....	23	"	10.1	149	23.5	493	32.9	976	38.1	1,535	43.0	2,165	43.4	2,802

All readings taken in same direction and from same point and same motorman. Could obtain test in only one direction as only one controller on car. No load.

TABLE II.—SPEED TEST WITH REGULAR PASSENGER CAR.

Car.	No. of Cars.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds.		50 Seconds.		60 Seconds.	
				Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
Car 15—22 pass., west.....	1	24	1	9.7	142	26.6	532	34.8	1,042	39.6	1,622	40.8	2,221	47.2	2,913
Car 15—14 pass., east.....	1	24	"	7.0	102	17.8	363	27.9	772	36.1	1,293	47.4	1,888	43.1	2,520
Car 14—25 pass., east.....	1	24	"	9.3	136	19.0	415	28.4	831	34.2	1,333	40.4	1,925	41.1	2,528
Car 13—12 pass., east.....	1	24	"	8.8	129	18.9	406	25.0	772	32.2	1,744	37.4	1,793	40.0	2,380

No wind of account. Different cars and motormen. Same section of track as in table 1.

TABLE III.—TEST WITH REGULAR PASSENGER CAR.

Car.	No. of Cars.	Weight of Train in Net Tons.	Grade, Per Cent.	10 Seconds.		20 Seconds.		30 Seconds.		40 Seconds.		50 Seconds.		60 Seconds.	
				Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed. Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.	Speed, Miles per Hour.	Distance Run, Feet.
Car 17—23 pas., west	1	24	1	9.5	139	18.6	412	28.0	822	32.7	1,302	40.7	1,898	41.7	2,509
Car 56—13 pas., new car east	1	24	"	10.2	150	....	....	....	833	20.5	1,280	38.0	1,837	40.4	2,429
Car 10—25 pas., east.....	1	24	"	8.5	124	18.7	399	29.3	829	35.9	1,355	40.2	1,945	43.9	2,589
Car 10—west	1	24	"	9.3	136	20.0	430	28.9	854	34.1	1,354	41.0	1,955	42.8	2,582
Car 13—12 pass., west.....	1	24	"	10.2	149	18.8	423	29.9	861	34.6	1,368	37.8	1,923	43.0	2,553

Wind was from east to west and 10 to 15 miles per hour variable. Tests 3 and 4 were made over same section of track with same motorman, but different cars and in opposite direction.

loaded, but with the same equipment as in Table I. As with Table I., there was practically no wind at the time of the test.

Table III. shows five tests in different directions, with wind blowing from east to west at from 10 to 15 miles per hour. The track is almost exactly east and west.

Table IV. gives the voltmeter and ammeter readings, with feet, for every ten seconds, corresponding to the last run in Table I., *i. e.*, 1-5 per cent down grade, 23-ton car, with four G. E. 57 motors, etc.

Table IV.—Acceleration Data.

Seconds.	Amps.	Volts.	Feet.	Total Distance.
10	485	500	149	149
20	350	520	344	493
30	275	550	483	976
40	225	570	559	1,535
50	195	575	630	2,165
60	180	580	637	2,802

Table V. gives a selection of readings taken under most favorable conditions at two points along the line. As will be seen, the averages are respectively 31.75 lbs. and 32.53 lbs. friction.

Table V.—Traction Data.

Selections of readings obtained under most favorable conditions. Track practically level and straight.

Place No. 1.

Car.	Bound.	Passengers.	Amps.	Volts.	Speeds.	Wind.
15	West.	0	150	595	45	6 m. per h. East.
15	East.	13	145	575	47	6 " "
15	West.	20	150	570	46	6 " "
11	East.	8	155	580	45	5 " "
13	East.	8	140	535	49	30 to 35 East.
13	West.	14	160	570	40	" "

Average gives 31.75 lbs. friction.

Place No. 2.

15	West.	0	155	615	48	6 m. per h. East.
15	East.	13	145	610	50	6 " "
15	West.	17	155	610	48	6 " "
11	East.	8	155	615	48	5 " "
13	East.	8	135	620	51	30 to 35 East.
13	West.	14	180	600	39	" "

Average gives 32.53 lbs. per ton friction.

The wind is usually from West to East, and on the day readings for car 13, run obtained was quite high and variable as to velocity.

Average of both places gives 32.14 lbs. per ton friction.

Table VI.—Traction Data.

Car No. 15.

	Bound.	Passengers.	Amperes.	Volts.	Speed.
Practically Same Point.	East.	13	145	610	50
	West.	17	155	610	48
	West.	0	155	615	42
Practically Same Point.	East.	13	150	600	47
	West.	20	150	580	48
	West.	0	155	600	45
Practically Same Point.	East.	13	145	575	47
	West.	20	150	570	46
	West.	0	150	590	45
Practically Same Point.	East.	15	145	605	48
	West.	22	150	600	47
Practically Same Point.	East.	17	140	535	44
	West.	24	140	420	37
Practically Same Point.	East.	17	140	505	45
	West.	24	160	550	42
Practically Same Point.	East.	17	145	505	..
	West.	24	165	510	..

Wind about 6 miles per hour west to east. Average gives 30.8 lbs. per ton friction.

Table VII.—Traction Data.

Car No. 11.

	Bound.	Passengers.	Amperes.	Volts.	Speed.
	East.	8	155	580	45
	East.	8	150	595	48
	East.	8	165	610	47
	East.	8	155	615	48
Same Point.	East.	9	175	600	40
	West.	14	155	605	45
Same Point.	East.	9	152	605	45
	West.	14	150	610	50
	East.	9	165	615	48
Same Point.	East.	9	175	595	40
	West.	15	175	590	43
	East.	10	162	535	37
	East.	10	155	525	48

Average gives 34.6 lbs. per ton friction.

Wind about 5 miles per hour. This car seemed to me heavier than others, this was noticeable from rapidity of retardation when power was thrown off.

The results in Table VI. were obtained to determine the effect of wind resistance on speed. All readings are on the same car, and were taken in some cases while the car was running easterly, and in other cases in a westerly direction. The loading, necessarily, was different, however, as the car was in regular service. Tables VII. and VIII. are made up in the same way, except that other cars were under observation, and the velocity of the wind was different. In each case the equipment of the car was the same, viz., four G. E. 57 three-turn motors on Brill No. 27 truck, 33-in. wheels and 1:5.7 reduction.

Table VIII.—Traction Data.

Car No. 13.

Bound.	Passengers.	Amperes.	Volts.	Speed.
East.	10	140	535	..
West.	14	160	570	40
East.	10	150	600	..
West.	14	175	590	43
East.	10	135	620	51
West.	14	180	600	39
East.	10	145	610	40
West.	8	160	600	40
East.	10	145	550	45
West.	8	160	550	40
East.	10	165	535	48
West.	8	155	530	40
East.	10	145	560	45
West.	8	165	500	38
East.	10	140	525	45
West.	8	150	525	38

Average gives 32.6 lbs. per ton friction.

Wind high 30 to 35 miles per hour, West to East, and variable velocity. Very fair tests, as had few stops having mostly through passengers.

Carrying Mail in Germany

The carrying of mail pouches has been a part of the street railway business in Germany for some time. The manner in which this has been done is that a postal clerk, by paying the full or partial fare, traveled as a passenger and guarded the bags, or if but one or two pieces had to be transported at a time, the bags were placed on a certain car at a definite time by a postal clerk, and there were guarded by the motorman until the car reached its destination, where the matter was delivered to another postal clerk by the motorman.

Up to now these have been the only methods employed. Recently, however, special agreements have been made between the imperial postal service and the larger street railway lines, such as that in Berlin, to the effect that the companies will operate, for a certain compensation, specially constructed mail cars over their lines. Already most of the roads which are subject to the Prussian laws governing street railway lines have been obliged to have such a clause inserted in their original franchise; they would gladly have consented, however, without such compulsion, to transport merchandise—although originally the lines were intended for passenger traffic only—as considerable profit can be derived from such service.

With the transportation of mail, however, the exclusive use of the lines for passenger traffic has become changed, and there is a growing demand in a number of cases to introduce a parcel express service. In the granting of new franchises the municipalities have insisted in several cases that the roads for a certain consideration will transport corpses, the city's building material, such as paving stones, etc., as well as convey refuse matter; and at Hamburg they are even compelled of late to transport cattle to the slaughter houses.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee, V

Schenectady Railway Company.

Schenectady, N. Y., May 19, 1899.

Editors Street Railway Journal:

Concluding the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

12. Are they free from unnecessary repetitions, either within themselves or with one another? Rule No. 8 for Motormen is an exact duplicate of the first part of Rule No. 17 for Motormen and Conductors, and Rule No. 12 for Motormen is an exact duplicate of the last part of this rule. The latter part of Rule No. 18 for Conductors and Motormen is a repetition in idea—though not in phrase—of the latter part of this same Rule No. 17 and its duplicate, No. 12, thus triplicating a rule. The second paragraph of Rule No. 14 for Conductors repeats the same ideas as Rule No. 23 for Conductors and Motormen. These are specific instances of repetitions and duplications where the language and ideas are identical, and there are several other cases where the idea or general meaning is repeated. Now, it is true that the above repeated rules are important "safety rules," and neglect of them has probably caused serious loss to many companies, but they are not so important as *some* of the safety rules, and not a bit more important than some of the others that have not been repeated in either ideas or language. If the idea of the committee has been to make repetition act as emphasis to particularize important rules, their ideas of the relative value of rules are, to say the least, peculiar.

The value of any particular rule or rules is, with the exception of possibly one—that relating to accidents—very hard to fix—in the rule book. It is a difficult task to impress on a new employee by anything in the rule book the true value or importance of even the rules that the employer considers most important; it may be possible to impress him with one or two, which show their value on their face, but anything beyond that tends to bewilder him and give him false ideas. The true—and the relative—importance of a rule, or rules, must be mainly learned in his practice of them, and for this reason it is best in the rule book to emphasize only *one* of them—the one treating of the management and reporting of accidents, and to emphasize this one in some other way than by repetition. Any other rules may have their salient points emphasized by italics, capitals, etc., but in no other case should any one rule be emphasized as a whole. The sense of the value of the rules and of care and responsibility must be impressed on the new employee by the palpable clearness, completeness and logicality of the rules, by the care inculcated in their use, by the precepts and practice of his superior officials, by the example of his fellow employees, by the rewards and punishments meted out by his employer, and *not* by the inane repetitions of certain rules, ideas, or phrases.

13. Are they free from unnecessary, irrelevant, or axiomatic remarks and directions? Unhappily they are not! This point has been gone over in another article, but something still needs to be said on the subject. Rules are virtually specific "instructions," and as such should be as formally concise as is possible, everything necessary to the subject *must* be included, everything unnecessary *must* be excluded, therefore such remarks as "It is your duty to do so-and-so," "you will be held responsible for not doing such-and-such," "never do" such a thing, should not be placed in the rules—they are unnecessary, besides being senseless.

Other unnecessary remarks and directions are those which treat the new employee as an uncivilized savage, a hardened tough, or an idiotic imbecile, by pelting him with orders not to do some one or more of a hundred things that no sane civilized person would think of doing in the street railway service at present, especially if, as should be the case, the example of his superior officials and of his co-employees shows him at once that such things would not be tolerated for an instant. If the street railway industry were an absolutely new one, and the committee were making the rules for the very first street railway in existence, such orders and remarks might be tolerated, but with the developments of the last few years and the higher class of men now employed as conductors and motormen, the "usages" of the street railway have reached a higher plane, and these usages—the "*lex non scripta*" of the profession—can be safely trusted, in a set of general rules, to take the place of such remarks as have been instanced and spoken of.

14. Are they unnecessarily peremptory in tone? Do they use "must" and "shall" and "never do this and that" more than is needful? They certainly do! Now, while this is not a vital point, it is one of the minor ones that is worth considering as going to make perfect discipline, *not* the stiff-starchedness of military discipline, where the supreme authority and the power of life and death are behind the "orders;" *not* the dread of strict authority and the *letter* of the rules; *not* the fear of fines, suspensions and dismissal; but the heart-whole, cheerful, willing and intelligent obedience that makes a unit of the employees in their employer's interests; *that* is the true discipline of a street railway service, and to conserve which it is not necessary to use peremptory terms except as a means of emphasis in special cases, or—as in the case of the "qualification rules," where a standard is set to which all employees of a certain class must conform. To state in a rule that an employee "will" do such and such a thing is to make him feel that he does it voluntarily, or is *led* to do it; to state that he "must" or "shall" do it, is to make him feel that he is being *driven*.

15. Are they addressed to the second person, "you," or do they address the employees impersonally as "he," or "they," the latter preferably, for reasons given in a previous article? They do both; they mix these "persons" up in a way that would make the average employee wonder who he was. This is another point that is not vital; it is one of the "little things," but it only takes a little care in composition, and if strictly carried out adds to the force and appearance of the rules—unluckily it adds also to the elegance of their phraseology!

16. Do they threaten? No; the rules themselves are free from this defect, but—following Rule 23 for Motormen is a section entitled "Penalties," which invites criticism, both from its location—which may have been an inadvertence on the part of the committee—and for its contents. In its first paragraph is given a list of offenses that "are considered good grounds for dismissal from service," and among these are included dishonesty, lying, drunkenness, reckless running and—smoking and reading newspapers! This reminds one of the "good old days" when a person was hung for murder—and also for stealing a pig! Had the committee left out proven insubordination, dishonesty, lying, drunkenness and recklessness, which are *crimes* in any service, and therefore "dismiss" of themselves, and said "while on duty, the following, if repeated

or persisted in, will be good grounds for dismissal," there would have been some reason in the statement, although it is—in the writer's experience—bad policy to explicitly and formally specify dismissal for anything except the five "crimes" mentioned above. To all the other offenses and faults there are often found, on close and impartial examination, so many mitigating circumstances that a rigid application of a dismissal rule for such minor offenses as are given among those specified by the committee would be unjust and unwise.

The old quotation, "a little learning is a dangerous thing," is aptly illustrated in the case of new conductors and motormen. Knowing their own complete ignorance at the start, they are then very teachable, but when first "turned in" and put on "extra," or "regular extra" runs they will, despite previous good training, get the "big head" and run amuck among the rules. This is recognized by all who have the training of men as the first "critical period," and it is at this period that the disciplinary power of the official is shown. If it is of the "Medes and Persian" order, the employer will lose many good men—much potentially good material. If it is of the jelly-fish order, the employer will gain many poor men—much potentially bad material.

If, however, the discipline is of the kind that reckons on the "human element" among the employees, if it does not expect wings to sprout on their shoulders as soon as they enter the service, if the employer has the three "knows"—knows his business, knows his men, knows *himself*—then at this "hour of trial" to both the employer and the employee, cast-iron rules will not prevail as regards minor offenses, and the employer will be the gainer by so many "ripened" employees, men who have learned through hard experience that they "don't know it all"—the most valuable lesson that can be learned, and one that can only be learned by experience—the experience of failures —and for which the committee would recommend unlimited dismissal!

The second paragraph of this section recommends two punishments "for other offenses not meriting dismissal," although after the sweeping list just preceding, it would be a little hard to tell just what these "other offenses" could possibly consist of! Suspension without pay is damned without a hearing, which is unwise. *Indiscriminate* suspension without pay *is* unwise, but the writer has seen cases where the suspension without pay gave lasting good effects when other measures failed, and it did not "encourage dishonesty, hatred and discontent." "Punishment" is, as a rule, to be avoided if possible, but "it takes all kinds of men to make a world" (likewise a street railway), and, as we have been assured for ages "that one man's meat is another man's poison," it is as unwise to avoid all punishments, or to limit their number and kind, as it is to accord dismissal for pretty nearly every possible offense. The "Mikado's" practice "to make the punishment fit the crime," while a novelty in law, was hardly one in discipline, as many a successful superintendent and manager will testify.

To conclude: The members of the committee have asked for criticism—it is due them, for the report, if left unquestioned and uncriticized, might have had influence with those unfamiliar with the subject, and have done considerable harm.

In view of the fact that the Railroad or Street Railway Commissioners of some States are suggesting the promulgation by themselves of a set of rules—or at least of a set of *safety* rules—the use of which is to be enforced on the roads under their jurisdiction, it behooves the street railways of any State having such a Commission to see that such rules are those which *their* experience shows to be good and proper, and that they are put in, at least, *usable* shape. It also behooves the A. S. R. A., in its capacity as a *national* organization, to see that these rules as they are promulgated in one State after another, are as nearly uniform as possible, so that such inconsistencies as are manifested in such State laws as those in regard to—for instance—bankruptcy and divorce, do not occur in rules which may have the force of laws, and which—under the increase of interstate operation and ownership—may affect many corporations and employees. For this reason it is the province of the A. S. R. A. to set a committee of its own the task of preparing a set of *general* rules to be submitted to the various *State* Street Railway Associations for criticism and suggestion, with a view to making them *uniform* and *standard* for the whole United States, or for such of them as now have Railroad or Street Railway Commissioners, or legislative bodies or committees of like character and powers. If such action is not *promptly* taken by the A. S. R. A., and carried out thoroughly and effectively, we may within the next few years see a heterogeneous mass of conflicting and inefficient rules in adjacent States —beside which the present divorce laws and the rules suggested by the committee will seem good, clear, equitable and consistent.

H. S. Cooper.

Power House Operation

Cleveland, Ohio, May 18, 1899.

Editors Street Railway Journal:

An explanation should be made of the power house report at the top of page 267 of the last issue, in which the kw. hours per car mile are given as 3.4 and the lbs. of coal per car mile as 21.8. This to a certain extent is misleading as to the economy of the plant, as this figure includes the electric heating and lighting load, as well as the steam used to heat the large pavilion. No devices are installed for measuring these separate items, so that an estimate must be made of the amount of power consumed by each, in order to reduce the figures to the net kw. hours and net pounds of coal required to produce a car mile.

During the week referred to the pavilion required heat during a large part of each day, making an average of one-half of the total heating surface for 16 hours per day, or 112 hours per week. There are 7000 sq. ft. of radiation, and at 130 sq. ft. per h.p., this requires 54 boiler h.p. One-half of this, or 27 h.p., at 4.5 lbs. of coal per boiler h.p., gives a total of 13,552 lbs. of coal used per week for heating. Call this 13,500 lbs. 121,465 lbs. — 13,500 lbs. = 107,965 lbs. coal used for the week in running the road, including heaters, light and machine shop motor. 107,965 ÷ 22,451 = 4.81 lbs. coal per kw. hour.

Taking up now the electric heating, there are two cars on the line for 21 hours each day, and generally one in the station, all using current in the heaters. The machine shop motor and lights also take current, making the average steady load, exclusive of that taken by the car motors, about 40 amps. for the 21 hours. This is exceeded when the machine shop motor is running with the car lighting, but drops below when the lights are turned off, and also when the motor is stopped. 40 (amps) × 700 (volts) × 21 (hours) = 588 kw. hours per day, or 4116 kw. hours per week. Deducting this from the total for the week given results as follows: 22,451 — 4116 = 18,335 kw. hours per week, or 2,619 per day, and this, with the average of 823 car miles per day, gives 3.18 kw. hours per car mile, instead of 3.9. 3.18 kw. hours per car mile at 4.81 lbs. coal per kw. hour gives 15.3 lbs. coal per car mile, instead of

the 21.5. These results more nearly agree with the results obtained during the week ending May 14, 1899, during which there was little or no heating, and but little lighting; *i. e.*, total kw. hours per week, 20,798; average coal per kw. hour, 5.5; deducting for the machine shop motor, 10 (amps.) × 700 (volts) × 10 (hours) × 6 (days) = 420 kw. hours per week. This gives 20,378 kw. hours per day. There were 8,795 car miles, which makes the averages 2.31 kw. hours per car mile and 12.7 lbs. coal per car mile. No records are kept of the time which the service pump runs, so that no allowances are made for same.

Referring to the decreased coal consumption per h.p. and per kw. hour, this is very well shown by the record for the two consecutive weeks ending April 30 and May 7, 1899. The first week was run under regular one-hour schedule, and beginning with the second week cars were added to make one-half-hour schedule between 7.15 A. M. and 9.45 P. M.

	Week Ending April 30,	May 7, 1899.
Total kw. hours	15,273	19,741
Total coal	101,145 lbs.	107,245 lbs.
Average kw.-hours per day	2,181	2,820
Average kw. per hour	103	134
Average coal per kw.-hour	6.6 lbs.	5.4 lbs.
Average coal per h.p.	4.9 lbs.	4.0 lbs.

Yours truly, E. P. ROBERTS & Co.

An Argument Against Rear Grab Handles

DENVER, May 3, 1899.

EDITORS STREET RAILWAY JOURNAL:

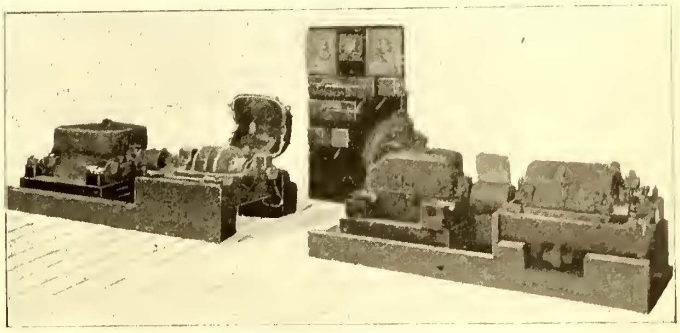
A large percentage of the accidents which occur on street railways is caused by ladies, and others unacquainted with traveling, stepping from the cars (before they have stopped) and facing in the direction other than that in which the car is going. My impression is that this practice is caused because they are not accustomed to use their left hand. If this opinion is correct, many accidents might be averted if the rear grab handles were dispensed with. I make this suggestion in hope that the cause, whatever it may be, is learned and efficient preventatives applied.

JNO. C. HENRY.

Testing Armatures in Repair Shops

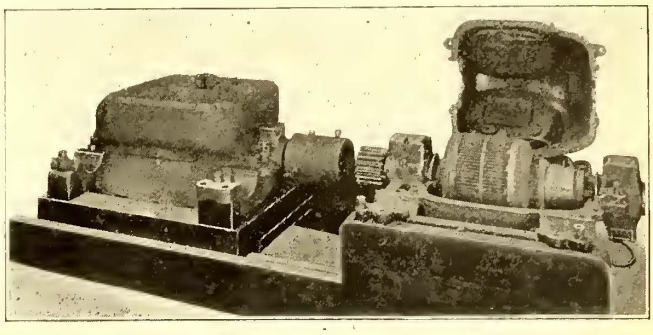
It is most desirable to thoroughly test all apparatus repaired in the shops, rather than run the risk of its breaking down on the road, but the trouble of putting armatures into the motor fields and giving them a practical test under load has sometimes induced superintendents to remain content with the ordinary magneto tests. An ingenious arrangement for testing armatures quickly, however, has recently been devised by Mr. Adams, master mechanic of the North Jersey Street Railway Company of Jersey City and Newark. This device has been in use in that company's repair shops on the Plank Road for some time with excellent results.

Mr. Adams has mounted a G. E. 1000 field rigidly in a wooden frame, and next to it a G. E. 1200 field, arranged so that it can be slid in a direction parallel to its armature shaft. In mounting these motors armature shafts are kept in line. The upper halves of the fields are arranged so that they can be lifted back without unscrewing any bolts, the place of the bolts being taken by taper keys. When a G. E. 800 and 1200 armature have been repaired in the shops they are carried to the motors on a traveling hoist and lowered into their places, the pinions coming opposite each other. The 1200 motor is then slid along its ways until the pinions touch, and the two are connected together by a sleeve, which surrounds the pinions and is fitted with six set screws which fit between the teeth. One motor is then run from the railway current, operating the other as a generator, the current for the second motor being taken



TESTING RACKS FOR ARMATURES

up by a water rheostat. A switchboard, located near the testing device, gives the amount of current used and generated. After having run in this way about seven and one-half minutes, the connections are changed by a double-throw switch, so that the former generator becomes a motor and the former motor a generator, thoroughly testing both machines. Adjoining this is another testing rack of a smaller type, made up of a Westinghouse No. 3 motor and a G. E. 800 motor.



RACK WITH ARMATURES DRAWN APART

In front of the motors is a large frame for holding the armatures to be tested. Every armature which leaves the shops is taken directly to this place to be tested, independent of the extent of the repair, even if it is only the replacing of the canvas on the end of the armature.

The entire system is very simple, and it takes only a few minutes to change the armatures on both machines, and the entire process can be carried on by one man and helper.

Municipal Regulations in Germany

An instance of the minuteness of the German municipal regulations in regard to street railways is shown by a recent ruling of the Police Department, that it is dangerous for a conductor to pass along the steps of open horse cars which have transverse seats. The railway company has therefore been obliged to cut a passage through the seats and end partitions of some cars that it has been operating. As the width of the cars in Germany is restricted to 2 meters (6 ft. 6¾ ins.) outside, this ruling reduces the carrying capacity 25 per cent, so tht a six-bench car will seat but eighteen people. Standing inside is prohibited on all German roads, but a limited number may stand on the platforms; this limit, however, which is plainly posted, is strictly enforced.

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Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

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A most valuable aid to the work of a building engineer on electric railways is a portable camera by which he can retain views of the construction of a power station or roadbed while in progress of completion. These views may often prove of value after the construction has been finished to show how certain portions of it were installed, as well as form an interesting souvenir. Important records, also, can often be made with a camera on operating roads by the superintendent or other officials.

Punctuality in running times is one of the best methods of securing and retaining business, particularly where cars are run on long headway and a person desiring transportation has to wait for a considerable time if he misses a car. This is so well recognized as to be almost a truism, but the best of care in timing cars at the termini of lines or at widely distant points on long distance lines does not prevent the motorman from departing from his schedule sometimes, especially if no particular system of checking this feature is adopted. It would not seem a difficult thing to do to establish frequent points along the line of a railway, such as by numbering certain poles, and the employee would then know whether he were behind or ahead of his schedule by comparing the time at which he passed these poles, as indicated by a watch carried on the dash, with the proper moment as given in his time card. Inspectors could be instructed to check up the crew, if necessary, by boarding the cars at different points and comparing the attained time with the schedule.

The ability to study each problem separately and suggest the remedy which is best suited to the conditions, is as important in electric railway work as in any other industry. There are so many factors involved in economical operation that it is not safe to assume that the same solution will do in every case. An instance of this occurred upon a railway recently where it was found that adding 4000 lbs. to the weight of a car cut down the watt output. This anomalous condition was caused by the topography of the road. It was in the form of a single track loop, with a comparatively steep grade near the power station, and a gentle descending grade for the rest of the line. The lightly loaded cars would not descend this grade without using current, but the heavily loaded cars required the use of motors only at starting. The result found was that when the line losses and motor losses for the lightly loaded cars, while on the loop, were compared with those of the heavily loaded cars when mounting the grade near the station, the former were found to be in excess.

Governor Roosevelt, in a recent speech made in Buffalo, said, in referring to the subject of taxing franchises:

"On the one hand we have the perfectly simple savage who believes that you should tax franchises to the extent of confiscating them, and that it is the duty of all railroad corporations to carry everybody free and give him a chromo. On the other, we have the scarcely less primitive mortal who believes that there is something sacred in a franchise, and that there is no reason why it should pay its share of the burdens at all."

In this enumeration, the Governor omitted to mention a third variety of political economists, whose teachings are equally fallacious and far more dangerous to the public than either of the two described. This is the *soi-disant* reformer, who thinks he takes a middle course between the other two views when he advocates franchise taxation and lower fare bills or the absorption of quasi-public corporations by the municipality without any knowledge of or investigation into the real conditions under which these companies operate. It is comparatively easy to protect property against the believer of direct confiscation. It is the person who advocates indirect confiscation under the plea that because in other countries and other conditions street railways do so-and-so, that is the most dangerous to the community.

The electric system has monopolized the attention of street railway engineers for so many years, and its advan-

tages have been so thoroughly demonstrated, that the claims of other powers during the last decade have received scant attention. The latest claimant for a hearing to demonstrate its ability to compete with the electric system, however, is compressed air—latest, not because trials in this power were not made before or concurrently with the electric system, but because the use of compressed air under high pressures as now being tried in this country is entirely new in the history of its application to railway service. Mechanically, the air power motor has been most carefully designed and it is our opinion that if the system should become a successful competitor of the electric for street railway use, it will be upon the general lines described elsewhere in this issue. It is needless to say, however, that some time must yet elapse before absolute figures as to the cost of operation in regular conditions of service on a large enough scale to make this comparable with electric railway service, can be secured. In many respects the system is an attractive one, but it remains to be seen whether there may not be troubles which are not now apparent, but which may militate strongly against its employment.

Elsewhere in this issue a description is published of the use of the three-phase system for current distribution upon a long interurban line. The small percentage drop secured by the use of high tension currents makes the system an attractive one; a number of these lines have been built during the last year or two, and a much larger number is now being installed. While much economy can often be secured in reducing loss of power on the line and in first cost by this method as compared with the several methods of boosting direct current, there are certain disadvantages connected with the three-phase system for small roads which ought not to be overlooked, and while local conditions do vary the problem greatly, it is a question whether electrical engineers are not rather prone to install the three-phase system for railway work when the same, or a slightly greater investment in copper would not secure more satisfactory results. The installation in a power station of both continuous and alternating current machinery, with the use of a substation with converting machinery, adds considerably to the variety of types of spare parts which must constantly be kept on hand to avoid a shut-down through accident. This is a more important consideration for a small than for a large road. Again, the depreciation upon this machinery must be equated against the capital investment and compared as well with that on copper wire, which is practically nothing. We, therefore, recommend designers to go carefully over their estimates on the cost of current distribution apparatus, before selecting any particular methods.

It is a well-known fact that the success of an electric railway company depends largely upon the motormen and conductors, and the ability and faithfulness with which they discharge their respective duties. The conductors are the employees most closely brought in contact with the general public, and the opinions formed by the latter of the company are drawn very largely from the treatment received from the men who collect the fares. The motorman, on the other hand, is the engineer of the car, and, especially in crowded streets or where high speeds are attained, his duties require a skill and discretion which are not found in every man of intelligence; in fact, the opinion is growing more and more pronounced that too much care can hardly be expended in selecting the proper men for this important position, or in training them for the proper discharge of the peculiar duties which they have to perform. Emergencies may often arise in a crowded street at any moment which demand the exercise of a high degree of coolness, judgment and a complete knowledge of the operation of the apparatus in their charge, and any defect in one of these qualifications may mean a serious loss to the operating company. While the possession of these qualities is to a certain extent innate, it can also be acquired, and no motorman should consider himself as competent unless he understands exactly the use of the apparatus under his control. By this it is not meant that he should necessarily understand all the electrical connections, or the principles of motor operation, but that he should know, *instinctively*, the exact distance, for example, in which he can stop his car at different speeds by the application of the brakes, the acceleration secured at different positions of the controller handle, the effect of a short circuit, etc. We note with considerable interest that a number of companies have established schools for instructing motormen on the special points on which a good knowledge is desirable. The Metropolitan Street Railway Company of New York, for instance, has fitted up one large room with eighteen or twenty brake-stands, as well as a complete motor truck, fully equipped with controller, brake, sand box, etc., all raised a short distance from the floor, so that the wheels can be revolved and the brakes applied, as in actual service. Around the walls of the room are hung photographs showing the right and wrong ways of applying the brakes, etc., diagrams of the motor connections, and other information which are useful on the road. Regular lectures and talks on the subject of car operation are given by the head of the instruction department, who also explains the proper procedure in case of emergency.

The most admirable thing about the Milwaukee street railway system, which we fully describe and illustrate in this issue, is its conservative financial scheme in which amortization of franchises, depreciation, uninsured losses by fire, accidents, and other contingencies are cared for by special reserve funds to which are passed each month from earnings, predetermined sums. Whenever a company's franchises are limited in tenure, particularly as in the case of Milwaukee, when they expire in so short a time as from twenty-five to thirty years, it is not safe to proceed upon the assumption that they will doubtless be renewed to the present company at the end of the franchise period, but the possible losses to stockholders which may be realized at that time, should be provided for years beforehand by such a reserve fund as that which the Milwaukee Company has wisely established. Depreciation, to which the happy-go-lucky manager shuts his eyes, inevitably forces itself upon his attention, usually at some particularly inconvenient time, by urgent demand for new track, new cars or new motors. The car house, with all its contents, burns down and has to be replaced at a cost twenty-five per cent greater than the insurance money obtained. Is this twenty-five per cent to be taken out of capital, or are the

earnings of the year properly chargeable with it? The theory of these reserves for contingent losses is that the first duty of the manager of any enterprise is to return to those who have invested money in it the principal of their investment, and his last duty is to declare the profits, and these profits should not fluctuate within wide limits from year to year.

The Ford Franchise Bill, even in its amended form, is an example of crude and ill-considered legislation, which is not an honorable part of the record of the State of New York or a credit to Governor Roosevelt, good as his intentions undoubtedly are. To tax as "real estate" that particularly unreal and intangible thing called a "franchise" —a thing whose value is changed every day by the whim of legislatures or councils, by the autocratic decrees of city department heads and tax assessors, by the judicial decisions of the courts, and by the will of the public affecting earning power—is a self-evident absurdity. But this is not the worst error of judgment. The Ford bill is capable of a thousand interpretations and can be put into effect only by the selection of some one method of arriving at the value of franchises from a host of those which may be suggested. The power of making the selection is, by the amendments to the bill just passed at the special session of the legislature called for the purpose, placed in the hands of a state tax commission whose judgment is final, subject only to revision by the courts in equity proceedings. Why was not the method of arriving at the value of these franchises specified in the bill itself and made a part of the statutes? The answer is that neither Governor Roosevelt nor the New York Legislature cared to take the responsibility of suggesting a practicable plan or could do so in the limited time allowed. They, therefore, leave this responsibility with the newly created tax commission without providing, as is usual in such cases, that the commission shall report its plan back to the legislature for final action, but they put in the hands of these few men the right to determine the value of thousands of millions of property. Such a power is far too great and is not in line with our institutions or traditions. By far the safer plan in dealing with interests so large, would be to carry out what is reported to have been Governor Roosevelt's first intention, namely, to refer the whole matter of taxation to a commission formed of the best legal and expert talent in the state and to have guided legislation by their report. As it is, the Ford bill, even in its amended form, is quite likely to be declared unconstitutional, in whole or in part, and the heavy expense to the state of the extra session will be lost, to say nothing of the harm caused by the unsettling of values meanwhile. We have been surprised to see that in the whole course of the discussion in the Legislature and Executive Chamber at Albany so little attention has been paid to the excellent, public spirited work done by the special commision appointed by the Governor of Massachusetts some three or four years ago to investigate the subject of street railway taxation. The plan determined upon by this commission, after a year or more of research, was in most respects sound, legitimate and consistent, far more so than this mongrel legislation fathered by Senator Ford and Governor Roosevelt, which will surely be a thorn in the flesh until amended or repealed.

Financial Analysis of the Brooklyn Rapid Transit System

In view of the many important consolidations which have lately taken place in the street railway system of Brooklyn and vicinity, an accurate statement of the new financial conditions and the possibilities of future development will be of general interest. The following analysis has been made from information furnished by the officers of the Brooklyn Rapid Transit Company for publication in "American Street Railway Investments," the financial supplement to the Street Railway Journal, and is correct to date:

The Brooklyn Rapid Transit Company was chartered in 1896, under the laws of the State of New York, as a successor to the Long Island Traction Company, whose assets were purchased under foreclosure of the collateral trust deed and transferred to the new company. The latter's control of the street railway properties of Brooklyn is through ownership of stock, and the operating agency of the system is the Brooklyn Heights Railroad Company, all of whose stock is in the treasury of the Brooklyn Rapid Transit Company, and to which are leased nearly all the properties originally and recently acquired by the Brooklyn Rapid Transit Company.

The nucleus, and by far the most valuable part of the system is the property of the Brooklyn City Railroad Company, which was leased to the Brooklyn Heights Company, in February, 1893, for a rental equivalent to fixed charges and a dividend of 10 per cent per annum on its capital stock of $12,000,000. About 217 miles, or nearly one-half of the mileage of the entire system, including that in the business district near the East River, most of the approaches to Brooklyn Bridge, the ferries, etc., belong to the Brooklyn City Company. The next largest property in point of mileage (136) is that of the Nassau Electric Railway Company, nearly all of whose stock is now in the treasury of the Brooklyn Rapid Transit Company, and which has just been leased to the Brooklyn Heights Railroad Company. The Brooklyn, Queens County & Suburban Railroad Company, which is a consolidation of three companies previously in independent operation, is owned in its entirety by the Brooklyn Rapid Transit Company, and was leased to the Brooklyn Heights Railroad Company last July. Control of the Brooklyn Union Elevated Railway Company, which is also a consolidation of several other companies, and which has had a somewhat checkered career financially, was acquired in March and April, 1899, and has also been leased to the Brooklyn Heights Railroad Company, and control of the Kings County Elevated Railway Company, the only other elevated railroad property in the city, is now being acquired by the Brooklyn Rapid Transit Company through exchange of stock.

The Brooklyn Rapid Transit Company owns the following securities:

Entire capital stock Brooklyn Heights R. R. Co., which includes equity in 999 year lease of Brooklyn City R. R. Co. to Brooklyn Heights R. R. Co., par value	$200,000
All right, title and interest of the Brooklyn Heights R. R. Co., in the construction account against the Brooklyn City R. R. Co., for extensions and improvements on leased lines, amounting Jan. 31, 1899, to	4,528,503
Entire capital stock, Brooklyn, Queens County & Suburban R. R. Co., par value	2,000,000
Entire capital stock, Sea Beach Ry. Co., par value	650,000
Entire capital stock, Sea View R. R. Co., par value	190,753
First mortgage 6 per cent bonds, Sea View R. R. Co., par value	52,500

84,997.16 shares out of total 85,000 shares of the common stock of the Nassau Electric R. R. Co., par value	8,499,716
60,520 shares out of total 65,000 shares of the 4 per cent cumulative preferred stock of the Nassau Electric R. R. Co., par value	6,052,000
34,713 shares out of total 38,302 shares of the 5 per cent non-cumulative preferred stock of the Brooklyn Union Elevated R. R. Co., par value	3,471,300
109,974 shares out of 129,267 shares of the common stock of the Brooklyn Union Elevated R. R. Co., par value	10,997,400
Entire capital stock of Coney Island & Gravesend Ry. Co. outstanding, par value	35,400
First mortgage 5 per cent bonds, Brooklyn, Queens County & Suburban R. R. Co., par value	*2,000,000
First mortgage 5 per cent bonds, Brooklyn City R. R. Co., par value	*1,627,000
Total	$40,304,571

*Composing guarantee fund for performance of Brooklyn City R. R. Co.'s lease.

The Brooklyn Rapid Transit Company has also acquired through one of its constituent companies, all the property of the former Brooklyn & Brighton Beach Railroad, and has contracted with the Long Island Railroad Company to lease for a period of 999 years certain portions of its line between Brooklyn proper and Coney Island, which can be used to advantage in the new system now being welded together.

The only street railway properties not included in the Brooklyn Rapid Transit system, are the Coney Island & Brooklyn Railroad Company, the Brooklyn City & Newtown Railroad Company, and the Van Brunt Street & Erie Basin Railroad Company. The two first named are valuable properties which may be brought into the system later. They are capitalized at about $5,700,000, and are earning about $960,000 per annum. The last is a small horse railway, 3 miles in length, earning about $30,000 per annum only.

The principal financial characteristics of the consolidated system are shown in the accompanying table in which appears the capital stock and funded debt outstanding and in the hands of the public, excluding that in the treasury of the Brooklyn Rapid Transit Company, which is represented, of course, by its own capitalization, together with the mileage and fixed charges of each company and the gross and net earnings of all the operating companies for the calendar year, 1898. The foot note explains slight inaccuracies in certain of the figures which have, however, no material effect upon results.

It is seen by this table that the entire outstanding capital stock of the system amounts to $59,739,484, equivalent to $121,495 per mile of track, and the funded debt to $48,787,000, equivalent to $99,221 per mile of track; the total capital, therefore, being equivalent to $220,716 per mile of track.

The total earnings of the system from operating and other sources amounted in 1898 to $10,832,642. After paying operating expenses only, excluding taxes, the earnings from operation, applicable to the payment of taxes, guaranteed rentals, fixed charges and dividends on the stock of the Brooklyn Rapid Transit Company, amounted to $3,603,037.

The interest upon the outstanding bonds of the entire system amounts at present to $2,166,730, and the guaranteed rental upon outstanding capital stock of the Brooklyn City Railroad Company to $1,200,000, to which should, strictly speaking, be added a small sum for the pro rata proportion, due upon the small amount of outstanding stocks of the Nassau Electric Railroad Company, and the Brooklyn Union Elevated Railroad Company, for the rental to be paid those companies. The taxes paid in 1898 amount to $379,123. It appears, therefore, that the gross and net earnings for 1898 were not quite sufficient to pay the interest, rentals and taxes of the system, the deficit being $142,816, and nothing was left for the stock of the Brooklyn Rapid Transit Company.

This statement, however, taken by itself, would be grossly unfair to the Brooklyn Rapid Transit system, inasmuch as few of the benefits of consolidation were realized in 1898, and it is also true that they will not come to anything like full fruition until 1900 or 1901. Every effort is being made to get the system into condition to handle a far larger amount of Coney Island traffic than usual this summer, and no doubt the plans are being perfected on a broad and comprehensive scale for the joint operation of the elevated and surface lines to the best advantage of the system in earning capacity. Nevertheless, the electrical equipment of the elevated lines can hardly be fully completed short of two years and the power stations must be given larger capacity for handling increased surface railway traffic as well as elevated. Consequently, as before stated, the full benefits arising from the consolidations of the past eighteen months cannot be realized for two or three years yet to come.

Let us see now what earning power will be necessary in order to make fixed charges and return a 5 per cent dividend upon the Brooklyn Rapid Transit Company's stock. It will not be far out of the way to assume that in 1901 the interest, guaranteed rentals and taxes combined will amount to, at least, $4,000,000, instead of $3,745,853, as at present, since further investment for equipment pur-

Capitalization (June, 1899) and Earning Power (Year Ending Dec. 31, 1898) of the Brooklyn Rapid Transit System.

NAME OF COMPANY.	Track Mileage.	Capital Stock Outstanding. *b*	Funded Debt Outstanding.	Gross Earnings, All Sources.	Earnings from Operation.	Fixed Charges.			
						Interest on Bonds.	Rental.	Taxes. *e*	Total.
Brooklyn Rapid Transit Co.	....	*a* 45,000,000	6,625,000	.....	.....	331,250	.....	.....	331,250
Brooklyn Heights R. R. Co.	1.3	.....	250,000	*f* 6,322,993	*f* 2,488,312	12,500	.....	147,505	160,005
Brooklyn City R. R. Co	217.0	12,000,000	*b* 5,298,000	.....	.....	*c* 267,150	1,200,000	.....	1,467,150
Brooklyn, Queens County & Suburban R. R. Co.	45.0	.....	*b* 4,574,000	.....	.....	*c* 228,700	.....	28,375	257,075
Nassau Electric R. R. Co.	136.1	451,284	13,500,000	2,214,901	521,412	585,530	(*d*)	72,000	657,530
Brooklyn Union Elevated R.R.Co.	36.9	2,288,200	12,890,000	1,658,131	525,259	515,600	(*d*)	107,289	622,889
Sea Beach Ry. Co.	13.5	.....	650,000	.....	.....	26,000	.....	33	26,033
Sea View Ry. Co.	2.3	.....	.....	.....	.....	.....	.....	362	362
Kings County Elevated Ry. Co.	*i* 39.6	.....	5,000,000	636,617	68,054	200,000	.....	23,559	223,559
Totals	491.7	59,739,484	48,787,000	*g* 10,832,642	3,603,037	2,166,730	*d* 1,200,000	*h* 379,123	3,745,853

a Including $2,000,000, soon to be issued in exchange for stock of the Kings County Elevated Railway Co. *b* Excluding holdings of Brooklyn Rapid Transit Co. *c* Excluding interest on holdings of Brooklyn Rapid Transit Co. *d* Excluding nominal rental due on outstanding stock. *e* For year ending June 30, 1898. *f* Including earnings from certain other small properties not then (Dec. 31, 1898) leased to Brooklyn Heights R. R. Co. *g* Excluding earnings of portion of Brooklyn & Brighton Beach R. R. Co. and Prospect Park & Coney Island R. R. Co. with allied lines. *h* Excluding taxes Brooklyn & Brighton Beach R. R. Co. and Prospect Park & Coney Island R. R. Co. with allied lines. *i* Including Brooklyn & Brighton Beach R. R. Co.

poses will doubtless be necessary, and there is a strong probability that the item of taxes will be increased. Adding to these fixed charges a 5 per cent dividend on the $45,000,000 of capital stock, we have $6,250,000 as the required dividend and fixed charge fund of the system. If now we may assume that the system can be operated for 50 per cent of its gross receipts (a far better result, of course, than can be shown at present) the gross receipts must be $12,500,000, while if 55 per cent of the gross receipts be required for operating expenses, the gross receipts must be nearly $14,000,000.

What are the prospects that such a gross earning power can be realized in 1901? The development of traffic in Brooklyn during the past four years will throw some light upon this question. Combining the gross passenger earnings from all sources and the track mileage of all the companies now forming the Brooklyn Rapid Transit system for the years ending June 30, 1895 to 1898 inclusive, we have the result shown in table on page 371.

It will be seen that the percentage increase in earnings from year to year is getting much larger, and that for the year ending Dec. 31, 1898, it is more than 10 per cent larger than for the year ending June 30, 1898. Whether this large proportional increase can be kept up in the next two or three years remains to be seen, but it seems not impossible to hope that this may be the case, and that unless some serious set back occurs, the Brooklyn Rapid Transit system may be earning 4 or 5 per cent on its capital stock in 1901 through the bettering of service, and possibly rates, and the lowering of the percentage of operating expenses to gross receipts.

Year Ending	Track Mileage.	Gross Passenger Receipts.	Per Cent. Increase.	Receipts pe Mile Track
June 30, 1895....	395.2	$8,428,699	..	$21,327
" 1896....	444.4	9,104,887	8.0	20,489
" 1897....	471.4	9,214,592	1.2	19,547
" 1898....	491.7	9,752,571	5.8	19,834
Dec. 31, 1898....	491.7	10,832,642	11.1	22,031

Class Distinctions Cause Trouble

It is a well-known fact that upon many of the tramways of Europe the cars are divided into two compartments, one for first-class passengers and the other for second-class passengers, the rates of fare in the latter case being from two-thirds to one-half of that in the former. In some cases the second-class passengers have no seats provided for them, but stand on the platforms; in other cases, where double-decked cars are used, the upper deck is reserved for the second-class passengers and the lower deck for the first-class; on still other roads the motor car transports the first-class passengers, and is handsomely fitted up, while the trail car carries the second-class passengers, and its decorations are not so elaborate as in the motor car.

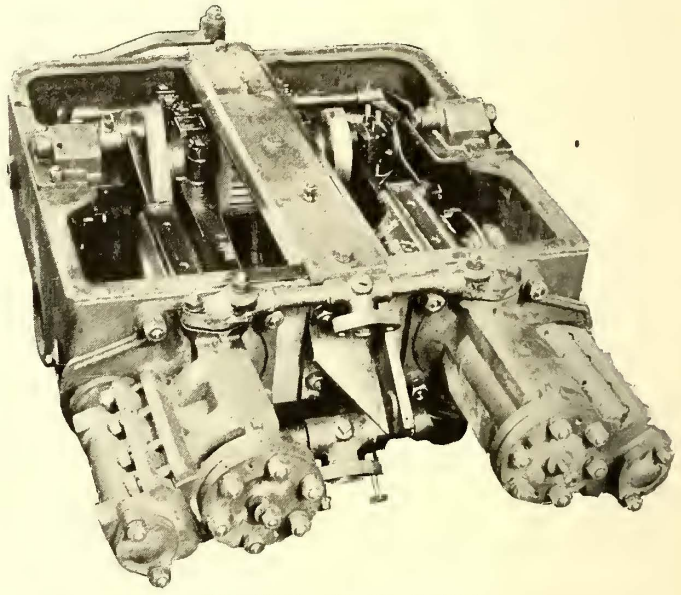
A curious effect of this division of passengers occurred recently upon one of the roads in France. In the early morning and late evening hours, when the majority of passengers prefer to ride as second-class, the trail cars became crowded, while the motor cars were so lightly loaded that the latter could not get sufficient traction to draw their loads, and as a result the trains became stalled. After a careful consideration of the problem no remedy could be suggested except that the second-class passengers should be admitted to the motor cars during those hours in which they supplied such a large proportion of persons desiring transportation. This was done, and the difficulty disappeared.

The Consolidated Traction Company, Pittsburgh, Pa., is about to put into regular service an automobile emergency wagon.

Compressed Air Motors in New York

It is well known that compressed air motors are in use abroad on several railways, and in the last issue of the Street Railway Journal some particulars were given of the cost per car mile during 1898 of the motor cars of the Mekarski Compressed Air system upon the line of the General Omnibus Company at Paris. Owing to the development of the trolley system in this country, but little effort has been made up to the present time to give the compressed air system a thorough trial in this country, although a few cars on the Mekarski system were operated several years ago in Toledo, Westfield and other cities.

The possibility of developing some system which would operate without overhead wires, however, induced certain prominent capitalists interested in the street railways of New York to look into compressed air as a motive power about three years ago, and to determine whether it might be



TOP VIEW OF AIR MOTOR

made a substitute for the underground conduit electric system and trolley. The preliminary steps taken by this syndicate, which resulted in the construction of an air motor equipment for street cars upon lines entirely different from those which had been followed abroad, are familiar to the readers of the Street Railway Journal, through an article published in these columns in August, 1897, which described the system as then constructed and in use on the Lenox Avenue and Columbus Avenue divisions of the Metropolitan Street Railway Company. Since the publication of that article, the American Air Power Company has been organized, and has acquired all the stock, patents and property of the General Compressed Air Company, the American Air Power Company, of New Jersey, and the Compressed Air Company of New York. This company has been organized with A. A. McLeod as president, Henry A. Humley as secretary and treasurer, and W. H. Knight, engineer, and the following board of directors: A. A. McLeod, W. L. Elkins, Thomas Dolan, Thomas F. Ryan and J. H. Hoadley.

In the meantime, also, important improvements have been introduced in the mechanical features of the system, so that now the company claims an economy of operation closely approximating, if not less than that of the overhead trolley. To determine the actual operating expenses, however, the American Air Power Company has made arrangements with the Metropolitan Street Railway Company to introduce the system on an extensive scale in the

equipment of the Twenty-eighth and Twenty-ninth Street lines of the latter company. These lines are now being relaid with 9-in. girder rail to afford substantial construction for the cars.

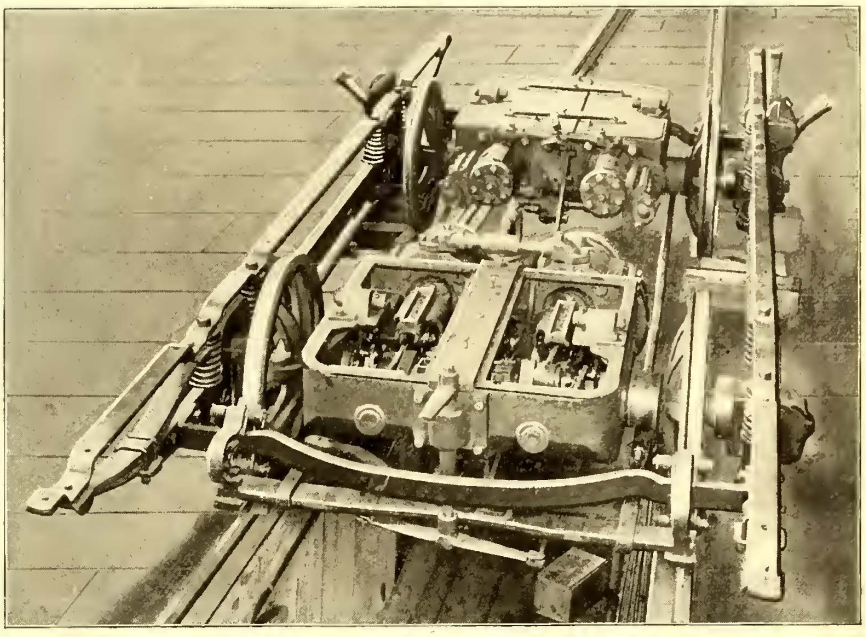
In the meantime, the company has built an extensive compressing plant at the western terminal of the Twenty-eighth and Twenty-ninth Streets lines at West Twenty-fourth Street and Twelfth Avenue, containing a 1000 h.p. direct driven, four-stage compressor, with charging outfit and car house to accommodate the equipment necessary for the operation of the Twenty-eighth and Twenty-ninth Streets lines. The capacity of this compressor is eighty cars, and it will operate the Thirty-fourth Street and other cross-town lines as far down town as Bleecker Street. During the completion of the large compressor ten air power cars are performing night service on the Twenty-third Street crosstown line in regular passenger service.

The cars do not differ in exterior appearance in any way from the ordinary underground conduit cars in use on that line. The car body is the same in every particular, and is mounted on a 21 E Brill truck, which carries the air motors. The latter are completely enclosed in a dust-proof case, in which they revolve in oil, lubricating themselves continuously without the attention of an operator. The use of side rods is completely dispensed with, as each axle is driven independently, one by two high-pressure motors, the other by two low-pressure motors. In fact, the principle closely followed in the design of the equipment was to follow the general standard street railway practice as developed on electric roads, the purpose being to retain the use of the standard wheels, axles, trucks and car bodies, as it was thought that these have now reached a form where the expense of maintenance was a minimum.

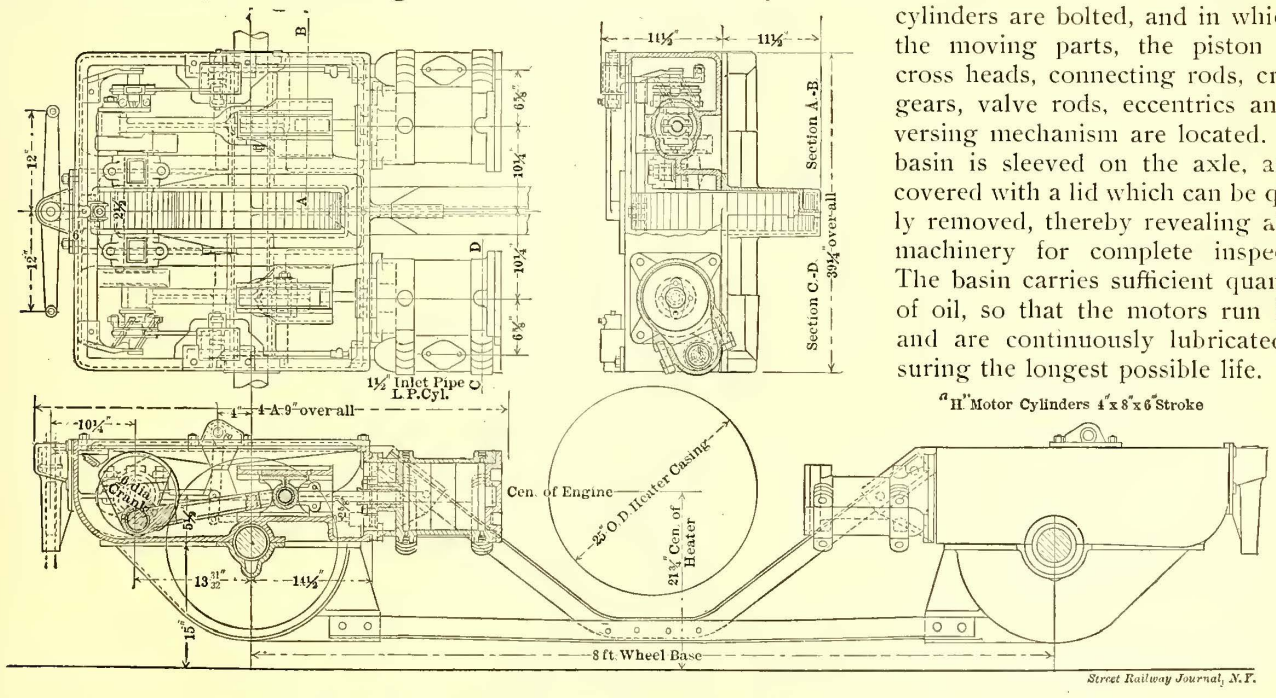
The controller is designed with two handles, one for direction, the other for speed, with duplicate controllers at each end of the car, making it easy for a motorman familiar with an electric power to operate one propelled by compressed air.

The air power system as in use now in New York may be described in detail as follows:

On each axle is mounted an iron clad motor having two cylinders and cranks at right angles. One motor has two high pressure cylinders 4 ins. in diameter and 6-in. stroke. The other motor has two low pressure cylinders 8 ins. in diameter and 6-in. stroke. Upon the crank shaft of these motors is a pinion about 9¼ ins. in diameter, meshing into a 21-in. gear wheel mounted on the middle of the axle. The axle is straight as used for electric motor cars, and the wheels are ordinary street car wheels. The motor consists essentially of a cast iron case or basin, to which the two cylinders are bolted, and in which all the moving parts, the piston rods, cross heads, connecting rods, cranks, gears, valve rods, eccentrics and reversing mechanism are located. The basin is sleeved on the axle, and is covered with a lid which can be quickly removed, thereby revealing all the machinery for complete inspection. The basin carries sufficient quantities of oil, so that the motors run in oil and are continuously lubricated, insuring the longest possible life.



VIEW OF AIR MOTOR TRUCK

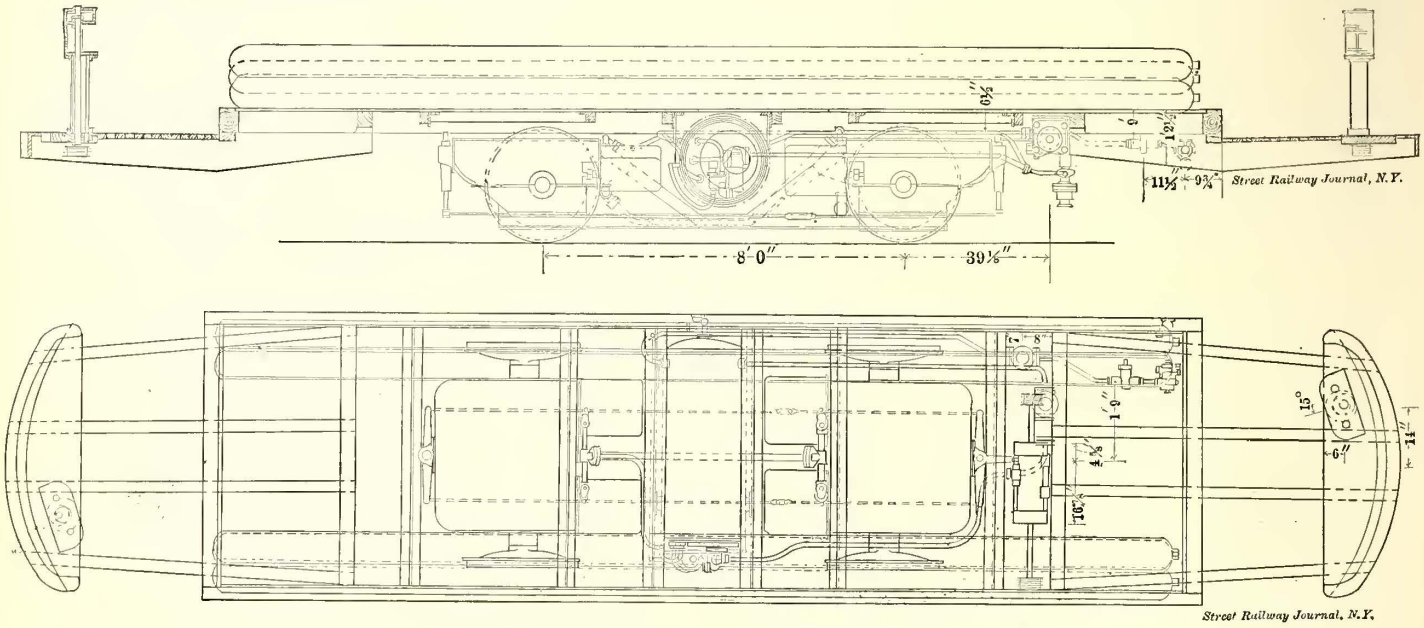


PLAN AND CROSS AND LONGITUDINAL SECTIONS OF AIR MOTOR

The air reservoirs, which are seamless steel bottles, are carried under the seats. These flasks measure 21 ft. 6 ins. in length and 2 ft. 5 ins. in circumference outside. There are six on each car. They weigh about 700 lbs. each, and are 9 millimeters thick, and are tested to three times the

pressure they are intended to carry. From these pipes a 1 in. pipe leads to a reducing valve, which reduces the storage pressure to the working pressure. Before reaching the reducing valve, the pipe passes for about 2½ ft. from its length through the heater, so that it can receive sufficient heat to prevent the subsequent freezing of any moisture which may be in it.

The heater consists of a wrought iron reservoir, that is supported on the cross pieces which connect the two motors, and is charged with hot water under a pressure of



PLAN AND SIDE ELEVATION OF EQUIPMENT

about 210 lbs., which corresponds to a temperature of 400 degs. The capacity of the heater is about 60 cu. ft.

After passing through the heater, where it takes up heat, as described, the air enters the reducing valve, which is of the ordinary type, where its pressure is reduced from 2400 lbs., which is that in the reservoirs, to 320 lbs. From the reducing valve it branches and flows to the throttle valves, one at each end of the car. From the throttle valves it passes to the injector, shown on page 375, where a certain amount of moisture is given to the air. This injector is fed from the heater, and consequently the water is at the same temperature as that in the heater, viz., 400 degs. The moisture not taken up by the air falls to

neath the heater to the low-pressure cylinder, and is then exhausted into the atmosphere on the lower side of the low-pressure cylinder through a muffler. By having one motor high pressure and the other low pressure, undue slipping of the wheels is prevented, as when the high-pressure wheels slip the low-pressure motor gets more air and more pressure. On the other hand, when the low-pressure slips its wheel it draws down the pressure in the exhaust of the high-pressure cylinder, correspondingly increasing the strength of the high-pressure motor.

The direction of the flow of the air is shown diagrammatically in the cut below, in which *A* is the charging valve through which the air passes through the head *B* to the bottles, and *B* to the reducing valve *D*. The throttle valves are shown at *E*, the injector at *F*, the connection to the high pressure cylinders at *G* and the connection to the low pressure cylinder at *O*.

In its use of a heater, the practice of the American Air Power Company is similar to that of practically all the other manufacturers of air motors, but, as will be seen, the form of heater adopted is quite different from that which has been used elsewhere. The object of imparting moisture to the air is two-fold; first, it assists in packing the

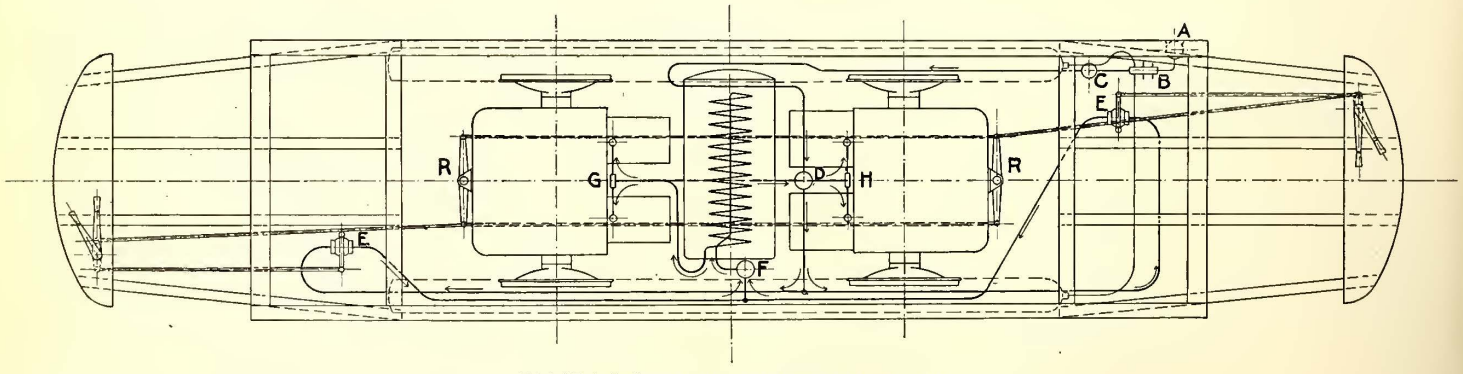
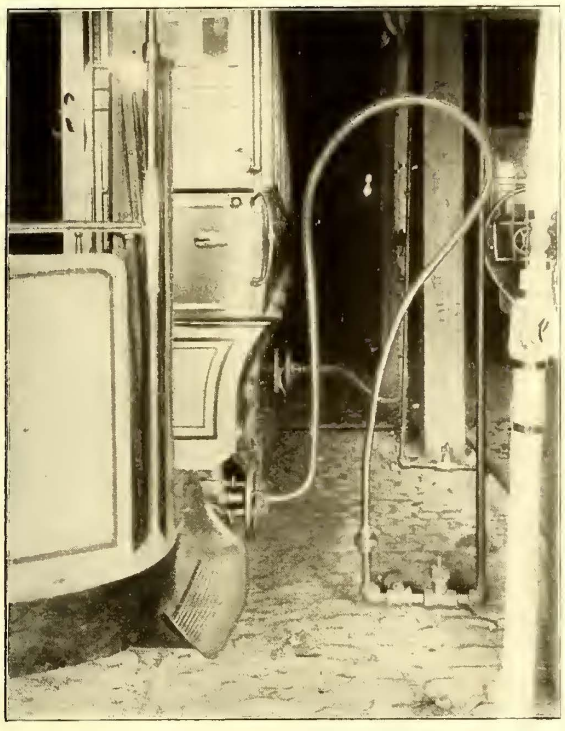


DIAGRAM SHOWING DIRECTION OF AIR

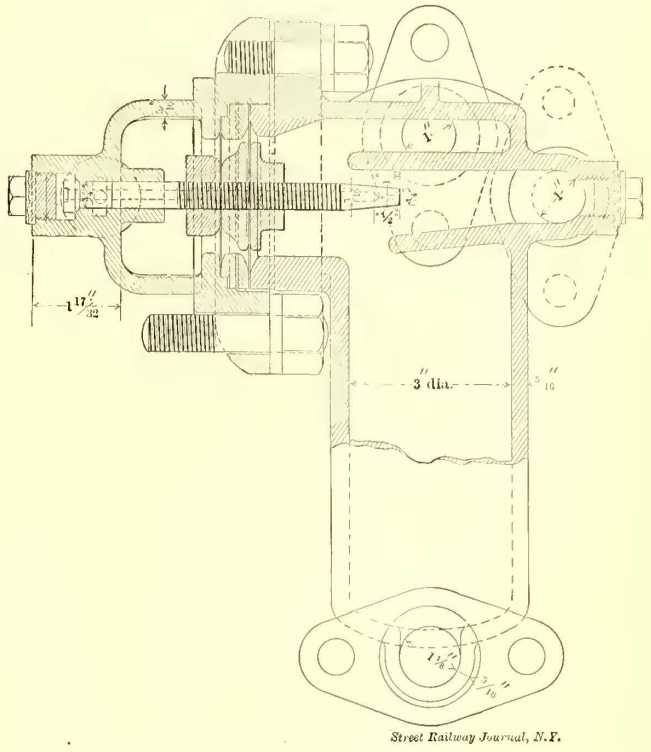
the bottom of the injector chamber, and is led back to the heater. From the injector the air passes through a spiral coil in the heater, consisting of a 1-in. pipe having a linear length of about 50 ft. In this passage it is brought up to the temperature in the heater, so that in the next step, when it is admitted to the high-pressure cylinder, it has a temperature of 400 degs. After exhausting from the high-pressure cylinder, it is carried through a connection under-

joints, thereby reducing the leakage, as the air would be excessively dry owing to the high temperature to which it is brought. Another advantage of adding the moisture is that during the expansion in the cylinders the water keeps flashing into steam all along the passage as the piston advances beyond the point of cut off. This keeps up the pressure toward the end of the stroke and gives an almost isothermal expansion instead of adiabatic expansion.

In the heater used on the Mekarski system, to which reference has already been made, the air is made to pass through the hot water; this system was not adopted, first, because the experimental tests conducted with it seemed to indicate that its use was liable to bring excessive quanti-



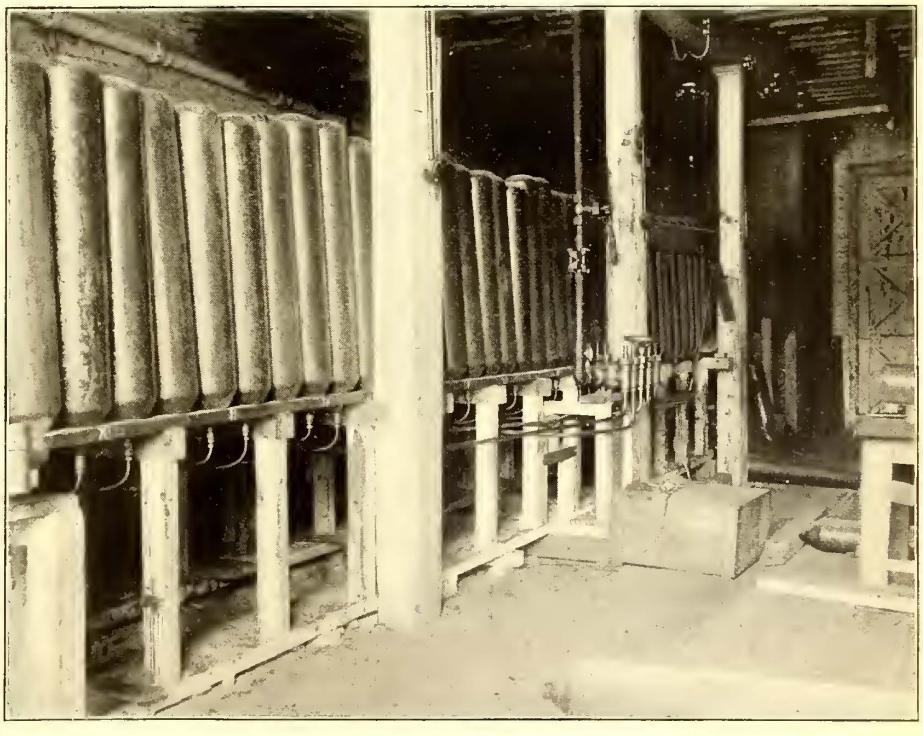
METHOD OF CHARGING CARS



SECTION OF INJECTOR

ties of water over into the motors, and secondly, to reduce the pressure in the heater from that of the air to the 210 lbs. required to maintain the temperature of the water at 400 degs. As will be seen from the sectional view of the injector, the amount of moisture injected into the air can be regulated, while the necessary amount of heat is imparted to the air through its dry passage through the heater.

Two methods of control are adopted, one by varying the cut off, and the other by the use of a throttle. Both methods of control are operated from the platform, which is equipped with a double handle controller, the upper handle being that moving the throttle and the lower that adjusting the cut off. The latter handle has four notches, corresponding to stop, and three degrees of speed. On the first notch the valve is set to cut off at one-quarter stroke, the second stop at one-third stroke, and the third notch at five-eighths the length of the stroke. At the neutral position the air pressure is entirely cut off, and as the motor cylinders are fitted with check valves, the car can coast without creating any back pressure or vacuum. The usual position of the cut off when the car is in operation is that of the first, or one-quarter, notch, which is, of course, the most economical point of running. The speed is then controlled by the throttle. Should the motorman desire more power or higher speed than can be given with the throttle open, the cut off can be advanced to one-third or five-eighths point, and to avoid accident the motors can be reversed if necessary, by throwing the cut off controlling handle around to the reversing position without touching the throttle, although this brings a strain upon the motors similar to that experienced by electric motors when suddenly reversed. No special notches are provided on the reversing side of the cut off controller disc, as they would be little used. When the car reaches the terminal of its route, the two controller handles are lifted off the spindles and carried to the other end of the car, as with electric operation.



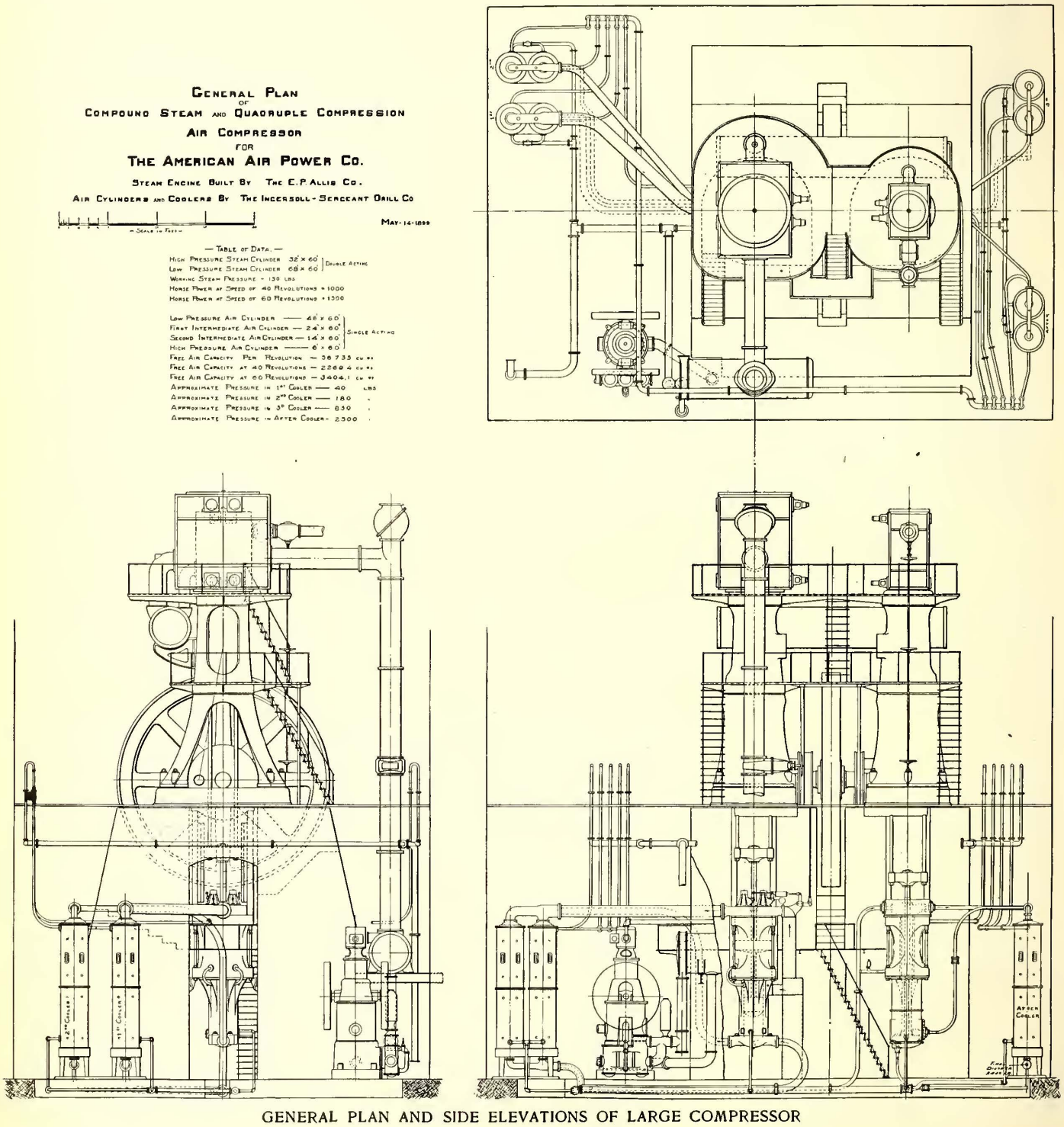
VIEW IN STORAGE ROOM

The results secured during the past two years have dem-

onstrated that the motors are highly efficient and exceedingly durable, all the original parts being still in use. The manufacturers estimate that making a liberal allowance for the wear which must occur, and which, in the case of the more rapidly wearing parts has been measured, the maintenance per car mile will compare favorably with that of an electrical equipment.

ble of slipping the wheels on a dry rail under a weight of 30,000 lbs., corresponding to that of a powerful electric motor equipment, with which, as will be seen, it does not differ materially in weight.

Several sample indicator diagrams, taken from the high and low pressure cylinders, are given on page 378. As will be noticed, they are similar to locomotive diagrams,



GENERAL PLAN AND SIDE ELEVATIONS OF LARGE COMPRESSOR

The weight of the standard car as in use on the Twenty-eighth and Twenty-ninth Streets lines is as follows:

Car body	6000 lbs.
Trucks	4500 "
Air reservoirs	4200 "
Heater	700 "
Motors (each 1400 lbs.)	2800 "
Controlling apparatus and other fittings	400 "
Piping	150 "
Total	18,750 lbs.

The motors upon which this estimate is based are capa-

and have the characteristics of diagrams taken from cylinders with link type of cut off.

Reviewing briefly now the motor equipment, it will be seen that the system differs in many respects from that used abroad, notably (*a*), in the form of motors employed, (*b*) in the method of heating, and (*c*) in the high pressure used. The adoption of a pressure of 2400 lbs. in the reservoirs was to increase their capacity. As at present designed, the cars can run 15 miles on a trip with a charge that is restricted to a space under the seats, and this can be increased to 20, 30 or 40 miles by crowding in all the

flasks that the space would allow, or by increasing the pressure, as the company is now preparing to do. As the reservoirs have a capacity for withstanding three times the pressure used in them, it will be readily seen that the element of danger is practically eliminated. There is no deteriorating influence on the reservoirs incident to the use of this pressure, nor has there been any explosion with any of the flasks by air except when premeditated, and only then with the greatest difficulty and with apparatus specially constructed to bring the required force into play.

The cars operate noticably without noise, and start noticeably without jar and with a cushioned effect which is extremely easy for passengers.

The method of charging is another feature to which the engineers of the company have devoted a great deal of attention, and which is now accomplished in a minimum space of time. A general view of the main charging room is shown on page 375. The main charging reservoir consists of a large number of the same type of flasks as used on the car, but carried in a rack and piped to a manifold, from which the air from the compressor is switched into any bank of reservoirs desired. From this point the air under pressure is piped to the charging room, where are located the charging nozzles. The latter are carried upon a flexible goose neck so arranged that the nozzles can be readily fitted to the charging valve. Adjoining the air charging nozzle, but located in such a position that it will come opposite to the heater, is the hot water charging nozzle, which is similar in general appearance to that used for charging the air reservoirs. This device has a double set of pipes, one for introducing the hot water into the reservoir, and the other to allow the discharge of the water which may be in the heater after a run. The process of charging the air reservoir, hot water reservoir and removing the cooled water can be accomplished simultaneously and in a short space of time.

The compressor plant, which has just been completed at the corner of Twelfth Avenue and Twenty-fourth Street, by the Ingersoll-Sergent Drill Company, is unusual in almost all of its features, but especially in two points, its great power and the high pressure obtained. High pressures with smaller machines are common, but pressures of 2400 lbs. to the square inch in 1000-h.p. machines are essentially unique.

In general the machine consists of a vertical cross compound engine, built by the E. P. Allis Company, of Milwaukee, which has cylinders 32 ins. and 68 ins. x 60 ins. stroke, and is provided with Reynolds Corliss valve gear.

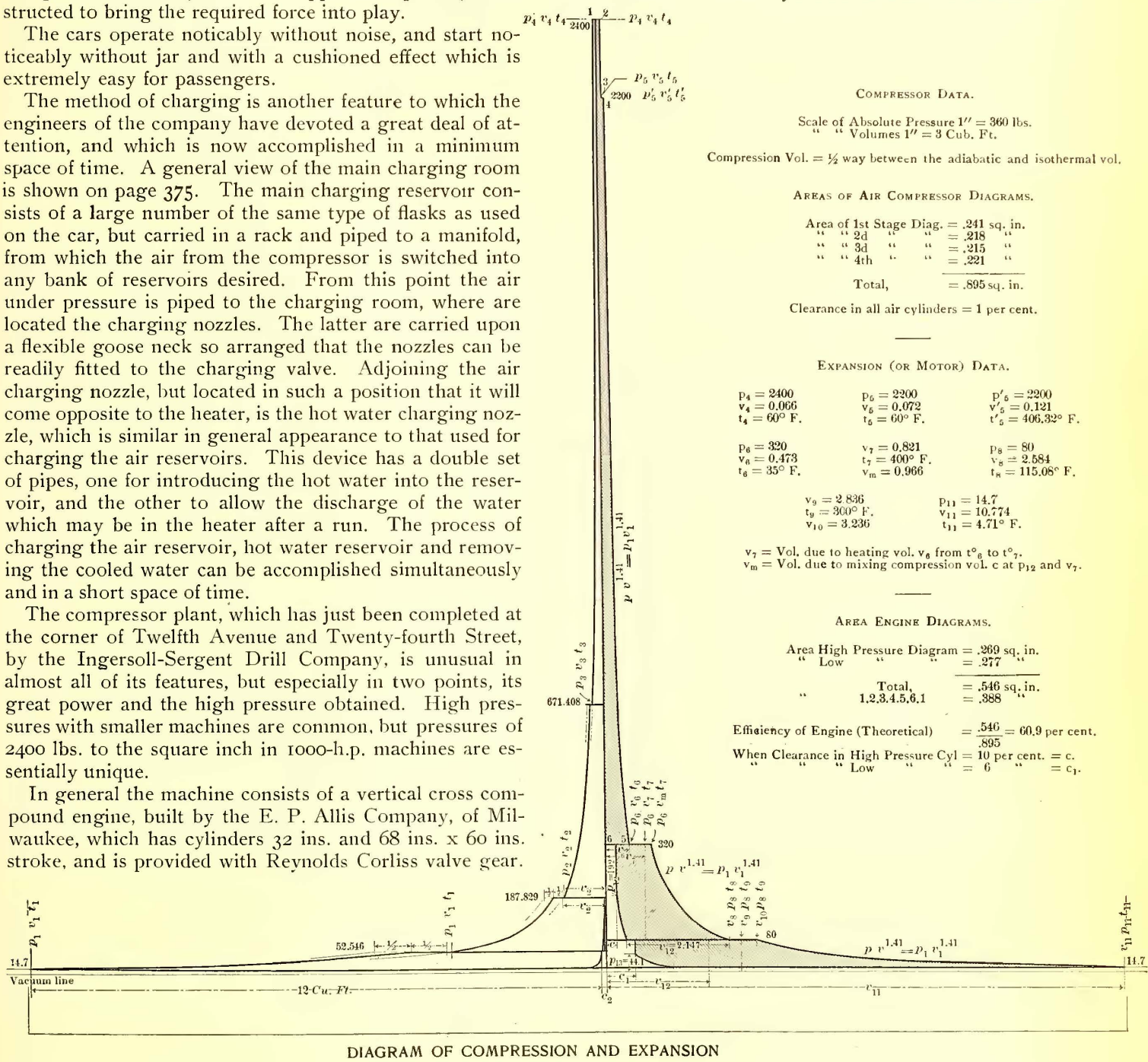


DIAGRAM OF COMPRESSION AND EXPANSION

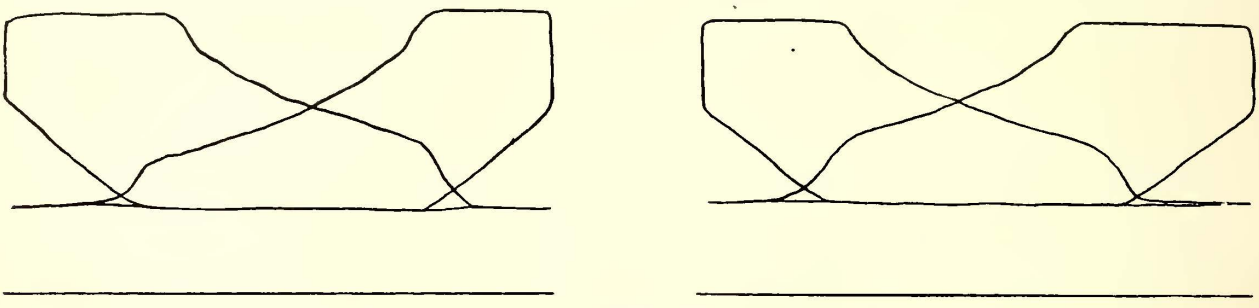
With steam pressure of 150 lbs., furnished by Babcock & Wilcox boilers, 40 r.p.m., and most economical point of cut off, the horse power is 1000. The shaft is of hammered iron 22 ins. in diameter outside of the journals and 20 ins. diameter in the bearings which are 36 ins. long. The fly wheel, placed between the cylinders, is 22 ft. in diameter and weighs 60 tons. The engine is mounted upon brick piers, and directly underneath it is placed the air compressor.

This machine is of the four-cylinder type, the low pressure cylinder being 46 ins., the first intermediate 24 ins., the second intermediate 14 ins., and the high pressure cylinder 6 ins. in diameter. The stroke being common with that of the engine is 60 ins. All of these cylinders are single acting and are water-jacketed. The free air capacity per revolution is 56.735 cu. ft.; capacity at 40 r.p.m., 2269.4 cu. ft., and the free air capacity at 60 r.p.m. is 3404.1 cu. ft. The approximate pressures in the different coolers are given in the large diagram showing cycle of operation.

The compressor pistons are arranged in pairs vertically in line beneath the steam cylinders as is shown in side and end elevations. The initial and first intermediate air cylinder being below the low pressure steam cylinder, while the second intermediate and high pressure air cylinders are below the high pressure steam cylinder. Motion is transmitted from the steam engine cross heads through distance rods, one pair for each crosshead, to a crosshead attached to the air cylinder piston rods.

The intercoolers employed are of two different designs. The two for the lower pressures consist each of a shell inclosing a nest of vertically arranged cooling pipes, through which the air passes going from one cylinder to the other. The coolers for the higher pressures consist each of a shell

inclosing a pipe coil. The former construction was adopted for the lower pressures because great cooling surface was required on account of the large volume of air, but in dealing with the higher pressures coils were substituted so as to dispense with as many joints as possible. The coolers are arranged so that in case of leakage of air from the cooling pipes into the shell or casing this air will rise with the circulating water up to the operating floor of the engine room and discharge through a slight discharge pipe under the immediate care of the engineer. All the



SAMPLE INDICATOR DIAGRAMS FROM HIGH PRESSURE CYLINDER OF MOTOR

piping from the first air cylinder and through the entire compressing plant is of copper.

What may be called an auxiliary governor controlled by air pressure is provided to act upon the governor of the steam engine. This consists of a weighted lever which is operated upon by a small piston, which in turn is actuated by the air pressure. If for any reason the pressure should become excessive, the lever is lifted. This opens a valve admitting air to a device on the governor, so designed as to reduce the steam supply and for all practical purposes, to throttle the engine.

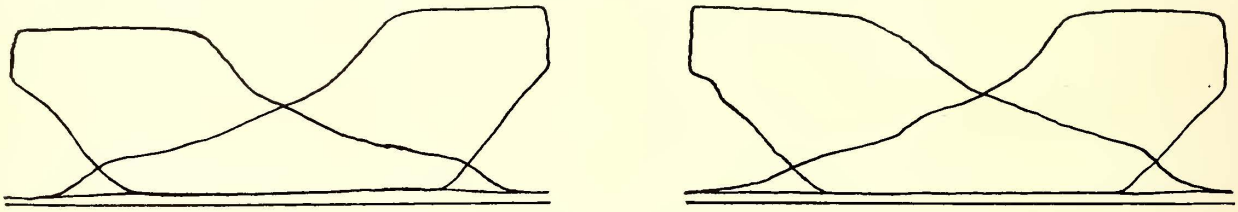
Some idea of the massiveness of the machine may be obtained from the bare statement that it is 60 ft. in height. It will be employed exclusively for supplying air to the air motor cars on the street railway cars.

The water used for cooling the air in the intercoolers is taken from the North River, which is a few hundred feet from the station, through a 16 in. water main. After passing through the intercoolers this water is discharged into the river through a second 16-in. main.

Referring now particularly to the diagram given on the previous page, showing the cycle of compression and expansion, this diagram is drawn to scale, the abscissæ representing volumes, and the ordinates pressures. The left hand side of the diagram shows the compression curve, and the right hand side the expansion curve. Twelve cubic feet of air is taken as a basis, the scale of pressures being 1 in. to 3 cu. ft. The curve of actual compression in each cylinder of the compressor is considered to be half way between the theoretical adiabatic and isothermal curves on account of the water jacketing, and at the end of each stage of compression the air is brought back to the corresponding point on the isothermal curve through the cooling of the air in the intercoolers. Short arcs of the true isothermal and adiabatic curves are given on the diagram at the end of each stage of compression.

The portion of the curve to the right hand of the center line shows the pressures and volumes at each stage of expansion. The actual values of pressure, volume and temperature at the end of each stage are shown by $p_4\ v_4\ t_4$, $p_5\ v_5\ t_5 \ldots p_{11}\ v_{11}\ t_{11}$. The effect of heating the air is shown in the differences between $v_5\ t_5$ and $v'_5\ t'_5$, and again between $v_6\ t_6$ and $v_7\ t_7$. The effect of the injection of moisture is shown in the difference between v_7 and v_m.

The theoretical efficiency of the entire mechanical cycle can, of course, be obtained by dividing that portion of the area of the right hand curve, which represents work performed, i. e., that of the high pressure and low pressure diagrams, by the entire area of the left hand curve. According to these figures, the theoretical efficiency of the cycle is 60.9 per cent. This figure, however, is, of course, slightly in excess of the true efficiency of the entire system on account of the addition of heat from the hot water heater. The effect of subtracting this, however, will not materially affect the total efficiency, as given above.



SAMPLE INDICATOR DIAGRAMS FROM LOW PRESSURE CYLINDER OF MOTOR

The question of air consumption and cost is, of course, an important one. Upon this point the company hopes to be able to contribute some important data soon. From tests already made, however, Mr. Knight, chief engineer of the company, states that the average consumption per car mile has been 450 cu. ft. of air, and the cost per car mile has been about $.025.

The writer has found the following system of repainting cars to be quite satisfactory: First remove all old paint by softening it with a blow-pot just enough to allow it to be scraped off with a broad putty knife, not allowing the flame from the blow-torch to strike the bare wood at any time. Then sand off the surface well with block and sand paper. Where any new work has been put in, it should be first primed with a coat of boiled oil and a little lead and allowed to stand for not less than four days. Dashes and all iron-work should be thoroughly cleaned with strong alkali and primed with a coat of linseed oil, put on boiling hot and allowed to thoroughly harden, giving one coat of oil and lead before color. If the surface is rough, plaster with lead on this coat. Then allow it to thoroughly harden, and sand with block; then lay on two coats of flat lead, two coats of color, color varnish, stripe and ornament, finish with one coat of rubbing varnish and one coat of finishing varnish. From paper at the Boston Convention, 1898.

Street Railway Parks

MIDDLETOWN, CONN.

The Middletown Street Railway Company serves an elaborate park located 2½ miles from the center of that city, which has a population of about 15,000, the total population served by the street railway system being about 20,000. The park contains about 20 acres of land, one-half of which is well covered with shade trees. It has been left in its original state as much as possible, and this fact contributes very largely to its popularity among lovers of rustic beauty. A deep ravine, over which a rustic bridge has been constructed, runs through the grounds. Although the natural features of the place have been carefully preserved, a large amount of money has been expended in improvements and in providing the usual attrac-

VIEWS IN PARK AT MIDDLETOWN, CONN.

tions for resorts of this kind. A rustic theater, having a stage 30 ft. x 50 ft., and situated at the foot of a hill, which is covered with a hemlock grove, is one of the most popular institutions. The stage was made extra large to enable it to be used for dancing after the shows are over, but dancing accommodations have not been found profitable. In front of the stage and on the slope of the hill are located some 400 seats, for which a charge of five and ten cents is made during the performances. The ten-cent seats are quite comfortable; the five-cent ones being ordinary chairs fastened together.

A large lake in the park adds greatly to its popularity. One section of the grounds, well shaded, is reserved for the use of picnic parties, so that churches and societies can have exclusive privileges for their outings, at the same time being able to avail themselves of all the advantages of the park. A small-sized restaurant building and a flying-horse merry-go-round are among the most recent attractions installed.

E. W. Goss, superintendent of the Middletown Street Railway Company, has the following to say in regard to street railway parks: "As far as our experience with running a park is concerned, as we have only had one year in which to judge, it is hard to form an opinion. Last season, after we commenced running the park, we handled heavy crowds, a large number of which were pleasure-seekers exclusively. We did not make any charge for admission to the grounds, depending for our remuneration upon the increased traffic on our cars and upon the money spent by visitors in seeing the entertainments. We think it would cost more to collect an admission charge at the gates from non-patrons of the cars than we would take in by so doing. We do not allow bicycles or teams on the grounds, wheels being checked at a small building near the entrance, and posts being provided outside the park for hitching horses. The park will be opened on June 19, and the theater entertainments will consist of the usual vaudeville attractions."

PADUCAH, KY.

Paducah has a population of 25,000, and there are no public parks, so that the park of the Paducah Street Railway Company forms the only outing grounds for the people. These grounds contain 75 acres, of which about 20 acres are now used for park purposes. The resort is located some 2 miles from the center of the town.

The value of the park is placed at about $50,000, and nearly $17,500 have been expended in improvements, as follows: Erecting a handsome brick building, which is occupied by the park keeper, who boards the actors in summer, $5,000; constructing summer theater, $2,500; total for improvements on grounds, $10,000. The park contains a lake covering about 5 acres, and supplied from the city water mains. Here bathing house, boats, etc., are provided.

George C. Wallace, general manager of the Paducah Street Railway Company, writes as follows:

"In our theater we have tried both stock companies and vaudeville shows, but find that a good stock company, with specialties once a week, and a good band are the best drawing cards. We also give balloon ascensions, fireworks and lake displays, for which we charge admission to the park. At other times admission to the grounds is free, and a small charge of five or ten cents is made for seats in the theater. We also keep a few animals, such as bears, monkeys, etc. We now lease the amusement features for a nominal sum. We have from 500 to 1000 people in attendance each night, and from 2000 to 5000 at the other attractions.

"Our season opens May 15 and closes Sept. 15. On account of our long, hot summer we find the park quite a paying investment."

SCHENECTADY, N. Y.

H. S. Cooper, superintendent of the Schenectady Railway Company, in reply to an inquiry regarding the recent improvements made in the pleasure park of his company, writes as follows:

"We still run our pleasure park as an 'assembly ground,' and find no reason as yet to change its character to an 'amusement park,' and do not believe that we could at the present time make it pay as such.

"We have already booked nearly every Saturday of the season, together with several other days, for picnics, 'field days,' etc., of the various societies and organizations of the city. The revenue from these, together with the returns from the sale of privileges, admittance to evening dances, hiring of boats, swings, etc., will go well towards paying fixed charges and operating expenses, leaving the extra traffic engendered by the park as nearly clean profit.

"We have made no large improvements, but are all the time adding any small thing that will increase the park's comfort, beauty and convenience.

"We will, this winter, try skating, hockey and curling rinks, so as to see if we can lessen the 'dead time' of the park, and add a little to our winter traffic. We shall try it carefully and conservatively, but thoroughly, and hope to be able to report a success.

"Specifically answering your question as to the value of parks, we can say that it has been our experience that our park has been a profitable enterprise to the railway company. It has been made so by fully studying our people here, their needs and desires, and by cautiously catering to them in all things that were profitable, and not by blindly following the lead of 'any old place,' and rushing into expensive and unremunerative 'attractions.' We may come to 'attractions' later on, when we find that our present course shows signs of failing to pay, or be popular; and we will then have the experience of others to aid us in knowing what NOT to do, and with our park in its present course shows signs of failing to pay or be popu- start anything we may wish, and without the extraordinary initial expenses and mistakes of an absolutely new and untried enterprise."

Summer Park Theaters

BY J. W. GORMAN

Park amusements in connection with street railway pleasure resorts have now developed to such proportions as traffic producers, as to warrant the most careful consideration of managers and directors everywhere. The progressive and up-to-date management of any corporation or institution is the one, of course, that is constantly studying out new methods of increasing and extending the business and revenue earning capacity of the plants under their control, and in no case does this apply with greater force than in the matter of adding summer parks and amusement features to already well equipped street railway systems for the purpose of adding to the regular, necessary and business patronage a purely pleasure traffic. Two features predominate in the life of every city, viz., business and pleasure, otherwise there would be but bare walls and business structures, grim stores, banks and markets, instead of, as now, attractive shops and windows, handsome residences, amusement halls and brightness in all things, as an expression of the tastes, likes and wishes of the dwellers. The far-seeing and progressive street railway manager takes advantage of these two characteristics, and while paying strict attention to the regular and what may be called the legitimate traffic on his road—at the same time increases his earnings by catering to the love for pleasure and recreation among the people his system serves.

A properly conducted park situated from 3 to 10 miles from a city and provided with proper amusement attractions, gives the incentive for a ride on the electric cars—the ride in itself bringing relaxation from the day's business cares, while the attraction to be witnessed acts as an additional inducement.

The writer, as the result of careful observation and inquiry, estimates that during the average weeks of summer, a traffic equal to the entire population of the city can be induced by a properly conducted amusement adjunct to a traction company. In illustration the following remark is given, made by the progressive and successful manager of a once non-paying and "run down road," who had revised all former methods, and added a handsome park. In conversation with a prominent manager of summer attractions, this gentleman said: "Mr. ——, our road paid you last week $400 for your amusement company, and we carried 45,000 paid fares to our park during the week. The population of our city is 48,000, so undoubtedly many witnessed the performance more than once. We do not hesitate to tell you this, * * * and your contract with us is a fixed one." The writer relates another instance in which a manager stated that during the entire amusement season his road had averaged 20,000 paid fares per week from the park travel, the city having a population of but 22,000 people.

The manager of a traction company who sends out letters and circulars or makes efforts to induce circuses or menageries to visit his city and to locate their places of exhibition on his line, is another example of up-to-date management.

The prevailing error that is being made by roads with handsome and suitable parks is in giving the cheap and mediocre entertainments easily obtainable, arguing that, "it is all free and the quality does not matter." Here lies the error of otherwise shrewd business men in catering to the masses. Now, is the show free? Does the public not pay for the exhibition? To convince any traction company, it need but to thoroughly advertise that its cars will start at a certain hour and day for such a park with no performance mentioned. There will be no unusual life, interest or fares taken. Announce as thoroughly that there will be presented a known and desirable attraction that has a reputation and drawing power at the local city Opera House in the regular season, and that there will be no charge for the performance, and the capacity of the cars will be crowded to the utmost. Do not the riders pay for the show? Certainly they do, and the fares are collected not for the ride alone, but in conjunction with the attraction.

The performance must be good and well conducted. The talent must be of merit to win the praise of intelligent people, and adapted to the wants and wishes of each city for the best results. This selection must come from experience. An evening's time to citizens is too valuable to be thrown away that some irresponsible talent may be presented, and some irresponsible "hawker" of amusement wares and goods may make a handling commission or profit. The right men can be found to provide desirable and worthy entertainments in line with good taste, and morality acceptable to church attending patrons, as well as to the general public. Nor should traction companies limit their amusements amount to such a low figure that good talent cannot be employed. Many a park that loses money at a small figure for attractions would make large profits if double the amount was expended for attractions of drawing power and of sterling merit and reputation.

The traction companies in the East have developed much beyond those in the West and Middle States, in availing themselves of the great revenue that comes from the pleasure seeking public. but there is little doubt that at no distant day, nearly every progressive street railway system in the country will have its summer park and open air theater presenting meritorious attractions as established adjuncts to its general business.

The Electrical Installation Company, Monadnock Block, Chicago, has just closed a contract for the complete rehabilitation of the Vicksburg (Miss.) electric lighting system. Work will be started immediately, and rushed to completion within ninety days.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge Jr., and Robert Ernest, of the New York Bar

Taxation of Franchises

The last few weeks have been prolific in the discussion of this topic in New York, owing to the introduction and passage, as the result of an emergency message of the Governor, presented to the Legislature last March, of what is known as the Ford Franchise bill, and as we go to press an extra session called by the Governor has passed amendments which he deems necessary. The original bill consisted of less than a dozen lines to be inserted in subdivision 3 of section 2 of the Tax Law of the State, which section defined the terms "land," "real estate," and "real property" as used in that chapter. The tax law provided that real estate should include, among other things, all surface, underground and elevated railroads, and also the pipes laid in and above any public or private street for the purpose of conveying water, oil and other substances or products, and the Ford bill inserted after the words "railroads" and "pipes" the words "the value of all franchises, rights, authority or permission to construct, maintain or operate the same" through streets, highways and public places.

This bill was held by some, and notably by two of the leading morning papers, as a radical measure of great importance, making an epoch in the history of taxation in the State and imposing upon corporations their just proportion of the burden of taxation which heretofore, it is asserted, they had not borne.

Another portion of the public, who found representation in another of the leading morning papers, talked and wrote against it in the strongest terms, alleging that it imposed double taxation upon corporations and was a socialistic attack upon wealth.

A third view was taken and seems still to be held by many to the effect that the law is of little importance, and that it practically imposes no new burden; that the amount of tax to be derived from it, instead of being very large, will be very small; and that, as a matter of fact, it is merely declaratory of the present law.

The laymen and, we have suspicion also, the Governor himself (certainly when the law was first drafted and passed), have had confused notions and inadequate ideas of the scope of the act and its effect.

This effect can only be determined by a careful examination of the decisions of last resort of our own State, with some side light thrown upon the matter by the decisions of the courts of other States where similar enactments have been pased. These decisions will only afford light when one has clear and definite ideas of what a franchise is, or of what taxes are already laid upon franchises in New York. Without quoting authorities, it is manifest that the franchise referred to is not what is often called a "corporate franchise," which is the right of several individuals to be and become a corporation, but it is that right possessed by a corporation or by an individual (for, as a matter of fact, the Ford bill applies to individuals who have such rights, as well as to corporations) to maintain and operate mains, pipes, conduits or wires for transporting certain products or substances, including electricity, or to maintain and operate railroads through streets and highways.

Were it not for some decisions in the State, it might be contended with some show of reason that the Ford amendments do not change the tax law, for manifestly if the assessor is to determine under the old law the value of a gas pipe in a street, it would be contendable, if not reasonable, to hold that in determining the value of the pipe laid below the surface of the street, the right to have it there should be included. Its value as a pipe, without the right to leave it where it is and to put gas through it, would be its value as old iron; or certainly not more than the cost of putting it there. One might even go so far as to hold that it is worth less than nothing since, without the right to leave it in the street, it would cost more to take it away than the value of the pipe.

But if the assessor places the value upon the pipe as a usable article in the street, in other words, adds to the value of the pipe, the value to use it (without which few articles would have real value at all), then manifestly the original Ford bill would not change the law one iota, nor would the amendments presented by the Governor in his message calling a special session of the Legislature, except so far as those amendments placed the assessing of the value in the hands of the State, instead of the local authorities, and make some provision against double taxation.

The impossibility of separating the value of the pipe and the value of its use is evidenced by the fact that in the amendments proposed, these two are included in one item, and by particular definition are dubbed a "special franchise," the value of which is to be ascertained by the State Board of Assessors.

But the original Ford bill does change the law, because the courts have construed the tax law as it was before the passage of the bill to mean that the mains and pipes of the gas company may be taxed, but not the privilege granted by the local authorities to use them. (*People ex rel. Keystone Gas Co. vs. Martin, 48 Hun, 193*). The decisions of the court maintaining this proposition, the Ford bill necessarily makes as a change in the law:

All corporations, under other provisions of the tax law, are taxed upon their capital stock to an amount determined by its value, arbitrary values being fixed upon stock paying specified dividends. This tax is often called a franchise tax. If this is a tax upon the mere right to be a corporation, graded by the size and the success of the corporation, then it is a tax upon a privilege which can scarcely be said to be property, for, as is asserted by the Supreme Court of the United States as late as last April, the Michigan Mileage Law case, the taking away of this right does not take away *property*, but leaves the company's assets intact. The fact that there are certain privileges given to corporations, such as operating a railroad, which are not given to individuals, adds to the value of many corporate franchises, because it makes them necessities in those particular lines of business.

A great variety of opinion has also emerged from the discussion of Mr. Ford's statement as to the simplicity of determining the value of a franchise such as he proposes to tax. He would take the market value of the stock, plus the market value of the bonded and other indebtedness of the company as being equivalent to the total value of all the assets tangible and intangible. Under the present law, it being the duty of the assessors to appraise the tangible assets, we have, according to Mr. Ford, only to take the value of those tangible assets as found by them and deduct it from the total market price of the securities of the company and we have the value of that intangible asset, which is to be called a "local" or "special franchise."

Many of the comments upon this method of arriving at the valuation have held it up to ridicule, and we think very justly so if it is taken as a rule which can be applied generally; and this, notwithstanding the fact (which seems to

* Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

have been overlooked) that this very rule has been applied in particular instances in Massachusetts and Illinois by the highest courts of those States and in the Supreme Court of the United States. *(Com. vs. Hamilton Mfg. Co., 12 Allen, 312; Aff., 6 Wallace, U. S., 632; Porter vs. Rockford, etc., Co., 76 Ill., 561; Illinois Railroad Tax Cases, 92 U. S., 575).*

This method, happily, is not embodied in the Ford bill, and the local authorities (or according to the amended bill, the State Assessors), will, under the decisions and subject to the review of the courts, be compelled to formulate a general rule or else a rule for each particular case. The latter method, we venture to predict, relying upon the general trend of the decisions of the Court of Appeals in tax cases, will be insisted upon by the courts.

If Mr. Ford's rule was applied to some cases, it would necessarily result in the greatest injustice. For example, a large proportion of a company's debt, represented, perhaps, by an issue or part of an issue of bonds or other securities, may arise out of bad management or peculation. This is especially possible in the small companies; but these bonds for which the company has nothing to show in tangible assets would increase the estimated value of the franchise, according to Mr. Ford's method, by an amount equal to their full value. *Very many things besides the franchise may make up the difference between the Stock Exchange value of the total capital stock and the issue of bonds on the one hand and the estimated value of the tangible assets on the other hand.*

Some effort has been made in the amendments to the bill to partially avoid double taxation, but they are not in the form that they undoubtedly would be had this matter been taken up with that deliberation which legislation of this character demands, rather than with that snap and push and energy which is more commendable on the battlefield and, even, in the strictly executive functions exercised by a Governor, than it is in the enactment of legislation—especially, legislation dealing with so supreme and complicated a subject as taxation.

Manifestly, the bill has been improved by the amendments, but there must be very grave doubts, in the minds of every one, as to whether it would not have been better to have had a measure like this discussed more fully, and there seems to be a reasonable certainty that the other amendments may have to be passed, even if the law is not radically altered at the next session of the Legislature.

If a company in one town or village pays a fixed sum annually to local authorities for rights in public streets, and another company pays for similar rights by paving the street and agreeing to keep it in repair, why should one company have a deduction made from its "special franchise" tax and the other company have no deduction? This is what the amendment to the Ford bill does.

The chief problem involved is not the question as to whether these intangible assets shall be taxed, but how the tax asssessors are to arrive at the value of the intangible assets for the purpose of taxation. This matter has vexed the Legislatures and courts of all the States, and much can be learned from their experience; and no one should attempt to frame a bill or advise the passage of one dealing with the subject until after an exhaustive study by skilled counsellors of that experience as it appears in the statutes and in the decisions of the courts of the various States.

Among the many ways other than that adopted by the Ford bill by which a franchise tax can be measured are the following: By dividends, by the gross receipts, by the net earnings, by the amount of the capital stock at its market value, by the market value of the shares and other securities less the value of the real and personal property (which is Mr. Ford's method, but not necessarily the method to be adopted by the State Assessors); and, finally, by a careful consideration of each case on its merits, giving weight to many, if not all, of the various indicia of value, instead of founding an estimate upon only one of them.

H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ILLINOIS.—Mandamus to Street Railroad—Use of Streets—Control of Fares—Estoppel—Contracts—Ultra Vires—Procedure.

1. Where a corporation accepts a public franchise, imposing certain duties to the public in return for rights conferred, the performance of such duties may be compelled by mandamus.

2. The State's power to attach conditions beneficial to the public to the charter of a quasi public corporation may be exercised by a municipality, as within its delegated power to permit the use of streets and public places by the corporation.

3. Const. art. 11, sec. 12, authorizes the general assembly to enact laws to prevent extortion and unjust discrimination by street railways in the transportation of passengers. Held, that though the Legislature had enacted no laws to carry out the provisions, it was, notwithstanding, a declaration of the sovereign power over a street railway's duties to the public to demand only reasonable rates, without unjust discrimination.

4. An ordinance of R., authorizing defendant to enter and use its streets for the operation of a street suburban railroad to Chicago, provided that the fare between any point in R. and the city of Chicago should not exceed the fare charged from any point in the town of C., etc., to the same point, or return. Held, that by the acceptance of the ordinance, defendant was estopped to deny that the exaction of a greater sum from R. to Chicago than from C. was an unreasonable and unjust discrimination against the public.

5. The fact that a city ordinance imposing conditions on a quasi public corporation, in consideration of the privileges granted, required the corporation to accept it, does not render it a mere license, or such ordinance a mere private contract.

6. Since the street railway company has no power to use the streets of a city, in the absence of an ordinance permitting it, the granting of such privilege is a sufficient consideration for obligations imposed and assumed by the acceptance of the ordinance.

7. Where a street railway has enjoyed the benefits of an ordinance requiring performance of certain conditions and obligations by it, it cannot escape performance on the ground that the ordinance and duties imposed were ultra vires to both the city and the company.

8. An obligation imposed on a street railway company by a city ordinance, to demand no greater rates between certain points than between certain other points, is a provision for the protection of the public against unjust discrimination; and hence any citizen is entitled to maintain mandamus for its enforcement.

9. In mandamus begun in the Supreme Court, that court may alow an issue of fact to be made after submission of the case and demurrer to the petition, or not, in its discretion.—(People ex rel., Jackson vs. Suburban R. Co., 53 N. E. Rep., 349.)

ILLINOIS.—Appeal—Reversal — Amendment — Eminent Domain—Necessity.

1. Where the judgment in a petition for condemnation is reversed, and the cause remanded, on the ground that the petition should have stated facts showing the necessity for appropriating the lands in question, the Circuit Court properly allowed an amendment to the petition stating such necessity, and admitted evidence of the facts alleged.

2. Under Rev. St., chap. 66, relating to horse and dummy railroads, and the eminent domain act (Id., chap. 47), allowing the condemnation of property when "necessary" for the construction or operation of such roads, the necessity is not an absolute physical necessity, but one created by expediency or reasonable convenience.

3. A street railway approached a public crossing at an elevation where there were six tracks of a steam railway company, with trains passing and repassing every fifteen minutes. The street railway would have to cross these tracks and the center of the yard of the railroad, if it kept its tracks within the highway. Held, that a necessity arose, within Rev. St., chap. 66, in relation to horse and dummy railroads, and the eminent domain act (Id., chap. 47), so as to authorize a condemnation of private property to avoid the obstacles in ascending and descending a hill near such tracks, and the danger of the grade crossing.—(Aurora & G. Ry. Co. vs. Harvey, et al., 53 N. E. Rep., 331.)

MINNESOTA.—Taxation—Equality—Irregularities—Statutes—Partial Invalidity—Corporations.

1. Gen. St., 1894, sec. 1530, was designed to constitute the ex-

clusive method of listing and assessing for taxation the franchises and other intangible property of corporations and associations falling within its purview. The method there provided for reaching such intangible property for taxation is by listing and assessing the entire capital stock at its market or actual value, less certain specified deductions.

2. The personal property referred to in item 7 is the tangible property specifically listed and assessed, and does not include "franchises." Item 14 of section 1524, Gen. St., 1894, providing for listing "franchises" as a separate and distinct class of personal property, applies only to private persons, or others not falling within the provisions of section 1530. The provision in section 1530 for deducting the total amount of the indebtedness of a corporation or association from the value of its stock is unconstitutional, because resulting in inequality of taxation. But the invalidity of this provision does not render the remainder of the section invalid.

3. Certain irregularities of the county board and county auditor in increasing the assessed value of items 18 and 27 of personal property, and in extending it on the assessment rolls. Held, not to have prejudiced the defendants; it not appearing that, as thus increased, either item was overvalued. Gen St., 1894, sec. 1669, providing for the taxation of railroad companies by requiring them to pay a percentage on their gross earnings, does not apply to street railroads.

4. Held, that upon the facts the Duluth Street Railway Company is not a "railroad company," within the meaning of section 1669, Gen. St., 1894.—(State vs. Duluth G. & W. Co., et al., 78 N. W. Rep., 1032.)

MISSOURI.—Municipal Corporations—Jurisdiction of the Circuit Court—Use of Tracks—Compensation.

1. Under Const. art. 6, sec. 22, giving the Circuit Court Appellate jurisdiction from inferior tribunals as may be provided by law, and under the charter of St. Louis, the city may, by ordinance of its assembly, confer on the Circuit Court jurisdiction to review the award of commissioners appointed to fix the just compensation to be paid by one street railway company for the use of another's tracks.

2. Under the charter of St. Louis, which allows one street railway to use another's tracks on payment of a just compensation, and Ordinance No. 12,562, sec. 3, requiring the commissioners appointed to ascertain the just compensation to hear proofs as to such damages as they may deem just, where the company whose tracks are used did not have an exclusive franchise to use the street, but had agreed to permit any other road to use its tracks, it is not entitled, as part of the compensation, to loss of profits from competition of the other company.

3. Where a street railway company has abandoned its cable line, filled up its conduit, and is operating an electric line, the value of the road at the time another company seeks to use its tracks, and not the original cost of constructing the cable line, is the proper basis of the annual interest to be paid by the second company as part of the just compensation for use of the former's tracks.

4. Where one street railway company uses part of another's tracks, it should not be required, as part of the just compensation therefore, to pay any proportion of the latter company's special franchise tax, payment of half the annual property tax on the tracks used being sufficient.

5. Where one street railway company using another's tracks is required to make and maintain connections and pay switchmen, it is properly allowed to select and employ such switchmen.—(Grand Ave. Ry. Co. vs. Citizens Ry. Co., 50 S. W. Rep., 305.)

MISSOURI.—Municipal Corporations—Jurisdiction of Circuit Court—Use of Tracks.

1. Const. art. 12, sec. 20, prohibits the general assembly from granting the right to construct and operate a street railroad within a municipality without first acquiring the consent of the local authorities. The freeholders' charter of St. Louis, which, under Const. art. 9, sec. 25, is the organic law of the city, by article 10 gives the municipal assembly power by ordinance to determine all questions with regard to street railways, section 6 giving any such company the right to use another company's tracks on payment of just compensation, under such regulations as may be prescribed by ordinance. Ordinance No. 12,652 provides that such compensation shall be determined by commissioners, to be appointed in a manner prescribed. Const. art. 6, sec. 22, gives the Circuit Court appellate jurisdiction from inferior tribunals, as may be provided by law. Held, that the municipal assembly might by ordinance confer on the Circuit Court jurisdiction to review the award of the commissioners.

2. Under an ordinance regulating the use by one street railway company of another's tracks, which provides that the former shall construct and keep the connections with the latter's tracks, the former has the right to select and control the persons employed to handle the switches whose wages it is required to pay.—(Grand Ave. Ry. Co. vs. Lindell Ry. Co., 50 S. W. Rep., 302.)

MONTANA.—Duty to Operate—Ordinance—Mandamus—An ordinance granting a street railway company the right to construct and operate lines in certain streets, and providing that, if the company shall not construct and operate a certain portion of the line within a certain time, the right shall be forfeited, as to the parts where the failure occurs, does not impose on the company the duty to continue the operation of any portion of the line; and mandamus cannot issue to compel it to do so.—(State ex rel., Knight, et al., vs. Helena Power & Light Co., 56 Pac. Rep., 685.)

NEW JERSEY.—Constitutional Law—Judicial and Legislative Functions—Equity Jurisdiction—Injunction—Forfeiture of Franchise.

1. Though a township ordinance granting powers and franchises to a street railway corporation provides that the township may adjudge a breach of duties and obligations and declare a forfeiture, an ordinance passed pursuant thereto, declaring a forfeiture and decreeing a sale of the corporate property, is judicial in its character, and equity has the same power to intervene and modify the proceeding as it would have to interfere in a proceeding in a court of law.

2. When a judicial act is in any particular contrary to the principles of equity, the fact that there may be a remedy at law on other grounds is not generally a sufficient reason to prevent equity from interposing its appropriate remedy on grounds not available at law.

3. Where a street railway corporation has expended large sums of money and exercised due diligence in building and operating its road, so as to comply with an ordinance of permission, but unforseen circumstances have caused a delay, which has occasioned no pecuniary injury to the township or its inhabitants, equity will interfere to restrain the adoption of an ordinance by the township declaring a forfeiture of the franchise of the corporation because it did not comply with the statute of permission, which provided that cars should be running at a certain headway, on a continuous line of double track, within a specified time.—(North Jersey St. Ry. Co. vs. Inhabitants of Township of South Orange, 43 Atl. Rep., 53.)

NEW YORK.—Carriers—Fares—Where a person boards an open street car, and then, because of a sudden change in the weather, leaves such car, and takes passage in a closed one, attached to the other, he becomes a new passenger, and liable for another fare.—(Lasker vs. Third Ave. R. Co., 57 N. Y. Suppl., 395.)

NEW YORK.—New York City Court—Removal of Causes.

1. Under Greater New York Charter, sec. 1366, providing that a defendant may apply to the justice holding court in the district in which the action is brought for its removal to the City Court of New York, an action is not removable on application of one of several defendants.

2. Mandamus—Remedy by Appeal—Mandamus will not lie on refusal of district court to remove case to City Court of New York, the remedy being by appeal.—(People ex rel., Metropolitan St. Ry. Co. vs. Roesch, 57 N. Y. Suppl., 295.)

NEW YORK.—Municipal Corporations—Construction—The power conferred upon the city of Buffalo (Laws 1870, chap. 519, title 3, sec. 19) to permit railroads to cross streets is not independent of, and free from, the limitations imposed by the general railroad act (Laws 1850, chap. 140, sec. 28, subd. 5). The railroad act confers the right to occupy the highway, upon a consent being given, and the charter prescribed by what vote the permission of the city authorities shall be expressed; and the right, when thus acquired by a railroad company, can be exercised only in the proper way, and with a due regard to the public convenience.—(Delaware, L. & W. R. Co. vs. City of Buffalo, et al., 53 N. E. Rep., 533.)

NEW YORK.—Corporations—Action by Stockholder—Pleading—Sufficiency—Relief in Equity.

1. A complaint, in an action by a stockholder to set aside a lease of corporate property, alleging that the scheme of leasing was unlawful, and that the intent of the stockholders approving the lease was to defraud the others, and setting forth the method of accomplishing the fraud, without a motion by defendants to make it more explicit, is sufficient for the introduction of every fact showing an intention of the stockholders approving the lease to defraud the others.

2. Where a stockholder brings an action to set aside a lease executed by the corporation, it is not for his benefit alone, but for the corporation; and his complaint must allege that the corporation was applied to, and refused, to prosecute the suit.

3. A complaint, in an action by a stockholder to set aside a lease by the corporation, alleging that complainant demanded his share of the proceeds of operating the property under the lease;

that he notified the directors that the lease injured the stockholders, and demanded a distribution of the profits arising from the operation, without regard to the lease; and that such distribution involved such action of the directors as would annul the lease, is sufficient to authorize the stockholder to maintain the suit, the allegations not being equivalent to an averment that the corporation was applied to, and refused, to sue to set aside the lease.

4. Where directors of a corporation execute a fraudulent contract with a third party on the express approval of a required number of stockholders, and the scheme will result in serious injury to them or to the corporation, equity will set aside the fraudulent transaction, and compel the delinquent parties to account.—(Flynn vs. Brooklyn City R. Co. et al., 53 N. E. Rep., 520.)

NEW YORK.—Appeal—Review—Findings—Eminent Domain—Elevated Railroads—Damages to Abutting Property—Evidence.

1. If findings prove irreconcilable, it is the duty of the Appellate Court to accept those most favorable to appellant, as he is entitled to rely on them in aid of his exceptions.

2. When fee value of property abutting on a street through which an elevated railroad is operated has steadily declined since the construction of the road, while property on the abutting streets in the immediate neighborhood, with no railroad in front of it, has steadily advanced, and the rents from the property during the period when the road was being built decreased $5000, and, though there was some increase after the road was completed, they have never come to within $4000 of what they were before, while rents on the side streets have rapidly increased, in the absence of any explanation, the inference is that the presence and operation of the road has kept the value of the abutting property down.

3. On appeal from a judgment of the general term of the Court of Common Pleas of the city and county of New York, the unanimous affirmance by that court does not have the effect of a unanimous affirmance by an Appellate Division; and hence a finding made without evidence to sustain it is a ruling on a question of law, which, when duly excepted to, it is the duty of the Court of Appeals to review.

4. Evidence that a station has been located two blocks away from hotel property that it is claimed has been damaged by the construction and operation of an elevated railroad, in the absence of evidence that people in large or small numbers used the station, or that any more people passed by or patronized the property in question after the construction of the road and the building of the station than before, or that the station was of any special benefit to the property, will not justify a finding that the property has been materially benefited by the construction and operation of the road.—(Israel vs. Metropolitan El. Ry. Co. et al., 53 N. E. Rep., 517.)

OREGON.—Receivers—Claims—An order appointing a receiver for a street railroad in forclosure proceedings, and directing him to pay "all current expenses incident to the administration of his trust, and to the condition and operation of said business, from time to time, as the same arises and accrues," does not require the receiver to pay any debt not entitled to preference over the mortgage creditors, or such as accrued prior to his appointment.—(McCornack vs. Salem Consol. St. Ry. Co. et al., 56 Pac. Rep., 1022.)

PATENT DECISIONS.

1.—Patents—Invention — Electric Railways — After dynamic-electric machines and electric motors were invented, sufficiently powerful and economical to operate a stret railway, there was no invention in combining them with a track and cars by a plan or system previously well known, and which had been unsuccessful solely because the electric machines then in use were defective.

2.—Same—The only combination shown in the specifications of a patent for an electric railway was one in which the electricity is carried by one insulated rail and the wheels on it to the motor, and back by the wheels and the other rail. There was a suggestion that independent conductors might be used, but no suggestion as to how contact therewith was to be maintained by the moving car; and at that time there was no practical device for maintaining contact with an overhead wire. Held, that the patent could not be pieced out, by reference to the art, so as to include in the combination an overhead wire and contact device.

3.—Same—The Green patents, Nos. 465,407 and 465,432, for an electric railway and means of operating the same, if valid at all in view of the previous state of the art, are confined to a combination in which the electricity is carried to the motor by one insulated rail and the car wheels, and back through the other wheels and rail or the ground, and is not infringed by the overhead wire and trolley-contact system.—(Kelly et al. vs. Springfield Ry. Co. et al., 92 Federal Rep., 614.)

LIABILITY FOR NEGLIGENCE.

ILLINOIS.—Cable Cars—Carriers—Passengers—Standing on Platform—It is not contributory negligence, per se, for a passenger on a cable car to ride on the rear platform, where others do it without objection, and there is no rule against so doing.—(North Chicago St. R. Co., 53 N. E. Rep., 568.)

INDIANA.—Master and Servant—Injuries to Servant—Action—Complaint—Special Verdict—Assumption of Risk—Negligence—Proximate Cause—Ordinance.

1. Under a complaint by an employee of a street railway company, merely alleging that the injuries resulted from the negligence of the company in running its cars, the employee cannot prove that they resulted from the failure of the employer to provide a safe place to work, and safe machinery, or that the injuries were willful.

2. One employed by a street railway company to turn switches at the intersection of several lines was familiar with the surroundings, and there was room for him to stand safely between the tracks. Having turned a switch, a car passed him, immediately followed by another, drawn by horses, which were prancing about, and to avoid injury therefrom the employee stepped back toward the other track, and was struck by a car thereon, moving in an opposite direction at 8 or 10 miles an hour, contrary to an ordinance limiting the speed to 6 miles. Held, that the appearance of the horses was the proximate cause of the accident, and not the speed of the car which struck the employee.

3. One employed by a street railway company to turn switches at the intersection of several lines assumed the risk of accidents caused by the switching of the cars.

4. A special verdict that the place of the accident, which was a curve on a street railway track, was rendered unsafe by the sway of the car, was not a finding that the improper speed of the car caused it to sway.

5. Where it is sought to make an ordinance, entitled one to authorize the operation of certain passenger railways on the city's streets, applicable to a company operating nearly twenty years after its passage, it should be shown that such company was existing when the ordinance was passed, and was one of the railways therein designated.—(Thompson vs. Citizens' St. R. Co., 53 N. E. Rep., 462.)

KENTUCKY.—Carriers—Negligence as to Passenger on Street Car—When Relation Ceases—Speed of Car as Negligence—Omission of signals.

1. Either the rapid speed of a street car at a public crossing in a populous city in the evening, or the failure to give a signal of the approach of the car to the crossing, is negligence, as to a passenger attempting to cross the track after alighting from another car of the same company moving in the opposite direction on a parallel track.

2. A passenger upon alighting from a street car does not cease to be a passenger, but is entitled to protection against the negligent management of cars by the same company on a parallel track.

3. Defendant having elicited from plaintiff, on his cross-examination as a witness, the fact that he had served a term in the workhouse, it was not error to permit an explanation by the witness of the offense for which he was convicted.—(South Covington & C. St. Ry. Co. vs. Beatty, 50 S. W. Rep., 239.)

MICHIGAN.—Trial—Province of Jury—Contributory Negligence—Witnesses—Interest.

1. Where the evidence is open to a construction that renders it conflicting, it is not error to refuse to withdraw the case from the jury.

2. It is not negligence for a passenger to ride on the running board of a street car, where the car is full, and he cannot get inside.

3. Where a witness testified, on cross-examination, that he went to defendant to see about a settlement for plaintiff's injuries, it is not error to sustain an objection to a question whether witness had told defendant the amount for which he would settle; his interest already appearing from his testimony.—Pomaski vs. Grant, 78 N. W. Rep., 892.)

MINNESOTA.—Costs—Rights of Prevailing Party—Witness Fees.

1. Actions were brought by different plaintiffs, husband and wife, against the same defendant, to recover for injuries received in the same accident. By consent of all parties, the cases were tried together, separate verdicts being rendered. Plaintiff's wife had a verdict on which her costs and disbursements were taxed and allowed, judgment entered, and paid. In the other action the verdict was in defendant's favor. Held, that under the provisions of Gen. St., 1894, sec. 5498, the defendant, prevailing party in the action brought by the husband, was entitled to recover $10 statutory costs, therein prescribed.

2. Held, further, that under section 5500, Gen. St., 1894, defendant, prevailing party in the action brought by the husband, was also entitled to recover disbursements paid or incurred as fees for witnesses who were subpœnaed and attended in that action, although it was admitted that the witnesses were as necessary and material in one case as in the other, and would have been produced and sworn in both, had there been separate trials.

3. It is not error to allow fees for travel and attendance of witnesses, who are not sworn at the trial, where the attendance of such witnesses is regularly proved. And fees of witnesses actually in attendance, though not called to testify, are properly taxed, where, if a certain state of facts had been shown by the other party, his opponent would have been compelled to call such witnesses.—(Schuler vs. Minneapolis St. Ry. Co., 78 N. W. Rep., 881.)

MISSOURI.—Injuries to Passenger—Negligence—Pleading—Evidence—Province of Jury.

1. Rev. St., 1889, sec. 2074, requires that in construing a pleading to determine its effect its allegations shall be liberally construed with a view to substantial justice. A petition alleged that a passenger on a street car requested the conductor to let her off at a certain street; that, on reaching there, it appeared that the car was not going to stop, and the passenger again indicated to the conductor her wish to get off there; that immediately, as if in response to her request, the car slowed down, until its motion was scarcely perceptible, when she attempted to alight; and that while doing so the car started suddenly, and she was thrown down. Held, after verdict, that it did not charge that the passenger specifically requested to be let off at an unusual place, but it implied that the car was stopped at her request, and that the conductor saw, or should have seen, her alighting; so that it was unnecessary to allege that the car started before she had time to alight.

2. Several blocks before reaching a crossing, a passenger on a street car told the conductor to let her off there, and, seeing that the car was about to pass that point, she again signaled him to let her off, and he nodded to her. Immediately the car slowed down until the motion was scarcely perceptible, when she attempted to alight, taking hold of the railing, and, when one foot was on the ground, the car suddenly started, throwing her. The company claimed that the car slowed up where it did, as was usual, to enable the motorman to see if there were any cars on an intersecting line on the next street, but the testimony did not show that the passenger knew this, or knew that it was unlawful to stop in the middle of a block to discharge passengers. She knew it was customary for the conductor to ring the bell to stop, but testified that she did not know whether he rang it this time or not, and that she did not see him after she signaled. Held, that the case was properly left to the jury to determine whether the passenger was justified in alighting.

3. The passenger and several witnesses testified that they did not notice whether the conductor rang the bell, but all the witnesses except one, who was on the sidewalk, were on the rear car. One witness testified that the conductor placed his hand on the bell rope. Held, that the evidence raised the question whether the car was stopped to let the passenger off.

4. The last witness also testified that, after the passenger had fallen, the conductor asked witness if he had seen that. Held, that the evidence raised the question whether the conductor saw the passenger attempting to alight.

5. While a street car was crossing a street, a passenger signaled the conductor to stop, and the car slowed up, coming nearly to a standstill, between such street and the next one. The passenger attempted to alight, and was thrown by the sudden starting of the car. The company claimed that the car was slackened, as was customary, to enable the motorman to ascertain whether there were any cars on an intersecting line on the next street, and that the conductor understood the passenger's signal as one to stop at such street. Held, that a very high degree of care was required of the conductor in regard to the signal.—(Cobb vs. Lindell Ry. Co., 50 S. W. Rep., 310.)

NEW JERSEY.—Contributory Negligence—A boy, nine and one-half years of age, while playing in the street, ran in front of a trolley car which he saw approaching, and was struck by the further corner of the fender. Held, that there was no element of danger which he did not perceive or which a boy of his years was not capable of fully appreciating, and that, therefore, he took the risk of failing in the attempt which he designedly made.—(Brady vs. Consolidated Traction Co., 42 Atl. Rep., 1054.)

NEW JERSEY.—Negligence—Obstruction in Street—New Trial—Newly Discovered Evidence.

1. While a street car company has the right to place a pile of car track rails upon the street, temporarily, for its use in reconstructing or repairing its car track, yet it is bound to the duty to exercise reasonable care to guard the public using the street against the danger arising from the rails so placed upon the street, and in the night-time to place a guard or signal of warning to persons using the street; and this duty exists whether the pile of rails be placed in the gutter of the street or in some other portion thereof.

2. Where the plaintiff, in the night-time, had come from a house on the street, and was endeavoring to cross over the curb and street to board a street car, and in doing so stumbled and fell upon a pile of street car rails placed in the gutter or alongside the street over which he was crossing in order to take the car, the pile of rails extending a few inches above the curb, there being no signal of danger or guard placed there to warn the plaintiff of the existence of the pile of rails at that place, and the street lamps or lights being at some distance away up and down and across the street, and, under the evidence, it being a matter of fair controversy whether the rails could be seen by the plaintiff in the exercise of ordinary care in passing over the gutter or side of the street, a case is presented which calls, as matter of fact, for a determination by the jury whether the defendant company, which placed the pile of rails in the gutter, had exercised reasonable care to protect the plaintiff from the injury arising to him by reason of his fall, and also whether the plaintiff himself had exercised reasonable or ordinary care in passing over the street to reach the car.

3. Newly discovered evidence in behalf of the defendant, tending to show the existence of lights in the vicinity, as bearing upon the question of the negligence of the defendant and the contributory negligence of the plaintiff, in order to be considered on a rule to show cause why the verdict should not be set aside, must be such as is not merely cumulative, and such as could not have been produced at the trial by the exercise of ordinary diligence on the part of the defendant.—(Thomas vs. Consolidated Traction Co., 42 Atl. Rep., 1061.)

NEW JERSEY.—Collision With Vehicle—The driver of a vehicle upon a road used by the public at large, which crosses the track of an electric railway, must exercise reasonable care to avoid collision, and the same duty rests upon the motorman of a trolley car in approaching the crossing of such a road, whether the crossing is in the country or in a town; and, in case of accident, the question whether either or both of said parties failed in such duty is one to be determined by the jury, when the proofs on the subject of negligence leave that question in doubt. Neither party at such a crossing has a paramount right of way.—(Atlantic Coast Elec. R. Co. vs. Rennard & Wilson, 42 Atl. Rep., 1041.)

NEW YORK.—Personal Injuries—Complaint—Specificness.

1. A complaint in a personal injury case, alleging that the occurrence inflicted severe injuries on plaintiff from which he has not recovered and will not recover, and that by reason of the injuries he has been unable to follow his usual occupation or do any work, and that he has suffered great pain, is sufficiently specific to warrant evidence as to any effects of the injuries received, in the absence of a motion to make the complaint more definite or for a bill of particulars.

2. Appeal—Matters Not in Record—Where the record does not contain a bill of particulars, the Appellate Court cannot consider its alleged contents.

3. Trial—Examination of Witnesses by the Judge—The action of the trial judge, in practically conducting plaintiff's case by examining plaintiff and his witnesses while on the stand, as to points not yet touched on by the counsel, by asking them questions which would have been incompetent if asked by plaintiff's counsel, and which were leading and suggestive, warrants a reversal.—(Bolte vs. Third Ave. R. Co., 56 N. Y. Suppl., 1038.)

NEW YORK.—Injury to Pedestrian—Evidence—A verdict against a street railway company for injury to a child four years old, struck by a horse car, is properly set aside as against evidence, the proof being that the car was 73 ft. away when the child and her older sister were at the first rail of the track, and it being apparent that the jury failed to consider the gross improbability of the car proceeding that distance while they were walking only part of the distance across the track.—(Gordon vs. Second Ave. R. Co., 57 N. Y. Suppl., 298.)

NEW YORK.—Injury on Crossing—Question for Jury—A building at the intersection of a private driveway leading from a public resort, and a street railway, obstructed the view of an approaching car. The building was only a few feet from the track. Plaintiff, who was proceeding along the driveway at night, without listening for a car, went upon the crossing and was struck. The car was running at a high rate, and did not slacken its speed. No gong was sounded nor other signal given. At that time of the evening many people were accustomed to leave such resort by the driveway. Held, sufficient to justify a submission of the case to the jury.—(Duncan vs. Union Ry. Co. of N. Y. City, 57 N. Y. Suppl., 326.)

NEW YORK.—Accident to Passenger—Evidence—Testimony of plaintiff that, after defendant's car had stopped, she was alight-

ing from the rear platform, with her right hand on the rail of the dashboard, and one foot in the air, ready to step off, when the car started, throwing her "forward," is not necessarily untrue.—(Bosting vs. Brooklyn Heights R. Co., 57 N. Y. Suppl., 119.)

NEW YORK.—Collision—Contributory Negligence—One who, seeing an electric car only part of a block away, coming very fast on a down grade, starts to cross the track diagonally for a cross street, passing close to a pillar of an elevated railroad, against which he is driven by the car, is prevented by contributory negligence from recovering therefor.—(May vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 277.)

NEW YORK.—Collision—Contributory Negligence—Contributory negligence is a question for the jury, where the plaintiff, driving along a street, and coming first to the track on the avenue on which the up-bound street cars run, had to turn the heads of his horses slightly to avoid a collision with such a car, and then, getting on such track, saw a car half a block away coming down on the other track, and, the crossing being clear, proceeded at a fast walk, and was struck by such car after the horses and front wheels of his wagon had got over the second track.—(Reilly vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 278.)

NEW YORK.—Collision—Contributory Negligence—One who, seeing a cable car coming, half a block away, very fast—at the full speed of the cable—gets into his wagon, covered at the sides, and, without looking further, starts to cross the track, is prevented by contributory negligence from recovering for injuries received.—(Lang vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 249.)

NEW YORK.—Negligence—Sufficiency of Evidence.

1. In an action for negligence, where plaintiff's evidence is not corroborated, and a defense is made out by disinterested witnesses, a verdict for plaintiff is against the weight of the evidence.

2. Damages—Personal Injuries—Pleading—Evidence—In an action for personal injuries, evidence of bodily ills, not complained of in the pleadings, is inadmissible.—(Hess vs. Metropolitan St. Ry. Co.. 57 N. Y. Suppl., 222.)

OHIO.—Wrongful Death—Recovery Limited to Pecuniary Loss for Mental Suffering—Competency of Evidence—Injury to Railway Employee.

1. While, in the trial of a case for causing death by wrongful act, neglect, or default, under sections 6134, 6135, Rev. St., the recovery is limited to the pecuniary injury resulting from such death to the beneficiaries, and nothing can be allowed on account of bereavement, mental suffering, or punitive damages, yet any evidence which tends to show the amount of such pecuniary injuries sustained by such beneficiaries, or which tends to show that such beneficiaries received financial aid from the deceased during his lifetime, and that they would likely have continued to receive such aid had he lived, is competent; and for the purpose of showing that such beneficiaries needed, and would likely have received, such aid from the deceased, the circumstances, age, health and means of support of the beneficiary, if a parent or next of kin of the deceased, as well as the age, health, disposition and thrift of the deceased, may be shown.

2. Rules adopted by a street railway company for the government of its employees in operating such railway are competent evidence, when relevant, in the trial of a cause for damages for personal injury caused by the negligence of the servants of such company.—(Cincinnati St. Ry. Co. vs. Altemeier, 53 N. E. Rep., 300.)

Legal Book Notices

NEGLIGENCE CASES*

In the December number of the Journal we had occasion to review the excellent work of Mr. Hamilton, entitled "New York Negligence Cases, Classified." It gives us pleasure to note the prompt publication of the supplement to that work, which contains all the cases "classified according to the facts," for the year 1898. The supplement follows the plan of the original work, with this important and useful addition, that in each case the disposition of the case in the first instance (including the amount of the verdict, if for the plaintiff) and the decision on appeal has been added to the brief statement of facts.

Mr. Hamilton's preface contains the interesting information that of the cases reported, with opinions, in the last twelve volumes of the Appellate Reports of New York, over 18 per cent were negligence cases, and about 13 per cent of those in the last four volumes of the Court of Appeal Reports.

These, with the negligence cases, covering the same period in the Miscellaneous Reports (about 7 per cent of the cases there reported) contain over 350 opinions on Negligence Law.

VALUABLE COLLECTION OF ELECTRICAL CASES†

This important and compendious work in six volumes has just been issued from the press of Matthew Bender. We know of no single work which contains as much of value, at first hand, for use in the legal department of electric and street railway companies as this. It contains full reports of between 2000 and 3000 cases, covering a period of twenty-four years. These reports are annotated by the head notes of, and references to, other cases decided during the same period. At the end of each volume is an admirable index which greatly increases the value of the work and makes it a time saver. Of course, an index or digest covering all the volumes under a single alphabet would still further add to its value. The cases in each volume seem to be arranged as far as is practicable, under different subjects, and perhaps the easiest way to give an idea of the value and extent of the work is to indicate the subjects treated of in the last volume, which covers the years 1895 to 1897.

Some fifteen cases are devoted to the powers of municipal corporations over the use by electric companies of streets and highways; of the right of the municipalities to impose license fees, and generally of the rights of electric companies in the streets, excepting those cases which involve the rights of abutting property owners.

The next eight cases treat of the rights of abutting property owners. Then, two cases are reviewed under each of the following topics: Cutting trees; the rights of the telegraph along a steam railroad; the crossing of electrical and steam railroads, and the inference by different companies in the use of the same street.

The next six topics relate to various phases of the law of negligence, and there are from five to thirty-six cases reviewed under each subject: Injuries caused by electric shock, negligence in the use of electrical appliances, negligence causing injuries to employees, the duties of street railway companies to passengers, and the duties of street railway companies to travelers in the street.

Six cases are reported which deal with the taxation of telegraph and other electric companies and their property. One or two cases are devoted to each of the following subjects: The rights of municipalities to supply electric light, discrimination practiced by telephone companies as common carriers, the relation existing by contract and otherwise between the United States, the Union Pacific Railroad and Western Union Telegraph Company.

Finally, nineteen fully reported cases deal with the negligence of telegraph companies in sending and delivering messages. The valuable note to these cases contains head notes of some fifty-six additional cases upon the same subject.

Perhaps in no department of the law is a work of this sort so useful. Ordinarily, especially in the older States of the Union, the practitioner finds precedents at hand in his own library from the courts of his own State, and can quickly advise the officers of the legal department of the corporation for which he is counsel, either out of his own knowledge or from the bookshelves of his own library; but where he is dealing with the legal rules that have to be applied to so new an element of modern commerce as electricity, very many questions arise in the conduct of a company using it which require the application of old principles to an entirely novel state of facts. Precedents have to be looked for not only in the home State of the corporation, but outside of it. It frequently happens that a question has only been decided in one or two States and has not been passed upon by the local courts at all.

This set of volumes is the best work we know of to supply the obvious need which exists in the library, both of the counsel and of the legal department of the corporation who deal with electrical questions. The arrangement of the volumes in chronological order is especially to be commended in a work of this sort, where the law is growing from year to year. For example, the question as to whether it is negligence for a street car company to run electrical cars without fenders is a question which is necessarily much affected by the date of the accident or decision. In 1895 the Supreme Court of Massachusetts decided that in the year 1893, at which time there was but one electric road in Massachusetts using a fender, the absence of a fender was not negligence. Mullen vs. R. R., 6 Am. Electl. Cas., 492. Subsequent volumes of this series will undoubtedly show an advance upon this decision growing out of the general adoption of this safety appliance.

* Supplement to Hamilton's New York Negligence Cases, classified according to the facts, by T. F. Hamilton. Matthew Bender, Albany, N. Y., 1899.

† American Electrical Cases. A collection of all the important cases (excepting patent cases) in the State and Federal Courts from 1873 to 1897, on subjects relating to the telegraph, the telephone, electric light and power, electric railway and all other practical uses of electricity, with annotations. Edited by William W. Morrill. Matthew Bender. Albany, N. Y., 1897.

Electrical Exhibition at Madison Square Garden

The second annual electrical exhibition was held at Madison Square Garden, New York, from May 8 to June 3, under the auspices of the National Electric Light Association. The show was opened on the evening of May 8, at 8.30, by Senator Chauncey M. Depew, who was assisted by A. M. Young, president of the National Electric Light Association, C. O. Baker, Jr., and Marcus Nathan, of the Electrical Exhibition Company. Telegrams of congratulation were received from President McKinley and from Governor Roosevelt.

The exhibition aroused considerable interest and enthusiasm in matters electrical, not only among the trade, but also among the every-day citizens of Greater New York, and it was well attended each afternoon and evening.

The occasion was taken by a number of electrical and technical societies in the vicinity of New York to hold regular and special meetings at the Garden during the exhibition, and in addition to these the National Electric Light Association met in regular convention in the lecture room of the Garden from May 23 to 25, inclusive.

On the evening of May 13 the New York Electrical Society held its 198th meeting, and celebrated the centennial of the discovery of the electric battery by Volta with special exercises. The meeting was held in the concert hall, and was attended by four or five hundred persons, including representatives of several Italian societies.

SOME OF THE EXHIBITS

The main floor of the Garden was filled with well-arranged exhibits of the heavier machinery, apparatus, etc., employed in the generation and distribution of electricity and in allied industries, and in the gallery running around the entire building were placed the lighter exhibits, such as historical and experimental instruments and relics, wireless telegraphy apparatus, etc. Among the exhibits the following may be briefly mentioned:

An attractive display of electrical instruments was made by the Cutter Electrical & Manufacturing Company, of Philadelphia. This company had a three-sided booth, upon the walls of which were hung standard circuit breakers of various capacities, the new Q. & C. rheostat, etc., one of the walls being reserved for what the company calls its freaks, or instruments made to meet extraordinary conditions. A prominent feature of the exhibit was a 1000-amp. single-pole circuit breaker, with laminated contacts.

The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, illustrated in a simple manner the development in the direct application of electric power for the driving of machine tools. The exhibit included four commercial machines, one 25-kw. engine-type generator, a 65-h.p. motor, a belted 10-h.p. motor running at 1050 r.p.m., and a 6-in. x 5-in. Forbes vertical engine direct connected to a 12-kw. dynamo arranged for the Bullock system of control. An artistic feature of this exhibit was a large revolving globe, around the circumference of which appeared the name of the company in incandescent lights.

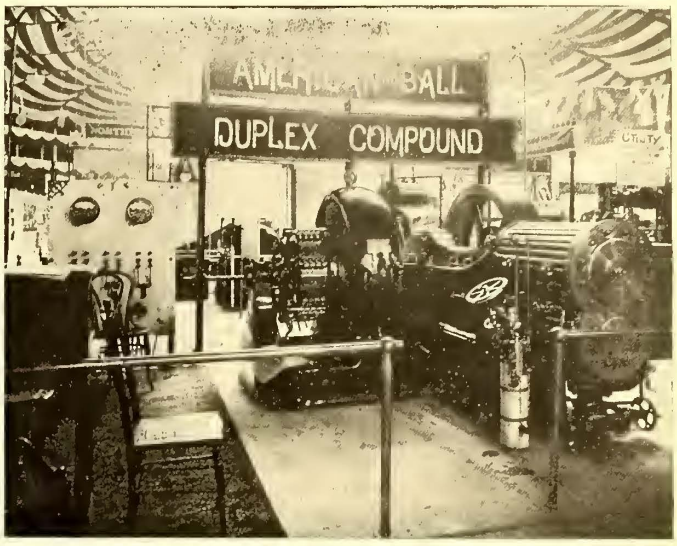


EXHIBIT OF THE AMERICAN ENGINE COMPANY

An exhibit of particular interest to central station managers was made by the Wagner Electric Manufacturing Company, of St. Louis. This comprised a 7½-h.p., 60-cycle, 110-volt, single-phase alternating current generator. The current was taken from the generator through a switchboard, upon which was mounted a number of direct current volt meters and ammeters and alternating current ammeters and volt meters, an indicating watt meter, and other instruments of the Wagner type. Samples of switches were also shown, these being of a new type just brought out by the company.

A time recorder for keeping the time of employees in large factories, street railway repair shops, and other establishments of like nature, was displayed by the Willard & Frick Manufacturing

GENERAL VIEW OF EXHIBITION HALL

Company, of Rochester, N. Y. This instrument does away with the necessity of a separate clerk for timekeeping, each employee making his own record. The system is of such a nature, however, as to prevent fraudulent records.

One of the most interesting features of the show, from a popular point of view, was the collection of automobiles, this being, it is stated, the largest number of electrically propelled vehicles ever brought together at one time. All sorts and conditions of carriages and wagons were shown, including buggies, hansoms, closed and open cabs, delivery wagons, stages, etc. Among the largest exhibits of automobiles were those made by the American Electric Vehicle Company, of Chicago; the Columbia Automobile Company, of Hartford; the Indiana Bicycle Company, of Indianapolis, and the Riker Electric Motor Company.

The American Vitrified Conduit Company showed samples of its multiple duct conduits, containing from two to sixteen ducts. This company in all its conduit work uses dowel pins for alignment in making joints, thus assuring a positive and true joint, and doing away with the necessity of using mandrils in laying the ducts. The company exhibited a subway system laid out in miniature, showing a manhole built of a new type of brick, with a special arch for the top, and covered with the McGregor noiseless manhole frame and cover, made by the McGregor Manufacturing Company, of New York.

The John A. Roebling's Sons Company, of Trenton, N. J., had a very complete display of samples of all its wire products, including bare copper wires, rubber and other insulated wires of all kinds, office and magnet wires, electric light wires, etc. A number of samples were also shown of cables which the Roebling Company has supplied, and which are of historical interest. Among these were sections of the last Commercial Cable. An object of particular interest to street railway men was the special splice of the large three-phase cable for the Metropolitan Street Railway Company, of New York. This cable is made up of three 0000 wires, and will be used for the transmission of high tension current over the company's system. The splice is quite compact, the only visible evidence of its existence being an enlargement about one foot long of the lead casing. Samples of Columbia and flexible rail bonds were also shown.

EXHIBIT OF CLING-SURFACE MANUFACTURING COMPANY

EXHIBIT OF GOLD CAR HEATING COMPANY

In one corner of the gallery was shown a device manufactured by the Evans Automatic Illuminating Car Sign Company, of Boston. This is a revolving sign designed to be placed on the front or side of a car, near the transom, and having open letters, through which the light from the interior of the car shows, doing away with the necessity of having extra lights for the sign.

An interesting and instructive exhibit was made by the Union Boiler Tube Cleaner Company, of Pittsburgh, Pa. This company gave practical illustrations of the methods employed in removing scale from the principle types of boilers with the cleaning device which it manufactures. The Union boiler tube cleaner was fully described in the Street Railway Journal for February, and the manufacturers state that it is coming into very extended use. With this apparatus tubes that have become nearly solid with the hardest kind of scale have been thoroughly cleaned and rendered equal to new in less than five minutes. The company showed in operation both the rigid cleaner for straight tubes and the flexible shafting for bent tubes.

The Joseph Dixon Crucible Company, of Jersey City, N. J., had a tasteful booth, in which were shown cases containing samples of graphite products for electricians and electrical industries, including resistance rods from 1 ohm to 1,000,000 ohms, graphite brushes, lubricants for dynamo and motor commutators, etc. The company was represented by John H. Baird, who distributed an acceptable little souvenir made of graphite. Extending the entire length of the booth was a changeable electric sign, which was one of the most attractive at the exhibition.

The H. B. Camp Company, of Aultman, Ohio, made a practical demonstration of the enormous strength of the vitrified clay conduit which it manufactures. It had on exhibition a 15-ft. span composed of sixteen ducts, built entirely without concrete or support of any kind except at the ends. This span had a breaking strain of 32,000 lbs. Various samples of the company's usual and special types of conduit were also shown.

A most tasteful and attractive booth was fitted up by the Safety Insulated Wire & Cable Company of New York. Here all visitors were made perfectly welcome, and something of the company's enormous business was explained to them. A number of samples of particularly interesting cables were shown, among them being sections of cable used in the Philippine Islands, Cuba and Porto Rico by the United States Government for submarine and land lines during the recent war with Spain; also sections of wire used by the telegraph and signal corps. It is a noteworthy fact that all the wire and cables purchased by the United States Government for installing the mine fields in New York, Boston and other harbors during the war were purchased from the New York Safety Insulated Wire & Cable Company, as was also the wire used in the United States Navy. A unique changing electric light sign completed the decorations of the booth.

The Stirling Company, of Chicago, had on exhibition a full-sized 125-h.p. standard Stirling boiler, showing the details of its construction in the clearest possible manner. A number of strong points are urged in favor of this type of boiler, among them being the advantages in cleaning, as there are no tube caps to remove or replace, the dried steam delivered, and the absence of all injurious strains in the interior due to the alternate heating and cooling. This latter advantage is secured by leaving the lower drum, into which all the tubes enter, without rigid attachment, thus permitting considerable movement of the tubes and drums without strain. In a test of eight hours duration Stirling boilers have been forced 133 1/3 per cent above their rated capacity, and held there through the entire test, without injuring in the slightest degree any of the parts. In actual tests when forcing the boiler 50 per cent above rating the moisture of the steam does not exceed 1½ per cent.

An extremely effective demonstration was made by the Cling-Surface Manufacturing Company, of Buffalo, of the results obtained by the application of cling-surface to belting for the purpose of preventing slipping. The exhibit consisted of a direct current 7½-h.p., 110-volt Westinghouse motor running at 750 r.p.m., and driving, by means of two 4-in. belts on its one pulley, two 3¾-kw., 125-volt Westinghouse multipolar dynamos, each running at 1000 r.p.m. Thus the two dynamos being of the same capacity and deriving their power from the same source enabled a comparison of the performance of the two belts, which were of the same size and made from the same piece of leather. The tension on the belts was obtained by means of heavy spring scales pulling

at the back of the machines, both belts having a tension of 120 lbs. The belt treated with cling-surface was run slack, and, in fact, kept so that both sides touched without in any way affecting the output of the motors. The untreated belt had to be perfectly tight before it would do its work, and any tendency to slacken was immediately noticed by the diminishing of the output. The load on the machine consisted of a bank of lamps forming a sign. Tests were made to show there was no slip on the cling-surface belt, while on the other there was constant slippage. Albert B. Young, manager of the company, had charge of the exhibit.

A very complete line of electric heaters was shown by the Gold Street Car Heating Company, of New York and Chicago. These were the usual forms of the Gold heating appliances having a zigzag rod or support for the resistance coil. The application of the heaters to street cars was shown by a longitudinal car seat fitted with the latest design of the Gold three-degree panel type. This device is divided into three even sections, all of which are controlled by a three-point regulating switch, so that one-third, two-thirds or the full capacity of every heater may be had at any time, according to the outside temperature. The very even methods of graduating insures uniform and comfortable distribution of heat at all times. A Hale & Kilburn walk-over seat was also shown fitted with the Gold standard heater, the construction and connections of which are very simple. Over twenty other designs of electric heaters, using the Gold resistance coil and support, were shown, all suited to different purposes, some of them being designed for steamships, and others for house warming. A very popular feature of this display was the electric fireplace placed at one corner of the booth. This was very attractively arranged, and excited a great deal of interest among visitors. It is well adapted to the heating of country houses, clubs, city residences, etc., wherever electric current is available.

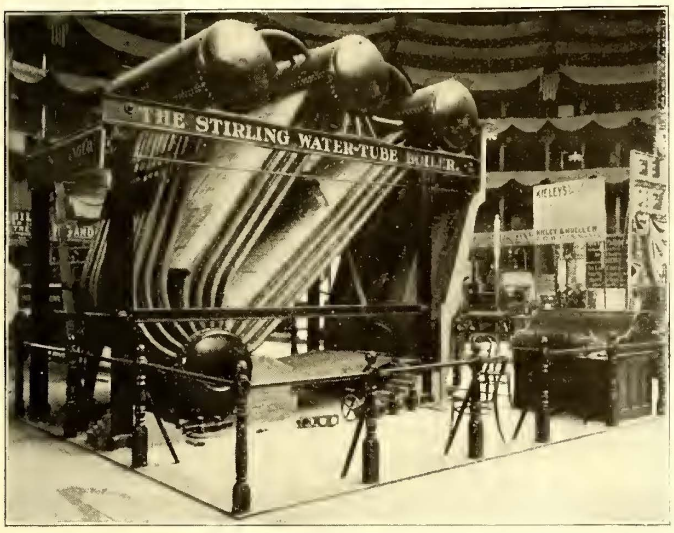


EXHIBIT OF STERLING COMPANY

The H. W. Johns Manufacturing Company of New York presented a novelty in the shape of a non-arcing inclosed fuse. This device is sold under the name of "Noark," and, it is claimed, entirely eliminates injury to electrical apparatus due to overloads or short circuits, at the same time making fires, often resulting from the arc caused by the blowing of the old types of fuses, entirely impossible. The invention consists of a strong inclosing casing filled with a special compound, which quickly and effectually interrupts any excess of current above the fuse's rated capacity. An important feature of the device is the indicator which tells the condition of the fuse at all times, so that there will never be any question as to whether the fuse has blown or not.

The Columbia Incandescent Lamp Company, St. Louis, exhibited a case showing lamp bulbs and filaments in different stages of manufacture. It also had an attractive sign fitted with Columbia lamps. The clear white light given from these lamps indicates the absence of gases in the interior to a remarkable degree. In connection with this exhibit the Bosert Electric Construction Company, of Utica, N. Y., showed samples of its terminal and switch boxes, porcelain cut-outs, porcelain lining and white enamel lining.

The D. & W. Fuse Company, Providence, R. I., had a number of its closed fuses for use with from 50 to 20,000 volts, also samples of its cut-out boxes for underground and overhead construction. This company is bringing out a new quick-make and quick-break switch, which was also shown.

An unusually complete exhibit of electric arc lamps was made by the Adams-Bagnall Electric Company, of Cleveland. Although the company had but a small booth, yet it utilized the space so well that a sample of about a dozen different types of lamps was shown. These included series inclosed, direct current arc lamps for 110 and 220 volts, series open arcs, alternating inclosed arcs, standard potential direct current inclosed arcs for 110 volts, and many others.

A new time recorder for use in factories and other large plants, street railway repair shops, etc., was shown by the Dey Patents Company, of Syracuse, N. Y.

The American Engine Company, Bound Brook, N. J., had in operation a 75-h.p. American Ball engine, directly connected to a 50-kw. generator. This engine attracted unusual attention on account of its smooth and easy running qualities, there being hardly any vibration perceptible even when standing very near the cylinder head. This is a new type of engine that the company is just bringing out, and for which unusual economy under small and varying loads is claimed. Its cylinders are 9½ ins. and 15 ins. x 11 ins. stroke. When running at 290 r.p.m. with 90 lbs. of steam, 25 lbs. of water per i.h.p. per hour are used. The engine is non-condensing.

A novelty in the way of a tower wagon was presented by the Columbia Automobile Company, of New York city. This wagon is operated by storage batteries, and was built for the Consolidated Traction Company, of Pittsburgh. The batteries are of sufficient capacity to carry the wagon 25 or 30 miles without recharging.

EXHIBIT OF BALL & WOOD COMPANY

The Ball & Wood Company of New York exhibited a new 300-h.p. engine with Corliss type valves and self-oiling device. The engine was run non-condensing at 250 r.p.m., with cylinders 16 ins. and 26 ins. x 16 ins. This engine, although carrying an extremely variable load, regulated to a remarkable degree, and many words of approbation were heard on all sides regarding its smooth operation.

The Fischer Foundry & Machine Company installed one of its 75-h.p. double-valve engines, running at 280 r.p.m. The company is making a specialty of this double-valve action, and now claims it can compete successfully with the Corliss type.

Sectional Steam Boilers

The New York Safety Steam Power Company, of New York city, the manufacturers of the Worthington water tube sectional steam boilers, is sending out a new catalogue in which are a number of interesting items on the construction and operation of sectional steam boilers.

Among the claims put forth in favor of this type are noticed the following: They are economical of valuable space, but at the same time are of liberal proportions in heating and grate surface; the furnace extends under the entire boiler and is of the proper height to permit the use of all kinds of fuel; the interior of the entire construction in every part and detail is readily accessible from the outside for examination, cleaning or repairs. Every tube used is lap-welded and of the best make, and each tube is straight; the heating surface and waterways are so arranged that the movement of the water contained in the boiler is constant and rapid.

The Peoria Electrolysis Case

Considerable advance was made last month in the trial before the United States Circuit Court in the case of the Peoria Water Works vs. Central Railway Company, which operates the electric railway system in Peoria. This case, it will be remembered, was brought by the water company against the railway company on account of alleged damages to its water pipes through electrolysis. The real complainant, it is said, is a large number of water companies who are interested in making this a test case. A number of electrical experts for the water company were examined last December and testified that the only remedy for electrolysis was the introduction of the double trolley system. The case of the railway company was not presented until last month, but in rebuttal of this testimony, the railway company presented the testimony of a large number of railway experts who testified that it was perfectly possible to eliminate all chances for electrolysis by good ground return, and that all reasonable precautions to accomplish this had been introduced by the defendant company. Among those who testified to this effect were Israel Lovett, of the Council Bluffs & Omaha Railway; Oscar Stiles, of the Omaha Street Railway; William Hand, of the General Electric Company, of St. Louis; J. C. Noe, of the General Electric Company, of Chicago; Edward M. Burch, of the Twin City Rapid Transit Company, of Minneapolis, and Albert B. Herrick, of New York.

Mr. Herrick, who was the chief witness for the defense, testified that he had made a thorough inspection of the railway system, had examined all the rail bonds and found only a very few defective joints, and that these were not at important points on the road. He had also made tests of the current returned to the station by the rails, and water pipes, and finding a large per cent passing by the water pipes, had made a further examination which disclosed the fact that the water company had placed a large number of its water gate boxes in very close proximity, and also in metallic contact to the rails of the electric railroad. These gate boxes were in metallic electrical connection with the rails and a very large current passed into the water pipe system, abundant to account for all the electrolytic action that was complained of. It was also brought out that these boxes had been placed in position by the water company and electrically connected to the rails after the tracks were placed in position, and that the location of the tracks and their position were made obligatory by the railway company by a city ordinance, but the location of the gate boxes was optional with the water company. Mr. Herrick also testified that from examinations he had made of lead service pipes used underneath the railroad track, and positive to the track near the power station, they permeated the earth between the rails and the track with lead sulphates which greatly reduced the earth's resistance, and this caused an influx of current to the paralleling water pipe system. Iron pipes are much better for this service as the oxide of iron has proved to act as an insulator to the pipe and does not afford a conductive medium in the path of current flow. He also testified that the amount of copper in the return circuit in the Peoria Railway was several times in excess of that in the positive trolley circuit, and that the connections of the negative feeder were made frequently and covered a large area. It was contended by the water company that the double trolley is the only way to relieve this electrolysis trouble and the Cincinnati example should receive general adoption by railroad systems.

Mr. Hand, of St. Louis; Mr. Noe, of Chicago, and Norman McD. Crawford, of Hartford, all testified in regard to their early experience of the double trolley which were not favorable to the imitation of Cincinnati's unique system.

Mr. Crawford's early experience made him abandon double trolley system and return to horses again, and all the evidence showed it to be a more expensive system to keep in repair. Mr. Lovett, of Council Bluffs, and Mr. Stiles, of the Omaha Street Railway, both testified as to having corrected all their troubles due to electrolysis by connecting the water pipes and rails together in affected districts.

Prof. Seaver, of Columbia College, brought out some very interesting facts regarding D. C. Jackson's early remarks in the electrolysis troubles, his lecture before the American Institute of Electrical Engineers taking exactly the same attitude as the experts for the railway company in the present case.

N. C. Draper, who was for three years electrical engineer for this property, gave in testimony all the conditions of the mechanical and electrical construction of the road, and due to his early efforts in bringing this road up to its present point of perfection regarding its negative circuits, the water company will have an extremely hard time in making any case on the grounds of wilful negligence or improper construction.

Judge Pinkney, who is conducting the case for the railroad company, has mastered the subject technically, and this, in connection with his well-known legal ability, makes the case extremely interesting from a technical point of view. The master also asked questions pertaining to the technical side of the subject, showing a technical knowledge very rarely found in court. This trial will be resumed on June 12, when the railway company will introduce further evidence in support of its case.

Meeting of the Southwestern Gas, Electric and Street Railway Association

The annual convention of this association was held in Austin, Tex., May 17 to May 19, and was a great success in every way. The attendance was large, the papers were valuable and interesting, and unusual enthusiasm was shown by all in attendance.

Among the papers presented was one by T. H. Stuart, of Waco, Tex., on "Summer Amusements for Street Railway Companies." In this treatise the author first reviewed the necessity of increasing the traffic on street railways in the South, and then gave a number of practical suggestions for the equipment and maintenance of pleasure parks. He laid particular stress upon the point that the first entertainment of the season given at any park should be a great success and well attended in order to start the enterprise aright. This is on the principle that people like to go wherever the crowd goes, and if the season can be opened with a large crowd in attendance the battle is more than half won. To this end great care should be exercised in selecting a first-class attraction for the opening, and in properly advertising it. The author points out the necessity of presenting nothing but perfectly respectable plays in order to induce women and children to visit the performances.

After suggesting the formation of a "theatrical circuit" of street railway companies, such as is now in operation in a number of places in the north, the writer touches upon the subject of an entrance fee, and the best way of getting revenue from the sale of privileges. He states that in his opinion visitors to the park that come by means other than the companies' cars should be charged the amount paid by those who use the street railway lines. The entrance to the theater, however, should be free, with a small charge for reserved seats. The writer concludes by stating that it has been the experience of the company with which he is connected that summer entertainments have been a source of considerable profit.

Other papers presented were: "The Item of Depreciation," by W. E. Hamilton, Shreveport, La.; "Meters," by W. E. Holmes, Austin, Tex.; "Transformers," by H. L. Monroe, Dallas, Tex.; "The Amount and Extent of Legitimate Investment in Electric Lighting Plants of Certain Capacities," by F. Fries, San Antonio, Tex.; "Art and Science of Selling Gas," by T. D. Miller, Dallas, Tex.; "A Model Plant Under Model Management; What Both Should Be Like," by J. F. Strickland, Waxahachie, Tex.

At the last day's session the following officers were elected for the next year: President, T. D. Miller, of Dallas; first vice-president, J. F. Strickland, of Waxahachie; second vice-president, C. A. Yeager, of Laredo; third vice-president, W. E. Hamilton, of Shreveport. The next meeting will be held at Waco.

A Visit to Schenectady

On Friday, May 26, the delegates to the convention of the National Electric Light Association, held in New York the last month, were the guests of the General Electric Company, who provided for them a most enjoyable trip to Schenectady. The visitors, who numbered about 170, traveled from New York upon a special train of eight palace cars, and reached Schenectady about noon, were guided about the works by the company's representatives.

Among the machinery which particularly interested the electric railway engineers of the party was a device for testing armatures, consisting of ingenius laminated horseshoe magnets. The poles of these magnets embraced an armature, and by means of an alternating winding in the magnet sets up an immense alternating field, which generates high e.m. f.'s in the windings and breaks down the insulation at any weak point. In another part of the works were seen two of the 990-kw. six-phase rotary converters for the Metropolitan Street Railway Company of New York, the first six-phase rotaries ever built; and in still another part four of the 100 gearless motors ordered for the Central London Underground Railroad. The armatures of these motors are mounted directly on the axles, with the wheels pressed on to either end, and present a peculiar appearance to eyes accustomed to geared machines. One of the 225-h.p. geared motors for the Paris-Orleans line was under test at the time of the visit. In the switchboard department were a large number of railway panels ready for shipment, some marked for cities in France.

Electric Locomotives in Practice and Tractive Resistance in Tunnels

An interesting and very extended paper on this subject was read May 4 by P. V. McMahon before the London Institution of Electrical Engineers, based on experiments and observations made by the writer on the locomotives and trains of the City & South London Railway. The extent of the paper forbids its reproduction in these columns in any comprehensive manner, but the following is an abridgement of the portion relating to tractive resistance:

Fig. 1 shows an outline of locomotive and train in the tunnel. The three locomotives used, Nos. 12, 15 and 17, were built to the same general design and over all dimensions, the only outward difference being in the shape of the cab, which in the case of 15 and 17 is bulged at the sides, instead of straight as in the case of No. 12.

LEADING DIMENSIONS

	Feet.	Inches.
Gage	4	8½
Over all height above rail level	8	5½
Over all length, buffer to buffer	14	0
Extreme width	6	10
Wheel base	6	0
Diameter of wheels	2	3
Width of tires	0	4¾

Each locomotive has two motors, the armatures of which are fixed directly on the axles. The motors are arranged in series, and the regulating gear consists of a reversing switch, which changes the armature connections, a simple rheostat switch in series with the motors, and a main break switch.

The remaining details are given in the following table, which makes comparison easier:

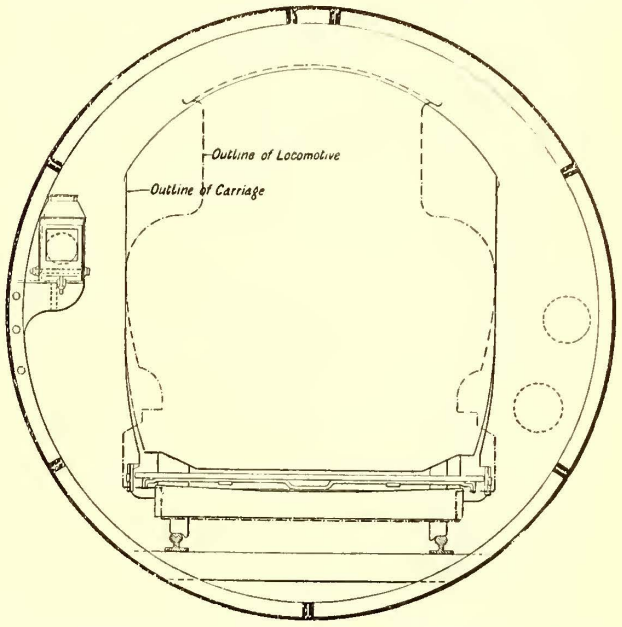


FIG. 1.—SECTION OF TUNNEL SHOWING OUTLINE OF LOCOMOTIVE AND CAR

	No 12 Locomotive.	No. 15 Locomotive.	No. 17 Locomotive.
Type of motor	2 pole Edison Hopkinson	2 pole Siemens.	2 pole Edison Hopkinson
Section of magnet	17" × 10"	24 × 10"	20" × 10"
Weight of magnets, complete with bearings	40 cwt.	53 cwt.	44 cwt.
Type of armature	Gramme Ring	Drum	Gramme Ring
Diameter of cone	17¼"	14⅜"	17½"
Length of cone	17"	24"	20"
Number of turns	540	500	540
Cross-section of conductor	No. 10 = .01286 sq. in.	.400 × .078 = .0312 sq. in.	No. 10 = .01286 sq. in.
Number of segments in commutator	54	125	54
Weight of arm with wheels complete	19 cwt. 3 qts.	21 cwt.	22 cwt.
Armature resistance	.3 ohm.	.181 ohm.	.315 ohm.
Total resistance of locomotive	.8 ohm.	.615 ohm.	.85 ohm.
Total weight of locomotive	10 tons 7 cwt.	13 tons 10 cwt.	11 tons 12 cwt.

Each train consists of three coaches coupled together, with intermediate platforms. The following are the

LEADING DIMENSIONS

	Feet.	Inches.
Gage	4	8½
Over all height above rail level	8	4¼
Over all width of body	6	10
Length of body over end framing	26	0
Centers of bogies	16	9
Wheel-base of bogies	5	0
Over all length of train (three coaches)	96	0
Diameter of wheels	2	0
Weight of empty train complete	21 tons, 2 cwt.	
Seating capacity	96 passengers	

Fig. 2 shows the result of a test made between Stockwell and the city, readings of the current, voltage, speed, and draw-bar pull being taken at five-second intervals. It will be noticed that the current at starting in this case is not over 100 amps., the current being kept low to avoid any jerk at starting, as it was not known at this stage what might happen to the diaphragm of the dynamometer. Although a value is given for the draw-bar pull at the first reading, the gage on the dynamometer did not show that any pull was being exerted for about one to two seconds after the current was switched on, showing that the locomotive takes an appreciable time to move. However, when the gage commenced to indicate, it gave varying values, the pointer sometimes going all over the scale with the current absolutely steady; by carefully watching the pointer during the interval it was possible to form a fairly accurate idea of the average pressure during each period. This jerking was most noticeable on down grades, as the pull of the locomotive seemed to be transmitted to the train by a series of jerks, the train and locomotive buffers alternately touching and separating. Upon an up grade the pull seemed to be more uniform, the buffers being nearly always apart. An inspection of Fig. 2 shows that the draw-bar pull curve follows the current pretty closely in shape, from which one might infer, that the dynamometer gave fairly accurate indications of what was going on between the locomotive and train. From the analysis of these curves the losses in the locomotive, and its draw-bar pull at starting and running were obtained, as well as the tractive force per ton of train hauled on the level, including air resistance.

LOCOMOTIVE LOSSES AND DRAW-BAR PULL AT STARTING

In order to arrive at the value of the draw-bar pull exerted by the locomotive on the level at starting, the starting periods at Kennington with 100 and 120 amps., and Elephant and Castle with the same currents, will be considered; these stations are chosen to avoid the errors (or uncertainties) introduced into the dynamometer readings by a quick down grade. In each of the four cases the values of the dynamometer reading, the tractive force due to gravity, and the tractive force due to acceleration were taken from the plotted curves, at five-second intervals, and reduced to the level at a constant speed. Thus at Kennington (curve Fig. 3) at five seconds after starting the draw-bar pull as shown by the dynamometer was 1075 lbs., the tractive force due to acceleration plus or minus gravity was 201 lbs., and as this force did not appear at the draw-bar, but was given out by the locomotive at the tread of the wheel, it must be added to the draw-bar pull, consequently the total tractive effort which should appear at the draw-bar at a constant speed on the level would be 1276 lbs. for a current of 105 amps. In the same manner at the tenth-second interval the draw-bar pull was 1075 lbs., the tractive force due to acceleration plus or minus gravity was 345 lbs., giving 1420 lbs at the draw-bar at a constant speed on the level for a current of 100 amps.; in the same way the tractive efforts at the draw-bar at the fifteenth and twentieth-second intervals were 1467 lbs., and 1596 lbs. for a current of 100 amps. To facilitate the analysis of these curves during the starting period, both as regards locomotive losses and tractive effort per ton of train at starting, the curves, Figs. 3 and 4 (from the Kennington and from the Oval curves) are plotted to a distance scale in Figs. 5, 6, 7 and 8. The value of gravity for half a coach on the level and half on the grade could then easily be allowed for. Plotting the values of speed and tractive force at the draw-bar at constant speeds on the level, we get two curves showing the tractive effort for 100 and 118 amps., at speeds of from 0 to 9 miles per hour. The value at 0 is taken from the static draw-bar pull. From these two curves it would seem as if the effective tractive force increased, or locomotive losses decreased, with the speed until the latter reached about 9 miles per hour.

LOCOMOTIVE LOSSES AND DRAW-BAR PULL WHEN RUNNING

To arrive at the draw-bar pull on the level exerted by the locomotive for speeds of 9 miles per hour and upwards, for various currents, the experimental runs between Stockwell and the Eleplant, and the Elephant and Stockwell, were analyzed as before

explained, but in this case the area of the speed, current, draw-bar pull, and the tractive force due to gravity and acceleration curves, Figs. 2, 3 and 4, were measured, and from these the average values were obtained as follows: Between Stockwell and the Oval the average draw-bar pull was 268 lbs. for an average current of 36.8 amps. at an average speed of 18.4 miles per hour (during the running period). The average tractive force due to acceleration, plus or minus gravity, was 8.36 lbs., leaving 259.7 lbs. as the tractive force at the draw-bar of the locomotive on the level at a constant speed. From the Prony brake test the tractive force at the tread of the wheel for a current of 36.8 amps. was 340 lbs., leaving 80 lbs. as the locomotive losses, in which are included journal and rail friction, and air resistance. Plotting the tractive force and current from these and other tests, the curve approximates a straight line with a fair amount of accuracy. From this curve it appears as if the locomotive losses increased with the current. This increase must be due to journal or rail friction, as the air resistance is certainly greater at a high than at a low speed, and the smaller current corresponds to a higher speed. There does not seem to be any definite relation between the locomotive losses and the speed as in the case of starting from rest.

FIG. 2

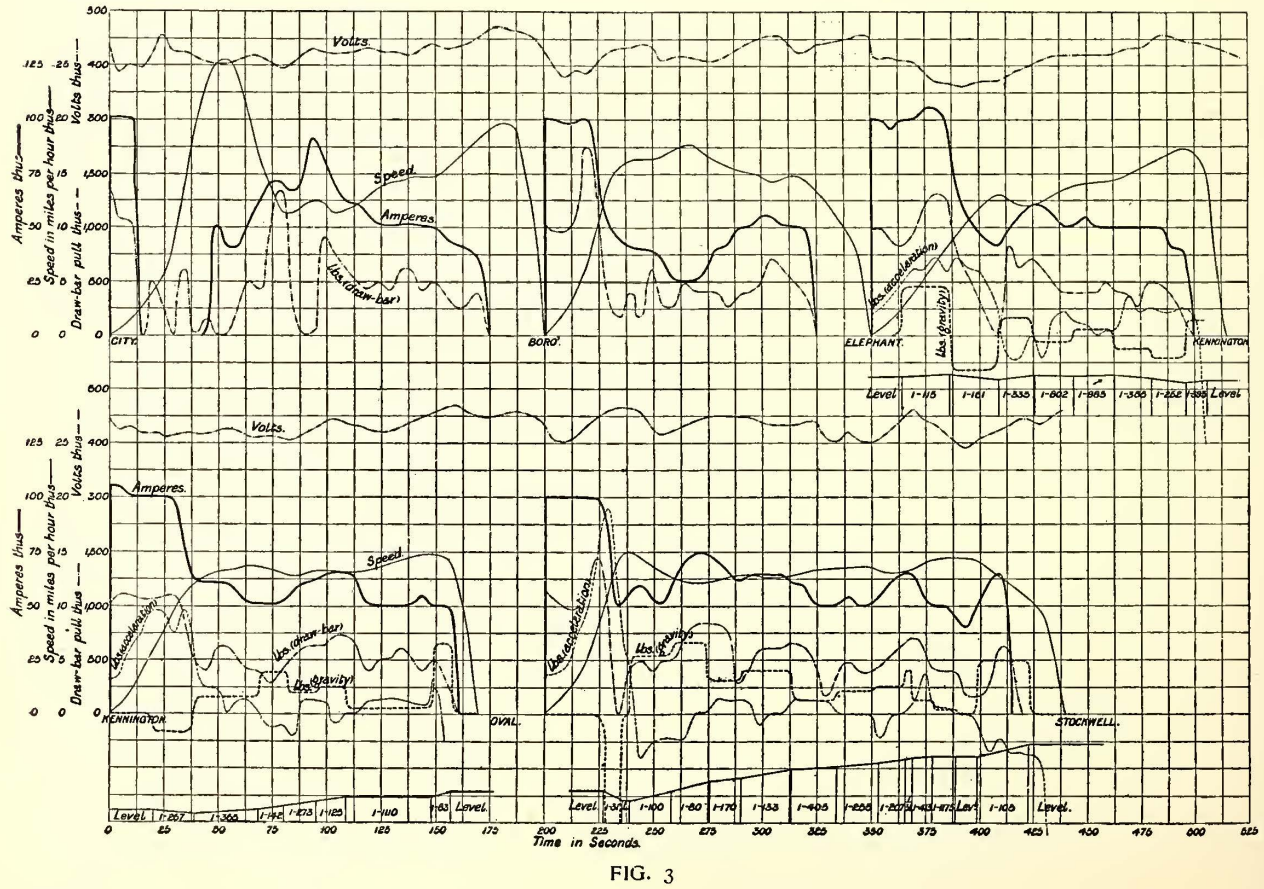


FIG. 3

TRACTIVE RESISTANCE PER TON OF TRAIN

From Figs. 2, 3 and 4, the tractive resistance per ton of train, in-

cluding air resistance, was also arrived at. In arriving at the tractive force per ton at starting, it was necessary to consider the length of the train in passing from one gradient to another, and this was allowed for in the following manner: The speed, draw-bar pull and tractive force due to acceleration were plotted to a distance basis from the calculated distance traveled; the gradient was then plotted and the position of each coach on the gradient (up or down) determined at each interval; the tractive force due to gravity was then obtained and plotted, and so on until a speed of about 10 miles an hour was reached. This is seen more easily by reference to Figs. 5, 6, 7 and 8. Here it may not be out of place to consider in detail what takes place in a starting period, say from Elephant and

The tractive force in lbs. per ton on a level is plotted in Fig. 9, and gives the first part of the curve shown there. The points of this curve above 9 miles per hour are the average values obtained from the running periods between Stockwell and the Elephant and Castle up and down roads, and are arrived at from the dynamometer observation curves, Figs. 2, 3 and 4, in a manner similar to that explained above.

The tractive force per ton in the case of the two-coach train came out rather higher, being 21.1 lbs. per ton for an average speed of 16.5 miles per hour. This slight increase may be due to both trains having the same area of cross-section exposed to the air, while the total weight in the second case is less than in the

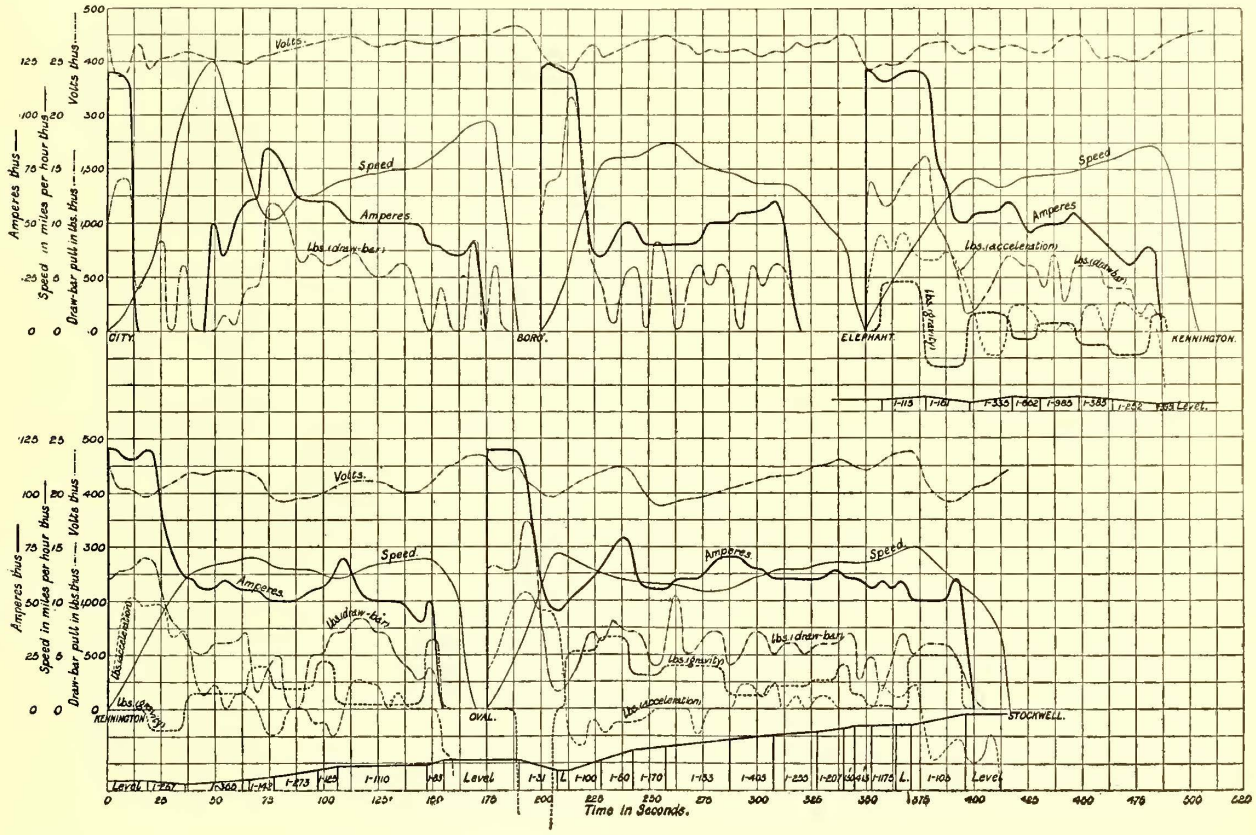
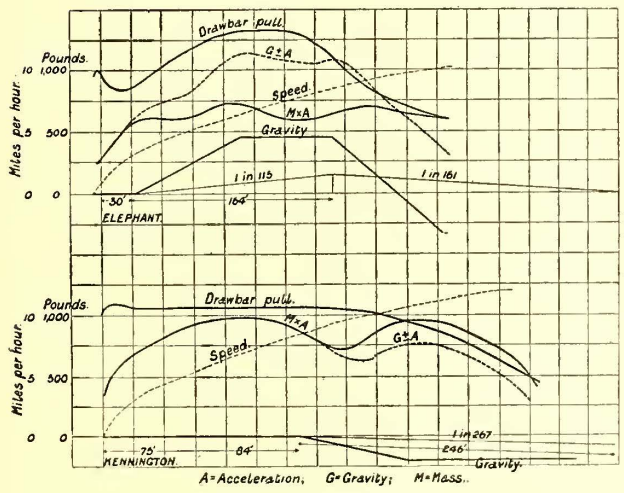
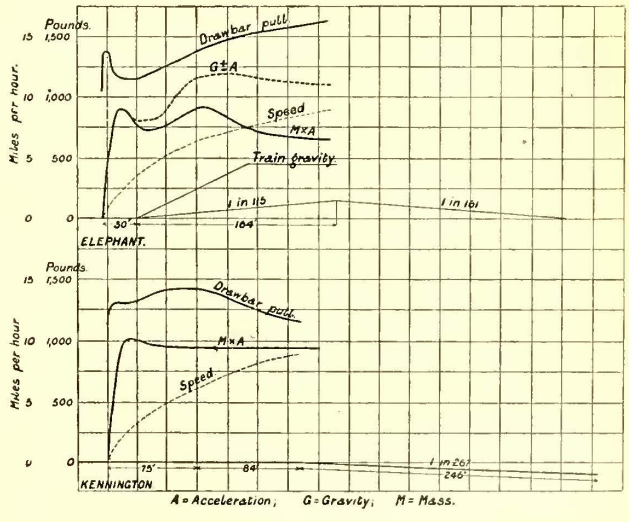


FIG. 4



FIGS. 5 AND 6



FIGS. 7 AND 8

Castle, Fig. 5. At the moment of starting the front end of the train was on the level, and 30 ft. from an up gradient of 1 in 115. After traveling about 60 ft., one coach was completely on the incline; in this position the effect of gravity was 152 lbs.; when another 30 ft. had been passed over, two coaches were on the incline, and the value of gravity was 304 lbs. When the whole train was on the incline the gravity curve ceased to rise and ran parallel to the base until the down grade of 1 in 161 was reached by the first coach. The down gradient was analyzed in a similar manner, and from the result the corresponding part of the gravity curve was plotted.

first. Again, the skin resistance should be less in the second case on account of the train being shorter. In the third experiment the current was shut off earlier, and thus the speed was maintained almost constant until it was switched on again; the resistance per ton in this case came out at 11 lbs. for an average speed of 15.86 miles per hour.

EFFECT OF CURVES

To arrive at the additional resistance offered by the curves on the line, the observations from which the tractive force per ton was obtained were further analyzed in the following manner: The

position of the curve in the section being known, the exact time when the train was passing over the curve was found as already explained, for the gradient, the draw-bar pull, tractive effort due to gravity and acceleration were taken from the respective plottings for the particular section, and in this manner the total tractive effort per ton on the level at a constant speed was obtained; deducting from this the tractive resistance per ton already found at that particular speed, the result gave the additional resistance due to the curve. Although there are several sharp curves their length is small and it was difficult to get accurate results, as in some cases the length of curve was not greater than that of the locomotive and train. The most consistent results were obtained on the curves between the Borough and Elephant stations, and between the Elephant and Kennington stations. The first curve has a radius of 390 ft., and the average of three sets of observations gave 27.9 lbs. per ton at 16.5 miles per hour, the tractive force per ton on the straight and level road being 12.75, leaving 15.15 lbs. per ton due to the curve alone. The next curve has 540 feet radius, and the

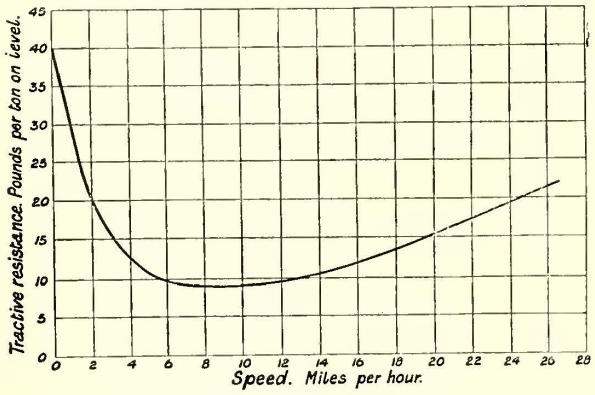


FIG. 9.—CURVE SHOWING TRACTIVE RESISTANCE PER TON AT VARIOUS SPEEDS

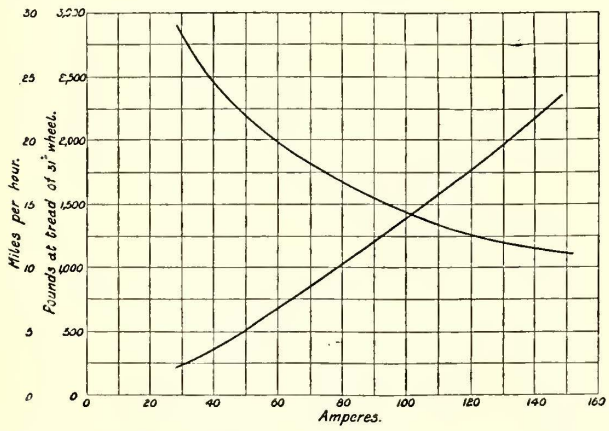


FIG. 11.—CHARACTERISTIC CURVES—NO. 19 LOCOMOTIVE

average of six sets of observations gave 22.6 lbs. per ton, at 13.5 miles per hour, that on the level straight road being 11.3 lbs., leaving 11.3 lbs. due to the curve.

It is, perhaps, worth mentioning that there is a guard-rail on each of these curves, which, although in good condition and very smooth, no doubt adds to the resistance.

ACCELERATION

After an extended consideration of electric locomotive design, the writer takes up the question of acceleration and speed. On this he says:

From practice it appears that to run a level section 2700 ft. long, 130 seconds is a convenient time to meet ordinary traffic requirements. Given this basis, the lowest speed at which it is possible to run the section is 14.25 miles per hour, assuming infinitely quick positive and negative acceleration; or, in other words, entering the section at full speed and running through without stopping. This is, of course, an impossible condition, but the nearest approach to it is to get up to full speed in the shortest possible time, and to stop in the same manner. It has been shown that a negative acceleration of 1.46 ft. per second per second, corresponding to stopping in twenty seconds from a speed of 20 miles per hour, does not cause discomfort to the passengers and is not too hard on the brakes and wheels. In practice we sometimes get an acceleration of 2 ft. per second per second or more, but 1.46 ft. per second will be taken as the maximum in this investigation.

If for practical reasons it is not desirable to adopt a higher negative acceleration than 1.46 ft. per second per second in bringing the train to rest, there is clearly no need to try and get a higher positive acceleration at starting. Adopting this acceleration for starting and stopping, we find that the speed at which the locomotive and train must run, after the acceleration is attained is 16.25 miles per hour. This is made clear by Fig. 10. Here the ordinates represent the speed in miles per hour, and the abscissæ the time in seconds. A series of speed curves can be obtained which will enclose the same area, and consequently any curve of this series will enable the run to be accomplished in the specified time. Stopping from 20 miles per hour in twenty seconds was adopted as the negative acceleration in all cases, and positive accelerations of 1.46, .974, .73, .584, .487, and .417 ft. per second per second were also adopted, corresponding to starting from rest and attaining speeds of 20 miles per hour in 20, 30, 40, 50, 60, and 70 seconds, respectively. A line was drawn parallel to the abscissæ from each of the above acceleration lines (if they may be so called), enclosing the same area in each case; this gave the speed at which the train must run, after attaining its acceleration, until the brakes are applied.

With a uniform acceleration of 1.46 ft. per second per second during the starting period, we see from Fig. 10 that the speed during the running was 16.25 miles per hour until the brakes are applied. The next speed curve, with its acceleration of .974 ft. per second per second during the starting period, requires a speed of

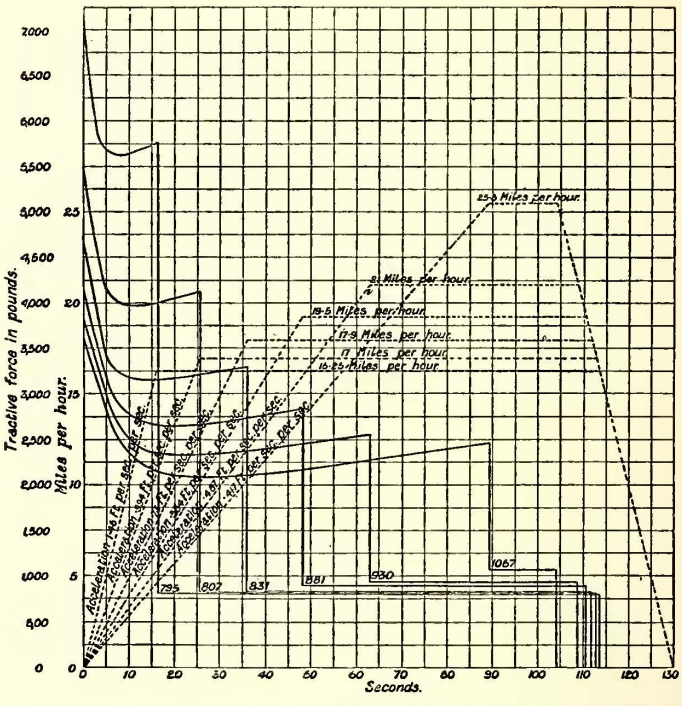


FIG. 10.—DIAGRAM OF ACCELERATIONS AND TRACTIVE FORCES

17.0 miles per hour during the running period. For accelerations of .73, .594, .487, and .471 ft. per second per second, during the starting periods, the respective speeds during the running periods, and until the brakes are applied, are 17.9, 19.5, 21.0, and 25.5 miles per hour. It is evident from this that the more quickly the train attains full speed, the slower the running speed will be. And as will be seen from a study of the tractive force curves, corresponding to the various speed curves, the slower the running speed, the lower the kinetic energy stored up at starting, and taken out again by the brakes in stopping.

Turning now to the tractive force required to obtain the various conditions laid down above, we see (Fig. 10) that to give the train and locomotive an acceleration of 1.46 ft. per second per second, a force of 4915 lbs. is required, and this must be kept up for 16.3 seconds until a speed of 16.25 miles per hour is attained. To this must be added the tractive resistance taken from Fig. 9 at every interval, as already explained. The total tractive force, then, exerted by the motors at the moment of starting is 7125 lbs., dropping to 6250 lbs. at 2 miles per hour, 5750 lbs. at 4, 5650 lbs. at 6, and 5625 lbs. at 8 miles per hour; it now commences to rise again, and is 5650 lbs. at 10 miles per hour, 5700 lbs. at 12, 5725 lbs. at 14, and 5750 lbs. at 16 miles per hour; when 16.25 miles per hour is reached, it drops to 795 lbs., this being the tractive force necessary for running at that speed.

The remaining five tractive force curves were arrived at in a similar manner, and need no further explanation. Returning for

a moment to the tractive force curve for an acceleration of 1.46 ft. per second per second, we see that 4975 lbs., acting for 16.3 seconds, that is 81,100 pound-seconds, were required for acceleration, and if this number is multiplied by the feet passed through in the

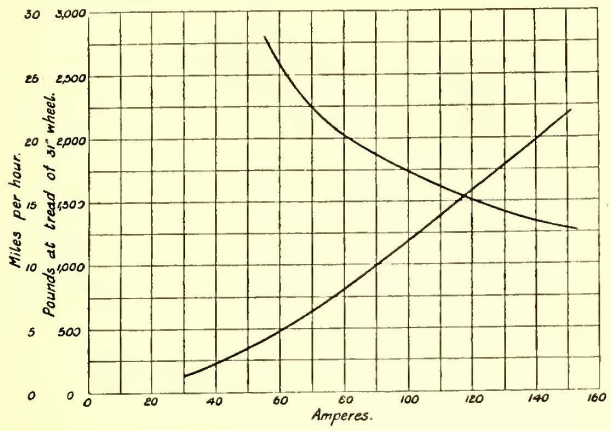


FIG. 12.—CHARACTERISTIC CURVES—NO. 20 LOCOMOTIVE

specified time, the result is foot-pound-seconds. It is, however, more convenient for present purposes to speak of pound-seconds or the area enclosed by the tractive force curve. When the tractive resistance is added to the above, the pound-seconds for the starting period are 95,220, and the running period requires 77,400 pound-seconds, making a total of 172,620 pound-seconds for the run.

The table in the next column gives the results of the six sets, and is self-explanatory.

This table shows the enormous advantage to be gained by adopting the highest acceleration compatible with the practical details of motor design. It fortunately happens, however, that we have a fairly large choice without increasing by more than 6 per cent the total energy drawn from the source of supply. In designing a locomotive, it is not of very great importance, or at least it will not affect the final result to any great extent, if the sharp peak of the tractive force curve at the moment of starting is averaged over the whole period of starting. This will reduce the size of the motors and the tractive force that they must give out during the first few seconds, and will prevent the speed curve from rising in a perfectly straight line as shown. Thus in the case of tractive force curve for an acceleration of 1.46 ft. per second per second, the tractive force instead of being 7125 lbs. at the moment of starting, may be reduced to an average of 5839 lbs. over the starting period.

Seconds to Attain 20 Miles per Hour.	Acceleration in Feet per Sec. per Sec.	Lbs., Secs. for Acceleration Only.	Lbs., Secs. for Acceleration and Tractive Resistance.	Difference Due to Tractive Resistance.	Lbs., Secs. for Running Period.	Total lbs., Secs. for 2,700 Ft. Run.	Percentage Increase Due to Acceleration.	Percentage Increase in Total lbs., Secs.
20	1.46	81,100	95,220	14,120	77,400	172,620	Stand'd	Stand'd
30	.974	84,600	106,350	21,750	70,600	176,950	4.32	2.51
40	.730	89,400	119,540	30,140	63,150	182,690	10 24	5.84
50	.584	95,600	136,140	49,540	55,200	191,340	17.87	10.86
60	.487	104,600	158,870	54,210	42,650	201,460	29.0	16.7
70	.417	126,800	204,300	77,500	16,070	220,370	56.4	27.65

Fig 10 and the table of results show the way in which to apply the tractive force to obtain economical working.

Since the completion of the portion of the paper given above, some two and one-half years ago, three new locomotives have been added to the rolling stock of the City & South London Railway, and twelve more are now in course of construction.

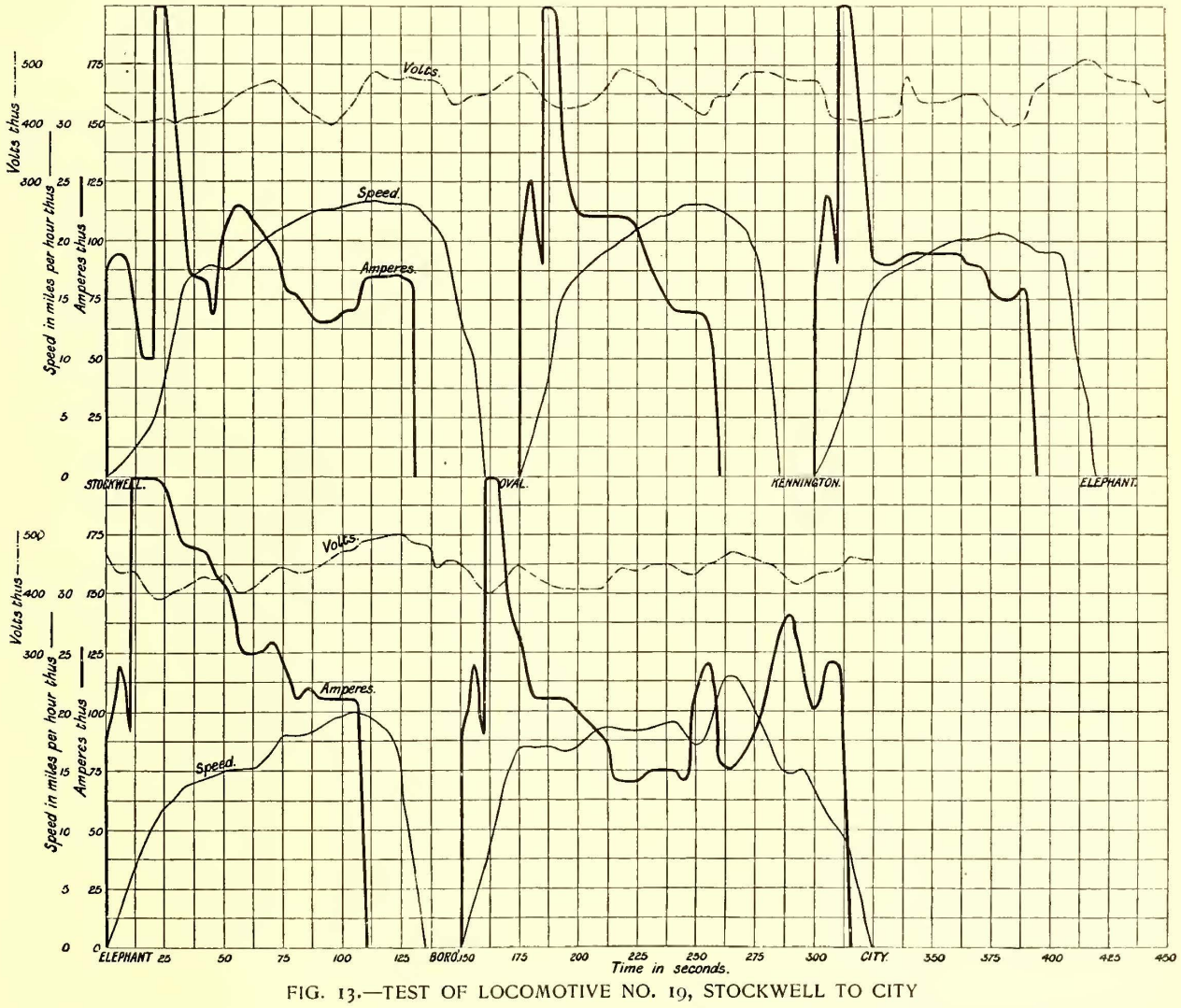


FIG. 13.—TEST OF LOCOMOTIVE NO. 19, STOCKWELL TO CITY

DESCRIPTION AND TESTS OF LOCOMOTIVES

Locomotives 19 and 20.—In view of the heavier trains, etc., it was decided to build more powerful locomotives. The size of the locomotive cab was practically limited to the same over all

dimensions as the old locomotives on account of local conditions, and it was therefore necessary to get larger motors into a cab of the same size. In the old locomotives the magnets are very close to the working conductor, and to get more clearance a wheel 31 ins. in diameter was adopted instead of a 27 in. wheel. This also allowed an armature of larger diameter to be used. Each locomotive is fitted with two motors of the four-pole type, the armatures having slotted cores and drum winding. The series-parallel method of control is adopted and, in addition to storage reservoirs for compressed air for the Westinghouse brake, independent electrical air-compressors are used. The weight of the locomotive complete is about 12¼ tons.

The characteristic curves of the motors of locomotives Nos. 19 and 20 are given in Figs. 11 and 12, from which it will be seen that the tractive force per ampere is considerably higher than in the case of the old locomotives. A "performance diagram" for locomotive No. 19, between Stockwell and city, is given in Fig. 13. This test was made with a three-coach train, and as the locomotive

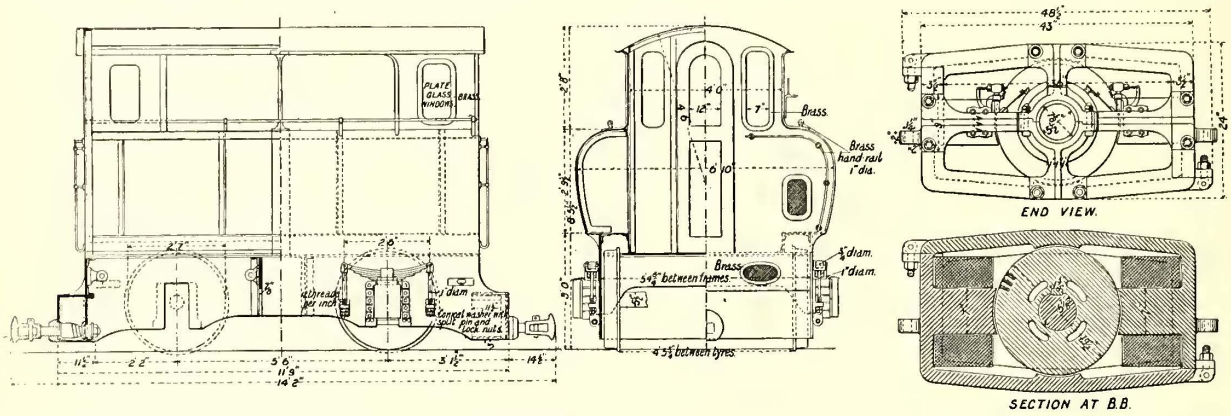


FIG. 14.—SIDE AND END ELEVATION OF LOCOMOTIVE NO. 21

was designed for a four-coach train service, it was not working under most economical conditions. The results of the tests with these locomotives, together with the previous tests of Nos. 3 and 12 locomotives, are given in the following table in kw.-hours per "ton-mile." It will be noticed that while the energy per ton-mile is practically constant, there is an increase in the average speed:

No. of Locomotive.	Kilowatt-hour per Ton-Mile.	Average Speed in Miles per Hour.
12	.0515	13.62
3	.0558	15.60
19	.0552	15.86
20	.0552	16.65

No. 20 locomotive gives the highest average speed, and it may be mentioned here that when this locomotive was ordered the author was in a better position to specify the requirements than when the order for No. 19 locomotive was placed. The latter locomotive was nearing completion before the former was required, and when the plans of No. 19 were prepared, the author had not gone so far into the question of locomotive design.

Locomotive No. 21.—The design and details of this and the remaining eleven locomotives were based upon the result of the tests and deductions already mentioned.

The general appearance and leading dimensions of the cab are given in Fig. 14, from which it will be seen that the wheels are 31 ins. in diameter, and the wheel base is 5 ft. 6 ins. The motors are so arranged that the floor of the cab is level, and the driver has considerably more room than in the old locomotives. The steel cylinders forming the air reservoirs are arranged one on each side of the cab, and have a total capacity of 18 cu. ft. Under the reservoir on one side are fitted the Westinghouse brake cylinder and brake gear connected therewith, and the electrically driven air compressor; while on the other side, the switchboard containing the series-parallel controller, reversing switch, motor cut-out, and main switches and fuse are placed; the regulating resistances are fitted directly under the air reservoir on this side, close to the controlling arrangements. The drawing, Fig. 15, gives the general arrangement and details of the motor, which is of the four-pole type, with the field magnet coils on the horizontal poles. The magnet is split across the diagonal corners, and the brackets carrying the motor bearings are divided in halves, so that each part of the magnet carries its bracket with it when the halves are separated to get the armature out. The armature is drum wound with the conductors in slots. The characteristic curves of the motor are given in Fig. 16. A description of the controlling arrangement and connections is added below. The weight of the locomotive complete is about 12¼ tons.

A "performance diagram" of this locomotive hauling a four-coach train is given in Fig. 17, from which it will be seen that the time taken to run a level section 2700 ft. long is 130 seconds, the current being shut off 74 seconds after starting, the locomotive coasting for 41.5 seconds, and the brakes being then applied. The watt-hour consumption for the section is 1360. If the current is kept on until the brakes are applied the section can be run in 122 seconds, the watt-hours being 1650.

METHOD OF CONTROL

In electric traction with separate locomotives there are conditions slightly different from those where motor cars are used. In coupling up the locomotive to the train the driver cannot always stop in the exact position to enable the coupling to be attached; and it is often necessary to move the locomotive through a mere fraction of an inch. Experience has shown that to avoid

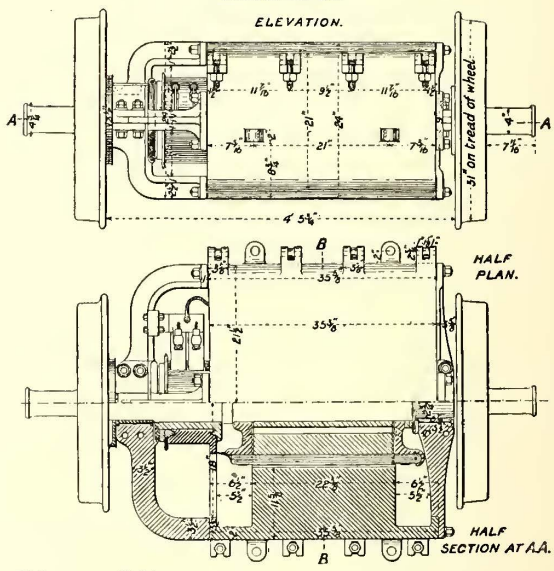


FIG. 15.—MOTOR OF NO. 21 LOCOMOTIVE

bad flashing on the controller contacts when a current of, say, 100 amps. is suddenly switched on and off before the motors have made a fraction of a revolution, the regulating resistance should be divided into a larger number of steps. The plain rheostat switch used on the old locomotives answered this purpose admirably, and in adopting a series-parallel controller this object was kept in view. Further, the drivers were used to this class of switching-gear, and a series-parallel controller, retaining the old form of rheostat switch, was developed. This series-parallel controller consists of two switches operated by a single handle, that part of the controller which puts the motors into parallel being moved only at predetermined points. Magnetic blow-outs, or other spark-killing devices, are not used, the motors being put into parallel practically without any flashing on the contacts, and not being put back into the series position again until the current is switched off the locomotive. Fig. 18 shows the connections of this arrangement. It is not necessary to lock the paralleling part of the switch to avoid short-circuiting when a motor is cut out of circuit, this contingency being provided for in the switch used for cutting out a motor. The contacts for shunting the field at starting are shown alongside the parallel contacts.

This controller was first used on No. 3 locomotive in the latter part of 1897, and has since given excellent results, having run over

22,000 miles in every-day use. It is fitted to No. 20 locomotive, No. 19 being fitted with the Electric Construction Company's controller, similar to the type used on the Liverpool Overhead Railway. The reversing switch which reverses the direction of the current in the armatures is quite independent of the series-parallel controller, and is mounted on a separate base; there is no mechanical interlocking, as in practice it has not been found necessary. A main switch and fuse is also fitted on the same board.

COASTING

In comparing the calculated "performance diagrams" with those actually obtained from tests on the line, a difference in the method of applying the brakes will be noticed. In the calculated diagrams the brakes were assumed to be applied at the instant the current was shut off, this assumption making the calculation easier. This method is not carried out in practice, as the current is shut off earlier and the locomotive allowed to coast before the

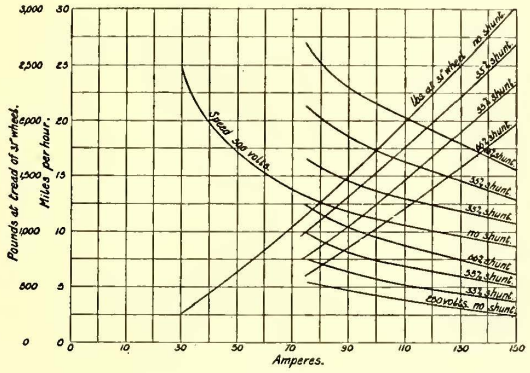


FIG. 16.—CHARACTERISTIC CURVES OF NO. 21 LOCOMOTIVE MOTOR

brakes are applied. The amount of coasting allowable varies with the gradients in the section.

While on this point it may be interesting to give the result of two round trips with No. 19 locomotive. The first portion of the run is plotted in Fig. 13. The time taken for the complete journey was .396 hour, and the average speed 15.86 miles per hour; the energy consumed was 13.32 kw.-hours, or .0552 kw.-hour per "ton-mile." In the second run the current was shut off earlier in each section, with the result that the time taken for the complete journey was .41 hour, and the average speed 15.35 miles per hour; the energy consumed was 12.214 kw.-hours, or .0507 kw.-hour per ton-mile. The average speed in the second case was 3.2 per cent and the energy consumption was 8.15 per cent less than in the first case.

On the up journey there is a continuous down grade to the Elephant station, and from the Elephant to Stockwell a continuous up grade. The average speed from Stockwell to the Elephant in the first and second trips was practically the same (the difference being less than 1 per cent), while there is a decrease of 10.95 per cent in the energy consumption in favor of shutting off the current earlier.

On the down journey from the Elephant to Stockwell the average speed on the first trip was 15.3 miles per hour, and on the second 14.5 miles per hour, showing a decrease of 5.2 per cent, while the energy consumed exhibits a decrease of only 8.25 per cent in favor of coasting. It will be seen from this that the advantages of coasting on an up grade are not comparable with those to be obtained by following this method on a down grade.

RAPID ACCELERATION

The author is aware that rapid acceleration for short sections is very desirable, but in his opinion a point can be reached long before the tractive force becomes equal to the adhesion, when it will not pay.

Apart from its influence on the comfort of passengers, very rapid acceleration necessitates the use of very powerful and heavy motors, and consequently leads to an increase in the ratio of the weight of the empty to that of the fully loaded train. Moreover, the starting current is increased several fold when rapid acceleration is used, and, of course, with it the cost of feeders and generating plant.

For the same section the kilowatts per "ton-mile" will be decreased, but the ratio of the average to the maximum demand upon the generating station will increase, and unless a very careful time table is followed in starting the trains, the generating plant must work on the average considerably under loaded. This remark does not apply with such force where a very large number of trains are running as where only a small number are in service. Again, with a rapid acceleration, the wear and tear of the rolling stock will be heavier.

The following example, worked out for a four-coach train and locomotive weighing 49 tons, running in a section 2700 ft. long, will be considered. The time to run the section is taken the same as before, viz., 130 seconds, giving an average speed of 14.25 miles

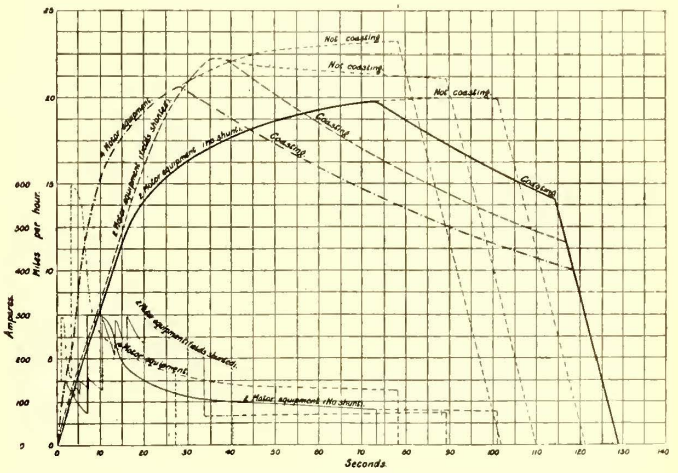


FIG. 17.—PERFORMANCE DIAGRAMS, 2 AND 4 MOTOR EQUIPMENTS

per hour. In the first and second cases "performance diagrams" are worked out for No. 21 locomotive, which has two motors, as already described. In the third case a locomotive is taken with four motors exactly similar to those of No. 21 locomotive; the seating capacity is, however, less, as the same total weight is taken, viz., 49 tons. The three "performance diagrams" are plotted in Fig. 17.

In the first case (2-motor equipment, no shunt) the speed-curve shows that a speed of 12.5 miles per hour would be attained in sixteen seconds, which is equivalent to a uniform acceleration of 1.14 ft. per second per second. After this point is reached the speed-curve bends over rapidly, a speed of 19.75 miles per hour being attained 74 seconds after starting; at this point the current is switched off and the locomotive and train are allowed to coast for 41.5 seconds; the brakes are then applied, and the run is completed in 130 seconds, the energy consumption being 1360 watt-hours, or .0540 kw. per ton-mile.

In the second case the starting current is limited to 150 amps.

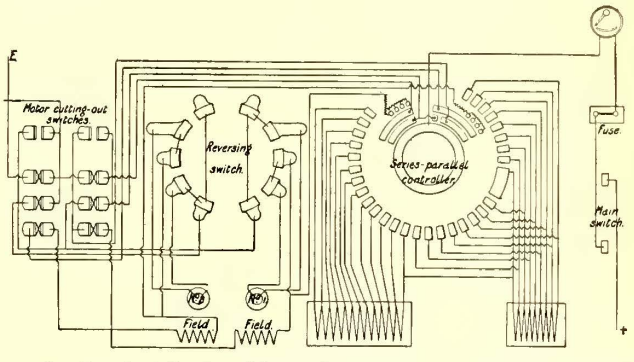


FIG. 18.—DIAGRAM OF CONNECTIONS OF SERIES PARALLEL CONTROLLER

as before, and when the value of the current flowing begins to drop the fields are successively shunted until a speed of 8 miles per hour is attained; the motors are placed in parallel at this point, and the current is limited to 300 amps., the fields are shunted as when in series, and when a speed of 22 miles per hour is reached the shunt is disused. Here the speed-curve bends over quickly and begins to drop, the motors being then in parallel with their full fields. At 40.75 seconds from starting the current is switched off, and the locomotive and train are allowed to coast for 67.25 seconds; the brakes are then applied, and the run is completed in 130 seconds as before. From the curve it will be noticed that a speed of 17.5 miles per hour is attained in twelve seconds after starting from rest, and this is equivalent to a uniform acceleration of 2.13 ft. per second per second. The energy consumed for the run is 1081 watt-hours, or .0430 kw.-hour per ton-mile.

We will next consider the third case, with the four-motor equipment. Starting with the four motors in series and 150 amps. as

before, at 2 miles per hour, the motors are placed two in series and these in parallel, the current being limited to 300 amps. At 6 miles per hour the four motors are placed in parallel and the current is limited to 150 amps per motor, or a total of 600 amps. This peak quickly falls, and in five seconds from placing the four motors in parallel the current drops to 300 amps. At 27.5 seconds after starting the current is shut off, coasting commences and continues for 92.5 seconds, the brakes being then applied, and the run completed in the required 130 seconds. The energy consumed is 946 watt-hours, or .0377 kw.-hour per ton-mile. In nine seconds from starting a speed of 15 miles per hour is attained, corresponding to a uniform acceleration of 2.43 ft. per second per second. From 15 to 20.5 miles per hour the speed-curve bends over more quickly than in the second case considered, but if the fields had been shunted the acceleration could have been maintained uniform until a higher speed was attained.

If in the above cases coasting were not resorted to, but the current were kept on until the brakes were applied, and the negative acceleration in each case were 1.46 ft. per second per second, the respective times required to run the 2700 ft. section would have been 122, 111, and 103 seconds, the average speed would have been 15.07, 16.0, and 17.87 miles per hour, and the energy consumed .0659, .0628, and .0745 kilowatts per ton-mile.

Having arrived at the effect of rapid acceleration upon the energy consumed per "ton-mile," we will now consider its effect upon the capacity of the generating station, feeders, etc.

By way of illustration let us assume ten sections of 2700 ft. each, and allow ten seconds at each station. Take as a basis a two-minute service, or thirty trains per hour leaving the terminal station. With the four-motor equipment, the seating capacity would be something like 20 per cent less than with the two-motor equipment, on account of the weight of the train and locomotive being taken as the same in each case.

Adopting the first "performance diagram" considered, viz., the two-motor equipment (coasting), as the standard, the following comparison is interesting and instructive. The time required to run the ten sections is 23.15 minutes, including stopping at stations. The maximum output of the generating station would be 2715 amps., and the average about 810. Thus the average is about 29 per cent of the maximum. With the four-motor equipment (coasting), where we get a high rate of acceleration, and a low energy consumption per ton-mile, the time to complete the run is the same, but the maximum output, arrived at as before, would be something like 5640 amps., the average being about 565 amps. Here the average is only about 10 per cent of the maximum, and any gain in the low kw.-hour consumption per ton-mile is lost by the low average efficiency of the generating plant.

In the above instances coasting was resorted to for a large percentage of the total running; if, however, coasting is not allowed, and the brakes are applied when the current is shut off, the two-motor equipment can complete the run in 21.82 minutes, or effect a saving of 5.75 per cent in time. The maximum output would be 2095 amps., and the average about 942, bringing the ratio of average to maximum up to 39.6 per cent.

If the four-motor equipment were used under similar conditions, the time would be 18.67 minutes, or about 20 per cent less than that taken by the two-motor equipment (coasting). The maximum output for this set of conditions would be 3407 amps., and the average about 1118, the ratio of average to maximum here being 32.8 per cent.

In practice the brakes would not be applied immediately the current was shut off, but to compensate for this, shunting the fields at starting and allowing a small amount of coasting for both equipments could be resorted to.

From the above considerations it would seem that to adopt very rapid acceleration at starting to reduce the energy consumed per "ton-mile" is uneconomical in working, and that the first cost of both generating and locomotive plant is about doubled. If, on the other hand, it is necessary to increase the average speed, a medium acceleration at starting will pay better than very rapid acceleration.

Entertainment at Berlin

The sixth annual oyster roast given by the Berlin Iron Bridge Company, of East Berlin, Conn., to its employees and a large number of invited guests was held April 26 at the factories of the company. Over a thousand of the company's friends partook of its hospitality, and the event was voted the most successful roast ever given.

Hundreds of barrels of oysters were provided, together with crackers, coffee, and other refreshments. The oysters were roasted in the forging shop and served at long tables. Dancing was enjoyed after the roast.

The Manufacture of Car Wheels*

BY G. R. HENDERSON

Like other branches of mechanical industry, the manufacture of chilled iron car wheels has been a gradually progressing science. Fifteen years ago it was customary to purchase and supply wheels to railroads on a mileage guarantee, the only restrictions as to quality being the depth of chill and the size, shape, and weight of the wheel. Certain mixtures were used by the founder which were known by experience to produce a given chill, and this and the color of the fracture, with perhaps the mileage records, were his guides in continuing his work. Chemical analyses of the pig iron and the finished output were considered unnecessary, if at all contemplated, and the irons, both coke and charcoal, were bought by fracture and chill. Some founders used a certain percentage of steel scrap, but this never became, as far as the writer knows, common practice. Now all this is changed; the progressive wheel-maker buys his irons on specifications, and checks them by chemical analysis, and every heat is tested physically and chemically. Records are kept of the strength and resilience of the various irons on the market, and of the manner in which his wheels fail, and as many as possible of these are examined in order to avoid duplicating unsatisfactory products.

The actual shape of the wheel has undergone but little change from the original Washburn section, except in the matter of size and weight, but we have every reason to believe that the older wheels cannot be compared with modern wheels in strength or endurance. A seeming inconsistency may be occasioned by a long life of old wheels, but it must be remembered that no such weight was then carried as is now the practice, where every effort is made in the interest of economical train movement.

About the time when the drop test was first introduced, the writer was assistant superintendent of a railroad shop which contained a foundry making 100 wheels per day. The introduction of this test, and the failure of a number of wheels in service about that time, caused him to make efforts to secure a stronger casting. Each day test bars were made along with the wheels, and these were subjected to transverse test, and a graphical record kept of the same, as shown by Fig. 1. The bars for this purpose were 2 ins. square by 24 ins. long, and were placed on supports 21 1/3 ins. apart, and a center load applied. As one-half the bars were chilled, it was considered that a 2-in. bar was a proper size to illustrate the chilling qualities, without becoming white through and through, and the span was fixed at 21 1/3 ins., so that when the proper deductions were made for the span and modulus of section, the corresponding direct stress was exactly four times the center load, thus facilitating the preparation of the form for recording the tests.

The bars of wheel iron so tested should stand a center load of from 12,000 to 14,000 lbs. before breaking, this corresponding to a maximum fibre strain of 48,000 to 56,000 lbs. per square inch. The deflection at the moment of breaking is also of great importance, and there are wide differences between various irons in this respect. While the *strength* of the metal indicates a power to stand pressure, we need the *resilience* to withstand shocks. A ready means of comparing the relative resilience of different irons is derived from the curve shown in Fig. 1. As the ordinates represent loads and the abscissæ deflections, the area bounded by the axis of abscissas, the ordinate passing through the final point of the curve (*i. e.*, the ordinate corresponding to the final deflection), and the curve itself will represent the work done or absorbed by the test bar up to the breaking point; and for quick comparisons the small rectangles into which the sheet is divided may be counted within the boundaries above mentioned. Good wheel iron will give curves with an included area of from 150 to 200 of the small rectangles, and a total deflection of 0.2 in. at center. Of course, these comparisons can only be made with bars of the same size and under the same conditions.

This same treatment has been accorded to unmixed pig iron of the various grades suitable for wheel founding, the pig being melted separately in a small experimental cupola, and from these records the wheel founder makes his selections. The curves present to the eye a meaning easier to grasp than mere figures, and when bound together in a book comparisons can be quickly and accurately made. The amount of chill and shrinkage are also noted, together with the color of fracture and the chemical analysis of the iron.

As the composition of different shipments of iron from the same furnace will vary greatly, it naturally follows that the strength and chilling properties are not always the same.

It happened not long ago that a certain iron, which had previously given good results, became almost unfit for use, princi-

* Paper read before the American Society of Mechanical Engineers, May, '99.

pally by reason of a great decrease in the amount of manganese. At one time this would probably not have been considered of such vital importance, but the fact has recently been well established that a certain amount of manganese is necessary in order that a wheel shall successfully stand the thermal test; it also seems to increase its strength under the drop test.

We have now seen that the wheel founder of the present day has the results of chemical analysis and physical tests of the unmixed iron, and also of the mixture, as well as the results of the drop and thermal tests, to guide him in his work. The tests of to-day's heat are carefully studied by him in order that any defects may be corrected to-morrow. For this reason it is important that the analysis and deflection test should be placed in his hands early.

The drop and thermal tests cannot be made until the wheels are taken out of the annealing pits, a period of from five to eight days.

But this is not all. These tests are intended to show us quickly what kind of service we may expect from our wheels when under the cars, and the records of the life and failure of wheels in service are of the utmost importance. The actual mileage of a wheel under a freight car is a difficult thing to obtain; that is, it requires considerable labor, especially when the number of wheels in use runs up into the hundred thousands. For this reason the life of wheels is often kept by months; and while this does not take into consideration the time spent in the repair yard or on the side track, it has the advantage of being very easily obtained.

As new wheels are made, the foreman of the foundry makes a daily report, giving the wheel numbers and the mixture used. The former are entered in a book which contains the serial wheel numbers, and the latter are entered in another book, which later has the result of the drop and thermal tests recorded, as well as the depth of chill, shrinkage, etc. When the wheels are mounted on the axles, a report is made weekly of the number and place at which this work was done, and this is entered in the book with serial numbers. Each week a report is also made from each point at which wheels are scrapped, giving the number and the cause; and when these are also entered, we have a complete record of dates and places of the "birth, marriage and death" of each wheel.

In looking over such a record it is at once apparent that a large number of wheels are always damaged by improper handling or usage. The proportion of *slid-flat* wheels has been very large heretofore; we hope that the more general use of air brakes will effect an improvement in this line. Chipped flanges and worn flanges are also not generally chargeable to the wheels themselves.

What most interest the founder are those which are scrapped for *cracked plates*, *cracked brackets*, and *broken-to-pieces*, as these show improper manufacture in the majority of cases. As the master car builders' regular guarantee is for forty-eight months, all wheels which run over five years may be considered as giving good service; and if these wheels can be obtained, the study of their analysis is very beneficial. Therefore, wheels giving a very short service or a very long one should be carefully inspected and analyzed, as they will show the bad and good features in a much more forcible way than drop or thermal tests. Mr. W. W. Davis, chemist of the Norfolk & Western Railway, who, with the writer, has given much attention to this subject, analyzed a large number of wheels giving a long or short service or tested by the drop or thermal methods, and we present the results of some of his work:

	Analysis of Car Wheels.					
	Which Stood Thermal Test for 60 Mins.		Which Stood 40 or More Blows Drop Test.		Which Gave 5 or More Years of Service.	
	Max.	Min.	Max.	Min.	Max.	Min.
Graphite	3.28	2.65	3.31	2.65	3.18	2.23
Combined carbon	.95	.32	.90	.55	1.24	.56
Silicon	.75	.50	.70	.50	.94	.58
Manganese	.53	.20	.46	.24	34	.13
Sulphur	.088	.055	.086	.040	.085	.047
Phosphorus	.48	.35	.52	.36	.49	.25

It will be seen that these limits are rather wide, but below are given what are considered to be the desirable limits for the chemical constituents of wheels:

Desirable Wheel Analysis.	
Graphite	2.75 per cent. to 3.00 per cent.
Combined carbon	.50 " " .75 "
Silicon	.50 " " .70 "
Manganese	.30 " " .50 "
Sulphur	.05 " " .07 "
Phosphorus	.35 " " .45 "

By comparing the above with the analyses of a large number of wheels it was found that these limits excluded those which broke through rim in ten minutes or less under the thermal test; broke with twenty blows or less under the drop test; or gave less than two years' service. This last is important, as a wheel can easily be made to stand strains, but the wear will be unsatisfactory, and the metal must have enough chill to stand the abrasion of the track. It is possible to obtain a chill ¾ in. deep on the tread with these proportions.

The analyses of seven wheels which had given from eight to eleven years' service each had the following limits:

Graphite	2.56 per cent. to 3.10 per cent.
Combined carbon	.63 " " 1.01 "
Silicon	.58 " " .68 "
Manganese	.15 " " .27 "
Sulphur	.05 " " .08 "
Phosphorus	.25 " " .45 "

Fig. 2 shows the comparison between chemical analyses of pig iron and of the test bar made by remelting the pig in a cupola by itself. Twenty-seven different irons were examined in this way. The solid line represents the analysis of the pig, and the broken line that of the test bar. It will be seen that phosphorus remains constant, as does silicon when present in quantities under 1 per cent, whereas some of the manganese always disappears. The total carbon remains the same, but the proportions of graphitic and combined carbon seem to vary in an erratic manner. This is evidently due to the effect of the chill, as the analyses were made from the chilled test bars when possible, and the great increase in combined carbon in tests Nos. 11, 12 and 22 may be accounted for by the fact that they chilled clear through the two inches.

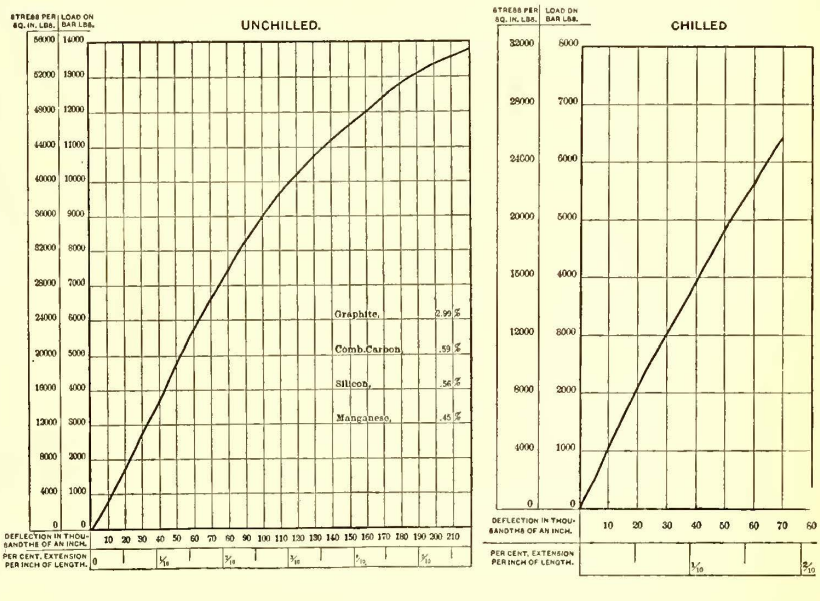


FIG. 1

From the above it will appear that the metal charged into the cupola should contain more graphite, silicon and manganese, and less combined carbon than are desired in the finished product.

If the iron in stock is deficient in manganese, the proper amount can easily be added to the mixture in the ladle by the use of ferro-manganese containing about 80 per cent manganese, 13 per cent iron, and 6 per cent carbon (combined). The use of large proportions of scrap makes this particularly useful, and it is of great assistance in enabling the wheel to stand the thermal test, and consequently the strains from severe braking when in service.

Indeed, cracked plates are almost a thing of the past with foundries keeping the manganese up to the limits prescribed above, where previously much trouble was due to that cause. To overcome this it appears that ¼ of 1 per cent should be present in the wheel. Ferro-manganese, however, seems to reduce the chill by increasing the graphitic carbon, as Fig. 3 will show, and this must be allowed for in proportioning the charge for the cupola. The combined carbon is partly changed to graphite, but not entirely in proportion to the amount of ferro-manganese used.

The experiments from which results Fig. 3 was constructed were made by filling small ladles containing different proportions of ferro-manganese from a large ladle which had been filled with the regular wheel mixture, and casting test bars from these small ladles. The effect of this is plainly illustrated both in altering the structure of the iron and the condition of the carbon content.

In preparing specifications for charcoal irons the difficulty of obtaining limits which should be perfectly satisfactory was not

underestimated. It is therefore hoped that these will be criticized more as representing an effort to compass a complicated subject than as an absolute specification which has stood the test of time.

CHARCOAL PIG IRON

"The material desired under this specification is a charcoal iron with chilling properties as designated below, the various grades to conform to the detail specifications:

Grade.	Chill.	G. C.	C. C.	Si.	Mn.	S.	P.
2	¼ inch.	2.50–3.00	.40– .90	1.25–1.75	.50–1.00	.03 Max.	.25–.40
3	½ "	2.25–2.75	.50–1.00	1.00–1.50	.50–1.00	.03 "	.25–.40
4	¾ "	2.00–2.50	.75–1.25	.75–1.25	.50–1.00	.035 "	.25–.40
5	1 "	1.75–2.25	.90–1.40	.50–1.00	.25– .75	.035 "	.25–.40

"The chill is to be measured in a test bar 2 ins. square by 24 ins. long, the chill piece to be so placed as to form part of one side of the mould. The actual depth of white iron will be measured. The white and gray portions should blend without a definite line of demarcation. The test bars will be made by melting in a small cupola several pigs of the shipment without admixture with other irons.

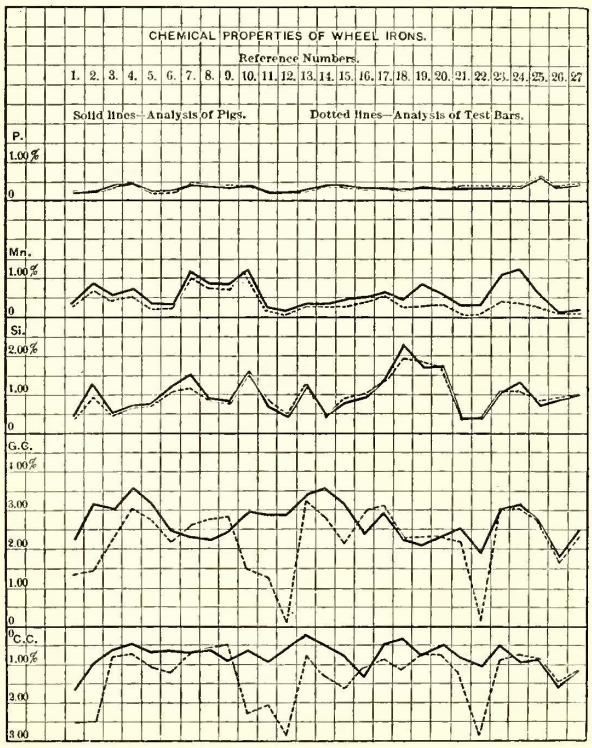


FIG. 2

"The chemical proportions given above are the amounts of the constituents desired in per cents, and will be determined by the analysis of mixed borings in equal quantities taken from twelve pigs from each car.

"In addition to the chilled test bars above mentioned, some unchilled bars of the same size will also be made. These will be placed upon supports 21 1/3 ins. apart. A center load will be applied and the deflection measured. The bar should not break with less than 9000 lbs., and the deflection at center with this load should not be less than 0.15 in."

While charcoal iron is the principal ingredient in car wheels, it is often advantageous to use a small amount of coke iron, and the following specification is therefore submitted:

COKE PIG IRON

"The material desired under this specification is an open-grain foundry pig conforming to and graded by the following detail specifications:

Grade No. 1, Silicon, from 3.00 per cent. to 2.50 per cent.
" " 2, " " 2.50 " " 2.00 "
" " 3, " " 2.00 " " 1.50 "
" " 4, " " 1.50 " " 1.00 "

"Iron will be rejected which shows:

Combined carbon below	.10 per cent.	
Graphitic carbon below	3.00 "	
Manganese below	.50 per cent. or above	.80 per cent.
Phosphorus below	.50 " "	.80 "
Sulphur above	.06 "	

"Should the silicon vary from standard grading, the next lowest grade under the specifications will be paid for, and should the silicon fall two grades low the material will be rejected. No higher grade is desired, and no excess price will be paid for higher silicon.

"Samples of twelve pigs will be taken from each car, two from the top of each end, two from the middle, and two from the bottom. The borings will be mixed in equal quantities and the resultant sample represent the shipment."

Reference having been made to the drop and thermal tests, it may be well to conclude this paper with a specification for car wheels, which will give the details of these tests for ready reference.

33-IN. CAST IRON WHEELS

"The design of wheels must be such that they will be in accordance with the measurements shown on the drawings for 33-in. wheels, and also such that the wheels when cast shall weigh between 590 and 610 lbs. The tread and flange are to be identical with the M. C. B. standard section for same, and the flange thickness must pass the M. C. B. gages for same.

"Wheels must all be cast in true metallic chills of the same internal diameter and of uniform cross section. The body of wheel must be of clean, soft, gray iron and smooth and free from slag and blowholes, and hubs must be solid and free from drawing. The tread and throat of wheel must be smooth, free from deep and irregular wrinkles, slag and sand-wash, and practically free from chill cracks and sweat. The depth of clear white iron must not exceed ⅞ in. at throat and 1 in. at middle of tread, nor be less than ⅜ in. at throat and ½ in. at middle of tread. Neither should there be a variation throughout the same wheel of more than ¼ in. in depth of chill. The blending of the white iron with the gray iron behind it must be without any distinct line of demarcation.

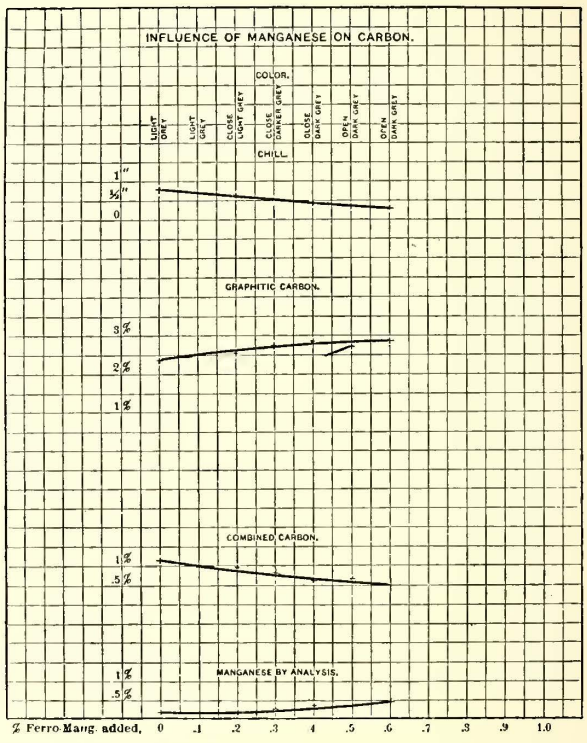


FIG. 3

"Each wheel must be so nearly circular that when a true metallic ring is placed upon the tread, and bears somewhere on the cone, it shall at no part of the circumference stand more than 1/16 in. from the wheel tread. No wheel made in a solid chill will be accepted whose circumference differs more than 1⅝ ins. or less than ⅞ in. from the circumference of the chill in which it is made. Wheels cast in contracting chills should not differ in circumference more than 2 ins. from that of the chill.

"All wheels must, during inspection, receive three heavy blows with a 6-lb. sledge at as many different points under the flange, between the brackets, without cracking flange or brackets.

"Each wheel must also be capable of standing a pressure of 50 tons when being mounted on the axle.

"For each pouring of 100 wheels, or fraction thereof, two additional wheels must be furnished for test purposes. These wheels shall be selected by the inspector, and subjected to the following test: One wheel shall be placed flange downward on an anvil block weighing not less than 1700 lbs., set on rubble masonry 2 ft. deep, and having three supports not more than 5 ins. wide for the flange of the wheel to rest upon; it shall be struck centrally upon the hub by a weight of 140 lbs. falling from a height of 12 ft. Should this wheel stand fifteen blows without breaking in

two or more pieces, the lot of 100 may be accepted (as far as this test is concerned), provided that the broken wheel shows proper depth and uniformity of chill; also subject to return if the wheels do not satisfactorily stand boring and mounting, as explained above. Should the wheel break in two or more pieces with fifteen or less blows, the lot of wheels represented by the one tested will be rejected.

"The other test wheel must be laid flange down in the sand, and a channelway, 1½ ins. wide and 4 ins. deep, must be moulded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top with molten cast iron, which must be hot enough when poured so that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. The time when pouring ceases must be noted, and two minutes later an examination of the wheel must be made.

"If the wheel is found broken in pieces, or if any crack in the plate extends through the tread, the 100 wheels represented by the test will be rejected.

"Wheels may be dried before submitting them to the thermal test, but must not be warmer than 100 degs. F."

Street Railway Franchises and Fares*

BY EDWIN B. GAGER

So many bills are now pending before you relating to street railways and depending for their intelligent consideration upon a knowledge of the financial condition of the street railway interest in Connecticut, that I have been at the pains of collecting some facts which seem to me pertinent. The transfer bill (H. B. 360), the electric lighting bills (H. B. 371 and H. B. 499), the bill concerning street railway franchises (H. B. 502) and the various fare bills and resolutions (H. J. R. 373, H. B. 497, H. B. 219, H. B. 19, H. J. R. 372) are the more important examples of the class of bills I refer to. You cannot fail to have noticed that in every case these bills have been advocated because it was claimed that the street railways had been granted valuable franchises, that they used the highways for nothing, and that the additional burdens sought to be imposed by these bills could well be borne by the companies as some compensation for these so-called valuable franchises.

Many supporters of these bills, especially the fare bills, have gone so far as to claim that these burdens should be imposed because the people would receive a benefit which they should have whether the companies could afford it or not. Others claimed the companies could afford it. Not a single claim in support of these bills, nor a single argument has been based upon an examination of the conditions and facts fundamental to the proper discussion of these questions. The popular notion of this "valuable franchise" is made to do duty in support of any and every measure imposing further financial obligations upon these companies.

What is this "valuable franchise"?

It is not the right to be a corporation. That right, which is a franchise, is common to all corporations whether created under the general law or by special act of the Legislature. The franchise intended is the right, obtained from the Legislature, to lay down and operate a street railway in the streets and highways without paying for such a right by way of purchase. It is claimed to be a free right of way through our streets, of great pecuniary value, given without compensation to the State or the municipality.

Let us examine the nature of this right. It is a right to operate our vehicles, or cars, in the streets. These cars are the cheapest and most comfortable means of local travel yet devised, which, for most distances, you can hire for your personal use for five cents. This right, therefore, is really a right which enables the people to travel frequently, speedily, comfortably and cheaply. The only thing about it rendering a franchise necessary is that in order to furnish such a service these vehicles must run over a prepared surface or track. In no other respect does the street car differ from the ordinary bus. Any man may establish a line of busses without a franchise and without compensation for the use of the streets. No one would think of imposing special burdens on him. Yet he does not take care of a strip of road nearly 9 ft. wide for a single track at his own expense and pay taxes besides, and then furnish the cheapest service in the world. The Massachusetts Railway Commissioners in their report for 1896 (p. 111) said: "The railway is not to be regarded as an intruder, having no legitimate place or right to be on the public street. It is nothing more or less than an improved method of public highway travel. The use of the highway by one method of travel necessarily interferes to a greater or less extent with the convenience and safety of its use by other methods. There are well known inconveniences and dangers to other travelers attending the use of the highway by travelers in street cars. It must be conceded, however, that there is no known method of conveyance by which such large numbers of persons can be transported through the streets with so much convenience, expedition, and safety to themselves and other travelers, with so little noise, confusion and dirt, and with so little obstruction and wear and tear of the street, as by the electric railway. There are carried on the railway whose lines center in Boston, an average of 425,292 persons daily—a number equal to nearly 86 per cent of the entire population of the city. The great majority are carried through the most crowded thoroughfares. If it were possible to transport the same number of persons by any other available method of public or private conveyance, the obstruction, annoyance and danger would, on the whole, be much greater than they now are."

Our every day experience justifies every word of this statement.

But it is said that this right is of immense financial value to these companies. We admit that without this right we could not do business. We deny that, in Connecticut, this right has an appreciable financial value as an asset of the company, adding substantially to the market value of the company's property.

A franchise, to have a financial value as such, must be of such a nature that it will enable its owner to reap a financial profit from its possession in excess of a reasonable profit on his property investment. For illustration, a patent right is a franchise. That right or franchise is of value when it enables its owner to gain a profit or reward beyond the normal return on the capital invested. If a patented article sells for two dollars where, if open to general manufacture, it could be sold at one dollar, and at the same time secure the normal return on the capital invested in its manufacture, then this extra dollar represents the value of the franchise secured by the patent. If a street railway company can, by the use of its franchise to run in the highways, secure a return far in excess of the normal return required by its investment and the risks of its business, so that its property is worth largely in excess of what has been put into it, such excess would represent the value, the financial value, as an asset, of its franchise.

No such value exists in this State, and this is so for several reasons:

1. There is nowhere in this State sufficient density of population. There is no travel to be accommodated that is far in excess of and above the proportion required by the outlay necessitated to construct, maintain and operate the line. You cannot reason from New York and Chicago to New Haven and Hartford, much less to the other cities and towns in this State having street railways. In short, we have not the people to be carried proportional to the miles of track, required to create a financially valuable franchise.

2. This franchise right has not the element of permanency, if the other conditions existed, to make it materially valuable. Every charter in the State is subject to alteration or repeal at the pleasure of the General Assembly. New lines may, at any session of the Legislature, be authorized on streets already occupied or on parallel streets. There is no monopoly in this respect that cannot be broken the moment the Legislature deems the interests of the traveling public require it. A right uncertain as this does not furnish a sound basis for a financial value.

3. If, at any time, it appears to the Legislature that any such franchise is enabling its owner to reap an inordinate profit, the Legislature by its reserved powers has the right to compel a reduction of charges so that the returns will not be out of proportion to the capital invested and the nature and risks of the business.

For these and, perhaps, other reasons, we say that the franchise of a street railway in this State is not, of itself, of substantial financial value. It is simply a preliminary right required to do business, just as the right to use the highways is a preliminary right requisite to enable a man to engage in trucking or running a bus line, and nothing else, and through the medium of the Legislature is subject, like any other business, to the law of competition.

Now if there is, as is claimed, a financial value to this franchise, it ought to appear in the financial results of construction and operation of electric lines in this State.

Two years ago, I had occasion, before the judiciary committee, to examine this question. I could not then find this value. I have re-examined the question and beg leave to submit the results of my examination. It is based on the reports for 1897, the last reports for a full year, and for 1898 so far as available. Briefly stated, the proposition is this: If a street railroad franchise is a

* Address delivered before the committee on railroads of the Connecticut Legislature, May 3, 1899.

valuable pecuniary asset it ought to appear as a material element of value beyond the capital invested in the roads. Such an element I do not find. Several tests may be made.

Take the test of taxable value. Street railways are required to pay to the State 1 per cent on the fair market value of stock, bonds and other indebtedness, just the same as steam roads. The board of equalization has full power to determine this value, and no one but a crank will question that this board has treated the State fairly. In this particular we can use the reports for 1898.

In 1898 the street railways of the State paid to the State Treasurer in taxes $161,164.36. This is 1 per cent on the value of these properties as determined by the board and makes the fair market value of all street railway properties in the State $16 116,436. By the same report the actual cost of construction and equipment was returned as $19,806,240.78. In other words, the fair market value was $3,689,804.78 less than the cost of construction and equipment. There is no margin here for this "valuable franchise." But was this fair market value really fair? For the answer to this we must go to the reports of 1897, as those of 1898 are as to business done, for only nine months. The net earnings of all the roads for 1897 were $951,412.30. From this sum was paid in taxes $132,937.47, leaving for depreciation, interest and dividends $818,474.83. The market value for that year was placed at $13,293,747. This makes the net earnings for that year, exclusive of taxes, 6 1-10 per cent, out of which must come the element of general depreciation of plant which the companies generally have not, in my judgment, sufficiently allowed for. No one at all familiar with the nature of the business and the element of depreciation will say that the valuation was over favorable to the roads.

If we take now the cost of construction and equipment for this same year, viz: $19,849,206.52, then the net earnings, exclusive of taxes, will be 4 1-10 per cent. This does not disclose the "valuable franchise." In Massachusetts in 1897 the net earnings were 6 4-10 per cent on the cost of construction and equipment (Report of Mass. Special Commission. House . . . 475, p. 37).

The stock, bonds and floating indebtedness for the same year amounted to $19,934,661.25, substantially the same as the construction and equipment account and showing substantially the same return, 4 1-10 per cent.

The capital stock of these roads amounted to $9,770,440, and the dividends paid amounted to $265,625.97, being 2 7-10 per cent on the capital stock. The "valuable franchise" element does not appear here.

The steam roads, as a whole, showed in 1897 net earnings, less taxes, of 6 per cent on stock, bonds and floating debt and 7 1-10 per cent on cost of construction and equipment as against 4 1-10 per cent in each case, respectively, for the street railways.

That the reports as to cost of construction and equipment are substantially correct, will appear from a comparison with the reports as to street railways in Massachusetts. In 1897 the average cost per mile of all the street railways of Massachusetts was returned as $44,415. This included long country lines, comparatively inexpensive, for there were in Massachusetts 1413 miles of main track as against 362 in Connecticut, and many of the Massachusetts companies had charged off for depreciation. In 1894 the average cost per mile in Massachusetts was $53,632. (See Table R. R. Comrs. Report for Mass., 1898, pp. 89 and 106). Our average cost per mile was reported in 1897 at $54,829, and in 1898 at $51,177.

This is somewhat in excess of the actual railroad cost, for the commissioners say (Conn. R. R. Comrs. Rep., 1898, p. 27) "the cost of construction and equipment include the cost of electric lighting plants in several companies which cannot be separated from the cost of road and equipment."

You are asked on most of these matters to legislate for the whole State on the theory of this valuable franchise, the use of the street, which it is claimed the roads can afford to pay for indirectly in the various ways presented in these bills. The ultimate reason alleged does not exist. There is no such valuable franchise to draw upon.

As confirming my results reached from an examination of our reports, I would refer to the report of the exceptionally able special commission appointed in 1897 to examine and report on the question of street railways The committee consisted of Charles Francis Adams, William W. Crapo and Elihu B. Hayes. They examined with the greatest care the street railway systems of the United States, Great Britain and the Continent and their report is of very great interest and value. If our friends would study it carefully, they would not be making some of the absurd claims you have heard. On this subject of valuable franchise permit me to quote the following: "So far, however, as a further special street railway franchise tax is concerned, grave popular misapprehension seems to exist as to the burdens in the way of taxation to which street railway companies are already subject—a misapprehension due in no inconsiderable degree to the indirect and anomalous character of those burdens. It seems to be generally assumed that the street railway companies received, and are now receiving, public franchises of unusual value, for which they pay no money consideration and render very inadequate public service; that their profits consequently are inordinately large is also assumed, and that those profits are in some way concealed through a system of vicious financiering and deceptive bookkeeping.

The facts, however, do not seem to be as assumed in this presentation of the case. A more careful investigation fails to disclose those Massachusetts franchises of great value given away without consideration, or unduly large profits on the part of the companies as a whole, or more than exceptional cases of vicious financiering, or a deceptive general system of bookkeeping. There are in all seventy-seven street railway companies in operation in the Commonwealth. Of these, one, the Boston Elevated, or West End Street Railway, may be left out of consideration, its case being exceptional to such a degree as to make it necessary to put it in a separate class, as has, in fact, been done through recent legislation (Acts 1897, chapter 500). Of the seventy-six remaining active companies, thirty-four paid no dividends in 1897, while forty-two paid dividends of from 1.25 per cent to 10.5 per cent, averaging 4.29 per cent—a return certainly not excessive. Upon this point the inquiries of the committee tend to confirm the conclusions of the Board of Railroad Commissioners in their report for 1896 (page 110). While in the business of operating street railways, as in every other business, there are—as, within reasonable limits, there should be—exceptional cases of large profit offsetting cases of failure to earn reasonable profits, yet the idea sometimes entertained that the electric railway is likely to prove a source of extraordinary or abnormal profit must apparently be abandoned. It is a close business, yielding with skilful and prudent management only a fair average return, quite within the limit allowed by statute and conservative opinion as adequate and proper for investment of this character. (Report of Special Commission, pp. 35, 36).

I doubt not you have been struck by the difference between estimates for new lines and the reported cost per mile which I have stated. This is accounted for when you recollect that the value of the older horse railroad plants and the heavy cost of material and plant in the earlier days of electric road construction have to be taken in to the equation.

All this represents actual cost which has gone into the plant and on which the companies are entitled to receive a reasonable return. This feature is so concisely and fully covered by the report of the Massachusetts Commissioners (Report, 1898, p. 110), that I reproduce it in full:

"The establishment and maintenance of an electric railway is a very different thing in point of cost and expense from that of the horse railway. There has been, moreover, a certain amount of loss in the reconstruction of the horse into the electric railway. The construction and equipment accounts of the older companies represent to some extent the cost of two systems, only one of which now exists. There has been besides a very considerable shrinkage in the value of the electric railway properties which were built or reconstructed some years ago, owing to the large reduction in price or market value of material. The motors which cost $2850 can now be bought for $850. A suburban railway which it cost $35,500 per mile of track to build and equip, including power plant, in 1892, could be built and equipped in the same manner the last spring, for $22,600 per mile. Many of the companies require, in order to place or maintain themselves on a sound financial basis, to charge off from their property accounts large sums for shrinkage and depreciation of this character, if of no other character, as soon and as fast as their surplus earnings will permit."

The promoters of these bills desire to take away, as far as possible, all chance for any surplus earnings which will enable the older companies to charge off that portion of their investment which has become valueless so far as the present operation of their roads is concerned. This policy would be extremely unwise for a manufacturing company, and it is equally so for a street railway company.

There is another element in this question which is not to be overlooked. It is said prices generally have gone down, and that we are now paying five cents for a ride that in horse railroad days cost at the most but six. In the "Street Railway Review" of Feb. 15, 1897, is a carefully prepared article on " Reduction in Street Car Fares."

From an examination of twenty-eight large and small cities the writer came to the conclusion "that the price of car fares not only has been reduced, but that no other article of as common use has been as greatly reduced in price."

This reduction has been brought about in three ways, by making a straight five-cent fare, by great extensions of lines and by transfers. The whole matter is exhaustively examined and taking the years 1886 and 1896 for comparison, and taking the purchasing power of five cents in 1886 as the unit, it was found that five cents would in 1896 buy a ride 3.375 times as long, while of steel rails it would buy 1.74 times as much, of sugar 1.37 times as much, of wheat 1.34 times as much and of cotton 1.22 times as much. And this takes no account of the increased speed and comfort of the traveler.

The result in Connecticut is substantially the same. In Bridgeport in 1885 you could ride 4 miles for five cents. Now you can ride 9.75 miles. In 1885 the Fair Haven and Westville R. R. carried a passenger at the lowest rate, 3½ miles for five cents. Now you can ride 9½ miles for the same rate. In Waterbury in 1886 you could ride 1½ miles for five cents. Now you can ride 6½ miles for the same sum. In Hartford in 1892 you could ride 2.9 miles for five cents. Now you can ride 9.18 miles for the same sum.

This very important element should not be lost sight of, that the quantity of service has been tripled while its quality has been greatly improved.

Comparing this with the steam road rates, it will be recollected that on steam roads rates to-day are substantially the same as in 1885, the standard being now, as then, two cents per mile.

But it may be said, and especially in relation to the fare bills, that in New Haven, Hartford and Bridgeport, neither your figures nor your reasoning will apply. From their size we ought to, as we do, find the best results in these cities. These results, however, do not come up to the results on the consolidated road, and this Legislature has already refused to attack its fares We do not expect different treatment from the steam roads unless it appears we are doing much better than the steam roads. I have already shown that the general result on street roads is 4 1-10 per cent, as against 6 per cent on stock, bonds and debt of steam roads, and 4 1-10 per cent as against 7 1-10 per cent on cost of construction.

The Hartford Street Railway Company controls the entire traffic of the second city of the State. The total cost of its construction and equipment was reported in 1897 as $2,608,030.43. Its net earnings, less taxes, $155,212.15, or 5 9-10 per cent on its cost of construction and equipment. Its capital stock, bonds and debt amounted to $2,469,000, upon which its net earnings would be 6 3-10 per cent. This is less than the general average of the State on steam roads, based on cost of construction, and only 3-10 of 1 per cent above on stock, bonds and debt. There is no franchise value here.

In New Haven the traffic is divided between two companies, the Fair Haven & Westville and the Winchester Avenue lines, which in a general way divide the city, the Fair Haven and Westville having taken in the New Haven Street Railway Company. The total cost of construction and equipment returned in 1897 was $3,615,924. The net earnings, less taxes, $264,638.27, or 7 3-10 per cent of cost of construction and equipment. The total capital stock, bonds and debt of the New Haven roads was $3,026,700, upon which its net earnings would be 8 7-10 per cent. This is a little better than the average steam road results. This, however, is far below the results upon the consolidated road, which for the same period showed 15 per cent on cost of construction and equipment and 9 + per cent on its total investment, and paid 8 per cent dividend with a surplus of $74,728.76.

The Bridgeport Traction Company reports a cost of construction of $3,836,468, and net earnings of $123,145, or 3 2-10 per cent on cost. Its stock, bonds and debt were $4,030,000, upon which its net earnings, less taxes, were 3 + per cent. Now, none of these roads so far as appears charged off for general depreciation. It is self-evident that no ordinary repairs will quite suffice to keep a road up to its best standard, that there must at times be reconstruction as distinguished from repairs. This will not come till a road has been some years, perhaps ten or more in operation, but it is sure to come and must be met by an extraordinary outlay which must increase the permanent investment unless provision is made for this expense either by charging off some percentage yearly or the creation of a surplus. For the long continued operation of a road the above percentages should be materially reduced to show a sound basis of net income which can be paid to the stockholders as dividends.

The foregoing figures do not show a situation which justifies the Legislature in interfering in the business management of these companies. They are simply well managed, fairly successful companies, such as we would like to see all the railway companies in the State.

The more we study the reports and the more we learn about the narrow margin of profit after paying all expenses of operation, maintenance of track and roadway and taxes, the less shall we feel inclined to look at street railways as furnishing any short and easy road to wealth. The cold fact is, taking them generally, that thus far the riding public and the local property owners have been the gainers. Stockholders have invested on faith in ultimate results which have not yet been realized. The best of the roads have done no better than a fairly successful manufacturing or mercantile business. If they are left to themselves to conduct their business on ordinary business principles without spasmodic, uncertain and almost surely disastrous legislative interference, the public will be better served and the just claims of those who have invested their money better protected.

Permit me to quote again from the Massachusetts Report already referred to (p. 110). I do this the more freely because in Massachusetts the street railways have long been under supervision of an able board and the conclusions reached by it are based on a wider experience than has been possible in our State:

"It is not by any means intended to convey the impression that electric railway operation is, or is destined to be, a financial failure. The idea that it is likely to prove a source of extraordinary or abnormal profit must, however, be abandoned. It is a close business, yielding with skilful and prudent management only a fair average return, quite within the limit allowed by statute and conservative opinion as adequate and proper for investments of this character. It was suggested in the report of two years ago that the financial conditions and results of street railway enterprise would not be found to differ in the long run essentially from those of railroad enterprise. The average return on street railway capital was the last year a little below that on railroad capital, in this State."

This conclusion, you will observe, coincides absolutely with the conclusion reached from an examination of our own roads and is not, I think open to question. If this conclusion is correct, then every proposed law based on the idea of valuable franchises and excessive profits and which must result in directly or indirectly diminishing these profits must be rejected, because the assumed conditions do not, in fact exist.

It has been said by those who are favoring these various bills, and especially the fare bills, that foreign cities furnish very much more favorable rates than are furnished with us. Upon this point I beg again to refer to the report of the Massachusetts Special Committee already mentioned. This committee was not unmindful of the claims of the visionary and enthusiast, that somewhere beyond the seas, a condition existed that was infinitely better than our own, and they examined the roads of Great Britain and the Continent, and as a result of a careful examination, have said this: (See Report, page 15): "On this head, as already intimated, it is not safe to accept loose assertions, no matter how positively made or frequently reiterated, as evidence of what really exists. In every community, persons claiming to speak as authorities are apt to be in evidence declaring that somewhere else, in this case in Baltimore, perhaps, or in Toronto, in Glasgow, or in Birmingham, or in Berlin, an ideal condition of affairs has been reached, in which perfect street railway accommodations, low fares, rapid transit, and contented officials and employees are working in harmony with a thoroughly well-satisfied municipal government, to the expenses of which the railway company contributes a liberal share, while at the same time paying reasonable dividends to its stockholders. The members of the committee have only to say that, if such a street railway Utopia anywhere exists, they have in the course of their investigations failed to find it."

Various foreign cities have been mentioned in which the street railway management would, it is claimed, throw the excellency of our American systems into the shade. Among others those of Birmingham, Glasgow and Berlin. I can only refer in detail to one of them, and I take my figures from the same special report, pages 16, 214 and 217. Glasgow has a population of some eight hundred thousand, served by 73 miles of tramway measured as a single track. Compare this for a moment with Hartford with a population recently estimated at about 75,000, and served by 56 miles of track; or New Haven with a population in the neighborhood of 100,000, served by between 70 miles and 75 miles of track; substantially more miles of track in New Haven than in Glasgow. In Great Britain at least the same ratio will very generally apply. For instance, Birmingham with a population of 501,000, has 33 miles of track; Southampton with a population substantially that of New Haven, has 5 miles of track; or, taking the United Kingdom generally, Great Britain shows 618 miles of street railway in a city population of 7,600,000, while Connecticut, with its little population of 800,000 urban and country, has 387 miles. But even with the very short mileage of tracks in Great Britain and upon the Continent, there is to be specially noted the fact that rates there are based upon distance instead of the flat five-cent rates for ordinary service as with us, and the distances are divided so that they

increase by comparatively short stages. Take Glasgow again for illustration, we find there that on the rate of the Glasgow corporation, for one cent you can ride one-half of a mile; for two cents, 1¾ miles; for three cents, 2 1-3 miles; for four cents, 3½ miles; for five cents, 4 2-10 miles. You cannot, in Glasgow, in our money, buy as long a ride for five cents as you can upon most of the street railways in Connecticut.

It has been said over and over again that the street railway is the poor man's carriage; practically, we know, it is the carriage of the rich and poor alike. But look at it from the point of view of a man working for wages. In Glasgow it costs him a much greater proportion of his wages to travel a given distance than it does with us. For illustration, in Glasgow point boys, as they are there called, or switch boys, as we would call them, get 28 cents a day; in New York the boys doing the same service get $1 to $1.25 per day. Drivers and conductors, as their highest rate of wages, after three years' service, get $1.08 a day, as against $2.25 in New York for conductors and $2.40 for motormen; and so it runs through the various classes of workingmen upon the roads, and this relative scale of wages is, I believe, about proportional to the difference in wages between Glasgow and this country, so that actually a man who is working in a shop or anywhere for wages here has to work less time to get a given mileage of ride than in Glasgow.

Well might the Massachusetts committee say that, after examining these conditions in the Old World, they have failed to find the street railway Utopia which the visionaries loudly, and with amazing assurance, claim existed there.

There is another point of view founded on the foregoing examination. We have seen that the average street railway net earnings, without deducting for general depreciation, is 4 1-10 per cent on cost of construction and equipment, and 4 1-10 per cent on total stock, bonds and floating indebtedness, yielding after paying interest charges 2 7-10 per cent on capital stock, and that under the very best conditions in the State, viz., New Haven; still without deducting for general depreciation, the net earnings show only 7 3-10 per cent on cost of construction and equipment, and 8 7-10 per cent on capital stock, bonds and floating indebtedness. Now, as a fair business proposition, at what point can the Legislature presume to manage or regulate the financial management of these roads better than those who make it their business to manage street roads? Do you think, as careful business men, that an average of 4 1-10 per cent will, with any information you have obtained here, justify you in imposing additional burdens on all the roads of the State, or that the exceptional rate of 7 3-10 per cent, under the most favorable conditions, will justify you in interfering in the management of the roads in the larger cities?

Do you think so, especially in view of the fact that in the case of a steam road earning 15 per cent on cost of construction and equipment you have, properly enough, deemed it unwise to interfere with its rates?

What is the point where the Legislature may, with propriety, be asked to consider the rate question? Perhaps the neighboring States may aid in answering, for I assume that this committee is desirous of dealing with all these bills in a prudent, conservative way.

In New York it is provided that rates may be reduced, but not below a net income of 10 per cent on the amount actually expended. In New Hampshire rates may be regulated, but not so as to reduce the net income below 10 per cent on the capital stock. In Massachusetts the Railroad Commissioners control the rates, but no reduction is permitted which will bring the income below 10 per cent on the actual cost. We have no law, but rely upon the good sense of the Legislature, and primarily of this committee, and I submit that you can justify yourself to the business world if you conform to the standard of New York, Massachusetts and New Hampshire. The street railways generally, and every one of them in detail, do not show, nor can they be made to show, any such net income as will justify your interference in the management of their financial affairs.

No one can be presumed to know better than the managers themselves what the financial results of any change in rates would be. If advantageous to the companies, they would long ago have been adopted. If disadvantageous, then you certainly will let them alone. The settled policy of this State has been hands off. The result has been that our railroads and street railways have been as well managed, and the public have got as good service at as low rates as in any State of the Union.

The Legislature of the State of Wisconsin has just enacted an anti- pass law, by virtue of which no city, county or State official or employee will be permitted to accept or use passes of any kind on steam or street railways. This law applies as well to local police.

Receipts of Street Railways in New York State

At the hearing on the Ford Franchise Tax bill, before Governor Roosevelt, Executive Chamber, Albany, N. Y., May 11, 1899, the following statement was submitted by G. T. Rogers, president of the Street Railway Association of the State of New York.

STATEMENT

The following facts and figures are compiled from the annual report of the State Board of Railroad Commissioners for 1898:

One hundred and three street surface railroads submitted annual reports to the State, forty-nine of which show a surplus amounting to $1,102,855, and fifty-four show a deficit amounting to $471,848. Of the $1,102,855 surplus, $805,288 is shown by twelve companies in Greater New York, leaving but $297,567 to be divided among the thirty-seven companies outside of that city.

Of the 103 companies reporting, but eighteen declared dividends (five of these being in Greater New York), the total dividends amounting to $3,069,465, of which the five Greater New York roads paid $2,512,374, leaving a balance of only $557,091 to be divided among the remaining thirteen dividend paying roads. Six of the dividend paying roads showed a deficit after so doing. Eight of the 103 street surface railroads mentioned have gone into the hands of receivers during the past four years.

In addition to the above mentioned eight companies, at least twelve or fifteen have gone out of business entirely or saved themselves from going into receivers' hands by making some arrangement with the bondholders.

Briefly, the above report shows that the small and medium sized street surface railroads in New York State, and in fact all the roads with the exception of those in the very largest cities, are struggling along under the most discouraging conditions.

I submit the following significant figures:

1st.—Showing a proportion of net income paid in taxes by street surface, elevated and steam railroads of the State of New York, during the year 1898.

STREET SURFACE RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$5,139,722
Taxes paid in 1898	1,439,250
	$3,700,472

Percentage of net income paid in taxes, 28 per cent.

ELEVATED RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$1,929,327
Taxes paid in 1898	886,853
	$1,042,474

Percentage of net income paid in taxes, 46 per cent.

STEAM RAILROADS

The net income after deducting operating and miscellaneous expenses, interest on funded debt, rentals, etc., not including taxes	$29,356,598
Taxes paid in 1898	8,543,587
	$20,813,011

Percentage of net income paid in taxes, 29 1-10 per cent.

2d.—Statement of percentage of dividends upon the capital stock of the street surface, elevated and steam railroads of the State of New York, for the year 1898.

	Cap. Stock.	Div. Paid.	Per Cent.
Street surface railroads	$132,844,303	$3,069,465	2 3-10
Elevated railroads	49,224,352	1,200,000	2 2-5
Steam railroads	771,452,304	14,546,582	1 9-10

The above statement demonstrates that the transportation companies of the State of New York are bearing all the burden of taxation they can stand, and are already paying a large proportion of their net income into the public treasury.

The sum of $1,683,195,749 is invested by the combined transportation companies of this State in road-bed and equipment. A large portion of this enormous amount invested—representing the capital stock and bonded indebtedness of the several companies—has been sunk in a depreciation of the value of both construction and equipment and in expenditure for replacement made necessary thereby, particularly by street surface railroads for the development of mechanical traction, especially electrical, the operation of which for the past decade has been largely experimental, necessitating frequent expensive changes of station and car equipment, and the consignment to the scrap pile of costly machinery, which necessarily had to give way to more improved and modern equip-

ment; also the expenditure incurred in the construction of experimental electrically operated roads, both overhead and underground, which have been tried and have proven a failure, both from the standpoint of profit and operation.

In many instances where horse street railroads were purchased for the purpose of installing with electricity, the entire equipment, for which high prices were paid, proved absolutely valueless to the purchasers.

In the early days of electrical traction enormous prices were charged for equipments of all kinds; for instance, ten years ago $3000 and upward was the price charged for a car equipment which to-day, owing to its crude and undeveloped condition, is worthless, and which can be replaced by a modern, up-to-date outfit for $720.

Without going into details, I would state in a general way, that the same rule applies to track and overhead construction, to car bodies and appurtenances, all of which have to be kept up to date and carefully maintained to meet the requirements of an exacting public.

The interest paid upon that portion of the bonded indebtedness, sunk by depreciation of values, and expended for replacement by the several street surface railroad companies of the State, in order that the city or village wherein their respective roads are located, might be properly subserved, is a material and permanent burden imposed upon each individual road which should be taken into careful consideration in the adjustment of the important question of taxation.

The sum of $164,161,692 was paid out in operating expenses in 1898, the greater portion of the amount being for labor, proving the benefit of these institutions, and demonstrating the fact, when taking into consideration the immense amount of money invested and the cost of operation, that the net income as shown by the above statement is small, and proves conclusively that the proposed tax imposed upon the railroad companies of this State would be unjust, unfair and undeserved.

Two years ago the Legislature of this State passed a gross earning tax bill, imposing upon street surface railroads a tax of 1 per cent upon gross earnings (while the tax law affecting steam railroads remained unchanged). This measure imposed a serious additional burden upon provincial street surface roads, particularly the non-dividend paying companies.

The street railroad companies of the smaller cities of this State are entitled to consideration and relief, rather than additional burdens. In fact, they must receive such consideration and relief, otherwise the number of street railroad companies in receivers' hands will be materially increased. Furthermore, the imposing of additional taxation upon street railroads will thwart the splendid growth and development, which they have successfully inaugurated throughout the State, and curtail the convenience and comfort of the people, and stop the increase of assessed valuations (particularly of suburban property), they have materially assisted in building up, as it goes without saying that extensions and new roads will not be constructed with a franchise tax confronting them.

We ask that you adhere to your message of March 27, and respectfully submit that the bill should not receive your sanction until it becomes operative for the entire State. As it now stands, if it becomes a law, Greater New York will escape this year, while the country roads would suffer. We maintain that this would be an unjust distinction.

Air Brakes on European Street Railways

[*From Our Regular Correspondent*]

To Germany belongs the credit of having had the first experimental electric railway in the world, but many years later, when it was proposed to operate the street railways by electricity, the conservative authorities imposed many restrictions which impelled the managers to adopt power brakes in cases where American managers would consider the hand brake quite sufficient. The very general use of trail cars has also been a factor in encouraging the employment of continuous brakes, as by them the service of an extra man on the trail car for operating the hand brake, may be dispensed with. The Standard Air Brake Company, of New York, early recognized that in Germany there was a good field for its apparatus, and this company has now more than 600 cars equipped. Its first installation was made three years ago on 150 motor cars and 100 trailers of the Grosse Leipziger Strassenbahn, which has been adding to its equipment every year until it now has some 250 motor cars, all with air brakes.

At first the motormen were permitted to use the air brakes only when hauling trailers, but, it being so much easier to stop the cars by means of the air than by hand, they naturally used them also when without trailers, if they thought they were not liable to be detected; they are now expected to use the air at all times. This brake had been tried in other cities, where the conditions were similar to those in Leipzig, and was condemned, but it would seem that the failure must have been due to lack of proper understanding and care. Each car comes into the repair shop every three months to have the motor cleaned out, and the compressor is then taken off the axle and cleaned; every second time the eccentric strap has to be closed about 1-32 in. to take up the wear, and occasionally the axle bearings are closed, but the parts being enclosed in an oil-tight casing, wear very slowly. A pint and a half of good oil is put into the casing every two weeks. The management takes considerable interest in the brake and has devised a special screen that is put directly on the pump head over the air inlet, instead of using the screen that is ordinarily put under the car seat. About all the track is paved, so there is very little dust, but to prevent the oil from dropping on the pavement, a drip pan is hung under the pump that catches all that works through the axle bearings. In how many American cities would objections be raised to such drippings?

The city of Prague, in Austria, owns its street railways and is equipping them electrically as fast as possible; they are putting on the "Standard" brakes and have forty out of the first hundred already in operation. The very long and steep grades are favorable to the use of air brakes, as the power used in controlling and stopping on the descent is supplied by the momentum of the car, and the motors have a chance to cool off after the heavy work of ascending the grade. These single truck cars, with channel iron body frames, have the truck running well out toward the ends, and the parts of the two are so intermingled that it is very difficult to distinguish which is which, and the reckless way in which expensive forgings are employed in the construction of these, and, in fact, a large part of the German cars, would bankrupt an American car on a line which will run a little way into the suburbs, and they favor for the denser city traffic and they are being equipped with power brakes, although the limit of speed is still below that of similar American practice.

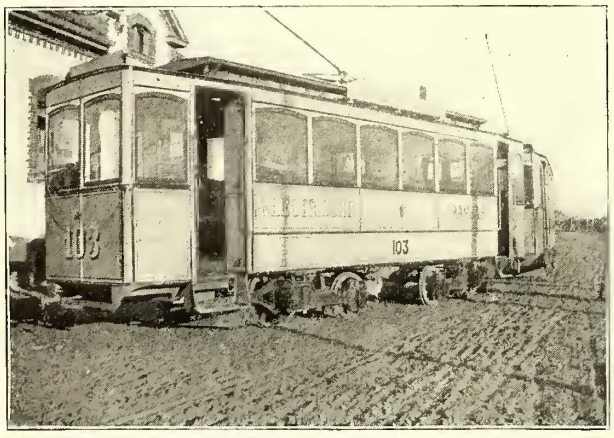
The accompanying illustration shows a handsome car built on lines familiar to American readers; this is one of a hundred on the Munich Electric Railway, equipped, as are the Leipzig cars, by the Union Electricitäts Gesellschaft, of Berlin, and supplied with air brakes. Nuremberg is putting twenty-four of this same type of car on a line which will run a little ways into the suburbs, and they will be equipped with air brakes. All of the above equipments are of the axle, eccentric driven compressor type, which the Leipzig experience has proven to be well adapted to the needs of city service, but the Grosse Berliner Strassenbahn is trying a later type of spur gear driven axle compressor that is doing very good work. All of this company's electric cars that run into the center of the city are double-truck, and are operated by storage batteries, within certain limits, and by trolley when outside. The cars are naturally very heavy (over 30,000 lbs.) and it has been impracticable to brake them by hand, so the company adopted the expedient of making the stops by short circuiting the motors, which, however, has been found to be severe on the motors, and liable to make a jerky stop. Here the trucks have a great pivotal movement, so it is impracticable to have a mechanical connection between them for the brakes; by putting a cylinder on each truck, the mechanical connection is unnecessary and the brake shoe pressure is perfectly equalized betwen them.

Another car illustrated is one on the Siemens & Halske Company's Berlin-Treptow combination overhead and underground trolley line, on which an extended trial was made by that company of the "Standard" motor compressor air brake equipment before adopting it for the Düsseldorf-Krefeld interurban electric railway, a road about 13 miles long, built on its own right of way. This latter road is operated by 40,000-lb. motor cars with 29-ft. bodies and vestibuled platforms, carried on pivotal trucks; these have a strong plate frame that forms pedestals for the journal boxes. Each box has bolted to its under side a semi-elliptical leaf spring which is parallel with, and just outside the plate frame. The ends of these four springs are fixed to the plate frame by means of stirrups, and the cars ride very smoothly. Each truck carries on its inner axle a 75-h.p. motor with armature mounted direct on the axle. The current is taken from a flexibly supported trolley wire by two of the Siemens & Halske standard low trolleys, of such length that when the direction of the car is reversed the trolley throws over without any attention on the part of the employees; switch points never give trouble as the trolley can't get off. The contact part is renewable and made of an aluminum casting of inverted U section, ¾ in. wide, 1¼ ins. deep and 3 ft. long; it is kept well greased and gives good satisfaction.

This same motor compressor type of air brake is used in large numbers on the Upper Silesia Interurban Electric Railway, which is an interurban road with 75 miles of line connecting a number of cities in the coal mining and iron smelting district of Eastern

Germany, an open rolling country that reminds one of Nebraska. The gage is but 29½ ins., and the company has at present fifty double truck motor cars and fifty double truck trailers, all equipped with air brakes, and more have been ordered.

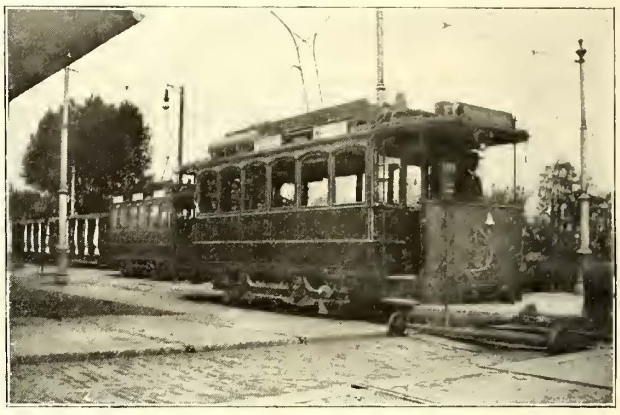
The only other air brake for street railways that is used in Germany is Riesinger's "spring pressure" brake, which, as its name implies, makes use of a strong conical spring of steel of a rectangular section, and with a long range of action, as the braking power. The rod to which the spring pressure is applied is also connected to a diaphragm similar to that used in vacuum brakes, in such a manner that when compressed air is admitted to the chamber, the spring action is overcome to any desired degree, thereby reducing the brake pressure or throwing it off altogether. Thus air pressure must be maintained in the train pipe and diaphragm chambers while running, and to apply the brakes air is allowed to escape, giving a braking force equal to the difference between strength of spring and the pull of the diaphragm. This is, therefore, an automatic brake, as the parting of the coupler will allow the air to escape and the springs will make an emergency application. The hand brake must, of course, operate in the reverse from the ordinary, i. e., it must be pulled off to effect a release. This brake is used on the Bergische Kleinbahn, near Elberfeld.



ELECTRIC CAR IN MUNICH

Brussels is situated at the base and on the side of a very considerable hill, and the finest boulevard runs well up on to it and down again, having thus two steep grades, each about three-quarters of a mile long. One of the tramway companies has a line running from the Southern Railway station, through this boulevard, to the Northern station, a distance of 3½ miles, and it is operated with single truck cars drawing trailers. On account of the grades, a city ordinance requires that these trains be equipped with automatic brakes, and the road has therefore supplied the twenty motor cars and their trailers with Westinghouse automatic air brakes. Each motor car carries on its roof two main reservoirs 12 ins. in diameter and 12 ft. long, which are charged, at the southern terminus, by a stationary compressor situated in the power station not far away. They use a maximum pressure of 105 lbs. per sq. in. and run it down to 50 lbs. The balance of the brake equipment is similar to that used on steam railways. One charge will last for 12½ miles, making 100 stops with motor car and trailer. The railway people express themselves as being well pleased with the brake, but do not use it as yet when running the motor car without the trailer.

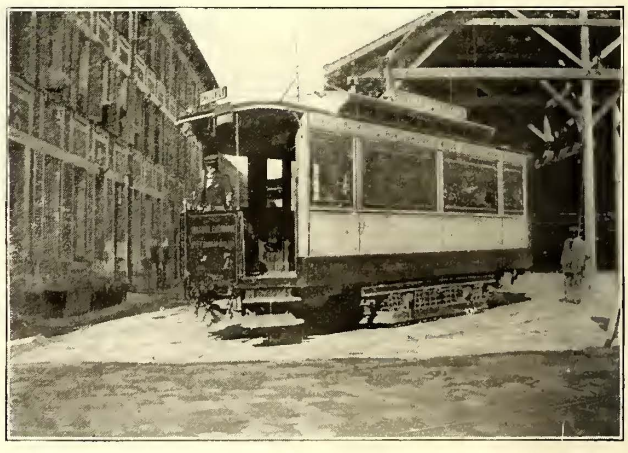
In France the electric tramways have hardly done anything with air brakes, although there is a growing interest in them. Here, as in European countries generally, the trail car meets with considerable favor, and the Department of the Prefect of Police of Paris has recently issued an ordinance to the effect that all street railways running into Paris and operating trail cars must be equipped with a continuous power brake, that may be applied from any platform of the train without previous warning to the "wattman," as they term the motorman. The Thomson-Houston Company, which built and operates the Bastille-Clarenton line of the Cie Générale Parisienne de Tramways, proposes to use trailers there, and as the electric brake does not fulfil the requirements of the Prefect of Police as regards trailers, they are trying the "Standard" geared axle compressor equipment. The engineers, preferring the less complicated direct air system to the automatic with triple valves, etc., fulfil the requirements by carrying a reservoir pipe back through the trail car, and providing on each platform a stop cock, by means of which the conductor can let the air from the reservoir into the brake cylinders whenever necessary. The police also require that all cars shall be provided with a brake that will stop the car (loaded to its allowed capacity) on a 2 per cent down grade, within 65.6 ft. when running at a speed of 12.5 miles per hour. This the hand brake will do if the slack is well taken up before the signal to stop is given. The engineer of the Prefect of Police states that in a test made by him of a loaded car equipped with air brakes, it was stopped, without using sand, on a 2.2 per cent grade in 33 ft. when running at 13 miles per hour, which was highly satisfactory. The illustration shows one of the motor cars of this line, and it will be noted that steps are provided only at two diagonally opposite corners, also that the platform extends into the body for a distance equal to half the width of the car. Swinging doors are provided so they may be swung out from the sides until they meet, shutting off the narrow outside platform,



BERLIN CAR WITH AIR RESERVOIR ON ROOF

at the forward end, and forming a little vestibule in which eight second class passengers may ride, six standing and two sitting on little folding seats that shut up to permit of swinging the doors open when this end is to the rear. Eighteen first class passengers may sit inside, and ten more second class may ride on the rear platform. The fare within the city is, first class, four cents, and second class, two cents.

For many years tramways have been operated in Paris by steam or compressed air motor cars hauling trailers, and these are equipped with the Soulerin automatic air brake. The compressor, placed on the front platform (the cars always run one way) which is occupied by the driving mechanism, stands vertically, and is actuated, through a bell crank under the car, by an eccentric on the



PARISIAN ELECTRIC CAR WITH STEPS AT SIDE

axle with a long connecting rod, so the vertical motion of the car body has practically no effect on the stroke. This brake has given very good satisfaction, but the speed rarely attains 15 miles per hour; this compressor could not be used on electric cars, as its location on the platform would be objectionable, as also the long connecting rod.

In England, on the Liverpool Overhead Railway and the Waterloo & City and the City & South London, the Westinghouse automatic brake is used, the air being stored in reservoirs carried on the train. The latter road, however, is equipping its new electric locomotives with Standard compound motor-driven compressors and will have twelve in service shortly. The Central London Underground Railway electric locomotives will all be equipped with motor-driven compressors supplied by the Christensen Engineer-

ing Company. The surface tramways have begun to use the air brake, fifteen of the "Standard" geared axle compressor equipments having been put on the double truck cars of the Liverpool Tramways last fall. There are some long, steep grades in Liverpool that make it advisable to equip the heavy cars with power brakes. This corporation also operates fifteen trains of single truck motor cars with trailers, supplied by a German firm, and these are equipped with electro-magnetic brakes. The Potteries Tramway Company, of North Staffordshire is to operate with single truck cars hauling trailers, and they are equipped with the same air brake that is used on the Liverpool tramways.

Power brakes have become a necessary part of the equipment of double truck cars, and of single truck ones on roads with heavy grades, or where trailers are used, and the use of the compressed air for this purpose is meeting with increased favor.

Electric Railway Construction in Germany

George P. Pettit, American Consul at Düsseldorf, writes as follows:

"Of the more important German cities, Aix la Chapelle, Brunswick, Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich and Stettin have almost completely abandoned horse cars and are supplied with electric roads. In the cities of Berlin, Breslau, Cassel, Cologne, Frankfort-on-the-Main, Düsseldorf, Barmen, Elberfeld, Königsberg (East Prussia), and other places, horse lines are being converted into electric roads, and most of these have suburban electric roads completed. A large number of electric lines are being constructed in the country districts about Aix la Chapelle, Bochum, Gelsenkirchen, Düsseldorf, Vohwinkel, Elberfeld, Barmen, Elbthal, Essen, Krais Hoerde, Reisengebirge, Waldenburg (Silesia), Witten-Ruhr, and in the mining districts of the Saar (Southern Rheinland) and in Upper Silesia. In thirty-five cities and districts, not mentioned in the above lists, electric roads were in the course of construction on Sept. 1 last, in nine of which the roads were completed and put into operation before the close of the year; so that at the beginning of the year 1899, there were seventy-seven cities and districts in the Empire supplied with electric roads. In thirty-five of these places, extensions were being made to the lines in operation Sept. 1, 1898, some of which were completed before Jan. 1.

"The following is a comparative statement of electric railway construction in Germany for the past three years:

DESCRIPTION.	August, 1896.	September 1, 1897.	September 1, 1898.	Per Cent. of Increase in 1898 Over 1897.
Power houses	42	56	68	21.4
Miles of roads	362.2	594.7	888.1	21.4
Miles of tracks	530.7	842.1	1,204.9	43
Motor cars	1,571	2,255	3,190	41.5
Trailers	589	1,601	2,128	32.9
Electric power, kw	18,560	24,920	33,333	33.8

"Adding the roads put in operation since Jan. 1, 1899, it is estimated that there are now 930 miles of electric roads, with a total of 1300 miles of tracks in Germany. Many American cars are used.

"From the city of Düsseldorf there are now four suburban electric lines completed: From Düsseldorf to Crefeld, about 12 miles; from Düsseldorf to Rattigen, about 8 miles; from Düsseldorf to Benrath, about 6 miles, and from Düsseldorf to Kaiserswerth, about 5 miles."

An Outside Paint

Thomson Brothers, of 395 Park Place, Brooklyn, N. Y., manufacture a paint for the protection of all kinds of metal and wood structural work, etc., and which, it is claimed, will greatly prolong the life of such constructions. The company exhibits a number of testimonial letters testifying to the fact that the Thomson paints, wherever applied, have shown unusual qualities in retaining their life in pigment color and body to a remarkable degree, and effectually protecting metal work from corrosion and rust.

One firm, after using these paints for from seven to eight years, states that it has not re-painted its freight car bodies which were treated with the Thomson paint in 1891, 1892 and 1893, and that the roofs of the same cars did not require repainting until after four years of hard service. Another concern says, "we cannot recommend Thomson's paint too highly;" and another states it is the greatest coverer and cheapest paint of which it has any knowledge. The Government Building, at the World's Fair, Chicago, was painted with this brand.

The Functions of an Electric Truck, I

BY EDGAR PECKHAM

I read with much interest and some amusement the article on the Parallel in the Development of the Locomotive and the Electric Truck, by John A. Brill, in the May issue of the STREET RAILWAY JOURNAL. The comparative description of the early English locomotive and a recent type of heavy passenger locomotive intended for use on American railways seems to me to be particularly unfortunate, and especially so in the deductions drawn that, because the two engines are not alike, the bar type of frame is more suitable than a plate frame for use on an electric car. The writer forgot, or perhaps he is not aware, that the great majority of the locomotives of the world have plate frames, and that the bar frame is a distinctively American characteristic and is by no means acknowledged to be the best by builders and users outside of the United States. He also overlooked the fact that the duties required of a locomotive and of an electric truck are entirely different.

It would have been better, it would seem, to have discussed the stresses which an electric truck has to bear, and then to have considered the most desirable means for carrying an electric car,

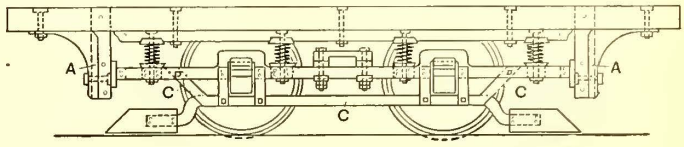


FIG. 1

rather than to have branched off into a field where the conditions are absolutely dissimilar.

The function of a locomotive frame is not to sustain a load, as is the case with an electric truck frame, but to hold the wheels in alignment and resist the stresses resulting from the operation of the machinery. The electric truck, on the other hand, is built to carry a load and the horizontal stresses are those involved in the propulsion of its own burden. As the power is applied directly to the axle, these horizontal stresses, due to propulsion, drop to comparative insignificance, leaving the principal function of the

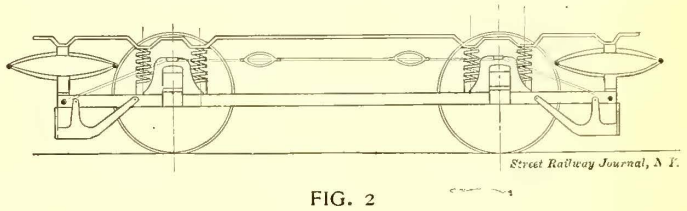


FIG. 2

truck that of carrying the load, which must be done in such a way as to make the car ride easily and without oscillation. Both experience and theory dictate that to eliminate the oscillation, a long spring base is necessary, so that, as a result, practically all of the single trucks on the market carry the greater part of the weight of the car at the ends of the truck.

With these facts before him, the writer of the article under consideration says that "it is hardly surprising that the truss idea took such firm hold upon the builders who had thought of the subject in a superficial manner only. The truss is naturally the first thing that comes into the mind, because the load seems to be the most important factor of the problem."

This statement is apparently accompanied by a lapse of memory, which can be easily filled in by a reference to Figs. 1 and 2, which are examples of the first attempts to introduce the principle of the truss into truck construction. Fig. 1 is that of the braced cantilever construction, which has been found to be so thoroughly suited to the needs of the service for which it was designed, and so capable of being adapted to all varieties of cars that it has been adopted, and is in use by the largest electric railway companies of both this country and of Europe, over 10,000 of these trucks being in constant service. Ever since their introduction these trucks have been continuously and are still replacing the solid forged truck frames, for the reason that their design is based upon correct mechanical principles.

The truck shown in Fig. 2, on the other hand, was an attempt to utilize the suspension principle in the framing of the cantilever car truss. This design was found in practice to involve the constant taking up of the stretch of the rods, coupled with the liability of the ends of the cantilever to droop. These conditions

caused the Brill Company to abandon the use of the suspension rods and substitute therefor the plain bar frame.

In a recent discussion of the subject in the London "Electrical Review," by Henry E. P. Cottrell, A. M. I. C. E., some illustrations are given, which are here reproduced in Figs. 3 to 6. Figs. 3 and 4 are examples of the standard extension trucks, as made by the Peckham and Brill companies respectively, and drawn to the same scale. Figs. 5 and 6 are diagrams showing how the cantilever trusses have been combined by the two companies. The differences betweeen the two are clearly apparent, and it is equally apparent that the form shown in Fig. 5 is superior to that of Fig. 6, and that, with the same wheel base, the spring base of the type shown in Figs. 3 and 5 is much greater than that of Figs. 4 and 6, and that the inclination of the raking members of the extension truss is much more favorable for affording support in the former than in the latter, also that whereas the underframing of the car body serves to materially increase the strength and resistance of the same to bending moments at the ends or to counteract the tendency to drooping into the former, this is not at all the case with the latter truck. Referring to these diagrams the writer mentioned says:

"The adaptation of the extension principle in the truss shown in Figs. 3 and 5 is evidently the *only* practical solution of the problem involved in the ever increasing demand for longer car bodies supported on a single four-wheel truck of a limited wheel base."

Could anything be more widely removed from the above opinion of an English expert than the closing sentences of the article in the Street Railway Journal, where it is stated that: "A little practical experience was required to show the fallacy of the idea," that is, of the truss. To be sure there is some reason for considering the truss idea fallacious when experience in practical construction was limited to the design shown in Fig. 2, and which, not being susceptible of improvement, was naturally abandoned, especially when practical experience agreed so perfectly with the theoretical analysis, that has been carried out to embrace even the type for which Fig. 2 was abandoned as shown in Figs. 4 and 6. In short, for extended car bodies, the unbraced solid brackets prove entirely inadequate, as is shown by the attempt to employ a modified truss frame under the car by the advocates of the single bar truck, but hampered by the unfortunate design of the truck proper, the result has been unsatisfactory.

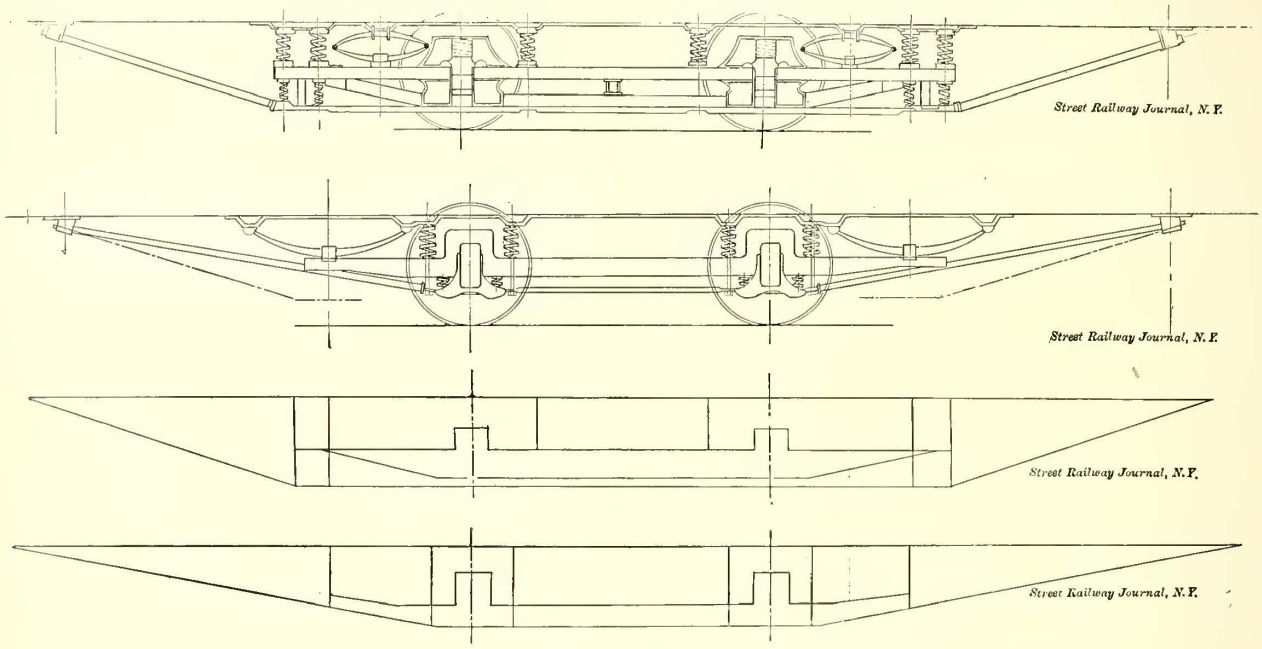
As a final argument, Mr. Brill claims to believe that the riveted construction used in the cantilever bridge truss frame is an objectionable feature, and thinks that the rivets will become loose under service, but the same argument would apply to all made-up structural work, including railroad bridges, trusses and viaducts, in which the jars and strains upon the members are greatly in excess of those encountered under an electric car. If there was any foundation for this claim that riveted girders are structurally weak, every railroad bridge in the country, and every supporting span on elevated railroads would be unsafe for travelers. As a matter of fact, the riveting in truck construction is carried on and surrounded by all the facilities of an up-to-date machine shop, with pneumatic machines, so that the construction is certainly superior to that possible outside of a shop, but the experience with all structural work in the country proves that there is nothing stronger or more durable than riveted construction, when properly done.

It is, of course, quite impossible within the limits of a single article to discuss the distribution of the stresses as applied to an electric truck and a comparison of the same in relation to those applied to a locomotive. I, therefore, reserve such a discussion for a future article, and meanwhile merely wish to reiterate the fact that an electric truck does not perform the functions of the framing of a locomotive, that its main purpose is to carry the weight of the car and motors, and that this is the viewpoint taken by competent engineers, and that when they are called upon to design the two, they plan in accordance with principles suited to the work in hand, and do not make a thoughtless jump to the conclusion that because American engineers consider a bar frame as best suited to their locomotives, it follows that the same construction is to be blindly followed in the building of an electric truck.

(To be Continued.)

New Rail Bond Catalogue

The Protected Rail Bond Company, with general offices at Philadelphia, Pa., has just issued an exceptionally attractive catalogue of its rail bonds and rail bonding tools. The catalogue consists of thirty-two pages and cover, and illustrates fully all of the various types of "Protected" rail bonds manufactured by the company. The Protected Rail Bond Company has acquired all of the patents and the rail bond business heretofore conducted by Messrs. J. M. Atkinson & Company, of Chicago, and the Forest City Electric Company, of Cleveland, and is now manufacturing the "Protected" bonds under these patents.



FIGS. 3 TO 6

The product of the company will be sold through two general sales agencies, located in Philadelphia and Chicago. Messrs. Mayer & Englund, of Philadelphia, Pa., will have full charge of all business in the eastern part of the country, including all export business. Messrs. J. M. Atkinson & Company, of Chicago, will have full charge of all business for the western part of the country. District agents will be appointed to work under supervision of the general agencies.

The rail bonds manufactured by this company are so well known that they need no introduction to street railway managers and engineers, as they have been sold in large quantities all over the world for the past three years. The facilities of the Protected Rail Bond Company for manufacturing its bonds are most excellent, and provisions have been made to take care of the unusually large business already secured for this spring. The factory, which is located in Cleveland, Ohio, is now working night and day to keep up with the orders, and the season of 1899 is just opening up.

The Protected Rail Bond Company will shortly announce its readiness to place upon the market its complete outfit for punching and bonding rails with hydraulic tools, on which experiments and tests have been conducted for the past year. Two or three important contracts have been taken for the installation of "Protected" bonds with these hydraulic tools, and the result is being watched with interest by many leading engineers.

Electro-Magnetic Traction System

For some years the Westinghouse Electric and Manufacturing Company has been perfecting an electro-magnetic system for traction purposes. A short line equipped with this system was operated successfully for several years on North Capital Street, Washington, and it has been in active daily service in the yards of the Westinghouse Company for the past four years.

The Government has recently installed an electric railway on this system at the United States Navy Proving Grounds at Indian Head on the the Potomac. The entire line is about 3 miles in length, part being operated by an overhead trolley, and the remainder by the Westinghouse magneto-electric surface contact system. The railway track crosses the firing line, where the overhead wires would be in danger from projectiles, and an underground or surface system was imperative. A part of the track is shown in Fig. 1. The line is equipped with two 100-h.p. Westinghouse freight locomotives shown in Fig. 2, and one combined passenger and freight locomotive of 50 h.p. The principle and operation of the magneto-electric system will be best understood by referring to Figs. 3 and 7.

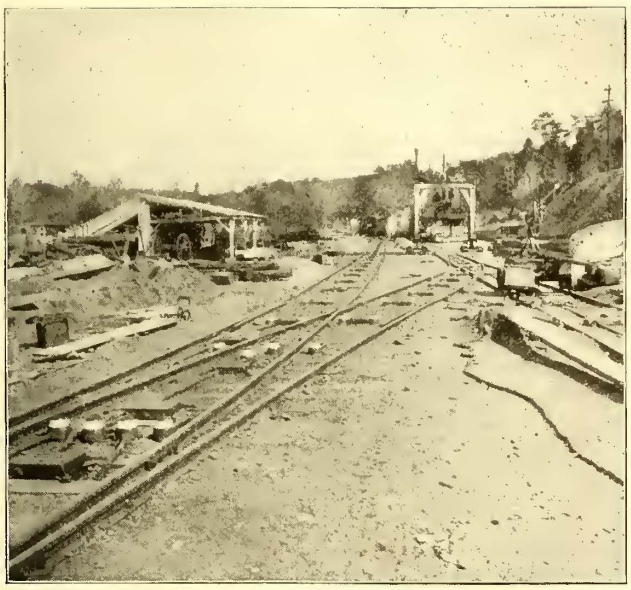


FIG. 1.—VIEW OF TRACK

FIG. 2.—ELECTRIC LOCOMOTIVE

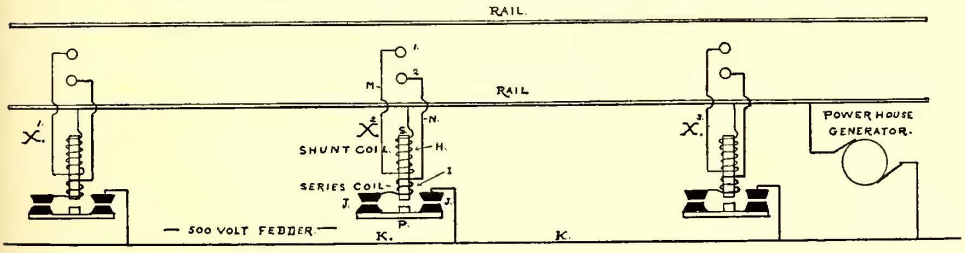


FIG. 3.—DIAGRAM OF TRACK CIRCUITS

Electro-magnetic switches, X, X, X, encased in water-tight casings, are installed at intervals of about 15 ft. along the track to be operated. Each switch is provided with two windings, I and H, which are connected by the wires N, M, to two cast iron contact plates, 1 and 2, which are mounted on suitable insulators and placed between the running rails. Each car to be operated on this system is provided with two spring mounted T steel contact shoes, Q^1 Q^2, six cells of storage battery, and a small motor transformer in addition to the usual controllers and motors. The contact shoes, Q^1 Q^2, are mounted at the same distance apart as the contact pins 1 and 2, so that as the car advances along the track the shoes will make contact with the successive pairs of pins in turn, always being in contact with at least one pair, as the length of the bar exceeds the distance between any two pairs by several feet. To fully understand the operation of the system, suppose a car is standing on the track over the switch X^2, the contact shoes Q^1 and Q^2 being then, of course, in connection with the pins 1 and 2 respectively. The first step is to pick up the current, i. e., render the pins 1 and 2 alive. Switch A is first closed, this completes the circuit from storage battery D, through the motor transformer, which immediately starts up. As soon as transformer is up to speed, requiring only a few seconds, switch B is closed; current then passes from transformer through wiring R R, contact shoe Q, pin No. 1, coil H to ground. This current passing through the coil H, magnetizes the core S, which, in turn, attracts the armature P, closing the switch and establishing connection between the pin 2, and the 500-volt main feeder K, K, through wiring N, coil I, and contacts; switch C is now closed and switches A and B opened, the transformer then stops, the switch X^2 is kept closed, however, by the current flowing from the main feeder through lamp L connection R, M, coil H to ground. The car now proceeds on its way, current from the main passing through coil I, contact bar A^2 connection T, to the controller and motors in the usual manner. When the car has advanced a short distance the contact bars make connection with the pair of buttons connected to switch X^3. Current then passes from the bars through the shunt coil of this switch, closing it, and connecting it in its turn with the main feeder.

As soon as the bars leave the pins 1 and 2, current ceases to pass through the coils I and H, and switch X^2 immediately opens by gravity, leaving the pins connected to it dead and harmless. As connections with the main have already been established through switch X^3, the opening of switch X^2 does not interrupt the flow of current to the car. It will be observed that all the current passing to car from main through switch contacts J, J, passes through the heavy coil I, holding the switch firmly closed, precluding all possibility of switch opening while current is passing through contacts, even should circuit through coil H be interrupted. Although the act of "picking up the current" requires some time to describe, it takes in practice only a few seconds. The battery and transformer are employed only to lift the first switch, for after that has been closed, the contact shoes bridge the main voltage over from one set of pins to another, closing the successive switches, without further attention from the motorman. If it is desired at any time to render the section "dead," over which the car is passing, this may be immediately accomplished by opening switch C. Figs. 4 and 5 show the practical installation of this system for yard work, and is the form installed at Indian Head Proving Grounds.

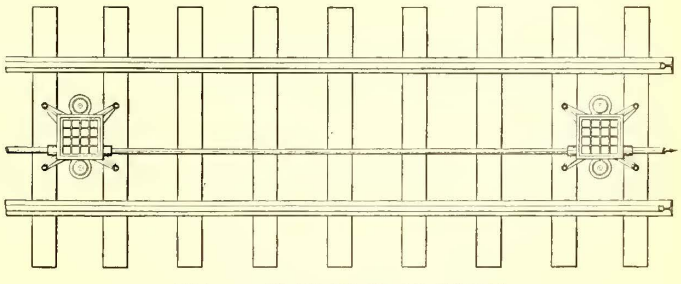


FIG. 4.—PLAN VIEW OF BOXES

The switch, switch box, and contact pins as shown, are made up into a complete unit which is wired up before leaving factory

and shipped ready for installation, only requiring to be set upon the ties and connection made with the main feeder. This spider-like structure consisting of box rim, insulator receptacles, and supporting arms, is made in one malleable iron casting. The lid, which is removable, is a separate casting. A wooden box coated with tar is fitted into a recess provided for that purpose in the bottom of casting and is bolted in place. In this box is placed the electro-magnetic switch which is covered by an air-tight bell shown in Fig. 6, and which will be described more fully later on.

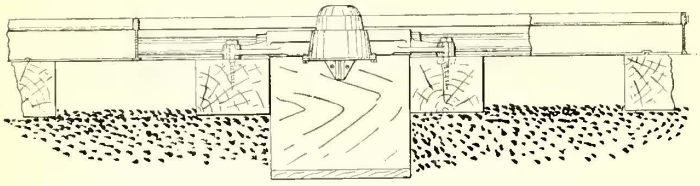


FIG. 5.—SIDE ELEVATION OF TRACK

The insulators, Fig. 5, which are mare of a special composition, are cemented in the tapered cups and backed up by the malleable iron plate. The contact pins are mounted on top of these insulators, and stand, when placed in position, 1½ ins. above the running rail.

The simplicity in the wiring required for this system should here be remarked. One wire only, and that the main feeder, is required to be run, and this is encased in iron pipe and passes

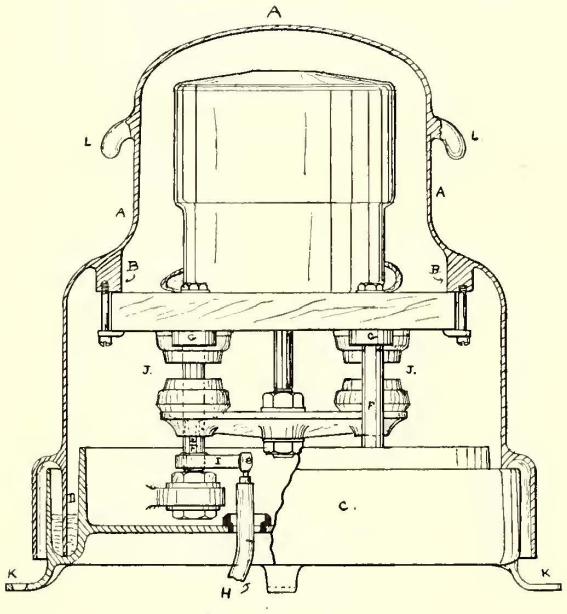


FIG. 6—SECTION OF BOX

directly through each switch box. No additional wires are used interconnecting the coils or contacts of adjacent switches, this objectionable feature being entirely eliminated. The contacts are of carbon and their life seems practically unlimited, as we have been unable to detect any appreciable wear on the contacts of switches which have been in continual use for three years.

Fig. 6 clearly shows general arrangement of switch, bell and

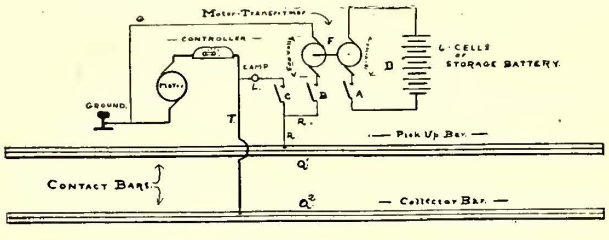


FIG. 7.—DIAGRAM OF CAR CONNECTION

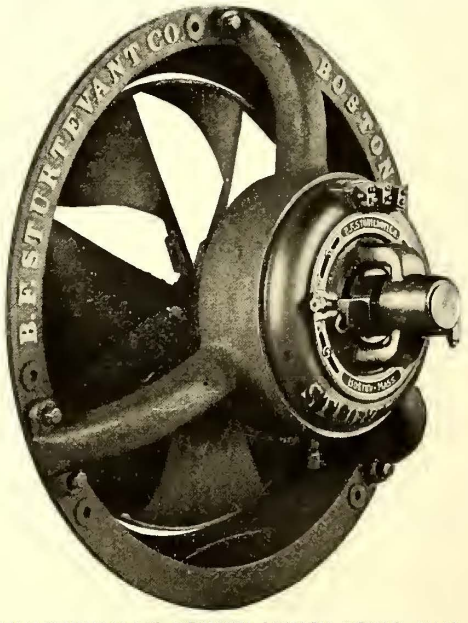
pan. The switch is mounted upon a marble slab, which is secured in the circular bell by means of screws to the bosses, B, B. The bell A is provided with lugs L to facilitate handling, and also with a double lip which fits into and over the annuallar groove D, in pan C, when bell is in position; thus providing a simple and effective method of protecting the switch from moisture. The bells may be entirely submerged in water without affecting the operation of the switches. Connection from the several cables is made to split pins, which are supported upon lugs in the pan C, and insulated therefrom. The switch is provided with receptacles which correspond to these pins, so that it may be quickly and readily removed for examination, without the necessity of disconnecting any wires. All switch parts, bell, pans, insulators, etc., are made interchangeable.

On the turn tables are placed two switches and pairs of buttons. A light section of steel, bent to the radius of turn table pit, is fastened on insulators to inner side of same, and permanently connected to main feeder. A spring contact finger mounted on turn table, makes contact on face of T section, thus keeping up constant connection with the main regardless of position of turn table.

A New Type of Electric Propeller Ventilating Fan

Since the B. F. Sturtevant Company, of Boston, Mass., has entered extensively upon the manufacture of electric motors and generating sets, it has been carefully studying the problem of the manufacture of a compact, efficient and convenient type of electric ventilating fan. Exhaustive tests were made with different types of wheels. The result is made clear by the accompanying engraving, showing a view of one of its electric ventilating fans which has just been put upon the market.

The fan wheel has eight blades rigidly attached to a spider at the center, and held in place by a hoop at the periphery, at an angle of approximately 30 degs. The angle is increased in such a manner that as the center is approached, the theoretical velocity of the air remains practically constant. In other words, the delivery edge is helical, and the air is picked up on the inlet edge of the blades at low velocity. When well under the influence of the blades, it is accelerated to its maximum velocity with the least amount of slip. The result is an extremely efficient wheel.



ELECTRICALLY DRIVEN VENTILATING FAN

The motor likewise has been the result of very careful study in the attempt to provide a light machine, entirely enclosed, and at the same time to avoid the excessive temperature which is incident to the operation of most enclosed motors. The result is a machine capable of continuous operation for ten hours, with a maximum temperature rise of not exceeding 30 deg. F. A practical efficiency of over 80 per cent is obtained even with the small-sized motors, and an excess load of 75 per cent above the rated capacity may be carried without sparking, and without changing of brushes. This feature, combined with the small temperature rise, allows of carrying temporary overloads with impunity.

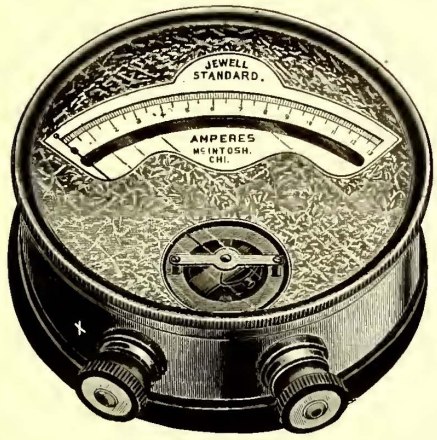
The bearings are self-oiling and self-aligning, and are fitted with phosphor-bronze sleeves, which are removable from the outer ends of the boxes.

The wheel is partially enclosed in a conoidal inlet ring, which decreases the frictional resistance of the entering air, and furnishes at the same time a rigid support for the motor, to which it is attached by the tripod hanger.

These fans are built in sizes from 18 ins. to 120 ins., with motors designed for either medium or maximum speed, and to run at any ordinary direct current voltage. A speed controller is always provided, by means of which the fan can be efficiently operated at different speeds.

Standard Portable Meter

A new portable standard electrical measuring instrument, for direct current only, is being placed upon the market by the McIntosh Battery & Optical Company, Chicago, and is shown herewith. Its construction is exceedingly rigid, fitting it to withstand the rough usage to which portable instruments are frequently subjected. This meter is of the d'Arsonval pattern, having a coil moving in the field of a permanent magnet. It has uniformly spaced scale divisions and an adjustable dial, so that should the



PORTABLE AMMETER

index become bent it is but the work of a moment to set it to zero. The instrument is dead beat.

The permanent magnets are made from imported magnet steel, and are thoroughly aged before being placed in the instrument. The springs are made from a special low-resistance phosphor-bronze alloy, and are of a very fine temper. The series coils in the volt meters and the shunts of the ampere meters are made from an alloy having a zero temperature coefficient.

A neat hardwood carrying case is provided with each meter. The volt meters have a resistance of about 120 ohms per volt of scale; *i. e.*, a 0-150 volt meter has a resistance of 18,000 ohms.

New Open Cars for Brooklyn

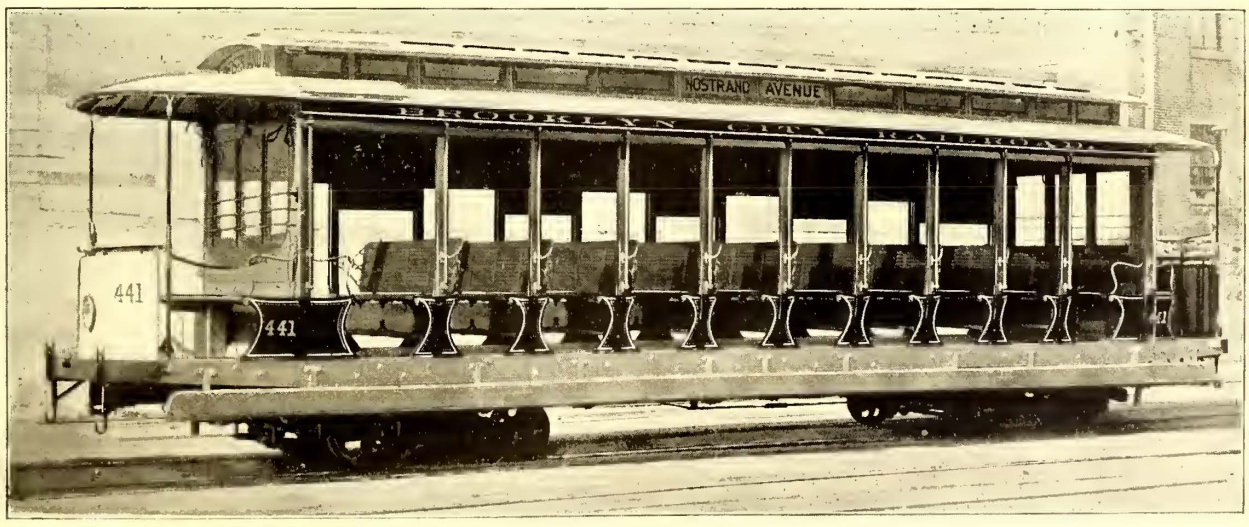
The Brooklyn Heights Railroad Company, of Brooklyn, N. Y., is now putting in service a large number of thirteen-bench, bulkhead open cars, which, on account of the careful way in which the details have been worked out, are worthy of special attention from street railroad men. These cars are built by the J. G. Brill Company, and are 35 ft., 9 ins. over the corner posts and 45 ft. 2 ins. over all. The greatest width, which is over the drip rail, is 7 ft. 10¾ ins. At the sills they are 6 ft. 6 ins. there are two platforms, each 3 ft. 11 ins. long, and a seat is placed on each of them. The height from the head of the rail to the underside of the sill is 25 ins. The height over all is 8 ft. 11 ins. A single step is used which is 18 ins. from the head of the rail, with a 15-in. riser. These cars are mounted on a pair of Eureka maximum traction trucks with the usual 4-ft. wheel base and wheels of 20 ins. and 30 ins. diameter. These long, large and comfortable cars are especially fitted for the heavy work which the Brooklyn street railways experience during the Coney Island season. The power is furnished by two W. P. 50 motors. Although plated sills are used, and the Brill Company in the construction of these cars has taken great pains to make everything as strong and substantial as necessary, the total weight of the car complete, without motors, is only 18,250 lbs.

There are four stationary seats set back to back against the bulkheads, and nine reversible seats in the body of the car. All of these are furnished with round corner seat end panels. The seats and backs are of slat. The interior finish is of ash, with a plain three-ply quartered oak head lining with the usual advertising moldings, etc. The guard rails are of solid ash, made in one piece, extending from bulkhead to bulkhead. These slides on the hickory grab handles which are set in bronze sockets. The platforms are closed with leather covered chains. The glass in the raised roof is of beveled edge throughout. There are electric headlights on each platform. The curtains are of pantasote mounted on Hartshorn fixtures and come all the way to the floor. These cars when closed have nearly a perfect protection from the weather the same as an ordinary closed car. The curtains being waterproof and fitting closely are much more effective than the old type. The registers are operated by a half-inch square rod running along the posts with ringing handles at the proper places. The edges of the sill plates are carefully rounded so that there is no danger of catching the foot in entering or leaving the car. The seat arms are made in such a way as to give great strength and to have the least possible projection in the seat. The seats themselves are spaced 2 ft. 7 in. This is not so great as to invite overcrowding, and yet it gives ample space for comfortable seating. The details throughout have received an unusual amount of attention. The car is tastefully painted in cream and maroon, with striping and lettering of aluminum. Taken in connection with the solid bronze trim, which is used throughout, these cars are among the handsomest recently turned out from the Brill shops.

Demand for Brake Shoes

The "Compo" brake shoes, as manufactured by the Composite Brake Shoe Company, of Boston, Mass., and which have been in very extensive use for some time on the electric street railways of the United States, are now being introduced into other fields. By making a few minor modifications the shoe has been adapted for use on all kinds of heavy carriages and wagons, fire apparatus, automobiles, etc.

As is well known, these shoes are made of cast iron, with sock-



NEW OPEN CAR FOR BROOKLYN

ets into which cork inserts are compressed. The cork is tenacious, and being elastic, gives excessive braking or frictional results without the gripping effect of contacting metals. It wears uniformly with the iron; not more, nor faster.

In proof of the fact that the Compo shoes are well suited to the requirements of heavy wagons, such as fire apparatus, etc.,

it is stated that the fire department of Boston, after a very severe test, has ordered these shoes placed on twenty engines, twenty hose wagons, and ten ladder trucks in that city.

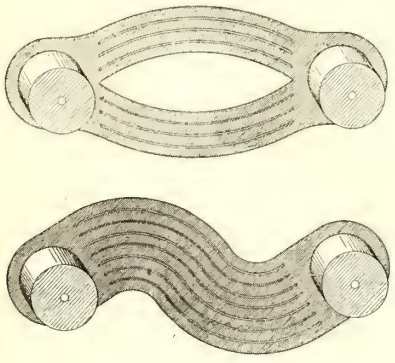
The Compo shoe is, of course, also well adapted to the needs of steam railroads, and is very extensively used on passenger and freight cars throughout America. In a recent test on the Boston & Maine Railroad a shoe fitted with cork inserts ran 58,794 miles from March 18, 1898, to March 1, 1899, and when taken off was still good for service. During this period it had made 14,688 station stops; the average miles per hour, including stops, being 30. The shoe weighed when put in 64½ lbs., and when taken out 51¾ lbs., showing a loss of metal of 12½ lbs. The average thickness of the shoe when new was 2⅛ ins., and when taken out it was 1 5/16 ins., showing an actual wear of 13/16 in. This record gives 4700 miles for each lb. of metal lost by wear. There are a number of very heavy grades on the route over which the test was made.

A One-Piece Rail Bond

A device that promises to perfectly fulfill the long existing demand of street railway managers for a one-piece protected copper bond is being brought out by Elmer P. Morris, of New York city, the well-known dealer in electric railway specialties and supplies.

The new bond is shown in the accompanying illustrations. It is drop forged compleett, with terminals and body in one piece from pure copper, thus insuring the best possible carrying capacity. To give flexibility, and to permit the bond to be used under varying conditions, a number of parallel slits are cut, running the length of the body as shown. The bond is then spread apart or bent at the middle, according to the circumstances under which it is to be used.

The bond is applied in the usual way, terminals being furnished in any size desired, ranging from ⅝ in. to 1 in. or more in diameter. The connecting strap or body is made of any capacity, from that of 00 copper wire up to 00000000. Mr. Morris reports that there are orders already in hand for this new device to keep the works busy for six weeks to come.



TWO FORMS OF ONE-PIECE RAIL BOND

Heavy Engine Building in Milwaukee

The home and foreign demand for heavy engines for electric railway work continues to be urgent, and it is becoming impossible to fulfill desired dates of delivery. The E. P. Allis Company, of Milwaukee, one of the best-known heavy engine builders in the world, has now actually going through its works in various stages of construction, nearly 125,000 h.p. of heavy engines for electric railway service, among these being engines for the following well-known companies:

Metropolitan Street Railway Company, of New York, eleven engines of 4500 h.p. (each maximum capacity 7000). These are the largest engines of any kind ever built in this country and perhaps in the world. The cylinders are 46 ins. and 86 ins. x 60 ins., and the distance from the foundation to top of cylinders is about 38 ft. 3 ins. The shaft is hollow, being 37 ins. in diameter at center, and having an opening 16 ins. in diameter extending the entire length. The journals are 34 ins. x 60 ins. Three of these engines have been delivered and the fourth is ready for shipment.

The Boston Elevated Railway Company, two engines, 4500 h.p. each, of substantially the same type as the Metropolitan engines, but without the cross connections between high and low pressure cylinders, which, in the New York engines, secure independent operation of each side, in the event of breakage.

The South Side Elevated Railway Company, of Chicago, two engines of 2500 h.p. each.

Metropolitan Street Railway Company, Kansas City, one engine of 2500 h.p., and one engine of 1200 h.p.

Metropolitan West Side Elevated Railway Company, of Chicago, two engines, 2250 h.p. each.

North Jersey Street Railway Company, Jersey City, one 2000-h.p. engine.

Northwestern Elevated Railway Company, Chicago, three 2000-h.p., and one 1000-h.p. engines.

London Electric Lighting Company, three 1600-h.p. engines.

The Milwaukee Electric Railway & Light Company, two 1600-h.p., and two 1000-h.p. engines.

Toledo Traction Company, one 1600-h.p. engine.

Consolidated Street Railway Company, Grand Rapids, one 1300-h.p. engine.

New Orleans & Carrolton Railway Company, one 1300-h.p. engine.

Richmond, Va., three 1000-h.p. engines for railway service.

LARGE ENGINES FOR NEW YORK

Bristol, Eng., four 1000-h.p., and the London Tramways Company, four 1000-h.p. engines.

Among the smaller railway engines building in the same shops are a 900-h.p. for Sioux City, and 800-h.p. for Buenos Ayres, Argentina; two 600-h.p. for Cork, Ireland; two 500-h.p. for Lebanon, Pa., and two 400-h.p. for Anderson, Ind.

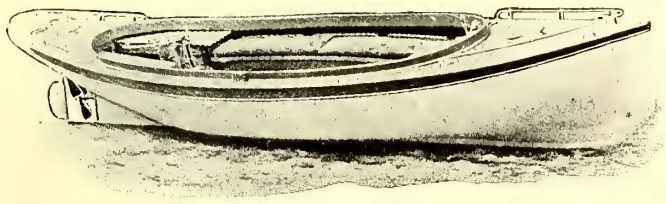
It is announced that the Fifth Avenue Stage Line, of New York city, has been purchased in the interest of the Metropolitan Street Railway Company, and will be used as a feeder to that line. It is also reported that automobiles will be put in operation at once along the route, in place of the old horse busses.

Vapor Launches

To street railway companies owning pleasure resorts containing bodies of water of sufficient depth to float light boats there can be no better investment than a number of neat, strong open launches. It has been proven beyond question that the patrons of such resorts will take advantage of a boat ride when no other form of amusement will attract their attention. The number of launches and the price to be paid for them will, of course, depend entirely upon local conditions.

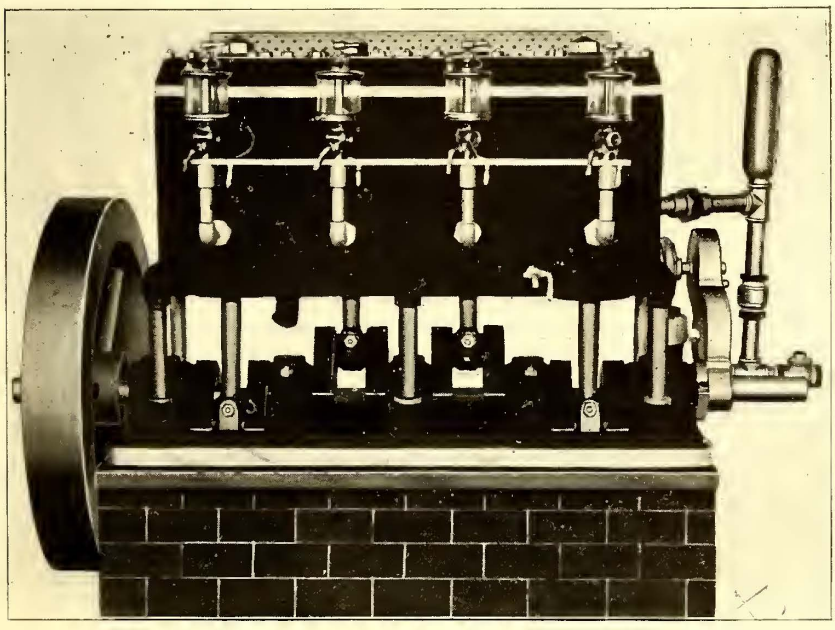
One of the best types of pleasure launches, and at the same time one of the least expensive, is the gasoline or naphtha boats, for which C. B. Sterling & Co., 120 Liberty Street, New York, are the agents. The boats handled by this concern are made entirely from the best materials, on the most approved lines, and of any size from 12 ft. to 53 ft. in length.

The motive power is furnished by an improved type of marine gas engine, using a vapor of either gasoline or naphtha for power. The vapor is exploded in the firing chamber of the cylinder by an electric spark from a small chemical battery regularly at each revolution. It is claimed that these engines are absolutely safe,



VAPOR LAUNCH

there being no vapor of water, gasoline, naphtha or alcohol under pressure, no storage of dangerous pressure, and no boiler or retort. Therefore, there is no possibility of explosion from overpressure. Special care has been given in the designing to secure the greatest simplicity possible, and the use of all complicated parts liable to derangement has been avoided. The engine occupies a small space at the stern of the boat, leaving the cockpit



FOUR-CYCLE VAPOR ENGINE

free of machinery, and can be safely operated by any one of ordinary intelligence without any previous engineering training.

These engines are also made in the four-cycle type, having an explosion every other revolution. These are built for from 8 h.p. to 40 h.p. The company has recently booked a number of orders for large boats, one of which is to have twin screws.

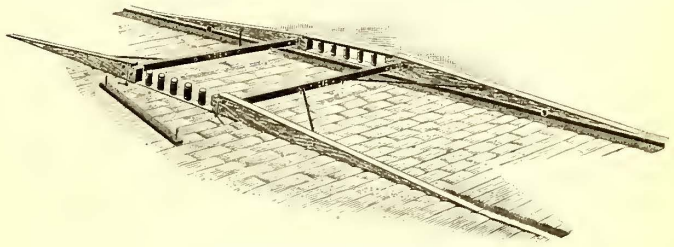
New Line in Wisconsin

The Citizens' Traction Company, of Oshkosh, Wis., is building a 14-mile line to Neenah, and has closed a contract with the Falk Company of Milwaukee for the entire and complete construction of this line. The Falk Company has contracted with the Babcock & Wilcox Company for boilers, with the General Electric Company for generators, with the St. Louis Car Company for double-truck cross-seat cars, and with William Wharton, Jr. & Co. and Pennsylvania Steel Company for rails and track material. The power will be sent from the Oshkosh power stations to a rotary converter substation 9 miles away, and a General Electric six-pole, 300-kw., three-phase generator will be used, with 6600 volts transmission.

A Portable Hose Bridge

In the accompanying engraving is shown a portable hose bridge designed for the purpose of preventing blockades due to fires. As is well known, traffic on a street railway line is often interrupted for several hours owing to the necessity of fire companies running their hose across the track, although the fire may be several blocks off. These delays can be entirely avoided by the use of this bridge.

As will be seen from the cut, the device consists of two parallel trusses, 16 ft. in length, fastened together by two double-hinged



PORTABLE HOSE BRIDGE

joints. When opened the joints form a cross-bar, and become a rigid connection between the two trusses, each cross-bar being locked in position by two iron rods, which are permanently fastened to the truss by an eye and staple at one end, and when in use are hooked into the center of the cross-bar at the other end. These rods have four braces, which render the bridge perfectly rigid. A steel lug an inch in length projects downward from the inside of the lower rail of the trusses at each of their ends. These lugs are slightly beveled, and will fit against either a T, flat, or grooved rail equally well. There is no downward pressure on them, their mission being simply to keep the bridge from sliding off the rail sideways. When the device is in position these lugs fit just inside of the inner side of the rail.

The total weight of the bridge is about 117 lbs., and it being contractable to 9 ins. in width, four of the machines may be readily carried on the ordinary repair or tower wagon. There are six pockets, 4 ins. square, for the reception of hose.

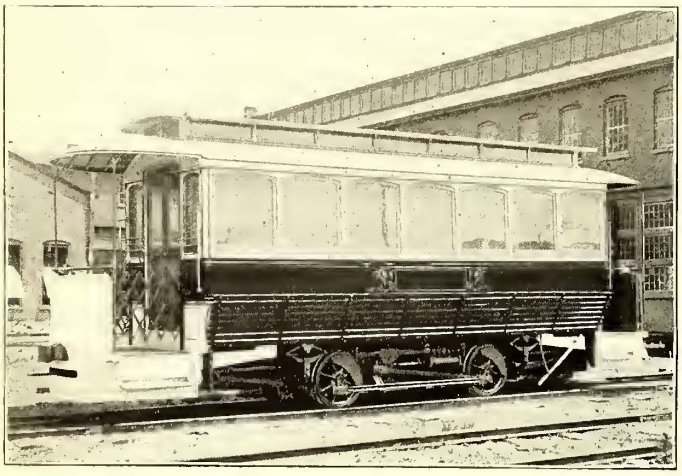
Changes in Dublin

Owing to the recent death of Dr. Carte, by which the chairmanship of the Dublin Union Tramways Company was made vacant, William Murphy has been appointed by the company to that position. At the same meeting William Anderson was elected to the place on the board of directors filled by Mr. Murphy, and was also appointed managing director. His service of twenty-six years as secretary and manager of the company, during which it has been steadily and increasingly successful, makes Mr. Anderson's appointment to his new position a particularly desirable one. R. S. Tresilian has been appointed secretary of the company to the place made vacant by the change of position of Mr Anderson.

The suit brought in the Circuit Court of the United States for the Northern District of Illinois by the Falk Manufacturing Company vs. the American Improved Rail Joint Company and Andrew S. Littlefield, for alleged infringement of letters patent No. 587,718, dated August 10, 1897, for a "portable melting furnace," was duly argued and submitted to the court in pleadings, proofs, illustrative exhibits, etc., introduced by complainant and defendants, but before the rendering of the decision by the court suit was withdrawn at the request of the complainant, who assumed costs.

Compressed Air Cars in Chicago

A test is being made of compressed air as a motive power on some cars being operated on the lines of the North Chicago Street Railroad Company. The work is being done under the auspices of the Compressed Air Motor Company, of Chicago. The cars are modeled after those that were operated for a year on 125th Street, in New York, and have all the added improvements suggested by the experience secured with this type of cars in New York. The system employed is known as that of the Hardie, and



COMPRESSED AIR CAR

Robert Hardie, chief engineer of the company, and well known in the field of compressed air development, is in charge of the installation, and superintends the operation of the cars. To bring out the new features, a brief description of the equipment will follow: The cars are 28 ft. long over all, and weigh, when fully equipped, including the truck and mechanism, about 9 tons. The wheels are 26 ins. in diameter, and are coupled after the manner of locomotive practice. The power is supplied from two cylinders, each 7 ins. x 14 ins., mounted one on each side of the truck, from which the piston rod connects with the crosshead, and this is connected to the coupling rod by means of a rocker arm. The valve gear is controlled by a regular Stevenson's link, with a cut-off, and is operated by separate eccentrics. A variation of cut-off is effected by the reversing link.

Air brakes are employed for controlling the car, and the brake cylinder is located under one end, near the platform. The controlling handle is located against the dashboard, and in connection with this is a by-pass starting-valve.

The air is stored in reservoirs, which are located under the seat and in other convenient positions on the truck beneath the floor of the car. The tanks under the seats are 9 ins. in diameter, and extend the full length of the car. All these tanks are of seamless tubing, manufactured in Germany by the Mannesmann Company, and bear the marks and guarantee of the inspectors of the German Government, by whom every tank is tested before shipping. The testing pressure is 4860 lbs. to the square inch. The charge for operating the cars is carried at an initial pressure of 2200 lbs. to the square inch, and the tanks included in the equipment have a capacity of 51 cubic feet. The pressure is automatically reduced, however, to 150 lbs. to the square inch, and is then passed through a reheating tank, and is delivered to the cylinders at the latter pressure. The reheating tank consists of a shell of boiler plate, and is 18 ins. in diameter x 7 ft. in length, and when the car is ready for service is reheated by live steam at a temperature of about 300 degs. The air is admitted to a perforated pipe in the bottom of this tank and bubbles up through the water, and in its passage absorbs heat and moisture, which adds to its economical value and prevents the ports from freezing from the excessive low temperature attending the expansion of the charge.

It is interesting to note in this connection the economical feature of reheating the air. From some tests that have been made, it was found that a car with a full charge of cold air was able to make a trip of 8 miles, while with the same charge and the air reheated as above described a total of 15 miles was easily made, a gain of 7 miles having been secured with an estimated expenditure of 10 lbs. of coal, the amount theoretically required for raising the water to the necessary temperature. This estimate is based on the theory that there are about 8000 available heat units to a pound of coal. For starting the car the valves are so arranged that air under increased pressure can be delivered to the cylinders, enabling the cars to start easily and positively under all conditions, without regard to the position of the cut-off valves. As soon as the car is under way the high pressure is cut off, and the cylinders work under a normal pressure of 150 lbs.

In order to provide the necessary pressure for operating the cars two Norwalk three-stage compressors have been installed in the tension room of the Clark Street cable power system, and steam for operating them is taken from the boilers of the station. A nest of twenty reservoirs of the same type as those described for carrying the charge on the car is provided near the compressors. These are arranged in four rows and five tiers, and are divided in two sections of ten each, each section being coupled at one end by means of copper tubing to a single pipe, which is fitted with a valve and operating wheel. These tanks are 22 ft. in length and 9 ins. in diameter. In the process of compressing a charge the air passes through a coil of pipes contained in a large tank filled with water. From this it passes through a condensing device, by means of which the condensation from the moisture in the atmosphere is tapped off, so that only comparatively dry air enters the storage tank.

Mr. Hardie has been experimenting with compressed air as a motive power since 1876, and is now confident that he has brought his system to a commercial success. He states that the only drawback or delay in the introduction of compressed air as a motive power has been the difficulty of getting sufficient capital to demonstrate the system on a large scale. He claims that the compressed air motor has passed through the stages of evolution very much as the electric motor; that while the early types of electric motors were virtually failures in the light of present experience, they have now reached a degree of commercial efficiency, and he believes that with ten years of experience with the compressed air motors, under the same care and interest that has been expended on the electric motor, that the air will have surpassed the latter and become as universally popular. The Compressed Air Motor Company in Chicago was virtually organized four years ago, at the time the experiments were undertaken in the East, but very little has been done, as the company has been awaiting results of experiments made by the Eastern company. The organization of the company is now composed of the following: Henry D. Cooke, president; Alexander C. Soper, treasurer; William E. Selleck, assistant treasurer, with Robert Hardie as chief engineer. W. J. Chalmers, of the firm of Chalmers & Co., engine builders of Chicago, is one of the directors.

Portable Air Compressing Apparatus

The Christensen Engineering Company, of Milwaukee, Wis., has recently put a very neat and compact compressing apparatus on the market, to be used wherever electric current is available

PORTABLE AIR COMPRESSING APPARATUS

for general purposes, such as cleaning car cushions and operating pneumatic tools for chipping, calking, riveting or drilling. The apparatus herewith illustrated weighs about 1400 lbs. and is strictly

portable and self-contained. The air compressor has a capacity of 50 cu. ft. of free air per minute, and is of the same style and pattern as the company is putting on the market for air brake purposes. The manufacturers are prepared to furnish this kind of portable apparatus in all sizes, ranging from 10 cu. ft. to 300 cu. ft. free air per minute.

All working parts run in a bath of oil, the motor being arranged on the top of the compressor, and connected to the compressor crank shaft by means of a gear and pinion of special pattern, first introduced by the Christensen Engineering Company, said gear and pinion being composed of sections of a true helical form, which construction makes their operation practically noiseless and increases their durability, it is stated, fully 25 per cent over that of the ordinary straight faced spur gear and pinion.

The compressor delivers air into the reservoirs from which a hose connection is taken, and the compressed air thereby conveyed to the point where it is to do the work. The action of the compressor is controlled by means of an automatic governor, which operates by the air pressure accumulated in the reservoirs, in such a way that the motor stops whenever the pressure is at a maximum and starts when it is at minimum, with any desired variation between the two extremes.

The compressor is not provided with a water jacket, as it is claimed, in this form of construction the compressor will run half the time without any undue heat. This makes the apparatus much more practical than if it were necessary to have cooling water around the cylinders and the back heads, thereby introducing extra complications and need of care taking.

The box which encloses the motor compressor, together with the electric apparatus in connection with same, is all water tight, and is so arranged that access is readily had to all the various parts of the apparatus by simply opening doors arranged in the box for that purpose. This apparatus is used in connection with riveting the structural iron work now being done on the new Post Office Building in Chicago.

Well Known Supply House

The Falk Company of Milwaukee has absorbed the Cloos Electrical Engineering Company of Milwaukee, manufacturers of devices for the controlling of high voltages, especially oil switches, in which a special acidless oil is used, imported from abroad, by means of which arcing between high voltage terminals is absolutely done away with. Switching, which formerly required many careful precautions on the part of station attendants, is now rendered almost as safe as that of ordinary direct-current work. The well-known mechanical ability of the Falk Company is a guarantee that its work in this line will become well known and widely used.

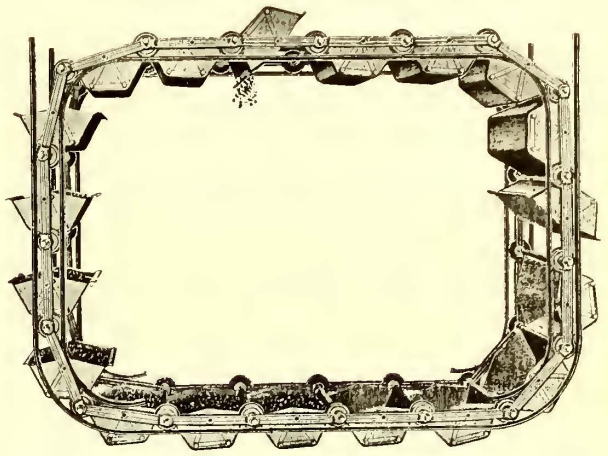
The construction department of the Falk Company has recently obtained some important contracts, including one for the change of a 5-mile cable line of the Metropolitan Street Railway in Kansas City to electricity, and a bulk contract for the complete construction of a 14-mile line between Oshkosh, Wis., and Neenah.

The company's gearing and special work departments have also large contracts on hand, and the cast welding business is assuming constantly larger proportions all over the country, and, in fact, the world. The Falk Company has just closed a contract with the Yerkes lines in Chicago for three complete cast welding equipments and a license to weld joints under the Falk patents. Equipments have also been furnished to the Boston Elevated Railway Company, and a full equipment of welding machinery was recently sent to Buenos Ayres for work being done there under the supervision of Kincaid, Waller & Manville, the well-known London tramway engineers.

In fact, the work of the Falk Company in all its departments is increasing so rapidly that the present factory facilities have been entirely outgrown, and new ones are being created on a large scale. A plot of eight acres of land has been purchased near the present shops, and is now being prepared for the erection of new shops, in which all the work of the various departments will be concentrated. The machine shop will be 100 ft. x 200 ft. in length. The foundry, which will be equipped for casting steel, will be of the same size. There will be a power house covering 60 ft. x 140 ft., and an office building 40 ft. x 60 ft. Electric motors will be used throughout for driving machinery, the power coming from the company's own power house, and the buildings will be so put up as to make possible large expansions longitudinally. A special spur track from the Chicago, Milwaukee & St. Paul yards in the immediate neighborhood will be run directly through the center of the shops, and large electric cranes will travel longitudinally through the foundry and machine shop for the transference of work in all stages.

Coal Bucket Conveyor

As stated in another part of this issue, the new power station of the Milwaukee Electric Railway & Light Company is equipped with complete coal conveying apparatus. This is manufactured by John A. Mead & Company, of New York City, and is shown in the accompanying illustration. The apparatus consists of an endless series of chain links and cross shafts, mounted on track wheels, and from which the conveyor buckets are pivotally mounted in the chain. The conveyor is supported on, and is guided by the system of tracks through all the various changes of angle or direction in which the conveyor is moved. The chain links are so constructed as to give the proper strength, bearing



COAL BUCKET CONVEYOR

and perfect alignment for the conveyor buckets. There are four links to each section. The conveyor buckets are made out of the best quality of steel plate, and have malleable dump cams riveted to either end, which form the pivotal connection with the chain links, and also for turning the buckets on their pivots for discharging their contents.

The conveyor buckets when on a horizontal track overlap in such a manner as to form a continuous receptacle, and in passing from a lower to a verticle or inclined track the buckets maintain their normal upright position by gravity. By overlaping the buckets the material is delivered into the conveyor at any desired point along the horizontal track through an ordinary chute, having in it a gate to regulate the flow of the material. The material is carried from receiving point to place of delivery without transferring from one system into another and without breakage.

The driving mechanism consists of two hexagonal shaped spider wheels, having rollers in the outer ends of their arms, which bear against the track wheels of the conveyor. The track at the driving point is concentric with the centers of the driving wheels. There is no sliding or lost motion between the driving spiders and the conveyor chain, and consequently no wear. The motion imparted to the conveyor by this arrangement is remarkably even and steady, and any elongation in the centers of the chain links is automatically compensated for by the point of contact between the driver and chain.

John A. Mead & Company have installed this device in a large number of power plants, including the stations of the Chicago City Railway Company, the Southside Elevated Railway Company, Chicago, the Consolidated Traction Company, of Pittsburgh, the Cincinnati Edison Company, and three stations of the Metropolitan Street Railway Company, of New York.

Air Brake Catalogue

A neat brochure, that illustrates in a very forcible manner the simplicity and efficiency of the storage system for air brakes on electric railway cars, is being sent out by the G. P. Magann Air Brake Company of Detroit, Mich. In the Magann system the air is compressed at the power station, and is stored under each car in a reservoir at 300 lbs. pressure. From here it is taken through a reducing valve as required. This apparatus does away entirely with all complicated compressing devices on the car, and, in addition, it is claimed, gives a more satisfactory and reliable pressure at the shoes, preventing skidding of the wheels and "jamming" of the brakes.

Lubrication in Power Plants

BY J. N. EDELIN

In constructing power plants the owners or consulting engineers often say, when the subject of lubrication is approached, "we have not completed the large and more important contracts yet, and when these are completed we will then take up the minor details of our plants." Now, one of the most important necessities of a plant is the proper lubrication of the machinery, and it is one of the points which should be considered in making the original plans. This thought was suggested by a recent visit to the immense power house of the Southern Electric Railway Company, of St. Louis, as well as to the two large power houses of the Missouri-Edison Electric Light Company, of St. Louis, Mo., who furnish the lights for the whole city of St. Louis. To prove the importance of the subject of lubrication, we take the liberty of quoting a few remarks from Herbert A. Wagner, general superintendent, Missouri-Edison Electric Company, who says: "In the six months that we have had our oiling system in use we have effected a saving of over $300 per month in the cost of oil, and $150 a month in wages paid to oilers. All of the saving in wages and about half the saving in oil we attribute to the use of the Siegrist oiling system, the balance being due to the change of the character and price of the oil itself. This apparatus, being entirely automatic, practically does away with oilers, for where we had four we have now only one."

The Siegrist oil pump, as used in this station, is mounted on a highly polished iron table 2 x 4½ ft., on which are four small duplex pumps, two for engine oil and two for cylinder oil. Only one of each set is used at a time; the other is held as a duplicate or reserve, and can be thrown in by a valve in a second, to take the place of the other in case of accident. There are also on the table three steam gages, one for steam pressure, one for cylinder oil pressure, and one for engine oil pressure, and three governors, which regulate and control the pumps, making them entirely automatic. Through suitable piping these pumps are connected to tanks. The engine oil is pumped to all necessary parts of each engine and generator, and a pressure of from 60 to 80 lbs. per square inch is maintained. This pressure is carried constantly throughout the oiling system, no matter how much or little oil is being used, by means of suitable regulating valves, placed in a discharge pipe of each pump and acting to close or open the steam admission.

At each bearing or part to be oiled is located a Siegrist automatic sight feed pressure oil cup, connected to the oil pipe system. The rate of speed of each oil cup can be regulated at will by a thumb-screw provided for that purpose, but a diaphragm pressure valve in each cup instantly closes the oil drip if the pressure in the system is lowered more than 2 or 3 lbs. One globe valve placed in the supply pipe for the oil system of each engine is therefore sufficient to start or stop all the oil cups on that engine. In closing this valve the flow of oil is stopped within a few seconds at every oil cup whether located in the highest or lowest parts of the engines. This precludes any waste of oil after the engine is stopped.

Mr. Wagner states that hot journals or bearings belong to the past, for with this system it is possible to use three times as much oil on the bearings as before and yet effect a big saving over the old gravity system, "which is affected by changes in weather and the feed not being reliable." All the surplus oil is piped back from the drips of the engines and generators to the filters located in the basement, where it is refiltered and repumped by this system over and over again.

For the lubrication of cylinders with cylinder oil the Siegrist automatic sight feed lubricator is of polished brass, and has a 1-in. glass, which allows a free passage for the oil without coming in contact with glass whether in a drop or a stream. This sight feed is also controlled automatically by a diaphragm. There is also a connection from the main pipe of lubricator connecting under the diaphragm, giving the same steam pressure as on top; this causes the sight feed to close if the oil pressure gets below that of steam, and also prevents the oil from backing down in glass. This steam also keeps diaphram hot, thereby heating the oil and allowing it to flow freely.

Influence of Mechanical Draft

Walter B. Snow, a member of the engineering staff of the B. F. Sturtevant Company, of Boston, Mass., and an expert on the subject of induced and mechanical draft, has recently written an interesting article on "The Influences of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers." Mr. Snow treats the subject very exhaustively, and his paper is a valuable addition to the engineering literature of the day.

He says in part: "Mechanical draft may be applied under either of two general methods, the plenum or the vacuum. Which is to be employed must depend upon the circumstances, for it cannot be asserted that either is unqualifiedly superior under all conditions. As ordinarily applied under the plenum or forced draft method, the air is delivered to the closed ashpit under pressure, and then finds its escape through the fuel on the grates above. Its success depends largely upon the manner of introduction of the air to the ashpits. Under the vacuum or induced method a fan is introduced as a direct substitute for the chimney, creating a vacuum in the furnace and drawing therefrom the gases generated in the process of combustion. As the draft is thus rendered positive and practically independent of all condition except the speed of the fan, it is only necessary to provide a short outlet pipe to carry the gases to a sufficient height to permit of their harmless discharge to the atmosphere."

The author has worked out very carefuly the relative cost of installation, and also the total amount that can be saved by substituting the various systems of artificial draft for natural draft. He states that from actual conditions he has found that the total expense for installing a forced draft plant is only 18.7 per cent; that of a single induced fan and accessories 26.7 per cent, and that of a complete duplex induced draft plant 42 per cent of the cost of building the necessary chimney. In each case the cost of a short steel plate stack for carrying off the gases is included. In other words, if a chimney is estimated to cost $10,000, there can be saved on a basis of these averages the respective amounts of $8,130, $7,330 and $5,800 in the first cost, according to which system of mechanical draft is substituted. It is found that in a plant where the annual fixed charges (including interest, depreciation, repairs, insurance and taxes) of a chimney would be $800, the figures for the various mechanical draft systems would be $462 for the duplex induced draft, $294 for the single fan induced draft, and $206 for the forced draft with one fan. In addition to this the mechanical draft apparatus can be easily placed overhead or on top of the boilers, where it occupies no valuable space, and also leaves the space otherwise occupied by a chimney available for other purposes, in many cases this being an important point, especially where real estate values are high.

Convention of the Ohio Street Railway Association

The annual convention of the Ohio Street Railway Association will be held at Springfield, Ohio, on June 14 next. We are advised by Charles Currie, of Lima, Ohio, secretary of the association, that a special rate of a fare and a third for the round trip will be granted on the certificate plan to those desiring to attend the meeting. A large representation of supply men is expected, and Mr. Currie is desirous of being notified as soon as possible by all who expect to be present, in order that proper provision may be made for their comfort and convenience.

Municipal Ownership in Detroit

The transfer of the street railway lines of the city of Detroit to the municipality has been delayed indefinitely on account of the failure of the city and the street railway officials to agree upon the price to be paid the present owners of the line. The matter will probably be decided in the courts.

Strike at a Truck Works

There was a strike of short duration among the men of the McGuire Manufacturing Company in the early part of May, 250 truck builders and machinists refusing to work over time for less than double pay. The works were shut down for two days, when a compromise was reached by the company putting on a complete night shift, thus avoiding the question of over-time altogether.

The truck which is known as the No. 39, which this company is now turning out for the South Bend (Ind.) Street Railway Company and the Peoria & Pekin Terminal Railway is attracting considerable attention, because of its very peculiar features. A full description of this will appear in the next issue of the Street Railway Journal. The company has begun delivery of the trucks for the Northwestern Elevated, of Chicago.

New Road in Mississippi

One of the best equipped railway lines for its size in this country was opened at Vicksburg, Miss., April 24. The Vicksburg Electric Street Railway is 8 miles in length, and runs through the center of the city, with two or three branches. The company was formed in 1898, and construction work was begun last November. The prime movers in the enterprise have been S. F. Mordaunt, the general manager, and J. C. Schaffer, of Chicago, who furnished the necessary capital for the construction of the road. The power house is equipped according to the very latest methods, and contains two 250-h.p. Stirling and one 200-h.p. Heine boilers; one 300-h.p. Cooper and one 300-h.p. Russell engines, and Westinghouse generators. The road was constructed by the North American Railway Construction Company; the cars were built by the St. Louis Car Company, and the Westinghouse Company furnished the complete electrical equipments. The opening day was a gala occasion, and the cars were received with great enthusiasm by the entire city.

Consolidation in Buffalo Completed

The organization of the International Traction Company is now fully completed, and the following official statement is made of the securities in the company's treasury:

The entire capital stock of the Niagara Falls & Suspension Bridge Railway Company (operating the Niagara Falls Whirlpool & Northern Railway, under a traffic agreement); the entire capital stock of the Niagara Falls Park & River Railway Company, the entire capital stock of the Niagara Falls Suspension Bridge Company, the entire capital stock of the Clifton Suspension Bridge Company, the entire capital stock of the Lewiston Connecting Bridge Company, the entire capital stock of the Queenston Heights Bridge Company, 9985 shares out of a total of 10,000 shares of the Buffalo & Lockport Railway Company, 12,369 shares out of a total of 12,500 shares of the Buffalo & Niagara Falls Electric Railway, 52,094 shares out of a total of 53,705 shares of the Buffalo Railway Company. The Buffalo Railway Company owns the entire capital stock of the Buffalo, Bellevue & Lancaster Railway and the Crosstown Street Railway Company, of Buffalo. The Buffalo & Lockport Railway owns the franchises and other property of the Elmwood Avenue & Tonawanda Railway Company.

It is expected that the total outstanding stock of the above companies will soon be acquired, and negotiations are either in progress or have just been completed for the acquisition of certain other properties in the neighborhood.

The capital stock of the International Traction Company is $15,000,000, of which $10,000,000 is common stock, and $5,000,000 is 4 per cent preferred cumulative stock. The company has no direct funded indebtedness, but the funded debt of the nine constituent companies amounts to $12,548,000, as follows:

	Funded Debt.
Buffalo Street Railway Company	$6,150,000
Crosstown Street Railway Company	2,830,000
Buffalo Traction Company	600,000
Buffalo & Niagara Falls Electric Railway Company	925,000
Buffalo & Lockport Railway Company	500,000
Niagara Falls & Suspension Bridge Railway Company.	518,000
Niagara Falls, Park & River Railway Company	600,000
Bridge companies	425,000
Total	$12,548,000

Personal

MR. ROBERT C. TAYLOR has been appointed chief engineer of the Twin City Rapid Transit Company, of Minneapolis.

MR. W. J. HAMMER contributed an interesting article on the present status of electric railroading in the Independent for May 5.

MR. WILL CHRISTY, of Akron, Ohio, has entered upon his duties as manager of the reorganized Akron Traction & Electric Company.

MR. JOHN C. DOLPH, of the Sterling Varnish Company, is making a business trip in Europe, visiting both Great Britain and the Continent.

MR. F. E. FISHER has been appointed superintendent of the Joliet Street Railway Company, Joliet, Ill., succeeding Mr. C. C. Rush, who recently died.

MR. HARVEY R. BOWEN has left the Binghamton Railroad Company, and has accepted the position of chief engineer of the Utica Street Railway Company, Utica, N. Y.

MR. JAMES R. LEDYARD has been given the superintendency of the South Covington & Cincinnati Street Railway Company, taking the place of Mr. T. M. Jenkins, who has accepted a position in St. Louis.

MR. A. G. DAVIDS has been promoted to the position of general manager of the Schuylkill Valley Traction Company, of Norristown, Pa., to take up the duties laid down by Mr. R. M. Douglass, the former general manager.

MR. CHARLES F. MORSE, president of the Metropolitan Street Railway Company, of Kansas City, Mo., will retire from that position on June 1, and will probably be succeeded by Mr. W. H. Holmes, the present general manager.

MR. GEORGE F. GREENWOOD, who recently resigned as general manager of the Consolidated Traction Company of Pittsburgh, has been appointed general manager of the Havana Street Railway Company of Havana, Cuba.

MR. J. F. MACARTNEY, of Macartney, McElroy & Company, made a short visit to this country last month. Mr. Macartney is at present located in London, and reports large business as a contractor for electric railways and tramways.

MR. FRED H. FITCH, formerly with the Chicago City Railway Company, and recently manager of the South Western Missouri Electric Railway Company, has accepted the position of general manager of the Sioux City Traction Company, of Sioux City, Ia.

MR. PHILIP DAWSON, who is connected with R. W. Blackwell & Co., and who is a well-known writer on electric railway subjects, sailed for America, May 20, on the steamship Lucania. Mr. Dawson is accompanied by Mrs. Dawson, and will spend some time in America.

MR. W. F. KELLY, general superintendent of the Columbus Street Railway Company, of Columbus, Ohio, has tendered his resignation, to take effect immediately. Mr. Kelly leaves Columbus to take up more important duties in New York, and will be associated with Mr. Emerson McMillin. He will probably be succeeded by Mr. M. S. Hopkins, electrician of the company.

MR. B. F. HARRIS, JR., and his brother, Mr. N. M. Harris, of Champaign, Ill., formerly the principal owners of the Urbana & Champaign Railway, Gas & Electric Company, have sold their holdings in this property to a party of capitalists of Portland, Me. Mr. Harris and his brother will probably remain in Champaign for the present, at least, but will have no connection with the street railway company.

MR. CHARLES FITZGERALD has taken up his duties as general superintendent of the Consolidated Traction Company, of Pittsburgh, this position until recently having been filled by Mr. G. F. Greenwood. Mr. Fitzgerald has had a very extensive engineer training, both in the street railway and other fields. He has been connected with a portion of the Consolidated Traction Company for some time, having been employed with the Citizens' Traction company since 1889.

MR. H. TALBOT, electrical engineer of the City of Nottingham, Eng., made a trip to this country last month to investigate the subject of electric traction with the view to the proposed installation of an electric tramway in the city of Nottingham by the municipal authorities. Mr. Talbot was accompanied by the city engineer of Nottingham and visited a number of the cities in the eastern part of the country, including New York, Philadelphia, Baltimore, Washington, Buffalo and Boston.

MR. J. H. GIBSON, who was formerly connected with the Baltimore City Passenger Railway Company, has accepted the position of superintendent of the Philadelphia and West Chester Traction Company, whose system is described elsewhere in this issue. Mr. Gibson is well known as a practical street railway engineer, and previous to his connection with the City Passenger Railway, of Baltimore, held responsible positions in the engineering staff of the Short Electric Railway Company and the Edison General Electric Company.

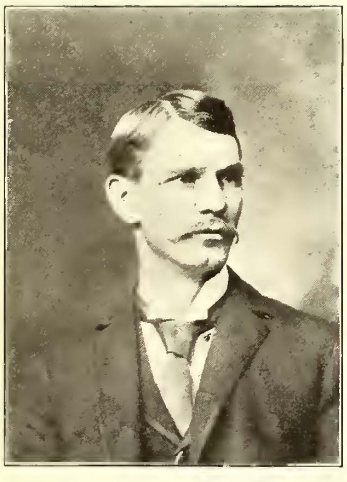
MR. T. M. JENKINS, who was for some time superintendent of the South Covington & Cincinnati Railway Company, has resigned that position to accept a place with the St. Louis & Sub-

urban Street Railway Company and the St. Louis & Meramec River Railway Company, of St. Louis, Mo. Mr. Jenkins has been very successful in his management of the Cincinnati property, and has developed it until it is now one of the best systems of its size in the United States. He has been extremely popular with all the men on the road, from the officers of the company down to the conductors and motormen, and just before his departure for his new field the employees tendered him an elaborate testimonial banquet. Preceding the dinner a large parade was formed, and Mr. Jenkins was given an old-fashioned serenade and ovation.

MR. C. L. ROSSITER, president of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., has just returned from a short combined pleasure and business trip to Europe. On his departure, which occurred May 9, Mr. Rossiter was presented with a handsome floral piece in the shape of a miniature electric car, by the employees of the company, the men taking this method of showing their regard. Before leaving, Mr. Rossiter gave out the following notice of appointments recently made on the Brooklyn Heights system. Mr. Ira A. McCormack will be general superintendent, having charge of transportation; Mr. J. C. Brackenridge will be chief engineer, having charge of all construction and maintenance work and the operation of all power houses. A new position is created, that of superintendent of shops, and Mr. F. S. Drake is appointed to fill this. Mr. Lincoln Van Cott is appointed purchasing agent for the system.

MR. ROBERT H. DERRAH, who has been for the last ten years connected with the West End Street Railway and the Boston Elevated Railway Company, in the office of the president, leaves the service of the latter company to enter upon business for himself. He has for several years made a special study of the growing electric railway system of New England, and as the publisher of "Derrah's Street Railway Guide for Eastern Massachusetts" has a wide acquaintance among street railway men. Mr. Derrah is to start upon a new enterprise in this part of the country—the management of electric car excursions for individuals and parties. In England the low price excursion is a popular form of entertainment, and in Boston and its vicinity more attractions of greater diversity can be found than in any other section of the country. While such a business is an experiment in New England, it has great possibilities, and Mr. Derrah leaves the Boston Elevated Railway Company accompanied by the best wishes of its officials and employees to be first in the new field.

MR. RICHARD McCULLOCH, of St. Louis, has been offered an excellent position in Geneva, Switzerland, and is now on his way to take up his new duties. Although his many friends will be pleased to hear of his advancement, they will learn with regret that he is to be absent from this country for several years. Mr. McCulloch's genial nature and unusual ability have attracted to him a wide circle of acquaintances and friends, and he has been especially popular with the employees of the company with which he has been connected. In order to manifest to some extent their appreciation of his sterling qualities, about a hundred of his business and social friends in St. Louis tendered him a farewell banquet at the Planters' Hotel on Thursday evening, May 11. An elaborate menu was prepared, and a number of the leading citizens of the city were present. Mr. McCulloch will superintend the construction of an electric street railway for an English syndicate at Geneva.



RICHARD McCULLOCH

Obituary

MR. C. C. RUSH, who has been the successful superintendent of the Joliet Street Railway Company, of Joliet, Ill., for some time, died on May 3 from injuries received by being struck by an engine on the Chicago & Alton Railroad. Mr. Rush was walking along the tracks, and for some reason did not hear the approaching train. He was born on September 10, 1864, in Champaign, Ill.

CAPT. ALFRED E. HUNT, president of the Pittsburgh Reduction Company, of Pittsburgh, Pa., and a well-known chemical expert, died recently at Philadelphia from illness contracted while in command of Battery B of the National Guard of Pennsylvania in Porto Rico during the Spanish war. Mr. Hunt was born at East Douglas, Mass., on March 31, 1855, and received his technical education at the Massachusetts Institute of Technology. In 1888 he organized the Pittsburgh Reduction Company, to manufacture aluminum, and up to the time of his death was president and general manager of this concern.

AMONG THE MANUFACTURERS

THE BRITISH THOMSON-HOUSTON COMPANY, of London, has moved its Glasgow office from 639a St. Vincent Street to 141 West George Street.

THE FRANK W. MEAD AMUSEMENT COMPANY, of Boston, Mass., is prepared to furnish high class vaudeville specialties for street railway parks, casinos, etc. The company's new catalogue mentions a few of the artists in its employ.

THE UNION BOILER TUBE CLEANER COMPANY, of Pittsburgh, Pa., has begun action in the United States Circuit Court to enjoin Gameliel St. John from manufacturing, selling, or using a certain device for cleaning the interior of boiler tubes.

THE ELECTRICAL INSTALLATION COMPANY, Monadnock Block, Chicago, has just closed a contract for building and equipping the Waupaca Electric Street Railway, Waupaca, Wis. There will be 5 miles of single track. Work was to begin May 24, and the line is to be in operation July 1, giving only thirty-seven days for the completion of the entire contract.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., among recent publications, has issued catalogue No. 222, devoted to direct connected railway generators; No. 223, devoted to lightning arresters for alternating current and direct current circuits, and No. 228, on Tesla polyphase induction motors, type C, for constant speed.

THE CLING-SURFACE MANUFACTURING COMPANY, of Buffalo, N. Y., is arousing great interest in its new compound for treating leather belts. A test upon this dressing and the results secured were published in the last issue of the STREET RAILWAY JOURNAL. Owing to a typographical error the company's office was there given as New York city instead of Buffalo.

THE MULTIPLEX REFLECTOR COMPANY, of Cleveland, is making a specialty of Schroeder's patent multiplex reflector, and is also manufacturing a complete line of reflectors, headlights and bicycle lamps of every description. The Cleveland City Railway and the Cleveland Electric Railway Company have a number of these reflectors in use, and are thoroughly testing the same.

THE ROBB ENGINEERING COMPANY, of Amherst, N. S., has been awarded the contract for two 230-h.p. engines by F. S. Pearson, of New York, consulting engineer for the Cuban Electric Company. These engines are for an electric railway from Regla, on the opposite side of the harbor from Havana, to Guamaeoa, about 8 miles distant.

THE RUMOR that the works of the Pennsylvania Car Wheel Company, of Pittsburgh has been purchased by another company is authoritatively denied by that company. To enable the company to further enlarge its business this year additional property has been taken and its capital stock increased from $100,000 to $200,000, paid in. It is possible that the rumor mentioned was occasioned by these proposed changes.

THE SIMONDS MANUFACTURING COMPANY, of Pittsburgh, Pa., is sending out a new circular on electric railway supplies. A large part of the catalogue is devoted to a discussion of gears and pinions and the different stages of the gears, from the rough casting to the accurately finished wheel are shown. The catalogue also discusses Babbitt bearings, worms, worm wheels and racks, and the Murphy car wheel truing machine.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., among other printed matter, has issued during the past few weeks the following bulletins: No. 4172, devoted to the G. E. 51 B railway motor; No. 4173, to the G. E. 53 railway motor; No. 4174, to slow and moderate speed motors, type M. P., Form H; No. 4177, to pendant push-button switches; No. 4178, to current indicators, Form B; and flyer No. 2038, to improved practice for series incandescent street lamps.

THE CLAYTON AIR COMPRESSOR WORKS, of New York city, have published a very complete catalogue describing their air compressors for all pressures and for every purpose to which compressed air is applied. The greatly extended use of compressed air has created a positive demand for efficiency and maximum economy in the design and construction of air compressing machinery, and it is thought that the Clayton compressors perfectly fill this demand.

THE CLEVELAND FROG & CROSSING COMPANY, of Cleveland, Ohio, has found its Eastern construction work increasing so rapidly as to require the establishment of an Eastern agency. The company has, therefore, appointed L. J. Buckley & Company, of 257 Broadway, its Eastern agents. F. A. Lapham, of the company, has been spending some time in the East recently, giving Messrs. Buckley & Company such information as will enable them to care satisfactorily for their customers.

THE DREHER GREASE & OIL COMPANY, of 80 Cortlandt Street, New York, is making some very broad claims as to the superiority of its journal and motor grease for electric car work. These claims seem to be well substantiated by the numerous letters testifying to the merit of these greases, and by the fact that a large number of roads are using them exclusively. To any one not familiar with these greases the company will send a sufficient quantity of each kind free to give a thorough trial.

THE GARTON-DANIELS COMPANY, of Keokuk, Ia., reports that since April 1, the sales of Garton lightning arresters have been over double what they have been in the same period of any previous year. The company, in order to keep up its stock, has recently doubled its force of employees, and states that it will be able to meet any requirements for prompt shipments. The new Garton-Dainels kicking-coils and lightning arresters for the protection of small motors, fans, etc., are meeting with a large demand.

FRANK H. MONKS, of 35 Congress Street, Boston, is becoming well established as an expert in the examination of street railway properties in all parts of the country. Mr. Monks has had over fifteen years of practical experience in street railway work, and his reports are of exceptional value to bankers and others desiring to know the exact condition of individual properties. Mr. Monks will be remembered by many as the former general manager of the West End Railway Company, of Boston, now the Boston Elevated Railway Company.

DICK, KERR & COMPANY, of London, Eng., have just secured the order for eighty cars with their complete electrical (Walker) equipment, to be sent to Liverpool, for municipal tramways in that city, and have also secured an order for thirty car bodies for Sheffield. The 110 car bodies will be made by the Electric Tramway & Carriage Company, of Preston, and the Walker motors will be made in America, although a little later they will be manufactured by the new works of Dick, Kerr & Company, to be located also in Preston.

GEORGE A. PARMENTER, of Cambridgeport, Mass., manufacturer of the well-known car fenders, reports that his device continues to give entire satisfaction wherever it is used. In fact, he states that there has not been a single case of fatal accident, or even broken bones, with cars equipped with this guard. Among recent contracts received are one from the Anacosta & Potomac Railway Company, Washington, D. C., for double equipments, and contracts from four companies in the State of Vermont, this fender having been recommended by the Railroad Commissioners of that State.

THE TAUNTON LOCOMOTIVE MANUFACTURING COMPANY, of Taunton, Mass., announces that hereafter its Wainwright department will be represented in New York city by Charles H. Paine, with offices in the Singer Building, corner of Broadway and Liberty Street, and it assures its customers that they may count on prompt and courteous attention to any business intrusted to its care. This company's Catalogue E, for 1899, containing illustrations and descriptions of its feed water heaters, surface condensers and expansion joints, is now ready for distribution, and will be gladly sent on application.

THE DEMING COMPANY, of Salem, Ohio, has published a special catalogue devoted to the subject of pumping machinery for various services, including triplex power pumps, deep well pumping engines for operation by steam engine, gas engine, gasoline engine, oil engine, electric motor and water power. In designing these pumps, it has been the aim of the manufacturers to secure as nearly a uniform flow of water as possible, thus avoiding all shock to the pump parts and piping system. The Deming system of pumps, it is claimed, is somewhat of a departure from the usual type and contains numerous improvements.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received a contract from the La Capital Tramway Company, of Buenos Ayres, Argentina, for a steel water tower, supporting a tank, and having a capacity of 7000 gallons. This is the fifth order received from the same company. The Berlin Iron Bridge Company has also received a contract for a new meter house from the Providence Gas Company. This building is to be 65 ft. wide and 110 ft. long. Also, an order for a purifier house, which is to be 40 ft. wide and 175 ft. long, and three stories high. Also, for a gas holder building 184 ft. in diameter. The entire construction will be of steel framework, absolutely fireproof.

THE BROWN HOISTING & CONVEYING MACHINE COMPANY, of Cleveland, Ohio, is sending out a 175-page illustrated pamphlet describing its various lifting and moving devices, including hand and power traveling cranes of all descriptions, jib cranes, tram rails and trolleys, transfer tables, etc. This firm has had many years of experience in the designing and building of implements of this character and its engineers have made a special study of the best methods of raising and moving heavy pieces of machinery, metal work, etc., in power plants, railroad construction and engineering work of all kinds. The catalogue contains a large number of fine engravings, showing the many different types of cranes doing the work for which they are designed.

JAS. BONAR & COMPANY, of Pittsburgh, Pa., reports orders for Pittsburgh feed water heaters and purifiers for shipment to the following parties: Herman Krels, Knoxville, Tenn., 200 h.p.; Danville Artificial Ice Company, New Orleans, La., 160 h.p.; Oliver Wire Works, Pittsburgh, Pa., 150 h.p.; Duquesne Forge Company, Rankin, Pa., 600 h.p.; J. H. Denhelm & Son, Pittsburgh, Pa., 200 h.p.; Pittsburgh Horse Shoe Company, Glassport, Pa., 600 h.p.; Baker Forge Company, Ellwood City, Pa., 200 h.p.; Pittsburgh Brick Company, Briggston, Pa., 200 h.p.; York Manufacturing Company, York, Pa., 160 h.p.; James H. Baker Manufacturing Company, Tarentum, Pa., 250 h.p.; W. H. Herr, Altoona, Pa., 150 h.p.; Pittsburgh Steel Foundry, Glassport, Pa., 400 h.p.; Altoona &Logan Valley Street Railway Company, Altoona, Pa., 1000 h.p.

THE NEW PROCESS RAWHIDE COMPANY, of Syracuse, N. Y., is meeting with unusual success in the manufacture of its rawhide pinions, and the demand for these supplies is constantly increasing. The company has recently received the following letter from Charles H. Mayer, treasurer of the York Street Railway Company, of York, Pa., which speaks for itself: "I have shipped to your address by Adams Express a rawhide pinion (single reduction—W. P. 30) that has been in use on our road for fourteen months, averaging 105 miles a day. It is one of a lot purchased from you during May, 1897, all of which have given most satisfactory results. Its wearing qualities have been almost equal to that of a steel pinion, the teeth being worn to a knife edge without a break, at the same time leaving the gear with which it was used in as good condition as it was when the pinion was put on."

THE AMERICAN ENGINEERING COMPANY, of Philadelphia, Pa., has under course of construction the Newtown Electric Street Railway, extending from Newtown, Pa., to Doylestown, the county seat of Bucks County. This makes a through connection between Bristol, the largest town in the county, and the county seat. The work will be finished about June 15. The company is also building the Elmira & Senaca Lake Railway, running between Horseheads and Watkins Glen, a distance of 18 miles. The grading is nearly done, and abutments for several of the bridges are in place. The track laying will begin soon, and the road will be completed about the middle of July. The company also has under contract the line of the Michigan Traction Company from Kalamazoo to Battle Creek. Work on this line will begin before June 1, and be completed within ninety days. There is 27 miles of work.

GATES & RANDOLPH have taken the offices and warerooms at 13 and 15 Monadnock Building, Chicago, on the ground floor, formerly occupied by Sargent & Lundie. They are handling the apparatus of the Triumph Electric Company, of Cincinnati, Ohio,

for direct current work; the Warren Electric Manufacturing Company, of Sandusky, Ohio, for alternating work; the Empire Electrical Instrument Company, of New York, portable switchboard, alternating and direct current instruments; F. A. La Roche & Co., of New York, switchboards, circuit breakers and switches, and Sterling Arc Lamp Company, of New York, enclosed arc lamps for all circuits. It is the purpose of this firm to operate a miniature electric lighting plant in its new warerooms, using a Triumph motor running a Warren alternator through a La Roche switchboard, with Empire instruments and transformers, etc., with arc and incandescent lamps and motors running through the same circuit. Gates & Randolph will not only handle electrical apparatus, but will undertake entire contracts for street railway and lighting plants.

MESSRS. P. R. JACKSON & CO., LTD., of Manchester, England, are sending out their new general catalogue and price list, which is a very well printed and splendidly gotten-up book, handsomely bound, and containing about 400 pages, profusely illustrated with good cuts. The volume is not too large for the great field it covers. The earlier sections contain gear wheels of every description, including the well-known double helical-toothed wheels in which this firm was pioneer, and to whom the largest share of credit is due in introducing them into general practice. Pistons and piston rings form another section, while the remainder and the most elaborate part of the book is taken up by the electrical section, including dynamos, motors, traction plant, switchboards, arc lamps, and instruments of every kind. Too high praise cannot be given to P. Slater Lewis, M. M. Inst. C. E., who has compiled a publication which possesses such excellent qualities. Many valuable hints to purchasers are given, and other useful information which should prove of practical value to the English and foreign buyer. The price of the book is 7s. 6d.

THE CONSOLIDATED CAR FENDER COMPANY, of Providence, R. I., reports that orders for car fenders have never been so large as during the past month. It is now supplying fenders to the Metropolitan Street Railway Company, New York; Omaha Street Railway Company, Omaha, Neb.; Ottawa Car Company, Ottawa, Ont.; Des Moines City Railway Company, Des Moines, Ia.; Paterson Railway Company, Paterson, N. J.; Troy City Railway Company, Troy, N. Y., and Union Depot Railroad Company, St. Louis, Mo. It has also shipped a large number of parts of equipments to City Electric Railway Company, Port Huron, Mich.; Hartford Street Railway Company, Hartford, Conn.; Staten Island Midland Railroad Company, Stapleton, N. Y.; Meriden Electric Railroad, Meriden, Conn.; Fair Haven & Westville Railroad Company, New Haven, Conn.; Auburn City Railway Company, Auburn, N. Y.; North Hudson County Railway Company, Hoboken, N. J.; North Jersey Street Railway Company, Jersey City, N. J.; Middletown-Goshen Traction Company, Middletown, N. Y., and Utica Belt Line Street Railway Company, Utica, N. Y.

THE PNEUMATIC SUPPLY & EQUIPMENT COMPANY has been organized under the laws of the State of New York, and has opened an office at 120 Liberty Street, New York. It is the purpose of this company, as its name implies, to deal generally in compressed air equipment, and it will make a specialty of the installation of complete plants, eliminating the division of responsibility which has heretofore existed in the trade. The company is bringing out several specialties in the compressed air line, such as pneumatic oil rivet forges, quick acting hose couplings, and has in addition closed agencies for several standard types of compressors. J. W. Duntley, the president of the Chicago Pneumatic Tool Company, is the president of the new company; E. B. Gallaher, formerly with Patterson, Gottfried & Hunter, is the vice-president and engineer, and W. P. Pressinger, formerly manager of the Clayton Air Compressor Works, is secretary and treasurer. The rapidly widening scope of compressed air application opens a large field of usefulness for the new company, and the character of its incorporators is an assurance of its ability to meet the requirements of the trade.

THE CHRISTENSEN ENGINEERING COMPANY'S shops are overrun with work to such an extent that increased facilities are an immediate necessity, and will shortly be made. From the orders now going through the shops it appears that it is far from correct to suppose that it is the foreign, and not American, street railways which are taking up with air brakes on a large scale, for among these orders are those for a greater or less number of brakes from the following companies: Northwestern Elevated Railway Company, of Chicago; Brooklyn Elevated Railway Company; Twin City Rapid Transit Company, of Minneapolis; Union Railway Company, of Providence, R. I.; Quincy & Boston Street Railway Company; Union Traction Company, of Anderson, Ind.; Brockton (Mass.) Street Railway Company; Detroit, Lake Shore & Mt. Clemens Railway Company; Dayton, Xenia & Bellebrook Street Railway Company; Hingham (Mass.) Street Railway Company; Albany Railway Company; Wason Manufacturing Company, Springfield, and Montville Street Railway Company, Norwich, Conn. All these orders are for independent electric motor compressors and track equipment, and this seems to be the type which is almost universally preferred for city and interurban street railways.

New Publications

History of the Union Traction Company. By Frederick T. Chandler and Percy M. Chandler, of Philadelphia. Paper. 31 pages. Published by the compilers.

This is a descriptive and statistical analysis of the consolidation and development of the street railway properties of Philadelphia. The pamphlet contains a statement of the capitalization of the constituent companies, comprising the Union Traction system, together with the statistics of operation, interest, taxes, etc. A large inset map of Philadelphia showing the complete system is also included.

Red Manual of Statistics. Published by Haven & Stout, New York city. 580 pages. Illustrated.

This manual contains statistics of great value to investors in stocks and bonds, giving, as it does, financial information regarding all the principal railroad, street railway, industrial and other corporations whose securities are handled on the leading stock exchanges in America. This information includes a statement of the capital stock and funded debt, comparative earnings and names of officers and directors. A large number of maps, together with a statement of the high and low record of the securities for the past year, are included.

Liquid Air and the Liquification of Gases. By T. O'Connor Sloane. 365 pages. Illustrated. Price $2.50. Published by Norman W. Henley & Co., New York.

Dr. Sloane is well known as the author of a number of books on electrical subjects, and he has treated his subject in the new book mentioned above in his usual clear style. The entire history of the liquification of gases is given from the earliest times to the present, and the later experiments, particularly of Tripler, are given in great detail. It is difficult at present to gage exactly the commercial value of a cheap method of liquifying air, but the process has wide possibilities of application to the arts, as well as possessing great scientific interest. The book is well illustrated.

Trade Catalogues

Pumping Machinery. Published by the Deming Company, Salem, Ohio. 33 pages. Illustrated.

Cranes. Published by the Brown Hoisting & Conveying Machine Company, Cleveland, Ohio. 175 pages. Illustrated.

Catalogue. Published by the Simonds Manufacturing Company, Pittsburgh, Pa. 15 pages. Illustrated.

Amusements. Published by the Frank W. Mead Amusement Company, Boston, Mass. 32 pages. Illustrated.

Catalogue. Published by the New York Safety Steam Power Company, New York. 40 pages. Illustrated.

The Clayton Air Compressors. Published by the Clayton Air Compressor Works, of New York. 90 pages. Illustrated.

Various Catalogues. Published by the General Electric Company, Schenectady, N. Y.

Various Catalogues. Published by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

In the Great Northwest

The Northern Pacific Railroad, whose headquarters are at St. Paul, Minn., has ready for circulation its annual publication describing the regions tributary to its system. Its book this year is known as "Wonderland '99," and contains a most entertaining story of the beauties of this region. Many of the principal resorts are mentioned in detail, and the best fishing and hunting points are charmingly described. The book is full of beautiful half-tone engravings, bringing out more forcibly than a mere description the wonderful scenery and resources of the "Great Northwest."