Street Railway Journal

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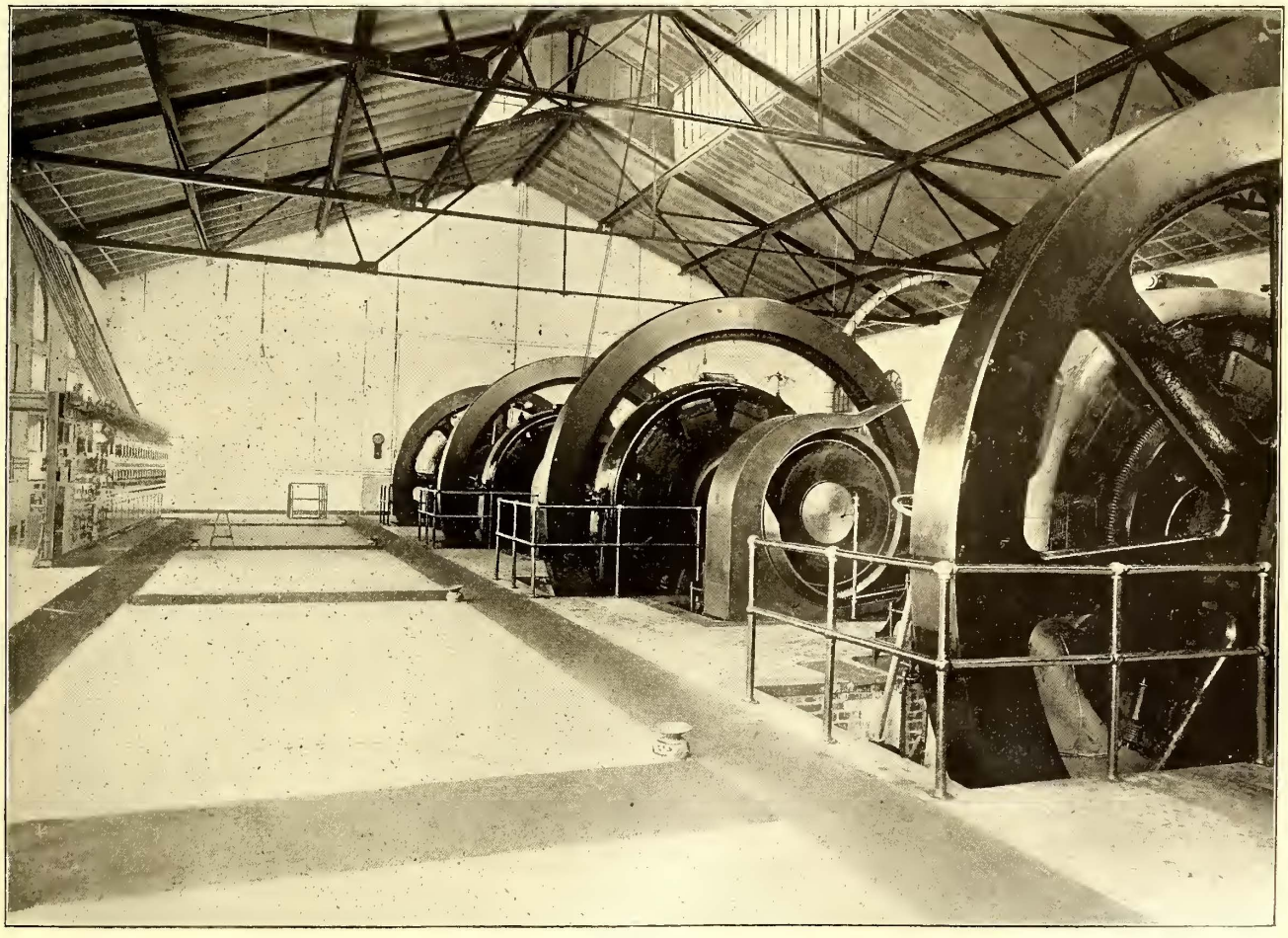
SYSTEM OF THE UNITED TRACTION COMPANY, PITTSBURGH

The United Traction Company, of Pittsburgh is a typical example of the tendency developed during the last few years of combining in one corporation a large number of individual electric railway systems, and the history of the company exhibits in a striking way the advantages in the direction of economy derived by such consolidation. The company was chartered July 27, 1896, and has purchased all the rights and franchises of the Second Avenue Traction Company, the North Side Traction Company and the Pittsburgh, Allegheny & Manchester Traction Company. It includes all of the electric railway lines in the city of Allegheny, as well as the important Second Avenue line of Pittsburgh, which parallels the Monongahela River as far as McKeesport, with branches to East Pittsburgh and Wilmerding. Included in the Allegheny lines is the original system of the Federal Street & Pleasant Valley Railway, which possesses historic interest from the fact that it was one of the first, if not the first, of the electric conduit railways in America to be operated commercially. This line was changed to the trolley system, however, a number of years ago.

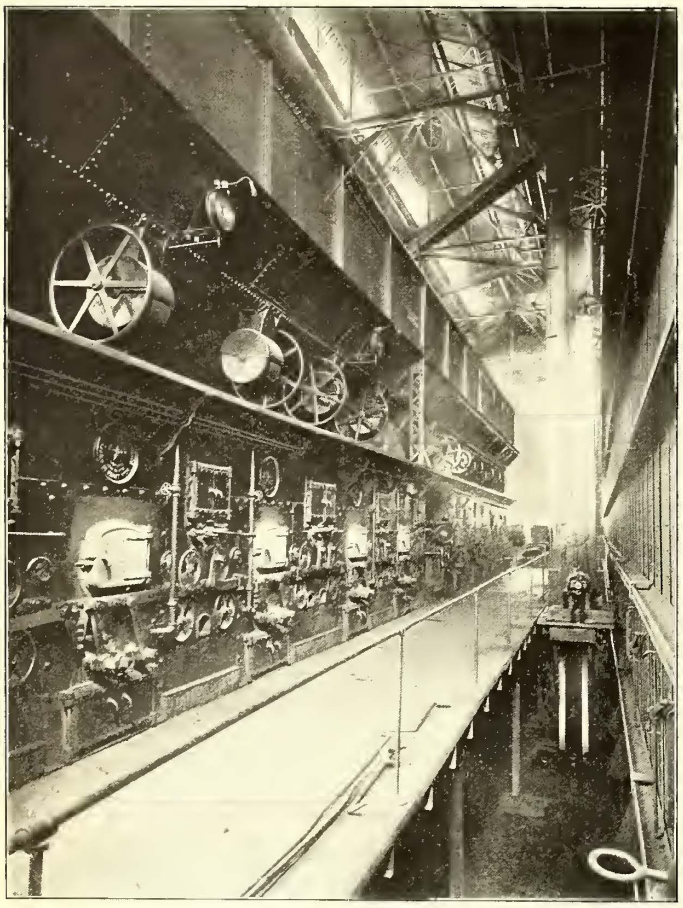
With the consolidation of the various lines the company found itself in the possession of a number of power houses, of which one only, that at Glenwood, which operated the Second Avenue system, was of modern construction. This fact, together with the extension of its lines east and west following the consolidation, made the subject of power generation and distribution an important question, and one requiring immediate consideration.



VIEW IN POWER STATION OF UNITED TRACTION COMPANY, PITTSBURGH

The system, as shown in the map on page 423, possesses a resemblance to an extended Y, with the Allegheny system near the base of the letter. It was finally decided to concentrate the generating power plant at two points, viz., at Glenwood, at the apex of the Y, and at Juniata Street, in Allegheny; and to have a third distributing point, *i. e.*, a storage battery booster station, at Dravosburg, near the McKeesport terminal, to be supplied with power from the Glenwood station. The need of three distributing points

was accentuated by the topography of the line, as steep grades are frequent. The steepest grade is on Pennsylvania Avenue, on the Manchester division, and averages

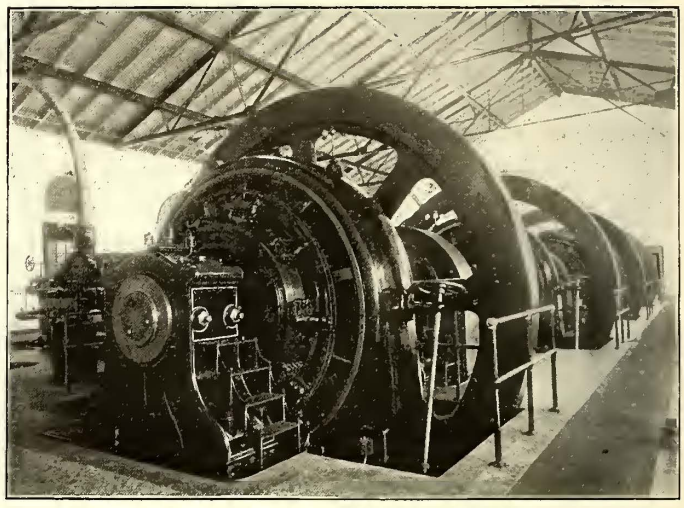


INTERIOR OF BOILER ROOM

13 per cent for a length of 900 ft. On the Dravosburg branch there is a grade of 6 per cent for 8000 ft., and on the Perrysville branch one of 11 per cent for 500 ft. In addition to these many other steep grades are encountered in ascending and descending the precipitous banks of the Allegheny, Monongahela and Ohio Rivers in the neighborhood of Pittsburgh.

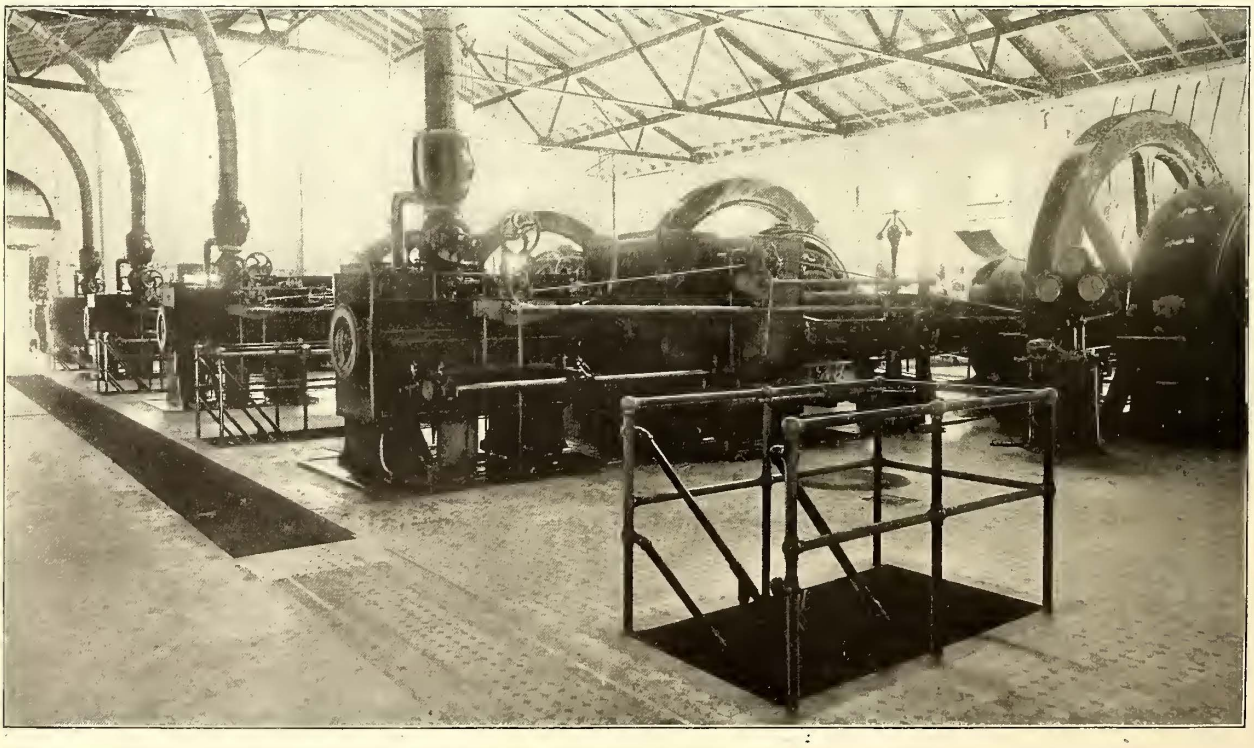
As now constituted the company possesses 117 miles of track, all electric, and 298 cars, of which 259 are motor cars and 39 trail cars.

In selecting a site for its new power station to take the place of the stations then existing in the western end of the system, the location of the existing station of the Pittsburgh, Allegheny & Manchester Traction Company, one of the constituent leased companies, was selected. This point seemed desirable in every way, as fuel could be delivered at the station doors from either of two railroads, or, at a slight expense for conveyor machinery, from the river barges, and as the station was near the "center of gravity" of the Allegheny section of the system. This station was



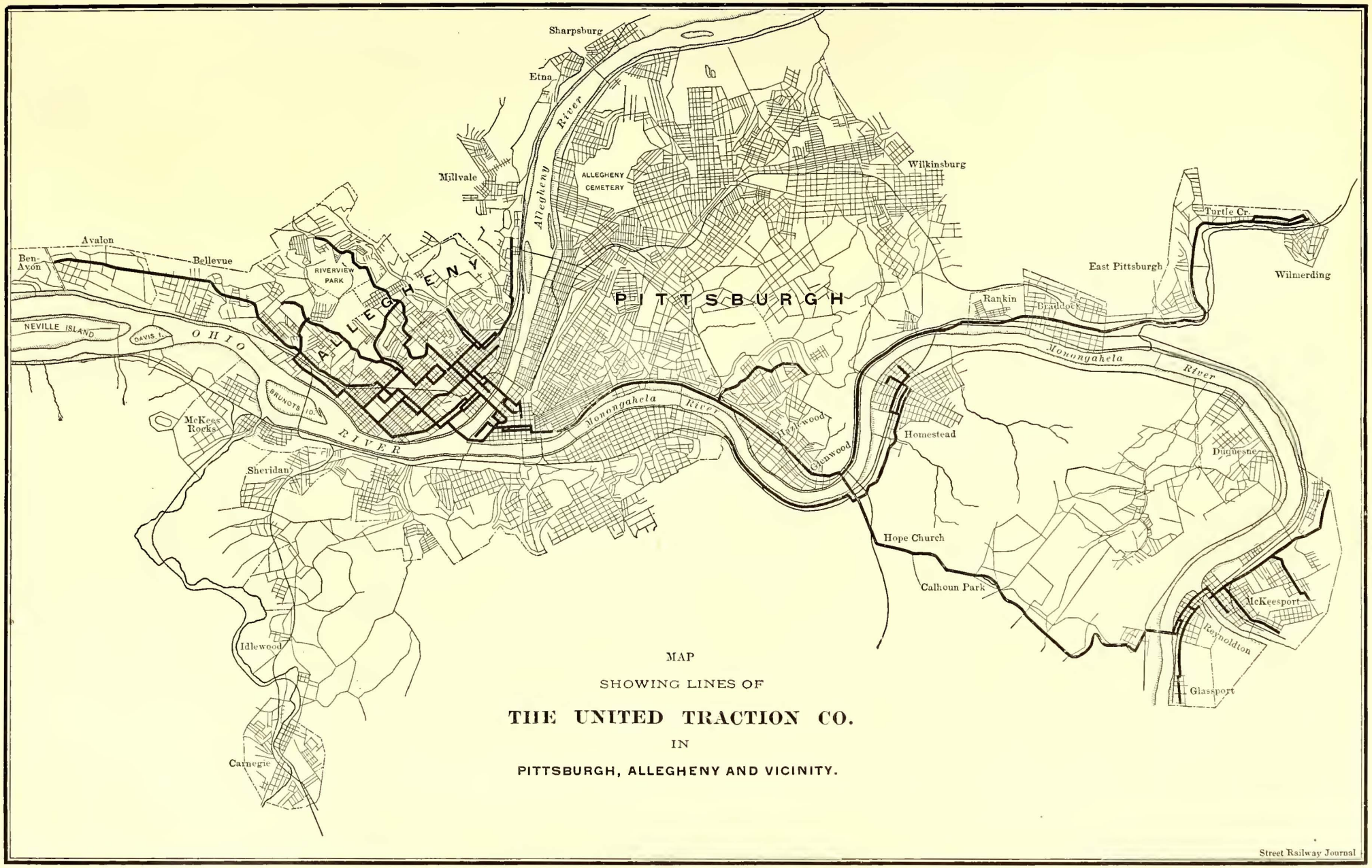
GENERATOR END OF ENGINE

on Juniata Street, Allegheny, and close to the banks of the Ohio River.



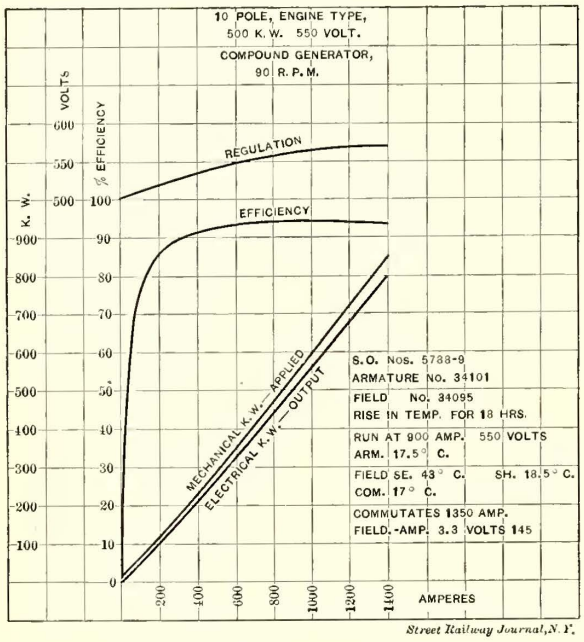
VIEW OF ENGINES

The old engine room gave abundant space for four direct connected units, although formerly all the available


Sharpsburg
Etna
Millvale
Allegheny River
ALLEGHENY CEMETERY
Wilkinsburg
Turtle Cr.
East Pittsburgh
Wilmerding
Avalon
Ben-Avon
Bellevue
RIVERVIEW PARK
ALLEGHENY
PITTSBURGH
Rankin
Braddock
NEVILLE ISLAND
DAVIS I.
OHIO
Monongahela River
BRUNOTS I.
McKees Rocks
RIVER
Sheridan
Hazlewood
Glenwood
Homestead
Duquesne
Hope Church
Calhoun Park
McKeesport
Reynoldton
Glassport
Idlewood
Carnegie
MAP
SHOWING LINES OF
THE UNITED TRACTION CO.
IN
PITTSBURGH, ALLEGHENY AND VICINITY.
Street Railway Journal

space had been occupied by half the same capacity in belted machinery. The boiler capacity, however, was inadequate, so that a new boiler house was added, adjoining and just west of the existing station. Reconstruction was commenced late in 1897, and, owing to the continuous demand for power, the new generating apparatus and boilers had been installed singly, so as not to interfere with the continuous operation of the plant. Gradually all of the old machinery was removed, and the existing station now represents a harmonious arrangement, and one fully up to date as regards modern methods of electric engineering. There is not a piece of machinery now in the station that was there when the installation of the new machinery began. The difficulty of the changes can be appreciated when it is stated that current to the former capacity of the plant was furnished continuously for the operation of the road during the progress of the installation.

One of the chief considerations which had to be borne in mind by the designing engineers was the changes in water level produced by the rise and fall of the Ohio River at different periods. The difference in the water level between

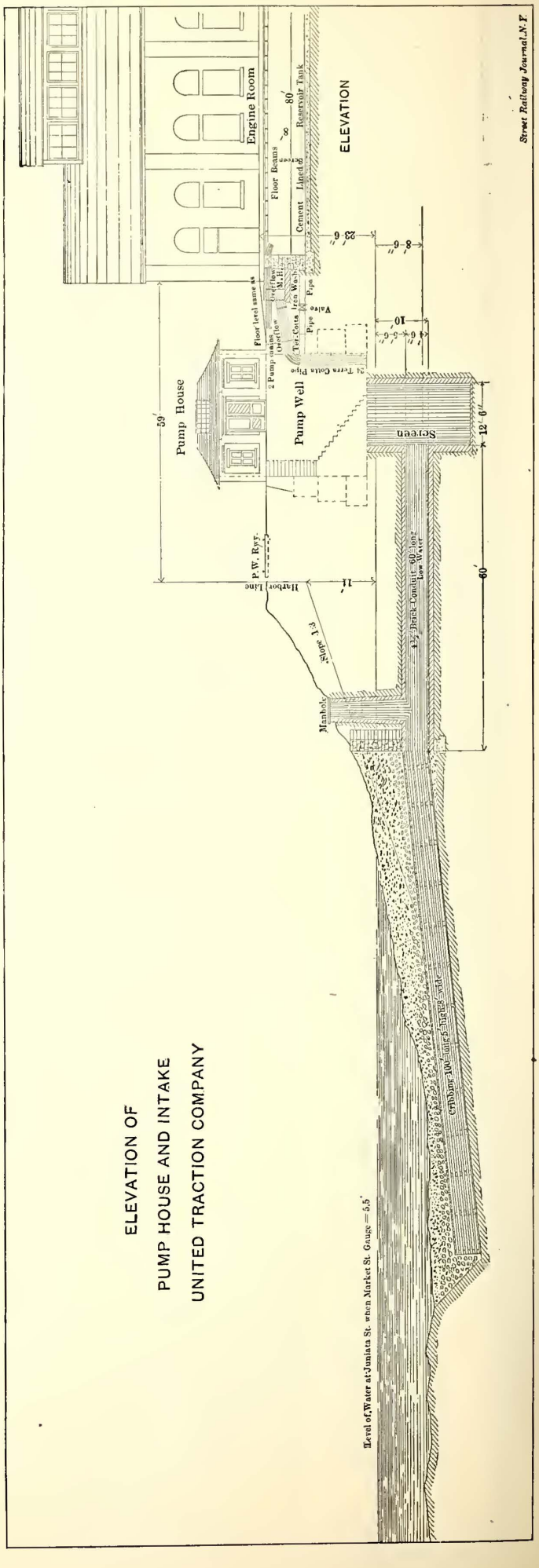


GENERATOR DATA CURVES

high and low water mark amounts to about 30 ft. The extent of this rise and fall can be seen graphically from an inspection of the diagram on this page, in which the low water mark is given, while the high water mark is close to the tracks of the P. & W. Ry., or within a few feet of the engine room floor.

The rise and fall of the river level necessarily affected also the location of the condenser pumps, which, as will be seen by the diagram already referred to, are located in a well. From this point they lift the water 20 ft. above the lowest water level, and then force it 8 ft., discharging it into a cistern, from which point it is pumped to the condensers.

The same diagram also shows the construction of the crib, which was an important feature in the installation of the plant, as the feed water is also taken from the river. It was found that the river water itself was too muddy for use directly in the boiler, but if filtered somewhat it was amply good for the purpose. The crib is made up of hemlock plank laid 2 ins. apart, with a transverse plank every 8 ft., and measures 100 ft. long x 8 ft. wide x 5 ft. high. The top is from 3 ft. to 5 ft. below the natural bed of the river. It was then covered, first with broken stones and



brickbats, and afterwards with gravel and sand, which provided an excellent filtering material.

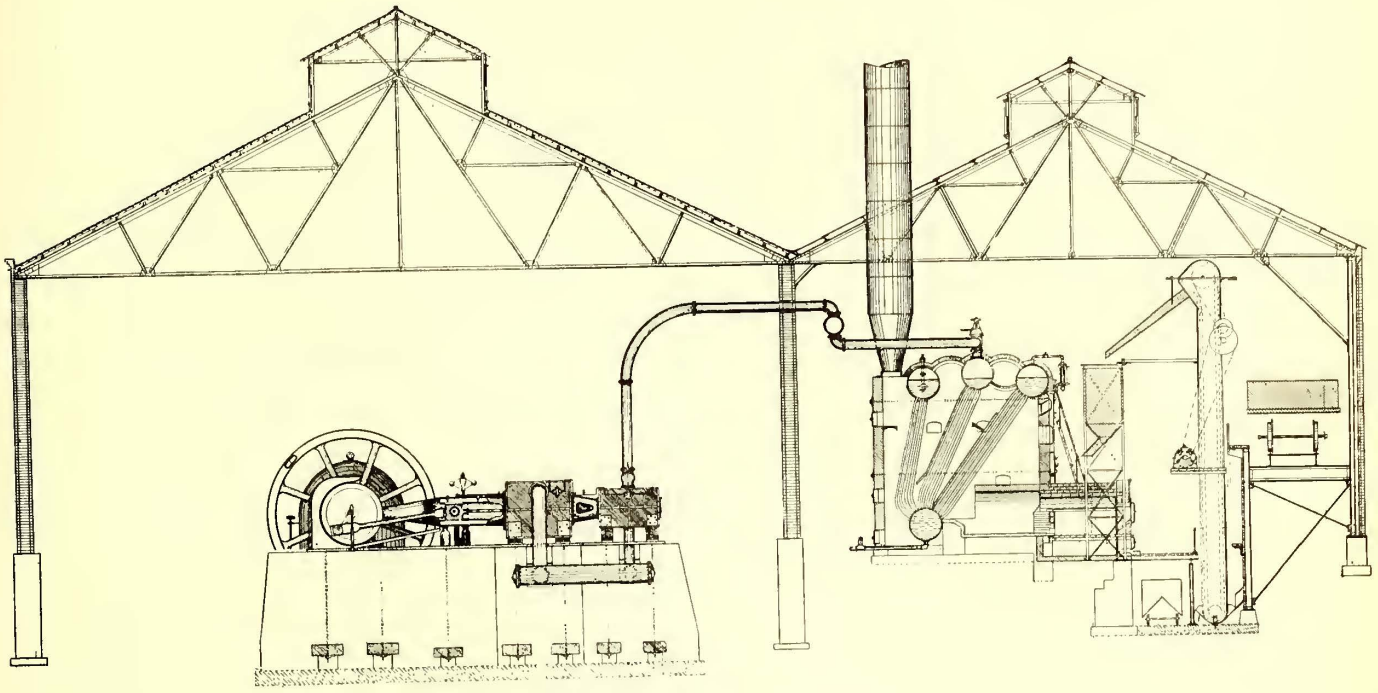
The engine room illustrated on page 421 presents a light and attractive appearance from the fact that the walls are painted white and are furnished at their bases with a dado of white glazed tiles with green stripes. The floor is laid with white unglazed tiles.

The engine room contains four tandem compound Green engines, the cylinders of which measure 28 ins. and 38 ins. x 48 ins. stroke. They are operated at 100 r.p.m., and are rated at 750 h.p. nominal, with capacity for 50 per cent overload. The flywheels weigh 60,000 lbs., and the steam pressure used is 125 lbs. These engines have shown on test an economy of 14 lbs. of water per h.p. hour. They were supplied by the Providence Steam Engine Company, of Providence, R. I.

Each engine has its own pump and separate jet condenser, which is of the Laidlaw-Dun-Gordon type. These condensers are located in the basement, and obtain their water supply from the crib system already mentioned.

The generators were built by the Westinghouse Electric & Manufacturing Company, are of 500-kw. capacity each, but are guaranteed to run up to 625 kw. continuously, with no part rising in temperature more than 40 degs. C. above the surrounding air. A load of 750 kw. for two hours, or of 875 kw. for ten minutes, is permitted under a guarantee that there shall be no injurious sparking or heating, and no necessity for shifting the brushes from the no load position. If the armature shall be placed 1-16 in. out of center there shall be no vibration, heating or sparking. All of these guarantees were easily fulfilled in a recent test.

The generators are of the well-known Westinghouse "engine type" construction; the field has ten poles, with



CROSS SECTION OF POWER STATION

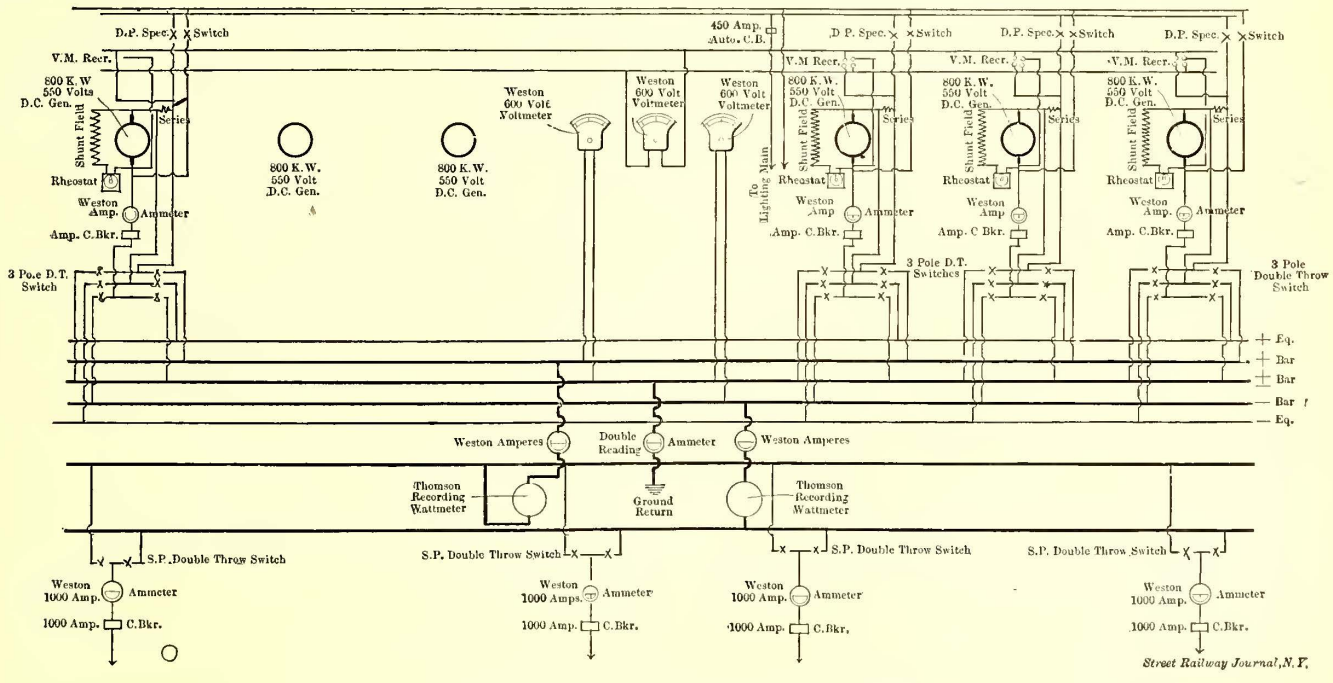
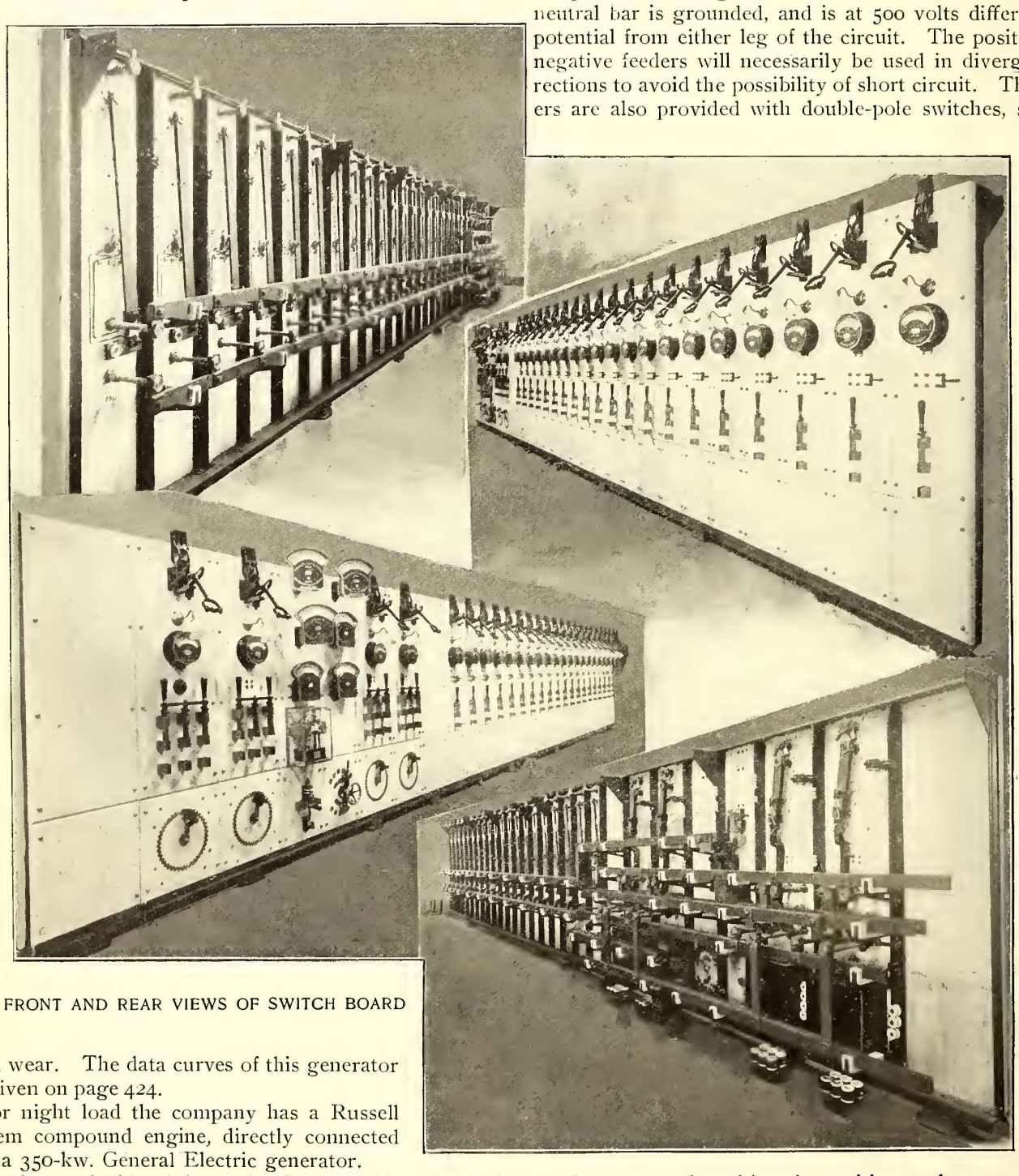


DIAGRAM OF SWITCH BOARD CONNECTIONS

series and shunt coils, wound and insulated separately, giving excellent ventilation. The pole pieces are of laminated steel, cast into a massive cast iron yoke. The field frame is split vertically and rests on a wedge-shaped bed plate, by means of which it can be raised or lowered 1 in. The armature is of the ironclad type, and has no bands, the coils being held in place by fibre wedges driven into notches near the top of the slots. The armature winding is of copper bars bent to proper shape, and then insulated. The commutator has ample surface, and the bars will stand 2 ins. wear. The data curves of this generator are given on page 424.



FRONT AND REAR VIEWS OF SWITCH BOARD

For night load the company has a Russell tandem compound engine, directly connected with a 350-kw. General Electric generator.

On the south side of the station is a switchboard, which for a number of reasons possesses unusual interest. One of these is that it has the largest three-wire street railway panel switchboard in the world. While the company has not yet commenced the operation of its lines on the three-wire system, and has no immediate plans for changing to this system at any stated date, the advantages of that method of operation were considered so great as to warrant the installation of the necessary apparatus on the switchboard for making the change at any time in the future. A general diagram of the connections is given on page 425, and the actual location of the apparatus and equipment on each panel on the opposite page.

By means of double-pole generator switches any generator can be connected to either side of the three-wire system, or all may be used on one side of the system, in which case the station would operate as a two-wire plant. When run three-wire, the difference in potential between the positive and negative bus bars is 1100 volts, while the neutral bar is grounded, and is at 500 volts difference of potential from either leg of the circuit. The positive and negative feeders will necessarily be used in diverging directions to avoid the possibility of short circuit. The feeders are also provided with double-pole switches, so they can be connected to either the positive or the negative bus bars, which will facilitate the balancing of the two sides of the three-wire system.

The construction of the switchboard is the standard Westinghouse No. 5 type, the slabs being white Italian marble and having the standard angle and channel iron frame. There are four generator panels, one double-load panel and twenty feeder panels, with space for two more generator panels.

The generator panels are 1200 amps. capacity each, and each is supplied with a standard rheostat panel below. The double-load panel has a normal capacity of 10,000 amps. at 1100 volts. The necessary Weston ammeters are supplied for indicating the station load in each of the three circuits, and Weston voltmeters are provided for reading the generators when changing the light circuit from one machine to the other.

The feeder panels are 900 amps. capacity each, and each ammeter is fitted with a double-throw switch to reverse the ammeter leads when changing the feeders from the positive to the negative bus bars, or vice versa, to prevent

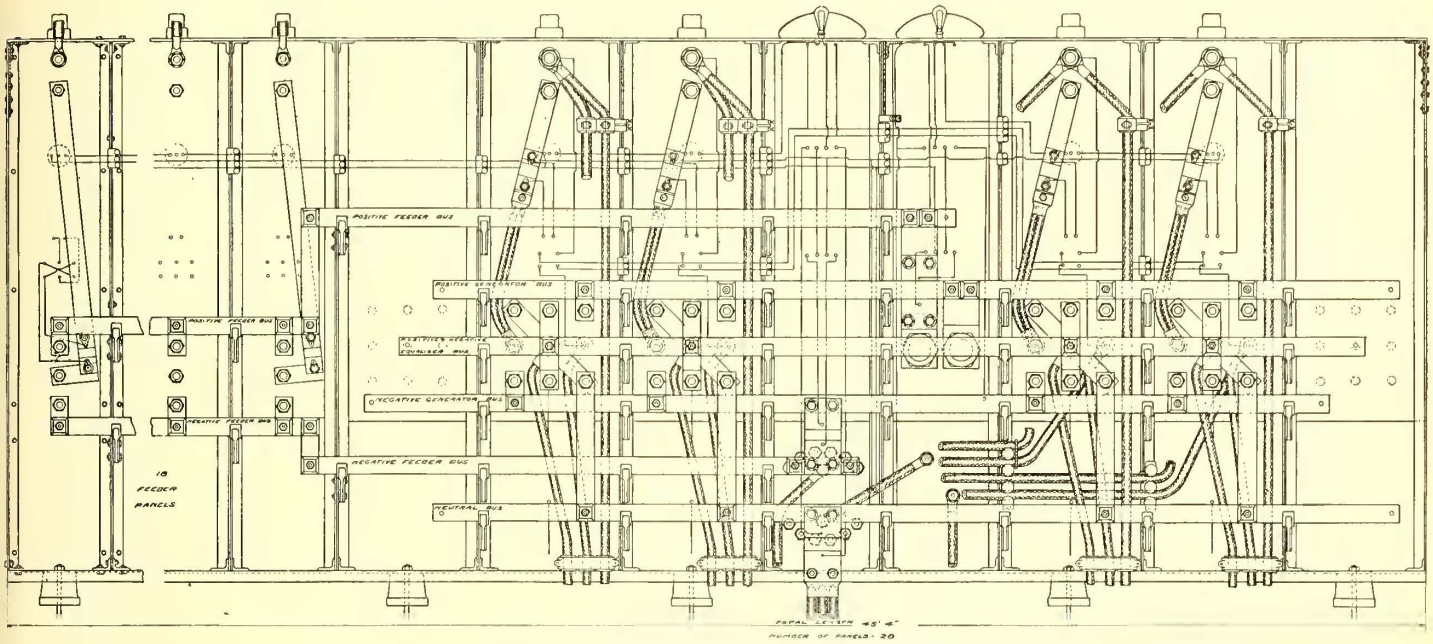
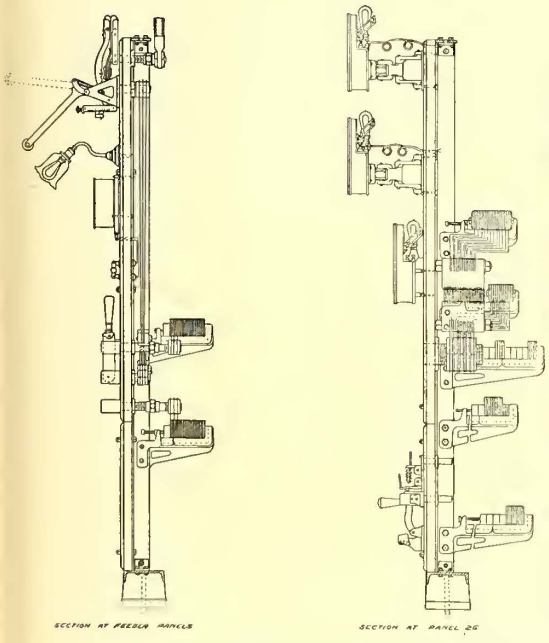


DIAGRAM OF SWITCH BOARD CONNECTIONS

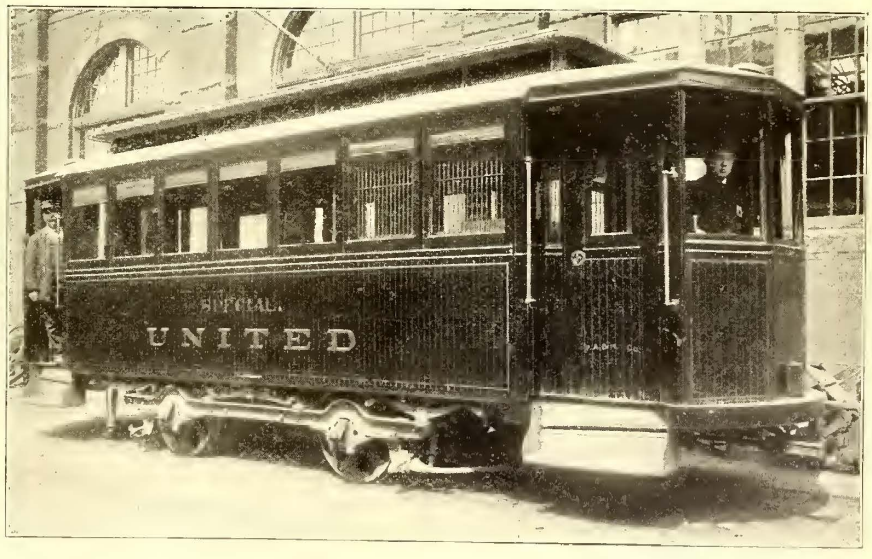
the bus bar potential when the machines are run in multiple or series. The voltmeters are mounted on swinging brackets, so that they may be readily seen from the ends of the switchboard; in addition a Thomson recording wattmeter of 10,000 amps. capacity is provided for use when running as a two-wire system.

The lighting switch situated beneath the load panel is

reversing the current in the ammeter. On each feeder panel is a 1000-amp. ammeter, a single-pole double-throw switch, and an 800-amp. Westinghouse circuit breaker. There is also a small double-pole double-throw switch for reversing the ammeter connections when the feeder is thrown from one side of the three-wire system to the other. This switch can also be used for opening the ammeter circuit when the engineers desire to put a temporary overload on the feeder for burning out a short circuiting wire, or for any other purpose.



SECTIONS OF FEEDER AND MAIN INSTRUMENT PANELS



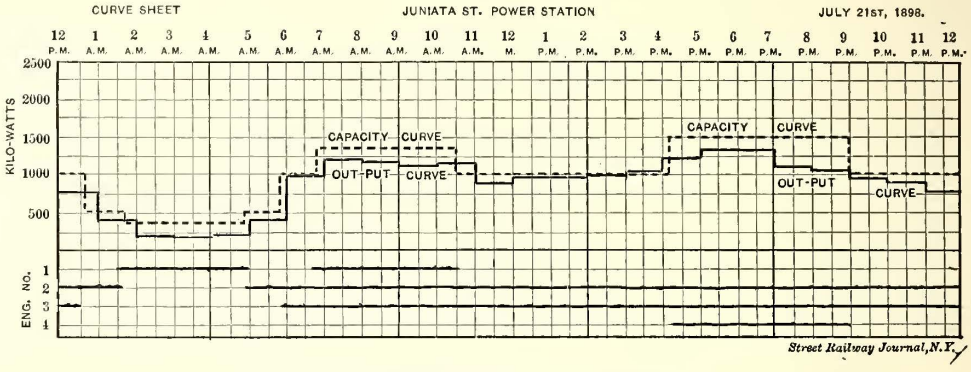
PAYMASTER'S CAR

so connected to the generators that the light circuit may be taken from any machine in the station and the lights will not be affected by the opening of the main circuit breakers. The small circuit breaker beside this switch is directly in the main lighting circuit. The switch is special, and made so as to interlock and prevent short circuiting

The circuit breakers are of the Westinghouse "brush" type, and are placed at the top of the board. This type of breaker is one of the latest productions of the Westinghouse Electric & Manufacturing Company. The switches are made entirely of copper, are of the "washer" type, and are all double-throw, as noted.

The large capacity of this board, together with its complicated set of connections, made it difficult to place the necessary copper conductors on the rear, and the engraving of the back of the board shows the construction which was used. In order to get the necessary cables to the instrument studs on the switchboard the rheostats were placed separately, being connected to their face plates by conductors carried in a hose.

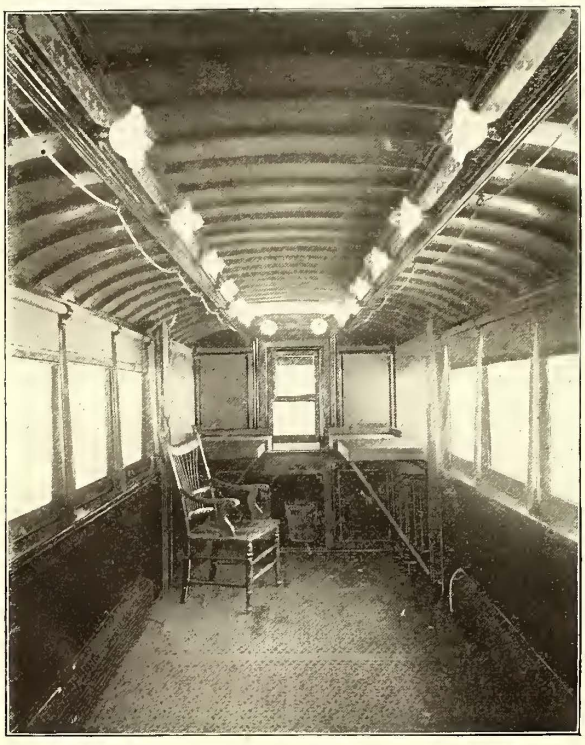
The bus bars are of bare copper, being made up of individual bars of 3 ins. x $\frac{1}{8}$ in. section, with $\frac{1}{8}$ in. space between for ventilation. The positive, negative and neutral bus bars each consist of twenty-three of these bars, and each total bus bar is of sufficient carrying capacity for six 500-kw. generators operating on the same side of the three-wire system. As the bus bars are laminated and tapered, the maximum carrying capacity for the least amount of copper is obtained.



FORM FOR KEEPING STATION RECORDS

The connections between the generators and switchboard consist of two 650,000 c.m. rubber-covered cables in parallel, for positive, negative and equalizer. These cables are supported by special porcelain insulators to the I beams forming the ceiling of the 10-ft. basement and the floor of the engine room.

The switchboard itself rests on large wooden blocks, which are carried on 10-in. I beams, which in turn rest on



INTERIOR PAYMASTER'S CAR

brick piers built up from the basement floor. The latter is of concrete.

The boiler room contains four Stirling batteries of 400 h.p. each, and one battery of Babcock-Wilcox boilers. A special stack is provided for each battery, and each boiler is equipped with Murphy stokers.

The freight cars carrying the coal are run on a trestle into the boiler room, and discharge their loads into a large iron bin of thirty carloads capacity, in front of the boilers. In front of this bin is a track, on which runs a coal conveyor or elevator consisting of an endless chain of buckets, driven by an old Sprague No. 6 motor, which has been changed over to shunt winding. These buckets can be filled at any point along the bin, and raise the coal to a height where it can be shot down into the hoppers above the Murphy stoker with which each boiler is equipped. The ashes are discharged from the boilers into hoppers located in the basement, and are taken out by a small car drawn by a cable operated by an electric motor situated just outside of the boiler room proper. A National feed water heater completes the equipment of the boiler room.

For feed water the company is using the overflow from the condensers, and although there is naturally a slight admixture in it of oil from the cylinders, no trouble has been experienced with scales in the boiler tubes. The advantage of using this overflow is, of course, that water of a temperature of from 95 to 100 degs. is available. The heater is supplied with exhaust steam from the auxiliaries, and the feed water is forced into the boilers at a temperature of 212 degs.

A method of keeping engine and output records maintained at this station is illustrated in the accompanying form. An ordinary sheet of plotting paper is used, on the upper part of which is plotted the output curve, shown by the solid line, and below the hours during which the different engines are run. From the latter the capacity curve, shown by the dotted line, is drawn, superimposed on the output curve. These daily sheets show at a glance whether too many machines are being run for the work to be performed.

The Glenwood station, from which the power for the eastern end of the line is taken, was described in the Street Railway Journal for August, 1895. It contains two compound Russell engines, each coupled to a 500-kw. Westinghouse generator, and two Green engines of the same type as in the Juniata Street station, directly connected to 500-kw. Westinghouse generators. The company will also install two 800-kw. generators at this station in the future, but the contract for these has not yet been awarded. The station also contains two boosters; one for supplying the Wilmerding line, and the other for supplying the current to the storage battery station at Dravosburg. This battery contains 424 cells, has been in use about a year, and it is found in practice most satisfactory. Since its original installation its capacity has been doubled by adding the necessary number of plates to each cell. By its use the company has been enabled to shut down an auxiliary power station which it formerly used at McKeesport.

In its track construction the company uses a 90-lb. girder rail and Bryan bonds are used throughout. For its overhead line the company used a 7 in.-6 in.-5 in. tubular pole, with General Electric line material.

The standard car has a 20-ft. body, vestibuled, and it is mounted on a single Lord Baltimore truck, which is used

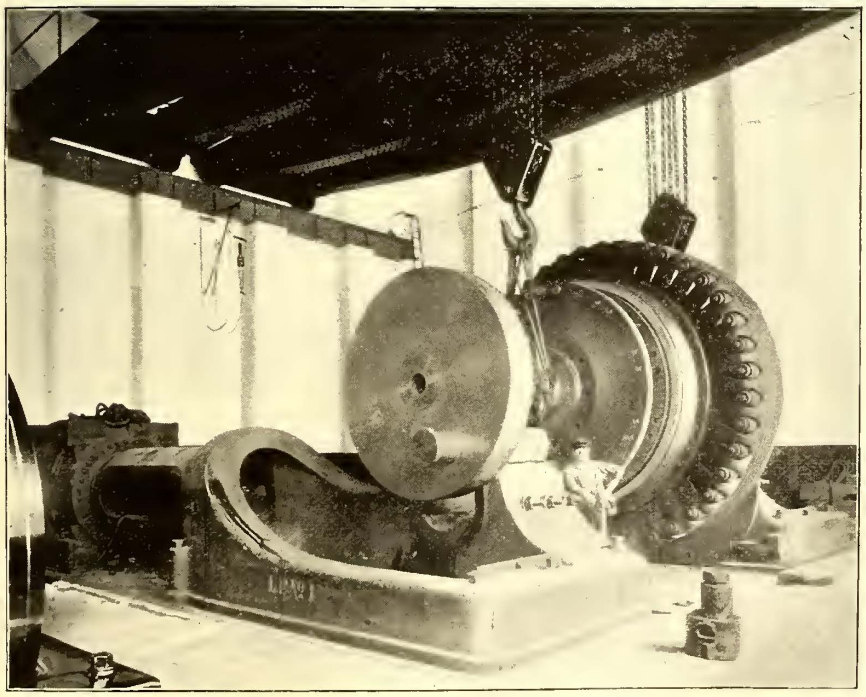
as a standard on this line, and is giving good satisfaction. The company has only one double-truck car equipment. The Sterling register is used throughout, and the gongs are carried on the hood, instead of under the platform. This is done because it is thought the sound is louder and clearer than when located under the platform. The gongs are rung by means of a strap which the motorman pulls by the same hand with which he manipulates the controller. All cars are equipped with illuminated signs on the hood.

A somewhat novel type of car is illustrated on page 427. This is a car used by the paymaster, and is fitted at one end with a safe and closed vestibule, in which the paymaster sits. The employees are paid off three times a month, and as they pass through the car they are given their envelopes by the paymaster.

The officers of the United Traction Company are: President, James D. Callery; secretary, J. H. Callahan; treasurer, John W. Taylor; superintendent and chief engineer, John Murphy. The mechanical engineer of the company is S. L. Tone, and constructing electrical engineer is P. N. Jones, of the Westinghouse Company.

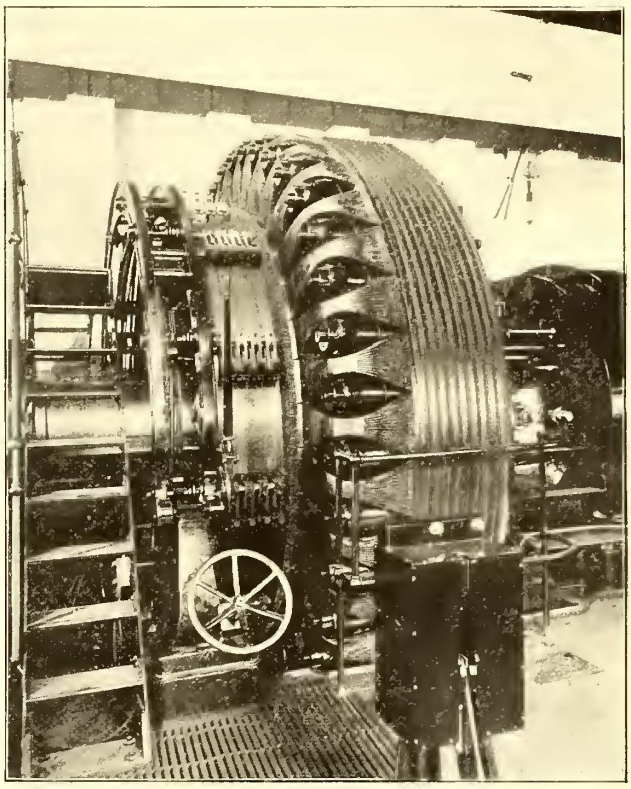
Additional Equipment for Western Avenue Power Station of the West Chicago Street Railway Company

The accompanying illustration shows the armature and shaft of a 1500-kw. Siemens & Halske generator in the process of being installed in the Western Avenue power station of the West Chicago Street Railway Company. This is an additional unit to the five that compose the original equipment of the station. This armature has a specially designed commutator, as shown in the illustration. The armature is 14 ft. outside diameter, and is designed to run at 75 r.p.m. The shaft is hollow and 23 ft. 3 ins. in length, and is composed of fluid compressed steel made by the Bethlehem Iron Works. It is 28 ins. in diameter at the wheel, while the bearings are 22 ins. in diameter and 46 ins. long. Each of the crank pins is 12 ins. x 12 ins.



PLACING ARMATURE AND SHAFT IN POSITION

The engine to which the generator is coupled is a cross-compound non-condensing machine, with cylinders 34 ins. x 54 ins. x 60 ins., and is rated at 2000 h.p. The flywheel is 25 ft. in diameter, and weighs 80 tons. The steam and exhaust valves are operated by separate eccentrics, while the valves are of the double-port type. The engine was designed and built by the Pennsylvania Iron Works Company.



MODIFIED ARMATURE

When completed the total engine power capacity of the station will be 12,000 h.p. It is interesting to note in this connection that three of the original generators, which were also manufactured by the Siemens & Halske Company, have been redesigned, with the commutator placed on the side, and of smaller diameter than the armature. It will be remembered that in the first installation of the generators in this station the commutator bars were placed in the periphery of the armature, but owing to the high speed some difficulty was experienced in maintaining the bars in position. The remodeling consisted of introducing connections, thus reducing the diameter of the commutator. The equipment is now working in a highly satisfactory manner, although it has been loaded greatly above the rated capacity of the machines ever since it has been in operation. Current is not only supplied for operating the cars of the West Chicago system, but for operating those on the Lake Street Elevated Road. The voltage is 550, and the two systems are operated from the same bus bar.

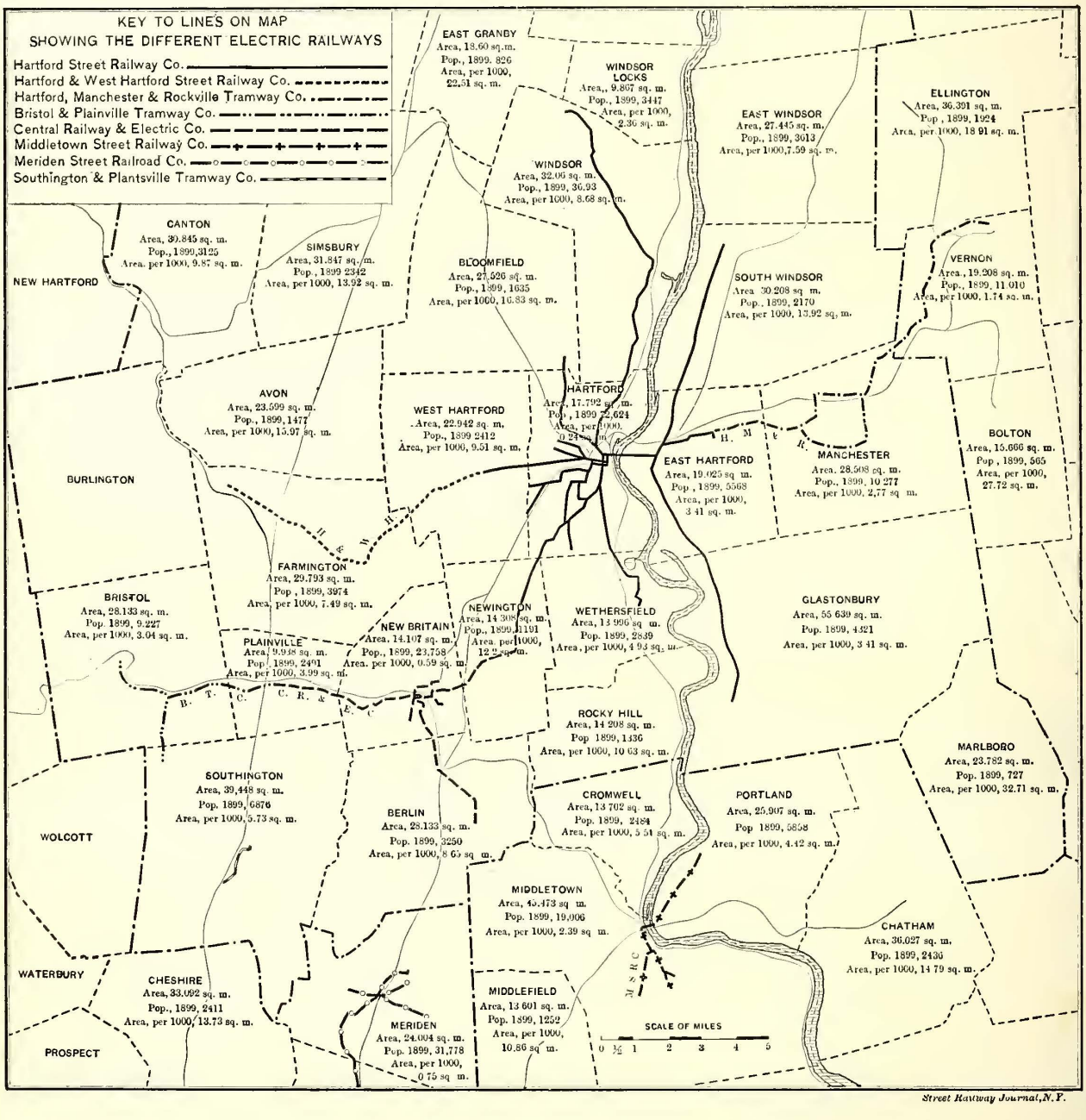
The steam equipment is being improved by the installation of automatic stokers. The boilers are of the Stirling type, and two of these, which are rated at 400 h.p. each, are each being provided with two American stokers, which are required to burn 1000 lbs. of Illinois coal per hour. One of the other boilers is being equipped with a stoker of a chain grate type, installed by the Greene Engineering Company, of Chicago. These two types of stokers are being installed

for the purpose of making a competitive test, with the view of deciding which type shall be employed for equipping the remaining boilers.

Electric Railways in Central Connecticut

Although possessing no city of 100,000 population, an electric railway system of considerable extent exists in the central part of Connecticut surrounding the cities of Hartford, New Britain, Middletown and Meriden. These systems are controlled by eight separate corporations, of which several form connecting links, while others are operated entirely independently of the others. The region through which these railways run is dotted with small manufacturing communities, and the inhabitants are, as a whole, quite prosperous, so that a study of the earning capacity of these railways per mile of track is of interest.

The accompanying engraving shows the location and extent of the different systems, with area of the several townships and area in square miles per thousand inhabitants. The earnings for the several systems, as given in the table below, are taken from the last report of the Railroad Commissioners of the State of Connecticut, and, owing to a change in the fiscal year of these commissioners, are given for nine months only. The final two columns give the proportionate increase for twelve months, derived from adding one-third to the nine-months' figures, but in reality the earnings would be somewhat in excess of this, as the earnings reported to the Railroad Commissioners cover six winter months and three summer months. As will be seen, the earnings per mile vary from $2,200 to $8,300 per mile, the maximum figure being practically the same in the case of the Hartford Street Railway Company and the Central Railway & Electric Company:



	Miles.	Earnings, 9 Mos.	Earnings per Mile Track, 9 Mos.	Earnings, 12 Mos.	Earnings per Mile, 12 Mos.
Middletown	7.9	18,403	2,329	24,537	3,106
Meriden	17.5	72,177	4,124	96,236	5, 99
Central Ry. and Electric	18.6	116,193	6,247	154,924	8,329
Hartford Street	70.3	438,069	6,230	584,092	8,309
Hartford and West Hartford	17.8	29,599	1,663	39,465	2,217
Hartford, Manchester and Rockville	18.7	61,183	3,273	81,591	4,363
Southington and Plainville	1.6	*2,252	1,434	4,504	2,868
Bristol and Plainville	7.9	44,384	5,618	59,179	7,491

Earnings Ending June 30, 1898.

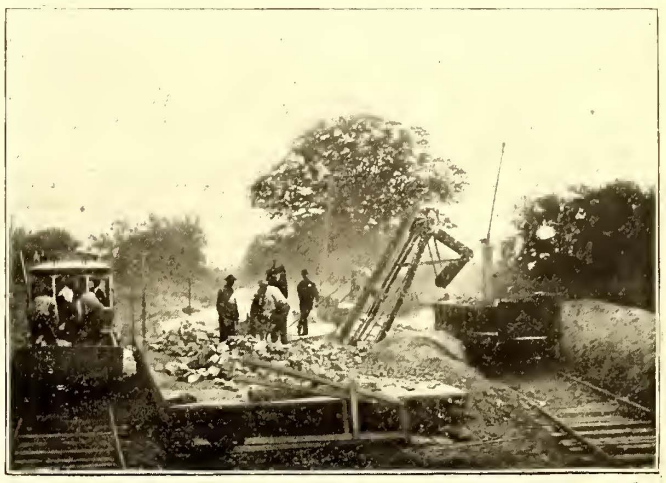
* For 6 months.

Interurban Railway Between Wilmington and Chester

The connecting link between the electric railway systems of Wilmington, Del., and Chester, Pa., was put in operation March 22, and is now carrying a large number of passengers. This completes the through line of electric roads extending from Darby from just outside of Philadelphia, to Wilmington, all of which is under one management; the operating official is R. F. Fox, who is general manager of both the Wilmington City Railway and the Chester Traction Companies. Through cars are now run from the P., W. & B. R. R. station in Wilmington through Chester to Darby, a distance of 13½ miles; at Darby the cars connect with the Darby division of the Union Traction Company of Philadelphia. The running time between these terminals is one hour. The cars have to conform to the running schedule of the city cars while within the limits of Wilmington and Chester, but between cities often run at a speed of 20 miles an hour.

The line between Chester and Darby, which was put in operation several years ago, has developed the traffic on the Chester Traction system enormously, as shown by

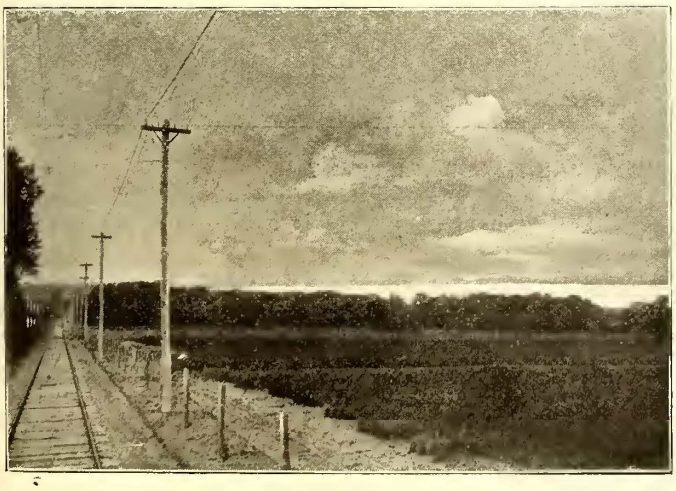
STANDARD CAR



LOADING BALLAST CAR AT QUARRY

STRAIGHT TRACK NEAR CLAYMOND

CATTLE GUARD



ON THE TOP OF THE RIDGE

CONSTRUCTION NEAR WILMINGTON

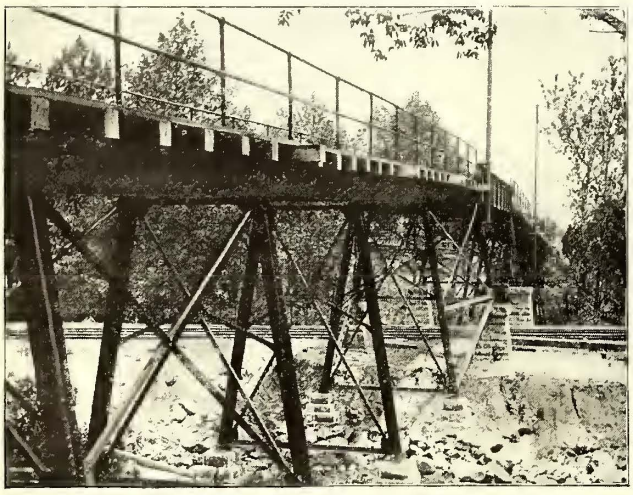
figures published in the Street Railway Journal for February, 1898, in which a table was given showing the average rides per capita per year for a number of towns, varying in population from 20,000 to 40,000. In this table it is shown that on the Chester lines the average rides per capita was 222; while in nine isolated cities of about the same population the rides per capita did not average much over 50. Statistics showing the increase in traffic, owing to the opening of the through line to Wilmington, are not yet available, but present indications point to a large increase due to the through traffic between the cities.

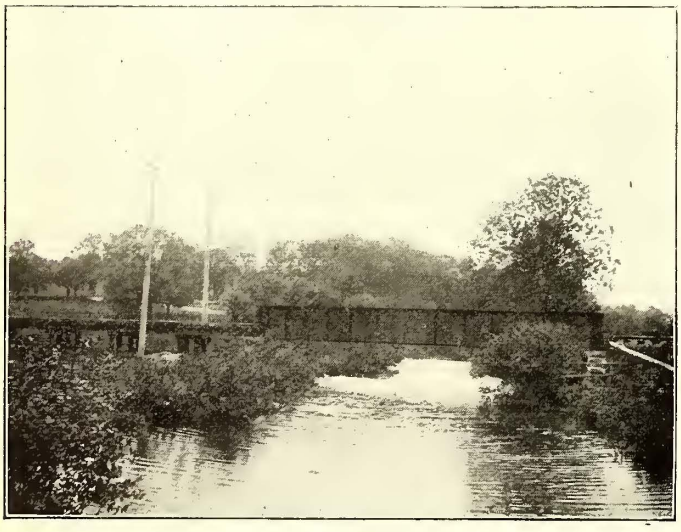
The line extends for a considerable distance on the top of a ridge which lies between Wilmington and Chester, so that the ride is a most picturesque one, with attractive views on each side, and one on which the pleasure traffic ought to be considerable. After leaving the lines of the Wilmington City Railway it extends over a private right-of-way about four miles in length to Claymond; then, for about 3800 ft. the line is built along the side of the turnpike, and then branches off into a private right-of-way for a distance of 2 miles until the Chester city line is reached.

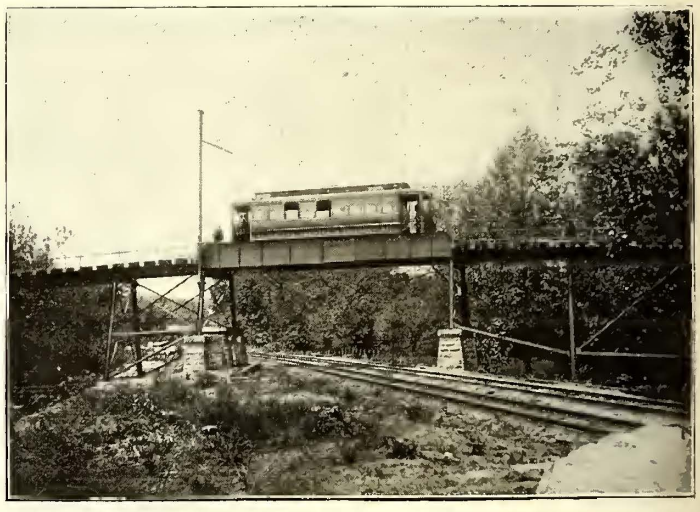
The track is laid with 70-lb. A. S. C. E. rails in 60-ft. lengths. Churchill ties are used, and the rails are double bonded with No. 0000 protected bonds, supplied by Mayer & Englund. The ties, which are of oak and chestnut in equal proportions, measure 7 ins. x 6 ins. x 7 ft. 6 ins., and are laid 2 ft. centers. The track is ballasted with broken stone throughout, to a depth of from 3 ins. to 4 ins. below the ties, and in some places the ballast is considerably deeper. The company owns its own quarry and crusher, and all ballasting was done from a special car into which the broken stone is loaded at the quarry and from which it is distributed along the track.

The grades are frequent, and on the section between Wilmington and Chester are in some places as high as 6 per cent. This portion of line is 10.3 miles long, of which .65 of a mile are in turnouts. Wharton frogs and switches are used throughout.

The poles are of chestnut, not less than 7 ins. in diameter at the top and 12 ins. at the butt. They are 30 ft. long, shaved and pointed, and set 100 ft. apart. The overhead line is partly of flexible bracket construction and partly span work. The H. W. Johns line material was used throughout. The trolley wire is a No. 00, supplied by Roebling.







BRIDGES AND VIADUCTS ON CHESTER-WILMINGTON INTERURBAN RAILWAY

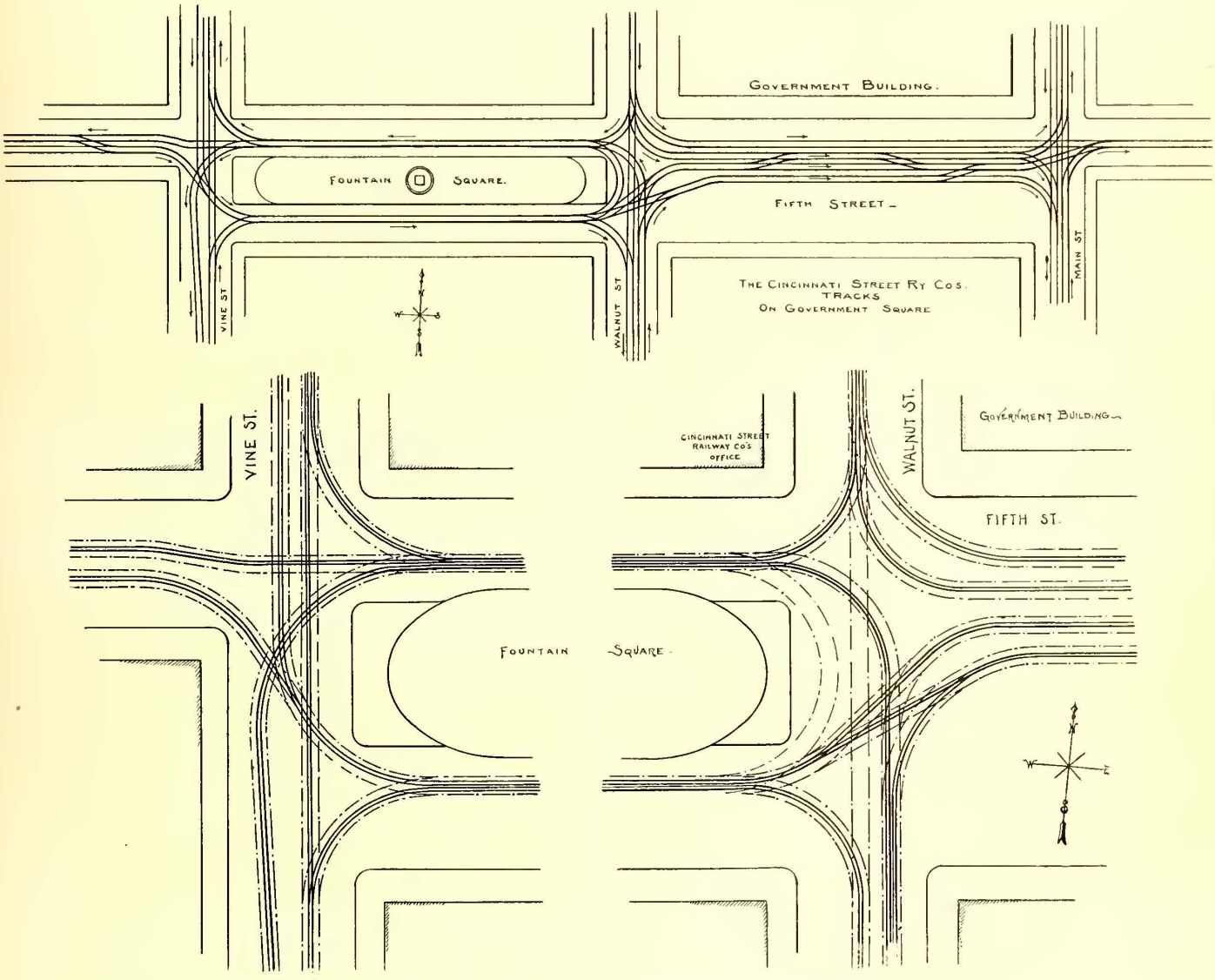
The cars were built by Jackson & Sharp, and are extremely tasteful in design and finish. They are mounted on Brill maximum traction trucks, with 4-in. axles and 33-in. wheels, and are equipped with Westinghouse No. 38 B motors, with K-10 controllers. The company is also having six open twelve-bench cars built by the St. Louis Car Company, the equipment of which will be similar to that of the closed cars already mentioned.

A half-hour service is conducted between Wilmington and Chester, except on Saturdays, when the cars are run every 15 minutes. Between Chester and Darby they are run every 17½ minutes. The fare between Wilmington and Chester is 20 cents; that of the railroad connecting the two cities is 33 cents. The line is supplied with power from the existing stations at Wilmington and Chester.

Track Construction of the Cincinnati Street Railway Company

In July, 1894, a description of the track construction of the Cincinnati Street Railway Company appeared in these columns, and the standard then employed in track work was described as follows:

"In the process of construction the pavement is removed and the surface excavated to a depth of 20 ins. The foundation is then rolled with a steam roller weighing 250 lbs. per lineal inch of surface measure. The oak ties, 6 ins. x 7 ins. x 8 ft., with joint ties, 6 ins. x 12 ins., are then placed with 2 ft. 6 in. centers. The rails are then spiked directly to the ties and the tracks surfaced up and supported on



TRACK AND OVERHEAD LINE CONSTRUCTION—FOUNTAIN SQUARE, CINCINNATI

wooden blocks. A foundation of concrete 6 ins. in depth is then placed under the ties and the space between the ties is filled with concrete and tamped. Where asphalt or brick is employed the concrete is placed above the ties, so that they are entirely inclosed in a pocket of concrete. With granite the concrete is brought to a level with the ties, above which are 2 ins. of sand to receive the blocks. On all paved streets a full grooved girder rail weighing 95 lbs. per yard is employed, and which, with granite paving, is required to be 8 ins. in depth. With asphalt and brick paving the same pattern of rail is employed, but the depth is only 6 ins. and the weight 86 lbs. per yard.

"The cost of the new track construction, including the repaving and renewing of the blocks that are worn out, is about $38,000 per mile, single track, or $76,000 for double track. This is claimed to be the most expensive street railway track that has ever been built for electric service in this country on so large a mileage."

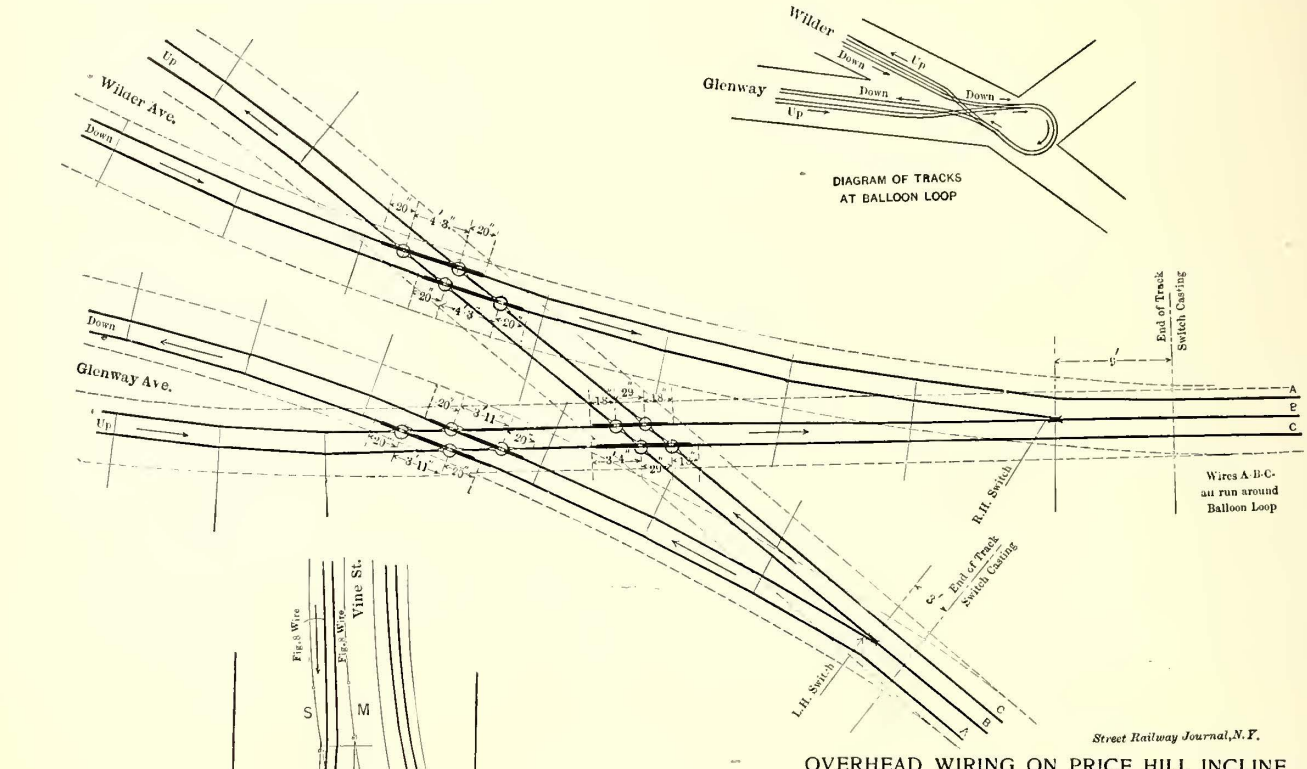
The officials of the Cincinnati Street Railway Company were recently asked as to how the construction was standing up after nearly five years of service, and stated that it had been reasonably satisfactory. It has been found necessary, however, to shim up the joints two or three times, but as a general thing the foundations are still intact, except in some cases where the soil was porous. In these cases the concrete foundation has gone down, carrying track and all, so that for such conditions broken stone foundations are considered preferable. It should have been noted that the joints were united by means of heavy twelve-bolt fishplates, and that the base of the 8-in. rail was 5½ ins. wide, while that of the 6-in. rail was 6 ins.

The company's engineers estimate that it requires considerably more power to operate cars on the grooved rail, which is in general use in the city, than on a side bearing rail. As proof of this it was noted that after the Vine Street cable line was reconstructed with a grooved rail about 30 per cent. more coal was burned in the station to operate the lines than before the grooved rail was substituted. This line has since been changed to electric.

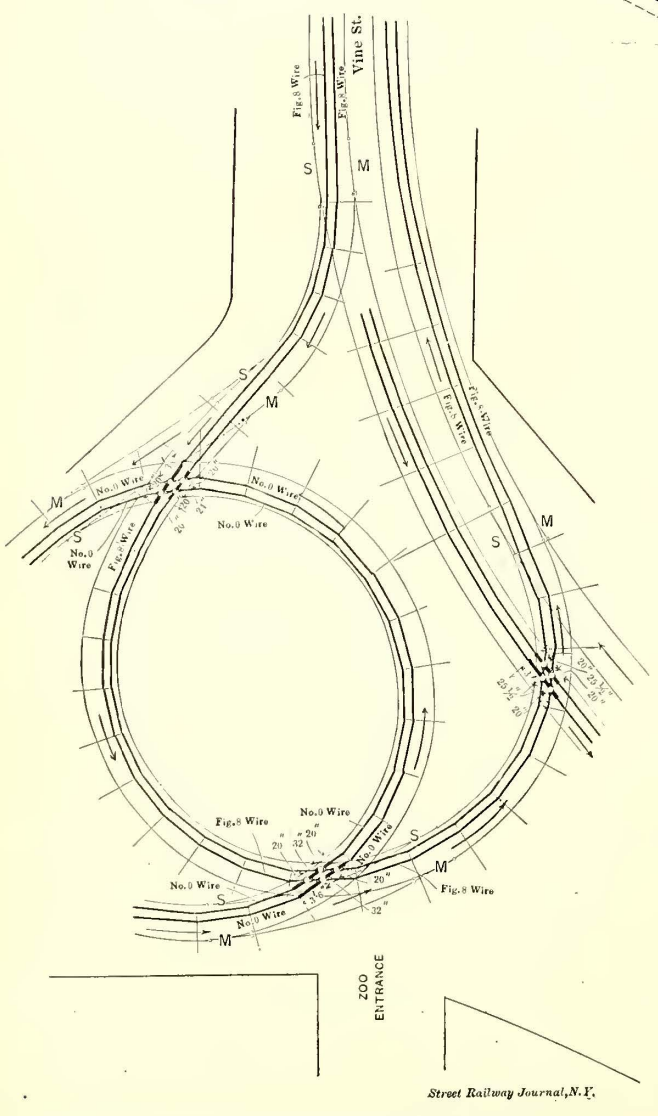
The one remaining cable line is that on Sycamore Street. This was formerly known as the Mt. Auburn Cable Railway, and will be transformed to an electric line in the near future. This change would probably have been made this season had it not been for the excessive rise in the price

of steel rails. This cable line operates over steep grades, one of which is 13 per cent, and contains a compound curve. In case the change is made to electric traction this grade will be cut down, or will be avoided by making a turn into an adjoining street.

In the operation of the system it is found necessary to clean the groove of the rails every day to prevent the wheels from riding upon the flanges. This is accomplished by means of a peculiarly formed hoe or scraper, which is attached to a long flexible handle, and which is manipulated from the rear platform of a car as it passes on its regular route. The attendant fastens a strap to the side and end of the platform and connects the other end of the strap to the hoe handle on a line with the floor of the car. He then stands on the platform and holds to the end of the handle, which comes above the dash and rests against it. By this means the hoe is pressed into the groove with sufficient force to rake out the accumulated sand and dirt as the car passes, and is also in position to be readily lifted at the crossings and switches.



OVERHEAD WIRING ON PRICE HILL INCLINE



OVERHEAD WIRING WITH FIG. 8 WIRE AT ZOO LOOP

Quite contrary to general expectation, a section of track extending for three or four squares that was laid with the duplex type of construction has stood up all the years as well, or better, than any other section of track. It will be remembered that this type of construction consists of a split rail, laid with broken joints, and supported on cast iron chairs, which, in turn, have broad bases and are supported on concrete pedestals.

The cast weld joints that have been employed are standing up well, except in some sections in which a light 6-in. rail was employed.

In connection with the track construction it should be noted that loops are provided at each of the terminals, so that the cars run the same end forward continuously. The loop at the entrance of the Zoological Garden is interesting in that two lines from intersecting streets have interlocking loops, that is, both lines circle around the same center, but not on the same track, as shown by the accompanying illustration. There is another interesting feature in the track construction on what is known as the Price Hill incline, where a section of track was built upon a long and steep ascent, on which the grades are about 11 per cent. The tracks make a loop in ascending this grade, but the up and down tracks are crossed at the loop, as shown in the accompanying diagram. The ascending cars use the outside tracks both before and after the turn, and the descending cars the inside tracks. This arrangement was adopted as a matter of safety, as it is thought that should a car become derailed on a down grade it would not be so likely to topple over the bank. The accompanying illustrations show the overhead wiring and switches for the

double trolley at this loop, as well as the track arrangement.

Nearly all the cars of the system and those of the Covington & Newport (Ky.) system which enter the city, circle around or pass on one side of Fountain Square, which is in the business center of the city, and in busy hours a large number of cars may be found rounding the various corners. The illustrations on page 431 show the arrangement of overhead wires and switches at Fountain Square. In some cases there are four wires on the streets approaching the curve, so that a trolley may be shifted from one set of wires to another, thus avoiding difficult overhead switch construction. In arranging these switches there are certain dead sections over which the cars pass by momentum, the current being carried past these dead points by insulated cables above the switches. It is interesting to note that the double trolley has held its own in this city since electricity was adopted as a motive power on the principal systems, and that it is in favor with the management. It is claimed that it avoids the danger of electrolysis in the gas and water pipes. The system has recently been inspected by a number of foreign engineers, who have recommended the double trolley for use on some of the new lines in England and on the Continent, and the electrician of the company is frequently in receipt of letters from foreign engineers and municipalities asking as to the working of the double trolley. When people become accustomed to it, the double trolley is not thought to be much more unsightly than the single wire, with its supports.

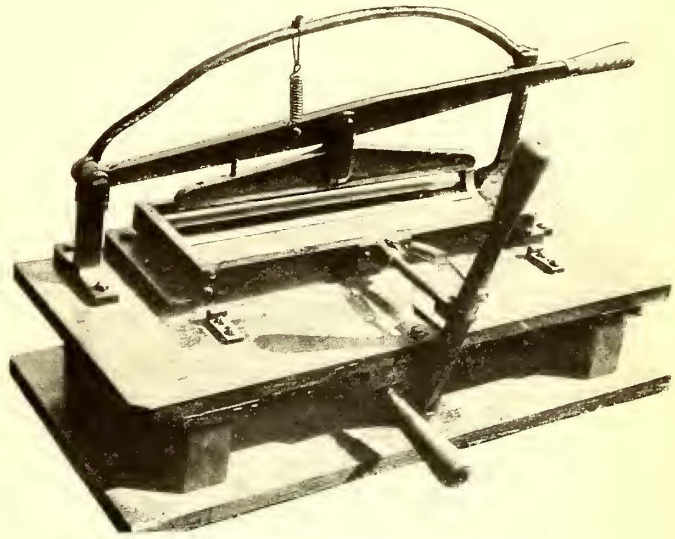
Notes on the Cincinnati, Newport & Covington Railway Company

An additional unit is being installed in the power station of the Cincinnati, Newport & Covington Railway Company, consisting of a cross compound condensing engine of the Corliss type, manufactured by the C. & G. Cooper Company. The engine is rated at 1200 h.p., and will be direct coupled to a 800-kw. Westinghouse generator, which will give the station a total capacity of 4000 h.p. The original capacity of this station consisted of four 500-h.p. vertical compound condensing marine engines, each of which drives by means of belting a generator of the M. P. type, rated at 500 h.p.

Since the former description of this power station in these pages in the issue of June, 1894, an additional unit of power has been installed, consisting of a Westinghouse vertical compound engine direct coupled to a Westinghouse generator of 375-kw. capacity.

The original boiler equipment consisted of six Stirling boilers and four of the B. & W. type, with a total normal capacity of 4250 h.p. Since the former description of this station the old type of stokers has been removed and those of the American type have been substituted. There has also been installed a mechanical draft appliance with economizers, which were provided by Westinghouse, Church, Kerr & Co. It is estimated that since the installation of the economizers and forced draft a saving of at least 10 per cent has been effected in the cost of coal. The steam pipes leading to the engines have also been changed, by which it is estimated a saving of 5 lbs. in steam pressure of the engines has been effected over that of the old method of piping. The boiler room is provided with cold storage bins and an automatic coal-handling apparatus. There has also been an important change made in the method of providing feed and condensing water. Formerly pumps were installed on a movable platform, which was supported by inclined tracks which led down the bank of the river, a distance of 800 ft. from the power station. The pumps were operated by steam taken from the boiler plant. In place of this a well, known as the intake well, has been sunk 20 ft. deep beside the river. On the bank not far from the power station a second well 50 ft. in depth has been dug. This well is about 20 ft. in diameter, with a brick and cement wall, and is provided with three duplex pumps of the Stilwell & Bierce type, having a capacity of one and three-fourths millions gallons each per day. The pumps are located on a level with the surface and housed in. This well is connected with the intake well, and by the new arrangements it is expected that a saving of $3,000 a year will be made in providing water, as in connection with the above described wells there are two settling basins, which have a capacity of 250,000 gals. This will provide feed water, as well as condensing water. Formerly the feed water was obtained from the city mains. With the various economical features installed in the station the daily coal consumption has been reduced from 44 tons to 25 tons.

What is now known as Soup Creek coal is employed for fuel, and is delivered by cars from C. & O. R. R. The entire power for operating the system is now derived from this station. The second, or auxilliary station, or what



ARMATURE COIL FORMING MACHINE

was the first electric station established by the company, has been abandoned. The old station was located at Second Street, near the end of the Suspension Bridge, and had a mixed equipment of engines of the Armington & Sims type and McIntosh & Seymour make, a 400-h.p. Corliss engine of the Lane & Bodley type, and a 500-h.p. vertical marine engine like those described in connection with the main power station.

CAR HOUSE AND REPAIR SHOP

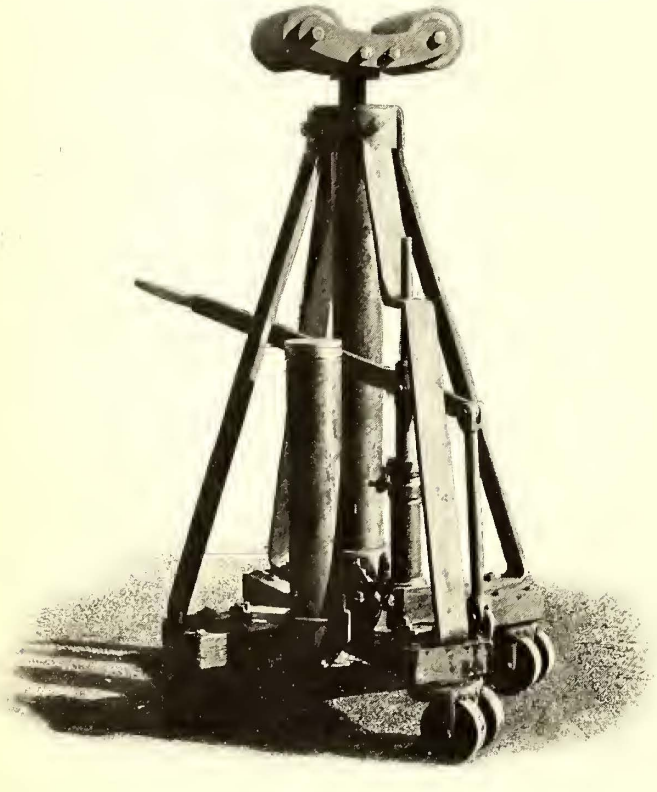
The company is building a new car house and repair shop, to be located near the main power station, which is at Newport, on the Licking River, near Eleventh Street. The car house has a ground dimension of 90 ft. x 375 ft., with a basement under the rear end for storage and possibly for light repairs. The front part of the building is two stories in height, and the second floor will be occupied by offices, drafting room and reading room for the employees. The repair shops consist of a machine shop, blacksmith shop, storeroom and office under one roof, 60 ft. x 180 ft., and a double building, to be occupied as a paint shop and woodworking shop. The ground dimension of each of the latter is 50 ft. x 110 ft. When finished the plant will be equipped with a full line of wood and metal-working tools, and with all the latest labor-saving devices that can be found, including dismantling pits, improved punches and

shears, cranes, hand lifts and pulleys, as many as may be required.

CARS

The standard closed car of the company is of the accelerator type, and those that were put in service on the lines in February, 1894, are still standing up and giving excellent satisfaction. The Peckham truck has been substituted on most of the cars for different types of trucks formerly employed. This is the extra strong No. 7 B, with a 7-ft. wheel base. The open cars with reversible and folding seats are also still the standard with the company. The duplicate brake equipment that was designed to operate the brakes on the inside of the wheels, and which was employed some years since, has been abandoned, as it was found that, used as an emergency brake, it was not necessary.

As the cars cross a number of bridges, the open cars are provided with a wire screen on each side, which is attached to the outside post, and which extends the full length of the car, so that the passengers enter and leave at the rear platform, as in closed cars. This is rendered necessary for



HYDRAULIC ARMATURE LIFT

the reason that a number of bridges are crossed and in a number of places there is a clearance of only 6 ins. between the cars and the bridge trusses.

MOTOR REPAIRS

For conveniently removing and handling armatures a 1000-lb. home-made hydraulic jack is provided, the pump of which has a stroke of $2\frac{1}{2}$ ins. The cylinder and plunger are supported by means of four flat bars, which rest on a square base, and which is provided with caster rollers, on which it is readily shifted about. The upper end of the plunger is provided with a pair of rollers in a curved base, which serve to receive and hold the armature. No track is provided in the pit for shifting this device, as the casters serve for this purpose. With this device the workmen are able to remove and replace the No. 3 Westinghouse armatures in twenty-five minutes. In connection with the repair department, an armature coil-forming machine is provided, which is illustrated on the preceding page. The application of this machine is apparent in its design, and does not require further description. The motor equipment of the system includes 107 of the Westinghouse No. 3 equipments and ten equipments of No. 49, with type K controllers.

WHEELS AND AXLES

The standard axle now employed by the company is $3\frac{5}{8}$ ins. in diameter, with a $3\frac{1}{2}$-in. journal, while the boxes are so designed that a 4-in. axle can be used if necessary.

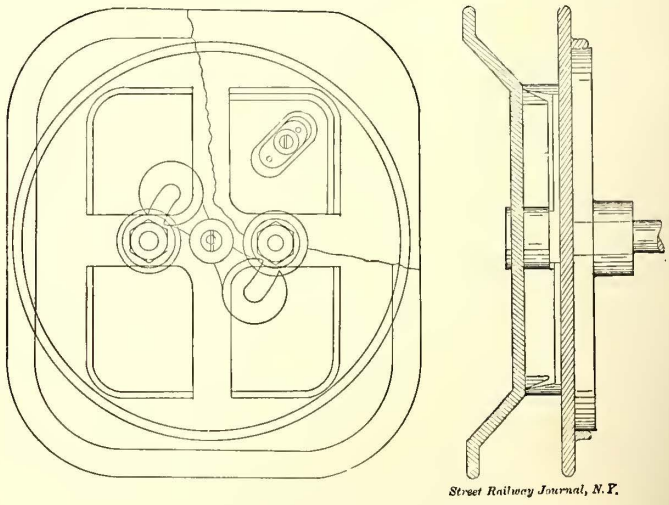
In fitting wheels, the practice is to turn the wheel to fit the axle with very little taken from the surface of the axle. In some cases the gears are pressed on the axles without keys. The gears are cast with large hubs and provided with large bolts and bored 1-3000 in. smaller than the axle. The wheels are put on axles under a pressure of 37 tons.

The personnel of the operating staff of the road has recently changed: J. C. Ernst is president; J. R. Ledyard, general manager, in place of Thos. M. Jenkins, who has recently resigned to accept a position as general manager with the St. Louis & Suburban Railway Company, St. Louis, Mo., and A. C. Harrington, as superintendent of motive power and electrical engineer.

Convenient Coil Form

Several types of field coil forms have been illustrated in the Street Railway Journal, but all have been quite different from the one shown herewith. It is employed in the Kensington repair shops of the Union Traction Company of Philadelphia, and has been found so convenient that it is employed for all the motor field winding on that large system.

The form is of iron, as that has been found to keep its shape better than wood, and is made in two parts as illustrated. The two plates composing the form are held together by means of two studs. The studs are screwed firmly in the inner plate. The outer plate has two holes large enough to allow the heads of the studs to slip through. At the end of each of these holes is a short slot cut on the



FORM FOR WINDING MOTOR FIELDS

arc of a circle. To attach the outside plate to the inner the studs are first slipped through the holes in the outer plate and then given a short turn.

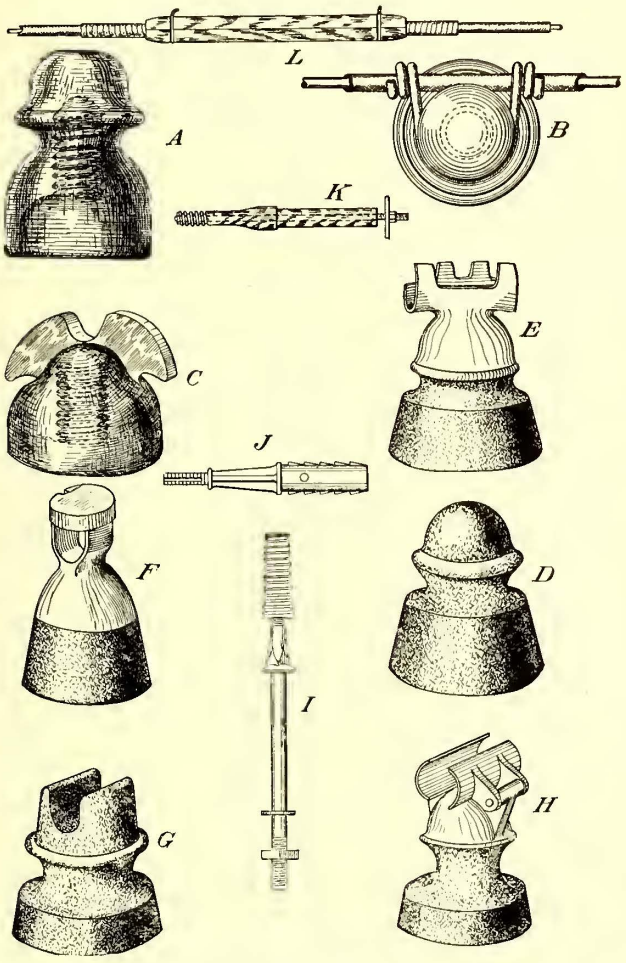
All that remains to be done now is to give the studs one or two turns, which will bring them down firmly on the outer plate. After the coil is wound it is another simple matter to loosen the studs, when the studs are slipped through the large holes, releasing the outer plate. This requires a few seconds only, and it is this ability to take the form apart quickly which makes it so convenient.

Overhead Line Construction II.

BY ALBERT B. HERRICK

THE INSULATION OF THE FEEDER

In addition to the insulation covering on the feeder wire, a second insulation should be introduced between the feed wire and its mechanical supports. The materials generally used for this purpose are porcelain, glass and compounds



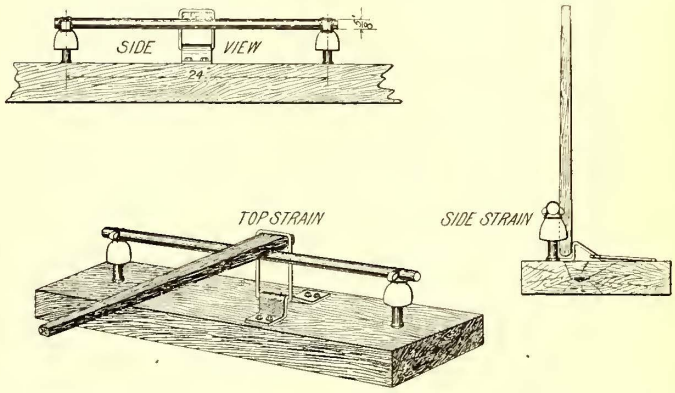
FORMS OF FEEDER INSULATORS

of mica and shellac, rubber and asbestos. The mechanical properties of this insulation should be such that it will stand strains without fracture, and that the surface will not absorb moisture. Glass or porcelain is generally used for No. 000 feeders or smaller, but for larger feeders with long spans, exceedingly strong insulators should be selected, especially where it is also necessary to use an iron pin. Porcelain has been greatly improved in strength during recent years, and the present method of firing it in the kiln has thoroughly vitrified the body of the insulator, still leaving it tough. The method of testing a porcelain insulator, to determine whether vitrification has taken place, is to break it and apply analine ink to the fractured surface of the broken portions of the body. If, after washing, a general discoloration of the porcelain is found, it has not been properly fired.

In the saddle form of insulator, shown at C, with butterfly wings, the portion of the insulator where the wire rests should be provided with rounded edges so as not to abrade the wire, if there is any movement of the feeder due to temperature changes. The flarings of the petticoat should not be too wide to allow water to spatter under them from the cross arm, or too narrow, as this condition invites insects to make cocoons and nests in them. Where a flaring petticoat is used, the top of the cross arm may be rounded and the edge of the insulators made helmet-shaped, so that the drip shall fall outside the cross arm, but these considerations are more pertinent in high tension transmission work.

The strength of insulators can be tested as follows: Place two of the regular pins 24 ins. apart in a wooden beam, 4 ins. x 6 ins., and tie down into the top of the side groove of the insulator a ⅝-in. rod of iron 28 ins. long. A strain by a lever that will give a permanent set to this rod should not fracture the insulator. A test should be given for both top and side strains. The method of making this relative strain test is shown herewith. No copper line can withstand such strains to an insulator as these tests impose. The strain of the copper conductor is a limiting mechanical factor beyond which it is not profitable to increase the strength of the pole line.

The composite insulator, which is formed of a metallic saddle for the feeder and a metallic bushing for the pin, is a form of insulator largely used. These two metallic parts are held together and insulated from each other by insulating material which is generally molded into place under heat and great pressure. The desirable qualities in the composition used are that it have sufficient mechanical strength and that the strength be maintained when the temperature of the insulator has been raised to 150 degs. F. The worst fault of these composite insulators is that they become plastic in warm weather and yield to conductor strains. This composite insulating material should not be affected by rain so as to dissolve any of the substances in



DEVICE FOR TESTING STRENGTH OF FEEDER INSULATORS

the composition, as a roughened surface will hold dirt and produce a leaky surface.

Where the line passes through trees it must be protected from contact with the latter, as the movement of the branches by the wind abrades the insulation of the wire.

For cases of this kind the split wooden sheath, shown in "L" on this page, is often used. This should be held firmly in position so as to not slip along the wire, but the really best protection, where it is possible, is to pull the feeder away by guying it to another limb. If a split porcelain insulator is used to enclose the feeder and the guy twisted around the porcelain insulator and some tension put on it to an adjacent limb, the tree and the wire are both free to move without any considerable strain.

THE MOST ECONOMICAL ARRANGEMENT OF FEEDERS

The next matter to be decided in line construction is the proper amount of copper to use and its most economical disposition. We will first view this question from commercial considerations; but returns in the way of investment in copper may be from several sources. The first and direct loss caused by a deficiency of the copper in a feeder system is in the loss of energy; second, in the increased depreciation of the equipment due to the higher temperatures

attained by motors operated by low voltages; third, in the added expense of operating more equipments where a given headway between them is maintained, due to the lower maximum speeds and slower acceleration under low voltages.

In connection with the energy it can be seen that the smaller we make the feeder for a given load, the greater the loss and the less will be the fixed capital charges against this feeder per annum. On the other hand, the cross section may be increased until the interest charges are largely in excess of the energy saved. Thomson determined that the most economical sized feeder to use was the one in which the annual interest charges were equal to the annual cost of the energy lost, and this is accepted as a general rule for the determination of the proper capital investment in the feeder. To the cost of feeder should be added the cost of its insulation and pole line or of conduit, and the interest charge can be fixed by local conditions.

The price per unit of energy generated in the station should be based on that charge on which a power station could sell all its output without loss, and the items which enter this charge should be coal, water, labor and all the supplies necessary to create this power; this cost should also include the interest charges for the power station upon its investment, taxes and insurance. The power station should also bear its proportion of general expenses, in the ratio which the capital invested in the power station bears to the total capitalization. In other words, the cost should be that at which this power could be sold without a profit or without a loss.

Calling this the prime cost the cost for the losses on the line will be some value less than this cost, per unit lost, depending upon cost of this additional production of energy, and the cost varies on each plant for this loss, but the cost of increasing a load 10 per cent on a station will make little difference in its consumption of coal, oil and water, except where an extra unit has to be operated to maintain the usual 25 per cent overload, allowed in operating capacity, and under these conditions the losses in this added unit are chargeable to the line losses. Strictly speaking, the fixed charges belong to that portion of the energy of the station which produces a revenue, and again the increased loading of a unit brings up its efficiency, and this line loss is reflected in decreased cost of the total output.

If these costs and current deliveries are determined for any road, it is very easy to construct a table in which the cost of the energy lost is compared with the capital charges, and this determines which size of wire can be most economically used. The next and most difficult question is the fixing of the current required to propel the car or cars which are fed by the copper to be supplied.

Assume the energy consumption as 1.2 kw. per car mile for level track, 28-ft. car body weighing 18,000 lbs., single truck, two G. E. 800 motors with K2 controller, and speed 10 miles per hour. This, with 500 volts, gives the average of 24 amps. per car for current delivery. On the first step the car would require 60 amps. at 500 volts; but, with this flow of current, a drop will occur over the copper conductors. Say the voltage fell to 450 volts with the controller on the first notch, then the current will be 54 amps. The second notch of the controller cuts out $4\frac{1}{2}$ ohms., and this should largely be taken up by the counter e.m.f. of the motors, which have started and commenced accelerating.

The speed gained on the first notch reduces the current obtained when the second notch is reached, and the greater the feeder drop the slower the acceleration. The greater the amount of energy required to bring the equipment to speed, the higher will be the temperature attained by the motors, and the greater the rate of equipment depreciation and the maximum demand on the power station. These losses and station investment can be reduced by greater line copper investment.

In this consideration, both the copper and ground return system have to be considered. Allowing 20 per cent drop, which means an effective voltage delivery of 400 volts to the equipment, the maximum current at starting, which will be on the second notch, can be assumed as about 90 amps. Say that 8 per cent drop is allowed for the ground returns, and 12 per cent for overhead copper; this gives a maximum feeding resistance of two-thirds of 1 ohm per equipment. The average demand then is 24 amps. per car, and the maximum demand 90 amps., for the case under discussion.

The effect of grades is to both increase the starting current and also the running current value. The chart here-

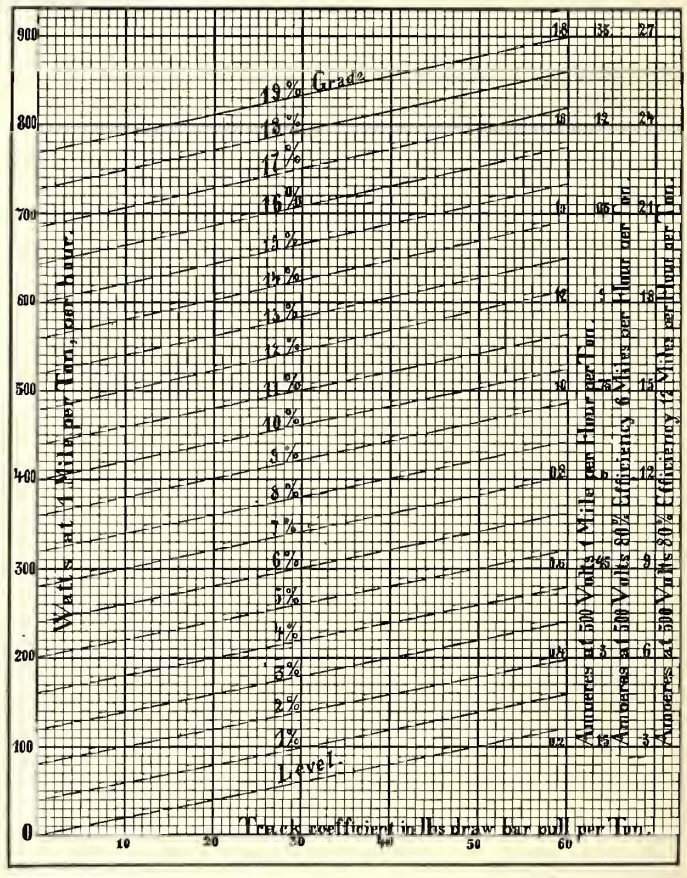


DIAGRAM SHOWING AMPERES REQUIRED PER TON WITH DIFFERENT SPEEDS, GRADES AND TRACTION COEFFICIENTS

with shows the relation which exists between the traction coefficient, which is plotted as ordinates on the chart, and the watts at 1 mile per ton per hour, which are plotted as abscissæ on the chart. Diagonal lines are drawn across the chart corresponding with grades from level up to 19 per cent, to assist in giving what is really required, i. e., the amperes flowing for different speeds and grades. On the right hand of the chart is given a scale in amperes, assuming the current delivery to the equipment is at 500 volts, for speed of one mile per hour. While the current delivery is not a rectlinear function of grade and speed, approximately proportional results can be obtained by multiplying the speed on grades by the weight of the car by the current given in this chart at the required grade, will give the total amperes required.

As an example, suppose we have a car weighing 18,000 lbs. climbing a 4 per cent grade at 10 miles per hour, with

a track coefficient of 25 lbs. Pass up the vertical line 25 until the diagonal line indicating 4 per cent is reached, then pass horizontally until the 1 mile per hour scale of amperes is reached; this gives 0.42 amps. per ton. For 9 tons this would be 0.42 (amps.) x 9 (tons) x 10 (miles) = 37.8 amps. The two other vertical columns at the extreme right of the chart, one 6-mile speed and the other 12-mile speed, give the current required, including 20 per cent loss on the line. For example, suppose an 8 per cent grade, 30 track coefficient, car weighing 20,000 lbs., running at 8 miles per hour, at 20 per cent transmission loss. This will give 5.7 amps. per ton, adding 1/3 more for increased speed and multiplying by 10 for weight in tons would give 5.7 x 4/3 x 10 = 76 amps. This, of course, is without any rheostat in circuit with the motors. The same problem can be worked out by the table given below.

It is extremely difficult to give the exact speed at which a car will ascend a given grade, for each equipment will fall in speed in mounting a grade until the counter e.m.f. of the motors has been reduced to such a point that the current is sufficient to propel the car up the grade. This point is variable, depending upon the equipment.

In considering the copper service on grades, the cars coming down grade require less current than those ascending, and generally above a 3 per cent grade a car will float with open controller after being started up to speed. It is very important to maintain potential at grades in order that the car can climb the grade at good speed, and to reduce the heating of the motors; and if the schedule can be maintained up grades the motorman will not be called on to make up time by coasting too fast down grade.

The usual practice of feeder taps from trolley to feeder every ten and eight poles on levels should, on grades, be reduced to six and four poles between each tap, in order to maintain the feeder pressure at trolley wire.

The headway of the cars will have to be known in order to get the average current demand, but the average demand is taken care of when provision is made for the maximum demand.

In the operation of a railway it is necessary at times to operate more cars over a section of track than are required by schedule, and fixing the maximum current demand is purely a local problem. The maximum demand is usually figured for a total drop of 140 volts where 500 volts are used at the station, and 150 volts with a 550 station voltage.

There are a number of ways in which copper investment can be reduced to handle this maximum load; one is to have a two-potential railway board, use a separate generator whose voltage can be raised to compensate for the unusual feeder losses and throw these feeders on to this higher potential bus, or a generator can be thrown in series with these feeders, and used to add voltage to that already supplied to the bus. In such a case this current would pass to the loaded feeders through the series field and the armature, when the dynamo becomes automatic in its action and boosts the current. By estimating the possible number of cars that could be massed together and using the constant given for each individual car, the maximum demand can be determined. On level roads the main ampere meter readings average 65 per cent of what would be acquired by assuming all cars operating at once. Where traffic is dense, and stops many, this is increased to approximately 70 per cent of figured maximum average demand.

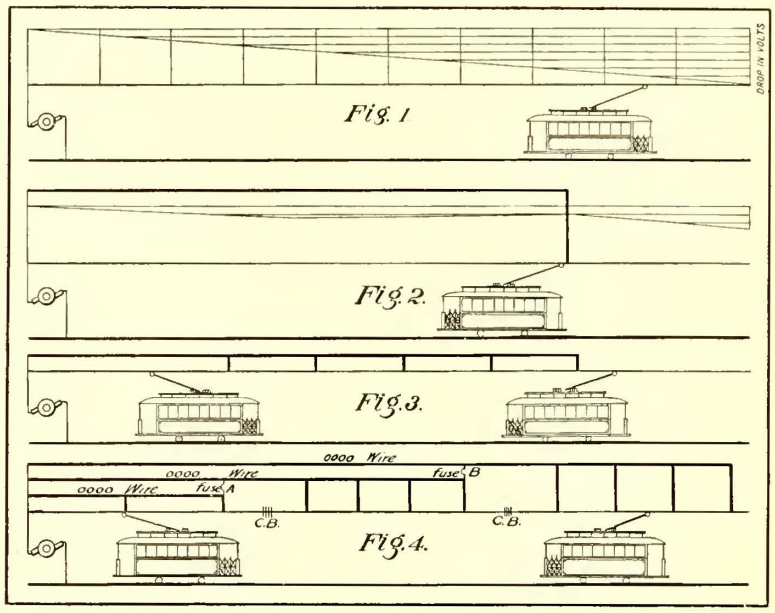


DIAGRAM SHOWING METHODS OF WIRING AND DROP IN VOLTAGE

Grades tend to increase slightly the average station de-

THEORETICAL WATTS PER TON OF 2,000 LBS. AND PER MILE PER HOUR, WITH VARIOUS GRADES AND TRACTION COEFFICIENTS.

PER CENT. GRADE	COEFFICIENT, IN POUNDS DRAW BAR PULL PER TON										
	12	13.5	15	18	20	25	30	35	40	50	60
0	23.9	26.9	29.8	35.8	39.8	49.7	59.7	69.6	79.6	99.5	119.4
1	63.7	66.6	69.6	75.6	79.6	89.4	99.5	109.4	119.4	139.2	159.1
2	103.4	106.4	109.4	115.4	119.4	129.3	139.2	149.2	159.1	179.0	198 9
3	143.2	146.2	149.2	155.2	159.1	169.1	179.0	189.0	198.9	218.8	238.7
4	183.0	186.0	189.0	194.9	198.9	208.9	218.8	228.5	238.7	258.6	278.5
5	222.8	225.8	228.8	234.7	238.7	248.7	258.6	268.3	278.5	298.4	318.3
6	262.6	265.6	268.5	274.5	278.5	288.4	298.4	308.3	318.3	338.1	358.1
7	302.4	305.4	308.3	314.3	318.3	328.2	338.1	348.1	358.1	378.0	397.9
8	342.4	345.1	348.1	354.1	358.1	368.0	378.0	387.9	397.9	417.8	437.6
9	381.9	384.9	387.9	393.9	397.9	407.8	417.8	427.7	437.6	457.5	477.4
10	421.7	424.7	427.7	433.7	437.6	447.6	457.5	467.5	477.4	497.3	517.2
11	461.5	464.5	467.5	473.5	477.4	487.4	497.3	507.2	517.2	437.1	557.0
12	501.3	504.3	507.2	513.2	517.2	527.2	537.1	547.1	557.0	576.9	596.8
13	541.1	544.1	547.1	553.0	557.0	567.0	576.9	586.8	596.8	616.7	636.6
14	580.9	583.9	586.8	592.8	596.8	606.7	616.7	626.6	636.6	656.5	676.4
15	620.7	623.6	626.6	632.6	636.6	646.5	656.5	666.4	676.4	696.3	716.2

EXAMPLE.—Given a car weighing 12,000 lbs. loaded; the grade at the point where we wish to know the current is 4 per cent.; speed required is 7 miles per hour; traction coefficient on this track is, say, 20 lbs.; motor efficiency is 80 per cent; current delivered at 500 volts. The current taken at this point will be equal to watts in table, shown at intersection of 4 per cent grade and 20 coefficient, multiplied as follows:

$$\frac{198.9 \times 7 \text{ (miles per hour)} \times 6 \text{ (tons weight)}}{.80 \text{ (efficiency)} \times 500 \text{ volts (pressure)}} = 20.88 \text{ amps.}$$

mand, but types of equipments, trucks and weight of car, and motorman, are all variables entering into this problem, and they require careful consideration on new roads; but on old roads, where the copper has to be reinforced, these variables can very readily be given fixed values, and the profit or loss for additional copper can be easily figured.

There are a number of methods by which current is supplied at a given potential along a trolley wire. In some the trolley wire is divided up for safety, a method which largely increases the copper cost of delivering current at a given potential. The simplest system consists of a single trolley, fed at one end; in this the car gradually loses potential as it passes away from the station. With a 12 per cent drop, the distance in feet which the car can go and not exceed the fixed drop is the product of resistance per foot of trolley multiplied by the current demand, divided into the drop in volts allowed on the trolley. A double trolley will give twice this distance, if the current demand remains the same. Fig. 1 shows the drop in volts at each point on the trolley.

After this distance has been reached the trolley has to be reinforced by a feeder leading from the station. Fig. 2 shows the redistribution of potential due to such connection. A car located between the station and trolley tap will now be fed two ways; one through the trolley direct, and the other through the feeder. The drop will now be due to two conductors in multiple, which will be the product of the resistance of the trolley wire from the station to the trolley wheel multiplied by the sum of the feeder resistance, plus the trolley wire resistance from the wheel to feeder connection. If this product is divided by the sum of these resistances, it will give the resistance of these conductors feeding in multiple, which multiplied by the current required by the car will give volts drop, which is the quantity sought. It will be noticed in this consideration of feeders that the farther from the station the current has to traverse the trolley in order to reach the feeding point, the less effect the feeder has on the potential delivery to the car. Fig. 3 shows taps at frequent intervals between the feeders and the trolley, gaining the maximum usefulness out of the feeder.

It has been the practice to isolate feeding sections by placing line circuit breakers in the trolley wire and providing independent feeders, so that if the trolley falls or a feeder becomes grounded it will not shut down the whole system. Other simple means can be used for the same effect and yet obtain the multiple feeding effect of all feeders, as by introducing between the terminal of one feeder and the feeder connecting an adjacent section, a safety catch or automatic circuit breaker, mounted in a box located on a pole. In Fig. 4 the car with open independent feeding sections will have a drop of 150 volts with a 300 amp. maximum, and connecting feeders, together with automatic devices as shown, will reduce the drop to 30 volts with the same load, or one-fifth the single feeder drop.

Judge Miller has handed down an important decision in one of the tax cases of the city of Louisville against the Louisville Railway Company. The amount involved is $151,824, this sum being claimed by the city as unpaid franchise and personal taxes due from the street railway company for the years 1894, 1895 and 1896. The company claims these taxes were uncollectable, owing to new ordinances passed by the City Council, and also that the taxes are excessive. The court holds that under the present laws of the State no corporation can acquire, by contract or otherwise, an exemption from the burdens of taxation, and that the payment of a license tax cannot be pleaded in bar of an ad valorem tax.

The Possibilities of the Trolley Excursion Business in Eastern Massachusetts

BY ROBERT H. DERRAH

It is surprising that until the last two years comparatively nothing had been done in Boston in the way of conducting excursions on the electric cars of the city and the neighboring country. Probably in no portion of our country can be found a greater variety of scenery and places of historical associations than in Eastern Massachusetts, and the whole district has been covered with electric railways. But, apart from running out a special car whenever it was ordered, and purchasing a couple of parlor cars, which have been in more or less demand for theater parties or on the occasion of the annual football games, practically nothing had been done by the companies which were to secure the greatest returns. When, in 1896, I began the publication of the "Street Railway Guide," telling people how to reach the points of interest on the electric lines of Eastern Massachusetts, I became firmly convinced that there was a vast amount of "pleasure travel" on the railroads which brought in a tremendous amount of business to the companies. Since then I have seen plenty of evidences that such was the case, for the circulation of the "Guide," which was designed to be primarily of benefit to people who wish to travel on the electric cars for pleasure, has increased so much that it is evident that the travel of this kind has increased enormously within the last two or three years. Recent developments have made it possible to make the trolley excursion traffic an important factor in the street railway business of Eastern Massachusetts.

In the first place, attention is called to the facilities for special excursions on the street railways in this part of the country. These form the largest connected system of street railways in the world, running from Nashua, N. H., on the north, through Boston to Newport and Providence, R. I., on the south, a distance of 130 miles. Eastward they extend to the tip end of Cape Ann, some 45 miles, and westward to West Warren, Mass., some 80 miles. All this district is covered with a network of electric lines.

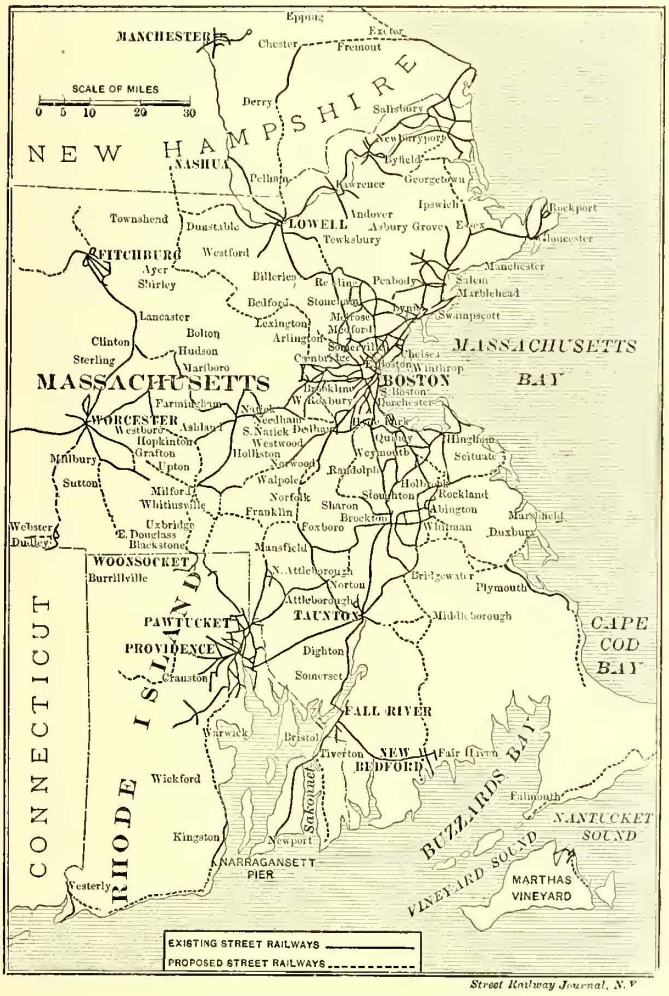
Heretofore one of the great difficulties of conducting trolley excursions, except of limited extent, has been the fact that special cars of one company were not allowed to run over the lines of another. Even in cases where this prohibition did not exist, tracks of different companies were not actually connected, so that a change of cars was compulsory. For this reason each company was obliged to run its own special cars to provide for any long trolley trip that might be planned. For the past three years these suburban roads have had, and are having, these missing links connected up. At the present time, it is unreasonable to expect a large corporation like the Boston Elevated Railway, operating some 1200 cars in a congested city like Boston, to assume the responsibility of allowing the cars of ten suburban street railways which connect at its various termini to run over its tracks, but I feel certain that within the near future all the street railway lines within a radius of at least 50 miles of Boston will be virtually under one management, and when it has reached that point some satisfactory arrangement can doubtless be made whereby special cars can be run over each other's tracks to the advantage of both companies.

A gentleman representing some 250 Sunday-school children called in reference to their annual picnic. I handed him a list of the several picnic grounds within easy reach of Boston especially adapted for that purpose. He selected one, and after visiting the place, stated that although

he had lived in Boston nearly all his life he had not believed there were such beautiful scenery and trolley rides in New England. This is an example of how little the people know of the beauty of the country that surrounds them.

The trolley excursion business in this section of the country has a much broader field than in other parts where it is operated on a very large scale, such as Brooklyn, for example, they have Coney Island, Bergen Beach, North Beach, Jamaica, Flushing, etc., while we have numerous beaches, the finest in the country, where a great many wish to go; on the other hand, we also have inland parks and country for those who wish to spend a quiet outing.

There are many disadvantages at the present time, resulting from the fact that the roads are run independently;



MAP SHOWING ELECTRIC RAILWAYS IN EASTERN MASSACHUSETTS, RHODE ISLAND AND NEW HAMPSHIRE

for instance, cars frequently do not make good connections, and if a special car followed a regular car on a single track, and the regular car is behind time, a half-hour wait is often necessary at the terminus, as the country lines frequently run on a half-hour schedule. The consolidation of the various lines will obviate this difficulty.

Another factor which has prevented the development of the trolley excursion business in this part of the country has been the lack of suitable cars. Except for the two parlor cars owned by the Boston Elevated Railway, there have been no cars which were especially adapted to excursion business. Regular open or closed cars were run out as might be needed, but these are not well adapted to the use of trolley parties. I think the time is not far distant when Boston will be the foremost in the trolley excursion business, under the management of a separate company, with cars especially equipped for this class of traffic, built on a plan to combine buffet and parlor car, fitted with all conveniences. Each car would have its own motorman and conductor, with an experienced man serving as a guide, if desired. With these cars a party could go over the different railway lines, visiting points of interest and stopping wherever desired, traveling for a week or more without going over the same country twice, as the lines connected make up a system of more than 1200 miles.

It would seem that the possibilities of such a business are practically unlimited. It only remains to secure the cars and acquaint the 2,000,000 people with the advantages of this form of excursion. Compared with railway excursions they might be made cheap, and the passengers would have the advantage of seeing the best, rather than the most uninviting, of the country traversed. Taking their own time, stopping when and where they pleased, the trolley excursionists making up a party have at their disposal the resources of all the electric companies for only an extra fare on each line, or even less. Short-distance excursions have been for years popular in London and the large cities of England, and in a country where there is so much to be seen, and an endless diversity, the prospect for this class of business is an attractive one. Special knowledge of street railroading is, of course, necessary to successful management, but the passenger has no need to know anything more than where he wishes to go. A series of trips can be arranged covering a diversity of points of interest, for a half-dollar or a dollar, providing a whole day's outing, and giving the passenger an intimate knowledge of the country about him. Within a short time this business is likely to develop into an important one, and nowhere is there a better field for its operations.

Shop Wrinkles

BY J. F. HOBART

Repair shops now frequently get into the habit of using the slowest possible speeds on any machine. A lathe is often back-geared when not necessary, and when a faster speed would not only do more work for the owners, but would actually make the work easier for the operator!

A case of this kind comes to my mind, of a shop where about eighty men were employed in all branches of car work. The shop had been for a long time under the control of an easy-going mechanic of the old school. When a new management took hold of the road a young mechanic, with more modern ideas, was put in charge of the shops. He made the attempt to have faster speeds used on all the machines in the shop, but had very poor success in so doing. As long as he was present the faster speeds would be used, but tools would break or get dull quickly, and some excuse was surely found for putting the work back on the old speed again.

One Sabbath day the foreman of the shop went quietly to work and speeded up the line shaft, so that all the machines were brought up to about the required speed. This act caused a vast howl of indignation, and sixteen men threw up their jobs and left. But the high-speed line shaft stayed, the high-speed machines did likewise, and the tools stopped getting dull or breaking, proving that the slow speed of the men, not the high speed of the machines, had been the cause of trouble in that direction.

The scheme is a good one to apply to a large number of existing shops, thereby improving both the quantity and the quality of the work turned out. Aside from speeding up the main line shaft, it is frequently profitable to speed up the steam engine. Then, not only will the speed

be increased, but the power developed by the engine will be increased also.

With small throttling engines there is usually no reason why the speed should not be increased at will, but with Corliss, or other engines with large pulleys, the safety of the wheel at the proposed speed should be passed upon by a competent mechanical engineer before making a change. This precaution is necessary, because many such engines are already running close to the speed limit.

STRAIGHTENING AXLES

A good many slightly bent car axles can be made as good as new (nearly) by judicious straightening. It does not answer well to straighten axles cold. Thus treated the metal seems to have taken a "double set," and will bend much quicker than before either the first or second bend was made. Axles should always be straightened hot. Thereby the strains are removed, or neutralized, and the metal is almost, if not quite, as stiff there as at any other part of the axle.

To properly test the straightness or crookedness of an axle it should be placed between centers. In no other way can an exact test be made, although a close approximation of the center method may be arrived at by placing the axle on friction wheels, said wheels being placed at the extreme ends of the axle. An old lathe bed placed close to the straightening forge is about the best rig for testing axles. A pair of old tailstocks may be rigged on, stout enough to stand a rap from the sledge upon a hot axle when necessary.

MILLING AXLE-BOX HOUSINGS

Jig-work is the passport to economy in street railway machine-shop work. When hundreds of castings are to be milled in two or three places, then drilled and tapped, it does not pay to do the work under an ordinary drill press, using an end-mill for the surface work, and locking up the casting for the drilling and tapping. If only a few dozen castings need drilling the hand method is well enough, and the castings should be laid into a face-plate vice, one at a time, after being milled or planed ready for drilling.

A short iron level should be laid across the milled upper surface of the casting, but if necessary a very short level may be used, placed upon a parallel piece of metal which is long enough to reach across the opening in the casting. Two parallel bearings below the vise will allow the casting to stand upright between the vise jaws. Then the level is applied, the casting adjusted until it is level both ways when the vise is closed, the level being kept in place to reveal any possible movement which might throw the casting out of true.

The drilling may now proceed, the holes having been previously laid out and marked by circle and four center-punch witness marks. After starting the drill it is brought central by the usual method of chipping out one side of the hole with a small three-cornered or half-round chisel, so as to draw the drill over.

All this work and loss of time would be dispensed with if a template had been provided, into which the casting could have been fastened at the beginning by a turn of a lever or screw. Then it could stay there during both the milling and the drilling, thereby causing all finished surfaces and holes to be in line with each other, and requiring no leveling or hole chipping.

IRON AND STEEL CUT TO LENGTHS

Among the unprofitable work often done in car shops, smithies and machine shops is that of cutting up round and flat bar iron into the lengths required. Merchant iron and steel can now be bought in lengths required (cut up at the mill) at a very trifling advance, if any, over the price of regular bar material. When a man and machine are seen day after day working in slow moderation, and with still slower efficiency, to mangle material into short pieces, the contrast becomes too great. The iron cut at the mill is smooth and square, and of exact length—much more than can be said of the haggled-off stuff cut in the average car shop.

This idea may well be carried further than to merchant iron. Many shops keep men and machines running continually on standard bolts. It may be a surprise to some shop managers to learn that manufactured bolts can be bought in quantity at a very slight advance over the price they are now paying for the iron to make bolts of. In a number of shops this has been found to be true, reckoning the iron and bolts pound for pound.

Repair Shop Accounting on a Small Road

The Wilmington City Railway Company, of Wilmington, Del., is employing a convenient and systematic method of keeping repair shop accounts, the invention of Joseph Kuen, master mechanic of the company. While not elaborate, it answers perfectly the needs of the company in determining the life of the apparatus used on the road, and takes but little time to keep up.

The form below is that used in the shop, and gives exactly what apparatus is changed, as the shop foreman checks off on the list any part which has been renewed:

WILMINGTON CITY RAILWAY COMPANY.

MECHANICAL AND ELECTRICAL DEPARTMENT.

Overhauling Report.

Date.....189 .

Car No.....	Truck No.....
Arm. Bear. No. 1.....	Right Hand Shoes.....
" " No. 2.....	Left " " .....
Axle " No. 1.....	Car Wheels No. 1.....
" " No. 2.....	" " No. 2.....
Arm. out No. 1.....	Axle out No. 1.....
" in No. 1.....	" in No. 1.....
" out No. 2.....	" out No. 2.....
" in No. 2.....	" in No. 2. .....
Gear Wheel No. 1.....	Truck Overhauled.....
" " No. 2.....	.....
Pinion " No. 1.....	.....
" " No. 2.....	.....
Motors Overhauled.....	

Signed,.....

This report is sent to the master mechanic, who enters the date and extent of the changes in a truck record book, in which a page is given to each truck. Each truck is given a number, and the pages are numbered in consecutive order, corresponding to the truck number, and the date of removal is given opposite each item.

TRUCK NO. —— (CAR NO. ——)

Arm. Bear. No. 1.....	Gear Wheel No. 1...	Wheels No. 1.....
Arm. Bear. No. 2....	Gear Wheel No. 2...	Cause for change....
Axle Bear. No. 1.....	Pinion No. 1...	Wheels No. 2.....
Axle Bear. No. 2.....	Pinion No. 2...	Cause for change....
Arm. put in No. 1....	R. Brake Shoes.....	Axle in No. 1.....
Arm. put in No. 2....	L. Brake Shoes.....	Axle in No. 2.....
Motors Overhauled..		Truck Overhauled...
		Into Service.....
		Out of Service.....

Truck and Motor Changes.....

The car body repairs are entered in a separate book, which also contains data relating to the equipment of the car body, so that a glance at this book will tell the purchasing agent just what parts and equipment to order for

repairing. These data are grouped under the following headings:

Length over bumpers.	Style of seats.	Heaters.
" " all	Size of side glass.	Controllers.
" " body.	Size of vestibule glass.	Trolley base.
Number of windows.	Register.	Rheostat.
Color panel and coves.	Chandeliers.	

The company also has a third book, called an "Armature Book," which contains a page for each armature. All armatures are numbered, and all repairs on the same armature are entered under the proper serial number. This book is written up from the armature winder's day book.

Mr. Kuen says it is his usual custom to allow the reports to accumulate for some days, and then to enter them into the above books at one time. It requires only about a half an hour for one man to enter in this way the work of one week in the repair shops.

Accident Blanks

The accident blanks given below are those in use on the Brisbane Tramway Company, of Brisbane, Australia, the general manager of which is J. S. Badger, who is well known in America. These present several features which are somewhat novel, and are, at the same time, complete and compact.

Two forms are used. The first is a single sheet, shown in Form 2, and is intended to cover minor accidents. That in Form 1 is more complete, and is intended for reporting more serious accidents. It is filled out by the conductor in ink after he has returned to the car house, and has four pages. The blanks are abbreviated somewhat in the re-

PRIVATE.

Brisbane Tramways Company Limited.

ACCIDENT REPORT—FORM NO. 1.

N.B.—This report is furnished for the information of the Company's solicitors, and must be treated as Strictly Private and Confidential.

INSTRUCTIONS.

Employees must report every accident to any individual or to or in connection with any car or vehicle belonging to the Company or any other company or person, which occurs within 14 paces or steps of the tracks or cars belonging to the Brisbane Tramways Co., no *matter how trivial* it may seem, or even if the person states he has received no injury. You must at once obtain all the facts connected with the accident, the names and addresses of persons who met with the accident, and of all witnesses whether on or off the car. If any policemen should be present be sure and take their addresses and numbers, and in any case it is important to get as many witnesses as possible. All the addresses must be obtained in full, with district, street and name of house, or if it has none, then its vicinity to some cross street, or hotel or other business. The most important duty of employees, in case of accident, is to secure the names and addresses of the largest number and the most intelligent and reliable witnesses. In case of a serious personal accident, when persons who saw the accident will not give their names, some employee of the Company should stay with the witness and follow him until he finds out the accurate name and address.

Employees, after having an accident, resulting in damage to person or property, must report same verbally to the first inspector they meet, and also report the same *at once* by telephone to the head office, during ordinary business hours, or to the Cash Receiver's office at Petrie's Bight when the head office is closed.

Accident reports must be filled out in ink and handed to the Yard Foreman before the conductor and motorman leave after turning in the car.

Employees must not under any circumstances, tell any one who their witnesses are in any case of accident, or make any statement with reference to the accident, except to an official of the Company.

Conductors will fill in the diagram on the fourth page of this blank, showing the exact location of car or cars, vehicle or person connected with the accident, naming streets, and cross streets.

Car No.____ Date____ 189- Exact time____ { a.m. / p.m.

Line____ To____ From____

Exact place of accident____

Speed of Car in miles per hour____ { Down Grade. / Level Grade. / Up Grade.

At instant of accident brake was { on. / off. Power was { on. / off. Controller was { forward. / reverse.

What distance did car run after { brake was applied____ paces. / power was reversed____ paces.

How far did Car run after striking object____ paces.

Measured by____ Witnessed by____

State of Weather____ Condition of Track____

Names and addresses of persons meeting with accident____

PAGE 1, ACCIDENT BLANK

Nature and extent of injury, if any____

Were injured persons removed from place of accident? If so, by whom and where to?____

License No. and kind of vehicle damaged____

Nature and extent of damage to same____

Direction in which vehicle was going at time of accident____

Speed at which it was travelling____

Name and Address of owner of vehicle____

Name and Address of driver of vehicle____

Damage to Car, if any____

No of passengers on Car,____

Names and Addresses of witnesses, with position on car or street____

PAGE 2, ACCIDENT BLANK

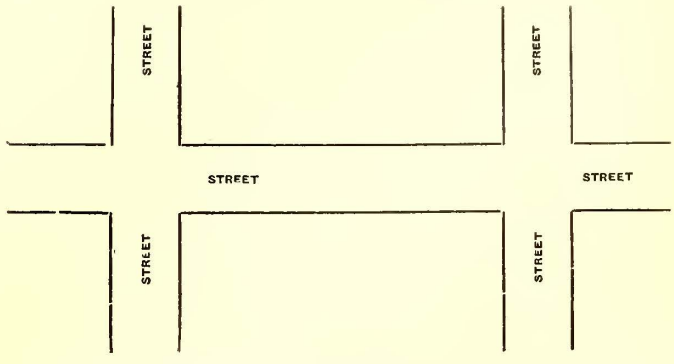
GENERAL DESCRIPTION OF ACCIDENT WITH FULL PARTICULARS:

Accident reported verbally to Inspector____ at____ { a.m. / p.m.

Conductor____ Motorman____

Badge No.____ Badge No.____

PAGE 3, ACCIDENT BLANK



The Conductor will fill in the above diagram, showing the exact location of car or cars, vehicle or persons concerned in the accident, giving names of streets and cross streets.

PAGE 4, ACCIDENT BLANK

PRIVATE

BRISBANE TRAMWAYS COMPANY, LIMITED.

ACCIDENT REPORT—FORM 2.

Report on this blank such minor accidents as the following:—Car off track, car missing points, trolley leaving wire, broken lamp chimneys, broken headlight glasses, broken trolley wheels, any troubles with motors or other fixtures or appliances about the car, insulators off the line, obstructions on track or any obstructions to traffic, and in general any breakage or defect of the Company's property in which the public are not in any way concerned or connected; also all disputes with passengers over payment or non-payment of fare, offences against the by-laws, ejection of drunken or disorderly persons, etc.

Car No. ..... Date ..... 189 Exact time ..... a.m. / p.m.

Line ..... From ..... To .....

Exact place occurrence happened .....

Name and address of persons concerned .....

Names and addresses of witnesses—

Nature of trouble, with full particulars—

Conductor ..... Motorman .....

Badge No. ..... Badge No. .....

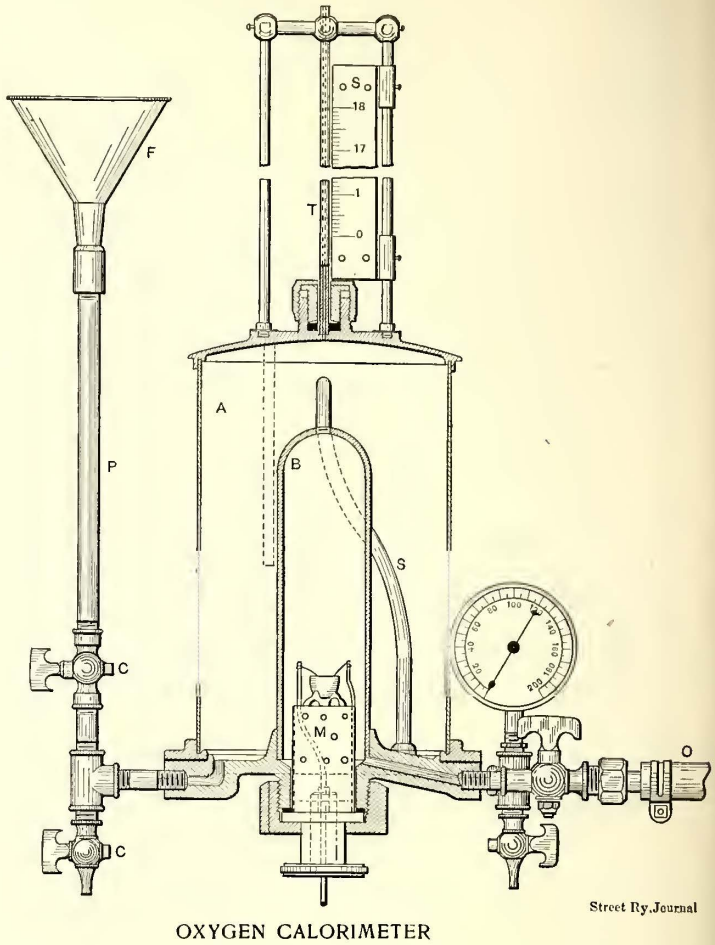
FORM 2, ACCIDENT REPORT

production herewith by the omission of a number of blank lines in the page where a general description of the accident is requested.

An Apparatus for Testing Coal, Fuel Oil and Other Combustibles

An oxygen calorimeter for testing fuel oil, coal and combustibles has been constructed by J. R. Chapman, chief electrician of the North Chicago Street Railroad Company, along lines suggested by articles appearing in certain technical papers a year or two ago. The construction of Mr. Chapman's apparatus will be made clear from the accompanying illustration and the following description. A large vessel, *A*, water sealed at the bottom and connected with a pipe fitted with cocks, *CC*, and a funnel, *F*, by which it may be filled and emptied, is also connected with an open glass tube, *T*, extending vertically from the top some 20 ins. or more, and paralleled by a graduated scale, *S*. Inside the vessel, *A*, is a closed retort, or bomb, *B*, into the bottom of which passes a metal plug, *M*, carrying on its top a little cauldron, or "charcoal pot." The bomb is connected at its base with an inside source of supply, *O*, through which oxygen gas may pass into the bomb, expelling the air before it through tube *S*.

The apparatus works as follows: The plug *M* is removed, and one gramme of fuel oil, coal or other combustible to be tested, is placed in the cauldron, and a platinum wire connected with an outside electric battery is immersed in the combustible. The plug is then screwed into position, the vessel *A* is filled with water to a point such that the water in *T* is approximately at *O*. The water is allowed to assume the temperature of the room as nearly as possible, as determined by a thermometer, oxygen is passed into the bomb until the pressure reaches a predetermined testing point, and when all the temperature conditions are stable and uniform, connection is made between the battery and the platinum fuse, the combustible is ignited, and combustion takes place with great rapidity in the oxygen atmosphere. The air in the bomb becoming heated, the walls of the bomb expand, forcing the liquid in *A* further up into the tube *T*, and the maximum point reached by the water is noted on the scale. The initial point having been previously noted, the differences between these readings are compared with the readings found by the combustion of pure graphite, or charcoal, and the relative efficiencies of different fuels are thereby obtained. The whole apparatus is extremely simple, and



OXYGEN CALORIMETER

should be quite accurate within desired limits, and the apparatus can be made in any street railway machine shop without great difficulty.

Milwaukee Accident Report System

The Milwaukee Electric Railway & Light Company carefully classifies all its accidents, both as to their character and, in the matter of payment, as to the year in which the accidents occurred. The classification is as follows:

Collision with vehicles.
Collision with persons.
Collision with animals.
Collision with bicycles.
Collision with cars.
Cars leaving track.
Employees injured when on duty.
Center pole accidents.
Alighting or boarding moving train.
Alighting or boarding stationary car.
Fell in, on, or off car.
Fell off car on curve.
Trouble on account of fare.
Disturbance on car.
Ejectment from car.
Frightened horses.
Electric shock to horses.
Electric shock to animals.
Damage to company's property.
Unusual occurrences.
Miscellaneous.
Power plant.
Lighting.

In the auditor's accident report blank the accidents for each of these classifications for the month and year to date are reported, and the payments are entered in separate columns for the year in which they occurred, so that the total monthly and yearly payments to date appear in both

classifications. The legal expenses connected with accidents are also presented in a number of subdivisions, classified in the same way as are the payments on claims.

System of Uniforming Men in Milwaukee

The accompanying diagrams and specifications of uniform coats, vests and overcoats for the Milwaukee conductors, motormen, station masters and inspectors will be found worthy of study, as they represent a very careful effort on the part of the management to standardize a system of uniforming their employees in such a way as to make it possible for the latter to employ any local tailor, while purchasing the cloth at cost from the company:

GENERAL NOTICES TO EMPLOYEES

Standard uniforms will hereafter be made to conform with the following diagrams and specifications:

Uniform cloth, "Slater" No. 311, for suits, and No. 958, for overcoats, will be furnished by the company at cost, and may be obtained from the storekeeper on order, issued by superintendent of transportation. Failure to procure uniforms within twenty days after issuance of order on storekeeper will be sufficient cause for suspension.

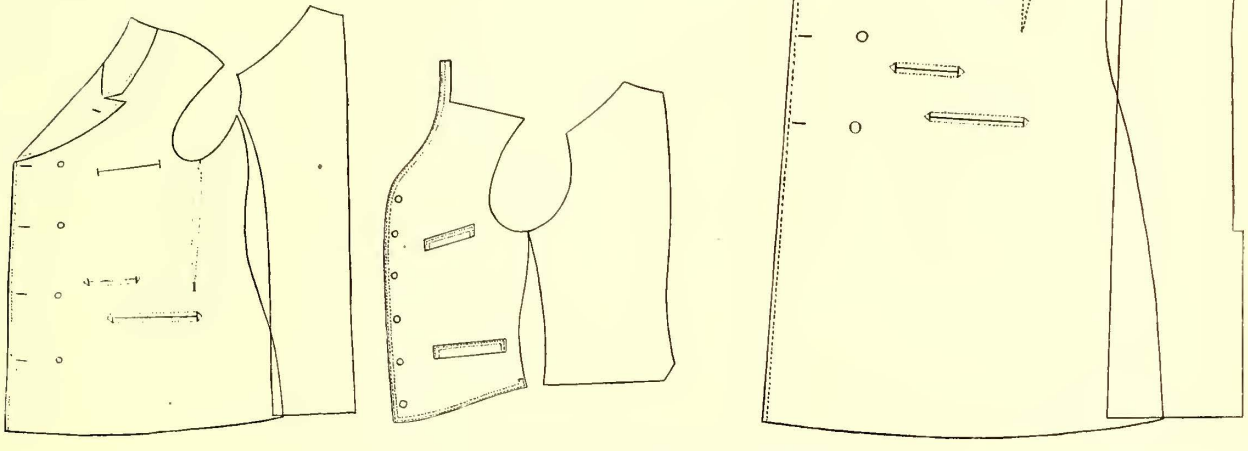
The uniform for patrolmen will consist of a regulation suit made as per diagram *A*. Material to be of corduroy, as furnished by the storekeeper on order of line foreman or superintendent of construction and maintenance of way.

Employees can have uniforms made by any good tailor.

All uniforms must be inspected and approved by station masters or superintendent before being worn on duty.

The winter weight uniform cap for conductors, station masters and inspectors is of blue cloth, stiffened with haircloth, with straight peak and two gold uniform buttons; price $1.50.

Motorman's cap, same as above, but with vizor peak and two silver buttons; price $1.50.



PATTERNS FOR UNIFORMS—MILWAUKEE

The summer cap is of the same general description as the winter weight, but is covered with indigo blue duck; price $1.

The uniform cap for patrolmen is of corduroy to match uniform, yachting pattern, vizor peak, with two silver buttons; price $1

All uniform caps must bear the stamp of the maker, but employees are permitted to purchase their uniform caps from any reputable dealer.

Summer or winter caps may be used at pleasure of the wearer.

GEO. M. KUEMMERLEIN,
Superintendent of Transportation.

Approved, T. E. MITTEN,
General Superintendent Railway Department.

COAT (FIGURE A)

Coat for conductors, motormen, station-masters and inspectors:

Coat, ———. Double breasted, square corner sack, lapel collar. Velvet collar for station-masters and inspectors only.

Length, ———. To extend 4 ins. below the crotch seam, with five buttons on each side.

Edges, ———. Double stitch, ⅜ ins. wide.

Cuffs, ———. Three ins. deep, imitation stitch to match edge, two buttons.

Pockets (outside), ———. One breast, plain finish, two skirt, and two ticket, to be leather corded. (Recommended to be of leather or heavy linen duck, well stayed to prevent sagging).

Body lining, ———. Triple warp, black serge.

Sleeve lining, ———. Extra durable cotton stripe.

Cloth, ———. To be furnished by the company; 3½ yds. required for full suit.

Buttons, ———. To be furnished by the company; silver for motormen and patrolmen; gold for all others. (Recommend all buttons to be sewed firmly in place).

VEST (FIGURE B)

Vest, ———. No collar, six buttons, opening 13 ins. to first button.

Edges, ———. To correspond with coat.

Pockets (outside), ———. Two upper, two lower.

Lining, ———. Extra durable cotton twill.

Back, ———. Triple warp black serge.

Cloth, ———. To be furnished by the company.

Buttons, ———. To match diagram *A*.

TROUSERS

Two top or side pockets; two hip and one watch pocket. Cloth to be furnished by the company; 1⅜ yds. required.

OVERCOAT

Coat, ———. Double breasted lapel, five buttons on each side.

Length, ———. For motormen, 8 ins.; all others 6 ins. below the knee.

Collar, ———. For conductors and motormen, cloth collar, 5 to 6 ins. deep; station-masters and inspectors, velvet collar of ordinary depth.

Edges, ———. Same as diagram *A*.

Cuffs, ———. Same as diagram *A*.

Pockets (outside), ———. Two skirt, two ticket, two hand pockets; all leather corded. (Recommended to be of leather or heavy linen duck, well stayed to prevent sagging.)

Body lining, ———. Blue or black. (Recommend cassimere interlined with blanketing.)

Sleeve lining, ———. Best quality lusterine.

Cloth, ———. To be furnished by the company; 2¾ yds. required.

Buttons, ———. Same as diagram *A*.

In no direction can a railway company save money, or increase dividends more rapidly than by having its equipments thoroughly inspected by competent men, working systematically under intelligent direction. From paper at the Boston Convention, 1898.

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NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

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.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

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There have been so many important happenings in the transportation field during the past three months that it is difficult to keep pace with the progress of events, or to deal with them adequately within the limits of any publication. From all over the country and from foreign lands as well come reports of transportation projects which bid fair to tax home and foreign manufacturing facilities far beyond their capacities, and immediate expansion of these facilities seems a necessity of the most urgent kind, if grave disappointments on the part of customers are not to be realized. It appears probable that new realms are on the point of being conquered by mechanical motive powers, and that the horse will soon be displaced from cab and wagon service in our cities, and from many pleasure vehicles. New York city is to secure real rapid transit at last. Almost the entire transportation system of Brooklyn, surface and elevated, is now under one control, which may also secure the extensive steam railroad which controls the traffic of Long Island. Steam is to be as much a thing of the past in elevated railroading as are the horse and cable systems in street railroading. Foreign cities all over the world are yielding to a desire for better transportation facilities. Everywhere is found activity, energy, engineering enterprise, skill—and extraordinary indifference to investment costs if the ends to be achieved appear desirable.

Schedule speeds, car frequencies, operating expenses and net profits to stockholders are very closely related, and the street railway manager who appreciates this fact and makes a study of each of his lines with a view to increasing speeds and reducing frequencies, still giving due service to the public, will, all other things being equal, give a better account of his stewardship than will he who runs his cars slowly and too frequently. The advantage of high speeds is a double one. The same service can be given with less cars, and, therefore, less transportation wages; the power station cost per car mile is usually, within limits, somewhat reduced, and the gross receipts should be increased, owing to the greater inducement offered to the people to save time by riding. In more than one case, to our knowledge, the increase of car speeds has been the most potent influence in effecting the financial rehabilitation of street railway properties, turning a deficit into a comfortable surplus. In one instance, where higher speed was accompanied also by a longer time interval between cars, gross receipts per car mile were increased in two years about 33 per cent, with hardly 5 per cent increase in operating expenses, and the net earnings per car mile applicable to return on investment was increased 150 per cent. There is no doubt that not a few street railway companies have given to the people a service too frequent to be profitable to stockholders. Statistics show that in nearly every case where electricity has displaced horses, the immediate effects of the change have been a substantial reduction in the gross receipts per car mile. It is true that this has been brought about partly by the building of extensions in new territory and the consequent pulling down of averages, but it has also been caused in part by the great increase in the number of trips per hour and per day. We do not say that the service to the public should not have been bettered in this way—in many cases this betterment was a "franchise tax" in disguise—but a little less liberality with the people would quite surely have increased dividends.

The trustees of the new Massachusetts Electric Company, which controls thirty-one street railway and several electric lighting properties in Eastern Massachusetts, north, west and south of Boston, are fortunate in that the public resident in the territory served by their lines has not been educated to a too frequent car service, while the territory, being suburban in character, is such that high speeds—higher even than at present—can be easily obtained. A consolidation of this kind is more than likely to prove a decided public benefit, through reductions of fares, unification of policies, etc., while at the same time, in spite of the heavy overcapitalization which in these days

always accompanies a transaction of this kind, it seems possible to hope for materially increased profits. The Washington consolidation is a happy solution of a very difficult financial and administrative problem. The numerous suburban lines of Washington ought to be feeders of a central system, and not independent properties. The Chicago consolidation of the Yerkes properties is a simple and self-evident step, which would doubtless have been taken years ago had important franchise questions been settled. Capital has many times tried to effect a consolidation of the many street railway systems of St. Louis, and that it has finally been effected is a cause for congratulation, certainly to the people of St. Louis, and is, very likely, also for the capital invested. There is much talk of a consolidation of the surface and elevated railway systems of New York, but no rumors have thus far been verified, and there are, doubtless, serious obstacles in the way, but capital is, in these days, used to overcoming obstacles of almost every kind, and we should not be surprised at any time to learn that the apparently impossible has been accomplished.

The real and most serious difficulty which capital finds in carrying out these great consolidations is in obtaining the right men to handle the properties. There are hardly a dozen men in the country who are generally recognized in the industry as strong, forceful and thoroughly capable administrators of large street railway interests. These men are "placed," and cannot be shifted, for their associates will not let them go at any cost. A new list must be created from those who have hitherto successfully managed smaller street railway properties, or from the general business world, and the success of capital in fulfilling its promises to the investor will depend very largely upon the men to whom the operating responsibilities are given. The best managers are cheap at any price.

One feature of many of these new consolidations deserves special mention and thoughtful consideration. In Massachusetts the new consolidated company will own eighteen railway and electric lighting power stations. In Washington the two electric lighting companies of the city are consolidated with the railway companies, and plans are on foot for transmitting water power, and otherwise greatly improving the power station proposition. In New York the railway and lighting companies are largely owned in common, and further consolidations are in the air, while in many other cities the tendency is toward similar blending of interests. It is certain that through these consolidations electric power will be generated at much less cost in the future than in the past, and the utilization of that power will be far more general. The average load of an electric lighting station rarely exceeds 25 or 30 per cent of its maximum capacity, and the load factor of a railway station is hardly 10 per cent more. The mere union of these two interests will not in itself greatly improve matters, for the heavy loads of both lighting and railway service usually occur at about the same time of day, but the installation of large storage batteries in the power stations will make it possible to bring the load factor up to 60, 80, or even 100 per cent, provided that a market for the stored current can be found. That this market exists is a certainty. Consider, for example, the possibilities of the electric vehicle business—that infant industry which has just now cast off its swaddling clothes. One difficulty with electric vehicles heretofore has been their comparatively short radius of action. Before long—in Eastern Massachusetts, for example, with its thirty or forty power stations, located in every city, village and town of that great area, and with its magnificent roads—electric vehicles can take on a battery at Boston, exchange it for another at Lynn, for another at Gloucester, another at Newburyport, etc. In Washington, an electric cab and carriage service will doubtless be inaugurated with a similar plan of action, and in other cities wherever pavements are good the future for automobiles is assured. We must again point out to street railway managers how important it is that they should in some way obtain a hold upon this new and promising industry, which should immediately add to revenue, and at the same time act to prevent disastrous future competition.

A correspondent has written to us suggesting that the electric railway companies should publish maps of the different sections of the country showing their routes, so that persons, on pleasure bent, wishing to tour through any district, can lay their plans for traveling by electric cars. While the possible traffic to be secured in this way may seem to some to be rather small, there is no doubt that many electric railways, particularly those in the suburbs of large cities, could develop a considerable amount of pleasure riding by running through cars over connecting roads, especially where it is understood that such cars could be chartered to carry special parties. Among other territories where such traffic could be made popular the following might be mentioned: Around Boston, in the northern part of New York city, the Newark, Orange, Paterson region, the suburbs of Philadelphia, Chicago, and, in fact, of most all large cities where the suburban cars do not now run to the center of the city. The possibilities of following this plan in Eastern Massachusetts are discussed elsewhere in this issue, but while the treatment in that article is intended to cover a particular case, there seems to be no reason why the suggestions made are not equally pertinent to other districts

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The Street Railway Purchase Plan in Detroit

It is impossible to deny to Governor Pingree and his political associates the merit of ingenuity and persistence, however much we may criticise their judgment and sincerity. They have devised a plan for securing municipal ownership of street railways in Detroit, which, though somewhat complicated, would certainly seem to accomplish the main object, which is to secure to the city the possible profits from street railway operation without imposing on it any of the risks and burdens of actual ownership. The plan in its elements is this.

1. The Street Railway Commission is to organize a new company, to which is to be transferred all of the present properties in the city. The new company is to be granted a consolidated thirty-year franchise for the operation of these properties, in place of the present franchises under which they are working, which expire from ten to twenty-five years hence. The new franchise provides for a general three-cent fare on all lines, and for special low priced labor and school tickets in addition.

2. The new company will join the old in mortgaging the present properties and future extensions (made by the new company) for the sum of $17,500,000, represented by fifty-year, 4 per cent gold bonds. As a further valuable asset behind these bonds, it is proposed that the city shall grant to the new company an additional "security franchise," so called, which provides that in the event of default in the interest or principal of the bonds, leading to foreclosure of the mortgage, the purchasers of the property under foreclosure shall have the right to operate the system during the remainder of the thirty-year period and for eighteen years beyond, upon terms and conditions nearly the same as those under which the present companies are now working, which include a five-cent fare with six tickets for twenty-five cents, with somewhat lower rates during the heavy hours of the day.

3. A sinking fund is to be established out of earnings sufficient to provide for the retirement of the bonds in fifty years.

4. Of the $17,500,000 of bonds thus secured by the present properties, the future extensions, and the security franchise, the old companies are to receive $16,800,000, and the new company is to retain $700,000 to provide for extensions, improvements, etc.

5. The stock of the new company is to be held by the Street Railway Commission as trustees, and if, later on, it is decided that the city can legally accept this stock for its treasury, it is to be formally turned over to it, but if not, then the city is to have the power, by a clause in the franchise granted to the new company, of so taxing the latter as to prevent it from making any profits whatever, i. e., the city can impose a tax equal to the entire net profits from operation, after paying interest on bonds and providing for the sinking fund.

It will be seen that the present street railway companies thus surrender control of their properties without a penny in cash, and without the benefit of the city's endorsement of the bonds. In other words, if the new company is unsuccessful, and the interest on the bonds is not paid, the bondholders can do nothing more than take back their property, but they will have as an additional asset a franchise terminating forty-eight years hence at remunerative rates of fare. The scheme is, as above stated, ingenious, plausible and not, perhaps, unfair to any of the interests involved. The experiment of three-cent fares can thus be carefully tried under most favorable conditions for its success and without putting the risk of the experiment upon private capital.

The method of arriving at an appraisal of the property upon which the $17,500,000 bond issue was based seems to be reasonably fair, though it is not, as is locally believed, unduly favorable to the street railway companies. In the first place, the physical assets of the present companies were appraised on the basis of "cost of duplication" by M. E. Cooley, J. D. Hawks, Gilbert Wilkes and others, all men of reputation and special ability in different departments. Their estimates coincided quite closely and led to the determination by the commission that the sum of $8,000,000 represented a fair valuation of the tangible assets. As auditor, E. B. Hutchinson, an expert accountant, went through the books for four years past, and determined that the true net earnings of the property last year were $805,000. As actuary, Prof. Edward W. Bemis, of the Kansas State Agricultural College, then determined the valuation of the franchises and fixed it at the sum of $8,478,564. Prof. Bemis arrived at this sum in the following way.

1. He first scaled down last year's earnings from the auditor's figures, $805,000 to the sum of $750,000, the difference being accounted for, as he claimed, by probably insufficient charges for depreciation.

2. He next assumed an average increase in net earning power of 4 per cent per annum during the remainder of the franchise life of the different properties. This figure was considerably less than the increases of the last few years, but it was deemed by him, as protector of the city's interests, conservative.

3. Having obtained in this way an estimated net revenue for each of the remaining years during which the franchises were to run, he deducted from this revenue, interest at 4 per cent on the cost of the tangible assets, thereby obtaining for each year what he calls the "monopoly earnings," or earnings due to the possession of a franchise over and above the fair return on the actual capital investment.

5. He then discounts these earnings, at 4 per cent, in order to find their present value.

6. The sum of the present values of the estimated "monopoly earnings" of all the years for which the present franchises are to run, becomes, therefore, according to his theory, the value of those franchises above that of the tangible assets.

The effect of a valuation theory of this kind is, of course, to capitalize future earnings, and, temporarily to increase the interest and sinking fund requirements of the new company. This fact is recognized by Prof. Bemis, and he recommends that the sinking fund be created in such a way as to follow the city's ability to pay, the payments of the first few years being less than those of later ones.

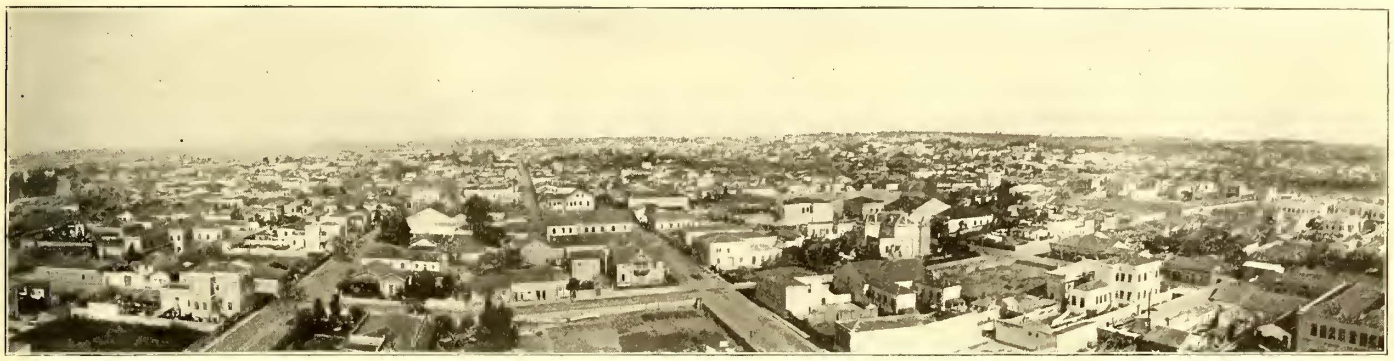
The whole investigation of the Detroit situation has been carefully made, and is, in principle, scientifically correct, but that fact is not fully recognized by the people, who see in the plan only the price which the street railway companies are to get for their properties, forgetting first that a 4 per cent bond of that character will quite surely have to be sold at a considerable discount, and second, that the 4 per cent rate of increase in net earnings assumed by Prof. Bemis is probably considerably less than would be realized by the present companies were they to continue in the possession of their properties.

The Street Railway Commission in Detroit proposed to refer the whole matter of purchase to the people for action, but on June 27 the whole question was laid upon the shelf by a unanimous vote of the common council sustaining the action of its committee on streets and ordinances in unanimously declining to recommend any steps toward city ownership at this time, in view of the facts, first, that no bargain could be made with the railways if three-cent instead of five-cent fares are specified in the security franchise; second, that no legal authority can be found for obtaining a special vote of the people on the subject; and, third, that litigation seems assured if any favorable action should be taken.

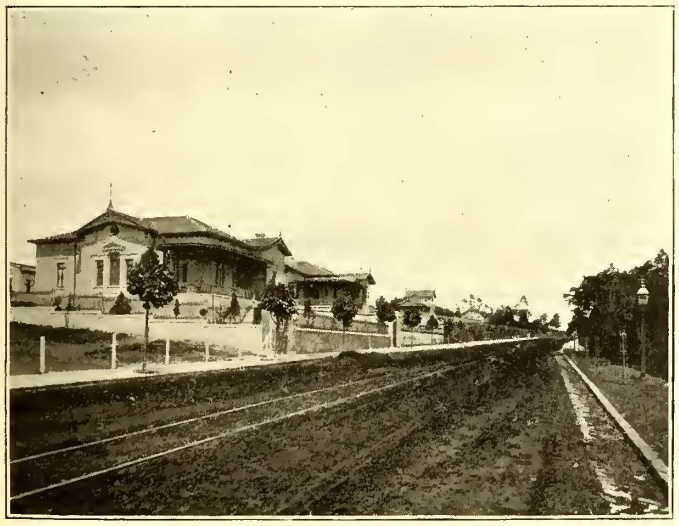
Too much care cannot be given to the sizing and alignment of wheels and the pressure with which they are forced on the axle. At least 50 per cent. of the wheel removals throughout the country are caused by broken or sharp flanges, or a broken wheel. From paper at the Boston Convention, 1898.

The New Railway, Light and Power Enterprise in Sao Paulo, Brazil

Comparatively few North Americans know that in the southern part of Brazil, hardly 300 miles southwest of Rio de Janeiro, lies one of the richest and most rapidly growing cities of South America, the capital of the State of Sao Paulo, and most advantageously located as regards climate, elevation, railway connections and seaport facilities The city of Sao Paulo is situated about 40 miles from the seacoast, directly under the Tropic of Capricorn, 23½ degs. south of the Equator. At a point about 5 miles from the ocean hills rise abruptly to the height of 2000 ft., and from this point a table land extends inland for many miles. Sao Paulo is one of the highest points on this table land, its elevation being 2500 ft. above sea level. The climate is, for a tropical country, cool, bracing and healthful, and is not characterized by that depressing tropical humidity which is felt in the seacoast cities of Brazil. The latest estimates place the population at not less than 250,000, the growth having been extremely rapid during the past ten years.



BIRD'S-EYE VIEW OF SAO PAULO, BRAZIL



VIEWS IN THE CITY OF SAO PAULO

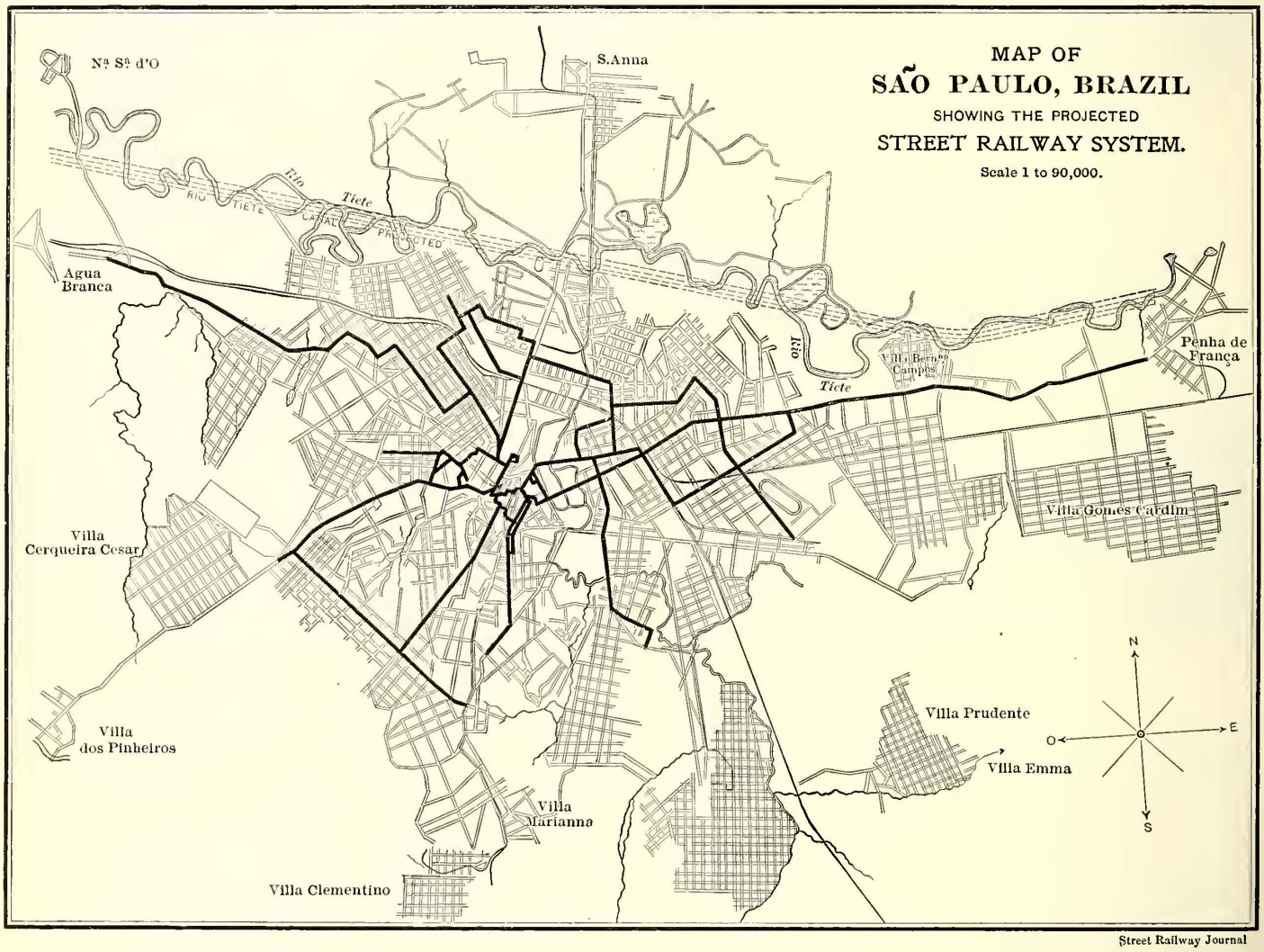
It is to this city that the attention of a number of New York and Canadian capitalists has been directed for some time, with the result that a syndicate has been formed, consisting of F. S. Pearson, chief engineer of the Metropol-

itan Street Railway Company, of New York; William McKenzie, who is largely interested in many street railway properties of Canada; B. F. Pearson, of Halifax, and others, to develop the street railway, light and power interests of Sao Paulo. Franchises have been obtained for street railway lines covering all desirable routes in the city, including a few miles of street now traversed by an antediluvian mule railway, which has been in existence for some years. R. C. Brown, whose management of the Halifax (N. S.) property was such as to win him the entire confidence of its owners, Messrs. Pearson, McKenzie and others, sailed on June 5 for Sao Paulo with a large consignment of electric railway apparatus, and will be in full charge of construction, equipment and, temporarily, of the operation of the system. He is accompanied by F. S. Pearson, who will determine the main outlines of the installation, locate power stations, etc.

The State of Sao Paulo is the principal coffe producing State of Brazil, and is one of the leading and most populous in the entire republic, the production of coffee being a very profitable industry in this climate and under the conditions found here. Forty miles away from the city lies its seaport town, Santos, which gives the name to the coffee produced in the State. The manufacturing industries connected with the coffee trade and supplies for the State have been established in the city of Sao Paulo, which has thus become quite a manufacturing center. The city is obliged to be largely self-supporting, as it is 240 miles away from Rio de Janeiro, and is connected with a railroad running through a hilly district not favorable for the transportation of freight.

The city is quite cosmopolitan, having about 70,000 Italians, and a large number of German, French, English and American residents, and as a result of this foreign mixture there is less opposition to the introduction of foreign customs and enterprise than is found with the people of the Portuguese and Spanish towns of South America. Many of the local enterprises, including the Sao Paulo Steam Railroad Company, the mule tramway company and the gas company, are all of English origin, though a considerable portion of their stock is held locally.

The "old town" of Sao Paulo, which was founded in 1554 by the Jesuits, was built upon a bluff, the sides of which were quite steep. This part of the city is of small extent, but in it are the chief business houses, especially of the retail dealers. The streets are narrow and crooked, but are well paved, and the sidewalks are kept in good



Street Railway Journal

order. Generally speaking, most of them are not, even in this old town, any more hilly than in the average city of the North, but two or three of the approaches thereto are upon streets which are wholly inaccessible to teams or cars, while others have considerable grades, running as high as 9 per cent, though these are short.

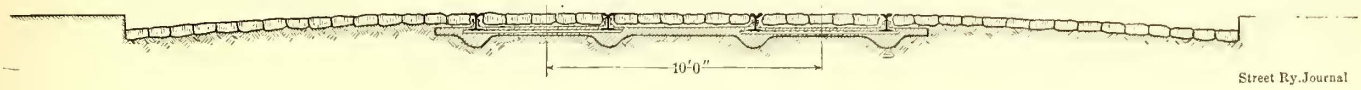
Radiating from the side of the old town, the city has grown outwards quite uniformly, although the development has perhaps been more rapid to the northwest. On the west side, to a distance of 1½ miles from the old town, and considerably above its level, are found some of the finest residences of the city. These districts have, however, very poor and inconvenient transportation service into the center of the city. Northwest of the old city, and quite near it, are thickly populated districts, one of which is so densely populated that electric lines will be well patronized for short distance riding. The present mule

tramway lines are so circuitous that time can often be saved by walking.

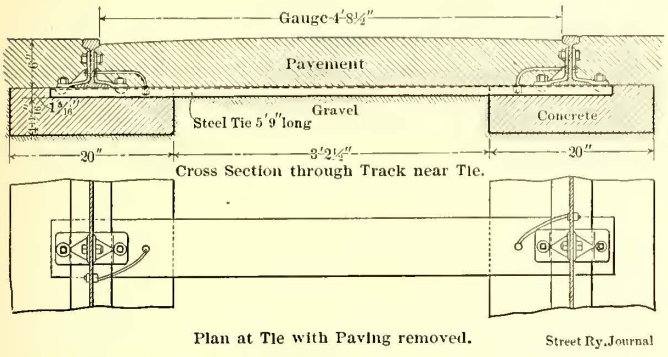
The Pearson-McKenzie syndicate has obtained a concession for the lines shown on the accompanying map. These are laid out in such a way as to give the whole city a good service, but it is not believed that the development of the system will stop with the completion of these lines, for there are desirable suburbs to be reached.

Coal in Sao Paulo sells for $10 per ton, and wood is equally costly. As a consequence, the price of gas and electric lighting is high, and none of the city lighting is as yet done by electricity. Five thousand commercial incandescent lamps are, however, supplied from the present station. The electric light service begins at sundown and, except for a few large customers, extends only until ten o'clock in the evening.

About 20 miles west of the city of Sao Paulo is the only large water power near the city, with a probable minimum supply of 10,000 h.p. to 20,000 h.p. This has been secured by the Pearson-McKenzie syndicate, which intends developing power and transmitting it to Sao Paulo for furnishing the lighting, railway and power service. The introduction of cheap power into a city where steam power at present costs from $100 to $150 per annum will mean a great deal to the industries of Sao Paulo, and to the lighting and railway enterprise. The right to build a transmission line has been obtained, and this line will pass through the town of Augua Branca, where there are at present several factories.

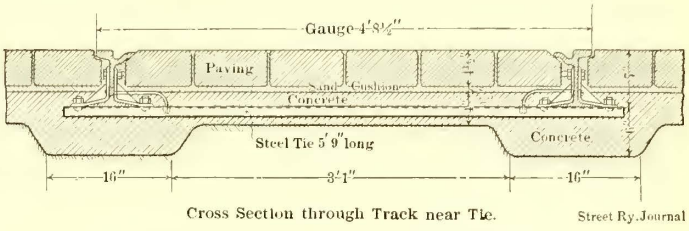


SECTION OF ROADWAY

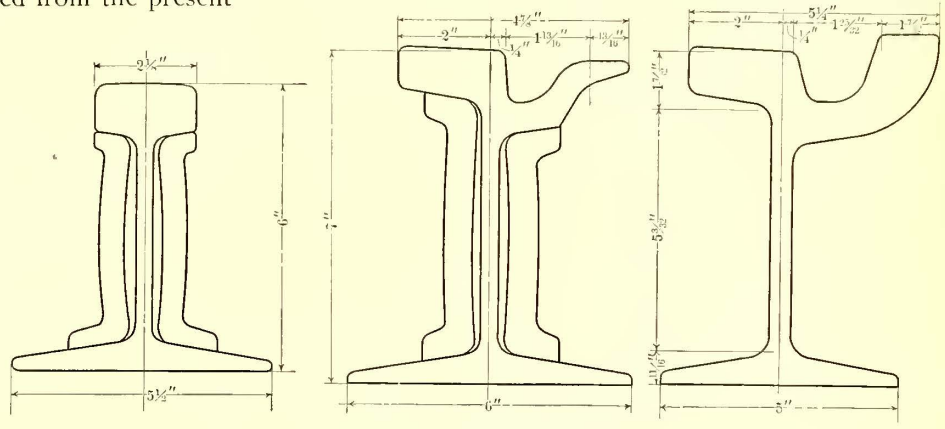


SECTION AND PLAN AT TIE OF T-RAIL CONSTRUCTION

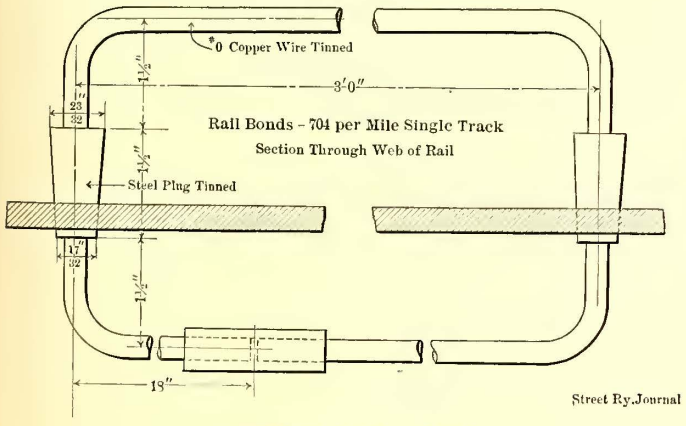
The new syndicate has obtained the government approval for a type of street car, which is almost an exact duplicate of the Broadway (N. Y.) car, and also for a modification of the rail section to the "Trilby" section shown in the accompanying drawing. At present there has been shipped to Sao Paulo 10 miles of track, with necessary ties and other railroad iron, furnished by the Pennsylvania Steel Company; fifteen Brill cars, Broadway pattern; two 225-kw. General Electric generators for direct connection with the Robb Engineering Company's engines, and Cahall boilers. By the end of the year it is expected that 35 miles of track and seventy-five cars will be in Sao Paulo, and within a short time thereafter the temporary steam power station, now building, with apparatus described above, will be replaced by power electrically transmitted from the waterfalls by the three-phase system. At this waterfalls a brick and cement dam, 40 ft. high and 400 ft. long, will be constructed.



SECTION OF GIRDER RAIL CONSTRUCTION



SECTIONS OF STANDARD RAILS



METHOD OF BONDING

The method of track construction used by the company is illustrated in the accompanying engravings. The standard 7-in. girder rail, which is used for city streets, weighs 90 lbs. per yard and is mounted on steel ties spaced every 10 ft. The ties are set in concrete, the latter being carried a distance of 4 11-16 ins. below the base of the rail. The rails are connected with the ties by clips, and are bonded to them, making a cross connection. The joints are also bonded by the Anderson West End bond, illustrated herewith. The guard rail weighs 110 lbs. per yard, and the T-rail for suburban service 62 lbs. per yard.

Ash seems to be most universally used in post and light framing of cars. This is probably due to the difficulty in securing the grade of oak necessary; the lighter the weight of the ash the greater ease with which it is worked. In spite of these difficulties, oak is far preferable, being stronger and more elastic, and will give a far longer life. From paper at the Boston Convention, 1898.

Power Station of the Northwestern Elevated Railway of Chicago

This plant, which is one of the large power stations in Chicago, is nearing completion. It is located on Fullerton Avenue, 3000 ft. west of the elevated structure, and about midway between the ends of the line. The outside dimensions are 255 ft. x 112 ft., the engine room being 57 ft. 7 ins. wide, and the boiler room 50 ft. 2 ins.

The building is of brick, with concrete roof and checkered steel plate floors. The basement, extending under both engine and boiler rooms, is 12 ft. 4 ins. high, with concrete floor, finished in granitoid. The engine room basement contains all steam and exhaust pipes, separators, receivers, as well as the electric cables to and from the switchboard. The boiler room basement contains the smoke flues and the entire system of feed and blow-off piping, ash conveyors, etc. The boiler feed pumps are also located in the basement, on the side of the chimney.

The latter is a prominent feature of the building. It has a 16-ft. flue, and the top is 203 ft. above the street level. It is 27 ft. square at the base, and rests on a foundation of piling, driven 30 in. centers. These piles carry a concrete footing 31 ft. square and 5 ft. thick.

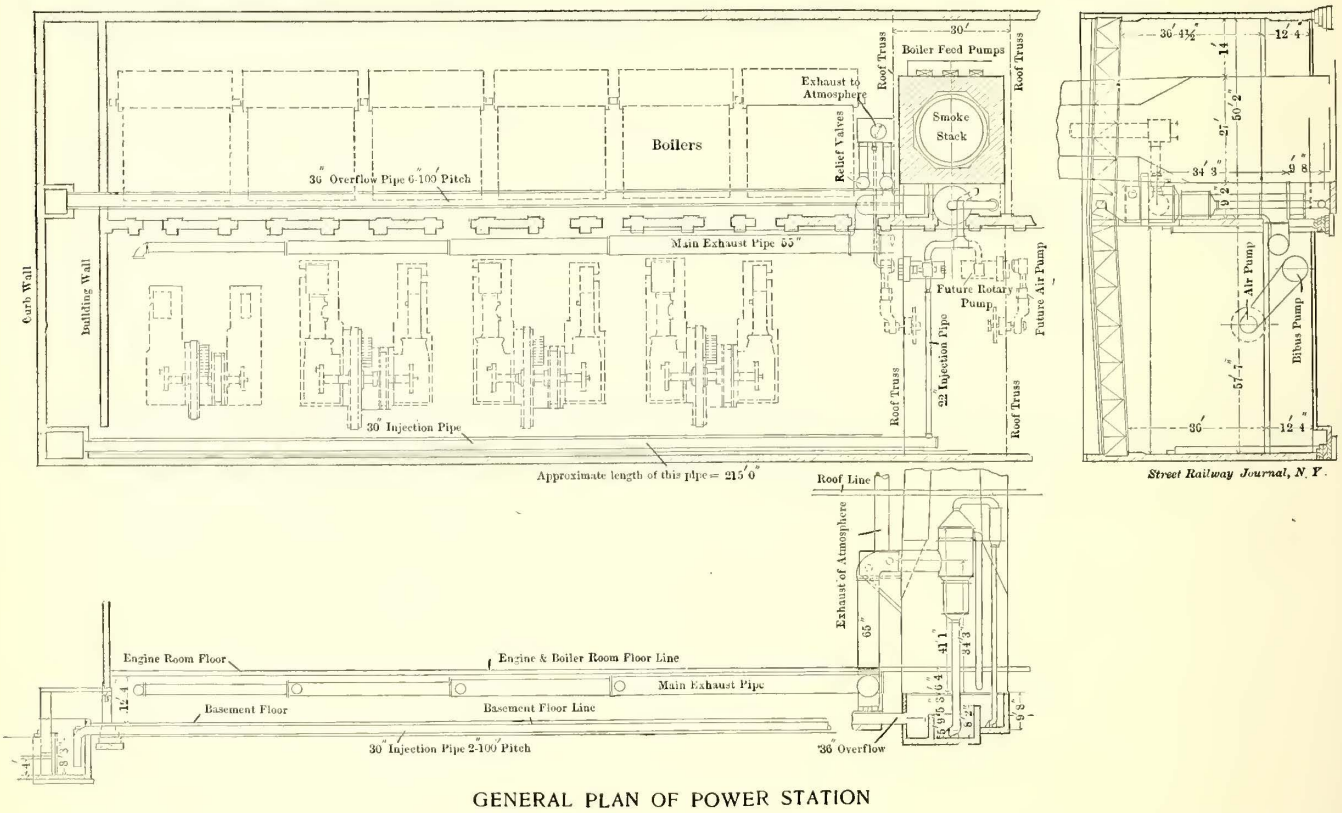
The plant will contain three engine and generator units of 1500 kw. capacity, and one of 750 kw. The engines are cross compound, of the Allis-Corliss type, and are direct connected to Siemens & Halske generators with the internal armatures. The cylinders of the 2000-h.p. machines are 30 ins. and 60 ins. x 60 ins. stroke. Those of the 1000-h.p. machine are 23 ins. and 46 ins. x 48 ins. stroke. The diameters of the flywheels on the two engines are 25 ft. and 20 ft., operating at 75 r.p.m. and 80 r.p.m., respectively.

The plant will contain twelve batteries of Babcock & Wilcox water tube boilers, set in batteries of two boilers, and equipped with twenty-four Murphy automatic smokeless furnaces. In connection with the furnaces there will be storage bins, conveyors and chutes, which will deliver the coal into magazines, from which it will be fed automatically into the furnaces. The conveyor system will be of the gravity bucket type, and will be so arranged that the buckets will receive the ashes in the basement and carry them to the ash bins outside of the building. The coal, after going through the cracker, will either be distributed by the conveyors along the length of the outside storage bin, or else distributed in bins above the furnaces.

The main steam header, to which all boilers are connected, is located in the boiler room above the boilers, and is made of 28-in. lap-welded wrought iron pipe, with the flanges welded on. The header is made in three sections, each section being connected by four 8-in. "U"-shape steel pipes. A 6-in. separate header is provided for the auxiliary machinery. The maximum working steam pressure will be 160 lbs. per sq. in.

All the live steam valves are extra heavy-ribbed, bronze-seated gate valves of the Chapman manufacture.

The boiler feed water will be supplied by three vertical duplex feed pumps of the admiralty type, manufactured by Henry R. Worthington Company. The water, before entering the boilers will pass through two heaters of the Berryman type, with a capacity of 2000 h.p. each. All exhaust steam from the auxiliary machinery is taken into these heaters.



GENERAL PLAN OF POWER STATION

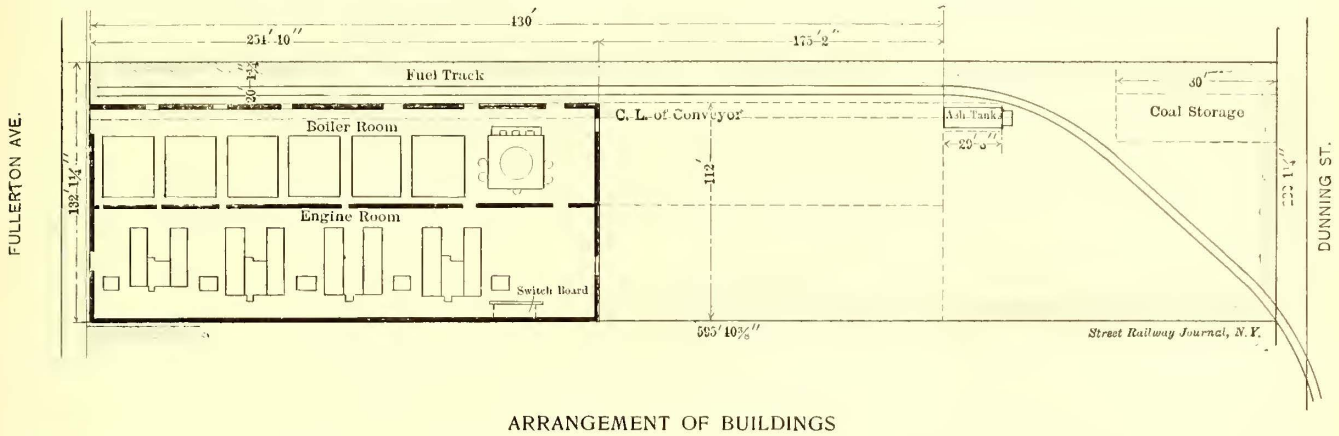
In place of the usual arrangement of an independent condenser for each engine in the power house a central condenser of the Weiss counter-current type, built by the Southwark Foundry & Machine Company, is being installed by Edward M. Hagar & Co., the Western agents for this device, to condense the steam from all the engines in the power house. The condenser vessel being installed has a capacity sufficient to take care of the ultimate capacity of the station, that is, 14,000 h.p. The auxiliary machinery, consisting of a steam engine driving tandem

The city has a 12-ft. brick tunnel from Lake Michigan, which flushes the north branch of the Chicago River. This tunnel runs in Fullerton Avenue directly in front of the power house, and arrangements have been made with the city whereby all water used in the station for condensation and other purposes is supplied from this tunnel through a 30-in. pipe.

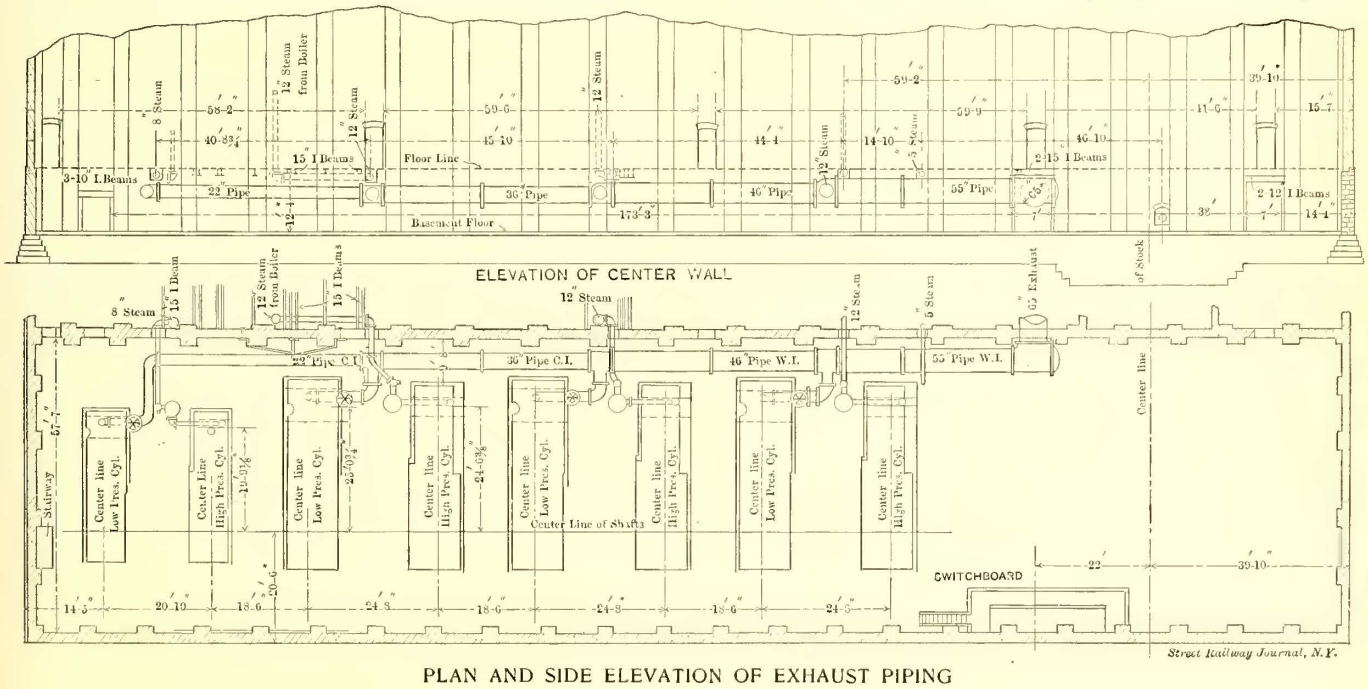
a dry air pump and belted to a Bibus pump of the rotary type, is of sufficient capacity to take care of the present installation of engines, which have a nominal power of 7000 h.p.

The air pump is an improved type of air compressor, with positive and automatic valve motion, working absolutely free from water. The circulating pump is of the positive type, of high efficiency, and both this and the air pump are driven by an economical engine provided with a capacity regulator. This circulating pump only handles the cold injection water, the hot water passing out automatically through a barometric column, or so-called water leg.

Many advantages are obtained by the use of this central condenser, and it is said that the amount of power required to drive the condensing machinery is only a fraction of that required by the usual jet condensers. It is also claimed that this condenser uses only one-half to two-thirds the amount of cooling water necessary for a jet or surface condenser, and again, the height that the condensing water has to be lifted is not so great in the Weiss condenser as it is in an ordinary condenser using a wet air pump, there being a "balance" due to the height of the water in the barometric tube or water leg. The hot well of this condenser is hotter than with any other, as the temperature of the overflow can be the same as that of the exhaust steam. In other words, it obtains without cost the same effect as would be produced by a feed water heater in the exhaust pipe. For these reasons, and on account of the simplicity of its construction and the positive regulation of the amount of the condenser water, the system seems particularly adapted for use with fluctuating loads and for central condensing plants. The reliability of the condenser comes from the fact that there are no valves of any kind, of contracted area or small openings for the air or water to pass through, which can become clogged or congested, causing a dropping of the vacuum. At the same time the amount of water fed to the condenser is automatically regulated by the positive displacement rotary pump, which is driven by the air pump engine. In the usual condenser a sudden increase in the load, or a leak, lessens the vacuum, which in turn reduces the quantity of water, causing a still poorer vacuum; whereas in the Weiss system the water is pumped in entirely independent of the vacuum. An increase of load, however sudden or severe, does nothing except slightly lessen the vacuum. A back flow of water from the condenser into the main engines can never occur, because the water flows out freely by gravity through the water leg, which is always of liberal size. The exhaust piping in a central plant using a Weiss system is also simplified, and a large number of cross-connections, gate and free-exhaust valves are dispensed with, as the exhaust main is run through the plant, and all engines attached to it. A free-exhaust valve located at the condenser vessel will lead the steam to the atmosphere should it be necessary at any time to operate the station non-condensing. The ability to maintain a good vacuum at the engines situated a distance from the



ARRANGEMENT OF BUILDINGS



PLAN AND SIDE ELEVATION OF EXHAUST PIPING

condenser comes from the fact that the air is removed separately from the water, thus taking care of any moderate leaks in the main exhaust pipe.

The switchboard panels are the General Electric Company's standard railway type. The generator panels are on the main floor, and the feeder panels on a gallery.

James R. Chapman is the chief engineer, and Z. E. Knapp, engineer in charge of the work.

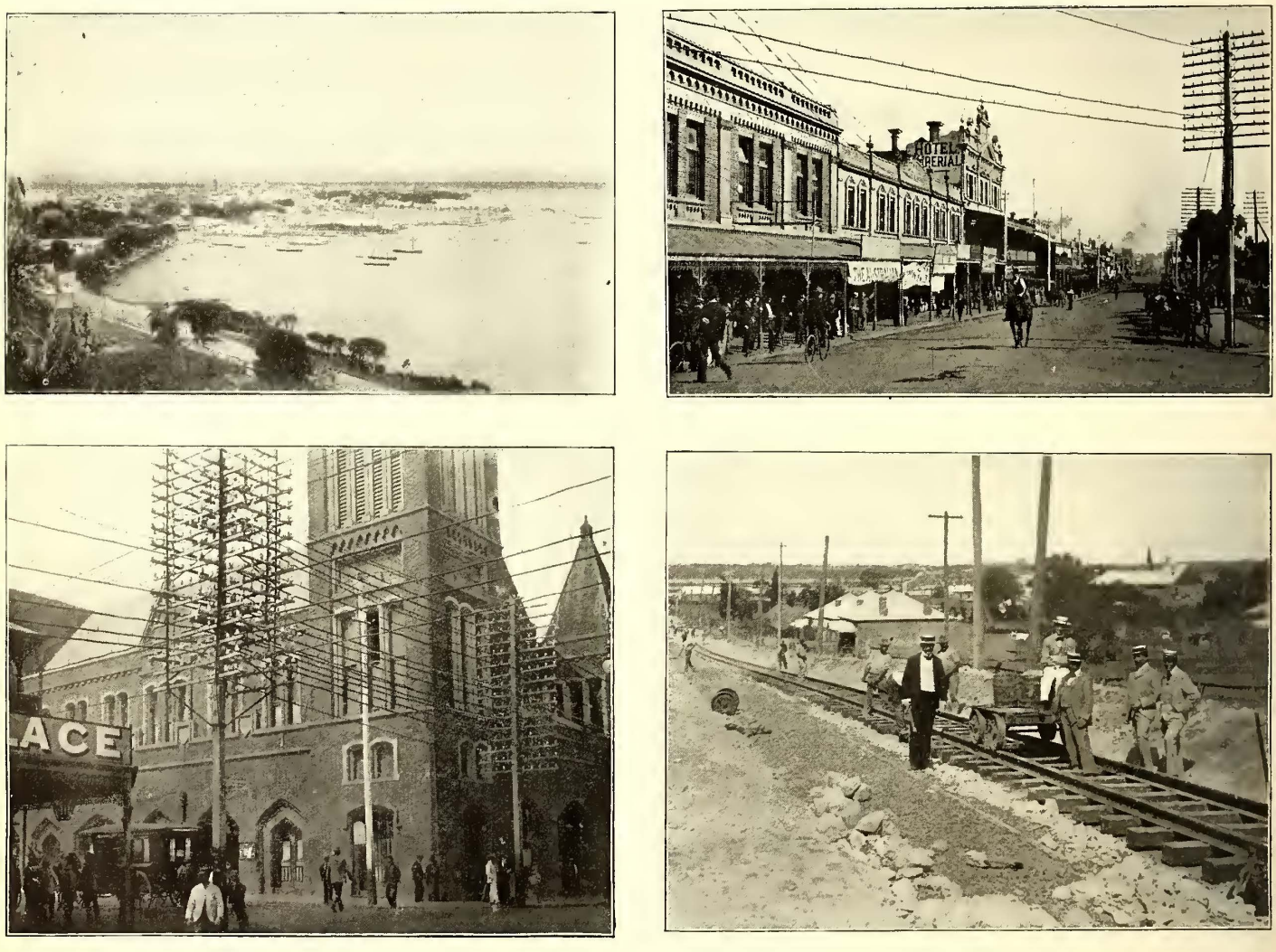
New Plant at Perth, Australia

The construction of a new complete steam and electrical plant for the Perth Tramways, Ltd., Perth, Western Australia, is progressing rapidly. The equipment for the station will be as follows: Two 250-h.p. Babcock & Wilcox boilers, with wrought headers; two 325-h.p. tandem compound engines built by the Robb Engineering Company, of Amherst, N. S.; two outside packed single cylinder double plunger feed pumps, each capable of feeding 500-h.p. of boilers; two 225-kw. direct connected railway generators, manufactured by the General Electric Company, together with switchboard and accessories. A complete system of steam exhaust feed water and drip piping will be installed, and all fittings in high pressure piping will be made of gun iron; all joints are of the Van Stone type, and each boiler is equipped with a No. 12½ Hayden & Derby double tube lifting injector. All the piping in the plant will be covered by H. W. Johns fire-felt covering; Chapman valves will be used.

The steel roof trusses and purlins for the car barn were furnished by E. B. Gumaer, Jersey City, and the corrugated roof covering was furnished by McCullough Iron Company, of Wilmington, Del. Ten new cars have been ordered from the J. G. Brill Company, of Philadelphia. These will be single truck, 18-ft. bodies, with cross seats and center aisle, and will be mounted on Brill 21-E trucks.

The 9-in. girder rail, with fittings for 2 miles of the system, was furnished by the Pennsylvania Steel Company. The remainder of the rails were shipped from Belgium. The special work of hard center construction was furnished by William Wharton, Jr. & Company, of Philadelphia.

J. G. White & Company, of New York, prepared the plans for the foundations and buildings, and all detailed drawings for temporary power house, car barn and power plant, and acted as the general purchasing agents in the United States for the London syndicate owning the tramways. W. E. Cooke, representing the London owners, has complete engineering supervision of the erection of the new plant.



VIEWS IN PERTH

Milford, Attleboro & Woonsocket Street Railway

The Milford, Attleboro & Woonsocket Street Railroad Company is building an important link, 33 miles in length, which will connect the terminals of ten electric railroads and pass by the depots of seven steam railroads. Upon the route are five well-known pleasure resorts, including Pearl Lake, where a natural amphitheater seats 3000 persons. One section of the line connects Hopkinton, Bellingham, Franklin, Wrentham and Attleboro. Another

section connects Caryville with Bellingham, Blackstone and Woonsocket.

The company will have two power stations. One will be equipped with two 250-kw. Westinghouse "engine type" generators, direct connected to steam engines working at 120 r.p.m. The other will contain two 325-kw. Westinghouse direct connected generators, working at 100 r.p.m Thirty-two new cars are being built for the service; one-half will be single truck, with two 30-h.p. Westinghouse railway motors, and the other half will be mounted on double trucks, and equipped with four 30-h.p. Westinghouse railway motors. The larger cars will be capable of maintaining a speed of 30 miles an hour.

History of the Cleveland Strike

The history of the strike of the Cleveland Electric Railway Company's employees is largely told by the following communications which have passed between the company and the men.

On June 9, the day before the strike was actually declared, the company sent out a circular letter to each of its employees at their home addresses, reading as follows:

To the employees of the Cleveland Electric Railway Company:

The company having learned that for the first time in many years dissatisfaction exists among its employees, which it believes is very largely due to mutual misunderstandings, desires to make a plain statement of its position, so that entire harmony may be secured.

It may be true that in the management of so large a system of roads, involving so many details, conditions at times exist which ought, for mutual benefit, to be modified, and the company stands ready to make every concession for the comfort and benefit of its employees which can reasonably be asked, or which can be granted consistently with the proper performance of its public duties.

This company is a common carrier, and has the entire burden of responsibility for the safe and proper carriage of its passengers. It cannot free itself from this burden, nor can it lawfully leave to others who have not this responsibility any direction or control in matters affecting the efficiency of its service.

It will be readily conceded that the company must make and rigidly enforce all rules which are necessary for the safety and comfort of its passengers. The company, however, needs and desires the hearty co-operation of its employees in the enforcement of rules, and stands ready to make modifications in its present rules, if any of them are unjust to its employees. Its attention has, however, only been called to three or four specific objections, such as the pay of men working short hours, lay-over time at end of routes and swing runs. The schedules at present in force were adopted after careful consideration, with a view to the most efficient transportation of passengers upon its cars. The forms of the schedules have not been changed, nor are there additional swing runs therein. The company has so far been unable to find any way in which to handle the increased traffic of morning and evening except by means of swing runs. It, however, desires to use no more runs of this character than are absolutely necessary, and it is possible that a readjustment of the time table may do away with some objectionable runs and modify the speed of others, as well as provide suitable lay-over time. In so far as this can be done, the company will make the necessary changes, if any feasible plan can be found which will obviate these difficulties.

With reference to wages of men working short hours, the distribution of extra runs and the pay therefor, the company will be glad at any time to receive any committee of its own employees for the purpose of considering these questions, as well as the other complaints which have led to the present situation, so that, so far as such complaints are reasonable, they may be corrected. If the company and its employees are unable to agree as to the reasonableness of such complaints and the proper redress thereof, the company stands ready to submit the same to disinterested arbitrators, to be chosen in the usual way.

By order of the board of directors.

The Cleveland Electric Railway Company,
H. A. EVERETT, President,
R. A. HARMAN, Secretary.

Cleveland, Ohio, June 8, 1899.

On June 10, the strike was formally declared, a strike in its essence one for the recognition of the street railway employees' union, and a demand that the company should employ only union men, and should compel all their present employees to become members of the union immediately.

On the afternoon of June 11, the following resolution was adopted by the board of directors of the company:

Whereas, The Cleveland Electric Railway Company has exhausted every effort to come to an amicable understanding with its employees; and

Whereas, In spite of such efforts its employees have inaugurated a strike upon its lines and have refused longer to perform their duties. Now, therefore, be it

RESOLVED, First, that all of the company's employees who desire to continue in its service are hereby required to report for duty at their respective stations on Monday morning, June 12, 1899, at 7 o'clock, and that the employment of those who do not so report be terminated.

Second. That the superintendent of the company post a copy of this resolution upon the company's bulletin boards at its different stations, and that the resolution be also published in the daily newspapers of the city of Cleveland, so that all employees have notice thereof.

By order of the board of directors.

R. A. HARMAN, Secretary.

On June 11, the State Board of Arbitration met in Cleveland and attempted to bring about a reconciliation of the differences between the parties, but after a conference with the labor leaders and President Everett, the following letter was received by the Board of Arbitration:

June 12, 1899.

Honorable State Board of Arbitration:

Dear Sirs—At a meeting of the board of directors just held, the following resolution, offered by Mr. Stanley and seconded by Mr. Andrews, was unanimously adopted, viz.:

RESOLVED, That the differences between the Cleveland Electric Railway Company and its former employees have substantially narrowed down to the proposition, upon which the company must stand, that it must hire and discharge men without the dictation of anybody. As already stated, it does not attempt, nor will it attempt, to dictate to its employees whether they shall belong to a union or not. It will not require them to join, nor will it discharge them for joining or refusing to join, at their pleasure. The company must reserve to itself the right to treat directly with its own men, to hire new ones as the needs of its service require, and to discharge inefficient men without accounting to anybody except to its directors.

Entertaining these views, it must respectfully decline to submit these questions to arbitration. Very respectfully,

R. A. HARMAN, Secretary.

The strikers' appeal to the public, issued on June 12, is as follows:

To the Citizens of Cleveland:

We, the undersigned employees of the Cleveland Electric Railway Company, earnestly request every citizen to co-operate with us in our time of need, to help us settle our differences between said company and its employees, as they are shipping in men from other cities by the carloads to take our places by misrepresentation, telling these men through agencies in other cities there is no trouble here, and as we are not asking anything but citizens' rights in our public streets, we want slower time, so as not to endanger the lives of the people of our community.

We have tried every means in our power to live up to said company's rules and protect our families and citizens, and found it impossible to do under existing rules and schedules, so we earnestly urge you to assist us in our trouble.

We have met with a flat refusal to treat with us in any manner, except as individuals. Now, as from past experience we have found that their verbal agreements have never been lived up to, we have determined among ourselves to accept nothing but a recognition of our association, believing that in union there is strength. This is not a matter of wages, but one of principle, and that principle is the right to demand humane treatment from the Cleveland Electric Railway Company.

We request all citizens and taxpayers to be present at the meeting of our City Council to-night, to urge upon that honorable body the immediate settlement of the existing differences. Signed

HARRY S. BRYAN, President,
R. S. THOMPSON, Secretary.

On June 17, the strikers issued this further appeal to the public:

To the Citizens of Cleveland:

We, the employees of the Big Consolidated, do earnestly petition the citizens of Cleveland to refrain from riding on the cars of the Big Consolidated lines which are now being operated by workmen imported from nearly every city in the Union. We claim they cannot give as satisfactory service as can be given by members of our union, who are citizens of Cleveland, and who have families whose whole interests lie in the betterment of one of the grandest cities in the country. Therefore, we once more appeal to every citizen who has the love of his flag, city and family at heart to help win an honorable battle for right and justice.

Respectfully submitted,

Executive Board, A. A. of S. R. E. of A.

The strike collapsed a day or two later, the strikers intimating their willingness to give up recognition of the union. On June 21, the following offer was made by President Everett to the committee of the Common Council, specially appointed to deal with the matter of the strike:

The memorandum proposal of the committee composed of late employees of this company, submitted by your honorable committee to the company, has been considered by the company's board of directors, and by order of said board the company begs to make the following statement to your committee:

The first and most difficult question presented is that of the status of the company's former employees. This company cannot restore the status quo existing previous to the strike, because its men left their employment and refused to operate its cars, and being required by law and its contract with the United States Government and the city of Cleveland to operate the same, it employed other operatives, who have remained loyal during this trouble. In order to secure the services of these men the company was obliged to assure them regular employment, and it cannot honorably or legally violate those contracts and discharge these men. The company has, however, employed no more than from time to time have been absolutely necessary to operate such parts of its lines as it could safely operate, but has refrained from employing new men more rapidly with the hope and in the expectation that its late employees would re-enter its service. The only thing the company can do is to re-employ at once, without regard as to whether they are union men or not, as many of its former employees as its business requires, which will to-day be at least 60 per cent of the entire number, and as many more as possible, distributing the runs among the present employees and of those thus re-employed as equitably and fairly as possible, taking into account the rights of each. Beyond this, as additional men are needed in the company's service, its former employees will have the preference at all times.

In this re-employment two things must, of course, be understood: First, the service of the former employees with the company's present employees must be loyal, and the latter must not be subject to annoyance or abuse by the former; second, the company reserves to itself the right not to re-employ any of its former employees who have committed unlawful acts during the strike. It is not necessary to discuss any other matters of difference until some agreement is reached upon this most important proposition.

This proposition was refused by the strikers, who demanded that all employees except those who had been actually detected in destroying property be taken back, that all disputes between the company and its employees on questions of schedules or wages of men should be determined between the company and a committee of employees, and that all their questions should be determined by outside arbitrators, if the joint committee cannot agree. The strikers formally receded from their main original contention that union employees only should be employed.

On June 25, the strike committee of the Common Council reported as follows:

The council committee appointed by the City Council to aid in adjusting, if possible, the strike between the Cleveland Electric Railway Company and its late employees, can to-day obtain such an adjustment upon the following terms, to which the said company on its part assents:

1. The restoration of former schedules to stand, as publicly announced to the city authorities.

2. Upon questions of wages of the men working short hours, the distribution of extra runs and the pay therefor, as well as upon other grievances, the company will receive a committee of its own employees for the purpose of considering the same, and if unable to reach a conclusion with such employees or their committee as to the reasonableness thereof, the company will submit these differences to disinterested arbitrators, to be chosen in the usual way.

3. In order that the men in the company's employ may have a proper sense of security in their employment, the company shall not discharge any man except for cause, which cause shall, at his request, be given him, and he shall be given a full and fair opportunity to explain or disprove the same, by himself or a committee of said company's employees, to be selected by said discharged employee.

4. Questions of schedules and of wages shall not be submitted to arbitration. The company shall have the ultimate right to hire and discharge men, contracting with them individually, and not collectively. It shall take back into its employment such of its former employees as its business demands, aggregating at the present time 80 per cent of such employees, and as other vacancies occur shall give preference to such former employees, excepting always those who have committed unlawful acts against the company, its property, or its employees, during the present strike; but the rehiring of all men shall be upon the express condition that their services with the company's present employees must be loyal, and the latter must not be subjected to annoyance or abuse by them, and any violation of this condition shall be deemed cause for discharge.

5. The services of the employees shall be distributed as equitably as possible under existing conditions. The company shall at once, upon the return of its former employees to its service, give 80 per cent of the runs to the former employees and 20 per cent of the runs to its present employees; the remainder of its former and present employees to be placed on the extra list in the same proportion. The method of apportioning these runs between former and present employees shall be as follows:

The first four runs on the time-table of each line shall go to the former employees, the fifth run to the present employees; the next four runs to the former employees, and the tenth run to the present employees, and so on through the time-table, with the day runs, late runs and extra list.

Temporarily this adjustment may work some inequalities to some men, but the same will be adjusted as equitably and promptly as possible on these lines.

These propositions the committee deem equitable to both present and former employees and to the company, and recommend the same for your acceptance. Unless acted upon and accepted at once, the committee believes its service will be of no further avail. The committee is fully aware that the public services cannot longer await the adjustment of this difficulty. Some means will have to be adopted at once to provide for the public needs on this company's lines.

The above proposition was agreed to and signed, as follows:

The Cleveland Electric Railway Company, by H. A. Everett.

L. B. Whitney, R. S. Thompson, Everett Todd, Thomas McHugh, George S. Gilmore, A. N. Miller, strikers' committee.

It will thus be seen that the company has virtually won the strike, its refusal to make its system a union road being consistent and absolute. The later reports from Cleveland are that the strikers are not observing that clause in the contract which provides that new men taken on during the strike must not be subjected to annoyance or abuse by the old men. There have been a number of riots, due to the presence of new men on the cars, and they are at the present time being treated with great harshness by the old men.

Tapping an Oil Pipe Under Pressure

BY J. F. HOBART

An oil cup which was piped into the engine supply pipe several feet above the engine, recently became detached by the thread stripping out where the small pipe was screwed into the larger one. This allowed the steam to escape into the engine room rather too freely for comfort, until a pine plug was driven into the hole where the pipe came out. Soon the engine began to groan (in the cylinder) from lack of oil, and it became absolutely necessary to get the $\frac{3}{8}$-in. pipe connection in again.

The thread had come so completely out that the pipe could not be screwed back in again, and it seemed impossible to tap the thread in that hole, with 120 lbs. steam pressure in the pipe. The engine could not be shut down, for it was driving cars and working up to the limit with no relay, pending the putting in of a duplicate engine beside it.

The job was finally done in this manner: A tap was procured of the right size to fit one size larger pipe, and a reamer was put into a common brace (bit stock), the same as used by carpenters. A piece of heavy sheet packing—it was about ¼-in. thick—was found in the cupboard. The packing was about 3 ft. square. A hole just large enough to squeeze the shank of the reamer through was made in the middle of the sheet of packing, the reamer put through and the brace put on.

Then the plug was taken out of the pipe and the engineer stood right up to that hissing steam pipe—stood on the engine cylinder—and reamed out the hole in the steam pipe until the tap would enter. Then the reamer was removed and the tap put in the brace, and the sheet of packing used as before. It took but a very few minutes after that to tap the hole and start in the bit of pipe with a globe valve on it. After the pipe was in place the job was practically finished as far as the "kink" was concerned, but I have seen the same kind of a shield rigged up for use when a gage glass blew out and there was no way of shutting the valves without getting scalded. The packing did it all right then, too.

Employment Contract in Milwaukee

The employment contract used by the Milwaukee Electric Railway & Light Company in engaging its employees contains the following clauses:

I agree to submit to a medical examination by the company's doctor, and to pay for the same a fee of $1.

I agree to work on trial, under instruction, and without pay five days in said company's shops, and at least ten days on such of its cars as I may be assigned to.

I understand that no compensation is paid to trainmen for time spent by them while engaged "on watch" (which means waiting at any designated point for an opportunity to work), but that wages are allowed only for service rendered while actually employed on said company's cars, and are computed at following rates:

—— cents per hour for first six months after being placed on extra list.

—— cents per hour for second six months after being placed on extra list.

—— cents per hour for second year after being placed on extra list.

—— cents per hour for third year after being placed on extra list.

—— cents per hour after three years' service with said company.

These wages are entirely satisfactory to me, and for which, if given employment, I agree to work contentedly and faithfully.

I further agree that if I am discharged, or leave said company's service voluntarily at any time during or after the trial period above referred to, I shall have no claim against said company for services rendered or expenses incurred by me during said trial period or while performing duty "on watch," as above explained.

When placed upon the extra list I agree to deposit with the company, without interest, the sum of $25 as a surety fund for the faithful performance of my duty.

I agree within thirty days after being placed on the extra list to provide myself, at my own expense, with a standard uniform, in accordance with the rules and regulations of the company.

So long as I remain in its service I agree to study carefully and comply faithfully with all rules, regulations and orders of the company.

In witness whereof I have hereunto set my hand and seal at Milwaukee, Wis., this —————— day of ——————, 18—.

Electrical Exposition in Chicago

The National Exposition of Electrical Arts Company has been organized in Chicago and incorporated, with a capital of $50,000, in the State of Illinois, for promoting an exposition to be held at Tattersalls, Sept. 25 to Oct. 9. Coming as it does at the time of the fall festivals in Chicago, the exposition gives promise of meeting with very great success. The autumn carnival, to be held in connection with the laying of the corner stone of the new post-office, will be in progress on the date set for the opening of the exposition, and, as there will be thousands of visitors in Chicago, the exposition will undoubtedly be one of the chief attractions. The officers of the exposition company are N. J. Heimbach, president; W. E. Burnham, treasurer, and T. Carrabine, secretary, names well known among Chicago business men.

It is the intention to make this a general electrical exhibition. Manufacturers of electrical apparatus from all over the country are already signifying their willingness to co-operate, and the exposition will be one of the most complete ever held in Chicago.

The American Street Railway Association will have its exhibition in the same building, beginning a few days after the first one closes. This increases the interest of the latter to street railway men and manufacturers of street railway apparatus. Those who intend making exhibits at the street railway convention can, with very little additional expense, arrange to present their exhibits at the National Exhibition of Electrical Arts. All applications for space should be sent to the Exposition Company in the new Life Building, Chicago. Tattersalls Building will be handsomely decorated and lighted.

Space will be leased to exhibitors at rates varying according to size and location. The Tattersalls building is 148 ft. x 265 ft. There are 149 exhibition spaces, ranging from 100 sq. ft. to 400 sq. ft. In case of very extensive exhibits two or more sections may be combined. The aisles are from 9 ft. to 12 ft. wide, and plenty of open space is left at the entrance of the building.

Among the concerns that have already signified a determination to take part in the show are the Chicago Edison Company, Chicago Telephone Company, Postal Telegraph Cable Company, the Allen-Hussey Company, Advance Specialty Company, and Eureka Telephone Company. It is probable that gold medals will be awarded for excellence of exhibits.

Recent Sales of Electrical Supplies

Elmer P. Morris, of New York City, reports that during the past month the demand for electric railway supplies has been unusually heavy, and orders have came in from all parts of the world. He has sent poles to Brazil, Cuba, Syracuse, N. Y.; Asbury Park, N. J.; Phœnixville, Pa.; Brooklyn, and Westchester County, New York, and other supplies to Africa, South America, Cuba, Trinidad, etc. The sales of wire have been particularly large.

Mr. Morris has recently appointed two new agents; one the Miller Electrical Maintenance Company, at Pittsburgh, and the other, Henry L. Prather, New England Building, Cleveland, Ohio.

Additions for Brooklyn

The Westinghouse Electric & Manufacturing Company is executing an important contract for increasing the electric plant of the Coney Island & Brooklyn Railroad Company. Last year one power station was equipped with two 500-h.p. Westinghouse compound engines, direct connected to two Westinghouse generators of 500 h.p. each, to deliver current at 550 volts for the railroad. A duplicate outfit of 1000 h.p. is now being provided for the Smith and Knight Streets power station. In addition there will be installed a 500-kw. Westinghouse generator, with a series wound booster, direct connected to a steam engine, to do railroad work. A two-paneled switchboard is included in the outfit.

Major-General Leonard Wood, Military Governor of the Province of Santiago, has received an offer of the presidency of the Washington (D. C.) Traction & Electric Company, but he has not yet signified his decision in the matter, and will sail for Cuba on July 3 or 4, to continue his work in Santiago, at least for the present. General Wood's great organizing and executive ability, his long residence in Washington, and his high reputation in every way would seem to make him an almost ideal man for this position, but it is doubtful if he can be induced to give up his army career.

Convention of the Ohio Street Railway Association

The annual convention of the Ohio Street Railway Association was held at Springfield, Ohio, June 14. There were twenty-four members and visitors in attendance. The morning was spent in visiting the power house of the local company and in taking an inspection trip over several of its lines. After dinner at the Arcade Hotel, the convention convened at the Lagonda Club.

There were no papers read, but a general and informal discussion was indulged in, the chief subjects being how best to further the interests of the association and the procuring of new members.

New members were added to the association as follows: Wheeling Railway Company, Wheeling, W. Va.; Mansfield Electric Railway Company, Mansfield, Ohio; Canton & Massillon Electric Railway Company, Canton, Ohio; Zanesville Electric Railway Company, Zanesville, Ohio.

Cincinnati was chosen as the next meeting place of the association, the meeting to be held on the second Wednesday of June, 1900. Officers for the ensuing year were chosen, as follows: S. L. Nelson, president, Springfield, Ohio; J. F. Flood, vice-president, Steubenville, Ohio; Charles Currie, secretary and treasurer, Lima Ohio; executive committee—A. A. Anderson, Youngstown, Ohio; W. A. Lynch, Canton, Ohio; T. H. McLean, Toledo, Ohio.

After supper the members and visitors repaired in a body to the Elks Street Fair, which was in progress in the city, and where a most enjoyable evening was spent. The members and visitors in attendance were as follows: B. Walker Peterson, vice-president, Wheeling Railway Company, Wheeling, W. Va.; Charles Currie, secretary and treasurer, Ohio Streeet Railway Association, Lima, Ohio; E. J. Wehrly, general manager, Arbuckle-Ryan Company, Toledo, Ohio; H. C. Fogle, general manager, Canton & Massillon Electric Railway Company, Canton, Ohio; A. L. Wilkinson, Ohio Brass Company, Mansfield, Ohio; Charles Hodge, Westinghouse Electric & Manufacturing Company, Columbus, Ohio; John Harris, superintendent, Cincinnati Street Railway Company, Cincinnati, Ohio; G. A. Schroeder, Multiplex Reflector Company, Cleveland, Ohio; F. H. Strieby, General Electric Company, Cincinnati, Ohio; C. S. Nolloth, Standard Electric Company, Cincinnati, Ohio; F. E. Ginn, superintendent, Lancaster Traction Company, Lancaster, Ohio; C. E. Harrison, Hildreth Varnish Company, Steubenville, Ohio; O. C. Evans, Lorain Steel Company, Cincinnati, Ohio; William H. Sinks, Varney & McOuat, Indianapolis, Ind.; C. S. McMahon, Street Railway Journal, Chicago, Ill.; H. J. Kenfield, Street Railway Review, Chicago, Ill.; Arthur E. Jones, National Lead Company, Cincinnati, Ohio; G. R. Scrugham, Creaghead Engineering Company, Cincinnati, Ohio; Lou. Williams, superintendent, Springfield Railway Company, Springfield, Ohio; H. A. Dorner, Dorner Truck & Manufacturing Company, Cleveland, Ohio; W. R. Morrison, assistant general manager, Bay City Electric Railway Company, Bay City, Mich.; Reid Carpenter, Mansfield, Ohio; C. H. King, Ohio Brass Company, Mansfield, Ohio; P. Leidenger, Dayton Manufacturing Company, Dayton, Ohio.

The entertainment provided by S. L. Nelson, of the local company, was most hospitable, and the Ohio Street Railway convention at Springfield will be long remembered by all present.

The Ohio Brass Company exhibited its emergency hose bridge, and a test of it was made on the local line, the exhibit being attended by all present in a body. A number of cars were run over the bridge, both rapidly and slowly, and with absolutely no inconvenience; in fact, it scarcely seemed an obstruction. This bridge is now in use in Chicago, Dayton, Cleveland, Toledo, Nashville and other cities. The company states that it is meeting with universal success.

Varney & McOuat, of Indianapolis, through William H. Sinks, exhibited armature coils, of which this company is now making a specialty. The company is doing a large repair business for railways throughout the Central States. The company's excellent work, together with its central location and excellent shipping facilities, is building up a large business.

The Multiplex Reflector Company, of Cleveland, Ohio; was represented by George A. Schroeder, who exhibited one of the company's new multiplex reflector lamps. These lamps are no more expensive than others in use, and throw a most powerful light, owing to the peculiar construction of the reflector.

Virginia Street Railway Association

The latest State street railway association to be organized is that of Virginia. The association of that State includes both electric railway and lighting interests, and held its first annual meeting at the Hotel Jefferson, Richmond, May 16. Representatives were present from electric railways in Stanton, Norfolk, Richmond and Lynchburgh. The papers read were on "Track Bonding," by R. D. Apperson; "How to Increase Revenue of Electric Light Stations;" "Park Amusements," and "The Use of the Wattmeter on Electric Cars to Check the Unnecessary Use of Current." Mr. Apperson, in his paper, stated that he used the plastic bond on his railway, and referred to it in the highest terms.

The Washington Consolidation

The bankers who are financing the Washington consolidation have just issued a prospectus of the Washington Traction & Electric Company, and offer $12,000,000 out of an authorized issue of $20,000,000 of first mortgage, collateral trust 4½ per cent, fifty-year gold bonds. This company controls eight street railway companies, with 116 miles of track, and the only two electric light companies in the city, with 72 miles of subway, about 400 miles of duct, and many miles of overhead wires. The Capital Traction Company is the only railway in the city not in the consolidation. Of the $20,000,000 bond issue, $6,558,000 is reserved to retire outstanding bonds of constituent companies, $1,442,000 is held for future uses of the company, and the remaining $12,000,000 is now issued as stated. An estimated statement of earnings for the year ending July 1, 1900, issued by Messrs. Stevens, Crosby and Lieb, is as follows:

Gross earnings of railway properties	$1,750,000
Gross earnings of lighting properties	550,000
Total	$2,300,000
Operating expenses	1,150,000
Net income	$1,150,000
Total fixed charges	887,480
Surplus over charges	$262,520

H. H. Vreeland and F. S. Pearson, in their report to the United States Mortgage & Trust Company, estimate that the gross revenue of these properties will be $1,850,000 per annum, and that the operating expenses should not exceed 50 per cent at first, and 40 per cent eventually, of the gross receipts. They estimate also that within three years the electric lighting properties should earn at least $1,000,000, and the percentage cost of operation should not exceed that of the railways. Within three years' time the combined revenue from the entire consolidated properties should not, they say, be less than $3,000,000.

The different lines comprising the Washington Traction & Electric Company's system are being put in first-class shape, and a number of extensions are under way. The contractors for the work are J. G. White & Co., of New York, who are now building about 35 miles of new track and 45 miles of overhead work; the track work, including the laying of both girders and T rails, and comprising the reconstruction of the present track and overhead work of the Georgetown & Tennalytown Railroad and the extension of this line to Rockville; the reconstruction of the Brightwood Railway, including branches to the Soldiers' Home and Tacoma Park; the reconstruction of the Washington, Woodside & Forest Glen Railroad, including relining, surfacing and ballasting the present tracks and rebuilding overhead work; rebuilding the overhead line of the Glen Echo Railway, and rebuilding the overhead line of the Great Falls Road. The construction is all first-class in every way, a greater part of the T rail being rock ballasted. The overhead construction will all be double trolley, positive and negative. The size of the trolley wire will be 00.

The New York & Long Island Tunnel

The Long Island & New York Terminal Railroad Company was incorporated June 17, with a capital stock of $7,500,000, for the purpose of constructing a tunnel from the present terminus of the Long Island Railroad on Atlantic Avenue, Brooklyn, to the Manhattan Island terminus at the corner of Cortlandt and Church streets. The directors of the company represent many important financial interests, and are trustees of enormous capital, so that there is no doubt that the work will be entered upon immediately and pushed through as rapidly as possible. President Baldwin, of the Long Island Railroad, states that a force of men has been at work for more than a year making test borings in the streets of Manhattan Island and under the East River, and they are now perfectly familiar with the route to be followed, the materials to be encountered and the nature of the work to be done. The Legislature having at its last session granted necessary permission for the work to proceed, the next step will be to obtain franchises from the municipal assembly. There will be two tunnels, or parallel tubes, placed at a depth of 80 to 132 ft., and the lowest point below the surface will be reached at the Brooklyn City Hall.

LEGAL NOTES AND COMMENTS

EDITED BY J. ASPINWALL HODGE JR., OF THE NEW YORK BAR

The Right of a Street Railway to Carry Freight

In a brief, recently filed by eminent counsel, in an action where the right of a street railway to carry freight or express, it is stated that "from 1834, when John Stephenson invented the first street railway car, to within a period of one year no street railway company ever claimed or asserted the right to operate cars exclusively for the transportation of property." This, we believe, is a much broader statement than the facts justify. It would be interesting to learn of the earliest date when such a car was operated by a street railway in this country; but the vital question is not whether, or when, the right was claimed, but whether it *exists* under present statutes of the various States.

The question is being litigated in the action referred to *(DeGrauw vs. Long Island Electric Railway Co. et al.)*, and is pending before the appellate division of the Second Department of the Supreme Court of New York.

The plaintiff asked for an injunction restraining the defendant from operating a car devoted, exclusively, under a contract with the National Express Company, to the carriage of express packages between two depots of the express company in the Borough of Brooklyn. A demurrer of complaint was sustained in the court below, on the ground that the New York act granting to street railways the right to carry "passengers and property" included the right to run such a car, and the plaintiff has appealed from that decision.

The plaintiff's appellant contention is briefly: that no such right can be implied. If it exists it must be founded upon some express provision of law; that construing the words "passengers and property" in connection with the subject matter of a street railway act, applying the maxim "*noscuntur a sociis*," the words mean "passengers and passengers with property," and do not mean "passengers and freight;" that the legitimate uses of a street do not include the transfer of freight and express, and certainly do not include the transfer of the same from fixed places under contract with a particular individual or corporation, the public generally not benefiting, directly, thereby. In support of these propositions many *dicta* from decisions were cited, wherein it was stated that "street railways transport passengers only," while "commercial railroads carry both passengers and freight;" the first, stop at short intervals, on the highway to take passengers, off and on, and the latter receive and discharge both passengers and freight at regular depots, further apart. *East End St. R. R. Co. vs. Doyle, 9 L. R. A. (Tenn.), 100; Louisville, etc., R. R. vs. City R. R., 2 Duval (Ky.), 178; Funk vs. St. Paul R. R., 29 L. R. A. (Minn.), 208; Nichols vs. Ann Arbor R. R., 16 L. R. A. (Mich.), 374.)*

Among the text-book writers Messrs. Booth, Elliott and Rorer were cited.

On the behalf of the defendant-respondent it was urged with much force that the words "passengers and property" were precisely the same words which are used in the general railroad act of New York, and in fact to-day are used in a section of the railroad law which, by express provision, applies both to steam and street railways. And further, that prior to the Constitution of 1875, special acts were passed by the Legislature, granting to particular street railways various powers, and in some cases expressly prohibiting the carrying of freight; in other cases the special acts gave them the right to carry passengers without any reference to property at all. It was contended in the light of these statutes that the words "passengers and property" used in the general act must mean passengers and freight.

The weight of authority would seem to support the defendant's contention where these words are in the statute.

In considering the decisions in any particular State it is, of course, quite necessary to examine, carefully, the charter or the general act under which the street railway is formed, to determine what authority is given to it. In that connection it should be remembered, that the franchise to construct and operate a street railway is one that must be conferred by the State, and that its power is sovereign over the streets.

A serious problem is presented in New York, if the contention of the Long Island Electric Railway Company is sustained, since, under the decision of the case of the Broadway surface road *(People vs. O'Brien, 111 N. Y., 1)*, it would appear that this right, if now held by the street railroads of New York, can be exercised even against the will of the Legislature, on the ground that to deprive them of the right they now hold, would be taking away a property right, protected by the Constitution of the United States.

In such city streets as are now crowded with passenger cars the running of numerous freight or express cars might work to the public inconvenience, rather than to the public convenience. While, in the great majority of cases, it is obvious that the carrying of freight and express upon rails would work a great public benefit, whether within city limits or between towns and cities.

The problem is one of the present and future, and the courts may be trusted to develop the law in accordance with the needs of the public and the improvements of the age, according to the now well-established doctrine which is ably expressed in the Diamond Match Company case *(Diamond Match Company vs. Roeber, 106 N. Y., 473, 481)*.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

IOWA.—Duty to Refloor Bridge—Ordinance.

Under an ordinance authorizing a corporation to operate a street railway over certain streets, avenues and bridges, and requiring it to keep in repair that portion of such paved streets and highways which is included between its tracks and one foot on either side, and to pave such portion of any street or avenue when ordered by the council, the company is not bound to refloor with oak plank any portion of a bridge over which its tracks pass.—(City of Cedar Rapids vs. Cedar Rapids & M. C. Ry. Co., 79 N. W. Rep., 125.)

MASSACHUSETTS.—Parol Evidence—Illegal Sale.

1. Parol evidence to contradict the terms of a note is inadmissible.

2. Plaintiff was constructing a street railroad for the I. Company, but, before completion, was notified that it would not be accepted. Some three miles of the road had been finished, except the overhead work. Thereupon plaintiff acquiesced in such refusal, and sold "all the material and other property now being on the line of the street railway" to the A. Company, and agreed to take their notes in payment therefor. The purchasing company, by resolution of its directors, voted to buy "all the material and other property owned" by the plaintiff. At the same time plaintiff agreed to credit all sums received from the A. Company in payment of its claim against the I. Company. A short time thereafter the A. Company was operating the line. Held, that as soon as the rails were annexed to the soil by the plaintiff they became the property of the I. Company, within the meaning of Pub. St., chap. 113, sec. 56, forbidding a street railway company to sell or lease its road; that the refusal to accept them did not change this fact; and that, if the whole transaction was a scheme whereby the I. Company attempted to sell the road being constructed by plaintiff to the A. Company, it was illegal, and the notes given in consideration thereof were void.

3. For the purpose of showing the real nature of the transaction, oral evidence of what was said and done at the meetings of the directors of the companies at the time the matter was under

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

consideration by them is admissible.—(Clemons Elec. Mfg. Co. vs. Walton, 53 N. E. Rep., 820.)

MISSOURI.—Operating Over Other Lines—Injunction—Damages—Jurisdiction—Appeal—Reversible Error.

1. Where, pursuant to St. Louis city charter, art. 10, sec. 6, providing that any street railway company may run its cars over any other company's lines, on payment of compensation, under such regulations as may be prescribed by ordinance, ordinances were passed authorizing one company to operate its cars over the lines of another, and providing the manner of adjusting compensation, and such compensation had been fixed and accepted by the latter company, it is not entitled to an injunction to restrain the former from operating cars which interfered with the running of its cars, and from using certain modes of connection, where the connections were made according to the latter's plans, and the inconveniences suffered were the natural result of the legitimate use of the connections.

2. The court had jurisdiction of the subject-matter of the action, since, under the petition, complainant might introduce evidence showing that defendant had connected its tracks in a manner not authorized, and was running cars not contemplated by the award, to plaintiff's continuous damage.

3. Error in rendering judgment in plaintiff's favor, of which he cannot complain, is not reversible, where he alone appeals.—(People's Ry. Co. vs. Grand Ave. Ry. Co., 50 S. W. Rep., 829.)

NEW YORK.—Receivers—Claims.

A debt incurred for supplies furnished an elevated railway company prior to the appointment of a temporary receiver, in an action to foreclose a mortgage on its property, under Code Civ. Proc., sec. 1788, is not a preferred claim, and the receiver will not be ordered to pay it.—(Mercantile Trust Co. vs. Kings County El. Ry Co. et al.—in re Lovell et al.—57 N. Y. Suppl., 892.)

NEW YORK.—Change of Motive Power—Inference.

1. A horse railroad consists of two tracks laid on opposite sides of the two tracks of an underground trolley system occupying the middle of a street 50 ft. wide between the curbs, and there is 32 ft. between the outside rails of each track of the horse railroad. A change of its motive power to the underground trolley system contemplates that the cars will project over the rails so that there will be less than 12 ft. of clear space between them and the curb, but the rails are to be laid flush with the surface and the cars are to be run intermittently. Held, that it could not necessarily be inferred that the change would permanently obstruct it, and result in an exclusive appropriation of a portion of it to other than customary street uses, and that it would depend on the speed and frequency with which cars were run.

Same—Right to Change at Will.

2. Laws 1873, chap. 825, granting the right to construct, operate and maintain a street railroad by steam, animal or mechanical power over certain streets and avenues in New York city, including what is now Amsterdam Avenue, does not empower owners of the franchise to change at will the motive power of a constructed road, irrespective of the consent of the railroad commissioners or property owners.

Same—Consent of Propertyowners.

3. Laws 1890, chap. 565, sec. 100, providing that a street surface railroad may change its motive power on the consent of "the owners of one-half of the property bounded on that portion of the railroad with respect to which a change of motive power is proposed," contemplates that a majority of those owning property, measured by its extent in lineal feet along the route as to which a change of power is proposed, shall consent.—(St. Michael's Protestant Episcopal Church in City of New York vs. Forty-Second St., M. & St. N. Ave. Ry. Co; Society for Relief of Destitute Blind of City of New York and Its Vicinity vs. Same, 57 N. Y. Suppl., 881.)

NEW YORK.—Payment of Judgment—Right to Recover Back—Mistake.

After the denial by the Appellate Division of an application for leave to appeal to the Court of Appeals from an affirmance of a judgment, and during the pendency of an application to the Court of Appeals for leave to so appeal, made without the procurement of a stay of execution, the judgment debtor, erroneously believing that his application to the Court of Appeals had been rejected, paid the judgment on the creditor's threat to issue execution. Held, that, on being granted leave to appeal, the judgment debtor could not recover back the amount paid under a mistake, since the payment, made while the right to issue execution on the judgment existed, was voluntary.—(Third Ave. R. Co. vs. Klinker et al., 58 N. Y. Suppl., 136.)

OHIO.—Ejectment—When It Lies—Recovery of Possession of Streets by City.

1. Ejectment will lie by a city to recover possession of streets in which the public has an easement.

Courts—Following Prior Decisions.

2. Defendants, claiming as licensees of a city in a suit by adverse claimants, set up and successfully maintained the right of the city to certain land under a dedication for street purposes. Held, that in a subsequent action by the city against the defendants, the evidence being practically the same, the former decision as to the validity of the dedication as claimed by the city would be followed, on the principle of stare decisis, though the city was not a party to the adjudication.

Municipal Corporations—Abandonment of Street—Intention.

3. Where a city had granted, or attempted and assumed to grant, the right to defendants to use ground it claimed as a street, its acquiescence in such use for any length of time will not operate as an abandonment of its claim to the property.

Estoppel—Acts in Pais—Construction of Party's Conduct.

4. The conduct of a party, sought to be made the basis of an estoppel against him, must be viewed in the light of the understanding he then had of his rights, and not in the light of such rights as they may be thereafter determined.

Same—Acts of City.

5. In 1849 the city of Cleveland entered into a contract with certain railroads, by which it granted them the right to use a portion of a tract of land claimed as a street. Not long afterwards, in a suit against the railroads by an adverse claimant, the defendants alleged their interest in the land to be that of licensees of the city, and successfully defended on the city's title under a prior dedication. Held, that the city, by permitting the railroads to remain in undisturbed, or even exclusive, possession of the ground for forty-five years, and to expend large sums in the construction of improvements thereon without objection, was not estopped, as against them, to claim any rights in the property consistent with the contract, according to the construction and meaning given it by the defendants in their pleading in the former suit, where they had never given notice of any other or different claim.

Limitation of Actions—Ejectment—Nature of Defendants' Possession.

6. Nor can the defendants in such case successfully plead limitation against an action by the city, whatever may be the true construction of the contract under which they took possession, or the nature of their rights otherwise acquired, as by their own admission, in a sworn pleading, their holding was not adverse to the city, and it had the right to rely on such admission until notified that they claimed under a different tenure.

Same—Admissions in Pleadings.

7. A formal allegation in a petition in ejectment that, on the date it is filed, defendants unlawfully keep the plaintiff out of possession of the property, is not an admission that defendants' possession is adverse which will support a plea of limitation, on proof that they have held in the same right for more than the statutory length of time.

Rights to Public Grounds—Construction of Contract with City.

8. Under the constitution of Ohio of 1802, the only restriction upon the exercise of the power of eminent domain by the Legislature was the provision that money compensation should be made for private property when taken for public use, and by the railroad act of 1848 (46 Ohio Laws, p. 40) railroad companies were given power to construct and maintain railroads between the points named in their respective charters, and to appropriate streets or other public grounds to their use when necessary, either by agreement with the public authorities, or, such agreement failing, by a decree of a court. Held, that a contract made in 1849, while such act was in force, between a city and a railroad company, by which the city granted, "as fully and absolutely" as it had the power or legal authority to do, the right to the "full and perpetual use and occupation" of a portion of a street required by the railroad company for terminal purposes, did not reserve to the city any rights in, or control over, the property described, but that the railroad company took from the State under the statute, and not from the city, an easement of a perpetual and exclusive use.—(City of Cleveland vs. Cleveland, C., C. & St. L. Ry. Co. et al., 93 Fed Rep., 113.)

PENNSYLVANIA.—Contracts for Use of Tracks—Construction—Estoppel—Parties.

1. The S. Co. has no such substantial interest in the subject of the right of the T. Co. to use the tracks of the S. Co. under an agreement between the P. Co. and the A. Co. as will authorize the entertaining of its bill to enjoin the use thereof, where all the stock of the S. Co., except five shares, which are unrepresented, and the owners of which have made no objection, is owned by the P. Co., which has for years had possession of and run the road of the S. Co.

2. The P. Co. is estopped from contesting the validity of an agreement for use of its tracks by the A. Co. on the ground that it was not authorized by the directors, or reported to and approved by a meeting of the stockholders, where the officers of the P. Co. were the movers for the agreement, and it was sanctioned by its

attorneys, and approved, before it was made, by a majority of its stockholders, and was reported by its president to the next annual stockholders' meeting, when no objection was made to it, and it has been carried into effect fully and completely; the tracks being repaired, payments made, and the road operated thereunder for several years.

3. The T. Co., which owns all the stock of the A. Co., and has a lease for 999 years of all its franchises, property and rights of every kind, is an "assign" of it, within a contract giving certain rights to it and its assigns.

4. A contract which gives the A. Co. and its assigns the right to run its cars over the tracks of the P. Co. for a certain consideration, though not requiring a greater consideration in case of an increase in the number of cars, does not allow an assign of it, which owns other lines, to run its cars, and in addition those of the other lines owned by the assign, over such tracks for such consideration.—(South Side Pass. Ry. Co. vs. Second Ave. Pass. Ry. Co. et al.; Pittsburg & B. Traction Co. vs. South Side Pass. Ry. Co. et al., 43 Atl. Rep., 346.)

WASHINGTON.—Taxation—Validity of Assessment—Ownership of Property.

1. The power house and other buildings of an electric street railroad company were situated on a tract of land, a part of which was owned by the company and a part held under a lease for twenty-five years, which bound the company to pay the taxes thereon. Held, that the company might properly be regarded as the owner of the entire property for the purposes of taxation, and its assessment as an entirety was valid.

Same—Improvements on Real Estate.

2. Where a street railroad company may properly be regarded as the owner, for the purposes of taxation, of leased land upon which its power house and plant are in part situated, such buildings are taxable, under the statutes of the State of Washington, as a part of the real estate.

Same—Railroad Right of Way—Actual Use for Other Purposes.

3. Under the statute of Washington (1 Hill's Ann. Code, sec. 1046), providing that all lands occupied and claimed exclusively as right of way for railroads must be assessed as a whole, and as real estate, at a certain sum per mile, a part of the designated right of way of a railroad, but which is in the actual use and occupation of a street railroad company for purposes of its power plant, under a lease for twenty-five years, cannot properly be taxed as a part of the right of way of the railroad company.—(N. Y. Guaranty & Indemnity Co. et al. vs. Tacoma Ry. & Motor Co. et al., 93 Fed. Rep., 51.)

LIABILITY FOR NEGLIGENCE.

ALABAMA.—Collision with Buggy—Willful Injury.

Where a horse and top buggy, inclosed by curtains, moving in the same direction as, and about 100 ft. ahead of, a street car, running five or six miles an hour, turned to cross the tracks, and the motorman, though he saw the buggy turn, failed to slacken speed or give warning, and the car struck the buggy, his conduct amounted to a willful injury.—(Birmingham Ry. & Elec. Co. vs. Smith, 25 So. Rep., 768.)

CALIFORNIA.—Negligence—Sprinkling Carts—Trial—Questions for Jury—Compromise and Settlement—Evidence—Ratification.

1. Plaintiff was rightfully driving a street sprinkler on a street car track. According to his custom, on turning into the street on which the tracks were, he followed rapidly behind a passing car, sprinkling the street as he went, and turned around several times to see that no accident might happen. A car coming behind plaintiff sounded the only warning bell 700 ft. away, and then came on with accelerated speed; not attempting to slack the car until within two or three car lengths of the cart, and even then not using the most effective appliance for stopping the car. The cart and its load weighed five tons, and made considerable noise when sprinkling. Held, that the street car company was negligent, so as to be liable for the injuries to plaintiff.

2. A person severely injured by an accident compromised the claim next day, and made his mark as a signature to the receipt. He testified that his mind was a blank as to the occurrences from the time of the injury until several days after the alleged settlement, when he was taken to a sanitarium. Two witnesses testified that he spoke of the settlement after coming to the sanitarium, and there was nothing to show that at that time any one had informed him of the settlement. Held, that the question whether he had knowingly settled the claim was for the jury.

3. Evidence of a person who had been injured, that he knew nothing of what occurred the next day, when he made an alleged settlement of his claim, is equivalent to a statement that he was "entirely without understanding" at such time.

4. The retention of money paid in settlement of a claim for personal injuries is not a ratification of the settlement, where retained without knowledge of how it was obtained.

5. Where the jury was instructed that they might deduct from the amount of damages for personal injuries any money given to plaintiff by defendant by way of an alleged settlement, defendant cannot complain that it was injured by such payment.—(Los Angeles City Water Co. et al. vs. Superior Court of Los Angeles County; City of Los Angeles vs. Los Angeles City Water Co. et al., 57 Pac. Rep., 216.)

CALIFORNIA.—Injuries to Passengers—Evidence—Pleading—Damages.

1. Where a passenger was thrown from a street car while rounding a curve and injured, his testimony that the car was going at an unusually rapid rate of speed is sufficient to sustain a verdict, where other passengers were thrown at the same time.

2. Under an allegation that the accident was caused by the high rate of speed he may prove that the fall was occasioned by a sudden jerk, accompanied by the high rate of speed.

3. Evidence that uterine trouble was caused by an accident due to defendant's negligence is admissible under a general averment of bodily injury and resulting damage.—(Samuels et ux. vs. California St. Cable Ry. Co., 56 Pac. Rep., 1115.)

GEORGIA.—New Trial—Instructions—Arguments of Counsel—Injury to Passenger—Evidence—Appeal—Review—Pleading—Amendment.

1. That the contentions of one party were not as specifically set forth in the charge of the court as were those of the other was not cause for a new trial, when the charge as a whole fully, fairly and correctly covered the law applicable to every issue in the case.

2. There was no error in refusing to give a request in charge which implied that counsel for the adverse party had made an improper appeal to the jury, when, as shown by the certificate of the trial judge, no such appeal was made.

3. Refusal to give requests in charge is not error, when, so far as legal, they are fully covered by the general charge.

4. Where counsel for the defendant objected to certain language used by plaintiff's counsel in his argument to the jury, upon the ground that it was an appeal "to make a verdict based on matters not in the plaintiff's declaration and suit," and thereupon the presiding judge stated to the jury that "the position of the defendant's counsel was the law, and the jury should take it as such," and gave further appropriate instructions upon the subject, after verdict a new trial should not be granted the defendant upon the ground that "the court should have given direct and unqualified disapproval of such appeal to the jury, and that the response of the court to the point made by defendant's counsel on that line of argument was not adequate in view of the nature of the appeal made." The defendant's counsel should have requested such instructions as, in his opinion, would have been sufficient to remove any improper impressions made upon the minds of the jurors by the unauthorized appeal of plaintiff's counsel, or moved that the case be withdrawn from the jury and a mistrial declared.

5. The cries or exclamations of bystanders upon seeing an accident about to occur may be proven to explain the state of mind and conduct of a person hearing them, and who is injured in the accident.

6. This court cannot undertake to determine whether or not error was committed by the trial judge in refusing to permit counsel to ask a witness and have him answer a given question, when it does not appear what the answer thereto would have been had it been allowed. (a) A witness who is not an expert as to the subject upon which he is questioned is incompetent to give an opinion thereon, without stating the facts on which his opinion is based.

7. Though in defense to the plaintiff's contention that the person for whose benefit the suit was proceeding was injured by reason of the negligent running of the defendant's cars, the latter introduced evidence tending to show that the injury could have been caused or aggravated by excessive sexual intercourse, there was, under all the facts and circumstances, no error in rejecting other evidence offered to show that a given person had caressed, hugged and kissed such injured party.

8. Where the defendant offered to prove by a witness that he had taken liberties with the woman for whose benefit the suit was proceeding, and had become intimate or familiar with her, and by another witness the circumstances under which he had seen her and a certain man in the woods, and the intimacy existing between them, this court cannot determine whether or not error was committed in the rejection of such evidence by the trial judge, when it does not appear what the acts or circumstances constituting such familiarities or intimacies were.

9. There was no error in rejecting evidence offered to show the state of feeling existing between certain witnesses.

10. There is no merit in a ground of a motion for a new trial which complains that the court erred in allowing a given amendment to the declaration "after the trial had commenced, and when there was no opportunity for medical examination of the plaintiff" as to the additional injury alleged in the amendment; especially where it does not appear that the defendant objected to the amendment for any reason.

11. The evidence for the plaintiff was amply sufficient to authorize the verdict, and in the light of such evidence the verdict was not excessive.—(Atlanta Consol. St. Ry. Co. vs. Bagwell; Bagwell vs. Atlanta Consol. St. Ry. Co., 33 S. E. Rep., 191.)

INDIANA.—Injuries to Person on Track—Proximate Cause—Contributory Negligence—Vehicles—Right of Way.

1. Where the driver of a sprinkling cart saw a street car approaching, but erroneously thought he could cross the track before it reached him, there being no sudden or unexpected peril, his act was the proximate cause of his injury.

2. There can be no recovery for injuries where plaintiff's negligence proximately contributed thereto, unless defendant's negligence was willful.

3. The right of a vehicle to cross a street car track is subject to the superior right of way of the street car company.—(De Lon vs. Kokomo City St. Ry. Co., 53 N. E. Rep., 847.)

KENTUCKY.—Starting of Streeet Car Before Passenger Has Alighted—Evidence.

1. Though a street car has been stopped without a signal, yet where the driver sees a passenger about to leave the car, when he ought to know that such is her purpose, it is negligence on his part to start the car before she has had time to alight.

2. Evidence that it is customary for passengers to leave the car while in motion is not admissible to excuse the act of the driver in starting a car before a passenger has alighted.—(Louisville Ry. Co. vs. Rammacker, 51 S. W. Rep., 175.)

MASSACHUSETTS.—Master and Servant—Injury to Servant—Assumption of Risk.

Plaintiff was ordered by defendant to get on a pile of lumber and throw off a piece of timber, and was injured by the collapse of the pile, which had been defectively built. He had been working near the pile for two days, but there was no evidence that he knew it was defective, or that its defect was apparent. Held, that he did not assume the risk.—(Millard vs. West End St. Ry. Co., 53 N. E. Rep., 900.)

MICHIGAN.—Disorder on Street Car—Failure to Let Passenger Off—Conflicting Evidence.

In an action for injuries through failure to let a woman off a street car after disorderly persons began fighting thereon, evidence of plaintiff that the conductor stood in the front door, and that "he did not say anything to me when I screamed and wanted to be let off—never moved"—and paid no attention to her, and of a witness who saw the car pass, that she saw the conductor standing where plaintiff said he stood while the struggle was in progress (in the middle of the car), contradicts defendant's evidence that the conductor was engaged in attempting to disarm one of the disorderly persons when he responded to her request by calling to the motorman to stop the car, and that he failed on account of an obstruction forcibly placed in his way, so as to take plaintiff's case to the jury.—(Cross vs. Detroit Citzens' St. Ry. Co., 79 N. W. Rep., 11.)

NEW YORK.—Crossing Tracks—Degree of Care—Contributory Negligence.

1. One crossing a street car track at a place other than a crossing is bound to use reasonable care not to obstruct the passage of the car unnecessarily, but he has a right to rely on a delay of the car in its progress to enable him to cross, if it becomes necessary, and contributory negligence cannot be predicated on a mere mistake of judgment on his part.

Same—Jury.

2. Where one driving a heavy wagon at a slow walk attempted to cross a street car track at a place other than a crossing, and got on the track as a car was approaching some 50 ft. away, the question as to whether he used reasonable care not to obstruct the car, and whether the car driver could have avoided a collision by exercise of the same care, was properly submitted to the jury.

Instructions—Error.

3. Refusal of a requested charge covered by the court's charge is not error.

Same.

4. A charge assuming a statement of facts not supported by the evidence is properly refused.—(Lawson vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 997.)

NEW YORK.—Evidence—Negligence—Jury.

Plaintiff and one witness testified that plaintiff was thrown to the ground by a street car starting with a jerk after it had stopped to let her off. The conductor and gripman testified that she stepped down facing the opposite way before the car stopped, and that they called to her to wait till the car stopped. Two other witnesses testified that she fell or stepped off before it came to a full stop, and a third that she stepped off just as the car was coming to a standstill. Held, that the question of the company's negligence was for the jury.—(Bennett vs. Third Ave. R. Co., 57 N. Y. Suppl., 994.)

NEW YORK.—Injuries to Pedestrian Under Elevated Road—Evidence.

1. Evidence that an injury was caused by the falling of coals and cinders from a locomotive of an elevated railway company makes a prima facie case of negligence against the company.

Same.

2. Evidence that as a train was passing on an elevated railway, burning coals and cinders were seen to fall, and at the same time plaintiff, who was walking underneath, was struck on the forehead and rendered unconscious, and that the wound showed evidence of burns and contained foreign substances resembling coal, is sufficient to go to the jury on the question whether the injury was caused by coals falling from the engine.—(Kister vs. Manhattan Ry. Co., 58 N. Y. Suppl., 132.)

NEW YORK.—Injuries in Alighting from a Car—Witness—Impeachment—Verdict.

Plaintiff, suing for injuries caused by alighting from a street car, alone testified to the accident. In response to a motion for a bill of particulars, he denied knowing the number of the car, yet on the trial gave it to his lawyer. He testified that two men who picked him up gave him their addresses, yet one had known him before, and testified he did not see the accident, and the other was not produced. Plaintiff testified he was fourteen months in bed as a result of the injury, and had done no work. His physicians testified he was in bed two or three months, and during that time would go out, and visited them at their offices. It was proved plaintiff worked as a night watchman at $7 a week for eleven months between the accident and the trial. He testified he spent $125 for medicines, but could not give the name of a single shop where he spent any part of the money. Held, that the witness was thoroughly impeached, and a verdict based on his testimony alone should be set aside.—(Streicher vs. Third Ave. R. Co., 57 N. Y. Suppl., 716.)

NEW YORK.—Collisions with Vehicles—Contributory Negligence.

1. It is not negligence, as a matter of law, for one driving a wagon at night in the track of a surface railroad to fail to look back to see an approaching car.

Same—Evidence—Province of Jury.

2. In an action for injuries caused by an electric car running into a wagon at night, plaintiff, whose mental ability was somewhat impaired by the injuries, testified that he was driving at a slow walk, that when he heard the bell of the approaching car it was within 25 ft. of him, and that he looked back and turned out of the track, but was struck before he cleared it. A witness testified that the bell was rung when the car was three blocks away, that plaintiff then commenced to turn out of the track, and that the car was coming at a terrible rate of speed. Plaintiff had once before turned out for an approaching car. Held, that the question of plaintiff's negligence was for the jury.—(Bossert vs. Nassau Elec. R. Co., 57 N. Y. Suppl., 896.)

NEW YORK.—Injury to Child in Street.

Refusal to instruct that, if defendant's car was running at a moderate and proper rate of speed, and at the time deceased child left the curb to cross the tracks the car was so close to where deceased was struck that it was impossible for the car, under any circumstances, to be stopped before running over deceased, verdict must be for defendant, is error; the court not having elsewhere instructed as to what would be the duty of the jury, or the rights of the parties, on such a state of facts.—(Weitzman vs. Nassau Elec. R. Co., 57 N. Y. Suppl., 1120.)

NEW YORK.—Collision—Negligence.

Plaintiff stopped his delivery wagon in a street, supposing that he was clear of a street railway track. When within 100 ft. of his destination, he looked behind for an approaching car, but did not discover any. It was dark, but he could see the headlight of a car about 300 ft. Where he stopped the curb was about 6 ft. from the rail. The wagon was about 4 ft. wide, and there was some overhang to the car. Plaintiff, on stopping, stooped to get his packages, when he was struck. Held, that whether he was negligent in failing to look back for a car just at the time he stopped, and to make the necessary observation to see that he was clear of the track, were questions for the jury.—(Black vs. Staten Island Elec. R. Co., 57 N. Y. Suppl., 1112.)

NEW YORK.—Injuries at Crossing—Contributory Negligence.

1. Plaintiff was driving a wagon at an ordinary walk across car, and he was injured. He testified that he looked in both di-

rections before attempting to cross. Held, that a finding that he was free from contributory negligence was justified.

Damages for Personal Injuries—Question for Jury.

2. In an action for personal injuries, where the doctors who examined plaintiff immediately after the accident, and again after his leg had been in a cast for two weeks, refuse to testify that the leg was fractured, merely stating that it might have been, and that there were symptoms so indicating, it should not be left to the jury to determine whether there was a fracture.

Appeal—Reversible Error—Damages.

3. Where the question whether plaintiff in an action for personal injuries suffered a fracture of the leg was submitted to the jury, with no evidence that he did, it is reversible error.—(Weidinger vs. Third Ave. R. Co., 57 N. Y. Suppl., 851.)

PENNSYLVANIA.—Contributory Negligence.

In an action against a street railway company for injuries to plaintiff, one of a gang of workmen repairing a street, the question of plaintiff's contributory negligence is for the jury.—(O'Malley vs. Scranton Traction Co., 43 Atl. Rep., 313.)

NEW YORK.—Injuries on Tracks—Verdict—Weight of Evidence.

Where a number of disinterested witnesses testify for a street railway company that injuries to one driving on the track did not result from the collision of a car with the driver's wagon, but from a subsequent fight between the motorman and driver, precipitated by the latter, a verdict for the latter is against the weight of the evidence.—(Lynch vs. Nassau Elec. R. Co., 58 N. Y. Suppl., 23.)

NEW YORK.—Evidence—Public Records.

In an action against a street railway company for injuries to a horse and wagon through a collision with a car, entries on a blotter of the police department, purporting to be the report of a police officer, respecting the conduct of the motorman at the time of the accident, are not admissible, as such a blotter is not a public record.—(Kerr vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 794.)

NEW YORK.—Crossing Accidents—Negligence.

A pedestrian cannot recover for an injury from a street car at a crossing, where there was no evidence that she looked for an approaching car, or as to how far distant the car was when she attempted to cross, or that the accident was due to negligence of the company.—(Balla vs. Metropolitan St. Ry. Co., 57 N. Y. Suppl., 746.)

NEW YORK.—Appeal—Review—Excessive Damages.

A verdict for personal injuries will not be set aside as excessive where the amount is not so large as to show that the jury were actuated by prejudice or corruption.—(Timpone vs. Dry Dock, E. B. & B. R. Co., 57 N. Y. Suppl., 827.)

PENNSYLVANIA.—Trolley Cars—Passengers—Standing on Platform—Negligence.

It is negligence per se for a passenger to remain on the platform of a moving trolley car where there are vacant seats inside the car, though the injury to the passenger was caused by a collision, and he might have been injured had he been inside the car.—(Thane vs. Scranton Traction Co., 43 Atl. Rep., 136.)

OHIO.—Repair of Street Railway—Injury to Traveler—Although one driving a team of horses upon a public street has knowledge that a street railway company has negligently removed the pavement from its tracks and conducting wires, he is not to be charged with negligence if he drives upon the exposed track and wire, not voluntarily, but because his horses are partially beyond his control.—(Farmer vs. Findlay St. Ry. Co., 53 N. E. Rep., 447.)

PENNSYLVANIA.—Actions for Personal Injuries—Limitations—Statutes—Repeal by Implication—Subject—Sufficiency of Title—Vested Rights.

1. The failure of a statute to expressly repeal a former statute on the same subject does not necessarily leave the former statute in full force; it being a question of legislative intent.

2. Act June 24, 1895 (P. L. 236), sec. 1, provides that any right of action which may hereafter come into being by reason of an injury wrongfully done to the person of another shall survive the death of the wrongdoer. Section 2 provides that "every suit hereafter brought to recover damages" for injuries not resulting in death must be brought within two years from the injury. Held, that section 2 is not limited to actions where the wrongdoer dies before suit is brought.

3. Section 1 of the act creates no new right of action, but merely provides for the regulation of a class of rights which existed before.

4. The act embraces but one subject, i. e., actions for injuries wrongfully done to the person.

5. Act June 24, 1895 (P. L.236), entitled "An act providing that the right of action for injury wrongfully done to the person shall survive against the personal representative of the wrongdoer and street car tracks, when the rear end of the wagon was struck by a limiting the time within which suit for such injury must be brought," clearly expresses in its title the second section of the act, which provides that "every suit hereafter brought to recover damages for personal injuries" not resulting in death must be brought within two years from the injury.

6. Act June 24, 1895 (P. L. 236), limiting the time in which to sue for personal injuries, does not interfere with vested rights, in so far as it applies to pending rights of action.—(Rodenbaugh vs. Philadelphia Traction Co., 42 Atl. Rep., 953.)

PENNSYLVANIA.—Relation of Passenger—One who, having received a transfer from one line of a street railway company to its other line, is proceeding from the sidewalk to the car on the latter line, which is standing at the end of the route, when she is struck by a piece of the trolley, which breaks while being changed, as usual at such point, from one end of the car to the other, is entitled to recover as a passenger for her injury, in the absence of a showing that the company has used the highest degree of care.—(Keator vs. Scranton Traction Co., 43 Atl. Rep., 86.)

PENNSYLVANIA.—Injury to Employee—Negligence of Fellow Servant.

1. Where a motorman leaves his car standing on a switch, without setting the brake, and the car, because of such neglect, being on a down grade, moves onto the main track, and collides with a car thereon, injuring the conductor thereof, the injury was caused by the negligence of a fellow servant.

2. Where a street car was off the track, and the superintendent of the road called on employees standing by to assist in replacing it, and a motorman leaves his car, without setting the brakes, and, it being on a down grade, runs away and collides with another car, the negligence causing the accident was that of the motorman, and not of the superintendent.—(Hoover vs. Carbon County Elec. Ry. Co., 43 Atl. Rep., 74.)

Improvements at Celoron

The Jamestown Street Railway Company, of Jamestown, N. Y., serves one of the best equipped pleasure resorts in the country. This is at Celoron, on Chautauqua Lake, and is owned by the Celoron Amusement Company, a company composed largely of the same gentlemen owning the street railway lines. George E. Maltby, general manager of the amusement company, and also general manager of the Jamestown Street Railway Company, writes as follows concerning Celoron:

"Regarding the improvements at Celoron, we, like all other amusement companies, are obliged to keep fresh and attractive things before the public. This year we have changed the color of all our buildings, making them snow white, as well as the large boulders, which beautify the grounds. We have also added the Paul Boynton's "Trip Down the River," ours being, I understand, the only one in this country outside of Coney Island. We also have with us the miniature train that was at the Omaha Exposition. This is certainly an attractive feature, having a miniature engine propelling six coaches, each containing two persons, the engineer sitting on the tender, and firing his engine with hard coal. We also have a school of trained seals.

"We opened on May 29 with a good company for two weeks. The third week we had refined vaudeville show; fourth week, minstrels, opening up the week of July 3 with a comic opera company for four weeks. From this on, completing the sixteen weeks which we are open, our opera house will be pleasingly filled with the best talent which we are able to procure. We have found, as, no doubt, all others have in this line of business, that refined entertainments are the only kind which attract and draw. People will not follow entertainments that are vulgar, and it is impossible to succeed by permitting them on your stage.

"We have also given a series of animated pictures and stereopticon views; for instance, on one evening we gave a set of views of Germany; on another evening, France; then England, then Switzerland, and then views of interest in the United States. We did this for the purpose of attracting and entertaining the people on the grounds, and it is barely possible that we shall give a series of the "Passion Play," animated pictures as well. These, you understand, are entirely free, and are simply to attract those who may remain in the evening. Of course, we intermingle balloon ascensions, high dives and rowing contests, and everything of interest to the public.

"From a financial standpoint, we must say that our enterprise has been successful. Of course, we have quite a large investment, but believe that a park giving its patrons clean and wholesome amusements will financially succeed.

"For the week of May 29 we had a 'Wild West' entertainment. We are also figuring with the Banda Rossa for their famous concert some week in August, and will have several displays of fireworks at different intervals during the season."

NEWS OF THE MONTH

The Birmingham Railway & Electric Company has discovered a well organized movement to defraud the company on a large scale. It has been found that a number of the employees have obtained a large quantity of used tickets, which had been torn in half and thrown away. The two halves of the tickets were cleverly pasted together with a special glue, and the tickets were then sold three for ten cents.

The Market Street Railway Company, of San Francisco, recently replaced an old turntable at the end of one of its lines by one of more modern construction. The moving of the old turntable through the streets of the city was quite an undertaking, requiring about forty horses. The immense circular frame nearly occupied the width of the street in transit.

The Denver City Tramway Company has announced its intention of advancing the wages of all its employees in view of the fact that the court has recently decided the franchises are valid. Under the new schedule the men for the first year will receive 17½ cents an hour; the second, 20 cents; the third, fourth and fifth years, 21 cents; and thereafter 22 cents. This will place the Denver employees among the best paid street railway men in the country.

In the suit of the Mercantile Trust Company, trustee of two mortgages executed by the Denver Tramway Company conveying to the trust company certain lines of street railway, to restrain the corporate authorities of the city of Denver from repealing an ordinance under which the roads conveyed by the mortgages were constructed between 1885 and 1890, Judge Hallettt has granted the request of the plaintiffs and issued the desired restraining order. Notice of appeal has been entered by the city.

The Capital Traction Company, of Washington, has increased the wages of the men on the Cherry Chase branch from $1.60 to $2 per day.

The Court of Appeals, in session at Wytheville, has reversed the decision of the Circuit Court of Alexandria in the case of the City Council of Alexandria against the Washington, Alexandria & Mt. Vernon Electric Railway Company. The City Council adopted an ordinance requiring the railway company to lay grooved rails in King Street, between Fairfax and Royal Streets, which portion of the street was ordered to be repaved with vitrified brick. The railway company declined to comply with the terms of the ordinance relative to the grooved rails, and the corporation attorney was directed to institute mandamus proceedings to compel such compliance. Judge Nicol rendered a decision in favor of the city, and the railway company took an appeal to the Court of Appeals, which reversed the decision of the lower court.

Owing to an agreement recently signed it will soon be possible to ride all over the District of Columbia for a single fare. Switches and cross-overs will be built connecting different lines, so that the cars from one system can be transferred to the tracks of the other systems. One of the features of this arrangement will be the possibility of an extensive private car service.

A bill introduced in the Florida Legislature requiring street railway companies in Florida to provide separate compartments or cars for white and colored passengers recently passed the Senate, but did not pass the House of Representatives, and therefore did not become a law.

The Siemens & Halske Electric Manufacturing plant, which came into the hands of the Illinois Electric Vehicle & Transportation Company some time ago, is to be immediately fitted up for the manufacture of the company's vehicles.

The Savannah, Thunderbolt & Isle of Hope Street Railway Company has furnished all its employees with new summer uniforms. A new rule has also been put in force requiring conductors to be courteous at all times in their treatment of passengers, and ordering them to assist ladies and old persons on and off the cars.

It has been the custom for some time to turn the cars of the Rockford Railway, Light & Power Company over to the ladies of the city one day each year, and give the day's receipts to a charity fund. This was done on June 10, and over $1,000 was cleared by the Ladies' Union Aid Society.

It is probable that an appropriation will be made by the Common Council of Chicago to enable a committee consisting of three Aldermen and two engineers to make a very careful investigation of street railway problems in other cities during the summer vacation. It is intended to have the committee examine and report upon the systems in Boston, New York, Washington and other American cities, and also in England, France, Germany and other European countries.

An order has been issued by the South Park Board of Commissioners, of Chicago, forbidding automobiles the use of the parks and boulevards within its jurisdiction. The reasons given are the illegal speed at which horseless carriages are often run, and also the frightening of horses and the consequent danger from runaways.

The Madison Electric Light & Street Railway Company, which has been employing woman conductors for over a year, reports that it is well satisfied with the service given by them, and does not intend to return to men conductors.

The Indianapolis Street Railway Company has advanced the pay of conductors and motormen one cent an hour. Employees for the first three months will receive 15 cents an hour, for the second three months 16 cents, and after that 17 cents.

Judgment against the New Orleans Traction Company in the sum of $429,246.62 has been given to R. M. Walmsley, John C. Russell and E. W. Clark, Jr., this amount being the balance left unpaid, with interest, legal expenses, etc., on $1,500,000 of trust notes on which the company defaulted as to interest, and the collateral securing, which brought but $1,200,000 at its sale.

The street railway companies of New Orleans, in view of the attempted enforcement of an ordinance requiring them to provide seats on all cars for conductors and motormen, have sent a communication to the City Council stating that it is impracticable under present conditions to manage electric cars safely if the motormen and conductors are permitted to sit down while performing their duties.

As the result of a serious rear-end collision which occurred some time ago on the Riverview Park branch of the United Railways & Electric Company of Baltimore, the cars of the system will be equipped with a rear oil signal lamp. The accident in question was caused by the stopping of a car, due to the untying of the trolley rope by a passenger on the back platform. The trolley pole jumped the wire, and in the darkness the conductor was unable to find the trolley rope in time to avoid the accident.

Through the courtesy of R. S. Goff, president and general manager of the Globe Street Railway, the inmates of the Old People's Home at Fall River were recently given a trolley outing to the company's pleasure park.

Fifty new cars are being constructed in the shops of the Detroit Electric Railway Company. Of these twenty-five are open and twenty-five closed.

The directors of the Fitchburg & Leominster Street Railway Company held their annual dinner on June 8, and their guests were, as formerly, members of the newspaper fraternity. Dinner was served in the hotel at the company's pleasure resort at Whal-

com. After the dinner the hotel and the grounds were carefully inspected, and everything was found in excellent condition.

The Consolidated Street Railway Company, of Grand Rapids, has made a reduction in the fare from Grand Rapids to Reed's Lake and North Park. This has formerly been seven cents, but it is now reduced to five cents.

A bill has been introduced in the State Legislature of Michigan making it legal for the street railway, gas and electric light companies in the State to consolidate their interests.

There seem to be indications that a severe rate war will be carried on near Detroit. In order to meet the competition of the electric railway company, and if possible force it out of business, the Flint & Pere Marquette Railroad will run a regular semi-weekly excursion train from Northville and Plymouth at 25 cents for the round trip. The regular rate has been $1.55. The electric railway fare is 70 cents for the round trip from Northville, and 60 cents from Plymouth.

The street railway employees of Detroit have asked the companies to increase the wages of conductors and motormen to 25 cents an hour. The officials do not wish to make any change in the wage scale until the municipal ownership agitation is settled definitely.

A temporary injunction has been secured restraining the Detroit, Ypsilanti & Ann Arbor Electric Railway Company from running its cars faster than 12 miles an hour in the city of Ann Arbor.

Among the bills introduced into the Legislature of Michigan is one providing for the equipment of cars over 20 ft. in length with air brakes.

At a meeting of the City Council of Duluth on June 12 a resolution was passed appointing a committee to confer with the Lakeside Railway Company, with a view to the purchase of its line by the city.

At the recent annual meeting of the Metropolitan Street Railway Company, of Kansas City, it is understood that Armour interests of Chicago came into the control of the property. The earnings for last year were at the rate of 7½ per cent on the capitalization.

The general offices of the St. Louis & Suburban Railway Company are to be removed from the Wainwright Building to the De Hodimont station.

The South Orange & Maplewood Traction Company is considering the advisability of putting automobiles in service in Orange between the Orange Music Hall and the terminals of the company's lines in Main Street.

A suit brought some time ago by the city of Bridgetown against the Bridgeton & Millville Traction Company has just been decided in favor of the city. The city had entered suit to compel the traction company to operate its cars on certain streets, the service having been discontinued on said streets when the Board of Freeholders removed the rails from one of the bridges on the route.

The Brooklyn Rapid Transit Company has furnished to the New York Stock Exchange a statement, showing that it holds in its treasury $40,449,828 par values of stocks, bonds and accounts receivable of the underlying companies. The mileage now controlled is 482.2. The assets amount to $46,433,951, as against a capital stock then issued of $38,770,000 and bonds of $7,000,000. The surplus is $248,325. A detailed financial analysis of the property was contained in the STREET RAILWAY JOURNAL for June, 1899, page 370.

A gang of robbers was interrupted while breaking into the safe of the Jamestown Street Railway Company at three o'clock on June 19, and succeeded in making their escape. The bandits had sandbagged the watchman, and were preparing to blow open the safe, when they were frightened away by a number of employees returning to work.

The third rail on the Brooklyn Bridge used for carrying the current for the elevated and bridge trains became loosened from the insulators one day recently and fell to the ties for a long distance. The accident, which was caused by a defective contact shoe, interrupted traffic for several hours.

It is stated that all the employees of the principal street railway companies in Greater New York have secretly formed an organization under a charter from the Knights of Labor.

The Middletown-Goshen Traction Company has made an advance in the wages of its employees, from 14 to 15 cents an hour, and from 12 to 15 cents. The company recently had a spotter on the road for about a week, and as a result about eighteen motormen and conductors were ordered to report to the office for various reasons.

The Ithaca Street Railway Company recently posted in the car barn a notice cordially thanking the employees for their conduct and excellent work on Decoration Day, when the company carried the largest number of passengers in its history.

Two of the double-deck trolley cars for use on the Syracuse, Lakeside & Baldwinsville Railroad were put into service recently.

C. L. Rossiter, president of the Brooklyn Rapid Transit Company, has announced that the management has under consideration an advance in the wages of all the employees of the system.

The Canton-Massillon Electric Railway Company has voluntarily advanced wages of conductors and motormen to $1.75 per day. The old rate was $1.60 per day. For extra time the men will receive 16½ cents per hour.

The city electrician of Cincinnati has recommended in his annual report that all electric wires in the city be placed under ground, including the electric light and street railway wires. If this is done it will necessitate the removal of 15,000 poles, about 275 miles of feeders and 75 miles of trolley wire.

It is stated that the system of the United Power & Transportation Company, recently formed in Philadelphia, will be operated by water power from the Schuylkill River.

A funeral trolley car service will soon be inaugurated in Wilkesbarre.

A dozen masked men entered the car barn of the Fairmount Park Transportation Company, of Philadelphia, on June 19, and, after capturing and binding six of the employees, blew open the safe with dynamite and robbed it of nearly $4,000. The robbers got away.

A defective journal caused a serious accident at Pawtucket on June 1. The car was running at high speed, and when the journal broke, tipped completely over, injuring the motorman and conductor, the only occupants.

The employees of the London (Ont.) Street Railway Company have been on strike for some time, and there is no immediate prospect of a settlement. The company's cars are running, but the public has quite generally boycotted them.

The Montreal Street Railway Company, on account of the increased receipts of the road, has decided to greatly better the condition of its employees, and a new schedule of wages has gone into effect. The schedule is $25,000 a year higher than previous

years. Conductors and motormen between their second and fifth years will receive $34 a year more than they are now getting, and after the fifth year will receive $49 more. The company has also started an insurance fund, which it will maintain at its own expense. Disabled employees will receive a weekly amount from this, and at death $1,000 will be paid to the estate of the deceased. Motormen and conductors have formerly paid two-thirds of the price of their uniforms, but the company has now made arrangements by which they will pay but one-half.

The American Railways Company, which was organized some months ago, and of which A. A. McLeod, formerly president of the Reading Railroad, is the leading spirit, is negotiating for the purchase of the Consolidated Traction Company of Pittsburgh. It is reported that 40 is being offered for the common stock and 70 for the preferred stock, payments to be made in 5 per cent collateral trust bonds of the American Railways Company. The latter is also negotiating for the purchase of the Philadelphia Company, which owns nearly all of the Pittsburgh United Traction Company's stock, and of the Pittsburgh Gas Companies' stock, and the price offered for the Philadelphia Company's stock is said to be 97½ per cent, or $48.75 per share. The details of these two purchases are not yet completed, however, and the above prices represent current rumors. The American Railways Company formally announces its acquisition of the Bridgeton Electric Company and the Millville & Bridgeton Traction Company, which latter company owns the entire capital stock of the Bridgeton Rapid Transit Company, the Bridgeton & Deerfield Turnpike Company and the Bridgeton & Millville Turnpike Company. Other companies said to have been acquired by the American Railways Company are the railway and lighting systems of Springfield, Ohio, and similar properties in a Southern city.

The International Car Wheel Company has been incorporated under the laws of New Jersey, with a capital stock of $15,000,000. It includes a number of important firms in the Northeast and Canada, among them being the New York Car Wheel Works, with plants at Buffalo, New York city and Philadelphia; Swett Car Wheel and Foundry Company, Boston; Boston Car Wheel Company, Boston; Ramapo Car Wheel Works, Ramapo, N. J.; St. Thomas Car Wheel Company, Ontario, Canada; Hamilton Wheel and Foundry Company, Montreal; John McDougall & Co., Montreal; Weston Furnace Company, Manistique, Mich., and Pittsburgh Car Wheel Company, Pittsburgh, Pa. The temporary officers are: P. H. Griffin, president and chairman of the board of directors; T. G. Smith, vice-president, and Warren P. King, secretary and treasurer.

In a recently issued statement of the condition of the Electric Storage Battery Company, of Philadelphia, it is said that sales of the finished product for the calendar year 1898 amounted to $1,340,988, as against $1,026,926 in 1897, and that during the five months ending June 1, 1899, sales were $1,360,561, as against $314,498 in the same period of 1898. The company now owns five-twelfths of the automobile business controlled by the Electric Vehicle Company and the Columbia Automobile Company, through its ownership of $4,000,000 in the stock of the former and half of the stock of the latter. These two companies have united their patents and organized a manufacturing company called the Columbia & Electric Vehicle Company, for the purpose of manufacturing all parts of automobile vehicles, with the exception of the storage batteries, which will be furnished solely by the Columbia Automobile Company. The entire product of this new manufacturing company will be purchased by the Electric Vehicle Company, and sold by it to the various electric vehicle transportation companies now organized throughout the country.

The experiment of providing a 10-cent route to Brighton has been instituted by the Brooklyn Rapid Transit Company. There are already several 5-cent routes to this and neighboring resorts, but the officials of the company believe that many people will greatly prefer to pay a double fare and thus escape the annoyance of traveling on overcrowded cars. It would seem as if this plan could be worked to advantage in other large cities, and the idea might even be extended to smaller places by running a few cars as "specials" and limiting the number of persons carried to the seating capacity. This service, however, should be an adjunct to, and should not in any way interfere with the regular service.

Rumors of labor troubles in New York have been diligently circulated in Wall Street last month, to the effect that trouble was brewing among the employees of the Metropolitan Street Railway Company, but this turned out to be wholly untrue. The management of the Metropolitan Company is probably stronger in the respect and affections of its employees than is that of almost any other railway of the country, and it would be exceedingly difficult to foment trouble among them, particularly in view of the fact that they are now receiving high rates of wages, and have many collateral advantages through their connection with the company.

Albert L. Johnson, who has been until recently interested in a large number of American street railway properties, has been investigating the opportunities for investment in England during the past year, and in a recent interview says: "The project I have in mind is not primarily for London street traffic, but to bring the seashore within reach of the great mass of the population, just as Coney Island is brought nearer to New York by trolley lines. In other words, I want to make Brighton, 53 miles from Charing Cross, a suburb of London. I intend to make a proposition to Parliament and the County Council to establish an electric road from Brighton over a private right of way to the London city limits, and then, by some arrangement through the streets to the heart of the city. It is to be an underground trolley system, similar to the Fourth Avenue line in New York. It costs $1.50 to go by steam railway from London to Brighton, and the price prohibits the masses from reaching the seashore. I propose to carry passengers the entire distance for 12 cents, running a mile a minute."

Governor Stephens has finally signed the bill permitting street railway consolidations in the State, which has been for some time in his hands, and as a consequence it is practically certain that the remaining street railway properties of St. Louis not as yet purchased by Brown Brothers, of New York, will be brought into a general consolidation. These companies include the "Chicago Syndicate lines," seven in number, one of the most important and valuable systems in the city, the St. Louis & Suburban and one or two minor lines. The system will comprise over 400 miles of track, and a large sum, stated as $5,000,000, will be spent in improvements.

J. Edgar Leaycraft, one of the State Tax Commissioners, has briefly outlined the policy to be pursued by the commission in carrying out the provisions of the Ford law for the assessment of franchises. The commission will make its headquarters in Albany, and until August will devote itself to completing ordinary routine work. It is the intention to prepare a very comprehensive blank, to be ready in about six weeks. One or more of these blanks will be sent to every corporation, and its officers will be required to fill it out to the satisfaction of the commission. Where there are any suspicious circumstances connected with the information furnished, the commissioners will make a personal and thorough investigation, but otherwise they will not make any inquisitorial pilgrimage throughout the State. The commission will first take up the franchise assessment in those counties of the State where the tax books are closed earliest, and the work will be expedited in every possible way.

The United Railways & Electric Company, of Baltimore, has purchased a lot 2100 ft. x 900 ft., upon which it will build shops, car house and general office buildings for the entire system. The various shops and houses belonging to the different companies before the consolidation, and which are scattered throughout the city, will be abandoned, and all the repair and storage departments concentrated on the new property. The United system earned, gross, during the month of May, 1899, $32,500 more than for the same month last year.

The Problem of Elevated and Suburban Electric Railway Transportation.*

BY FRANK J. SPRAGUE

Rapid transit is the science of competitive railroading, and if by wheeled vehicles, ultimately reduces to a question of the proportion of weight upon the driving wheels. All other matters entering into the question for any given case and set of conditions, such as schedule speed, traffic capacity, extent of equipment, total investment, frequency of service, operating cost, and even safety and reliability of service, are incidental to and directly or indirectly dependent upon the adhesion of the driving wheels of the vehicles to the track.

The fastest possible car movement between stations can always, under equal conditions of equipment, load, grade and power supply be made by the vehicle which has the greatest percentage of weight on the drivers. Therefore, definite theoretical and practical limits exist for railroad schedule speeds under any given conditions, and the highest schedules in any case can only be made by a train system which preserves under all circumstances the specific characteristics of a motor vehicle with 100 per cent weight on the drivers.

In the present stage of development of rapid transit systems for urban, suburban and interurban service, where stations are close together, traffic much congested morning and evening, and yard and terminal facilities limited and costly, high schedule speeds are absolutely essential. How shall they be had?

There are three distinct and generic methods of railroad passenger transportation, as follows: The single car operating independently, the locomotive pulling trail cars, the multiple unit system, or aggregation of transportation units, each fully equipped, into trains and provided with secondary control.

The first received its great impulse at Richmond in 1887-8. Its history and characteristics as illustrated by the tens of thousands of cars in daily operation need no detailed description. Each car is a motor unit, with large effective driving weight, from 80 per cent to 100 per cent, equipped with hand control, but incapable of aggregation into trains with localized control. This system broadly includes all modern street railways.

The second is the locomotive system, following steam precedents, and dictated by the limitations of steam engineering, in which there is concentrated in a single unit the weight and power necessary to handle a train under given conditions. This locomotive idea has taken two forms, one of which copies one or other of the many types of steam locomotives, with such modifications as are permissible with electric motors, but which, despite the remarkable general progress of electric transmission, still finds comparatively few applications in actual practice. Notable among these are the B. & O. tunnel locomotive in Baltimore and the proposed equipment for the Central London Railway. Among the earliest, if not the first, of the large locomotives, is one of 1000-h.p. capacity, built by the writer and his associates for the North American Company about seven years ago. Another form of the locomotive may be described as the locomotive car, which consists of a car body of the usual form, arranged to carry passengers, with one or both trucks equipped with motors, and hence with the weight distributed over a considerable distance, and with, as in the other case, hand control provided at either end of the car. Such a one was experimented with by the writer on the Thirty-fourth Street branch of the Manhattan Elevated in 1886-7, where was used the first modern railway motor, and a special car was built about the same time which was to have had an equipment of two 75-h.p. motors on each truck. This was before the days when the Richmond road was built, and therefore before the modern advance in electric railroading. This type of locomotive car was used in the Intramural Railroad in Chicago during the World's Fair, and is now in operation on the Metropolitan and Lake Street elevated railways in Chicago.

A modification of this locomotive car plan has been more recently proposed, which consists in putting a locomotive car at each end of the train, passing the main circuits through all the other cars, and providing duplicate hand controls at each end of each locomotive car for the eight motors constituting their equipment. The system is absolutely untried, presents innumerable difficulties, and has about all of the defects of the locomotive system, but constitutes an acknowledgment of the utter necessity of greater weight on drivers and greater power for meeting the requirements of modern transportation.

In matters of transportation, the passenger's demand and the wishes of an operating manager are not always alike. The passenger requires for his convenience the most frequent time intervals, the shortest station waits, and the highest possible schedule speed. The railway manager is apt to concentrate loads, increase the time intervals, and let the passenger wait, but in so doing he may lose the passenger. With a locomotive car system this is the inevitable result, because otherwise the entire motive equipment would be kept in continuous operation at low economy and at great expense.

All these methods—the single car, the locomotive, the locomotive car and the doubling up of locomotive cars—fall short of meeting the requirements of a flexible railway system to be operated on a high schedule. The single high-power car, using all of its weight on the drivers, needs no commentary so far as ordinary application is concerned, but the methods proposed for the aggregation of cars and the handling of trains through the medium of a locomotive or locomotive car, or aggregation of hand-controlled locomotives occupying fixed positions, utterly ignore the possibilities of electric application and the advantages manifest in every car operated on the street. In some form or other this has been recognized for a number of years, and it occurred to a number of engineers that for increased adhesion and to provide more power with distributed weight motors could be distributed throughout the train, the mains carried through it, and the system governed by a controller at the leading end.

One of the earliest of these proposals was made before the Society of Arts in Boston in 1885, just prior to conducting experiments on the elevated railroad, at which time I contemplated the use of motors on each car or every other car and a pilot locomotive of car containing an adjustable controlling apparatus which could be made effective for handling one or more cars. This project, however, never reached fruition, and, of course, fell short of the possibilities. Much more seemed certainly feasible. The excuse for the last mentioned proposal is found in the evident engineering truth that if greater power is applied to a train, and a high percentage of the weight on the drivers utilized during acceleration, higher schedules with reduced strain were possible.

Considering for a moment a single car as a unit, and putting all the available power in the motors connected to each of the axles which space permits, it is readily possible to put on motor equipment which will develop over 20 h.p. per ton moved, and to use 100 per cent of the weight on the drivers. The possibilities of this unit, that is, using the entire weight of the car for traction, and all the power which can be put within the space permitted, is the limit, and absolutely the only limit of the possibility of the speed to be attained by an electric car. If now this unit is lengthened, that is, cars aggregated into a train, and the same ratio of weight on the drivers and the same horse power per ton is maintained, then it matters not what the length of the unit, identically the same schedules can be made with the train as with the single car.

The most effective train operation, however, requires something more than schedule speed, and it seemed that, considered from a competitive standpoint, and with the idea of gathering every passenger possible, the proper method of operating a railroad should be something as follows: Starting at the time of least traffic, to operate the smallest allowable unit at intervals determined by the ratio of the increased cost of operation to the increase of passenger receipts to be obtained by shortening the interval. Then, as traffic increases, to shorten up this time interval as far as is consistent with safety, then to increase the size of train unit while maintaining the same interval and high schedule to take care of the greater traffic.

It is said that smaller train units cost more to operate than larger ones. This is to a certain extent true, but against this is the simple fact that on the scale of wages paid on many railroads the difference in total cost between operating two two-car trains and one four-car train is one passenger per car for every fifty stations as spaced on the elevated railroads in New York. In view of this fact it can hardly be questioned that if shorter intervals are made possible then more passengers would be gathered than represented by these differences, and trains would, if a practical system were devised, be operated in any length from one car up.

These, I think I may fairly say, were the views which finally came to be held by such transportation authorities as Chief Engineer Wallace, of the Illinois Central Railroad, and Chief Engineer Cornell, of the Brooklyn Elevated, in the spring of 1897, and in this connection it is interesting to note a chronological review of various proposals which had from time to time been made for elevated railroad equipment and operation, which is appended to this paper, which will serve to illustrate a diversity of ideas and recommendations which have done much to bring ridicule upon the professions of electrical engineers.

This review is not intended to give a complete or detailed history of electric railway development, but is a running commentary on a variety of proposals made for train operation on elevated or suburban railroads from the year 1880 to the present time. A sur-

* Abstract of a lecture delivered before the American Institute of Electrical Engineering, on May 16, 1899.

vey of this record for the first seventeen years, up to and including the first proposals made as late as the spring of 1897 to the South Side road, shows that with the exception of proposals made by me at various times, beginning at the Society of Arts, in Boston, in 1885, and ending in definite proposals to the Manhattan Elevated Railway in 1896 and 1897, there were no propositions, or even a suggestion, from any manufacturing corporation or individual to equip a railroad on any other than a locomotive or locomotive car plan, with the single exception that on the Liverpool Overhead Railway two-car trains are operated as a unit, each unit having a motor disposed at the leading and back ends, and with a hand controller at each end. Typical important installations were on the locomotive plan pure and simple in 1895 at Baltimore, and on the locomotive-car plan, under the supervision of W. E. Baker, on the Intramural Road at the World's Fair in Chicago, 1893, and on the Metropolitan West Side Elevated Railroad, under the same supervision, in 1895, at the former of which Mr. Baker had to override recommendations in favor of a locomotive.

The variety of ideas indicated by these notes and the inexcusably wide divergence of expression concerning the commonest engineering facts, as well as the crudeness of many electric railway proposals, was never more sharply shown than in a paper by Mr. Wallace, of the Illinois Central Railroad, on the subject of "The Substitution of Electricity for Steam as a Motive Power for Suburban Traffic," before the American Institute of Civil Engineers, Feb. 3, 1897, and in the discussion which followed it. Mr. Wallace, having, in December, 1891, been directed by the management of the Illinois Central Railroad, of which he was then the chief engineer, to investigate the subject of adopting electricity on the Illinois Central Suburban Railroad, after a careful consideration of the requirements of the road, issued a list of forty-five categorical questions covering the operation of a fairly fixed equipment at 20 miles an hour. These questions were sent to all the various electrical companies except the Sprague, which had at that time been absorbed by the Edison General Electric Company. Consequently, for the Sprague Company and for myself I must disclaim any responsibility for the "mix up."

I will not attempt to review the answers to all the inquiries as presented by Mr. Wallace, but only touch upon a few of them, to illustrate the disparity of recommendations made, but for an interesting detailed comparison refer to the comments at the meeting by Charles Henry Davis, who began his remarks with a statement partly quoted from Mr. Wallace, that: "The engineers giving this matter their attention have been enthusiastic electricians; they have seldom been practical or expert mechanics, and the writer would add, usually inexperienced as railroad engineers."

But let us briefly take note of the recommendations. The motor capacity varied from 100 h.p., divided into four units, to 200 h.p., divided into two units, and distributed from one to two motors on each of two trucks under a locomotive car carrying passengers, or on, the other hand, aggregated into a locomotive pure and simple, without passenger capacity.

Both ring and drum armature construction was recommended, and driving wheels of from 30 ins. to 42 ins. diameter. About every possible form of axle driving, except chain or belt transmission, was proposed. One company was indifferent as to whether the motors were directly on the axles or gear transmission was adopted; another recommended spur gearing; another, cranks and parallel rods; and still another, no form of gearing under any circumstances, but an armature mounted on the hollow shaft surrounding the axle.

The central station equipment varied from 4800 h.p. to 18,000 h.p., and the steam units, from 400 h.p., driving single machines, to 1500 h.p., driving double machines. Horizontal compound and vertical triples had their advocates, and rope or belt as well as direct connection between engines and dynamos. The space required for the central station varied from 12,000 to 75,000 sq. ft., and the cost of power plant, not including real estate or buildings, from $320,000 to $1,169,000. Amount of fuel required per horsepower, from 2 to 3½ lbs. The annual cost of power plant operation ran from $60,000 to $225,000. The potential varied from 500 to 1000 volts. The cost of trolley lines and feed wires varied from $40,000 to $172,000, and repairs to the same and other line expenses, from nothing to $23.50 a day. The practical curvatures ranged from "50-ft. circle" to "150-ft. radius."

On one subject there was unanimity of agreement, the transmission was to be by continuous current, and by overhead trolley. Despite Mr. Wallace's request for information about a third-rail supply, it was incontinently waved aside. The multiple unit system was not in any form proposed, but there was discussion on the subject of the relative advantages of small independent units versus trains.

The recommendations made hardly need extended comment, and one can well imagine the reasons which stopped any then further action on the part of the Illinois Central Railroad. The whole paper is one of great interest, but from the discussion I will extract only a few comments which, in view of the immediate subsequent developments, are important.

Thomas C. Clarke, the past-president of the Society, stated as follows:

"The author, under the head of 'minor problems,' speaks of 'the size of transportation units and whether independent motors of large power shall be used to haul long trains of trailers, or whether small transportation units, run at more frequent intervals, shall be adopted.' with motors on the cars. In designing the rolling stock and structure of elevated electric railways in cities, this is the main point, and not one of minor consideration. Neglect to study this and to come to the correct conclusion has led to the financial failure of one of the largest electric elevated railways that has been constructed, and will lead to the financial failure of all others that follow the same lines.

"Carrying passengers in a city does not differ from any other business. The first requisite is to get abundant traffic; the second, to handle it with economy. Elevated lines run in competition with surface lines, and charge the same fare. The surface lines can beat them in all points but one. They afford more frequent stops; there is no climbing of stairs; cost of construction and, consequently, interest is less, and the system of transfers to branch lines is a great accommodation to the public. The elevated trains, not being impeded by surface traffic, can make better time; but for that, no person would ride in them, except to escape crowding.

"Common sense would indicate that the managers of elevated lines should try to approach, so far as possible, the conditions which have made surface lines a success. Frequent stops can only be attained, without losing too much time, by having a great power of acceleration. Any amount of power can be sent from the central reservoir, but if the wheels of the car slip, a limit is reached. Therefore, instead of having only one-third of the weight of the train available for adhesion, as is the case where an electric locomotive draws a train of trailers, utilize the whole weight of the train and passengers by putting motors on every car, connected electrically and mechanically, and worked by a motorman at one end of the train. Another advantage resulting from this is that gradients can be steepened, and the height of the station and their stairways reduced. If, in addition to this, short trains of light cars are used, the weight and cost of the structure can be greatly reduced, and the interest charges also. Small trains mean frequent trains to enable the traffic to be carried, and everybody knows there is no means of attracting traffic so powerful as that of frequent trains, as there is then no waiting at stations, which everybody hates.

"The summing up of the whole matter is, that to make city elevated railway a success, the surface electric system must be copied, and placed above obstructions from other traffic, and not the steam locomotive system of long trains at greater intervals. The process of evolution which develops everything along the fittest lines will make the city elevated railway of the future one of light structure, carrying light and very frequent trains, with motors on the cars themselves—a development of street trolley lines, and not of steam locomotive railroads."

Walter H. Knight said:

"The whole object of the elevated railroad is speed, and speed cannot be made with short headways. It would make little difference, as far as speed is concerned, whether the cars were all equipped with motors, or all the electric apparatus concentrated on one car."

Mr. Wallace stated that:

"One of the practical difficulties in the way of placing motors on each axle of the car and on several cars of the train, and coupling them up so that they can all be used and under the control of one motorman, is that, so far as the author's investigations have gone, there is as yet no perfect and adequate controller in use in the United States which will provide for the proper manipulation of more than two motors."

And his conclusions seemed to be that while a train system did not give that which was necessary, nothing had been presented to him in answer to all his inquiries and his painstaking research which gave him any promise of successful departure from his then existing method of operation.

There is small cause to wonder that the early project for electrically equipping the Illinois Suburban was for the time abandoned.

At the time when Mr. Wallace's paper was presented a committee, including himself and some other officers of the road, had been formed, with John Lundie as engineering secretary, and with a number of assistants, was making some further investigations as to the possibilities of electric application. A report was made about the end of the year, and accompanying it was a proposal from me to guarantee a 24½-mile schedule on the suburban service of the road, instead of the 18½, which was then being accomplished by steam, and if I am not mistaken, all further consideration of a locomotive pulling trailers was abandoned.

I think, as events have turned out, that with regard to the diametrically opposed views presented by Mr. Clarke and Mr. Knight, the former may well rest content with the position he assumed.

THE MULTIPLE UNIT SYSTEM

Such was the generally unsatisfactory state of electric railway development for all else than ordinary street roads in the spring of 1897, and the conclusions which I have already given, together with apparent advantages which would accrue, pointed unerringly to the necessity of the third generic system of railway equipment and operation, that which I have termed the *multiple unit system*, which is the most logical, and seems to me a finality in railroad development. It may be briefly described as a semi-automatic system of control, which permits of the aggregation of two or more transportation units, each equipped with sufficient power only to best fulfil the requirements of that unit, with means at two or more points on the unit for operating it through a secondary control, and a "train line" for allowing two or more of such units, grouped together without regard to end relation or sequence, to be simultaneously operated from any point in the aggregation.

For any given weight to be moved, whether it be in one or two cars, there is a certain capacity of motive equipment with which it is best to operate it under fixed conditions, and that is the motor equip-

ment which should be put on that unit, not something either larger or smaller, and then when more capacity is required, to simply add another unit of like character.

A unit may be a single car or a pair of cars, and the number of motors used whatever desired. The logical equipment is two motors for each car, and when so equipped the importance of some of the practical results is emphasized.

Among the advantages which such a general system when fully developed must possess, may be mentioned, first:

Similarity of Equipment.—This gives absolute flexibility of train operation. It insures like characteristics for trains, whatever the length, and whatever the combination of cars. The motor equipment is directly proportional to the number of car units. There is a practical fixed relation between the weight on the drivers and the total load, whatever the length of the train, and it is a matter of indifference to the motorman whether he is operating one car or any aggregation of car units in a train, for its characteristics are always the same.

Independence and Facility of Operation.—Each car being lighted, heated and braked independently, has independent movement in yards or car houses or on the tracks, wherever stored, and thus inspection, repairs and train combinations are facilitated. The head and tail switching characteristics of locomotive practice is entirely abolished. Trains in whole or in part can be reversed at any crossover, thus reducing the dead mileage and intensifying the car movement to meet the conditions of passenger movement. Cars can be added to or taken from a train in a third of the time that is possible with a locomotive system.

Where a system has main tracks with branches, car units for the different branches can be aggregated on the main line and then split at the junction, thus preserving the time intervals on the branches, but doubling the distance intervals on the crowded sections. The fullest use can be made of all sidings and tracks, wherever located, for storage, and in a large measure for inspection, which insures less dead mileage and useless returns, and effects concentration of car movement impossible where the cars must be stored in one place.

Increased Schedules.—Any required rate of acceleration or schedule speed up to the maximum becomes possible, thus giving the highest schedule with any given maximum, and the lowest maximum with any given schedule. A partial equipment may be made by equipping alternate cars, and this schedule later increased by additions to the existing equipment without changing its character. Local and express service can be operated with greater or less aggregation of motor equipments.

It has been suggested that with a locomotive system, when trains are reduced in length, and the service on the road is diminished the locomotive car can then increase the schedule, and that during the times of heavier traffic it still has capacity enough to pull a train.

Such an argument is a reflection on the common sense of a railway manager, and such practice a parody on railway operation. The time above all when schedule speed, capacity and effective operation are required is when traffic is greatest and the road most liable to congestion. It is difficult to see how any engineer can seriously offer such an argument in support of locomotive practice, for it is directly contrary to the most vital requirements on a railroad.

If, as is vital in competition service, a high schedule is necessary, and ignoring for the moment all questions about relative strains, weights, facility of making up and controlling trains, and the advantages of variable train lengths and intervals, when we come to six or seven-car train units a high schedule with short interval stations is impossible, except with two heavy four-motor locomotive cars or with every car equipped with a pair of motors. And, from every point of view, the latter is preferable.

Reduced Strains.—This is of importance where elevated structures or bridges are used, especially when already possibly strained. It is apparent that the weight of cars, truck and motive equipment between columns is necessarily less than with any locomotive or locomotive car system. All the longitudinal or shearing strains are greatly reduced.

The hammering on the rail joints, with the resulting shock to the structure and to the moving train, will be diminished because of the less weight per driver. The thrust strains for any given rate of acceleration are equalized and distributed over a considerable length of structure, and become practically the reverse of the braking strains. The strain on car bodies, platforms and couplers are reduced to a minimum.

Increased Density.—The safe time interval between trains for a given schedule and for any given length of train and station stop is dependent upon the maximum speed and the rates of acceleration and braking, and the greater these latter with any given schedule, that is, the lower the maximum speed and, consequently, the less the travel of the train after the brakes are applied, which distance varies roughly as the square of the speed at the time of applying the brakes, the shorter can be both the time and the distance interval between trains.

If there were an infinite rate of acceleration and braking, then there would practically be necessary, barring accidents, only that time limit between trains occupied by a train at and blanketing a station. In practice, a motorman will approach a station with more confidence and under closer headway when his maximum speeds are low, and the braking distance which he travels short, and when he has confidence that the train ahead, once started, will promptly accelerate and increase speed while that of his train is rapidly diminishing.

It is apparent, of course, that the length of a train is only limited by the platform accommodation.

Better Equipment.—From this standpoint better motor manufacture is insured. There are fixed limitations of wheel base, track gage, wheel seat, diameter of axles and distances between axle and bolster, and hence there are practical limitations to the outside dimensions of motors. The smaller the capacity of the machine put into that space, the greater the margin for increase of dimensions of the essential working parts, such as bearings, gears and commutators, and the greater the freedom for inspection. Likewise, also, is there greater space for the application of any kind of brakes, electric or mechanical.

Reduced Number of Cars.—With any given maximum hourly mileage the number of cars in service or on relay will vary inversely as the schedule. The advantage is further augmented by those already instanced, the concentration of car movements where most desired, and the storage of cars at the most convenient points, with consequent less dead mileage.

Simplicity of Operation.—The operation of the multiple unit system becomes the simplest. Every motor car or pair being a transportation unit, and every aggregation of such being, so far as the motorman is concerned, simply an extension in the length of the unit, without in any manner changing its character, the operation becomes almost automatic, a sort of second habit. Like hand and like train movement exists whatever the combination, and wherever the motorman is situated. The making up of trains, so far as electrical features are concerned, is as simple as coupling up an air hose. No main currents are carried from car to car, only small currents through reversible jumpers, and the electrical combinations are effected automatically, however the trains are made up and whatever the end relation of the cars.

Protected by the automatic features, a child of ten years can handle full-sized trains on regular service with less trouble so far as the electrical apparatus is concerned, and with less instruction than is required for the simplest form of air brake.

Ease of Inspection.—The train line and the main motor circuits being absolutely independent, and provision being made on any car for cutting out a set of motors, facility exists for an easy inspection whe ever the cars are located. Almost all the working parts of the motors can be inspected through the trap door in the bottom of the car, and since the cars have independent movement and can be rapidly run through an inspection shed over a pit, a little practice enables an inspector to make the most rapid survey of trucks, brake rigging, motors and everything else which is under a car.

Economy.—Transportation wages per car mile, the largest element of cost, are reduced because of the simplicity of operation, and because of the increased schedules. With the same efficiency, there is less power per car mile expended, and hence less coal burned, for any given high schedule with like conditions of traffic than with a lower rate of acceleration, because of the less amount thrown away in braking. The increase of power required because of low acceleration over high is anywhere from 25 per cent to 50 per cent.

When it is realized that a system like the elevated railroad would use only one-sixth of the power actually used now if it made no stops the importance of this fact may be seen.

The question of coal economy is of less importance, however, than many other features of railroading, and, from a financial standpoint, far less important than getting absolute freedom in determining train intervals and train lengths. In this connection it should be noted that altogether too little consideration is given to the question of car construction and car weights, and it seems to be forgotten by many engineers that useless tons of dead weight moved represent unnecessary investment in plant, and a continuous charge against operating expenses, and it is about as sensible to ignore this question as it would be to add pig lead to a car having all of its weight on its drivers to increase its traction. If half the gray matter was spent in reducing useless tonnage moved as there is in bargaining on the cost per kilowatt of apparatus, the cost per car mile and the ratio of operating expenses to receipts would be gratifyingly reduced.

Safety.—The highest safety is essential. In the case of fail-

ure of brakes or on slippery rails, the machines throughout the entire train can be safely reversed. The current input to the machines is automatically limited on each one to its safe capacity. In case an accident should happen to an operator, and he lets go of his controlling handle, the entire power is instantly removed from the train, and in case the controlling apparatus on the leading car should become disabled the train can be operated from either end of any other car. In fogs and on slippery rails a fixed schedule can be maintained more effectively because of the lower maximum speed, the less distance traveled in braking, the greater confidence in approaching a station, and the promptness of the leading train in getting away. On account of the reserve capacity of the machines it is possible to make up time in clearing a road, which is a matter of the gravest importance on a congested system. The automatic cutting off of current will have an important bearing in a not distant future when a Legislature is apt to, and should, prohibit the operation of a train with only one man in front unless there is some certain method of removing the driving power in case of accident to the operator. This is an instance of where a small thing, possibly determining the employment of several hundred extra men, has a vital importance.

Least Cost.—The multiple unit system means lowest first cost, as well as lowest cost of operatoin. This is contrary to first impression, but the explanation is simple in that the cost of the delivery of electrical energy to the car shoes per unit of constant use is eight to ten times the cost per unit of maximum capacity of car equipments, and by using the higher rate of acceleration rather than the lower for any given high schedule, the aggregate cost of the total equipment from power house to car equipments for any given hourly mileage is less, because, notwithstanding the increased cost of car equipment, the difference of economy creates a saving in that portion of the electrical equipment, that is generation and distribution, which costs so many times more per unit equipment than the units of car equipment, that the latter increase is more than made up by the saving in the former.

All this is readily proven, for I know of no problem presenting greater and more interesting possibilities of exact determination so far as results are concerned than that of electrical railway engineering; yet, on the other hand, I know of none in which there is a more reckless disregard of possibilities than in this very profession. In this, as well as in every other problem of kinetics or construction, and just as certainly as in the construction of a bridge, great increase of first cost and cost of operation may accrue from a disregard of the essential relations of all parts of the system, and on the other hand great savings may be achieved by a thorough knowledge of them. Despite these facts, it is curious to note oftentimes the inversion of the sound engineering with which the consideration of the electrical equipments of a road is often attended.

On any existing road whose traffic is known, the problem, put in the briefest form, should be: Given the existing maximum car mileage and schedule, how best and most cheaply, both as to first cost and cost of operation, most quickly and with the least interference with service, and without increase of strains on elevated structures or bridges, can the existing mileage be maintained, how much can it be safely increased, what possible schedules can be made, and what will be the effect on the traffic and operating expenses of the road?

The fact that there is a most intimate connection between the generating, transmission and the motor parts of the equipment seems often to be lost sight of entirely. The natural procedure would be to determine what results are desired, and then find the best method of getting them. Instead of that, oftentimes a purely empirical decision is made as to portions of the equipment, such as the capacity of the central station and size of its units, and the results so far as the movements of cars are concerned left to take care of themselves. This procedure reminds me of the architect who desires to erect a sky-scraper, deciding upon the foundation without regard to the weight of his building or the character of the soil beneath it.

There is, in fact, the most intimate possible relation, as should be perfectly evident, between the various parts of the equipment, and this relation is such that the cost of each part is seriously varied with exactly the same schedule, grade and load conditions by variations in the manner of making those schedules.

This is in no manner more effectively shown than in John Lundie's most interesting methods of detailing the essentials of first cost and cost of operation for various schedules under various rates of acceleration, all referred to a common factor, the percentage of weight on the drivers.

Such, then, are the practical advantages to be derived from a properly devised multiple unit equipment, but to be effective the details of the system had to be developed at great expense and much experience to a state of absolute reliability and reasonable simplicity. It may be stated, now, that the essentials of the multiple unit system are not complicated, despite the remarkable variety of functions which they have. They may be stated briefly to be as follows:

1. The master controllers on the platforms at each end of a transportation unit. They are of the simplest and most reliable character.

2. The master controller and train line cables, which become parts of the permanent wiring of a car, and are just as reliable and as simple as that for the lighting system. These secondary controlling cables are absolutely independent of the main motor circuits, and carry very small currents.

3. The jumpers, which are removable sections of the train line, connect the parts of the latter, which are permanent to each car, just as air hose couplings connect up a brake line.

4. The main controller, which is composed of the following parts: (*a*) certain relays and a throttle, developed in electric elevator service; (*b*) pilot motor with automatic limits, something like that used in elevator controls, but of more robust make; (*c*) a rheostat cylinder, with or without motor grouping switches, the parts similar to those of hand control; and (*d*) a reverser with like parts, but independently operated.

The braking system, whether using automatic air or electric, is something like the multiple unit electric system. There is a train line with means at each end of each transportation unit for simultaneously applying the brakes. When automatic air is used there is a train and equalizing line, a compressor with an automatic governor, illuminated gages, and a simple form of engineer's valve at the ends of each car for each transportation unit.

RESULTS OF THE MULTIPLE UNIT EQUIPMENT ON THE SOUTH SIDE ELEVATED RAILWAY

[Here follows a complete technical description of the installation of the Sprague multiple unit system on the lines of the South Side Elevated Railway Company, the substance of which has already appeared from time to time in the columns of the Street Railway Journal.—Ed.]

The financial results of operation on the South Side Elevated Railway are as follows, the months of November and December, 1897 and 1898, being the first strictly comparative months:

In addition to all "loop" expenses there is a rental charge equal to 10 per cent of the gross passenger receipts of the road. This should be considered really as an interest charge, not as an operative expense.

For these two months, with an average of 489,979 car miles on the main line, the comparative table following shows:

(*a*) Ratio of expenses to earnings, *including* "loop" rental, taxes and licenses;

(*b*) Ratio of expenses to earnings, *excluding* "loop" rental, but including taxes and licenses;

(*c*) Net earnings.

	(*a*)	(*b*)	(*c*)
November, 1897, steam.....	87.3	77.7	$10,603.80
November, 1898, *electric*.....	57.3	47.7	39,448.56
December, 1897, steam.....	83.6	73.8	14,691.69
December, 1898, *electric*.....	55.0	45.4	45,355.68

The succeeding months show increasing traffic and equally favorable results.

The operating expenses per car mile during November, 1898, on the main line, including and properly apportioning to it everything except licenses, taxes and rental, were less than 7½ cents on an average and maintained schedule of 15 miles an hour, with stations 2080 ft. apart.

So much for the actual results accomplished on the South Side road. The question naturally arises: Have there not been difficulties, and if so, of what character?

Of course there have been, and I should have been surprised, and almost sorry, if it had been otherwise, because it is only through the difficulties incident to the earlier operation of a system of this character that the essentials are fully determined and apparatus developed to a state of perfection. It is curious, however, that there have been more troubles with what is classed as "standard apparatus" than with that individual to the multiple unit control. These latter troubles were, first, with the rheostats, which were of new construction, and later, poor brush terminals, cracked gear cases, and with the earlier type of air governors.

With the specific multiple unit apparatus the principal troubles were with poorly and hastily wound relay coils, too light and unsubstantial construction of auxiliary contacts, and improper jumper construction, causing an occasional opening of the controlling circuits.

Taken all in all, however, the president and superintendent of the road state there were less troubles than when starting with their compound locomotives, and on the whole the success of the road has been unparalleled in electric railway history where so radical a departure has been taken.

ESTIMATES OF SAVING ON MANHATTAN RAILWAY, NEW YORK

Coming to New York conditions, I may say that, based upon the Chicago performance, and allowing for difference of coal cost, the Manhattan road, now operating at 12½ miles actual schedule during time of actual load, and making about 43,000,000 miles annually, can be operated at over a 16-mile schedule at not exceeding 9 cents, instead of 11.9, and on the existing mileage this would mean a saving, excluding interest on investment, of about $1,250,000 per annum, or, allowing interest on investment, of about $750,000, to say nothing of any other gains. A 17-mile schedule can actually be made with two motor equipments.

In closing, perhaps I may venture an opinion as to the general features which should characterize a suburban passenger railway equipment. I think it may be safely stated that the first is the use of the continuous current in the motor equipment, in spite of the claims which have been made and the results accomplished with alternating current motors, at least so far as we can judge by any present developments.

The problem, then, is whence shall be derived this continuous current, and that depends upon distances. For moderate distances, continuous current generators supplying current directly to the line, with or without the addition of storage batteries, are preferable. When the extent of the line becomes at all serious, then it must be considered as made up of a number of shorter sections joined together, each of which derives its principal source of supply from a local station, which station can be driven directly by water or steam power, or by an alternating current from a distant station, using a motor-dynamo combined in a single type of machine, the rotary converter, or joined in the form of a directly coupled set, the dynamo end being for continuous current and the driver a synchronous or induction type of motor.

Generally the sub-station should be supplemented by a storage battery, to take care of fluctuations in the load, to make even the duty on the sub-station and as far as possible at the central station, and to take care of some portion of the peak load caused by abnormal variations in the aggregate service at different times of the day. Of course, with the storage battery comes the necessity of a means of some kind of automatic regulation; there are various methods, but I will not enter into them here. Looking forward, however, to a perfectly assured future of a heavy service over considerable distances, I may state that the general equipment of such a road should generally involve the following essentials:

1. High potential alternating current transmission from one or two well-placed central stations, with or without static transformers.
2. Motor-dynamo sets, or rotary converters, at a number of conveniently placed sub-stations, to convert high pressure currents into continuous currents of about 600 volts' pressure.
3. Storage batteries of quick charge and discharge capacity at the same sub-stations as the motor converters to equalize their duty and to prevent sharp variations in the generating plant, as well as the sub-station.
4. A system of feeders and main conductors.
5. A power rail or trolley wire supplying continuous current, but ordinarily without any switching of currents.
6. Individual transportation units with a multiple unit control, so that combination of cars without regard to sequence or end relation can be made up at any portion of the line independently, and controlled from any selected point.

Chronology of Modern Electric Railroad Operation

Accompanying Mr. Sprague's paper on the "Multiple Unit System," read before the American Institute of Electrical Engineers, on May 16, was the following interesting chronology of modern electric railroad operation from 1880 to 1899.

1880.—Edison built and ran at Menlo Park an electric locomotive, and subsequently designed some others.

1883.—Daft, at Mt. McGregor, ran the Ampere, pulling one car, and Field, at Chicago, the Judge, also pulling one car.

1884-5.—Vandepoele, at Toronto, and later in 1885 or 1886, at Minneapolis, pulled trains of cars with an electric locomotive.

1885.—Daft, at Baltimore, operated a locomotive and trail car, subsequently increasing the equipment, and on the elevated road pulled a train with an electric locomotive for experimental work.

DECEMBER, 1885.—At Society of Arts Sprague stated some of the possibilities on the elevated railroad, and pointed out the advisability of putting motors under each.

1886.—Sprague built the first locomotive car. This was intended for experimental work on the elevated road, but was abandoned before the motors were completed.

1886.—About this period the Rhode Island Locomotive Works, under direction of Knight & Bentley, designed a locomotive for rapid transit train operation, but it was not built. About this same time Stephen J. Field designed an electric locomotive for the same purpose.

1886-87.—Sprague operated a standard elevated railroad car with two single reduction motors axle centered, and with one end spring supported from the truck body, on the Thirty-fourth Street branch of the elevated railroad, and also pulled a trail car, and prior to this, a platform car, with the same motors, in the Durant sugar refinery on Twenty-fourth Street, New York. This was followed by the Richmond equipment, the beginning of the modern development.

NOVEMBER 4, 1890.—City & South London Road opened. Originally designed for cable. Light trains operated by electric locomotives having two gearless motors with the armatures rigidly mounted on the axles of drivers.

1892.—Sprague, Duncan & Hutchinson designed, afterwards building it, a 60-ton electric locomotive for experimental work in connection with the North American Company. It was not put to use.

FEBRUARY 4, 1893.—Liverpool Overhead Railway. Operates two-car trains, each car having one motor disposed at the leading and back ends of the couple, the two cars being kept together as a unit. Hand control at each end.

SPRING OF 1893.—Under the general supervision of W. E. Baker, assisted by B. J. Arnold, in charge of the steam plant, and Charles H. Macloskie, in charge of the car equipment, the Intramural Railway was constructed at the World's Fair. The General Electric Company was largely interested in this enterprise. Four-motor cars, with hand control, were used to pull three trail cars, this plan of distributed motors under the passenger car having been advocated by Mr. Baker in opposition to the general opinion then in favor of electric locomotives. The third-rail supply, with the flexible sliding contact shoe, was here used for the first time, and the road may be said to be the first real practical train operation on any serious scale in this country.

NOVEMBER 3, 1893.—The General Electric Company's engineers, in a communication to Col. Hain, general manager of the Manhattan Elevated, recommended eight-car trains to be pulled by a single 40-ton, four-motor car, guaranteed an increase of 14 per cent in schedule, and stated that the motor car could pull thirteen-car trains as easily as present steam locomotive could pull five cars.

Proposed potential of about 600 volts, direct supply, unspecified number of stations, and did not suggest alternating currents, boosters or storage batteries.

MAY, 1895.—Metropolitan West Side Elevated Railroad equipped under the supervision of W. E. Baker, and using General Electric Company's apparatus, opened on locomotive car plan, using two motors on locomotive cars. This was the first commercial elevated road put into operation in the United States.

JUNE 27, 1895.—First of three 95-ton locomotives put in operation in Baltimore, by General Electric Company, for pulling freight and passenger trains through B. & O. tunnel.

SEPTEMBER 20, 1896.—Lake Street Elevated Railroad, which had been operated since October, 1893, with steam, began electrical operation, plans similar to those on the Metropolitan.

FEBRUARY 1, 1896.—(Daily paper.) Electric Storage Battery Company, of Philadelphia, described and proposed a storage battery locomotive to pull trains, storage batteries to be used in combination with current from third rail.

FEBRUARY 8, 1896.—(Daily Paper.) Sprague, in reply to strictures on the capacity of electric motors, in a daily paper, offered, under $50,000 forfeiture, to equip a train which could be pulled by a locomotive car, and also by motors under each car simultaneously controlled, and to make a speed of 40 miles an hour on express service.

APRIL 17, 1896.—In interview in daily paper, Westinghouse, on behalf of the Westinghouse Electro-Magnetic Company, with what was called the Westinghouse Wheeless system, proposed for all elevated and suburban roads the use of a contact pin system and the continuous current. At the same time it was stated that in ten days public demonstration was to be made to demonstrate success of the Tesla alternating current motor for this purpose.

JULY 16, 1896.—Exhibition of contact pin system for the benefit of Manhattan Elevated officials.

JUNE 6, 1896.—Sprague proposed to Messrs. Gould, Sage and Galloway, special committee of Manhattan Elevated, to make demonstration equipment of multiple unit system.

MAY, 1896.—Nantasket Beach Railroad put in by the N. Y. & N. H. R. R., under the supervision of Col. Heft, was opened—used General Electric apparatus and a locomotive car carrying passengers and pulling a trail car.

November 29, 1896.—Under the supervision of C. C. Martin, electric service was instituted on the Brooklyn Bridge Railroad. Twenty motor cars, each equipped with four General Electric Company 62½-h.p. motors and hand control, replaced the steam shifting engines, and were used in connection with the cable.

December 10, 1896.—The General Electric Company, through its Western office, proposed to the South Side Elevated Railroad an equipment of three and four-car trains, one of which should be a locomotive car having two motors, and six-car trains, one of which should be a locomotive car having four motors, guaranteeing that on the first combination 35 miles an hour could be made, and on the second 45 miles an hour between stations 2000 ft. apart. No central station system was described, either alternating or continuous, nor any potential determined.

December 10, 1896.—The Walker Manufacturing Company proposed to the South Side Elevated Railroad a system as follows: Continuous current, station in middle, pressure 600 volts, three and four-car trains, one being a locomotive car having two 125-h.p. motors, and guaranteed to save seven minutes in the trip from Congress Street to Sixty-third Street, a distance of about 8½ miles, that is, to make a schedule of nearly 19 miles.

February 14, 1897.—Sprague again stated the possibilities of the multiple unit system to the Manhattan Road, and again offered to make a demonstration equipment and to work up to eight-car lengths under every possible condition.

February 25, 1897.—Sargent & Lundy reported on general equipment for South Side Road, giving summary of locomotive car proposals and their recommendation, one of which was to double up trains.

February 26, 1897.—Potter, engineer of the railway department of the General Electric Company, reported to the third vice-president at Schenectady his recommendations of a system for the Manhattan, with details as follows:

Direct current,three-wire system, the cars on one track being in series with those on the other, 650 volts on each line, and 1300 volts between power rails on the two tracks, the track rails to be used as the neutral wire; two power stations equipped with 2300 kilowatt generators, direct current supply; five-car trains to be pulled by a single motor car with four motors; possible boosters or storage batteries at South Ferry alone; no alternating current, no sub-stations proper, and no storage battery regulations at sub-stations.

About the same date, a system diametrically opposed in almost every essential was proposed and recommended to the general contractors for the Central London Railway, by Mr. Parshall, of the British Thomson-Houston Company, with the General Electric Company in consultation as sub-contractors.

This proposition opposed the three-wire system, and on about 6 miles of road, recommended alternating current machines, four sub-stations with rotary converters, no storage batteries, five-car trains pulled by electric locomotives pure and simple, instead of locomotive cars. The locomotives are now being built and weigh 45 tons each. The schedule is moderate, and acceleration and braking are aided by having the station at peak grades of from 2 to 3 per cent.

The Westinghouse Company made proposals of something the same nature and the Siemens-Halske also, but the latter proposed the three-wire system, one track being in series with the other.

March, 1897.—Sargent & Lundy issued general specifications calling for alternative proposals for:

Thirty-six locomotive cars each having four 125-h.p. motors.

Forty-five locomotive cars each having two 150-h.p. motors.

One hundred and twenty motor cars each having two 35-h.p. motors.

April, 1897.—General Electric Company, through W. B. Potter, engineer of the railway department, proposed to the South Side Elevated Railroad four and five-car operation, one car being a locomotive with four motors.

April, 1897.—Westinghouse Electric & Manufacturing Company proposed to South Side Elevated operation of five-car trains, one being a locomotive car equipped with four 125-h.p. motors, and guaranteed to make an 18-mile schedule.

April 7, 1897.—Sprague, as consulting engineer, condemned the locomotive car system for South Side road, and recommended the adoption of the multiple unit system.

April, 1897.—Messrs. Sargent & Lundy, after report by Sprague, abandoned the locomotive plans for the South Side Elevated, and fully endorsed the multiple unit system.

April, 1897.—Chief Engineer Wallace, of Illinois Central Railroad, stated that trains could be run in any length, from one to a dozen cars, and he hoped to be able to run them with a push-button.

April 17, 1897.—Sprague tendered to the South Side Elevated Railroad a proposal to equip 120 cars on multiple unit system.

May, 1897.—Chief Engineer George B. Cornell, of the Brooklyn Elevated Road, stated that two essentials of his endorsement of any change from steam to electricity on that road were increase of schedule speed and a control which could enable him to run single cars or any desired aggregation of cars into trains.

July, 1897.—Short, for Walker Manufacturing Company, proposed locomotive car operation on Brooklyn Elevated Road.

July 16, 1897.—Sprague made demonstration at Schenectady of two-car multiple unit train, and ten days later of six-car train.

November-December, 1897.—Sprague made working test of multiple unit train on Metropolitan Elevated of Chicago of five-car multiple unit train.

Fall of 1897.—On the Brooklyn Elevated Railroad the General Electric Company's engineers recommended for a 15-mile schedule four and five-car trains, two of the cars being locomotive cars, each weighing about 35 tons, and equipped with four motors, with through connections of the main circuits, so that either the four or five-car unit could be operated from either one of the locomotive cars from a hand control. No independent operation of other cars was proposed. An alternating current central station, with sub-stations, rotary converters and storage batteries were also recommended.

1897.—Short, for Walker Manufacturing Company, proposed locomotive car plan for Manhattan Elevated.

December 23, 1897.—Sprague Electric Company sent the Illinois Central Railroad Company on specifications of John Lundie, the consulting engineer, a bid for an equipment for the suburban service of the Illinois Central Railroad, to use direct current system, with storage battery equalizers, individually equipped cars, multiple unit system, and to make a schedule speed of 24½ miles with stations averaging 2900 ft. apart.

December 23, 1897.—On same specifications, General Electric Company made similar bids to the Illinois Central, under agreement to get controllers for same from Sprague Company, in case their bid should be accepted.

January 12, 1898.—Mr. Sprague proposed to Mr. Gould to operate any combination of from one to ten cars under any conditions of rail on multiple unit system.

February 18, 1898.—Sprague tendered to the Brooklyn Elevated Railroad the multiple unit system. For temporary use, twenty-four equipments were consolidated on twelve cars to be used first as locomotive cars, and afterwards to be distributed.

The motor equipments were to be designed for 17-mile schedule, with existing station intervals.

Those on the South Side were designed for a 15-mile schedule, but make 16½ miles at times, with longer intervals.

February, 1898.—The General Electric engineers offered to supply on the first twelve cars actually equipped by the Brooklyn Elevated Railroad, motors with either hand or semi-automatic control, and proposed to supply four or five months later, when developed, a full multiple unit control.

April 20, 1898.—Sprague began operations on South Side road with multiple unit system.

June 18, 1898.—Sprague began operation on the Bridge end of the Brooklyn Elevated road.

July 12, 1898.—Waterloo & City, London. Straight run 1½ miles, no mid-station. Operates light four-car train units, the two end ones being motor cars with two motors, and the intermediates being dead cars.

July 27, 1898—Multiple unit system in full operation on South Side road, and steam abandoned.

Equipment on South Side road afterwards increased to 180 cars, 150 of which are fully equipped, and thirty for emergency service, partially equipped.

November 1, 1898.—Westinghouse Company began to put twenty cars on the Kings County Elevated Railroad, each equipped with two sets of two motors with controllers actuated by air pistons and controlled by a secondary electric circuit. Four only out of the twenty cars are in use at present and for locomotive purposes.

1898.—General Electric Company proposed six-car trains and double locomotive cars for the Manhattan Elevated, and three-car trains, with one single locomotive car, for the Boston Elevated.

And finally the engineers of the General Electric Company are credited with an intention to operate an experimental multiple unit train.

Of course, there are a number of other proposals which have been made both for multiple unit and other systems, and for various roads, of which, however, mention is unnecessary for the present.

Electric Traction on Tramways

Upon this subject, J. Clifton Robinson, M. Inst. E.E., A. Inst. C. E., managing director and engineer of the London United Tramways, Ltd., and the Imperial Tramways Company, Ltd., and engineer to the Bristol Tramways and Carriage Company, Ltd., read an interesting paper before the Cleveland Institution of Civil Engineers, of Stockton-on-Tees, England, May 29. The extent of the paper precludes its publication in this journal, but parts of it relating to the roads in which Mr. Robinson is interested, are given below.

BRISTOL TRAMWAYS

The Bristol tramways demand our attention as practically the first line in England where overhead electric traction was shown in its modern aspects. In the construction attention was seriously given to the provision of a solid roadbed, with heavy girder rails properly bonded, so as to secure a perfect return. The Board of Trade automatic recorder, now placed in the power house for the registration of any drop in voltage beyond the margin of 7 volts between any two points in the system, has commanded the most patient attention; and here, as in every line constructed subsequently under my supervision, this automatic record has remained from day to day and from hour to hour well within the margin.

The power station is located about the center of the present system. Its equipment has been extended and altered since the station was originally designed, and the two boilers have been increased to four; but they are all of the Lancashire type, and are fitted with Vicars' mechanical stokers, and one Green economizer in flue for the complete battery of boilers. The engine room contains four direct-coupled sets. Each unit consists of a 250-h.p. McIntosh & Seymour engine, driving one of the British Thomson-Houston type M.P. 6—150—200 generators. The total capacity of the station is 920 h.p. The engines are of the horizontal tandem compound type, with high-pressure cylinder 13 ins. in diameter; the low pressure 23 ins., and stroke 17 ins. The speed is 200 r.p.m., and the steam pressure 160 lbs. The economical load is 230 h.p. at one-third cut off.

In addition to the four traction generators there is a motor-generator which supplies current for the lighting of the station, and a negative booster for reducing the difference of potential on the rail return circuit. There are also four electric motors, of which two drive the feed pumps, one the mechanical stokers and fuel economizer, and one the machinery in the repair shops. Each of these motors will give up to 20 h.p. if necessary. The motor-generator is capable of developing on its secondary terminals an output of 230 amps. at 135 volts; its general construction is similar to that of the large generators. The motor portion of the machine is compound wound in such a manner that the e.m.f. at the secondary terminals is constant, but the compounding of the field is done entirely from the motor armature and not from the secondary armature, so that this latter may be used in connection with the accumulator battery. The primary terminals of the machine are connected to the main station bus bars, and have, therefore, to work at a potential of 500 volts. In connection with the shunt winding of the fields of the motor-generator there is a regulating switch with twenty steps and a suitable resistance, enabling the potential between the secondary terminals to be varied between 135 and 105 volts.

The total distance from the power station along the track to Staple Hill is 5.6 miles, and as there are usually about twenty-four cars distributed over this part of the system, there would be a drop on the return of about 9 volts, under these conditions. In order to diminish this drop and bring the operation into agreement with the Board of Trade regulations, a portion of the current is drawn from the rails by means of the negative boosters previously mentioned. This machine consists of a 500-volt motor, direct coupled to a separately excited, series-wound generator, having a maximum capacity of 300 amps. at 500 volts, on the terminals. The generator armature is connected in series with the negative bus bar through an insulated cable leading to the rails, while the field is in circuit with an insulated feeder connected from the positive bus bar to the trolley wire. It is instructive to watch the recording voltmeter in series with the test wire connected to the Staple Hill terminus, as the field of the negative booster is varied. The drop on this section with the booster cut out is 9 volts, and with the booster in, and with approximately zero potential on the rails, the drop is only 3 volts, or well within half the maximum limit allowed.

An armored feeder cable is laid underground the whole length of the line, and is connected about every half-mile to the cast iron section boxes containing switches and lightning arresters. In addition to the feeder there is a small three-strand insulated conductor laid the whole length of the system. One of these strands is for the Board of Trade leakage tests. It is only connected to the rail at the extreme ends of the line and at the power station to the Board of Trade panel. The other two wires are for telephones, an instrument being fixed in each of the section boxes for use by the company.

The trolley wires running from end to end of the line are of hard-drawn copper, 0.32 in. in diameter, and are divided by section insulators about every half-mile, where the two ends are brought to the switch boxes and joined to the feeders through the switches. Any section can thus be cut out, if necessary, without disturbing the traffic on the rest of the line.

The practical success of the early installation at Bristol has led the company to undertake the electrical conversion of all their lines, which amounts to some 50 miles. Work is also being vigorously pushed forward at the new central power station at St. Philip's Bridge, on the River Avon. The site is located advantageously in respect to coal and water. This station will be equipped with the highest type of plant and machinery, one unique feature being that the engine room is on the ground floor, and the boiler room vertically above.

The engines are of the vertical cross-compound Corliss type, with cylinders 22 ins. and 44 ins. x 43 ins. stroke, running at 90 r.p.m., and each has direct coupled a 500-kw. electric generator. The flywheels are 16 ft. in diameter and weigh 85,000 lbs. The steam consumption of these engines is guaranteed to be 12.7 lbs. of steam per i.h.p., with a mechanical efficiency of not less than 92 per cent. On account of the central location of the power house the distribution will be on the continuous current principle. The generators will be of the 10-pole type to generate 1000 amps. at 500 or 550 volts, as may be required.

The steel frame building will be 140 ft. long, 52 ft. wide and 93 ft. in height from the basement to the roof trusses; the basement being 9 ft. in height, the engine room 37 ft., the boiler room 26 ft. 8 ins., with an additional floor above the boiler room 15 ft. in height to contain the water tanks, coal storage bunkers, economizer flue, etc. A 25-ton electrically driven overhead crane will traverse the whole length of the engine room.

The boiler room will contain eight horizontal water tube boilers, each with the capacity of evaporating 8250 lbs. of water per hour, at a steam pressure of 160 lbs. Each furnace will be fed by an electrically driven mechanical stoker of the "Coking" type, and the ashes will be removed by the return line of the conveyor, and received into a tank outside the building, from which they can be drawn off into barges.

The coal supply will be received from barges by automatic shovels and delivered into a coal storage tank at the back of the building, from which conveyors of the noiseless gravity bucket type will deliver the coal into the bunkers above the boilers, and from these the supply will be drawn off for the furnaces through weighing hoppers.

The smokestack will be erected at the end of the boiler room, having 10 ft. clear inside diameter and being 200 ft. in height above the foundations. It will be built up of steel plates in rings lap-jointed and riveted, tapering upwards, and finished with an ornamental cap at the top. It will be entirely self-supporting, and will be lined throughout with firebrick.

On the floor above the boiler room there will be located the economizer, consisting of 360 tubes in thirty-six sections, and here also there will be two water tanks of 6000 gals. each.

The engine room will also contain two lighting sets, consisting of two two-crank tandem compound high-speed engines, running at 400 r.p.m., and each having direct coupled a 50-kw. 500-volt lighting generator, and three motor generators, each of about 40-kw. capacity, for use in connection with the rail return.

The condensing apparatus will consist of two surface condensers of the Admiralty type, each containing 3200 sq. ft. of cooling surface and located on the engine room floor. The air pumps will be of the vertical twin type, one set for each condenser. The circulating pumps will be motor-driven 8-in centrifugal pumps, one for each condenser. The condensing plant and auxiliary steam piping will be located in the basement. The boiler feed pumps will be of the vertical compound duplex type, and will be located in the boiler room.

The hot well will consist of a cylinder 96 ins. long and 48 ins. in diameter located in the basement; the water from this hot well being lifted to the water tank on the economizer floor by two electrically driven three-cylinder pumps.

The switchboard will be of white marble panels 8 ft. in height, bolted to angle-iron frames on a raised gallery at the bridge end of the engine room. It will consist of four generating panels,

two lighting generator panels, three booster panels, sixteen feeder panels, one lighting circuit panel and one meter panel; all complete with instruments and switches of the most approved type and design.

The system, including the St. George & Hanham Light Railway extension, when completed, early in the coming year, will have an equipment of 250 cars, and will prove in its organization to be one of the most modern and complete systems of electric tramways in the world.

DUBLIN TRAMWAYS

Only second in interest to this first Bristol line, and of more importance as regards length of line and the special and important mechanical and electric equipment which the greater length of line demanded, is the Dublin, Kingston & Dalkey Electric Tramway, 8 miles in length. This line was inaugurated as an electric tramway by the Lord Mayor of Dublin on May 16, 1896.

In point of construction of the permanent way all the experience of Bristol was adopted, and, where possible, improved upon, and as the line at some places in Kingstown and Dalkey lay along curved and sometimes rather narrow streets, and considerable differences in levels and contours of roadways had to be adjusted, the roadbed formed a problem which it took much care and contrivance to solve. But in the general detail, so far as the line below and above was concerned, the Dublin line merely repeated and accentuated the experience in Bristol.

It was different as regards the power house and the distribution of the current. The stringency of the Board of Trade regulations at once demanded that on a line of such extent special provision must be made, because, despite the greatest care in insulation and in the proper bonding of the rails as a return for the current, it was almost impossible to preserve so small a drop in voltage as the Board of Trade regulations allowed. In place of distributing the current for the whole 8 miles from one center, two substations were established—at Blackrock and Dalkey—so that the work of distribution was made from three points. Had the service been from the main power house only, the current would have been always in one direction, and the accumulation of minor (and unpreventable) leakages would no doubt have rendered the preservation of a maximum drop of 7 volts difficult, if not impossible. The means taken to counteract this difficulty I shall now proceed to describe.

In the initial plant the power house contained four Willans & Robinson engines, the flywheels carrying 18-in. belts, by which the electric generators were driven. Two of these generators are direct current, each capable of giving 100 kw. continuously, or 120 kw. on emergency. These dynamos supply directly the section of line nearest Dublin. The other two engines drive two three-phase alternators, which constitute the special feature of the installation. These alternators are six-pole, of capacity of 150 kw., and are driven with a frequency of 30 periods per second. The general design and construction of these machines were effected by the eminent electric traction expert, H. F. Parshall, who has been my coadjutor in most of the various works in this country, and whose idea of the three-phase distribution had its first extensive illustration here. From the power house at Ball's Bridge, two cables carry the currents generated by those machines to the substations at Blackrock and Dalkey. The current is carried at high tension, averaging 2500 volts, and at the substations it is transformed to the required line current of 500 volts continuous. At Blackrock there are two three-phase synchronous alternate current motors connected direct with two direct current railway generators, capable of working up to 75 kw., and from the latter the portion of line nearest Blackrock is supplied with current of the standard 500 volts. Similar apparatus at Dalkey, somewhat less powerful, takes off the high tension current from the cable and transforms it for the supply of the third section of the line.

Some of the practical advantages of this system are that by its use a much greater number of cars can be operated without breaking the Board of Trade rule; that the three-phase method of distribution requires about three-fourths the weight of copper which would be required by a single-phase alternating current system of the same voltage; that the motor generators may be run from either the 500-volt continuous or the 2500-volt three-phase mains; and that by the use of the synchronous motor the phases of the alternating currents can be so governed that the amount of power delivered to any substation can be regulated as desired.

The convenience and flexibility of the motor generator method of transmitting power is quite apparent when it is borne in mind that the reaction on the field of the synchronous motors can be compensated for by a few turns of wire in series with the armature of the generator to which it is coupled, thus keeping up the counter e.m.f of the motor, and insuring that under no circumstances whatever can the motor be thrown out of synchronism. The combined efficiency of the motor generator set is 85 per cent at full load. Another feature of the station which gave great satisfaction was the operation of the switches on the three-phase circuit. They consist of three switches mechanically operated from a single line through wooden connecting rods about 3½ ft. long. Their efficiency was tested by repeatedly breaking the circuit, and no instance of an arc being maintained is yet recorded.

During the tests which were made on this system the railway generators which are directly coupled to the three-phase motors in the substation were directly short circuited, and also run for some time at 60 per cent overload, but under no circumstances was it found possible to pull the synchronous motor out of step. The switchboard in the Blackrock substation has two panels for the distribution of power from the 500-volt generators. On the three-phase part of the board there are five three-phase switches, one for cutting out each of the cables coming in from Ball's Bridge, one for cutting out the cable that extends on to Dalkey, and one for cutting out each of the synchronous motors.

The three-phase synchronous motors are excited by means of the 500-volt continuous current machine. These three-phase motors are self-starting, but in normal practice the machines are brought to speed by means of the continuous current generator used temporarily as a motor, and driven from the 500-volt trolley line, which receives this starting current from the main power station at Ball's Bridge. This is the modus operandi of starting up one substation when neither of the machines is running. When one of the machines is running the current for starting the other is, of course, obtained from it.

The success of the Dublin Southern was so marked that the Dublin United Tramways Company has been led to convert to electricity the whole of its lines, which amount to some 75 miles of single track. The central power station at Ring's End, now under construction, will have a capacity for operating 600 cars. The coal handling is to be done entirely by automatic machinery. The boilers are of the water tube type, equipped with Vicars' stokers. The engines are of the vertical cross-compound type, with Corliss valve gear, and run at 90 r.p.m. Owing to the favorable location of the new power house it will be found possible to work the whole system by continuous currents. Earth boosters and pairs of test wires are run from the station to various points in the earth return system, so that the voltage drop can be regulated to any desired extent.

MIDDLESBROUGH, STOCKTON AND THORNABY ELECTRIC TRAMWAYS

The power station of this road contains three alternators of the three-phase type, each of 300 kw. capacity, 32-pole 2500 volt, giving a frequency of 25 cycles at 94 r.p.m. The fields are excited from the 500-volt bus bars. To supply light when the machinery is shut down and to start the dynamos in the morning a battery of accumulators has been provided. These are by the Tudor Company, and consist of 260 cells, with a discharge rate of 48 to 70 amps.; the capacity at the lower discharge rate being 240 amp.-hours. For charging these accumulators a boster is connected in series with the 500-volt bus bars. This booster consists of a rotary converter fed from step-down transformers of special design. Each transformer has the primary and secondary separated so as to give the effect of a considerable reactance, this arrangement giving a large range of voltage on the rotary converter to provide for the alteration in the charging volts required by the cells. The rotary converters employed at the generating station and at the substation are of comparatively recent introduction into this country, and have been employed in preference to motor generators on account of the high efficiency which they give and the general case of their manipulation. They consist essentially of direct current generators, to the armature winding of which connections are made at suitable points to a set of three collector rings on the end of the shaft opposite that occupied by the commutator. The three-phase current is led into these collector rings and the machine is run at the correct speed for 25 cycles. The same winding thus serves both for the alternating current led into the machine and for the direct current taken out.

The system of distribution of electrical power is further specially designed to give the maximum power at any point of the system on the most economical basis. A 500-volt continuous current direct from the rotary converters in the central power house feeds the trolley lines on either side, while the Middlesbrough and Linthorpe sections of the lines are fed by a current transmitted at 2500 volts from the central station to the substation at Newport, and there transformed down so that power is delivered from this subcenter direct into the line at 500 volts.

The considerations leading to the adoption of this method of distribution had reference not only to the position of the main generating station and the properties otherwise available as car sheds, machine shops, etc., but to the length of the line, and the

regulations of the Board of Trade as to the earth return. The experience in Dublin was repeated here. With the number of motor cars to be operated on the lines in the borough of Middlesbrough, had the current been supplied at 500 volts direct from Stockton, the drop in the earth return between the termini at Linthorpe and Ormesby Road and the Stockton main station might have exceeded the prescribed limit, and in order to secure compliance with the Board of Trade regulations a substation was established at the Newport depot for the distribution of the current.

The feeder cable which transmits the three-phase current at 2500 volts from the central power house to the substation consists of two three-core cables, in each of which are three conductors of copper suitably insulated, each conductor having an area of 50 sq. mm. or .0775 sq. in. With this small section it is possible to transmit 300 kw with a loss of less than 5 per cent. At the substation this current is reduced by step-down transformers of 80 kw. capacity to 320 volts, and this current is then passed into the alternating current side of a rotary converter, from which a direct current of 500 volts is drawn to feed the portion of the line supplied from the substation. The two four-pole rotary converters of 200 kw. capacity running at 750 r.p.m. in the main power station feed direct into the portion of the lines supplied.

A novel feature of the main station equipment is the combination of static and rotary transformers for charging the batteries, specially designed for this installation. The charging current is passed through the rotary, and raised from the line voltage 500 volts to a maximum of 650 volts for charging. There being no direct current primary generators in the station, it became a problem how to charge the batteries for supplying the excitation to the three-phase generators. This was solved in the following manner: A rotary converter was designed to supply the difference between the line voltage and the variable voltage required for charging; combined with this is a static transformer having a ratio of transformation of 330 to 80 volts on a non-inductive load. The transformer was designed with a large amount of leakage between the primary and secondary, the leakage being adjusted so that by changing the phase of the armature current by variation of the field current of the booster, the transformer ratio is varied, and consequently the voltage on the collector rings. In this way it is possible to vary the voltage on the continuous side of the rotary from 40 volts to 150 volts. The charging current is 60 amps. The armature of the rotary is designed to carry 60 amps. continuously.

In common with the Bristol and Dublin lines, two wires are extended above the tracks from end to end of the system, and convey current to the car motors by means of trolley poles fitted upon each car. The wires are of hard-drawn copper, .364 in. in diameter, and are divided electrically in half-mile sections by sectional insulators. There are overhead points and crossings at the ends of the lines and at the branches leading into the main and substations, and on the lines as well as in the substations the cars are moved and handled entirely by the trolley.

The section pillars are placed at each half-mile section on the road. They are about 4 ft. in height, and are placed on the curb lines, so that they are accessible from either side. The "Columbia 0000 rail bond" is used.

The Middlesbrough & Stockton track has a gage of 3 ft. 6 ins., and it will be obvious at once that the problem of constructing roomy and commodious vehicles is much more difficult on a gage of 42 ins. than (as in Ireland) on a gage of 63 ins. The cars carry sixty passengers, thirty inside and thirty outside, and this is seven more than were carried by the first electric car put on the Dublin-Dalkey line, and sixteen or seventeen more than were carried on the first electric cars at Bristol. We have thus shown that by judicious planning even the narrow gage line can give on each car as much public accommodation as where the lines are wider. The use of the larger type of bogie-truck motor cars, which I especially designed for this line, obviates the use of trailer cars, which are opposed to the most advanced principle of street railway practice—namely, to employ as units of service self-contained cars run at short intervals.

THE LONDON UNITED TRAMWAYS

The main work at hand in this kingdom at present in the extension of electric traction is that in the western suburbs of London, on lines owned and projected by the London United Tramways, occupying the district extending from Hammersmith to Hounslow and Hampton Wick on the southern boundary, and from the Central London Electric Railway terminus at Shepherd's Bush to Hanwell and Uxbridge on the north, with junction lines uniting these tramways into one vast system, amounting, if all that has been proposed should be carried out, to over 39 miles of road line, and practically to 75 miles of track. As regards actual accomplishment, the system already extends (working or under construction) to about 27 miles of route, and the balance is, to the extent of 13½ miles, actually under promotion, while a section of main road of about 2½ miles through the suburb of Ealing will come before Parliament next session.

On 1 mile of this the London County Council insists that we shall experiment with some method of underground electric conduit.

The London United original system, which is under process of reconstruction as described, is unique in its electrical arrangements. On account of the requirements of the committee of the Royal Society appointed to protect Kew Observatory, the company has been debarred from using the rails as an earth return, consequently the overhead wires are on the double insulated trolley system. Such a system, when connected up on the two-wire principle, requires, practically, twice as much copper in the conductors as a trolley system installed on the usual lines. To overcome this difficulty, and likewise to increase efficiency, the overhead trolley wires are connected up on the three-wire system, the two center wires forming the neutral, and the outside wires the positive and negative side. The neutral wire is grounded at the station, and at the central station only.

In the present session we are promoting extensions from points on the Hounslow line, to bring into direct tramway relation with London the favorite residential suburbs of Twickenham, Teddington and Hampton Court. Should our application to the Light Railway Commissioners prove successful, we shall, when completed, have a comprehensive system of 40 route miles of electric lines, with 250 motor cars in operation.

The power station will be in High Road, Chiswick. It will be a one-story building of brick and freestone, 154 ft long and 106 ft. wide, divided into an engine and boiler room. The boiler room will be 45 ft. wide, and consist of a steel frame structure in order to carry the heavy weights due to the coal storage bunkers (holding 500 tons), economizers, flue and water tanks, which will be located on a floor above the boilers. This steel structure will extend to the roof, and thus make the boiler room practically independent from the engine room.

The coal supply will be delivered from the ground level outside the building to the coal bunkers above the boilers by a noiseless gravity-bucket type of conveyor, capable of handling 40 tons per hour. This conveyor will also remove the ashes, dumping them into a special ash bin, from which they can be readily removed. An additional coal store of 2000 tons' capacity will be provided north of the boiler room. It is intended to deliver coal to the stores direct from the North & South-Western Junction Railway's depot, about 700 ft. distant from the boiler room, by means of a gravity-bucket conveyor. Alongside the coal siding, and entirely below the surface, will be placed a receiving hopper with the necessary apparatus for the delivery of coal to the conveyor, thus enabling the coal to be handled automatically direct from the railway trucks and to and from the company's coal stores and to the stoker hoppers.

The boiler room equipment will consist of eight horizontal water-tube boilers, each having a capacity of evaporating 8250 lbs. of water per hour at a steam pressure of 160 lbs. Each boiler will be fed by a mechanical stoker of the "Coking" type, the coal being delivered to the stokers by weighing hoppers from the coal bunkers above the boilers, thus securing a record of the exact amount of fuel consumed by each boiler.

The economizer, located on the floor above the boiler room, will consist of 360 tubes in thirty-six sections, provided with motor-driven scraping and cleaning arrangements. Here also will be two water tanks of 6000 gals each.

The smokestack is to be 10 ft. clear inside diameter, and 200 ft. in height above the foundations. This stack will be built of steel plates in rings, lap-jointed and riveted, tapering upwards, and finished with an ornamental cap. It will be entirely self-supporting and lined inside with firebrick.

The engine room will contain one 25-ton overhead traveling crane traversing the length of the room. There will be three vertical cross-compound condensing 750-h.p. engines, with cylinders 22 ins. and 44 ins. x 42 ins. stroke, three of them running at 90 r.p.m., and each of these having two 500-kw. electric generators; the fourth engine, running at 94 r.p.m., will be direct coupled to a 500-kw. three-phase 5000-volt generator, with a frequency of 25 cycles per second.

The lighting sets will consist of two two-crank tandem compound engines, each directly coupled to a 75-kw. 500-volt generator, and running at 400 r.p.m.

The condensing apparatus will consist of surface condensers of the Admiralty type, each containing 3200 sq. ft. of cooling surface, and located on the engine room floor. Each condenser will be supplied with a vertical cross-compound combined air and circulating pump, with steam cylinders 8 ins. and 15 ins., and air and water cylinders 20 ins., double acting, all 15-in. stroke.

Two cooling towers will be erected for cooling the water for condensation, these being of the twin type, arranged in two sections, having capacity to care for 4000 h.p., covering a ground space of 40 ft. x 15 ft. and 38 ft. high. The mats composing the cooling surface will be of galvanized iron wire netting, and a proper distributing system for the water over these mats will be provided. There will be two air propellors for each section of tower, operated at 160 r.p.m. by a direct-connected electric motor when giving maximum capacity; two vertical compound duplex boiler feed pumps, each of sufficient capacity, will feed all the boilers. The hot well will consist of a cylinder 48 ins. in diameter and 96 ins. long, the feed water for the hot well being passed through two feed water filters to thoroughly extract all oil before passing to the boilers. An auxiliary feed water heater will be supplied, having 520 sq. ft. of heating surface for heating the feed water before passing it into the economizer, exhaust steam from the boiler feed pumps and other auxiliaries being available for this purpose.

One motor generator set, consisting of one three-phase synchronous motor, having 500 kw. capacity at 5000 volts, and direct connected to two 250-kw. 500-volt generators, will be located in the engine room for converting from direct to alternating current and vice versa, for convenience on light loads and as a spare generating unit.

The switchboard of white marble 2 ins. thick, bolted to angle-iron framing, will contain ten generator panels, two lighting generator panels, one instrument panel, nine feeder panels, and also two three-phase generator panels, and two three-phase feeder panels, and will be supplied with the necessary instruments and switches.

The electrical current will be distributed over the whole of the company's system by lead-covered paper-insulated cables, drawn into cement-lined wrought-iron pipes laid under the footpaths of streets. As many as thirty of these cables radiate from the central power station at Chiswick, over one million feet of these pipes being required.

The London United system is almost entirely double track, and over the rails of each track will be located two trolley wires about 21 ft. in height from the ground, the two inside wires being interconnected and forming the neutral. The overhead lines will be divided into half-mile sections, and in order to meet the Board of Trade's requirements, each 1½ miles of the line being supplied by an independent feeder running direct from the power station, the neutral return also being reinforced for each section of 1½ miles by a separate feeder.

A section of the line furthest from the center of the system, about 8 miles in length, will be operated from a substation. This substation will be fed from the central power station through duplicate three-core lead-covered paper-insulated cables, power being transmitted at 5000 volts on the three-phase system. The substation will have a switchboard consisting of two three-phase high tension feeder panels, six transformer panels, four rotary converter panels, four feeder panels, and two instrument panels, the switchboard being similar in design and finish to that in the main generating station. In the substation will be provided seven static transformers (one being an extra), each of 150 kw. capacity at 25 cycles per second, transforming 5000 volts to approximately 350 volts. The cooling air for these transformers will be supplied by an electric motor directly connected to a suitable fan. Four rotary converters will also be supplied, each of 200 kw. capacity, and 6-pole machines running at 500 r.p.m, and delivering current at 550 volts, for supplying sections of the line radiating beyond 6 miles from the central power station at Chiswick.

The substation is designed generally on the lines of that already existing at Stockton, but there is a difference in the electric connections, owing to the rotatory converters feeding into a three-wire system. These machines will be electrically connected, so as to act both as rotary converters and as balancers; that is, in case one side of the three-wire system be overloaded, the rotary converter acting on the opposite side of the system will act as a motor, and thus assist the overloaded machine.

New Cars for Camden

The Camden & Suburban Railway Company, of Camden, N. J., has recently put into service on its interurban line a large number of 40-ft. double-truck cars of the design shown in the accompanying illustration. These cars were built by the St. Louis Car Company, from plans and drawings upon which considerable time had been expended, as the desire was to get a convertible car to answer the purpose of both a summer and winter car in every particular. The length of the body from outside to outside of corner posts is 28 ft., and from outside to outside of vestibules 38 ft. These cars are built on the style of steam coaches, with straight sides, and have ten windows on each side.

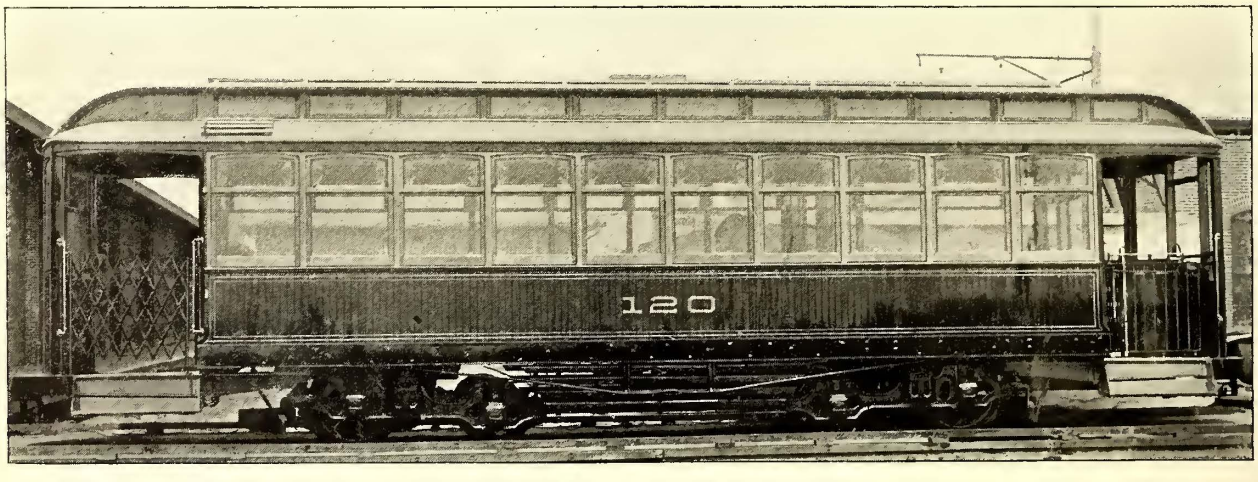
The side sills are plated with ⅝-in. x 8-in. steel plates, and the platform knees with ½-in. x 7-in. steel, while the bumpers are faced with ½-in. x 8-in. steel plates. The bottoms of the cars have truss rods extending from the corner of the sills through the inside sill to hold up the platform end of the car, and there is also a center truss rod between trucks underneath the sill. The cars are equipped with the St. Louis Car Company's patent sand boxes, and ratchet wheel brake, and are very handsomely finished throughout with solid bronze trimmings, highly polished.

The cars are furnished at each end with a vestibule 5 ft. long, with three drop sash in the end. The sides of the vestibule are open, and one side is provided with a Wood gate, while the other side is fitted with a large channel iron folding gate. Arrangements are made for one illuminated sign and hangers above the center sash in vestibule.

The interior finish of the cars is of the best quality white cane ash, finished in natural color. The ceiling is of quartered oak, finished in natural color and neatly striped. The seats are of the St. Louis Car Company's spring rattan "walkover" type. There are sixteen seats, accommodating two passengers each, and one stationary seat at each end accommodating three passengers each, making the seating capacity thirty-eight passengers to the car. The sides of the car are so constructed that when the sash are dropped down they are completely out of sight, and are held firmly by guides so they do not rattle. The opening is covered by a cap, which extends the entire length of the window pane. The windows are fitted with the best quality of Pantasote curtains, with the St. Louis Car Company's patent wire cable fixtures. One end of each car is fitted up as a smoking compartment, with sliding doors in the partition, but these doors and partition are so arranged that they can easily be moved by the railway company if so desired.

The roof is of the full ventilator, steam coach style, and is fitted with ornamental glass. The cars are wired for four two-light clusters, and one light at each end for illuminating the sign in the vestibule.

The bodies are mounted on the St. Louis Car Company's steel



DOUBLE TRUCK CAR FOR CAMDEN, N. J.

maximum traction trucks, No. 13. The diameter of the large wheels is 33 ins., the tread 2 ins., and flange ¾ in. The car will be equipped with No. 38 Westinghouse motors.

Report of the Detroit Street Railway Commission

On May 23, 1899, the commission appointed by the Detroit City Council to consider the purchase of the Detroit street railway system rendered a report to the Council, which is given in its entirety below, together with the report of the commission's actuary, Prof. Edward W. Bemis, of the Kansas State Agricultural College. A few words of preliminary explanation are perhaps necessary in order that the full meaning of this report be understood.

On March 24, 1899, the act known as the "McLeod Law," which authorizes the city of Detroit, Mich., to construct, acquire, maintain and operate street railways, was passed by the Legislature of Michigan and approved by Governor Pingree. It provided for the appointment of a street railway commission of three members, to be given authority to construct and acquire the railways for the city and to operate and maintain them. The Common Council of Detroit, in accordance with the act referred to, on April 1, 1899, selected H. S. Pingree, Elliott G. Stevenson and Carl E. Schmidt as members of the Detroit street railway commission.

The negotiations with the representatives of the street railway companies were concluded on May 23, 1899, and the result is given in the following report of the commission to the Common Council of Detroit:

To the Honorable, the Common Council of Detroit:

Gentlemen—We hereby report to you the result to date of the steps taken by the undersigned members of the street railway commission, looking to the acquirement of the street railways of Detroit for the purposes of municipal operation.

Two elements have entered into the question of fixing the value of such properties:

First. The physical property—real estate, power houses, cars, tracks, equipment, etc.

Second. The franchise rights and privileges, controlled and owned by the companies now operating such railways. This element, in short, is made up of the profit the present owners of the railway properties would make above operating expenses, fixed charges, interest upon value of physical property, etc., during the life of existing franchises.

To ascertain the value of the physical property we secured the services of the following experts: Prof. M. E. Cooley, J. D. Hawks, Gilbert Wilkes, George Dingwall, Albert Albrecht and Henry Spitzley, who were given instructions to take all the time necessary to thoroughly examine and ascertain the conditions of all the physical property, to verify the inventories submitted by the present owners, and to appraise such property at its present cash value—that is, what it would cost at this time to reproduce it, making proper deductions for depreciation on account of its use.

The experts named, we believe, have faithfully discharged their duties, and have reported the result of their labors. Their several reports fix the aggregate value of the physical property, after making allowance for depreciation, at $7,808,737.42.

The railway company insisted that this amount was too low by a million dollars. We have carefully investigated the claims made by the company as to the points of difference, and have reached the conclusion that, as to some parts of the property, the appraised value is a minimum value, and as to other parts it is the full value, and that, on the whole, the work of the appraisers is approximately the fair cash value of the property.

But for the purposes of our investigations and the calculations to be made to ascertain the value of the franchise, we have proceeded on the basis of the value being $8,000,000.

We have done this for the reason that in so doing the result in reaching the value of the entire property—physical and franchise—is not materially affected.

To make clear what we desire to express in this regard, it should be borne in mind that the franchise value is the aggregate of profits that would be realized during the lives of the franchises (reduced to present worth), and that to ascertain the profits, operating expenses and interest on the physical property necessary to produce the earnings, are to be deducted from the earnings. If the larger amount, $8,000,000, is taken as the value of the physical property, the amount deducted from the net earnings for interest on value of physical plant is larger, and therefore the franchise value is reduced, so that in reaching the net result, the difference, whether the value of the physical property be taken at $8,000,000 or $7,808,732.42, is comparatively slight.

To ascertain the value of the franchise owned by the railway companies Mr. E. B. Hutchinson, an expert accountant, has made a very complete examination of the books, records, vouchers, etc., of the railway companies, covering a period of four years, the entire period during which the railways have been operated with electricity as motive power. His report shows that the net earnings of the railway properties for the year ending April 1, 1899, were $805,000. While the work of Mr. Hutchinson was entirely satisfactory, we took the precaution to have it, in respect to the question of the gross and net earnings of the companies, verified by Prof. E. W. Bemis, whom we employed as actuary to make the necessary calculations to fix the franchise value of the property.

Prof. Bemis confirmed the result reached by Mr. Hutchinson as to earnings, but as a matter of precaution concluded it was prudent to deduct $55,000 from the net earnings as shown by the books for the past year, to cover possible, if not probable, increase in operating expenses, depreciation, etc.

The report made to us by Prof. Bemis fixes the aggregate value of the franchises owned by the railway companies at $8,478,563.86. His computation is made on the basis of $750,000 net earnings, deducting 4 per cent on $8,000,000, value of physical plant, and allowing for 4 per cent annual increase of traffic and earnings during the lives of the franchises. This franchise value, viz., 8,478,-563.86, added to the value of the physical plant, viz., $8,000,000, makes the total value of the street railway property and franchise rights $16,478,563.86. We submit herewith Prof. Bemis' report, showing the method adopted by him in reaching the conclusion he did, as well as observations made by him on the general subject under consideration.

In the matter of the franchise value, as in nearly every matter considered, we have had more or less controversy with the railway companies' representatives, and it is perhaps but fair that we give to the public their contention in relation to this subject, as contained in a communication submitted by them on being advised as to the result reached by Prof. Bemis, and the basis upon which he reached it. They contended as follows:

"1. That the method followed by the actuary of valuing the franchises is very unfair to us, because it allows only a 4 per cent annual increase in net earnings, while the net earnings of the company for the past four years have increased at a very much higher rate than the gross earnings. The gross earnings have increased at the average rate of 6.3 per cent per year, as shown by the report of your actuary. If a period of five years be taken, the increase in gross earnings is shown to have been nearly 8 per cent, and in view of the very much larger increase shown in the last few months, and the fact that the last four years have not been typical years of growth, the percentage of increase adopted by the actuary is entirely too small.

"2. That Prof. Bemis arbitrarily reduces the net earnings of over $805,000, as shown by your accountant, to $750,000, and as a result of this deduction of $55,000 a year, with its proportionate increase, the franchises are valued by him at over $1,000,000 less than they should be valued by the method of appraisal adopted by you."

In relation to the contention of the railway company above set forth, we were of the opinion that while the estimate as to increase of traffic and earnings upon which our calculations were based was lower than that shown by the experience of the railway company company here, as well as in other cities, during the four years referred to, yet we ought to have some margin in this record to offset possible reduction of receipts upon inaugurating three-cent fares.

In reference to their complaint as to the reduction of amount of net earnings to $750,000 from $805,000, we were of the opinion that it was justified as a matter of prudence and caution, and are therefore of the opinion that the amount fixed by Prof. Bemis represents the full value of the property.

After Prof. Bemis had given us the result of his investigations and calculations the railway companies' representatives submitted their first definite offer as to price, fixing their price for all the railway properties and rights at $17,500,000—the property being that a new security franchise covering all the lines be granted to a new company, which new company would execute bonds secured by mortgage on all the property of the companies and the security franchise for $17,500,000, and then the city would acquire such property, subject to the payment of such mortgage indebtedness.

We have strenuously endeavored to obtain concessions in the matter of price, and have succeeded to this extent only: The company offers to turn over to the commission, to be used for the purpose of making extensions, payment of interest, or carrying out the sinking fund provisions of the mortgage referred to, $400,000 of bonds, and one of the parties interested has offered to turn over for the same purpose an additional $300,000 of bonds, which would provide $700,000 as a safety fund, and practically reduce the purchase price to $16,800,000.

We feel warranted in saying that no better price can be secured on the terms indicated, which are substantially the only terms upon which we can negotiate.

We have had frequent conferences with representatives of the railway company with reference to the terms of the proposed security franchise, and have disagreed upon several important features.

We have contended for a thirty-year limit, while the company's representatives have insisted that under such a limit the sinking fund payments would of necessity be so large and unusual as to materially affect the saleability of the bonds. It is apparent that it would be of decided advantage to the city to distribute the payment of the mortgage indebtedness over a period approximating fifty years, so that the city might inaugurate three-cent fares, and pay such indebtedness out of the surplus earnings, after providing for reasonable extensions of track, increased equipment, cars, etc., to accommodate increased traffic, resulting from low fares. The contemplated arrangement, however, would permit of the payment of the whole or any part of the indebtedness at any time during the fifty years.

However, it was and is our view that without increasing the payments referred to, the security would be ample, even though but one-half of the bonded indebtedness should be provided for at the end of a thirty-year franchise, for the physical property—now worth $8,000,000—with necessary extensions, increased equipment, etc., would be ample security for the payment of what should remain unpaid at that date. But we have been unable to obtain the assent of the sellers to this view, or to any modification as to the length of the franchise, other than this: The security franchise to be for the term of thirty years, with the provision that at the end of that time if provisions shall not then be made for the payment of the balance of the mortgage indebtedness and the mortgage discharged, the franchise shall be extended until such indebtedness shall be paid, not exceeding eighteen years, the limit of time for paying it under the sinking fund provisions referred to.

So that at the end of thirty years, or for that matter at any time before that, by providing for the discharge of the mortgage indebtedness, the security franchise and all rights under it would terminate.

We have contended that the new security franchise should not disturb the provisions of the Detroit Railway franchise, which for twenty-six years secures to the people accommodated by it fares at eight tickets for 25 cents during the day. The representatives of the companies have contended for a franchise uniform in its provisions and embracing all the lines.

The company has finally receded from its position in this regard, and assents to the proposition that the provisions of the Detroit Railway franchise shall continue until the expiration of the same—twenty-six years hence.

We have contended for extension of hours for workingmen's tickets and transfer privileges, reduction of fares to school children, etc. The companies' representatives have stood for an extension of existing franchises, but have finally acceded to the following:

Six tickets for 25 cents, good at any time.

Eight tickets for 25 cents, 5:30 A. M. to 7:30 A. M.

Eight tickets for 25 cents, 5:00 P. M. to 6:30 P. M.

Ten tickets for 25 cents, 7:30 A. M. to 5:00 P. M., for pupils attending school; all with universal transfers.

To intelligently determine as to the advisability of acquiring the street railway properties upon the terms outlined, the controlling consideration, in our judgment, should be whether such a plan as is outlined can be carried out successfully and insure to the people of the city of Detroit three-cent fares immediately and permanently. With that end in view we have conducted our investigations, and have also given consideration to the consequences that might result from failure. We have, to the best of our ability, weighed all arguments for and against the plan, and have reached the conclusion that under the plan outlined, three-cent fares with universal transfers can be immediately and permanently secured to the people of Detroit.

In reaching this conclusion we have not only had the benefit of the judgment of people who are more competent to judge wisely in reference to the question than we are, but have also had the actual experience of the Detroit Citizens' Railway Company for seven months in 1896, during which time it operated its lines on the basis of eight tickets for a quarter. We found, according to the investigations made, that the gross earnings of the company were during that period greater on the basis of eight tickets for a quarter than they were during the same period the following year at six tickets for a quarter. The expense attending the handling of the increased traffic, however, exceeded the expense during the same period the following year, and the net earnings were slightly less than under the operation at six tickets for 25 cents.

The report of Prof. Bemis submitted herewith, as stated, outlines the basis upon which he reaches his estimate of the franchise values of the railway properties. The following shows the basis upon which the mortgage indebtedness referred to will be discharged through the sinking fund provisions of the mortgage:

$50,000 on the 1st of September, 1900, 1901, 1902 and 1903.

$75,000 on the 1st of September, 1904, 1905, 1906 and 1907.

$125,000 on the 1st of September, 1908, 1909, 1910 and 1911.

$180,000 on the 1st of September, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920 and 1921.

$200,000 on the 1st of September, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, and $37,800 September 1, 1947.

Those payments, together with the interest on the bonds, purchased for the sinking fund, by their use, will retire all of the $17,500,000 of bonds September 1, 1947.

It will be noted by the report of Prof. Bemis that he recognizes the possibility that for the first five years of operation on three-cent fares the net earnings of the properties may not exceed the net earnings of the past year at the higher rates of fare. Having this in mind, the sinking fund provisions have been so regulated that there will not be any danger, even if no increase in earnings is realized for five years, of not being able to meet the interest and pay the money required for the sinking fund.

To illustrate, the interest upon $16,800,000 would be $672,000; the sinking fund provision for the first four years is $50,000 per year, making a total of $722,000 annually, a sum $83,000 below the net earnings as shown for the past year, and $28,000 below such net earnings after making the deductions referred to for increased operating expenses, etc.

In fact, it will be seen from the figures submitted, that if no increase in the earnings over the last year was attained for twelve years, the interest upon the entire bonded indebtedness, and in addition the payments for the sinking fund, would be provided for safely, and the largest sum that will be required at any time, commencing approximately twenty-five years hence, would represent but $122,000 more than the net earnings of last year, as reduced by Prof. Bemis—an amount which would be largely made up by one item—of withdrawing deadhead tickets and having every one pay his own fare on the reduced basis.

That there are many items representing large amounts that can be saved under municipal operation, there can be no question—so many that we feel no hesitation in expressing our confidence that the security franchise, if granted, would never become more than a security franchise.

But, as stated, we have given consideration to the possibility of our judgment proving erroneous, and to the result that would attend the failure of municipal ownership and operation, and as we see it, the result would be as follows:

In any event, the city would control the situation, and the alternative would not be presented of having to pay the bonded indebtedness or permitting the security franchise to become an active one.

And the city could, in the event of being dissatisfied with the result of municipal ownership, lease the railway properties on the best terms attainable, using the rental, so far as necessary, to keep up the payments to which reference is made. Or, if any corporation or other organization would undertake the operation of the railways of Detroit on terms more favorable than the terms provided for in the security franchise, the city having control of the situation, could then make any bargain it saw fit, and either at once discharge the mortgage indebtedness by payment, or meet it as it matured under the provisions of the mortgage. This is made possible by a provision of the proposed mortgage that the mortgage indebtedness can be discharged at any time upon sixty days' notice.

If no more favorable terms could be obtained, the worst situation the city could be placed in would be that the security franchise would become an active one on the terms specified above. Such a situation would be much more favorable than the present, for the following reasons:

While the owners of the present railway properties give to the public six tickets for a quarter, they are not obliged to do so, but could at any time exact straight five-cent fares on all lines except the Detroit Railway lines. Under the security ordinance, if it shall become an active one, the railway companies would be required to sell six tickets for 25 cents, good at any time.

Under existing conditions, the eight tickets for 25 cents on the Citizens' line (workingmen's tickets) are good only between 5:30 and 7 A. M., and 5:15 to 6:15 P. M. No transfers are provided for on workingmen's tickets. Under the proposed security franchise workingmen's tickets at eight for 25 cents would be good from 5:30 to 7:30 A. M., and from 5 to 6:30 P. M., and transfers would be issued on all lines having same rates of fare.

The present franchises do not compel the railway companies to

grant transfers, although they do so at present on certain lines. Under the proposed security franchise the right of universal transfer on all lines having same rates of fare is secured.

Under existing conditions no concessions are made to pupils attending public or other schools of the city. Under the proposed security franchise for the use of pupils attending public and other schools in the city tickets good from 7:30 A. M. to 5 P. M. will be sold at the rate of ten for 25 cents.

On the whole, we think it will be recognized that even if the security franchise should become an active one, very substantial advantages are secured to the people of the city under its provisions. But, as stated, we feel confident that the security franchise would never become an active one, and that if the plan suggested can be carried out with the co-operation of your honorable body and the public, the people of the city of Detroit would immediately and permanently have the benefit of rates of fare as low as three cents, with universal transfers.

Before closing this report we desire to state that for several weeks past we have endeavored faithfully and earnestly to secure a reduction of the price. We have been unsuccessful, owing, we believe, in part to the fact that by the arrangement, as the owners view it, we would be securing the benefit of the use of this property without paying anything whatever upon its purchase price, or ever being required to pay anything except out of the earnings of that which is turned over by the present owners.

We would not look with favor upon the city becoming obligated to provide for the purchase price of the property, fearing that an increase for such purposes in the obligations of the city might hazard its present excellent credit. The proposition that is here presented is one that does not call for the payment of a single dollar by the city, or for the city in any way, directly or indirectly, becoming obligated, in any manner or at any time, for the payment of any part of the purchase price of the properties, nor is it rendered possible that in carrying out the plan the taxes of any taxpayer can be increased in providing for the purchase price.

The easy conditions under which the city can undertake the operation of the street railways undoubtedly enhance the cost, but the result, in our opinion, even at the enhanced cost, is simply to defer the time when rates of fare upon the street railways of Detroit can be reduced below three cents.

On the other hand, it should be understood that if the city should not acquire the railways under the proposed plan, the people of Detroit will pay to the owners during the life of the present franchises, in fares, more than the amount of the indebtedness which it is proposed to place on the property.

A study of the statement of payments required for the sinking fund will, we think, satisfy any one who will carefully consider the situation, that there can be no question as to the earnings providing for the payment of the property, even at the price demanded, and at the same time give the people of Detroit the low fares desired. The reduction of fares to three cents alone will represent a saving to the people of Detroit of $500,000 to $800,000 a year, which, within the life of existing franchises of the company, more than represents the franchise value of the properties of the railway companies.

This we report as the best price, terms, etc., we have been able to secure—the best, we believe, that can be secured. The question as to whether they are such as to warrant their acceptance is one which we feel ought to be settled by the electors of this municipality. It is a responsibility that the undersigned are not willing to assume without the sanction of the electors of the municipality, and we therefore report the situation to you, with the recommendation that, at a proper time, the question be submitted to the people for their decision. But we cannot recommend that any steps looking to the granting of a security franchise be taken under existing conditions, in view of the legal questions raised as to the power of the municipality to enter upon municipal ownership and operation of the railways.

If the security franchise referred to should be granted, and bonds secured by mortgage, including such franchise, were issued and sold to innocent purchasers, the franchise might—probably would—be held valid, even though the court might decide that the city could not, by reason of the constitutional objections raised, avail itself of the advantages we have been endeavoring to secure.

We therefore thought it prudent to co-operate in having the legal questions involved definitely determined, and regret that we feel it necessary to recommend that the matter of submitting the question as to whether the people desire the street railways of Detroit purchased upon the best terms we have been able to secure and operated on the lines indicated, be deferred until a decision shall be reached in the case now under consideration by the Supreme Court.

It does not follow, even though the decision of the Supreme Court should be against the constitutionality of the law under which we are now proceeding that the people of Detroit will, of necessity, be deprived of the advantages we have indicated they would secure under municipal ownership and operation of the street railways.

We have contemplated the contingency suggested, and have worked out a plan which, if acceptable to the owners of the railways, and should be approved by your honorable body and the electors of the city, would enable the people of Detroit, even in advance of the decision of the Supreme Court if desired, to avail themselves of such advantages under private ownership, surrounded by such safeguards as will protect the people in their enjoyment until the power shall be secured to enter upon municipal ownership and operation, if such power does not now exist.

H. S. PINGREE,
ELLIOTT G. STEVENSON,
CARL E. SCHMIDT,
Members Detroit Street Railway Commission.

RALPH STONE,
Secretary of Commission.

May 23, 1899.

REPORT OF EDWARD W. BEMIS, ACTUARY.

April 30, 1899.

To the Detroit Street Railway Commission:

Dear Sirs—I herewith submit as full a report of my investigation of the street railway properties as the time at hand allows, reserving for four or five days the presentation of such additional information within my possession as the needs of the commission may require:

I.—THE VALUE OF THE PHYSICAL PLANT

The appraisal of the structural value of all the street railway properties of Detroit, as given by your experts, is as follows:

Track, 175.95 miles, appraised by J. D. Hawks..		$4,350,183.42
Overhead construction, including feeders, ground wires, etc., appraised by Gilbert Wilkes		760,939.00
Citizens' power house	$440,894.04	
Detroit power house	366,249.32	
Citizens' repair shop	8,003.49	
Total power plant	$815,146,85	
Tools and supplies	75,990.59	
Rolling stock	1,102,212.39	
Total power plant, rolling stock, tools and supplies, appraised by Appraiser M. E. Cooley..		1,993,349.83
Car houses, land incident thereto and other land and buildings, appraised by George Dingwall, Henry Spitzley and Albert Albrecht...		523,248.30
Certain other buildings, fixtures and furniture, appraised by Messrs. Spitzley and Albrecht..		179,016.87
		$7,806,737.42

The average cost per mile, if based on the mileage report by the company of 177 miles of single track in the streets, is $44,106. The cost is much greater in Detroit than in most cities, because of the unusually fine roadbed, laid upon expensive concrete foundation, with steel ties.

Mr. Hawks allowed inspection charges of 2 per cent, engineering charges of 5 per cent, incidentals 10 per cent, and interest on the necessary investment during the course of construction at 5 per cent, thereby raising his portion of the appraisal to $24,150 per mile of a single track, or 22 per cent above the mere cost of material and labor. Such allowances, however, are common, and indeed necessary in such construction. It is also customary for street and steam railroad companies to give a contractor's profit of 10 to 15 per cent on the actual cost of construction. Companies even then will save money rather than by doing their own building. Mr. Hawks balances this contractor's profit over against depreciation, and makes no direct allowance for either in the above figures.

Mr. Wilkes does not explain in his appraisal whether he allows for engineering charges, incidentals, etc., but deducts an 8 per cent depreciation from his total of $827,108, in order to reach the figure given above, of $760,939.

Prof. Cooley has allowed 10 per cent as contractor's profit on the cost of reproduction of the Detroit Citizens' power house, and also 5 per cent a year for four years, or 20 per cent depreciation on the machinery there, including generators, 2½ per cent a year for four years, or 10 per cent, on the cost of electrical equipment, excluding generators, 2½ per cent a year for four years, or 10 per cent, on the cost of the building, or a total depreciation of 14 per cent. A similar treatment was applied to the power house of the Detroit Electric Railway, although for a shorter time, three years in the case of the machinery and generators, since they have

been more recently constructed. As Prof. Cooley states, "In obtaining the present value of the rolling stock and equipment parts, the condition of each separate article has been noted and a record made. The equipment parts were valued on the spot, but the valuation of the rolling stock was made after taking into consideration the amount of money spent per annum for repairs. The average percentage of depreciation for all rolling stock amounted to 16.8 per cent, or, in other words, the present value is 83.2 per cent of the cost of reproduction to-day."

The street railway officials would like to add $66,000 to Mr. Wilke's figures and $90,000 to Prof. Cooley's, on the theory that there is no present depreciation in the efficiency at least of the rolling stock; but there is a form of depreciation undoubtedly due to the progress of the art, the growth of invention, developing better types of cars, and ultimately forcing a company to discard cars that are as strong as when constructed. The company would also like to add $80,000 to Mr. Dingwall's appraisal, and $20,000 to that of Messrs. Spitzley and Albrecht, or a total of $256,000. Even admitting this claim, the grand total would only be raised to $8,062,737. In view, however, of the fact that there is that form of depreciation just spoken of above from the progress of the art; in view, further, of the exceptionally high prices of material to-day, although the same may continue for quite a while, and for other reasons developed in my talk with the appraisers, I am not disposed to concede any large portion of the $256,000. It is fair, however, to concede that several of the appraisers did not take into account, as indeed they were not asked to do, any interest during construction on the necessary investment, although it was done in other cases. It may fairly, therefore, be conceded that it would cost $8,000,000 to duplicate the present plant to-day, without making any allowance for any loss of profits during construction. In valuing the property in the further computations of this report, I shall, therefore, assume $8,000,000 as the fair cost of duplication. It would make no material difference, however, in the final conclusion, whether it be taken as a little higher or a little lower, because what is added to or taken away from my allowance of interest charge on the structural value of the plant would affect to nearly as great an extent in an opposite direction the allowances for franchise earnings.

II.—THE FRANCHISE OR MONOPOLY VALUE

Of the $8,000,000 total valuation of the tangible assets of the Detroit railways the following has been apportioned by the various appraisers as the valuation of the Detroit Electric Railway:

Track	$1,374,256.15
Overhead construction	255,327.00
Power houses	366,249.32
Other real estate	69,457.37
Rolling stock	201,705.00
Tools and supplies	7,599.06
Total	$2,274,593.90

This total of $2,274,593.90 is $41,659.22 per mile. The appraisers valued the property of the Citizens' Company at $5,532,143.22, or $45,197.24 for each of the 122.4 miles of track that the Citizens' Company seems to have, although Mr. Hawks allowed them a mile less. Reckoning 4 per cent as a fair interest on the structural value of the plant, or $90,983.76 payable yearly, the problem before us is to determine the remaining earnings of the plant during the next twenty-six years of the life of the franchise. The process taken has been the following: The total net income of all the city plants was $805,883.62 during the year ending April 1, 1899. Although the plant has been kept up out of operating expenses in such a state of physical efficiency as almost to justify the claim of the officials, that the plant is as efficient now and has as long a life before it, so far as wear and tear is concerned, as when it was constructed; nevertheless there is, as has already been stated, a depreciation because of the progress of invention, change in the taste of the people for style of cars, etc., which must be allowed for. The vice-president of the road, Mr. Hutchins, estimates that from $60,000 to $75,000 a year will have to be spent for the next ten years in enabling the plant to take care of increased traffic on the present miles of track, and it seems fair to consider $55,000 at least as nearly balancing the depreciation just mentioned, leaving the actual net earnings $750,000, or 93.03 per cent of the $805,883.62. Applying this same percentage to the net earnings of the Detroit Electric Railway last year of $135,996.79, there remains a true net profit of $126,558.64.

Further, the gross earnings of all the Deetroit railways have increased in the last four years at the rate of 6.3 per cent yearly, and the net earnings still faster. This is a lower rate than during the same time in Boston (rate, 8 per cent), Worcester (11 per cent), Springfield (12 per cent), and Lowell (10 per cent), Massachusetts, where sworn reeturns are made to the State. The present year, January to December, 1899, gives indications of yielding from 10 per cent to 12 per cent more than during 1898, if we may judge from the receipts since January 1. It has, therefore, seemed a conservative estimate to assume a future rate of growth of 4 per cent yearly. The competition of the bicycle is not likely to be any keener in the future than in the past, while the growth of population is on the outskirts, at greater and greater distances from places of work. To be sure, there are possibilities of invention, like that of the automobile, but when it is borne in mind that the total expense for motive power to-day in Detroit is less than 8 cents per car mile, and less than one-fifth cent per passenger, or 10 per cent of the total expenses, it will be seen that the possibilities for further economy in motive power are not great.

Returning again to the Detroit Electric Railway, let us assume its corrected net earnings of $126,558.61 increase during next year 4 per cent, or up to $131,620.95. Deducting from this the $90,983.76, as above found for interest on physical plant, there remains a monopoly, or franchise, revenue of $40,637.20, which would have a present worth, discounted at 4 per cent, of $39,052.34. Assuming for the second year that the above $131,620.95 increases at 4 per cent, and there would be at the end of the second year a net revenue in hand of $136,885.78. Deducting again the $90,983.76, we have $45,902.02 as the monopoly earnings during the second year. This has a present value on the same basis as before of 4 per cent of $42,413.47. Continuing this process, we have the following result:

Present worth of monopoly earnings of the Detroit Electric Railway:

First year	$39,052.34
Second year	42,413.47
Third year	45,729.93
Fourth year	48,739.41
Fifth year	51,844.17
Sixth year	54,631.08
Seventh year	57,349.15
Eighth year	60,020.98
Ninth year	62,582.38
Tenth year	65,038.95
Eleventh year	67,397.03
Twelfth year	69,663.83
Thirteenth year	71,847.44
Fourteenth year	73,956.92
Fifteenth year	76,002.40
Sixteenth year	77,995.11
Seventeenth year	79,791.99
Eighteenth year	81,542.64
Nineteenth year	83,261.08
Twentieth year	84,962.78
Twenty-first year	86,467.38
Twenty-second year	87,967.96
Twenty-third year	89,483.68
Twenty-fourth year	91,035.60
Twenty-fifth year	92,400.36
Twenty-sixth year	93,562.68
Total	$1,834.736.74

The present worth then of the probable monopoly earnings of the Detroit Electric Railway is $1,834,736.74. To this should be added the value of the physical plant as above determined, $2,274,594, or a total of $4,109,330.74.

Next, this method may be applied to the remaining railways of the city, which I classify under the general name of the Detroit Citizens' Railway. Since we assumed $126,558.61 as the present total net earnings of the Detroit Electric Railway, the remainder of the $750,000 above computed as the total revenue of all the lines in the city, or $623,441.39 is the present net earnings of the Detroit Citizens' system. Also assuming, as has been done above, that $8,000,000 is a fair value of the physical property, 4 per cent as interest on this is $320,000. Subtracting from this the interest, $90,983.76, allowed on the Detroit Electric Railway, and there remains as interest on the physical plant of the Citizens' lines $229,016.24. Following the same method as with the Detroit Electric Railway, we may assume the above $623,441.39 as increased 4 per cent yearly by increase of traffic. The total net earnings then during the first year would be $648,379.04. If from this we take the interest, $229,016.24, just found, there remains a monopoly earning of $419,362.80, which has a present value of $403,007.65. We then increase the $648,379.04 by 4 per cent for the second year's net earnings, and again deduct the interest charge of $229,016.24. Continuing this process for the ten years and eight months in which the entire Citizens' system has an uninterrupted franchise, and we have the following result:

Present worth of the monopoly earnings for ten years and eight

of the Citizens' Railway (including all except the Detroit Electric Railway):

First year	$403,007.65
Second year	411,455.21
Third year	420,320.76
Fourth year	427,274.97
Fifth year	435,774.80
Sixth year	442,270.42
Seventh year	448,865.05
Eighth year	455,670.60
Ninth year	462,151.31
Tenth year	468,334.75
Eight months of eleventh year	316,411.75
Total	$4,691,537.27

The total monopoly value of the Citizens' Railway for the next ten years and eight months may be assumed, therefore, as $4,691,537.27, to which may be added $5,274,594, as the value of the physical plant, making a total of $9,966,131.27. After ten years and eight months the eastern end of the Fort Wayne & Belle Isle Railway, which is that portion east of Clark Street, continues for seven months. That portion of the road had net earnings last year of $44,859.60, or 6.7 per cent of $623,441.39, assumed as the real net earnings of the whole Citizens' system. It should, therefore, be charged with 6.7 per cent of the interest charge of $229,016.24, or $15,344.09. The net earnings of the entire system the tenth year, on a 4 per cent increase, would be $922,845.51, and 6.7 per cent of this, or $61,830.65, may be considered as that portion of the total earnings of the Citizens' system that may legitimately be assumed as connected with this branch of the Fort Wayne system ten years hence. This would increase in seven months to $63,273.36. If from this be taken $15,344.09, as above described, there would remain a net earning of $47,929.28, but such a value eleven years hence is equivalent to $39,818.53 to-day. This may, therefore, be assumed as the value of that portion of the Fort Wayne franchise. The other portion of the Fort Wayne franchise, namely, that west of Clark Avenue, runs for twenty-three years instead of for eleven years and three months as does the portion east of Clark Avenue, and that portion of the line had net earnings of $30,307.29 last year, or 4.52 per cent of the total earnings of the Citizens' system; 4.52 per cent of $229,016.24 interest charge is $10,351.53. The same percentage of the net earnings of the tenth year of the whole system, namely, $922,845.51, is $41,712.62. During that year we must not only count, however, four months as not already included in the eleventh year in the previous computation of ten years and eight months. Continuing the same basis of reckoning as in the case of the Detroit Electric Railway, and the main franchises of the Citizens' systems, we reach the following result:

Monopoly value of the western portion of the Fort Wayne & Belle Isle system, after ten years and eight months:

Remainder of eleventh year	$ 7,145.39
Twelfth year	21,893.37
Thirteenth year	21,941.80
Fourteenth year	22,183.63
Fifteenth year	22,420.12
Sixteenth year	22,656.77
Seventeenth year	22,848.80
Eighteenth year	23,040.46
Nineteenth year	23,234.85
Twentieth year	23,435.42
Twenty-first year	23,592.11
Twenty-second year	23,757.77
Twenty-third year	23,936.78
Total	$283,087.27

The total monopoly earnings, then, of the portion of the Fort Wayne system west of Clark Avenue during the balance of the franchise is $283,087.27.

The Grand River Avenue system runs sixteen years and nine months from now. It had net earnings in the year ending April 1, 1899, of $161,615.38, or 24.12 per cent of the total earnings of the Citizens' system; 24.12 per cent of the entire interest charge of $229,016.24 on that system is $55,238.72. The same percentage of the total profits of the Citizens' system ten years hence, $922,845.51, is $222,590.34. There were only four months of the eleventh year, however, not included in the computations of the first ten years and eight months of the entire Citizens' system. The methods adopted above will give the following result for the remainder of the franchise of the Grand River system.

Present monopoly value of the Grand River system after ten years and eight months:

Eleventh year	$ 38,129.22
Twelfth year	115,761.35
Thirteenth year	117,087.08
Fourteenth year	118,377.59
Fifteenth year	119,644.92
Sixteenth year	120,902.42
Three-quarters of the seventeenth year	92,334.21
Total	$722,236.79

The main line of the Woodward Avenue expires in ten years and eight months, but the portion north of Pallister Avenue or thereabouts is a perpetual franchise, and is growing in traffic more rapidly than most of the city. It is also claimed by the company that if it should fail to secure a renewal of its main line on Woodward Avenue, it could build a short spur just north of the city limits to the Detroit Electric Railway line, which runs for twenty-six years, and thereby get to the heart of the city. It has been thought well, therefore, to compute the monopoly earnings of the Woodward Avenue line at 4 per cent for twenty-six years; that is, for fifteen years and four months after the expiration of the main line of the Citizens' system. This portion of Woodward Avenue now has net earnings of $44,077.72, or 6.58 per cent of the total earnings of the system. This percentage of $229,016.24 makes the interest charge to be apportioned to that part of the system $15,069.27. Likewise, 6.58 per cent of the net earnings of the whole system the tenth year, $922,845.51, is $60,723.24. Using the same methods as previously, the following result is reached.

Present value of monopoly earnings of Woodward Avenue north of Pallister Avenue after ten years and eight months:

Remainder of eleventh year	$10,365.44
Twelfth year	31,580.00
Thirteenth year	31,941.67
Fourteenth year	32,293.72
Fifteenth year	32,639.45
Sixteenth year	32,982.50
Seventeenth year	33,262.07
Eighteenth year	33,541.08
Nineteenth year	33,824.07
Twentieth year	34,116.06
Twenty-first year	34,344.16
Twenty-second year	34,585.38
Twenty-third year	34,845.93
Twenty-fourth year	35,132.63
Twenty-fifth year	35,358.67
Twenty-sixth year	35,519.09
Total	$516,331.92

This $516,331.92 is thus the present monopoly value on the above basis of that portion of Woodward Avenue north of Pallister, after ten years and eight months.

The last system to be considered is that of the Grosse Pointe line, east of Concord Street. This line also has a perpetual franchise, is one of the most rapidly growing lines in the city, and has a connection on Concord Street with the Detroit Electric Railway, which it can use for twenty-six years, although its direct connection on Jefferson Avenue expires in ten years and eight months, and on Congress Street in sixteen years and nine months. The net earnings of this Grosse Pointe line in 1898-99 were $33,365.04, or 4.98 per cent of the total of the Citizens' system; 4.98 per cent of the $229,016.24 interest charge is $11,405, and the same percentage of $922,845.51 gives the computed net earnings of the eleventh year of this road as $45,956.71. Taking the same basis of computation as in the previous cases, we have the following result:

Present worth at 4 per cent discount of the monopoly earnings of the Grosse Pointe line from ten years and eight months to twenty-six years hence:

Remainder of eleventh year	$ 7,872.27
Twelfth year	23,900.29
Thirteenth year	24,174.01
Fourteenth year	24,440.46
Fifteenth year	24,702.52
Sixteenth year	24,961.76
Seventeenth year	25,173.35
Eighteenth year	25,384.47
Nineteenth year	25,598.73
Twentieth year	25,819.72
Twenty-first year	26,009.88
Twenty-second year	26,174.92
Twenty-third year	26,372.11
Twenty-fourth year	26,589.10
Twenty-fifth year	26,760.17
Twenty-sixth year	26,881.58
Total	390,815.34

Thus the total monopoly earnings of the Grosse Pointe line on

the above basis, after ten years and eight months, may be computed at $390,815.34. This Grosse Pointe line increased 9.3 per cent in 1898 over 1897, and the Woodward Avenue line 7.91 per cent in net earnings, while the Fort Wayne increased 5.7 per cent, and the total increase for the whole city was 7.15 per cent. The actual net earnings were made the basis of the above computations, except in the case of Woodward Avenue north of Pallister, and in the separation of the Fort Wayne system into the division east and west of Clark Street. In these two cases the railroad kept no data, except the number of miles traversed by the cars during the last year on the separate divisions of Woodward Avenue and of the Fort Wayne system. But as the number of cars is regulated as closely as possible to the amount of traffic, it is a pretty fair test of net earnings, except as between lines like the Detroit Electric and the Citizens' where different rates of fare are charged.

No attention has been paid to the franchise value of the Michigan Avenue line west of Livernois of 4.36 miles, which has a twenty-eight-year franchise, nor of a long franchise on Mack Avenue of 1.53 miles. The latter, however, is not considered especially valuable.

We may sum up the results thus far by saying that the monopoly or franchise earnings of the various systems have the following value at present on the basis of 4 per cent increase.

Present worth of franchise earnings and of conservative prospects of growth:

Detroit Electric Railway	$1,834,736.74
Citizens', for ten years and eight months	4,691,537.27
Fort Wayne east of Clark Street, from ten years and eight months to eleven years and three months	39,818.53
Fort Wayne west of Clark Street, from ten years and eight months to twenty-three years	283,087.27
Grand River system, from ten years and eight months to sixteen years and nine months	722,236.79
Woodward Avenue north of Pallister, from ten years and eight months to twenty-six years	516,331.92
Grosse Pointe, from ten years and eight months to twenty-six years	390,815.34
Total	$8,478,563.86
Value of physical plant	8,000,000.00
Total	$16,478,563.86
Total value of physical plant and franchise, detroit Electric Railway	$4,109,330.74
Total value of Citizens' system	12,369,223.12

The above basis of reckoning has been accepted as correct by the commission and by the street railway, with the possible exception of some doubt as to the value of the Fort Wayne, Grand River, Woodward Avenue and Grosse Pointe lines, after ten years and eight months. The total on the basis taken in this computation, including all these lines, at the normal rate of growth of the whole system, is $16,478,563.86, or about $16,500.00.

This is practically the same result as would be obtained by reckoning the average life of all the franchises as a whole at sixteen years, nine months.

In the discussion of three-cent fares which follows, it is held that it would be probably wise to reckon on its taking about five years under such reduced fares to get back to the present rate of profits. Applying that to this calculation, it would appear that if the system is worth to the present owners $16,500,000, it is worth that to the city, less a postponement of five years, and plus the value to the people of a reduction of 1.1 cents per passenger, since the present fares average 4.2 cents for the 44,981,091 revenue passengers in the year ending April 1, 1899. The latter saving in fares would be about $500,000 a year to the people, therefore, on the present basis of traffic, or much more than the value of the five years' postponement.

Further calculation has been made of this kind. Suppose that during the next five years the net earnings of the system under three-cent fares only average the same as now, $750,000, being perhaps reduced to $500,000 the first year, and rapidly growing until the average of the five years was $750,000. We may even assume that the sixth year the net profit was only $780,000, and that it increased at 4 per cent thereafter. Assume further that every year from the start the city was obliged to pay $700,000 as interest at 4 per cent on any bonds issued for the plant, but in the first five years was only able to pay into the sinking fund sufficient to buy $250,000 of those bonds, the sixth year, to buy the difference between $780,000 and $700,000, or $80,000; the next year the difference between $780,000 compounded at 4 per cent, or $811,200, and $700,000 or $111,200, and so on for thirty years. At the end of this thirty years the city would have paid for $15,153,806, and in two years longer would be able to pay off $3,000,000 more, if that much were still due. However, I am decidedly of the opinion that it would be wise for the city to insist on having forty to fifty years for paying the bonds, with option of paying them at will sooner, and cancelling the security franchise. The great reason why it is proper for the city to take forty to fifty years while conceding to a private company only thirty years is that a private company is never known to the world over to attempt to repay to its stockholders and bondholders the value of the physical plant. That continues as an investment for the earning of profits. But in this Detroit case the commission is obligating itself to cancel the entire principal or cost of the physical plant, looking forward thus to the time when it will be no longer necessary to earn any interest or sinking fund charge, and when, therefore, fares may be reduced even to two cents or less. Further, in order to introduce three-cent fares, the city must count on the possibility of some reduction of earnings for three or four years, and a very heavy increase thereon afterwards, much beyond probably the normal rate of 4 per cent assumed above, unless contingencies now unforeseen should arise. It is therefore in the interest of the city to avoid any danger of defaulting on its bonds during the first few years, and this could best be secured by making the early payments into the sinking fund as small as possible.

THREE-CENT FARES

With regard to three-cent fares, I would say that the gross receipts per mile of track during the first seven months of 1897, under present rates of fare in the Citizens' Company, were $6,403. For a similar period in 1896, with fares of 3.45 cents, or .8 of a cent less than the year later, the receipts were $6,086 per mile of track. If we assume that the traffic in 1896 would have been fully 6.3 per cent less than in 1897, the receipts of 1896 would have been expected to be only $6,023, or 1 per cent less than they actually were. Since scarcely any increase per car mile of track was required to take care of this increased traffic, this basis of computation is not far out of the way, although in the course of years, increase of traffic would require some increase of equipment, and, therefore, of the interest charged per mile of track.

While the gross receipts were favorable under eight tickets for a quarter, because of the fact that increased traffic met reduced fares, the greater number of stops that the car must make per mile to take on and let off the larger number of passengers, the 1-7 more passengers per car mile and other reasons led to the fact that the expenses per mile of track in 1897 were $3,326, and in 1896 were $3,691, so that the net profits per mile of track, which were $3,077 per mile of track in 1897, were $2,395 in 1896, leaving a reduction of $682, that is, 28.3 per cent of the $2,395. Assuming that traffic would increase no faster under three-cent fares than it has done under four-cent fares, namely, 6.3 per cent yearly, it would have required about four years to have brought receipts per mile to the amount actually received in 1897, $3,077, that is, it would take four years to secure one year's gain, and it would require a fifth year, and possibly a sixth, to recover the losses of the first two years of the reduced fares. To-day the average receipts per passenger on all of the lines are 4.1 cents, although on the Citizens' line they are 4.244 of a cent per passenger. It should be stated that when the reduction was made in 1896, the state of war between the Citizens' and the Detroit Electric Railway compelled the Citizens' Company, according to their claim, to disregard many economies in the running of cars, which ordinarily would have been secured, and second, that since no one secured the advantage of cheaper fares except by ticket it did not reach the masses, who do not, as a matter of fact to-day, buy tickets by the quarter as much as do the rich and well-to-do.

This indicates considerable possibility of development of railway transportation with a straight three-cent rate.

Again, owing to the war then under way between two Detroit companies, a boycott was enforced against the Citizens' Company by many sympathizing with the efforts of the then Mayor, Mr. Pingree, to introduce low rates through the new Detroit Electric Railway. I should think, however, that it would be fair to consider that the average profit for the first five years under three-cent fares, would be about the average profit of the year just closed, namely, $750,000. It might be, of course, a little less, but could not be alarmingly so. A reduction of one cent of fare on the present 45,000,000 passengers would still leave $300,000 out of the $750,000, and, inasmuch as the traffic this year is already about 10 per cent more than last year, and would undoubtedly jump very much more than that for a while under three-cent fares, that item of increase alone would probably double this $300,000 in five or six years, to say nothing of various economies which would follow the increased traffic and saving incidental to municipal operation. And then in about five years the city might reasonably count on a 4 per cent rate of growth of net earnings upon $750,000. Giving 50,000,000 and more passengers yearly, a one-cent gift means half a million dollars a year, or 5 per cent on $10,000,000,

and when the traffic doubles, of course the benefit to the public would be proportionately increased. The people must pay the existing rate of fare to somebody for an average of seventeen years at least under private ownership, or give an equivalent for it in giving a company the right to exist during twenty or thirty years longer with a new franchise at higher rates of fare than the actual cost of transportation in future would render necessary.

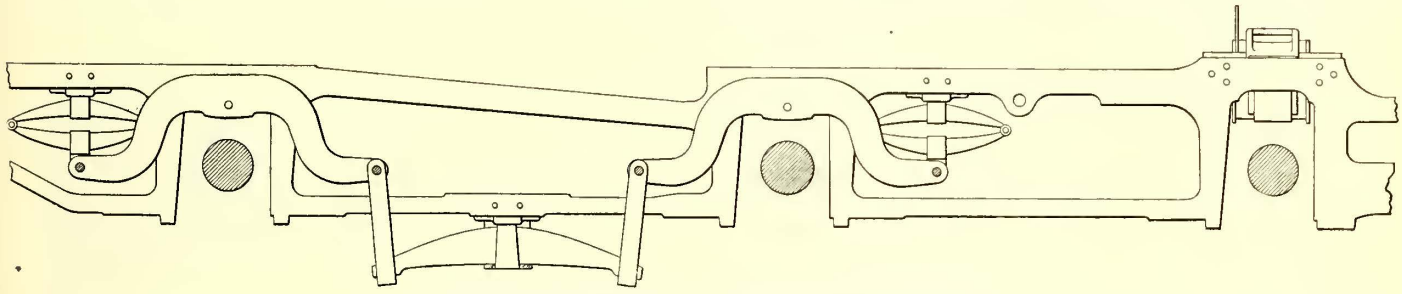
With regard to the practicability of universal transfers, I would say that while I have not much data on the transfer question, it has not seemed likely that universal transfers would diminish revenues more than they would increase them in the long run, because transfers would encourage many to ride who now walk.

EDWARD W. BEMIS.

The Functions of the Electric Truck II.

BY EDGAR PECKHAM

In the June issue of the STREET RAILWAY JOURNAL I took the position that the electric truck and the framing of a locomotive were not comparable, because of the difference in the burden and the duties imposed upon them. That I may still further substantiate this position, I have taken the framing of the Brooks express passenger locomotive of modern type, illustrated in the May issue, and propose to show that the horizontal and vertical stresses are very different in their ratios and intensities from that imposed upon an electric truck.



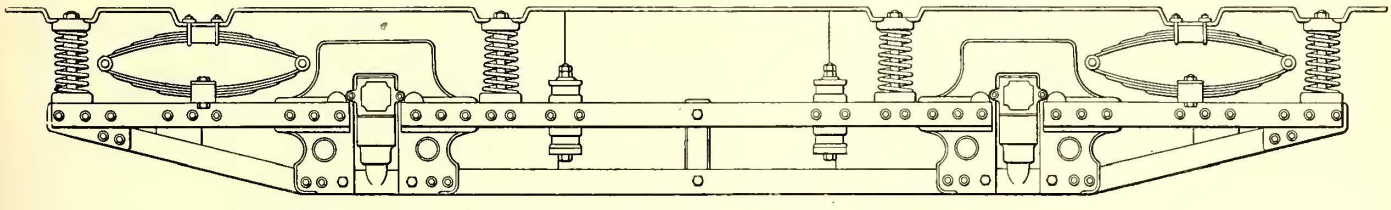
SIDE VIEW OF FRAMING OF BROOKS LOCOMOTIVE

Attention has already been called to the fact that an electric car is merely called upon to propel itself with an occasional trailer, while the locomotive is designed and intended to haul a heavy load, while its own propulsion is merely an incident to the work by which its earning powers are measured. In the case of the locomotive under consideration the cylinders are 18 ins. in diameter, with a piston stroke of 26 ins. With a steam pressure of 180 lbs. per square inch, this piston will produce a horizontal stress upon the frame of 45,800 lbs.; a stress that must be carried from the cylinder back to the front driving wheel pedestal, beyond which it is reduced for distribution to the other wheels. But there are positions of the crank when the whole of this enormous force must be carried by the frame back to the main driving wheel pedestal, a distance of 12 ft., so that the frame must be constructed with all the elements of a column capable of sustaining that load without buckling. Under such circumstances it is essential that the frame should have a high degree of lateral, as well as vertical stiffness. The former is obtained in the case in hand by using bars 4 ins. wide, and the latter by using two bars, thus obtaining a total depth of 23½ ins. between the pedestals, which is amply sufficient to meet any demands that may be made upon it. This is the American practice, and it is rapidly coming to be considered the best, though it is by no means universally acknowledged to be so. The plate frame must be stiffened laterally in order to meet these demands.

In the matter of vertical stresses the case is quite different. The front end of the frame carries no load whatever. The whole of the weight of the cylinders, the smoke-box and the front end of the boiler, with all of the extra attachments, such as the pilot and the like, at the forward end, rest directly upon the truck and the front drivers without any intervening vertical stresses on the frame. In fact, the whole front end of the frame is *carried* by the cylinder castings, and the only demands that are made upon it vertically are that it should have sufficient strength to carry its own weight; a condition that is very easily fulfilled, and which does not call for the great width and depth that are always given to these frames.

The rear end of the frame carries the back end of the boiler, and it is here that the only vertical stresses of the structure are to be found. Let us see how these weights are distributed. The bottom of the fire-box rests at two or three points on top of the upper rail, back of the main driving wheel. The frame itself is carried on three points. The equalization is such that one-half of the burden is carried by the two outside springs, and the other half by the one in the center. It will be seen, from an examination of the engraving, that the rear support is located directly beneath the fire-box, so that the vertical stress upon the bar of the frame at that point is merely a crushing stress upon the metal, and need not be considered. At the front end there is the same weight to be carried, and this does put a vertical stress on the frame. It comes from the weight of the frame itself, and that portion of the fire-box weight that is carried forward to it. As the distance out to the point of support is short, and as the stress is carried to it by that portion of the frame which is the heaviest, it may be disregarded and our attention turned to where the greatest stresses are to be found.

It will be seen that this is at the central portion, and that one-half of the total weight imposed upon the driving boxes is carried on the lower rail running between the pedestals of the main and rear drivers. This rail has a width of 4 ins., a depth of 2½ ins., and a length of 5½ ft., that may be attributed to this section. The stress put upon the rail is well within the elastic limits of the iron from which the frame is forged, as the load imposes a fiber stress of less than 6000 lbs. per square inch upon the metal when standing, and which does not rise to more than 9000 lbs. under the most unfavorable conditions of running, for the actual static load carried at this point is about 10,500 lbs. To this, 50 per cent may be added for the running load when moving over a rough track.



SIDE VIEW OF FRAME OF CANTILEVER TRUCK

It appears, then, that the builders of the modern first-class locomotive fully realize that the duty of the frame is to haul a load and not to carry one, and they therefore design accordingly.

Let us now consider the electric truck. The framing illustrated is that used to carry the ordinary electric car. The conditions are that it shall carry a car body weighing about 8300 lbs., and in addition thereto about one-half the weight of two motors, or 2500 lbs. more, which is distributed on two points of support. To the weight of 8300 lbs. must be added that of the passengers, which may be taken at 15,000 lbs. more, for a maximum, making a total of 25,800 lbs., which, owing to greater liability to track inequality than in the case of steam roads, should, with the motor weight, be increased by 50 per cent. This gives a total running load to be carried by the truck of 38,700 lbs., making a running load of 9675 lbs. for each axle box.

Again, as the total weight of the loaded car, including wheels and axles, is about 33,100 lbs., we may take one-quarter of this as the effective weight at the rail for each wheel. If we assume the

coefficient of friction between the wheel and the rail to be .35, the propulsive force exerted by each wheel at the rail will be:

$$\frac{33{,}100 \times .35}{4} = 2721.25 \text{ lbs.}$$

Deducting that due to the wheel and one-half the motors, which are taken to be equal to 1100 lbs., and treating this weight in the same way, we have 2336 lbs. as the propulsive effect of each axle box upon its pedestal; a thrust whose intensity is divided between the cantilever overhang and the central portion of the truck, in proportion to the weights carried on these parts respectively, and which will now be shown.

Reverting the vertical stresses which the cantilever truck is called upon to sustain, and which it is capable of sustaining, carefully conducted tests have shown that the cantilever will sustain a load of 5 tons at a distance of 38 ins. from the center of the oil box without being strained beyond its limit of elasticity, showing no permanent set after the removal of the load, while a load of more than 10 tons was required to buckle the lower bar and distort the frame. This places the sustaining power of the cantilever truck frame at 190 inch tons, or 380,000 inch lbs.

With the ordinary running load of 9675 lbs. per wheel, that has been assumed, the spring deflection ordinarily used has been found to be 2⅜ ins. The weight is carried by three helical and one elliptic springs. Calibrations of these four springs show that the stresses applied by them to the frame, when deflected 2⅜ ins., are as follows:

	Pounds.
Helical spring between boxes	2,753
Elliptic	2,749
Intermediate helical	2,753
Outer helical	1,420
	9,675

The distances of the elliptic, the intermediate helical and the outer helical springs from the center of the axle box are 22 ins., 38 ins. and 47 ins. respectively. Multiplying these weights carried by the springs by their several distances from the axle center, we find that the total running load upon its cantilever is 231,832 inch lbs. or exactly 61 per cent of a load that is still within the limits of elasticity of the structure.

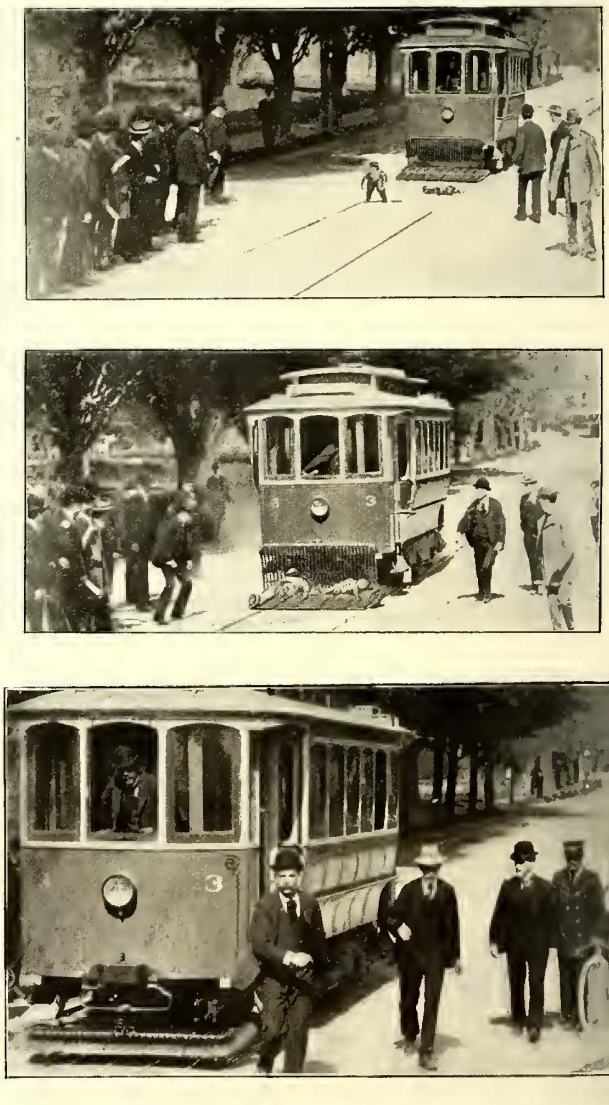
What I wish particularly to emphasize at this point is the fallacy of that position which assumes that the stresses upon a locomotive frame and that of an electric truck are at all comparable. I have shown that the horizontal stresses in the former amount to 45,720 lbs., which must be sustained by a column 12 ft. long, whereas in an electric truck the horizontal stress on the cantilever is but 2336 lbs., divided into items of less than 800 lbs. each, located at distances of 20 ins., 36 ins. and 45 ins. from the base. When the relative dimensions of the column are considered, any comparison of the horizontal stresses imposed simply become ridiculous.

The same absurdity appears when the vertical stresses are taken into account. With the locomotive having a total weight of 130,000 lbs. the greatest vertical stress on the frame is 10,000 lbs., while the horizontal thrust is 45,720 lbs., or a ratio of .24 to 1. In the case of the electric truck, on the other hand, with a total weight on the wheels of 33,100 lbs., the vertical stress amounts to 6922, while the horizontal stress is but 2336 lbs., giving a ratio of 3 to 1, or a difference in ratios of about 1 to 12. It is no wonder, then, that the lines upon which the framing of the locomotive and the successful electric truck have been developed are quite different. They are intended for different purposes, and naturally they do not and ought not to resemble each other either in design or in the distribution of the metal of which they are composed.

Now, as to the durability of the riveted cantilever truck frame. The first Peckham cantilever trucks of their present design were furnished to the Brooklyn City Railway, of Brooklyn, in 1892, for use under its 20-ft. closed (28 ft. over all) cars. As these were the first electric cars constructed of this length, they were considered experimental, it being a question as to the ability of a single truck with a 7-ft. wheel base to support a 20-ft. closed car. To determine this and the truck best adapted for the purpose, the Brooklyn City Railway gave every truck maker an opportunity to test his truck under these cars, and ten or eleven different styles of trucks, including the solid forged truck, were represented. As the result of this trial the Peckham extra long cantilever truck was adopted, and over 1200 were supplied to the Brooklyn City Railway during the years 1893, 1894, 1895, all of which are now in service. The rivets in these trucks are still tight, and give no evidence of becoming loose. Twenty-five trucks of this design were also furnished to the Broadway Cable Railway in 1893 for use under its 22-ft. closed (30 ft. over all) cars, and have been in constant use, winter and summer, ever since, and no trouble has been experienced on account of broken or loose rivets, although at that time the riveting was done by hand instead of by pneumatic power, employed the past four years. Considering the severe service to which they have been subjected under these heavy cars, which are frequently overloaded, the fact that they have run such a length of time (seven years) without the rivets becoming loose demonstrates the shallowness of the claim that the rivets are an element of weakness, and likely to work loose as a result of the jars to which they are subjected, and also as to the ability of the cantilever truck to successfully support a 20-ft or 22-ft. closed car under the most severe conditions. As to the comparison of the service between the cantilever and the solid-frame trucks, it would be very interesting to know the history of the solid-framed trucks put into service in 1892 and 1893, and how many changes have been made in their design and construction since that time to overcome their demonstrated defects, and also as to their ability to carry 20-ft. or 22-ft. car bodies without the aid of an auxiliary pipe truss, which is never used under closed cars with the cantilever truck.

Photographing a Fender Test for the Mutoscope

In these days of business activity, when Yankee genius and energy are being taxed to the utmost to develop new and successful methods of increasing trade and selling goods, an idea, to deserve special mention, must be exceedingly novel and valuable. To the



VIEWS SHOWING FENDER IN SERVICE

Hipwood-Barrett Car & Vehicle Fender Company, of New York, however, unquestionably belongs the credit for furnishing one of the cleverest and most unique schemes of advertising that has appeared for some time.

This company's fender has been in operation for about twelve months on the Newton & Boston Street Railway, of Newtonville, Mass., and in that time has fully demonstrated its value as a life-saving device. So sure were the inventors that the fender would pick up any object in its way under all conditions that they opened negotiations with the American Mutoscope Company for taking photographs of a practical demonstration of the device, for re-

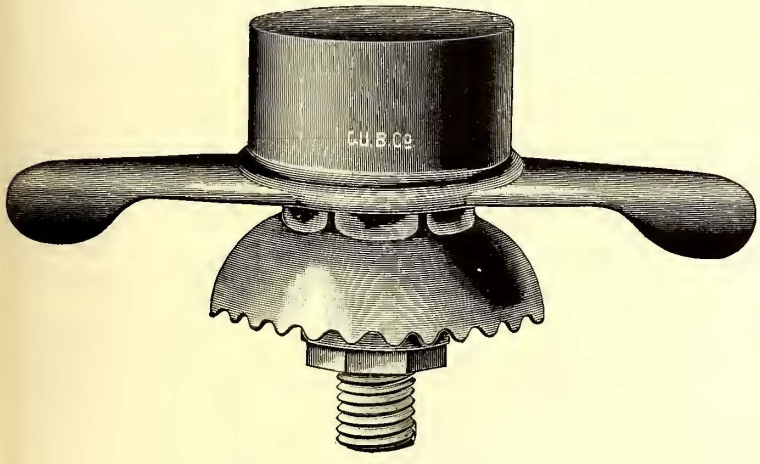
production in the mutoscope and biograph throughout this country and Europe, on the grounds that a moving picture of this kind could not fail to excite general interest. These negotiations were successful, and on May 10 a very satisfactory test of the fender was made at Newtonville, and photographed by the mutoscope camera. The picture secured makes one of the most interesting views owned by the Mutoscope Company, and will be shown in nearly every city in America and in the largest cities abroad. It was shown at Boston, and also daily for two weeks at Keith's Theatre in New York, to large crowds, who never failed to manifest special interest when it was thrown on the screen. The fender company also has a mutoscope at its New York office, showing the test. Although taken primarily for its popular interest, the picture is, of course, a splendid advertisement for the Hipwood-Barrett fender, and the company is to be congratulated on its enterprise in arranging the details for the mutoscope demonstration. While the views were being shown in New York, representatives from nearly every street railway company within a radius of 25 miles accepted invitations from the fender company to attend the performance at Keith's, and, of course, saw about as forcible an argument as to the ability of the device to save life as could be desired.

Some of the details of the demonstration will be of interest. Two dummies stuffed with sand and sawdust were employed, one weighing about 30 lbs. and the other about 50 lbs. The smaller one was laid upon the track with its head upon one rail, and one of its arms extending out in the direction from which the car was coming. It is particularly noteworthy that this arm was only about 1 in. in diameter. The other dummy was placed about 10 ft. from the first, and in a standing position. The car was started at full speed, nearly two blocks from where the dummies were placed, and was going at about 15 miles an hour when it reached the spot. The fender was dropped 1½ ft. from the first dummy, and picked up both of them without the slightest difficulty. No marks or tears of any kind appeared on the bodies. The mutoscope camera was directed toward the car through the entire operation, and every detail is very clearly brought out in the picture. The photographic film was 160 ft. in length, and there were 1200 separate views. It took just twenty-seven seconds to complete the test. In the accompanying engravings are shown three of the scenes that go to make up the complete picture.

Straight Line Hanger

The accompanying illustration shows a straight line hanger known as "The Gem," manufactured by the Central Union Brass Company, of St. Louis, and sold through the Central Electric Company, of Chicago, as general agents.

The hanger was designed on the well-known West End lines, but changed so that, it is claimed, there is no possibility of trouble



"THE GEM" STRAIGHT LINE HANGER

from the loosening of the cap which holds the insulated bolt in place, due to the continual vibration of the trolley wire.

It will be noticed that this hanger has no cap to jar loose, the skirt of the hanger being that part which holds the insulator bolt in place by the pressure of the span wire against the corrugation in the neck of the skirt. The skirt in the hanger has a fluted or beaded edge, which, in heavy rain storms, forces the water to run off in streams, therefore cutting down the leakage to a minimum. In this manner of construction it is possible to make several combinations of materials, such as using a malleable iron body with a bronze skirt, or malleable iron skirt with a bronze body or all iron or all bronze. The threaded portion of this hanger is so well protected that it is absolutely impossible for any moisture to get through into the insulation.

When double-petticoat glass insulators were first placed upon the market they became a universal standard, owing to their having less leakage than any other insulator made at that time.

The beaded skirt of "The Gem" is claimed to offer the same amount of protection against the leakage of current as the double petticoat does to the glass insulator.

Mechanical Power Brakes

The subject of brakes is one of the most important to be considered in the equipment of the modern electric railway. That the increased weight and high speed of the modern motor car demand a more powerful and effective brake than was necessary for slow-moving horse cars is generally admitted. Since the general adoption of electricity on street railways, various brakes have been put on the market, operating by compressed air, electricity and other agents. One of the most widely adopted substitutes for the old-fashioned chain and spindle brake is the Sterling safety brake, made by the Sterling Supply & Manufacturing Company, of New York, and introduced about five years ago. Since that time the brake has been extensively adopted, and its reliability and efficiency proved in service. A severe test of this brake has been made at Troy, N. Y. The line of the Troy City Railway extends for the greater part of its distance over a series of grades, some of them being over 10 per cent. The company has from thirty-five to forty of its cars equipped with the Sterling brake, and the management states that it is fully efficient and reliable. The brakes have also been used for three years by the Buffalo Railway Company, which has had seventy equipments. The Sterling Company also reports brakes in use in Rochester, N. Y.; Worcester, Mass.; Manchester, N. H.; Indianapolis, Ind., and many other cities. Its salient features are safety, ease of operation, great power and durability, and these advantages are realized with extreme simplicity of design.

It is, strictly speaking, a mechanical power brake, and is made up of a double sprocket wheel carrying two continuous chains and geared to the brake staff. The ratio of gearing is sufficient to afford easy and positive operation without sacrificing quickness of action, multiplying the motorman's power and enabling him to manipulate the brake shoes so as to greatly overcome the sliding of wheels. The wear on chain and gears is reduced to the minimum, being equally distributed, and there is not the continual "grinding," wearing through and replacing of chain, common to the ordinary brake. This is quite an important item, as the old-fashioned chain on a spindle shaft wears out on an average in from four to ten months, and costs considerable for maintenance. The Sterling brake is also adaptable to either single or double truck cars, and can be easily applied to old as well as new cars. With this device the motorman is enabled to control the car in any emergency with comparative ease.

Naturally it is argued that heavy cars and heavy grades create the principal demand for safetey brakes, and in service, the Sterling brake has proven fully effective as a medium of safety on heavy cars and grades. However, its adoption and use has not been limited to roads having heavy grades, as experience has proven to the majority of managers that even on a level, or a slight grade only, emergencies arise which require more safety and efficiency than is afforded by the ordinary brake. Hence the Sterling safety brake has been adopted, not alone because of its efficiency on heavy grades, but on any grade, and because of the medium of safety it affords against accidents, and suits for damages consequent thereto.

Sales of Hose Bridges

The portable hose bridge manufactured by the Ohio Brass Company, of Mansfield, Ohio, and which was described in the last issue of the STREET RAILWAY JOURNAL, is meeting with an increasing demand. The manufacturers report recent sales among some of the largest and best known street railway companies in the United States, bridges having been shipped within the last month to the Syracuse Rapid Transit Company, Chicago City Railway Company, Toledo Traction Company, Nashville Street Railway Company, Knoxville Traction Company, the People's Railway Company, of Dayton, Ohio, and numerous others.

The Provincial Council of Macerata, Italy, has voted a subsidy to the town of Camerino to construct an electric railway between that city and Castelraimondo.

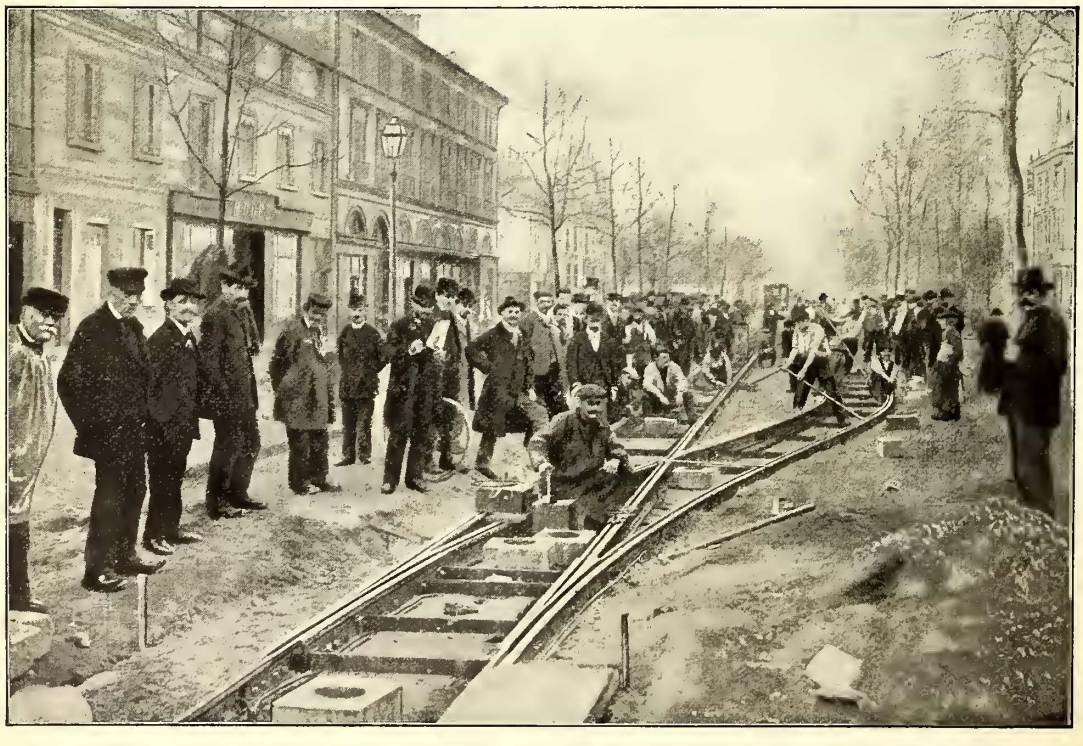
Surface Contact System at Tours

The tramway company of Tours, France, has recently installed the Diatto surface contact system for electric railways, and the first section of this line was put in operation April 22, before a large assembly of French electrical engineers and tramway managers. Considerable interest has attached to this system, owing to its adoption on such a large road, as the tramways in Tours measure 23 km. (14 miles) in length, and of this 12 km. (7 miles) will be equipped with the surface contact system, and the rest with the trolley system.

The principle of the Diatto system consists in the operation of a plunger by magnets carried on the car, the plunger making contact between the main source of supply and a surface knob, from which the current is taken by a skate to the motors. The special features of the system consist mainly in the method of improving the magnetic circuit about the plunger, so as to secure better control over it from the car.

A section of one of the contact boxes is given on page 487. The upper part of it consists of a block of asphalt, in the center of which is a button, *C*, of soft iron, resting in a flange, *A*, of bronze or other non-magnetic metal. The button *C* terminates in a carbon contact point, *D*. The plunger, which is of iron with a carbon head, is shown at *K*, and slips inside of an ebonite tube, which is partially filled with mercury, so that the plunger floats normally in the position shown in the cut.

SECTION OF COMPLETED TRACK



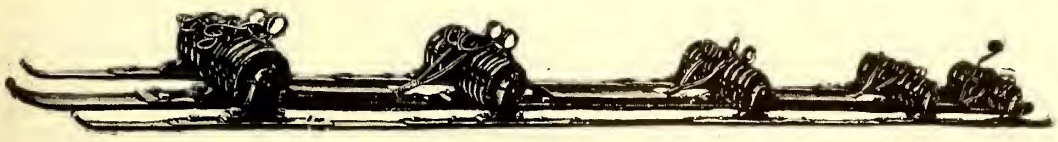
LAYING THE TRACK

The lower part of the mercury is connected with the main source of supply, *Q*, and at the upper end of the plunger is a carbon contact button of proper shape to engage with the button *D*. On each side of the plunger tube are two large soft iron wings, *M*, embodied in the asphalt, and with upturned extremities, so as to assist in completing the magnetic circuit as they are turned up toward the magnets carried on the car.

The skate, or collector, on the car is composed of three bars with upturned ends, as shown on page 487, between which is mounted a set of electric magnets, so arranged that the central shoe will be of north polarity, while the outside shoes are of south polarity. When carried on the car the central shoe passes directly over the contact knob and the outside shoes over the extremities of the flanged magnetic yoke in the asphalt. The plunger will then be attracted upward, when it will be brought into contact with the carbon button on the surface knob, and current will be taken into the cars through the central shoe.

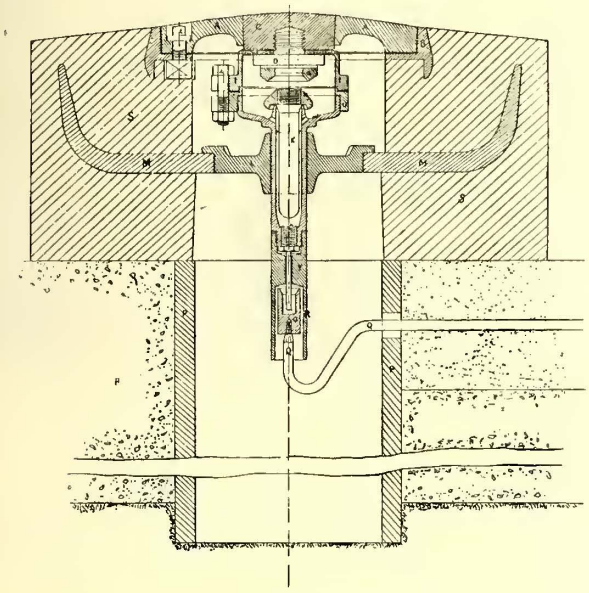
After the car has passed, the plunger drops down to its original position by gravity. Owing to the curved shape of the ends of the contact shoes, it is claimed that the electrical contact will be broken before the magnetic circuit. Consequently, any arcing which may occur from breaking the circuit will take place between the shoe and the contact button, and not inside the contact box, as no current will be passing from the button when the plunger falls back to its original position by gravity. It is claimed, however, that there will be no arcing whatever, as the skates are long enough to span two contact buttons. It is claimed that the amount of residual magnetism possible to be retained by the soft iron contact block is insufficient to overcome the weight of the plunger, and that consequently there is no possibility of the latter sticking in a raised position. Nevertheless, to satisfy the City Council of Tours, the railway company has attached to every car

a short circuiting device, consisting of a grounded brush, which is carried at some distance behind the car. If this brush should pass over a live contact block it will sound an alarm and also blow the main fuse of the car. To operate the magnets at starting, a small storage battery is carried on the car.



SKATE OF TOURS CAR

The length of the line now operated in Tours on the Diatto system is 2 km., and on the trolley system, 3.6 km. The Tours Tramway Company is building a large electric power station to operate its lines. There will be three 300-h.p. engines, built by Piguet & Co., Lyons, each belted to a 200-kw. generator, supplied by the Société d'Applications Industrielles. The generators will be wound for a voltage of from 550 to 600, with 12 per cent compounding. The cars of the company were supplied by the Compagnie Générale de Construction, of St. Denis, and the material for the overhead line, rail bonds, I. T. E. circuit breakers, etc., by R. W. Blackwell & Co.



SECTION OF CONTACT BOX

The Diatto system will also be installed at Lorient and Rheims, France.

New Cars for the Chicago City Railway

The new closed electric cars for the Chicago City Railway Company, which are now being completed by the John Stephenson Company, Ltd., at its Elizabeth works, are extremely tasteful in design and finish. The cars are 20 ft. long over corner posts, and 30 ft. over all. They have concave and convex paneled sides, with body 7 ft. 6 ins. wide at belt rail, and 6 ft. 2 ins. wide at sills.

The platforms are 4 ft. 6 ins. long, and are enclosed by vestibules having three drop windows, angularly placed. The front of the vestibule, however, is curved in form below windows, and is faced with sheet steel. The platforms have entrances at both sides, and are fitted with three-part doors, folding against vestibule. The steps are pressed steel, with rubber treads. The platforms are also fitted with angle-iron buffers.

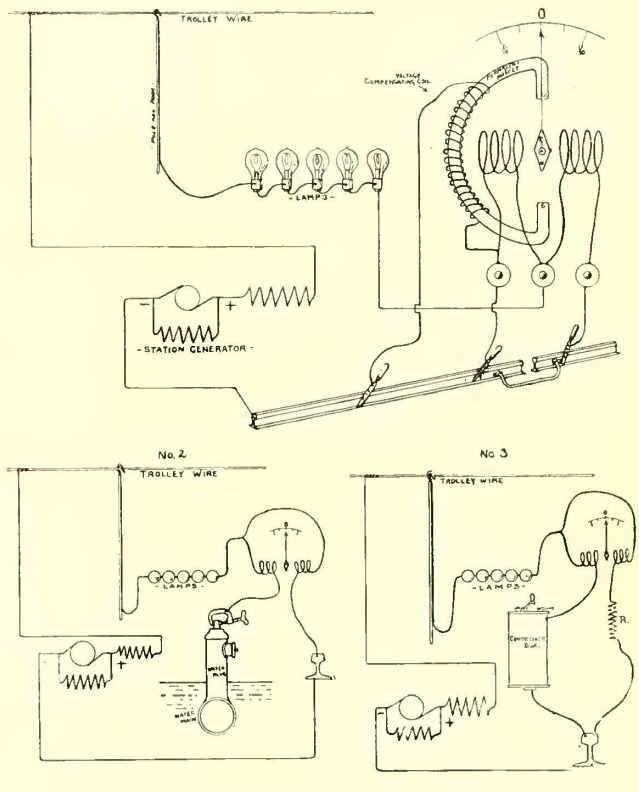
The body has six windows on each side, and all glass and sash frames are set in specially molded rubber pockets, which prevent all rattle whatever from this source. The interior finish is in cherry, stained dark, with hand-carved window and door pilasters and pressed mouldings, giving a very rich and handsome appearance. The ceiling lining is birdseye maple veneer. The seats are of the side pattern, with spring cushions and backs, covered with olive green carpet, and were supplied by the Hale & Kilburn Company. The metal trimmings are extra heavy bronze throughout.

Cars are painted in olive green in varying shades, the deck sash being set in green rippled glass to match. On the hoods are Hunter illuminated signs. The cars are wired for two light circuits, *i. e.*, eight lights in the body, arranged four in each corner of the monitor and two along the sides of the monitor, and one over the door on the platforms. The cars are also wired for conductors' signal, with buzzers on each platform and push buttons in the window pilasters.

The weight of the car body is 9000 lbs., and it will be mounted on Moore electric trucks with 9-ft. wheel base, equipped with Price power brakes.

A Resistance Detector

The accompanying diagram shows a differential resistance detector recently invented by John C. Henry, of Denver, Col., for determining slight differences of resistance. Fig. 1 shows its application to track joint testing. The indicating needle is normally held at zero by a permanent magnet. One-half an amp. is taken through the instrument from trolley to ground. This current divides between the solenoidal coils within the instrument, depending upon the resistance of the joint which is being measured, and moves the needle proportionately. The coil surrounding the permanent magnet is placed in shunt with the rail, the spaces depending upon the weight of the rail, and it is intended to balance the variation in the resistance of the joint, which is caused by fluctuations of the current. For other purposes, when it is desired to compensate for drop in voltage, the coil can be connected in shunt with one of the lamps. Where the tests are made at night, when the cars are not running, the compensating coil need not be used. Where there are two bonds, one of which is in good condition and the other not, or where the current can be shunted around the bond through a cross connection, the instrument, of course, would not show the defect, but this is also true of most other detectors.



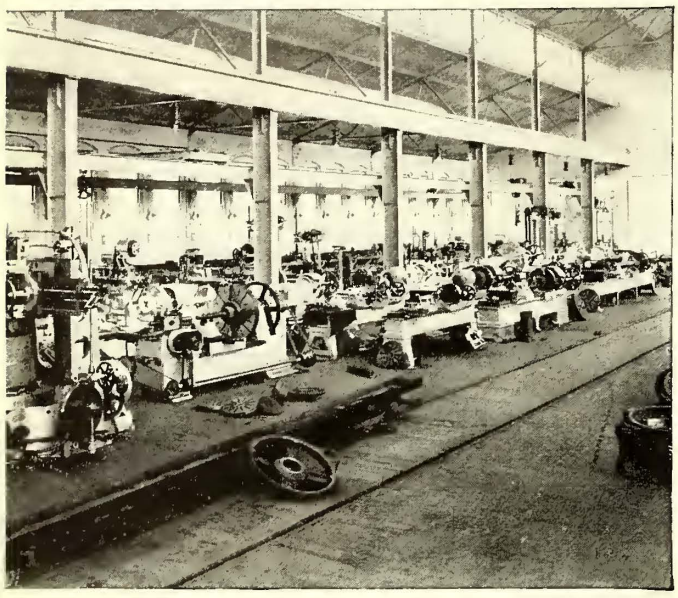
RESISTANCE DETECTOR

Fig. 2 shows the connections used to compare the relative conductivity of the track and water mains. In this case the deflection of the needle also indicates the direction of any current and voltage between the conductors. Fig. 3 shows the method of using the instrument to test controller connections. In this case the controller is then turned a notch at a time, and the indications noted on the dial, which should correspond with the known proper resistances of the different combinations.

Works of the Bullock Electric Manufacturing Company

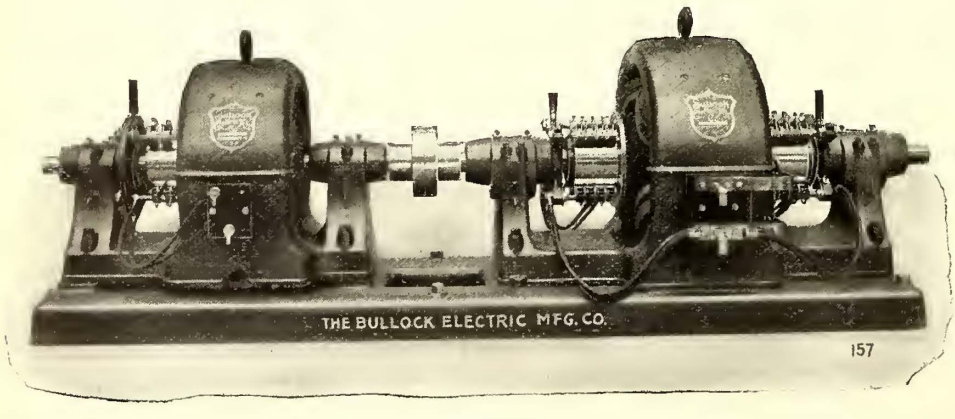
The works of this company were completed last summer, and are located at East Norwood, Ohio, one of the suburbs of Cincinnati, and less than 5 miles from the heart of the city. The B. & O. S. W. Railroad cross the tracks of the Pennsylvania Railroad at this point, and both roads have switches entering the works, giving the Bullock Company excellent facilities.

The company manufactures a large variety of electric machinery, including motors, boosters and generators, and some of its apparatus has been illustrated in the columns of this paper. It has recently gone into the manufacture of large generators for railroad in sizes up to and including 800 kw. These machines are built on the same lines as the other standard Bullock machines.



INTERIOR VIEWS OF WORKS

The Bullock electric machinery is used for power distribution purposes, and throughout the works of the company there is no line shafting and counter shafting, but each machine is equipped with a Bullock electric motor. Among the tools equipped in this way are cranes, power presses, planers, drills, milling machines, hydraulic presses, boring mills, etc. The motors used for driving these tools are specially designed and adapted for the work which they have to perform. The economies effected by the application of motors to machine tools, though in the first cost slightly more expensive than the use of the line shafts, belting and counter-shafts, soon justify the additional expenditure.



BOOSTER

The power house is provided with vertical water tube boilers, and equipped with automatic stokers. A cross compound engine, directly connected to two of the Bullock Electric Manufacturing Company's engine type generators, supplies current, not only for the lighting system, but for the Bullock multiple voltage power system used throughout the entire plant. The accompanying engravings show views of the company's machine shop and a standard booster for railway work.

The Eastern Massachusetts Consolidation

The prospectus of the new "Massachusetts Electric Companies," which is a virtual consolidation of thirty-one street railway and several electric lighting companies, covering the greater part of the territory north of Boston as far as Newburyport and Gloucester, and Nashua, N. H., and south as far as Fall River, Newport and Providence, R. I., has just been issued, and is an interesting document. It is a "voluntary association," managed by a board of fifteen trustees, who hold the title to its assets. The declaration of trust contains strong provisions against the creation of any indebtedness whereby any stockholder or trustee can be held personally liable. The board of trustees includes some of the best known and most highly esteeemed citizens of Massachusetts, five of whom are elected for one year, five for two years and five for three years.

The board of trustees have issued certificates of participation to the amount of $12,000,000 in 4 per cent common shares, and $12,000,000 in 4 per cent preferred shares, and each holder of a certificate will be entitled to a proportionate interest in each and all shares of stock held by the trustees. These securities are offered at public subscription at a price of $1,050 for ten preferred shares and five common shares.

The new company controls 647 miles of track, 1426 cars and eighteen power stations, the latter having a total rated capacity of 28,423 h.p. The earnings in 1897-1898 applicable to dividends upon the new shares of the Massachusetts Electric Companies were $733,233, equivalent to a 4 per cent dividend on the $12,000,000 preferred shares, 2 per cent dividend on the $12,000,000 common shares, and a surplus of $13,232.

It seems reasonable to expect that by a consolidation of these properties, substantial economies can be effected, particularly in the distribution of load among the many power stations of the system.

The "Compagnie Générale d'Enterprises Electrique de Para" is the title of a new company organized May 10 in Brussels, Belgium, to operate the electric tramway and lighting system of Para, Brazil. The capital stock is frs. 1,000,000. The board of directors consists of the following: MM. Jules de Borchgraeve, manager of the Compagnie Générale Coloniale pour Favoriser l'Industrie et le Commerce au Congo; Paul Macau, of Bruxelles; André Van Iseghem, of Bruxelles; Otto Fuerth, manager of the Société La Brésilienne, of Para; Arthur Brown, consul at Londres; Fernand de L'Abre, of Antwerp.

Traveling Link Grate

In the accompanying illustration is presented an endless chain grate for boiler furnaces. This grate, while resembling in general appearance some of the traveling grates already on the market, has some special features which make it very desirable. It has now been on the market for about three years, and has been, or is being, installed in steam plants of an aggregate of 16,000 h.p. Among the recent equipments are six grates for the boilers of the new power station of the Milwaukee Electric Railway Light Company, of Milwaukee, Wis. Each of these grates is approximately 10 ft. wide and 9 ft. effective length of grate surface, making a total of 90 sq. ft. Among the largest purchasers and users are the Cincinnati Edison Company, United States Glue Company, of Milwaukee; Armour Packing Company, Kansas City; Metropolitan Street Railway Company, Kansas City; Swift & Co., St. Joseph, Mo.; Brown Building, St. Louis; West Side Street Railway Company, Chicago.

One of the principal features in which the grate differs from others of its class is that the clips or links are so formed as to be readily removed or replaced in the chain without removing cross-rods or any of the principal parts. For this purpose the clips, or links, which are about a foot long, are slotted on the underside. There are two of these slots, which are enlarged into a circular opening, and which are provided to receive the transverse joining bars. The latter are oval, and of such shape as to allow the clips to be slid over them when held in a certain position. All the clips being in place on the adjoining bars, each bar is canted so as to bring its largest diameter across the opening, and being held in this position, the links cannot drop off or be removed. The joining bars are held in this position by means of outside links, known as binders, which have slotted openings to admit the ends of the joining bars when turned to the proper angle, and which the binders hold in the same position. The binders themselves are held in place by cotter pins. When it is necessary for any cause to remove or replace these slotted clips or links, the binding links of a pair of bars are removed, when, with a wrench, the bar is partly turned, permitting the links to be lifted off and replaced, and when in position it is again brought to its proper angle and the binders replaced.

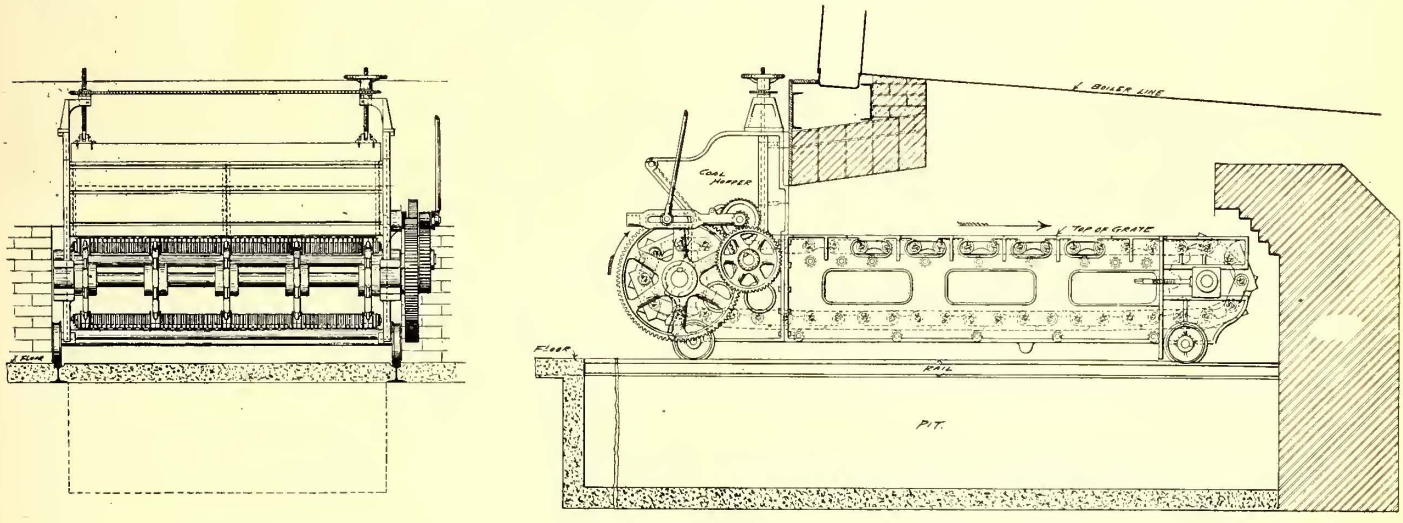
Another feature is the method of providing bearings on which the chain rides. These bearings consist of heavy steel piping, mounted at their ends upon roller bearings, the ends being reamed or recessed so that the rollers rest in the nest of bearings, thus making a double roller bearing for each roll. By this means easy and positive motion is secured without the use of lubricants. The roller bearings are housed in so that they are entirely protected from dust and ashes.

The chain is moved by means of sprocket wheels, which are mounted upon the front driving shaft, and which engage with peculiar shaped driving links, which are placed in rows in the face of the grate chain, so that the sprocket wheels engage with lugs on these special designed links. A second set of wheels is mounted on the rear shaft, which is horizontally adjustable, to provide for the chain tension. The individual clips or links are corrugated on their upper surface and are air spaced, according to the character of coal and strength of draft. The grate is mounted on an iron carriage having wheels which run upon track especially provided, and which extend in front of the boiler to permit of the grate being entirely withdrawn from the furnace without interfering with the boiler setting.

The driving mechanism of the grate consists of a train of gears actuated by a ratchet, as shown, and is operated by a lever or rod, which is connected to an eccentric upon an independent shaft. In the case of the Milwaukee plant, this shaft is located in the basement, and is operated by a small 6-h.p. engine. Besides the lever and ratchet, there is an attachment for operating the grate by hand, independent of the power connection.

A coal hopper is provided, together with a feed regulating gate, and is supported by means of the side frames of the carriage, which are extended upward. There is also a removable hopper curtain. The regulating gate is lined with fire brick, and moved up and down within vertical guides, and is operated by means of two screws, which are connected with a sprocket chain, power being applied by means of a hand wheel, as shown.

Another interesting feature in connection with these grates is the method of supporting the roof of the fire-box at igniting arch. This is composed of specially designed fire brick, having grooves which permit of their being slid over steel channel bars, which are securely supported to the brick work. By this means, a plain, slanting surface is provided above the fire, instead of the arched construction which is usually employed. The economic features of chain grates of this type are in the direction of smokeless and economical combustion, even when a low grade of bituminous slack is employed for fuel. The other features include low cost of attendance and low cost of maintenance and repairs. Recent tests made by one of these grates in the plant of the United States Sugar Refining Company, of Chicago, using Illinois crushed lump and slack, show that a 350-h.p. boiler developed power in different tests ranging from 359 h.p. up to 506 h.p., the evaporation ranging from 8.83 lbs. to 9.63 lbs. of water from and at 212 degs. evaporated per pound dry coal, with an efficiency of 73 to 77 per cent, and an average of 15 per cent Co_2 in the gases above the furnace. The coal used ranged in value from 11,500 to 12,500 B. T. U. per pound dry coal.



END AND SIDE ELEVATIONS OF LINK GRATE

These grates are manufactured and sold by the Green Engineering Company, of Chicago. This company not only manufactures grates above described, but contracts to provide a complete installation of power plants, either for electric lighting purposes, street railway plants or power plants of any description. The company is special agent for the Edgemore water tube boilers, but install any type of engines or generators. The personnel of the company includes W. M. Green, president; John R. Gent, vice-president; P. A. Poppenhusen, treasurer, and H. A. Poppenhusen, secretary. All these gentlemen have had practical experience in the installation of steam plants, having been connected with some of the leading engine and boiler manufacturers in the country.

Underground Conduits for Chicago

It is stated that the Chicago Union Traction Company, the consolidation of the North and West Side systems, will ask the municipal authorities for permission to use the underground trolley system for the lines in the down town districts, including the cable loops of the North and West Chicago Companies, and that permission will furthermore be asked to substitute the trolley for the cable on the lines north and west of the river.

Special Catalogue

The new catalogue of the Central Electric Company, of Chicago, Ill., is, as in previous years, one of the most elaborate issued by any electrical supply house. It is bound in cloth, contains 537 pages, and on every page is found from one to half a dozen cuts of some tool or apparatus used in the generation or distribution of electric currents. A complete index at the back of the book enables the intending purchaser to find the reference in the catalogue to any particular supplies he may be in need of. The catalogue should find a place in the library of every railway manager in the country.

Personal

MR. P. F. SULLIVAN has accepted the position of general manager of the Massachusetts Electric Company.

MR. MITCHELL JEANNES has been chosen general manager of the Fox River Electric Railway, of Green Bay, Wis.

MR. W. A. BELCHER, manager of the Ithaca (N. Y.) Street Railway Company, has resigned his position, to take effect July 1.

MR. J. W. BROWN has secured an interest in the Dubuque (Ia.) Light & Traction Company, and will assume the management of that property.

MR. H. F. PARSHALL, of London, has been appointed local honorary secretary for Great Britain by The American Institute of Electrical Engineers.

MR. JAMES S. FITZMAURICE, of Sydney, has been appointed local honorary secretary for Australasia by The American Institute of Electrical Engineers.

MR. O. B. VINAL is the new electrician of the Schenectady (N. Y.) Railway Company. Mr. William Steers has been appointed purchasing agent of the railway department.

MR. C. W. BLACKINGTON has resigned his position as superintendent of the Millbury division of the Worcester & Suburban Street Railway. He has held the place about a year.

MR. JOHN GRANT has taken up the duties of assistant manager of the Indianapolis Street Railway Company, having left the Detroit roads with which he has been connected for a long time.

MR. JOHN R. GRAHAM, president of the Quincy & Boston Street Railway Company, is to be general manager of the local division of the Massachusetts Electric Company, with headquarters at Quincy.

MR. E. C. HATHAWAY has taken up his duties as general manager of the recently consolidated street railway companies at Lexington, Ky. He was formerly connected with the street railway at Charlotte, N. C.

MR. THOMAS WILSON, who has had charge of the engineering work in connection with the extensions being built at Harrisburg, Pa., has accepted a position as assistant engineer with the Buffalo Traction Company.

MR. ARTHUR M. CRAM, of Walpole, Mass., who has been one of the superintendents of construction of the Norfolk (Mass.) Southern Street Railway Company, has left for Vermont, where he will engage in some important electric railway construction.

MR. W. A. HELLER, who recently resigned the position of superintendent of the Lewiston & Youngstown Frontier Railroad Company, of Lewiston, N. Y., it is stated, has accepted a similar position with the Niagara Falls & Lewiston Railroad Company (the Gorge road).

MR. C. C. LEWIS, formerly of the Pennsylvania Steel Company, has been appointed engineer of way of the International Traction Company, the recently consolidated system of electric roads of Buffalo, N. Y., and vicinity.

MR. J. A. MAXWELL, who recently resigned as superintendent of motive power with the Cortland & Homer Traction Company, goes to Troy, where he has accepted the position of master mechanic of the Troy City Railroad Company.

MR. CHARLES F. THOMPSON, secretary, treasurer and director of the Lane & Bodley Company, Cincinnati, has resigned his position in those capacities, to take effect July 1. Mr. Thompson has been with the company thirty-five years.

MR. H. C. BENAGH, superintendent of the Savannah, Thunderbolt & Isle of Hope Railway Company, has tendered his resignation, to take effect July 1. Mr. Benagh will probably return to Nashville, Tenn., which city he left when he went to Savannah.

MR. PIERRE OTIS KEILHOLTZ, chief engineer of the United Railways & Electric Company, of Baltimore, will hereafter, in addition to the duties of his office, act as general manager of the United Electric Light & Power Company, of Baltimore.

MR. F. E. SMITH, auditor of the Lynn & Boston Railroad Company, has accepted a similar position with the Massachusetts Electric Company, which has effected a consolidation of the principal suburban electric railways of Eastern Massachusetts, and has entered upon his new duties.

MR. FRANKLIN WOODMAN, of Haverhill, Mass., has been appointed general manager of the Merrimac Valley division of the Massachusetts Electric Company. Mr. Woodman was formerly manager of the Haverhill division of the Lowell, Lawrence & Haverhill Street Railway Company.

MR. F. L. HART, formerly of Baltimore, has been appointed general superintendent of the system of street railways at Washington, D. C., recently purchased by a syndicate for the purpose of consolidation. Mr. Hart has been for some time engineer in charge of the re-equipment of the Anacostia road.

MR. HENRY VILLARD is preparing for a journey to Alaska, and will start about July 1. In the course of his trip he will celebrate the twenty-fifth anniversary of his first visit to Washington—a visit which has had enormous consequences to the people of the great Northwest and the Northern Pacific Coast.

MR. HARRY D. LIVERS, formerly connected with the Tamaqua & Lansford Electric Railway Company, of Tamaqua, Pa., on June 1 succeeded J. A. Bonnell as superintendent of the Carbon County Electric Railway Company, Mauch Chunk, Pa. Mr. Livers has recently arrived home from active service in the Spanish war.

MR. G. SACCO ALBANESE, a well-known engineer, both in America and Europe, and who has been engaged in the construction of a large number of electric railways in France and French colonies, has recently been honored by the French government with the decoration of an officer of the Academy of Arts and Sciences.

MR. HENRY C. MOORE, president of the Trenton Street Railway Company, has been appointed vice-president of the United Power & Transportation Company, which controls about fifteen street railway properties in Philadelphia and the surrounding country. Mr. Moore still retains the presidency of the Trenton road.

MR. ELWIN C. FOSTER, general manager of the Lynn & Boston Railroad Company, has been given largely increased responsibilities in connection with the new consolidated system of the Massachusetts Electric Company, and will be in charge of the entire North Shore section of the system, from Boston to the Merrimac Valley.

MR. FRANK G. LOTT, who has held the position for some time of superintendent and general manager of the Buffalo & Niagara Falls Electric Light & Power Company, has been appointed superintendent of the Lewiston & Youngstown Frontier Railroad Company, of Lewiston, N. Y. He takes the place of Mr. W. A. Heller, resigned.

MR. H. A. EVERETT has been elected president, Mr. Will Christy vice-president, Mr. J. R. Nutt treasurer, Mr. C. S. Moore secretary, and Mr. L. S. Beilstein general manager of the Northern Ohio Traction Company, which is a consolidation of the Akron Traction & Electric Company and the Akron, Bedford & Cleveland Railroad Company.

THE METROPOLITAN ELEVATED RAILROAD COMPANY, of Chicago, has elected a new board of directors, including Dickinson MacAllister, the president; W. W. Gurley, Byron L. Smith, George B. Harris, John P. Wilson and George Higginson, Jr., of Chicago, and C. F. Dieterich, R. S. Hays and James J. Higginson of New York.

MR. WILLIAM D. BUCKNER, assistant chief engineer of the Guayaquil & Quito Railroad (a steam road), of Ecuador, is in New York city. His visit to the United States is for the purpose of attending to some improvements for the road, making purchases of construction outfit and engaging engineers. His address is 49 West Thirty-first Street.

MR. ALLEN F. EDWARDS, who, for the past year, has been the general superintendent of the Yonkers Railroad Company, is now general manager of the Virginia Traction Company, of Petersburg, Va., and also general manager of the Electric Light Company, of the same place. These two companies have been purchased by the same syndicate, and will shortly be combined.

MR. PHILIP DAWSON, engineer with Messrs. Robert W. Blackwell & Co., of London, has been traveling in the West during this month, particularly in Chicago and Milwaukee. In Chicago he has been looking very carefully into the operation of elevated electric railroads, and in Milwaukee is inspecting some of the engines recently ordered by Mr. Blackwell on British contracts.

MR. HUGH J. McGOWAN has been elected vice-president and general manager of the Indianapolis Street Railway Company. Mr. J. Grant, formerly superintendent of the Citizens' Street Railway Company, Detroit, is assistant general manager. Mr. W. F. Milholland, formerly treasurer and assistant secretary, has been re-elected to the same position, and Mr. Miller Elliott re-elected as superintendent.

MR. F. S. PEARSON, chief engineer of the Metropolitan Street Railway Company of New York, sailed for Sao Paulo, Brazil, on June 5, in order to inspect the city and determine on certain general problems connected with the development of the street railway and lighting system of Sao Paulo, for which franchises have recently been obtained by himself and associates. He expects to return in August.

MR. R. C. BROWN, who has been for some years connected with the Whitney-Elkins-Widener syndicate as one of its most trusted engineers and street railway managers, sailed for Sao Paulo, Brazil, on June 5, in order to take charge of the construction, equipment and (temporarily) the operation of the large electric tramway and light enterprise which is being developed there by a New York and Canadian syndicate composed of F. S. Pearson, William McKenzie and others.

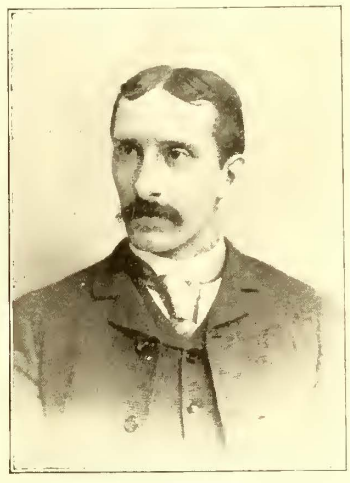
MR. F. P. BROTHERS, MR. NORMAN S. RANKIN and MR. SHIRLEY DAVIDSON, who have been for some time in Kingston, Jamaica, superintending the construction of the West India Electric Tramway of that city, have returned to Montreal, their native city, for a short vacation. These gentlemen report that the Kingston road has been practically completed as far as track construction is concerned, and the line will be in operation soon. It is about 30 miles long, and steel ties were used exclusively, owing to the climatic conditions and wood-boring insects.

MR. JOHN A. RIGG, president and general manager of the United Traction Company, of Reading Pa., has accepted the position of president of the United Power & Transportation Company, the formation of which is mentioned elsewhere in this issue. He has been a leading spirit in perfecting this consolidation, and its successful consummation is due largely to his energies. Mr. Rigg has been actively engaged in street railway work for over a quarter of a century, and has been prominent in the affairs of the American Street Railway Association, in which he has held various offices.

MR. F. H. CHEVALLIER BOUTELL, general manager of a large trust company of Buenos Aires, resident director of the Buenos Aires & Belgrano Tramway Company, of Argentina, and resident director for two important railroads and several industrial enterprises in Buenos Aires, in which London capital is interested to the extent altogether of $150,000,000, was in the United States for a brief pleasure trip, and returned to London on June 28,, and will reach Buenos Aires in August. He visited New York, Philadelphia, Washington, Chicago, Detroit, Niagara Falls, Schenectady and Boston, and derived a great deal of enjoyment from his first American experience. A report appeared in the Chicago papers soon after his visit to that city that he had placed an order for $5,000,000 worth of cars in that city, but this was wholly false. Mr. Boutell also very carefully investigated American locomotives, his disposition being to purchase future supplies for his Argentina enterprises as largely as possible in America.

MR. O. T. CROSBY, through whose efforts, in combination with those of Mr. C. A. Lieb and F. C. Stevens, the general consolidation of street railway properties in the city of Washington has just been made, sailed for Europe recently, with Mrs. Crosby, to secure a much needed rest. He has given up official connection with all of the Washington properties in order to free himself completely for a prolonged pleasure-seeking and health-restoring trip. In 1895 Mr. Crosby went to Washington with Mr. Lieb, and the two bought a controlling interest in the Georgetown & Tenalleytown Railway. In the latter part of the same year they also secured control of the Potomac Power Company, then located on the Virginia side of the river, together with pole and wire privileges in the District. A little later the Potomac Light & Power Company was organized, and Mr. Crosby extended his railway and lighting interests until the consummation of the recent general consolidation.

MR. H. S. COOPER, who has recently resigned from the superintendency of the Schenectady Railway Company, of Schenectady, N. Y., was born in Isle of Wight, England, in 1856, and came to America in 1865. He was educated at Farnum School, Beverly, N. J., and worked as office boy, clerk and salesman in Philadelphia from 1870 to 1876. In 1876 he went into the manufacturing of agricultural machinery in the South, first at Raleigh, N. C., and again at Jacksonville, Fla., and in connection with this business had, during 1884 and 1885, the charge of the electrical work on two lines of steamers on the St. Johns River, and of much work on the two lighting stations then in Jacksonville. From this time until 1893 he had charge of numerous electric railway and lighting installations, and in that year, at the urgent solicitation of the owners, he accepted the managership of the Schenectady properties of the Electrical Development Company, these properties consisting of the entire electric and gas lighting and railway and motor business of the city. These properties were then in desperate shape, and the business depression of 1893 necessitated the placing of them in the hands of a receiver. The receiver was changed in 1894, and in 1895 the properties were sold under foreclosure of the bonds, and then reorganized. Since taking charge, in July, 1893, the properties have been entirely and absolutely under Mr. Cooper's management, and without outside aid of any kind—financial or otherwise—they have been developed from their own resources until they are now in fine physical condition and on an excellent paying basis, and have the good will and co-operation of the entire community, both private and municipal.



H. S. COOPER

AMONG THE MANUFACTURERS

THE GENERAL ELECTRIC COMPANY, of Schenectady, has published recent bulletins on grooved trolley wire, the G. E. 55 railway motor, and the C. E. motor.

THE AMERICAN IMPROVED RAIL JOINT COMPANY, of Chicago, has taken a contract to cast weld some 5000 joints in Indianapolis, and work on the same has already commenced.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., after July 1 will be known as the Green Fuel Economizer Company. The new works are very busy, running to their full capacity.

THE CONSOLIDATED PUBLIC WORKS COMPANY, of Philadelphia, has acquired the business interests formerly owned by the Wheeler & Boody Company, the latter company having recently been dissolved by mutual consent.

J. G. SATTERTHWAIT, formerly with Walker & Kepler, is now connected with the C. & C. Electric Company, at its Philadelphia office. Mr. Satterthwait will be pleased to answer any inquiries regarding dynamos or motors, either direct connected or belted.

THE NORTH AMERICAN CONSTRUCTION COMPANY, of Chicago, which secured the contract for the deck work on the Northwestern Elevated, has commenced laying the material, and expects to have this finished within the next three months.

THE PITTSBURGH FEED WATER HEATER COMPANY, of Pittsburgh, Pa., has just issued a new illustrated catalogue of the Pittsburgh feed water heaters and purifiers, showing both the open and closed types manufactured by it. The cata-

logue is illustrated with numerous cuts, and a copy can be had by writing to James Bonar & Co., Pittsburgh, Pa.

THE COLUMBIA ELECTRICAL SUPPLY COMPANY, formerly at 329 Fourth Avenue, New York, has removed to 93 Liberty Street, where it has one of the handsomest arranged stores to be found in the electrical supply trade. The company carries a large stock of electrical goods, to which will gradually be added a line of street railway material.

THE MICA INSULATOR COMPANY, of Chicago, has received during the past month its usual large number of orders for its insulating materials, viz., micanite plates, segments, rings, etc., "Empire" insulating cloths and papers and M. I. C. compound. The company's business during the last two months shows a very heavy increase over the corresponding period of last year.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., since Jan. 1, 1899, has shipped its arresters into every State of the Union, and has made over fifty shipments abroad. It also states that the sales of these devices from Jan. 1, 1899, to the present time are equal to the total sales of any preceding year. This is convincing proof of very high merit in these devices.

EDWARD ROBINSON, proprietor of the Wells Light, 44 and 46 Washington Street, New York, returned from England on the steamer Umbria a few days ago, after a very pleasant trip, taken partly in the interest of the Wells Light business and partly for pleasure. During his absence abroad 1500 of the now famous Wells' Lights were sold to the Russian government for use upon the railroads in that country.

H. W. JOHNS MANUFACTURING COMPANY, of New York, will hereafter be represented in Chicago by the Manville Covering Company, with offices at 173 Randolph Street. H. A. Reeves, manager of the electrical department of the latter company, and long known in connection with the Chicago office of the H. W. Johns Company, will be in charge. He reports an immense demand for molded mica, vulcabeston, etc.

THE DORNER TRUCK & MANUFACTURING COMPANY, Cleveland, Ohio, has under way a new factory at Logansport, Ind., which will be fully equipped with all the modern machinery for turning out trucks and other street railway specialties, including the new friction brake recently brought out by this company, track cleaners, etc. The company reports quite a large number of orders for trucks, brakes and track cleaners.

THE ROBB ENGINEERING COMPANY, of Amherst, N. S., recently shipped, via New York and London, two 350-h.p. engines for the Perth Tramways Company, Perth, West Australia. These engines are tandem compound, side-crank type, and are for direct connection to General Electric 225-kw. dynamos. The order was placed through J. G. White & Co., of New York, who have the contract for the complete equipment of the tramway.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has adopted a somewhat unique method of proving the claims made for the Sturtevant system of ventilation and heating. This consists of an artistic pamphlet containing some fifty-three pages, and devoted exclusively to a list of buildings and steamships wherein the system has been installed. About 2500 names are given, and the list contains some of the very best plants in the country.

THE E. W. BLISS COMPANY, of Brooklyn, N. Y., manufacturers of presses, dies, shears and special machinery for all classes of sheet metal work, is sending out a neat pocket-size pamphlet containing small cuts and a brief, yet comprehensive description of many of its more important machines. The company carries in stock a complete line of standard tools, and makes a specialty of designing and manufacturing machinery for special purposes.

THE WESTINGHOUSE MACHINE COMPANY, of Pittsburgh, Pa., is calling attention to the Westinghouse Junior engine through a tasteful catalogue just issued. This engine is equal in every detail of workmanship and material to the regular Westinghouse standard engines, but is built in small sizes only. It is of the simple single valve automatic type, and its economy of operation, together with its comparatively low first cost, makes it a very desirable machine for a small plant.

THE PITTSBURGH FEED WATER HEATER COMPANY, of Pittsburgh, Pa., has published a new catalogue, setting forth the economy and efficiency of the different types of feed water heaters and purifiers which it manufactures. These devices have been considerably improved since first placed upon the market, and the manufacturers now claim they have the most efficient, simplest and most economical heater in the market, citing a number of features substantiating this claim.

J. G. WHITE & CO., of New York, are designing and supervising the erection of a brick power house, complete, for the Detroit & Lake Orion Railway Company, and are furnishing and erecting two 250-h.p. Cahall boilers, two 300-h.p. Ball & Wood engines, two 200-kw. Crocker-Wheeler railway generators, direct connected, one 60-kw. Crocker-Wheeler booster, together with chimney, piping, condensers, feeders, pumps, switches, wiring and all accessories; also one 90-kw. lighting generator.

THE H. C. ROBERTS ELECTRICAL SUPPLY COMPANY, of Philadelphia, reports a steady increase in the demand for its products, among the recent sales of trolley and feeder wire being large quantities to the interurban electric railway from Dayton to Xenia, Ohio, the Schuylkill Valley Electric Railway Company, of Pottsville, Pa., and the Norfolk Terminal Company, Norfolk, Va. The company's wire has also been shipped to Lewiston, Pa., Cincinnati, Ohio, Rising Sun, Ind., and numerous other places.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., has issued the following catalogues: No. 110-E, devoted to transformer fuse blocks of 1000 to 300 volts capacity; No. 188-B, describing the Westinghouse No. 38-B single reduction railway motor; No. 229, describing belt-driven railway generators; No. 200-A, describing generators and rotary converters for electrolytic work; No. 168-C, describing the Shallenberger integrating wattmeters for alternating circuits.

THE CHICAGO OFFICE of the Westinghouse Electric & Manufacturing Company has received a contract from the Muskegon Street Railway Company, of Muskegon, Mich., for an addition to the latter's electrical plant. This consists of a 275-h.p. belted generator, to be driven by a steam engine, and also an elaborate switchboard for regulating and manipulating the electrical current. This new generator will be worked in connection with those previously installed, and will supply power for the cars running upon the newly extended lines of the street railway company.

THE TURNER ENGINEERING COMPANY, of Bucyrus, Ohio, will erect at once a complete boiler plant for the Marion Steam Shovel Company, including a large self-supporting steel chimney, brick lined, after special designs. This latter company sends its shovels and dredging machinery to all parts of the world, and maintains its plant strictly up to date, with the most modernly improved money and labor saving devices. After careful and exhaustive consideration of all water tube boilers, the management decided to use the Turner boilers as possessing the greatest general merit and economy.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., early recognized the demand for electrically driven fans which was sure to follow the general distribution of electricity for power purposes. Its first fan motors were built about ten years ago, since which time designs have been perfected, the number of types greatly increased, and a large electrical department established. Some of the recent products of this company in the way of special electric fans are presented in its bulletins H and M. The former relates to the inclosed fans, the latter to propeller ventilating wheels.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., as an adjunct to its regular line of air brakes for street railway purposes, is also engaged in the manufacture of a complete line of air compressing appliances, including portable compressors, air hoists, air jacks, etc. The value of compressed air for performing a variety of work is rapidly coming to be recognized in a number of industries, and the demand for a simple and effective compressing apparatus is continually increasing. The Christensen portable air compressor was described in the last issue of the Street Railway Journal.

THE FALK COMPANY, of Milwaukee, Wis., recently lost by fire its complete blacksmith and special work shops. Shortly after the fire, however, the company had made arrangements for continuing the manufacture of its special work. The Falk Company has in process of erection several extensions to its plant at Milwaukee, and expects to be in a position within a short time to again take care of all orders. Eight acres of ground close to the present shops have been purchased, and new buildings will be erected thereon. These will consist of a machine shop, 100 ft. x 200 ft.; a foundry equipped for casting steel, also 100 ft. x 200 ft.; a power house, 60 ft. x 40 ft., and an office building, 40 ft. x 60 ft.

THE WAGENHALS MANUFACTURING COMPANY, Cincinnati, Ohio, reports that its new controller handle, which was described in the STREET RAILWAY JOURNAL for May, 1899, is creating considerable interest among street railway managers, and that its value as a current saver is coming to be recognized. These handles are now in use on the Union Traction Company's line, of Philadelphia; Cincinnati Street Railway, Cincinnati, Ohio; Detroit & Pontiac Railway, Detroit, Mich.; Syracuse & Suburban Railway Company, Syracuse, N. Y.; Camden & Suburban Street Railway Company, Camden, N. J., and several of the St. Louis lines. Orders have also been received from the Cape Town Tramways, Cape Town, South Africa.

THE TRADE PAPER ADVERTISING AGENCY, of New York, is sending out a unique and very artistic brochure, containing a number of original designs for advertising purposes, which were drawn by the special artist of the Trade Paper Advertising Agency. These are extremely striking, and many of them have appeared in the leading technical papers of the United States. This concern is prepared to take charge of the advertising of any reputable house, however large, and will attend carefully to all the details, thus giving the manufacturer the benefit of an expert knowledge of the design and arrangement of advertisements. Edward Caldwell, who was at one time business manager of the STREET RAILWAY JOURNAL, is manager of this advertising agency.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, reports repeat orders from the following well-known firms: The Kelly Axe Manufacturing Company, Alexandria, Ind., 400-h.p. live steam feed water purifier and 400-h.p. exhaust steam feed water heater; the Deering Harvester Company, Chicago, Ill., two 1250-h.p. purifiers; Louisville Railway Company, Louisville, Ky., three 625-h.p. purifiers; E. L. McClain Manufacturing Company, Greenfield, Ohio, 400-h.p. purifier and 350-h.p. heater; Danville Gas, Electric Light & Street Railway Company, Danville, Ill., 1000-h.p. purifier; South Dakota Hospital, Yankton, S. D., 200-h.p. purifier, 400-h.p. exhaust steam feed water heater; Jeffrey Manufacturing Company, Columbus, Ohio, 500-h.p. purifier and 500-h.p. heater.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received during the past few weeks a contract for building several new plants of considerable importance. Among these are the extensions to the plant of the Wheeler & Wilson Manufacturing Company, a warehouse building at Dutch Guiana, and a new furnace building at Perth Amboy, N. J., for the Raritan Copper Company. Among the foreign orders is one from the Council of Rangitikei County, New Zealand, for a highway bridge consisting of a single span of 204 ft., designed to carry a distributed load of 1500 lbs. per lineal foot. In transmitting this order the chairman of the Council said, "As far as I know, this is the first order of the kind ever sent to the United States, and the experiment is being watched by other local boards."

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, on June 14, in the United States Circuit Court, at Boston, Mass., secured a preliminary injunction against the Quincy & Boston Street Railway Company, restraining the latter from using and operating the elements of the Hatch storage battery installed at South Braintree, Mass., and used as an auxiliary to the trolley system. It is held that the Hatch battery infringes upon the Brush patents owned by the Electric Storage Battery Company, and which are fundamental patents underlying all forms of storage battery. This injunction becomes effective on August 1, as the railway company was given until that time to remove the infringing batteries. This is only one of four or more suits which are the outgrowth of that in which a preliminary injunction was granted against the Hatch Battery Company on May 5 last.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, is sending out a new catalogue, which will be found unusually complete. It describes the company's electric railway overhead line material and electrical supplies, and should be in the hands of every railway general manager. In addition to the well-known Creaghead type of insulators, mechanical ears, and other overhead supplies, all of which are fully illustrated in the catalogue, are notices and full descriptions of the Creaghead flexible and rigid brackets, trolley harps, wheels and poles, protected rail bonds, Garton lightning arresters, Weston electrical instruments, cut outs and switches, construction tools, and enclosed arc lamps. The company calls particular attention to the fact that the excellence of all its materials is the result of several years' experience in the construction of electric railways, and the devices described in the catalogue have been thoroughly tested. The catalogue will be sent on request.

HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., report the following recent sales of the Cochrane feed water heaters and purifiers: Haverhill (Mass.) Electric Company, 1000 h.p.; Alabama Steel & Wire Company, Ensley, Ala., 6000 h.p.; Ohio Steel Company, Youngstown, Ohio, 10,000 h.p.; Hoopes & Townsend, Philadelphia, 1000 h.p.; Barrett Manufacturing Company, Philadelphia, 450 h.p. special; American Steel Foundry Company, St. Louis, Mo., 850 h.p.; Telephone & Improvement Company, Sweetwater, Tenn., 100 h.p.; Detroit Reduction Company, Cripple Creek, Colo., 425 h.p.; E. Sutro & Son, Philadelphia, 150 h.p. special; Barnard & Leas Manufacturing Company, Moline, Ill., 100 h.p.; Dickson Manufacturing Company, Scranton, Pa., 200 h.p.; Mound Coffin Company, St. Louis, Mo., 200 h.p.; Munger Oil & Cotton Company, Mexia, Texas, 250 h.p.; Cocheco Manufacturing Company, Dover, N. H., two 250 h.p.; Vulcanite (N. J.) Portland Cement Company, 1000 h.p.; also the following recent sales of the Cochrane separators: Law Building, Chicago, Ill., two 5-in. vert.; James Clements & Son, Bay City, Mich., 8-in. and 3½-in.; Franklin Mining Company, Hancock, Mich., 14-in. and 6-in.; Carnegie Steel Company, Pittsburgh, three 16-in. and one 10-in.; Laughlin & Co., Ltd., Pittsburgh, six 5-in., five 10-in., one 7-in., one 4-in., two 6-in. and two 12-in.; Cambria Steel Company, Johnstown, Pa., two 12-in.; Cedar Rapids (Ia.) Electric Light & Power Company, 12-in.; Cunard Steamship Company, New York, 4-in. and 4½-in.; Haverhill (Mass.) Electric Company, 7-in.; American Blower Company, London, England, 4-in., and many others.

New Publications

Soft Coal Burning. By C. M. Higginson. Paper. 18 pages. Illustrated. Published by the "Railway Master Mechanic," Chicago.

This is the fifth edition of this pamphlet, and is a valuable treatise on the subject of soft coal, giving the relative economy of this fuel, and describing the best methods of burning it.

Verbatim Report of the Seventh Annual Meeting of the Pennsylvania Street Railway Association. Paper. 67 pages. Published by the association.

This is the report of the meeting held at Scranton, Pa., Oct. 19 to 20, 1898, and contains the papers read, the discussions upon same, the speeches at the banquet, copy of the constitution, and a list of the active members.

The Influence of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers. By Walter B. Snow. Paper. 22 pages. Illustrated. Reprinted from the "Columbian Engineer," of Columbia University, New York.

This is a lecture delivered by Mr. Snow, of the engineering staff of the B. F. Sturtevant Company, of Boston, before the Engineering Society, on Dec. 1, 1898. An abstract of the lecture will be found in the last issue of the STREET RAILWAY JOURNAL.

Duncan's Manual of Tramways, Omnibuses and Electric Railways. Cloth. 428 pages. Price, 3s. 6d. Published by T. G. Whiting & Sons, Ltd., London, England.

This is the twenty-second annual issue of Duncan's Manual, which has now come to be the recognized authority on financial statistics concerning the tramways of England and in the colonies which are owned by London capitalists. The manual is similar in typographical features to issues of previous years.

Derrah's Street Railway Guide. Compiled by Robert H. Derrah, of Boston. Paper. 210 pages. Illustrated. Price, 15 cents. Published by the compiler.

This is the fourth edition of this guide, and contains complete time tables, together with full information of all the street railway lines in Eastern Massachusetts. Everything that the tourist in this section might require is included in the book. A large inset map of the region covered is one of the features.

The Steam Engine Indicator (compiled from the regular issues of "Power"). Cloth, 208 pages. Illustrated. Price, $1.50. Published by the Power Publishing Company, New York.

Although there are a number of books on the construction and use of the indicator, we know of none which takes up the subject in a clearer or more systematic way than that whose title is given above. The valuable lessons on engine design and regulation which the indicator can teach are carefully explained, as well as the methods of computing the area of the diagram, mean effective pressure, steam consumption, etc. The book is fully illustrated.

L'Electricité en Amérique. By Marcel Delmas. Paper. 81 pages. Reprinted from "Le Genie Civil," Paris.

This pamphlet contains some notes on the application of electricity to industrial and railway purposes, gathered by M. Delmas during a recent visit to this country. The first chapter is devoted to electric traction, the installations described being the elevated roads of Chicago and (briefly) the surface systems of New York, Chicago, Buffalo and Boston, with an extended description of the subway in the latter city. M. Delmas attributes a large amount of the rapid development of industrial enterprises in this country (1) to the wider field that American engineers and manufacturers have as compared to any single country in Europe; (2) to the comparative freedom enjoyed from governmental restrictions; (3) to the greater absence of "red tape" in the conduct of their own affairs, and (4) to the quality of building apparatus and turning out work quickly, even if this sometimes involves a sacrifice of some minor economies.

The Commercial and Business Aspects of Municipal Electricity Supply. By Alfred H. Gibbings, Electrical Engineer to the City of Bradford, England. 270 pages. Illustrated. Price, 15s. Published by the author.

This book discusses many problems which arise in the commercial aspects of supplying electricity from central stations for lighting and power, and the means preferred by the author for dealing with them. They include methods of charging for electrical energy, the renting out of motors, whether lamps should be supplied by the company or by the user, street lighting, etc. Some very valuable tables are also given, showing the average amount of power required by the users of motors in small industries, of light, etc. Mr. Gibbings also gives a number of forms used by him in keeping his records, making charges, etc. The book should be extremely valuable to station managers on both sides of the water.

Municipal Monopolies. A collection of papers by modern economists and specialists. Edited by Edward W. Bemis, Ph. D., Professor of Economic Science in the Kansas State Agricultural College. Cloth. 691 pages. Price, $2. Published by Thomas Y. Crowell & Company, New York.

This recently issued book comprises a number of very interesting monographs on different kinds of municipal service enterprises, which are discussed by writers who are in more or less pronounced sympathy with an extension of municipal ownership over city monopolies, but the attempt has been made to treat the whole problem broadly and in full recognition of the difficulties involved in any suggested solution, and the result is the collection of a mass of information which is extremely valuable to the student of social economics. The subject of "Waterworks" is treated by M. N. Baker, of the "Engineering News;" "Municipal Electric Lighting," by Prof. John R. Commons, of Syracuse University; Prof. F. A. C. Perrine, of the engineering department of Leland Stanford University, and by Prof. Bemis; Max West, Ph. D., of the agricultural department at Washington, describes "Municipal Franchises in New York;" Prof. Frank Parsons, of the Boston School of Law and the Kansas State Agricultural College, treats of "The Telephone" and the "Legal Aspects of Monopoly," and Prof. Bemis discusses "Street Railways" and the problem of "Regulation of Ownership." The book is well worth to street railway and electric lighting managers its very moderate price, if only to obtain the point of view of the municipal ownership advocates.

Regelung der Motoren elektrischer Bahnen. By Dr. Gustav Rasch. Cloth. 140 pp. Illustrated. Price 8 marks. Published by Julius Springer, Berlin.

The "Control of Electric Car Motors" is the title of a new work by Dr. Gustav Rasch, of the Technische Hochschule of Karlsruhe, which forms the first volume of a series on electric railroads, and is the outcome of a course of lectures given by the author. This probably accounts for the fact that the subject is treated in a manner making the book suitable for a text-book, while its numerous mathematical demonstrations, including the use of calculus, will probably forbid its practical and universal introduction among the laymen. The book is thorough in its scope, and contains much valuable matter, which has to be dug out, however, and even after this is done the reader finds references to mathematics in the author's conclusions. The book is divided into eight chapters, dealing respectively with the following subjects: In Chapter I. the author discusses the various train resistances on straight and curved tracks, evolves formulæ for energy consumed on grades and returned on declines, acceleration, and shows how to determine the coefficient of traction. In Chapter II., the well-known e.m.f. and counter e.m.f. formulæ are attained, the various kinds of armature windings are discussed, as well as the questions of efficiency, losses, torque, effort at rim of wheel, the relative advantages and disadvantages of series and shunt motors at starting, speed and load. A general discourse on methods of control is given in Chapter III., and the author proceeds by first enumerating the various methods by which the speed may be altered, viz.: (1) by changing the counter e.m.f., and (2) by varying the magnetic field. The first-named presents two conditions, namely: a constant e.m.f. at the terminals of the motor, and an e.m.f. which may be varied, as in the case of accumulators. The constant e.m.f. can be varied by an external resistance or by connecting the motors together in various ways. The magnetic field may be changed by introducing a shunt resistance to the field, or by splitting up the field coils and connecting the sections to suit conditions. The author presents these various methods in a sort of "family tree fashion," which is highly commendable. In Chapter IV., the method of introducing an external resistance is discussed by curves, diagrams and formulæ. The author contends that the method is not applicable for varying the speed of motors employed for normal service, but is useful when the tractive effort and speed are not widely varying quantities. He further states that if one motor can exert the necessary effort it would be poor economy to subdivide that effort among two motors connected in parallel, unless a rise in speed is desired. As an example of this method, the Schuckert system is cited. Chapter V. is devoted to a discussion of the series-parallel method of control, showing the effect of one-half the e.m.f. on the speed, the starting torque and the use of four motors. He points out that the method is not practical when two motors are used, unless a resistance is inserted to aid in the control, as is the case in the Walker controller, which is described. In comparing this method with the one described in Chapter IV., the author states that the series-parallel method, permitting a great variation of speed, is applicable for city, city and suburban and suburban service, while the resistance method is only permissible for the first named. He devotes no space to accumulator traction, as the number of accumulator roads is continually on the decrease. The method of shunting the field coils is treated in Chapter VI., and this, the author states, permits a simpler controller construction than the series-parallel method. The former method, however, is only applicable where the traffic conditions are uniform or vary between very small limits, that is, for city or suburban service, and not for the combined. In Chapter VII. the method of connecting field sections in various ways is discussed, which simply implies a variation of the ampere turns in the field. This method is preferable to the shunt resistance method, where high speeds are employed, but the advantages of the one and the disadvantages of the other about balance each other. Electric braking forms the subject of the eighth and last chapter, and the author contends that for braking purposes series motors can be used as well as shunt motors. If, however, it is desired to win back some of the energy, the series motor cannot be employed, whereupon he discusses the question of winnig back the energy. This introduces the question of storage batteries where the method of electric braking has a distinct advantage. The author reaches the conclusion, however, that the advantages of returned energy are very frequently overrated.

Trade Catalogues

Advertising Designs. Published by the Trade Paper Advertising Agency, of New York.

Bulletins. Published by the General Electric Company, of Schenectady.

Catalogue. Published by B. F. Sturtevant Company, Boston, Mass. 53 pages. Illustrated.

Machine Tools. Published by E. W. Bliss Company, of Brooklyn, N. Y. 16 pages. Illustrated.

Various Catalogues. Published by the Westinghouse Electric Manufacturing Company, Pittsburgh, Pa.

General Catalogue. Published by the Central Electric Company, Chicago, Ill. 537 pages. Cloth. Illustrated.

Westinghouse Junior Engine. Published by the Westinghouse Machine Company, Pittsburgh, Pa. 35 pages. Illustrated.

Electric Railway Supplies. Published by the Creaghead Engineering Company, Cincinnati, Ohio. 85 pages. Illustrated.

Compressed Air Appliances. Published by the Christensen Engineering Company, Milwaukee, Wis. 16 pages. Illustrated.

Feed Water Heaters and Purifiers. Published by the Pittsburgh Feed Water Heater Company, Pittsburgh, Pa. 140 pages. Illustrated.