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STORAGE BATTERIES AS STATION AUXILIARIES IN PITTSBURGH

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Just before the first of the recent important consolidations of street railway interests in the city of Pittsburgh, which began by the organization of the Consolidated Traction Company in July, 1895, there were some thirteen independent systems, most of which were operated from their own power stations. Since that time there have been many extensions and improvements and some 30 miles of track has been changed from cable to electric traction. At present there are in the street railway system of Pittsburgh and Allegheny, exclusive of the inclined planes, 307 miles of track, all electric, while the number of companies has been reduced to nine. Of these the four most important are the Consolidated Traction Company, United Traction Company, Pittsburgh & Birmingham Traction Company and Pittsburgh & West End Passenger Railway Company.

Upon the completion of the consolidations already referred to, the Consolidated Traction Company found itself with seven power stations of which three were electric and four were cable, and the United Traction Company with four electric power stations. The stations of both of these companies had been built, of course, to serve the needs of separate sections of independent track so that after the several lines had become united the first problem became that of the proper rearrangement of the power generation for the most economical operation of the respective roads. This preliminary statement is necessary to a proper understanding of the subsequent steps taken by the managers of the two traction companies in altering their system of power production, one of the results of which has been the adoption of storage batteries as station auxiliaries.

In this the Consolidated Traction Company was the pioneer, its accumulator plants having been installed during June, 1896. Fig. 3 gives an outline map of the cities of Pittsburgh and Allegheny with the location of the present four power stations and of the two accumulator plants of this company. One of these, as will be seen, is at the Oakland station on the corner of Fifth Avenue and Atwood Street, while the other is about midway between the other three stations.

The rated output of the four generator stations, not including the batteries, is about as follows:

Allegheny station	1300 k. w.
Ben Venue station	2800 "
Forty-seventh street station . . .	500 "
Oakland station	800 "

The two battery plants have each a capacity of 500 ampere hours.

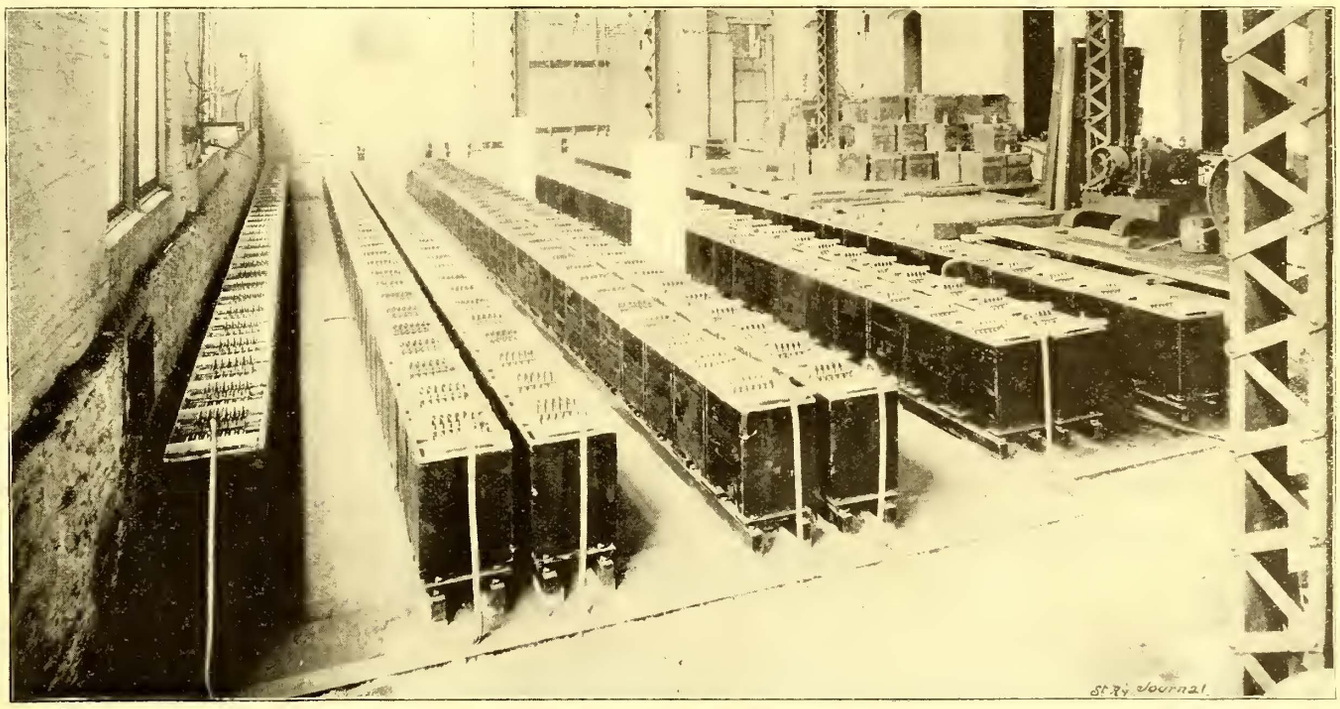


FIG. 1.—STORAGE BATTERY PLANT AT OAKLAND STATION—CONSOLIDATED TRACTION CO., PITTSBURGH

The type of storage battery used is that manufactured by the Electric Storage Battery Company for use in most of its installations, and consists of what is known as the "Manchester" positive plate and the "chloride" negative. The Manchester positive, which is a Planté positive, consists of a hard antimonious lead grid, with circular holes, about ⅞ in. diameter. Into these holes are forced by hydraulic pressure, coils of corrugated lead tape, which are machine made from the purest lead. This plate is formed electro-chemically, and the great surface of the corrugated coils receives a Planté formation, while the antimonious lead grid is unattacked by the process. For the initial formation, only from 3 per cent to 5 per cent of the lead ribbon is formed into a peroxide; the balance of it is available for further formations in the regular working of the battery, so that the life of the plate is very long. This can be understood from the fact that this initial formation

is held in the plate very much more firmly and securely, and with far less danger of falling out than was the active material in any of the old pasted forms of plates, which, after they had lost their active material, or a portion of it, also lost their capacity, while in the present form of "positive" the ribbon contains sufficient material that

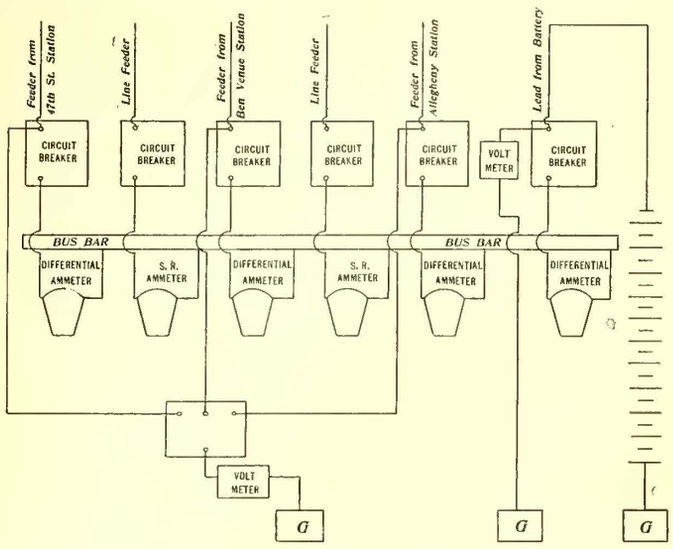


FIG. 2.—DIAGRAM OF SWITCHBOARD CONNECTIONS AT 34TH STREET STATION

can form into peroxide before breaking up, of from ten to fifteen times the extent of its initial formation. The negative plate is a regular chloride negative, which has been found much superior to any other form of negative plate. The process of manufacture produces a negative active material, which is of a perfectly porous crystalline structure, with the axes of the crystals perpendicular to the surface of the plate. The charge and discharge rate of this type of cell is very high, as compared with the older "pasted" form, the batteries being regularly rated to discharge their entire capacity in one hour's time, if needed.

The cells are connected in series, and at present 252 are in use at the Oakland station, and 244 at the Thirty-

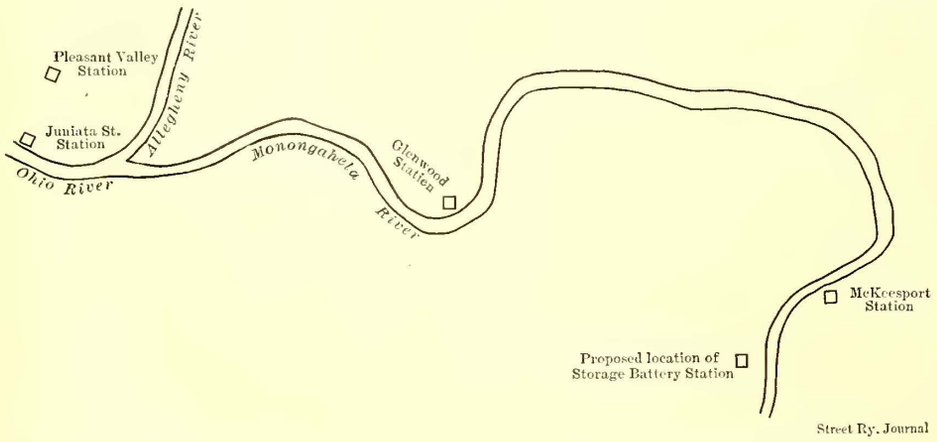


FIG. 4.—DIAGRAM SHOWING LOCATION OF STATIONS—UNITED TRACTION CO.

fourth Street station. The number to be placed in series is varied according to the voltage which the engineers wish to obtain at the different points. The Oakland station is an old cable station, and the batteries occupy the place formerly devoted to the tension run. The old cable engines are still in use. They are two in number, each driving one end of a shaft, but the main driving drums on this shaft have been replaced by an 800 k. w. generator, which is thus directly driven. The battery of 252 cells is connected in parallel across the bus bars, as would be the case with another generator, and are controlled directly on the switchboard by a separate generator panel, with circuit breaker, ammeter, voltmeter and quick-break switch. The ammeter is not of the ordinary type, but differential reading, with zero point in the center of the dial. It gives the flow of current in each direction, and during most of the day the indicator oscillates from one side of the scale to the other with the variation in load on the external circuit.

The second storage battery station, which is at the corner of Thirty-fourth Street and Penn Avenue, also occupies an old cable power station, which, however, does not contain any generating apparatus. The cells are also placed in the old tension room, and are connected to a

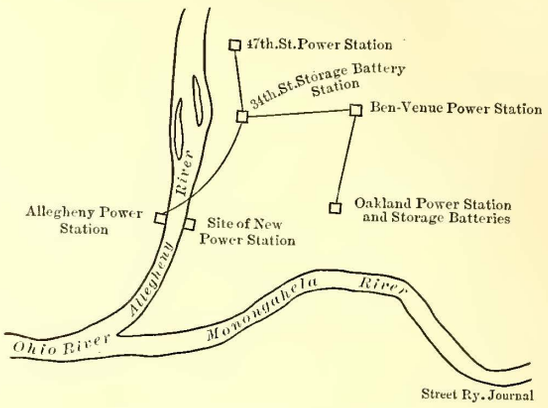


FIG. 3.—DIAGRAM SHOWING LOCATION OF STATIONS—CONSOLIDATED TRACTION CO.

switchboard, the bus bars of which are fed directly from the three other power stations of the company, as shown in Fig. 2. As will be seen, the power stations are thus connected directly to each other by feeders, as well as by the trolley circuit, a condition which while not impossible were no storage batteries in use, yet would require some care to prevent the reversal of some of the generators at a low potential station, and their operation as motors by the generators at the other stations. The batteries act as reservoirs and regulators, somewhat in the same way as standpipes in pumping stations act, to keep the pressure on the pumping engines constant. The switchboard connections at the Thirty-fourth Street station are given in Fig. 2, which shows six panels, three of which are feeder connections with other stations, one is a battery panel and the other two are ordinary line feeder panels. The first four are equipped with differential reading ammeters, and the line feeders with straight reading ammeters.

The quantity of charge in the battery can be readily determined by taking the specific gravity of the electrolyte in the cells by means of a hydrometer made for the purpose. The specific gravity of the cells rises with the storage of current, and in actual operation varies in readings on the scale from 1150—which indicates a low charge—to 1200, which shows a high charge. The individual voltage of the cells can also be determined on the switchboard by a special voltmeter, which can be connected to the terminals of ten of the cells, thus giving an idea of the condition of the other cells. In this connection it may be stated that the engineers of the company report that the maintenance of these batteries has been, as yet, nil. As they are not built for transportation on cars, they are substantial and contain plenty of lead; no buckling, or that old evil of storage batteries, the falling out of active material, is possible with them, and the only attention required by them during the six months during which they have been in operation has been the addition at occasional intervals of a small amount of distilled water to replace that lost by evaporation.

The flexibility in the manipulation of the power stations secured by the use of storage batteries is remark-

able. The engineers can adjust the total load between the different power stations as desired by changing the voltage. Thus, if any one station were carrying less load in proportion to its capacity than the other stations, the engineers at that station would cut out some field resistance, raising the voltage at that station, and throwing on it more of the mutual load, while relieving the other stations. This renders possible the shutting down of part of the equipment of a station for repairs during a heavy demand for current, by making the other stations carry part of the load of the station in which the repairs are being made.

Some of the results secured in economy since the introduction of the storage system are remarkable, and apply not only to the operating cost, but to the investment in station apparatus and feeders. It has been found, that the capacities of the stations has been increased greatly in excess of the added output of the batteries, so that while in the consolidation of the different systems three cable plants were abandoned, no additional generating apparatus has been installed, although the number of cars operated has been largely increased. This is attributed by the managers to the elimination in the loads of the momentary peaks, which really set a limit to the output of the generators. To illustrate this by a concrete example on the Consolidated Traction Company's system: a station containing an 800 k. w. generator in connection with a 500 ampere hour accumulator battery, has given an average output of 2000 amps. continuously at about 525 volts for twenty-four hours without destructive effects.

The actual economy in the $C^2 R$ loss maintaining the voltage constant is also large, and is not by any means confined to the feeders, and, as this loss increases with the square of the current, the total waste increases rapidly with the drop in voltage.

Induced largely by the successful results secured by the Consolidated Traction Company's lines, the United Traction Company, of Pittsburgh, has also determined to install a storage battery system. The conditions on this company's system are somewhat different from those on that of the Consolidated Traction Company, just discussed. The company has four stations, as follows:

Station.	Units.	Capacity.
Pleasant Valley	10	990 k. w.
Juniata Street.	3	1,100 "
McKeesport	1	165 "
Glenwood	8	2,530 "

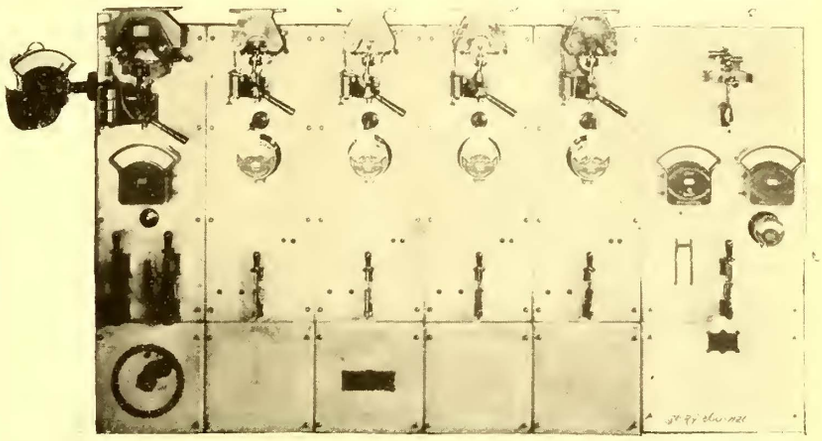


FIG. 5.—SWITCHBOARD AT 34TH STREET STATION

The locations of the company's stations are shown in Fig. 4. The company is proposing to abandon the McKeesport station and substitute for it a storage battery plant, which will be fed directly from the Glenwood station. The maintenance of the McKeesport station has cost the company on an average about $7200 per annum, most of which can be directly saved by the installation proposed.

The company will install at a point on the south side of the Monongahela River, opposite McKeesport, a battery station with a capacity of about 500 ampere hours. The battery will be housed in a building built for the purpose.

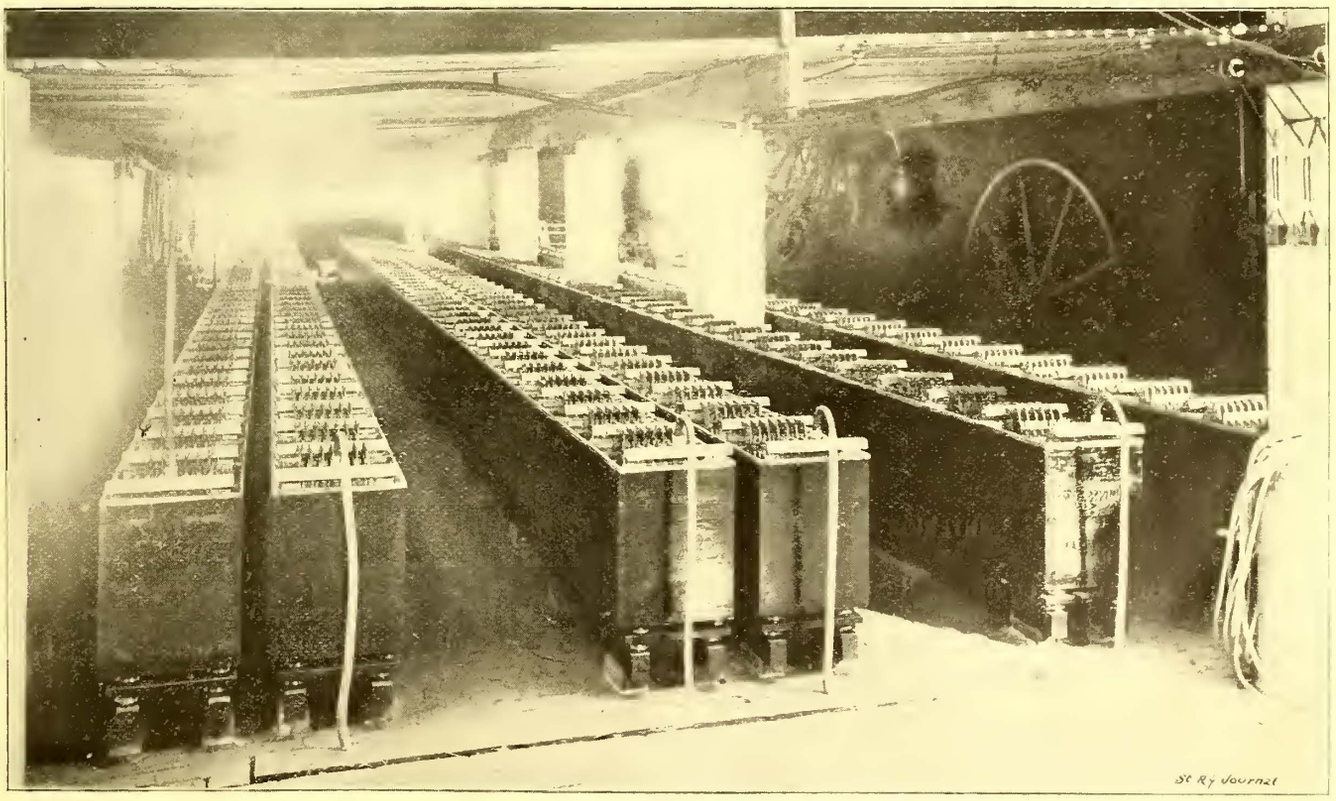


FIG. 6.—STORAGE BATTERIES AT 34TH STREET STATION

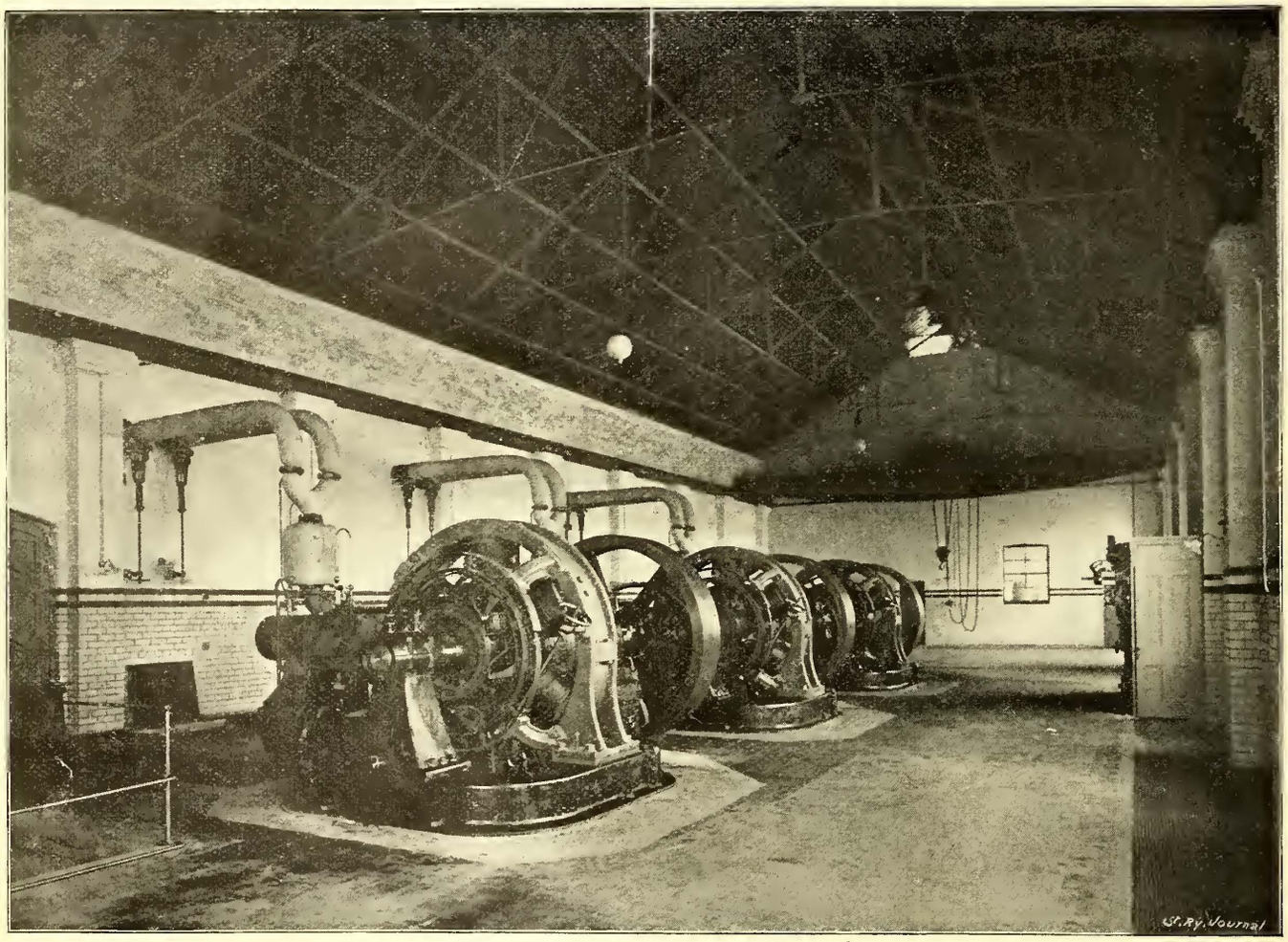
Electric Railways in Dublin

Some time ago electric traction was inaugurated in Dublin, Ireland, on the Dalkey section of the lines owned by the Dublin Tramways Company, Ltd. The results secured by the company were so favorable that arrangements were soon perfected by the managers for the equipment of their Clontarf section with the same motive power. The line, which has recently been electrically equipped, extends from the city boundary to Dollymount and serves a suburban district studded with residential villas of a superior class. The track throughout takes the line of the sea coast at the opposite side of Dublin Bay to that on which runs the Dalkey electric division of the company. At the Dollymount end of the line are situated the famous golf links of the Royal Dublin Golf Club which are largely patronized all the year round. The total length of the newly equipped line is slightly under 3 miles of double track, the gage being 5 ft. 3 ins., which is the Irish standard.

The power house, which is at the Dollymount end of the line is on a site previously used by the Tramways Company as stables and car houses, the buildings then existing being altered to suit the present requirements. It has been erected from plans supplied by the British Thomson-Houston Company, Ltd., the building works being carried out by R. O'Connor, of Dublin, under the direction of the Dublin Tramways Company's engineer.

The power house, including car and repair shops, covers a space of 166 ft. × 140 ft. It is divided into a boiler house, engine house, repair shop, offices and car house, the latter being capable of accommodating twenty-six motor cars. In the boiler house are three boilers of the Babcock & Wilcox type built in one and a half batteries. The main flue, which runs along the front of the boilers, is lined throughout with firebrick, and the gases can pass either directly through to the chimney, or by a bye-pass through the economizer to the chimney. The latter is of octagonal shape with inside diameter of 7 ft., and the height from the ground line is 112 ft. It has a firebrick lining from the floor level of the main flue, a distance of about 50 ft. Each boiler has a total heating surface of 2197 sq. ft. with a grate area of 44 sq. ft. The steam and water drums are of mild steel plates. There are two drums to each boiler, which are cross connected.

A Green's economizer of standard pattern and consisting of 160 tubes has also been erected in the boiler house. Water is supplied to the boilers by two direct acting horizontal Worthington steam pumps, each capable of delivering to the boilers 22,000 gals. of water per hour against the full working boiler pressure (150 lbs.). A cast iron water tank with a capacity of 10,000 gals. has also been erected in the boiler house, but in view of the possibility of the supply of water from the city mains not being sufficiently constant, a storage tank with a capacity of 38,000 gals. has been excavated on the company's land immediately adjoining the engine house.



INTERIOR OF CLONTARF POWER STATION—DUBLIN, IRELAND

The feedwater and steam piping is in duplicate throughout. The former is of cast iron, and so arranged that the supply can be taken from either water tank direct to the boilers, or through the economizer.

The steam main in duplicate is of lap welded steel pipes with cast steel flanges; from these branches are taken to the boilers and engines. The requisite number of valves are provided so that either main may be worked independently of the other. On each engine is a steam separator; this is placed immediately over the main engine stop valve.

The engines, three in number, are of the McIntosh & Seymour type. They are horizontal tandem compound and are directly coupled to six pole, 150 k. w., 500 volt, 200 r. p. m. British Thomson-Houston Company's generators

The cylinder dimensions of the engines are 11½ ins. and 23 ins. × 17 ins. Both cylinders are fitted with valves of the piston type of standard form and each valve is fitted with a patent adjustable seat for preventing leakage. The seat consists of two rings made in one piece and connected by several bridges across the port openings which the space between them forms. All engine bearings are lined with babbitt metal hammered in and bored out.

The generator armatures, which are drum wound, have special ventilating ducts, and highly laminated cores, the laminæ being individually dovetailed into the spider supported from the shaft and insulated from each other by means of high grade Japan coatings. The windings consist of interchangeable copper bars set into slots in the periphery of the core, insulated all over with layers of special paper and mica. The end connections of the armature windings are in one piece with the body of the winding and lie upon the circumference of the same cylinder. The inner surfaces of the end connections are protected by metal flanges from the spider extending laterally to support these end connections.

These generators are designed so as to deliver an overload of 25 per cent above their rating for two hours without heating; they are also capable of sustaining sudden fluctuations up to 50 per cent above their rating and down to zero without injurious sparking at the commutator and without shifting of the brushes. The switchboard is of the standard General Electric panel type. Besides the usual feeder and generator panels, there is also a total output panel, with Thomson recording wattmeter, and a leakage panel according to the Board of Trade requirements.

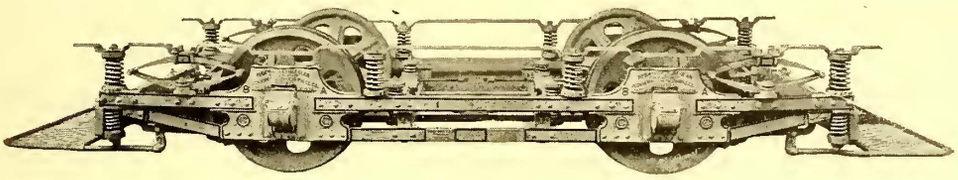


FIG. 3—STANDARD CANTILEVER EXTENSION TRUCK

The lights in the power house are supplied from a marine type generating set, consisting of a high speed vertical engine, coupled direct to a 4 pole, 10 k. w. generator running at 656 r. p. m., the lighting being by arc and incandescent lamps.

A Jessop & Appleby overhead traveling crane of 6 tons capacity runs the whole length of the engine house. The lifting and traversing gear are arranged so as to be worked by hand from the floor.

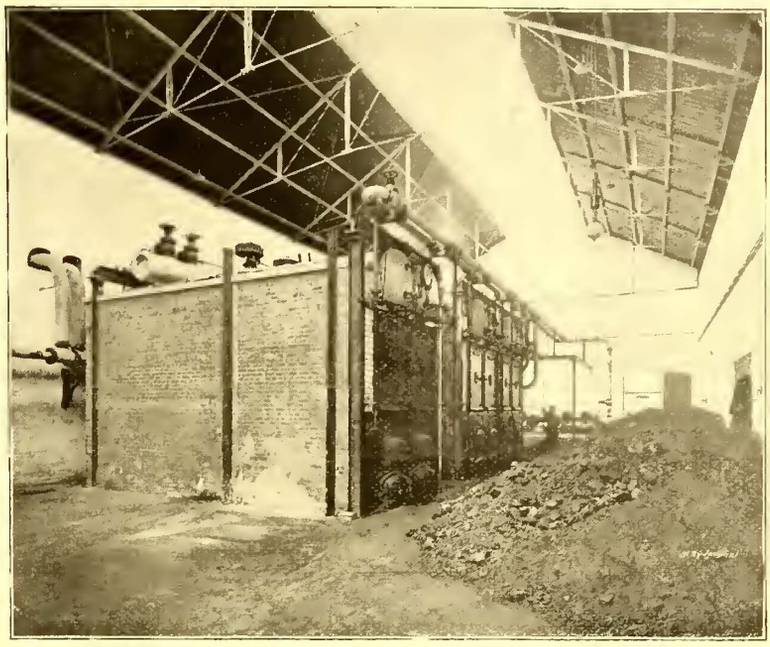


FIG. 2.—BOILER ROOM—DUBLIN

There are two main feeder cables looped at intervals into a switch pillar, each of which contains six quick break switches. These switches are so arranged that any section of the line or feeder may be cut out without interfering with any of the other sections. The switch pillar also contains a magnetic blow-out lightning arrester, which is connected to the trolley line.

The overhead line construction is of the span wire system throughout. The poles, which are 29 ft. 6 ins. in length, are in three sections of 5 in., 6 in. and 7 in. best quality tubular steel, made with overlapping joints shrunk together while hot. This type of pole has been specially designed to sustain the strains incidental to the

FIG. 4.—MAIN CAR HOUSE—CLONTARF

operation of an overhead trolley system while containing a minimum amount of steel. They are spaced at an average distance of 120 ft. The trolley wire is of No. 0. B. & S. gage, hard drawn copper wire, divided up into half mile sections.

The track, which has been relaid by the Dublin United Tramways Company with a 7 in. girder rail has been bonded with Chicago 30 in. No. 0000 bonds, and Brown plastic bonds, which have been adopted as standard for future extensions. It is also cross bonded at short intervals.

There are no grades or curves of any note throughout the entire length of line, and there is only one point where there is any variation in the height of the trolley wire over the track. This is where the track passes under a railway bridge and here the line is dropped from 21 ft. to 17 ft.

series parallel type, and embody the magnetic blow-out principle and an emergency stop switch, whereby the car can be very quickly stopped by connecting the motors, so that they become generators.

The motors are of the well known G. E. 800 type, and there are two motors on each truck.

Electric Railways of Cork

Cork is another city in Ireland which is soon to be electrified by the operation of trolley cars. The principal stockholders of the Cork Electric Tramways & Lighting Company, which will make the installation, are also largely interested in the railway system of Dublin, and the construction used in the latter place will be largely followed in the Cork installation. In addition, however, an equip-

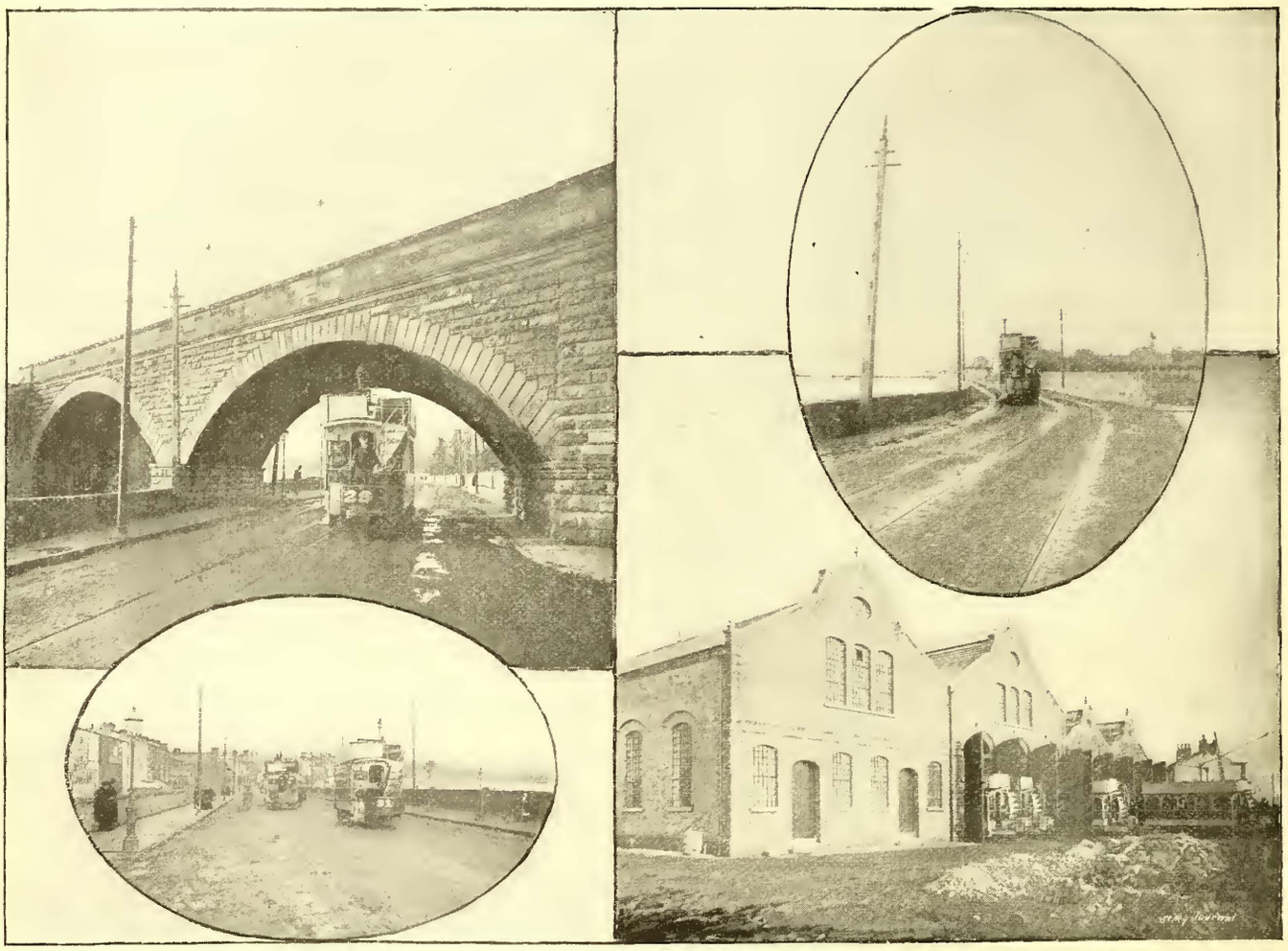


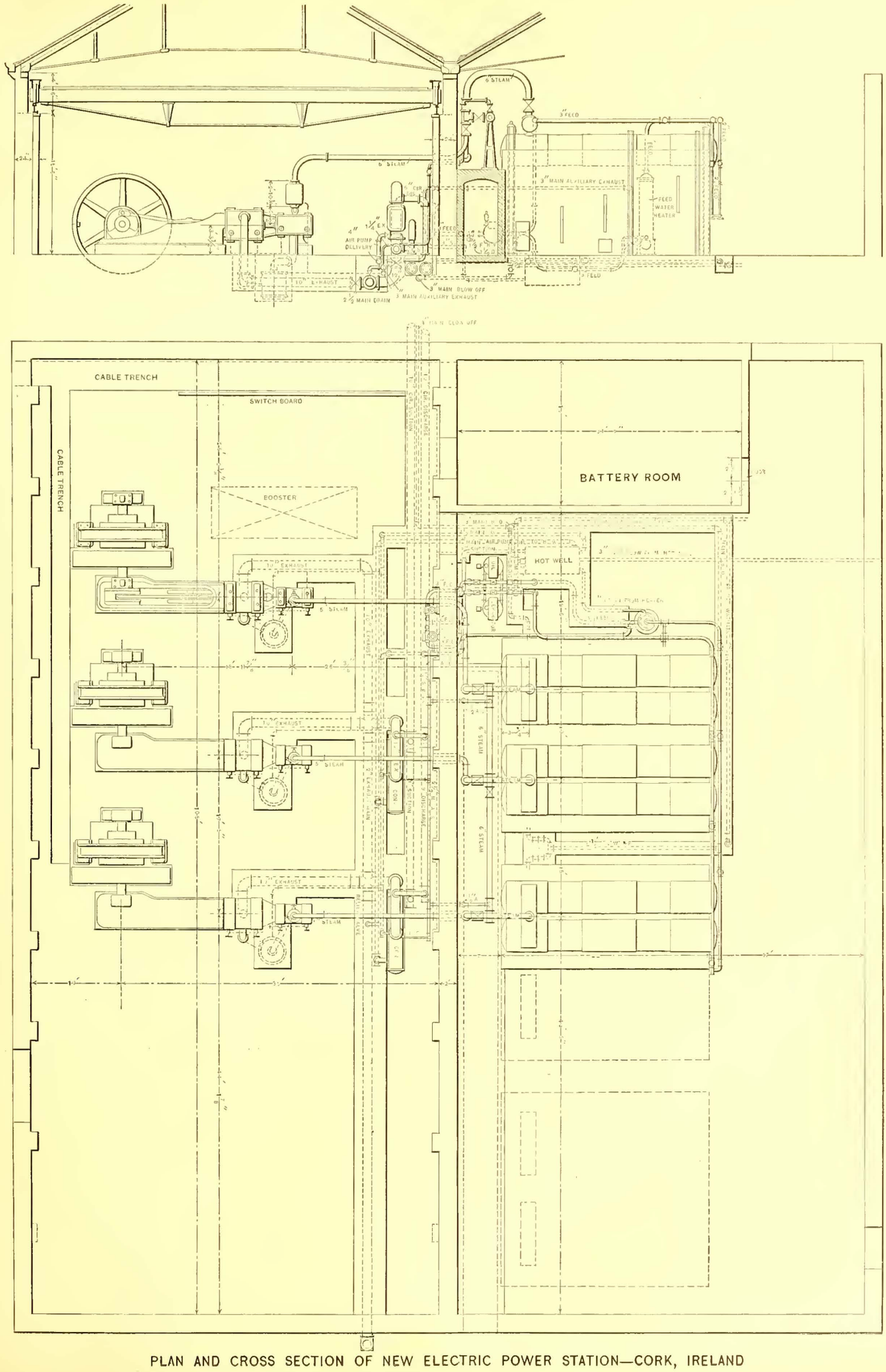
FIG. 5.—VIEWS ON CLONTARF LINE—DUBLIN

Fifteen motor cars have been equipped for this service. Twelve of the bodies were built by Milnes & Company, and the remaining three by the Dublin United Tramways Company. The cars accommodate fifty-four passengers, of whom twenty-five are carried inside, and are similar in most respects to those in operation on the Tramways Company's Dublin and Dalkey section. They are mounted on trucks of the Peckham Standard type, of which 150 have just been ordered by the company for future extensions. Each truck is also fitted at either end with an adjustable life and wheel guard, which can be adjusted to any desired height from the track.

The trolley pole and base are of the swiveling arm type, and the wheel is so mounted on a pivot as to prevent its catching in the span wire; it also has a special arrangement for bringing the wheel back into line should it come off the wire. The trolley pole is of light steel, insulated by means of braiding, the pole in its turn being insulated from the socket. The controllers are of the K2

ment of storage battery cells for equalizing the load on the generators will be used. Most of the contracts for the installation of this line were placed by the owners when in America last fall, and it is expected by them that the lines will be fully equipped and in working order for the summer traffic. The system of the Cork Electric Tramways & Lighting Company consists of about 11 miles of track, and will be installed by the British Thomson-Houston Company. The gage is 3 ft., which is the same as that of other lines running out of the city. The rails weigh about 83 lbs. per yard.

The station buildings will comprise an engine room, boiler room, battery room, car shed and repair shop, covering an area of about 12,000 sq. ft. The boiler room will contain three Babcock & Wilcox boilers, each of 2531 sq. ft. heating surface, and capable of evaporating 8000 lbs. of water per hour. There will also be an auxiliary heater, combined hot well and filter tank, and a duplicate set of Edmiston filters. The chimney stack will be of steel,



PLAN AND CROSS SECTION OF NEW ELECTRIC POWER STATION—CORK, IRELAND

self-supporting, with 7 ft. internal diameter, and 130 ft. high.

In the engine room there will be three McIntosh & Seymour side crank, tandem compound engines, directly connected to 200 k. w. generators, running at 150 r. p. m. The engines will be run condensing. Two Wheeler, admiralty type, standard surface condensers, each having a capacity of from 8000 to 12,000 lbs. steam per hour, will also be located on the engine room floor, together with the necessary compound feedwater pumps. The condensing water will be taken from the river at a point about 500 ft. distant.

The battery room will contain 256 Tudor cells, capable of discharging at 110 amps. for seven hours. A booster of suitable capacity will also be supplied for regulating the charge of the cells. The booster will be located in the engine room.

The switchboard will consist of a combination of lighting and railway panels. The same machines will be interchangeable in railway and lighting service, and the lighting distribution, using 220 volt lamps, will be on the three wire system at 440 volts across the outers. The battery and regulators will be connected to the neutral, so as to take care of any balancing current. The lighting day load will be taken from the railway generators by a motor generator consisting of a motor and two 220 volt generators on the same bedplate. The latter also act as regulators when a single 440 volt generator is supplying the lighting current direct.

There will be eighteen top seat cars, supplied by the Brush Electrical Engineering Company, seating forty-four passengers. The cars will be mounted upon Peckham Standard trucks with double G. E. motor equipments and series parallel controllers.

The line construction will consist of iron poles with brackets, side brackets being used for single track, and double brackets when center poles are used for double track. There will be ninety-four arc lamps mounted on the tops of the poles. Constant potential arc lamps will be used, connected to the underground network of lighting mains. The railway feeders will be of standard Callender construction.

Street Railroading in Mexico

The recent announcement that the Compañía de Ferrocarriles del Distrito Federal, the company operating the street railway system of the City of Mexico, is to install an electric system, will mark an epoch in the history of railroading in that city. The plans of the company are to equip immediately about 26 miles of track and about thirty-five motor cars. A power station will be erected at once, to be equipped with two 425 k. w. units. The president and general manager of the company is Thomas H. McLean, who was formerly general manager of the Citizens' Railway Company, of Indianapolis, and before that of the Broadway and Twenty-third Street lines in New York City. The accompanying financial statement will give an idea of the growth of the company's business during this period. The figures are given in Mexican currency.

	Gross Receipts			Net Earnings		
	1896	1897	Incre'se	1896	1897	Incre'se
January. .	$118,292	$120,041	$1,749	*$18,189*	$34,352	$16,163
February .	112,695	111,904	*791	*26,171*	26,554	383
March. . .	126,274	126,560	286	*33,298*	33,182	*116
April . . .	128,945	134,484	5,539	*41,403*	48,228	6,825
May. . . .	139,277	142,379	3,102	*46,922*	49,683	2,761
June . . .	127,608	140,286	12,678	*39,401*	50,242	10,841
July . . .	130,407	141,208	10,801	*35,507*	47,582	12,075
August . . .	135,488	142,408	6,920	*42,742*	46,889	4,149
September.	129,183	139,703	10,520	*34,100*	43,772	9,672
October. .	125,283	138,502	13,219	36,226	45,311	9,085
November .	126,698	139,458	12,760	38,952	50,306	11,354
December .	119,370	*144,000*	†*24,630*	31,595	*55,000*	*23,405*
Total . .	$1,519 520	$1,620,933	$101,413	$424,506	$531,101	$106,595

* Decrease. † Increase for first 21 days in December was $18,021. Note.—Figures in italics are estimated.

In the statement given the company has derived no benefit from the present low prices of grain and stores, as the contracts for those used in 1897 were made in 1896 when the prices of fodder were higher. The cost of operation will, however, be proportionately reduced in 1898.

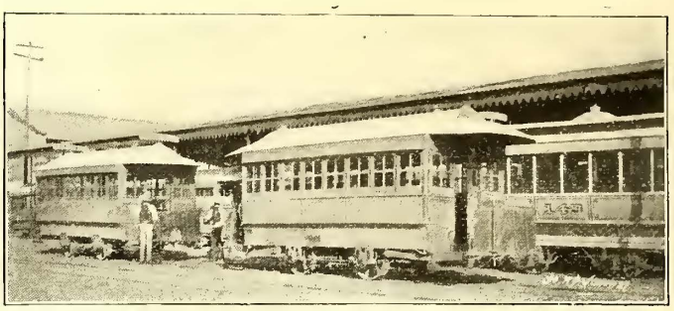


FIG. 1.—VIEW IN MAIN CAR HOUSE, MEXICO, SHOWING FIRST-CLASS PASSENGER CARS

From 1889 to 1895 inclusive, the company paid in dividends the sum of $2,057,410. In 1896 the company earned 6 per cent on the capitalization of $6,000,000.

The conditions of operation in the City of Mexico are in some respects quite different from those of any American city. Both first and second class cars are run. One of the former is shown in Fig. 1. It is one of thirty purchased from the West End Railway Company, of Boston, at the time that company gave up the use of horses, and 140 first class cars are owned by the company. Of second class cars the company has 120. The rates of fare permitted by the concessions of the company are 2 cents per kilometre for first class cars and 1 cent per kilometre for second class cars. First class cars are operated only on the lines exclusively within the city limits. The second class cars are run on the lines extending from the center to the suburbs. A view taken in the main car house of the company is also shown by Fig. 1.

FIG. 2.—MEXICAN FREIGHT CAR WITH LOAD OF HAY

The company does quite a large freight business, and 5 per cent of its gross receipts are from this source. One of the platform cars used in this service is shown in Fig. 2. It has a load of straw for the postas or stables. The company has 25 stables and 2800 mules.

Another source of considerable income is in the lease of funeral cars. All funerals, except those of the very poorest classes, are conducted on the tramways, and the company receives from $140 down for the rent of a car for carrying the casket and cars for the mourners. One used for the funeral of children and young women is shown in Fig. 3. The annual income to the company from this source is about $8000.

In this connection it might be stated that the average

wages paid to employes is as follows, all prices being given in silver:

Conductors	$1.00	per day
Drivers	.75	"
Carpenters, painters and blacksmiths	.83	"
Foreman of carpenter and paint shop	2.50	"
Foreman of machine shop	3.50	"

The improvements introduced by the present management have been mainly in the direction of placing the conductors in uniforms and requiring them to take out a bond

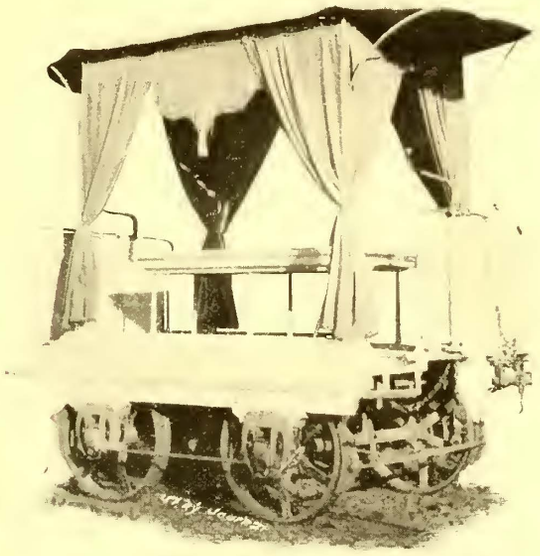


FIG. 3.—MEXICAN FUNERAL CAR

of $100 each with a surety company, introducing registers and attracting to the service a better and more reliable class of men. Much has also been accomplished in the economical purchase of supplies. The gross receipts have been increased principally by shortening the headway of the cars and by systematizing the routes run by them.

Electric Railway Motors

BY GEO. T. HANCHETT

V. Motor Suspensions

It is not possible to justly estimate the value of the various systems of suspension now in use, without considering the action of a loaded truck as it travels over a rough track. Inasmuch as many users of railway motors have not looked into this matter, other than superficially, this section is prefaced by a brief review of the action of a loaded truck.

Let us suppose that we have a single pair of wheels, around the axle of which is bolted a heavy cylindrical casting, such that the center of gravity of the system is practically the center of rotation. Place these wheels upon a track and set them in motion. So long as the track is level and there are no sudden depressions or elevations in its construction, the wheels will roll smoothly and steadily along it, but if a slight obstruction be encountered, either a depression between two rail ends, which are somewhat widely separated, or an elevation due to lack of exact alignment, the wheels thus loaded will jar heavily as they pass over the obstruction, and there will be between the track and the rim of the wheels at that point, an impact which is composed of two distinct actions. The first is that of ordinary impact. If a moving body meet an obstruction, the collision is sure to deface one or the other to a certain extent. The second effect is due to the fact that in striking an obstruction, the center of gravity of the revolving mass is suddenly lifted. If the speed of the wheels be anything like ordinary street car speed, the time in which this lifting takes place is almost instantaneous.

This will impart to the mass of the motor and car wheels an upward velocity, which combined with its weight will produce an enormous momentum. To take a hypothetical case, suppose that the dead weight of the wheels on the track is 1000 lbs., that the center of gravity is raised .1 in. and the obstruction is ½ in. in length, and that wheels are traveling at the rate of 10 miles an hour. These are easily possible conditions. Two rail ends may be out of line .1 in., although that is quite an excessive amount. Ten miles an hour is very common speed for car wheels, and it is quite probable that in this case the wheels would have to travel ½ in. before they could be fairly off one rail and on another. At 10 miles an hour the wheels would surmount the obstruction in .00284 second. This means that the center of gravity of a weight of 1000 lbs. would be lifted upward at least .1 in. in that time, and its velocity upward would therefore be approximately 3 ft. per second, and it would have a momentum of 93.2, which would be equal to that of a weight of 30 lbs. traveling at 100 ft. per second.

We may take this momentum as an approximate measure of the defacing forces of impact on the rail joint and car wheel, and without attempting to discuss its value in an accurate quantitative manner, the case can be forcibly represented by the following conception: if a man can strike a blow with a 30 lb. sledge, such that the head would have a velocity of 100 ft. per second at the moment of impact, it is evident that a series of such blows would rapidly deface the strongest rail joint that was ever built. It does not require an engineer to see that he may expect a precisely similar effect in case of a heavily loaded car wheel, under such conditions as have been outlined in the preceding paragraphs; and that the facts bear out the theory, every railroad man knows.

To minimize this pounding action of car wheels over rail joints, we must arrange the weights that rest directly upon the car wheels, or are rigidly coupled thereto, in such a way that when the wheels are lifted, due to meeting any obstruction, the center of gravity of the rigid system shall be raised the least possible amount. To put these directions in more practical diction, we must have less dead weight on the car axle.

The gearless motor, which is largely a future development commercially, involves this problem to a serious extent, but inasmuch as present street railway traction is confined entirely to single reduction motors, the greatest interest attaches to their methods of suspension.

It is evident that there must be a rigid connection of some kind between the motor and the car axle, for otherwise the gears will not keep in mesh. The distance between the centers of the gear and pinion must be a constant quantity. The simplest and most used device is to cast an axle bearing directly on the upper or lower half of the motor casing, thus rigidly connecting the motor with the car axle. Such a case is illustrated in diagram in Fig. 1.

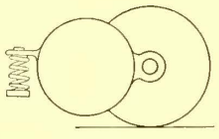


FIG. 1

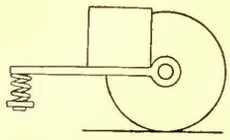


FIG. 2

The motor should be so designed that its center of gravity should be as far from the car axle as possible, for this will carry the center of gravity of the entire system in the same direction. The diagrams in Fig. 2 and 3 illustrate this principle. It is obvious that in Fig. 2 the center of gravity of the system is raised higher at the instant when an obstruction is met than in the case of Fig. 3, and as the blow on the rail joint is practically proportional to this lift, a gain of a mere fraction of an inch may represents hundreds of pounds in the reduction of the impact blow; therefore when considering suspensions of this type, the buyer of motors should look favorably on those which have axle bearing brackets at considerable

distance from the armature shaft, always providing that the wheel base of his trucks will permit him to use such a motor.

The weight of the wheels themselves, of the axle bearings, and of the gear is inevitable, but much can be done to mitigate the weight of the motor. If we can suspend the motor from the truck exactly at its center of

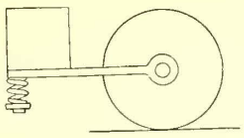


FIG. 3

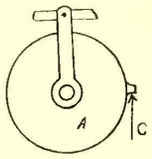


FIG. 4

gravity, we shall have a system in which there is no dead weight on the axle, provided that the motor is not doing any work—a condition to be discussed presently. Consulting Fig. 4, this principle may be more clearly understood. If we have a mass, *A*, supported at its center of gravity, and an impact, *C*, drives that portion of the mass upward as shown, the center of gravity of the mass will not be raised at all. The body will simply turn upon its center of gravity as an axis. Inertia has to be overcome to do even this, but the force which is expended is not nearly so great as in the case where the center of gravity of the system is lifted.

This condition has been approximately realized by two well known suspensions, used by the General Electric and Westinghouse Companies respectively. These are known as side bar suspensions.

In the General Electric adaptation of this principle, which is shown in diagram in Fig. 5, two bars of suitable shape pass on either side of the motor, and are suspended by their ends to the truck frame. The bars pass downward and below the center of gravity, and are attached to the motor by cylindrical lugs, and are supported as shown. The result of this is to actually lower the center of gravity of the motor when the wheels are suddenly raised. The condition is one of unstable equilibrium, the motor being balanced as it were on the lugs. This should be a most excellent arrangement, for the weight of the motor tends to assist the car wheels to rise instead of impeding them.

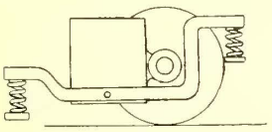


FIG. 5

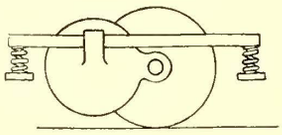


FIG. 6

Nevertheless to move the mass of the motor in any way requires that inertia be overcome.

The Westinghouse adaptation of side bar suspension (see Fig. 6) is somewhat different, the motor being suspended from above its center of gravity rather than below it. The equilibrium of the motor on its suspension is a stable one and requires a certain force to displace it, which force is expended on it by the car wheels when they are driven upwards. The side bars pass through straps, which are cast in the side of the motor frame as shown in the figure, and the point of support is very near the center of gravity, so that when the car wheels strike an obstruction, the latter point is only very slightly raised.

Following out this reasoning it would appear that supporting the entire system by its center of gravity, would result in an easier riding suspension than any heretofore constructed on this principle. Such an arrangement is shown in Fig. 7, and it will be seen at once that the weight of the motor counterbalances the weight of the car wheel and axle, and should make it very much easier for an obstruction to force the car wheels upward, resulting in a largely reduced blow on the rail joints. From a practical point of view, this suspension seems to be very feasible, yet no one has, as far as the writer is aware, attempted anything of the kind.

The latest adaptation of the side bar suspension of the Westinghouse motor has created considerable criticism among engineers, because at first sight it appears analogous to the case of lifting oneself over the fence by the boot straps. One end of each side bar is supported in lugs, cast on to the motor frame itself, and projecting beyond the car axle. About half of the weight of the motor appears to ride on the axle, and indeed this is the case as long as the motor rides over a smooth roadbed. If, however, the wheels meet an obstruction and are driven upwards, the motor tends to turn about its center of gravity, rather than to lift it. This suspension is shown in Fig. 8.

A modification of this suspension, known as the cradle suspension, has been used in some cases. This consists in simply bending the side bars around to form a U, and suspending from a point, as shown in Fig. 9. It is really a combined side bar and nose suspension, the latter being a cant name for the ordinary method for suspending railway motors by a spring supported lug or nose cast on to the motor frame as shown in Fig. 1. This latter suspension has been slightly modified into what is known as the yoke suspension, in which a crossbar is rigidly bolted on to seats cast on the motor casing, and the ends of these bars are spring supported on the truck frame.

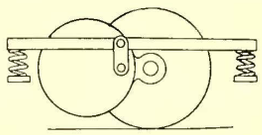


FIG. 7

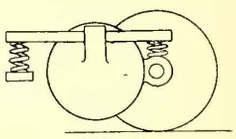


FIG 8

A new suspension has been recently placed upon the market by the Walker Company, of Cleveland, O., and it involved several features, which certainly appear to make it a valuable method, and practically it has seemed to bear out the claims. The gears are kept in mesh by two space bars, which rigidly connect the axle and armature bearings, but allow the mass of the motor to move freely up and down. These space bars are cast on the ends of a split tube or sleeve, which surrounds the car axle, and the motor itself is free to turn in the bearings provided for that purpose in the ends of the space bars. The result of this is that when the car wheels are suddenly forced upwards, the center of gravity is neither raised nor does the motor revolve upon it, but remains perfectly stationary, the force of the upwardly driven axle being gently arrested by springs which connect with lugs cast on the top of the motor casing. The principle of this suspension is depicted in Fig. 10.

There are, however, other considerations in a suspension than those of the riding of the motor as a dead weight. The motor is the driving factor, and when its armature is driven in one direction, its casing tends to be driven in the opposite direction, and this tendency to turn is resisted by the suspension.

For instance, considering the simple nose suspension as shown in Fig. 1, if the truck be driven to the left, the motor will tend to climb up the gear on the car axle and raise its mass as a whole; indeed unless

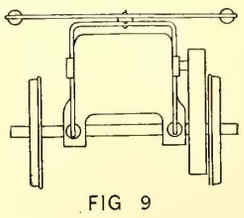


FIG 9

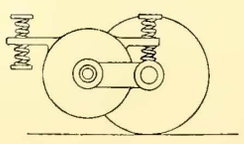


FIG. 10

this action is resisted in some substantial way, the motor is likely to strike against the car floor. Unless this tendency be resisted by a spring on the upper side of the lug or nose, the result will be that the jerks and strains of the motor will be rigidly directed on the truck frame and the gears. If the car be moved in the reverse direction, that

is to the right, the motor tends to climb downward on the gear, adding to the pressure on both car axle and suspension cross bar, but the suspension springs provided for supporting the motor should also absorb such jars as may be communicated in this way. Nevertheless when driven in this direction, the motor rides more rigidly than when driven in the other, for the suspension springs are more strained and less elastic.

The Walker motor suspension is said to meet the strains imposed upon it by the motor itself, and yieldingly absorb them by its springs. The motor casing is free to turn in the suspension arms, were it not for the springs. No matter in what direction it is attempted to turn the motor as a whole, such action is checked by spring cushions. The primary reaction of the motor is to revolve the casing in the opposite direction from the revolution of the armature, and this tendency being thus met, much jar and strain on the gear teeth is said to be absorbed. The Walker suspension is somewhat heavier than that of its competitors, and occupies more space on the car axle, but in sizes up to 50 h. p. it has been produced without seriously adding to the weight of the equipment.

We therefore have two principal desiderata in motor suspension. The first and most important is that a sudden upward thrust on the car wheels shall move as little weight as possible, either by directly lifting its center of gravity or causing a rotation about that point, for even the latter action requires that inertia be overcome. The second requirement is that the tendency of the motor case to revolve, should be stayed by spring cushions, for if it is rigidly arrested, the gears will suffer and the motor will ride with great vibration. In all moving vehicles the spring suspension should be as close to the point of shock as possible, in order that the jar transmitted to the vehicle be absorbed without moving any large mass.

One of the most beautiful practical illustrations of this principle is the pneumatic tire. Vehicles thus equipped can ride with comparative ease over the roughest roadbeds, simply because the minute vibrations are all absorbed before they can be transmitted to the axle of the vehicle. Pneumatic tires, of course, cannot be employed on electric railway cars, and we must approach the condition as nearly as possible by making the weight of the member which receives the vibrations rigidly, namely, the car axle, and all parts of the equipment that ride rigidly thereon, a minimum.

Life of Gears, Pinions and Trolley Wheels in Pittsburgh

John Murphy, general manager of the United Traction Company, of Pittsburgh reports the average life of motor gears on his line as two years, and the average life of pinions, nine months. He is employing the gears and pinions of the Simonds Manufacturing Company.

The service is an exceedingly severe one on account of the many grades on the line.

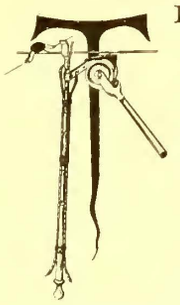
The average life of trolley wheels is 1000 miles, and the conditions under which they operate are quite severe, as the company has on its main line eighteen railroad crossings. A tempered copper wheel is employed.

Wheel Records in Pittsburgh

The United Traction Company, of Pittsburgh, reports the average life of its wheels to be 35,000 miles, and estimates that about one-third of this life is secured by prompt grinding of the wheels when flat spots are developed. The Consolidated Traction Company of the same city buys its wheels on a mileage basis, the manufacturers guaranteeing a life of 30,000 miles for each wheel, replacing those which have a shorter life and obtaining credit for those which have a longer life. Both companies use the Murphy wheel grinder.

Cutting down the Cost of Electrical Repairs of Railway Motors

By M. R. McADOO



THE feature in the reduction of operating expenses, in maintenance of electric railway motors, consists of carefully examining into the various items into which this expense is divided, and by analysis selecting those costs which appear excessive and determining the reason for them.

There is one item that is entirely too large with the majority of roads which have come under my notice, and that is the cost of electrical repairs to car equipments; and that on most roads they are greatly in excess of what they should be, my investigations have proved beyond a doubt. That the electric portions of the equipment show a very much greater cost of maintenance than the mechanical, is the usual case, and we do not have to go far to ascertain the reason for this difference.

The mechanical wear and adjustments are evident on visual inspection, while the electrical troubles and depreciation are only evident under the usual method of visual inspection, after they have crippled or injured the usefulness of the equipment, and no system of maintenance can be carried on intelligently and economically with such visual inspection. It only requires the forcing of the equipments, such as the holiday or special traffic conditions, to fill the repair shop full of cripples, which illustrates too plainly that there are many weak spots latent in the equipments, only requiring an overload to develop into a fault. A system must be applied whereby the electrical faults or weaknesses are indicated to the inspector as clearly as the mechanical, in order to maintain these equipments in good electrical condition, rather than in a condition of continual electrical repairs and electrical breakdowns.

To devise such a system, Albert B. Herrick, a member of the firm of Herrick & Burke, a thoroughly practical electrical engineer, was called in by us to inaugurate a method of simple electrical tests which would indicate completely the electrical troubles or weaknesses. He was so successful in this undertaking, and his system proved so simple and direct in its operation, that it had the immediate effect of a large saving in electrical repairs, and we have been able to maintain our equipments electrically by preventative measures, and have reduced electrical breakdowns to a minimum; in fact we have been able to get a much longer life out of our equipments, and greatly decrease the expense under which we were operating. The following technical description of the methods was furnished me by Mr. Herrick.

This system comprehends the following determinations:

The measurements given in capitals can be made without making any disconnection or disassembling the equipment, except removing the cover of the controller and the ground connections.

Wiring.

1. In new equipments, whether the car is correctly wired.
2. POOR CONNECTIONS IN CAR WIRING AND WHERE?
3. OPEN CIRCUIT, AND WHERE?
4. GROUND ON WIRING SYSTEM, AND WHERE?

Controllers.

5. IMPROPER CONNECTION OF CONTROLLER, AND WHERE?
6. POOR CONTACT, AND ON WHICH POINT?
7. Short circuit, and between which two contacts?
8. Poor connections to leads.
9. Whether the buttons make contacts at correct points on controller face.
10. Ground in controller, and where?

Rheostats.

11. ARE THEY PROPERLY CONNECTED IN?
12. ARE THEY STANDARD RESISTANCE ON EACH STEP?

13. ARE THEY GROUNDED, AND ON WHICH STEP?
14. TEMPERATURE OF THE RIIEOSTAT.
15. OPEN CIRCUIT, AND WHERE?
16. WHETHER THE PROPER RHEOSTAT IS USED FOR THE EQUIPMENT.

Motor Fields.

17. WHETHER THE FIELDS ARE PROPERLY CONNECTED.
18. WHETHER THE FIELD HAS BROKEN DOWN.
19. WHETHER THE INSULATION IS POOR BETWEEN THE FIELD AND GROUND, AND WHICH FIELD?
20. WHETHER THEY ARE THE PROPER FIELD COILS FOR THE EQUIPMENT.
21. What is their temperature?
22. Whether they have the proper number of turns.
23. Whether they have the proper resistance.
24. Whether the connectors are making good connections between field terminals.

Shunt Field.

25. WHETHER THIS IS CONNECTED AROUND THE FIELDS.
26. Its resistance.
27. Whether the two shunts are carrying equal loads or equally shunting both motors.

Armature.

28. INSULATION TO GROUND.
29. BRUSHES MAKING CONTACT WITH COMMUTATORS.
30. WHETHER ARMATURE STRIKES POLE PIECES.
31. Whether there are leaks or crosses between armature coils.
32. Whether there are poorly insulated or short circuited armature coils, and which?
33. Whether the armature is properly connected.
34. Whether the coils are properly soldered to commutators.

Complete Motor Test.

35. WHAT IS THE TEMPERATURE OF THE MOTOR?
36. WHETHER TWO MOTORS ARE EQUALIZED.
37. WHETHER THE MOTOR HAS BEEN PROPERLY HANDLED BY THE MOTORMAN.

As stated above, all the tests in capitals can be made without dismantling the equipment, and the system is so arranged that any of the above faults can be detected when the inspector makes three inspection tests; the first is made when the controller is on the first point; the second, when the controller is on the series step on the series parallel controller, or on the parallel step where rheostat is used; for the third test, the ground connection is then removed and the insulation of the equipment is taken. These three measurements, if they are standard, prove the equipment to be in good electrical condition. If there is any tendency to a breakdown, one of the above three tests will show that there is trouble.

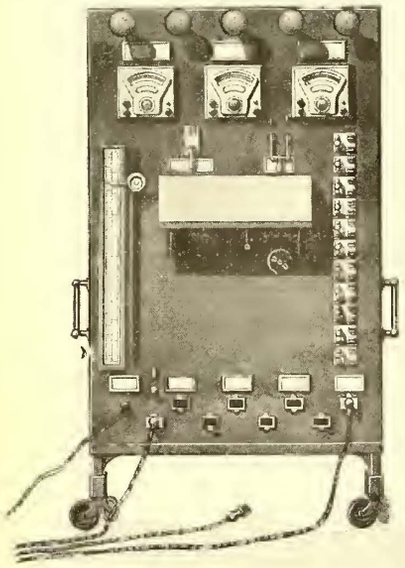


FIG 1.—TESTING BOARD

A detail test, occupying not more than five minutes, will then have to be made to locate the point or points where the troubles exist. For these tests, neither a bridge method nor the drop method were found to be applicable in practice, as the lower e. m. f., under which a bridge is used, may make a carbon brush contact or a bad controller point appear as an open circuit, whereas, if higher potentials are used, this will break down to a metallic circuit. The drop method requires that both the voltmeter and ammeter be read, and also requires the use of mathematics to figure the resistance, and as the current value changes at every step of the controller, it makes this method too tedious to be applied even for the three inspector's tests, and as the drop test is usually applied, the contact resistance is also measured, which seriously interferes with the accurate measurement of low resistance.

This testing system comprises a variety of different methods, each having been adopted after long practice, and those selected are the ones which gave the most satisfactory results.

The operation of the system is very simple. The meter on the left in Fig. 1, is the instrument which has to be kept at zero by means of the regulator with scale in front for every position of the controller, and when this meter hand stands at zero, the pointer indicates the position on the scale which corresponds to the actual measurement. It can be immediately determined visually, whether this is the proper position for the pointer, with the controller in the position measured. If there be any divergence, either above or below, the standard position, there must be something deranged in the equipment. The method used in the inspection test is to substitute a resistance equal to that cut out in the motor, which will bring the meter hand to zero again.

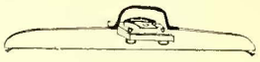


FIG. 2.—BOND TESTING SET.

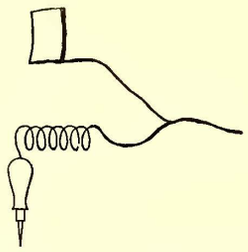


FIG. 4.—GROUND PLATE AND PLUG

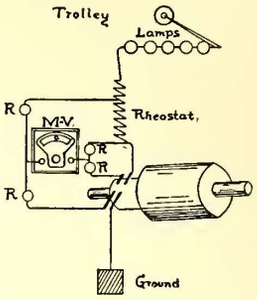


FIG. 3.—CONNECTIONS FOR ARMATURE TEST

The diagram (Fig. 3) shows the connections that are made when the plugs are inserted in the receptacles provided for armature testing. These receptacles are shown on the lower part of testing switchboard (Fig. 1). It will be seen from the connections that the Thomson method is used for this test. The current is carried through both the resistance rheostat and the armature, and a drop is taken from this rheostat, such that will balance the drop through the armature. In this way the variations in current will not affect the measurements, only the sensibility of the instrument.

If the armature is symmetrically connected, on rotating it the drop will be the same, or the millivoltmeter will stand at zero for every position of the commutator. The measuring contacts are usually set five bars apart, and a difference of .0001 ohm can be readily detected. The resistances, R, R, R, R, are so proportioned that the resistance of the leads are equalized out, and the drop measurements are not influenced by any contact resistances. A poor connection to the segment of any lead, or low resistance of any section of the armature or a connection between any two commutator bars, can be immediately located when this section of the armature passes between the measuring contacts on the commutator.

Selecting a few cases, for example; suppose an equipment came in provided with two General Electric 800 motors, and K2 controller; the operation is to put the trolley in the hook of the measuring pole, and the fork of the measuring pole under the trolley. This inserts the inspecting apparatus in series with the car. Suppose that instead of the pointer registering with the proper point when the controller is on the first notch, the pointer should be carried considerably above this; this will indicate that the current passing through the equipment with line voltage, is below normal, and consequently the total resistance of the car equipment at this point is too high. This may be caused by the temperature of the equipment. If this departure from the fixed point of this equipment on the scale is within the limiting temperature mark, these differ-

ences in measurement will be due only to differences between a hot and a cold equipment, but if the pointer should be beyond the limiting temperature mark, the second inspector's test will show whether this is due to excessive temperature in the motor and rheostat, or an abnormal resistance of either one. The second test is to place the series parallel controller on the last series notch, or rheostat controller on the last point of the rheostat. If the difference remains the same between the standard mark and the point at which the balance meter is again balanced for this point on the controller the increase is

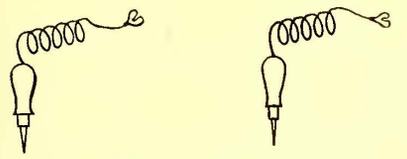


FIG. 5.—PLUGS FOR DROP TEST

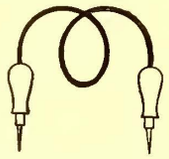


FIG. 6.—PLUGS FOR LOOP TEST

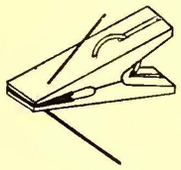


FIG. 7.—CLAMPS FOR FIELD TEST

FIG. 8.—ARMATURE CONTACT DEVICE

wholly in the motor. If the pointer is at the standard mark, the trouble is wholly in the rheostat or its connections, but if it is uniform temperature of the equipment the pointer will stand at a mark corresponding to that first determined, and this proves that the temperature of the whole equipment has been raised, due to overloading or improper handling of the controller.

By keeping a record of the motormen who bring in the equipments, and of the temperature indications from these inspections, those who do not properly handle their motors can be discovered and receive the proper instructions, in order to reduce the temperature of their equipments, as a high temperature is fatal to their insulation and maintenance. The third inspector's test is the insulation test of the equipment, and is made by removing the ground connections from both motors. The scale on the instrument at the right in Fig. 1 will show the insulation in megohms.

ELECTRICAL CAR INSPECTION.

Car No..... .....Truck..... ....

Controller.....

Condition of.....

No. of Controller.....Motor No. 1.....No. of.....Motor No. 2

No. of..... .....Armature..... ...No. of.....Armature...

TEST No. 1	SCALE	REMARKS
" No. 1 Step.....	.....	.....
" No. 2 Step.....	.....	.....
" No. 3 Step.....	.....	.....
" No. 4 Step.....	.....	.....
" No. 5 Step.....	.....	.....
" No. 6 Step.....	.....	.....
" No. 7 Step.....	.....	.....
" No. 8 Step.....	.....	.....
" No. 9 Step.....	.....	.....
" No. 10 Step.....	.....	.....

Insulation Test to Ground.....Volts..... ..... Line Volts.....

Special Test..... .....Field No. 1.....Field No. 2 .....

No. 3..... .....No. 4.....

Armature Resistance between Brushes.....

Temperature of Motor from Scale ....

The detail test for determining any fault is simply and logically made, and the trouble located without a doubt. By the use of a regular system for carrying out these inspections, anybody competent to make a mechanical inspection after instruction is equally competent to make an electrical inspection which will give complete electrical conditions of the equipments, so that they can be maintained in perfect condition.

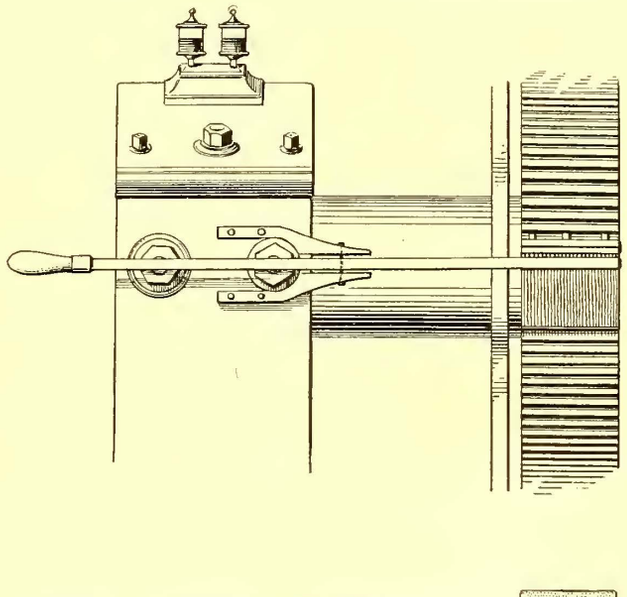
The accompanying table shows the inspector's report for a complete car test. This system can be applied to any car equipment, and the testing board can be either stationary or portable; a double trolley wire can be used throughout the car house where the board is stationary, and the trolley wheel of each car to be tested can be transferred to this testing trolley.

Fig. 4 shows ground plate with transfer ground plug for tracing an open circuit, and Fig. 5 shows the testing plugs for detecting poor fields and bad coils in armatures while in motor. Fig. 6 is the plugs for loop contact test for equalizing motors and measuring any part of the equipment independently. Fig. 7 is a clamp to be used in armature winding department for testing completed field coils, and Fig. 8 is a contact device used in armature room for detecting faults, grounds, crossses, or a misconnection, or a poor connection to the commutator.

Method of Sand Papering Generator Commutators.

A novel appliance for sand papering the commutators of generators has been devised by J. D. Lynch, chief engineer of the power station of the Hestonville, Mantua & Fairmount Passenger Railway Company, of Philadelphia, and is used in that station. It is designed to avoid the necessity of holding by hand a piece of sand paper against the commutator, a very tiresome operation.

The device consists of a bracket of wrought iron 3/8 in. thick, held against the pillow block of the engine by four lag screws. Inside this bracket a long iron bar with forged lever and slot running almost its entire length is held by means of a bolt. The sand paper is fastened to a



PLAN AND ELEVATION OF DEVICE FOR SAND PAPERING COMMUTATORS

wooden block at the end of this bar. The method of holding the bar in the bracket keeps the sand paper in a plane at right angles to the diameter of the commutator, so that the surface of the latter will always be flat. At the same time the pressure can easily be regulated by the handle. The commutators in this station run very smoothly and without sparking, and evince great care on the part of the engineers.

THE Brooklyn Heights Railroad Company of Brooklyn, N. Y., has under consideration plans for the building of an additional repair shop on the site next to the present one at Fifty-second Street and Second Avenue, South Brooklyn.

LETTERS AND HINTS FROM PRACTICAL MEN

Origin of the "Mixed System" of Electric Traction.

NEW YORK, Oct. 25, 1897.

EDITORS STREET RAILWAY JOURNAL:

The October issue of the STREET RAILWAY JOURNAL contains what purports to be the summary of a discussion carried on in the columns of the *Electrotechnischer Anzieger* with the object of establishing the identity of the originator of the so-called "mixed system" of electric traction, now used with success in Dresden and Hanover, by means of which accumulators carried in the car are charged while the car is in connection with the trolley line outside a city, and are discharged for the purpose of operating the car within the city limits where the trolley line is not allowed.

The article in your October number, in summarizing this discussion, states that "in its issue of June 6, 1897, the *Electrotechnischer Anzieger* editorially asks who is the inventor of the mixed accumulator system, and after referring to Dr. Sieg's paper on 'Accumulator Railways' read in Cologne last February, and the statement of O. L. Kummer & Company, of Dresden, in which they refer to themselves as the originators of the mixed system says: "the system is important enough for the name of the inventor to be handed down to posterity." The foreign journal just quoted as stated in your summary, printed in a subsequent issue an answer from the Patent Department of the Union Electricitäts-Gesellschaft claiming the credit of originating this system for Messrs. Huber and Magee, of that company, who took out patents for a switch arrangement in the year 1891, in which patent "the principle of the mixed system in question was distinctly described." As a result the *Electrotechnischer Anzieger* closed the discussion, so far as it was concerned, by saying:

"It appears to have been proved that the idea of the mixed accumulator system was first given to the world by J. L. Huber and Louis J. Magee, and that O. L. Kummer & Company, or rather their chief engineer, Mr. Fischinger, the Accumulatoren-Fabrik in Berlin-Hagen, and Director Kruger, of Hanover, have the equal merit of having applied and perfected the system."

I would respectfully call your attention to the fact that the so-called "mixed system" was invented and its advantages fully described by me as early as the year 1885, and that on Jan. 9, 1886, I filed applications for United States letters patent thereon, which were subsequently granted me on Nov. 9, 1886, and Aug. 20, 1889, the same bearing the numbers 352,265 and 409,237, respectively. The latter not only fully illustrates, describes and claims all the essential elements of this system, but also shows an automatic switch arrangement for cutting in and out the secondary cells on the car under certain conditions that are met with, either normally or under special circumstance, in the practical operation of the system. It will thus be seen that these patents not only anticipate by several years the claim made by O. L. Kummer & Company for originating the broad features of the system itself, but also antedate the claim for the switch arrangement made in behalf of Messrs. Huber and Magee.

But this is not all. The so-called "mixed system" and its many advantages for city and suburban railway lines were for the first time made generally public by me, under the name of "The Ries Combined Line Conductor and Secondary Battery System," in a pamphlet describing this system, which was published by me early in the year 1887, and which was widely circulated among electrical and street railway people. This pamphlet (which likewise described other methods and appliances devised by me for the safe and economical operation of electric railways, many of which have since found their way into practical use and are to-day in successful operation), was also taken up and discussed by various technical journals devoted to street railway interests, by which means the novel features and advantages of this "combined system" were made thoroughly known to electric railway engineers many years before the Hanover and Dresden lines were thus equipped.

For example, the *Street Railway Gazette* in its issue for the month of August, 1887, under the caption "A New Electric Railway System," comments upon this system and then quotes from the pamphlet as follows:

"One of the chief peculiarities of the Ries System is that neither the line conductor nor the secondary battery methods are entirely depended upon to furnish current to the motors, but a combination of both methods of supply is employed, this being carried out in such a manner that not only are new and highly important results obtained that are not possible with either system separately, but the best elements of both the secondary battery and line conductor systems are utilized without any of their individual disadvantages.

"Of the two methods just mentioned, the line conductor system of supply has very clearly the advantage in point of economy and efficiency over the secondary battery system, especially for city street railways on which the cars run under close headway and where the first cost of the conduit required for the supply conductors can be proportionately divided among a larger number of cars. On the other hand, the secondary battery system has the advantage (aside from the fact that no underground conduit or line conductors are needed), that each car is provided for a limited time with an independent source of power that permits of ready control and is not affected by interruptions in current to which the line conductors may be liable, and which does not restrict the car to any particular line of way. It is a fact, however, well known to all electricians, that the advantages of the secondary battery system as at present employed are far more than offset by the greatly increased outlay for running expenses and maintenance when compared to the direct supply conductor system, this being due first, to the necessity for providing and maintaining two complete sets of battery for each car, only one of which is at any time engaged in doing useful work; second, to the large amount of battery requisite for the necessary eight hours' supply usually provided in these systems to reduce the number of shifts; third, the great addititional dead weight to be hauled per car, and consequently the larger amount of power needed at the charging station for operating the road; fourth, the loss of current due to conversion, amounting in batteries of the most approved construction of from 20 to 25 per cent of the total current generated; and fifth, the additional attendance required for handling the batteries, and the extremely large cost of renewing the plates and maintaining the batteries in proper working condition.

* * * * *

The supply conductors, out and return, are carried in an underground conduit of special construction, as already described, and each car is provided with a single set of secondary battery of sufficient capacity to run the car continuously for two hours. This battery weighs less than one-fourth that ordinarily required for secondary battery cars, occupies no useful space, and is never removed from the car. It requires no change whatever in the body of the car for its reception, and the total amount of battery required for the road is less than one-eighth of that usually found necessary. Furthermore, as these batteries are only used as a source of reserve energy and to maintain the required potenital difference at the motor terminals, as will shortly appear, and require no handling or shifting about, their life is greatly prolonged.

* * * * *

The benefits derived from this reserved energy are very numerous and valuable, inasmuch as it secures all the advantages of the direct supply system in point of efficiency and ecouomy, while embracing at the same time all the beneficial results due to the independent control and flexibility of current characteristic of the secondary battery system. The number of cells of secondary battery are such that they can be placed directly across the line in parallel with the motors, their counter electromotive force being substantially equal, when fully charged, to that of the line conductors, which as already stated is somewhat lower than the pressures heretofore generally used. This battery, after having been recharged and while the car is running on the line conductor portion of the road, will supply the motors with any deficiency of current due to a temporary fall of potential on the line, such as occasioned by excessive loads, etc. In case of temporary accident to the generating dynamo or dynamos, the motor cars are propelled by the current from their respective secondary batteries, which automatically take the place of the line current until the fault is repaired. In addition to this, it becomes possible to make ordinary repairs or electrical connections at any part of the line with perfect safety and without interfering with the operation of the cars. The secondary battery is also used to furnish the current for lighting and operating the brakes, which cannot be readily done with the ordinary line current.

Other advantages of the system are described, such as the elimination of overhead conductors in city streets and of complicated switching devices at drawbridges, and the ability to convert the motors into generators on down

grades and use their current to charge the storage batteries, but enough has been said to show that the so-called "mixed system" was not only original with the present writer, and protected, in this country at least, by letters patent granted to him at a time when the electric railway industry was yet in its infancy; but also that it (as well as its chief modifications) was fully developed and its intrinsic merits pointed out by the writer and published to the world at large in this country more than ten years ago, at a time when the electric railways on which it is now being used were, in all probability, not even dreamed of.

In conclusion, the writer will say that while he fully agrees with the esteemed editor of the *Electrotechnischer Anzeiger* in the latter's estimate of the importance of this system, yet he has no special desire to "have his name handed down to posterity"—simply because he happens to have been fortunate enough to first invent and make public this system, but that he believes it is only proper, in view of the discussion referred to, to place on record where the so-called "mixed system" had its origin.

ELIAS E. RIES.

Instruction Book for Inspectors

BROOKLYN HEIGHTS RAILROAD COMPANY.

BROOKLYN, N. Y., Dec. 20, 1897.

EDITORS STREET RAILWAY JOURNAL:

I transmit you herewith copy of the hand book of instructions which we are putting into the hands of our inspectors. The book gives the diagrams of a number of the different controller combinations, diagrams of motor cut-outs, and general rules for the operation of controllers.

IRA A. MCCORMACK,
Gen. Supt.

BOOK OF INSTRUCTION FOR INSPECTORS

GENERAL RULES

Throw the power handle quickly from notch to notch.

Rest on each notch long enough for the car to gain the headway due to the combinations at that point.

Build up controller slowly to avoid overloading the motors, and sparking at commutators.

Do not allow power handle to come to rest between notches.

Throw power off with one continuous movement of the handle.

Do not use resistance points except for starting your car and getting up to speed.

Follow instructions given with diagrams in regard to safe running and economical points.

Never reverse your car except to avoid an accident.

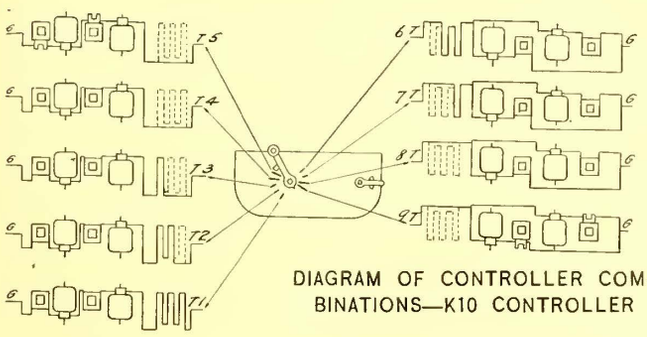


DIAGRAM OF CONTROLLER COMBINATIONS—K10 CONTROLLER

1st Position—All resistance in. Motors in series.
2d " ¼ " cut out. Motors in series.
3d " ½ " " " " "
4th " ¾ " " " " "
5th " All " " " " "
6th " ¼ " " " " parallel.
7th " ½ " " " " "
8th " ¾ " " " " "
9th " All " " " " "
Running points, 5 and 9.

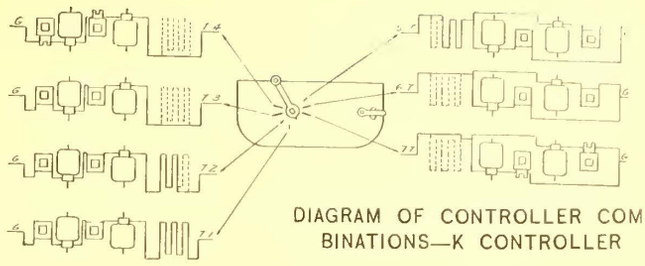


DIAGRAM OF CONTROLLER COMBINATIONS—K CONTROLLER

1st Position—All resistance in. Motors in series.
2d " One panel of resistance cut out. Motors in series.
3d " All resistance cut out. Motors in series.
4th " All resistance cut out. Motors in series. Shunt in fields.
5th " One panel of resistance cut out. Motors in parallel.
6th " All resistance cut out. Motors in parallel.
7th " All resistance cut out. Motors in parallel. Shunt in fields.
Running points 3 and 6. For high speed on level, use 7. On grades use 6.

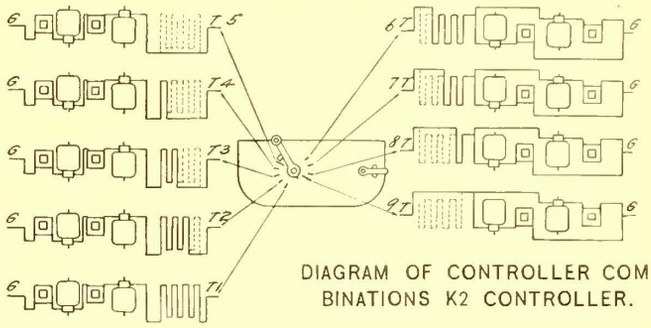


DIAGRAM OF CONTROLLER COMBINATIONS K2 CONTROLLER.

1st Position—All resistance in. Motors in series.
2d " ⅓ " cut out. Motors in series.
3d " ⅔ " " " " "
4th " All " " " " "
5th " All " " " " " Shunt in field.
6th " ⅓ " " " " parallel.
7th " ⅔ " " " " "
8th " All " " " " "
9th " All " " " " " "
Running points, 4 and 8. For high speed on level use 9. On grades use 8.

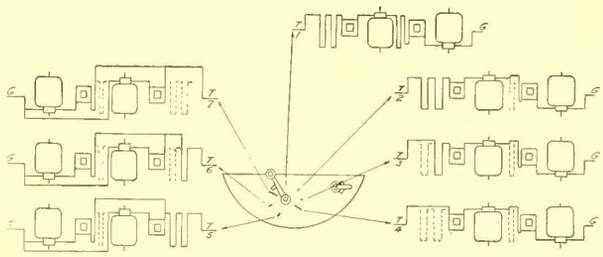


DIAGRAM OF CONTROLLER COMBINATIONS—NO. 28A WESTINGHOUSE

1st Position—All resistance in. Motors in series.
2d " One panel of resistance cut out. Motors in series.
3d " Two panels " " " " "
4th " All " " " " " "
5th " One panel " " " " parallel.
6th " Two panels " " " " "
7th " All " " " " "
Running points, 4 and 7. On grades use 7.

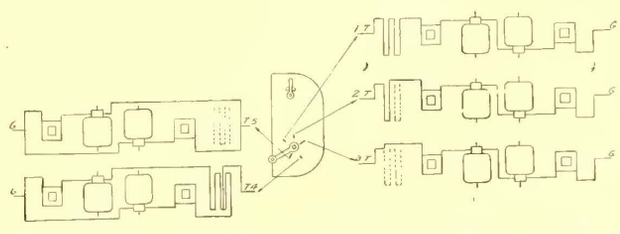
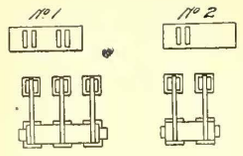


DIAGRAM OF CONTROLLER COMBINATIONS—CURTIS CONTROLLER

1st Position—All resistance in. Motors in series.
2d " One panel of resistance cut out. Motors in series.
3d " All panels " " " "
4th " Motors in parallel. One panel of resistance in series with each motor.
5th " Motors in parallel. All panels of resistance cut out.

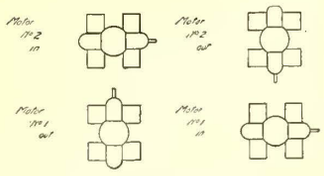


To cut out motor No. 1, throw up switch No; 1.

To cut out motor No. 2, throw up switch No. 2.

Motor No. 1 is the motor nearest the fuse box.

MOTOR CUT-OUTS—G. E. CONTROLLERS



To cut out motors when the Curtis or T.-H. controllers are used, disconnect motor leads.

MOTOR CUT-OUTS—T. H. CONTROLLERS

Profit Sharing on Street Railways

GOTHENBURG TRAMWAYS COMPANY.

GÖTEBORG, Sweden, Sept. 22, 1897.

EDITORS STREET RAILWAY JOURNAL:

DEAR SIRS:—Referring to your article in the September STREET RAILWAY JOURNAL on profit sharing, it may interest you to know that this system is not altogether unknown on the continent of Europe, a few tramway companies giving their employes a percentage of the gross receipts. Among others the Gothenburg Tramways Company, Ltd., started this system at the beginning of the current year, and there is every reason to believe that it will work well permanently and prove a success.

In addition to the advantages you rightly claim for the system it has another, viz., in case of an increased scale of wages being necessary, the percentage system is flexible and elastic, and easily adjusts itself to any change which may be found advisable.

Will you allow me to congratulate you on the production of such a valuable and interesting tramway journal as the STREET RAILWAY JOURNAL is. Its completeness as regards matter and excellency as regards illustrations are beyond praise, and I trust you may have the success which you merit.

F. W. STODDARD,
Managing Director.

Home-Made Testing Rigging

NEW YORK, Dec. 15, 1897.

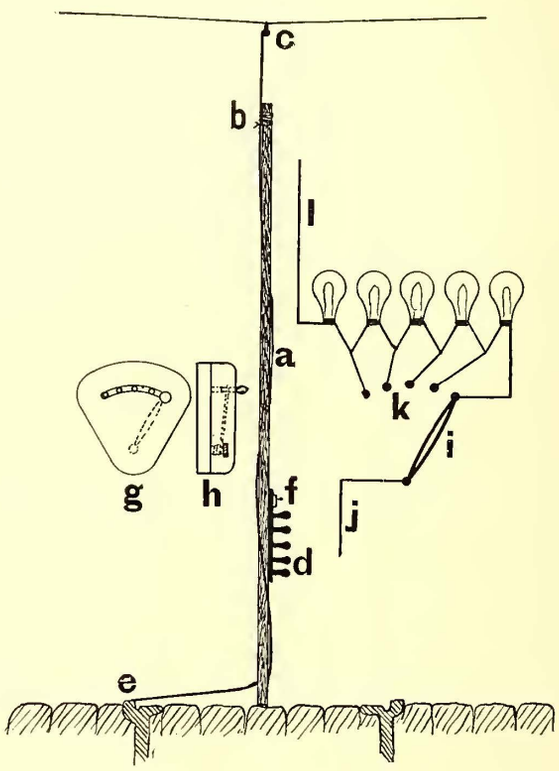
EDITORS STREET RAILWAY JOURNAL:

For testing the drop along a line of road, nothing goes ahead of a good voltmeter, but it is not always expedient to send out such an instrument, and for constant use in a "hurry-up wagon," the life of the best voltmeter is short. A good home-made rigging for this purpose, is illustrated by the engravings herewith. It consists of the pole, *a*, which is preferably long enough to reach from the ground to the trolley wire. A jointed pole may be prepared for this purpose, and quite a short pole can be used on a pinch. The bare contact wire, *b*, is bent into the form of a hook, so as to catch over the trolley wire, *c*, and hold the pole and rigging in position.

A bank of five lamps, shown at *d*, is connected in series with a wire running up the pole to the contact wire, *b*. Another wire is carried down the pole, through a rubber tube, and connected with another contact wire which is put on the rail, *e*, thus completing the circuit through the lamps from trolley to rail. The brightness of the lamps tells how the voltage is. This is, however, a rather discouraging test, and may be made much more valuable by adding a kind of a rheostat whereby some of the lamps may be cut out until the remainder glow up to full candle power, thereby giving a better clue to the voltage at that particular piece of track.

This arrangement is shown in the detail drawings. The rheostat shell, shown at *g* and *h*, may be the case of a played out voltmeter, with the glass removed, but a wooden case, or one made of fibre is better as there is less danger of the instrument getting grounded, thereby giving the operator a test instead of the line. Five contacts are arranged as shown in the upper part of the detail, *g*, and a spring arm is made fast so as to sweep over these contacts. The side view, *h*, shows how the arm is made part of a spiral coiled around the stout screw, and how the spring arm is moved by an insulating handle which projects through the top of instrument case.

The method of connecting up lamps is shown at the other side of the drawing, where *l*, is the wire coming from the trolley, and running to the first lamp. All the lamps are wired in series in the usual manner, the last lamp being connected to the last contact of the rheostat box. Branches are taken off between the lamps, and run to the other contact points as shown in the engraving at *k*. The wire *j*, is carried to the rail contact, and as the lever, *i*, is moved



around, it successively cuts out the lamps by short circuiting them.

In use, the pole is set up and the contacts made, and if the lamps do not go up to full brightness, the rheostat lever is moved a point and the lamps carefully watched. If the four remaining in the circuit go up too bright, the lever is released before the lamps have a chance to damage themselves much, but if the four do not go up to full power, another move of the lever cuts out a second lamp. This can be continued until only one lamp is left in the circuit, if necessary, but there will be a pretty big drop or a bad short circuit somewhere on the line when all the lamps but one can be cut out.

The object of having the spring lever to the rheostat is to prevent the burning out of the lamps, which would surely happen if an ordinary form of rheostat were used. The current could not be cut off quick enough when the limit of lamp cutting out had been reached, and away they would go. But with the spring rig, as soon as a man lets go of the handle, all five of the lamps come right into the circuit again and no damage will be done from leaving the lever turned.

A very desirable modification of this rig is to put in 50 volt lamps instead of 110. Then, the number of steps could be increased, and the testing made so much more elaborate. The 110 volt lamps would burn brightly at 550, 440, 330, 220, and 110 volts respectively, but with a bank of eleven 50 volt lamps, tests could be made at 550, 500, 450, 400, 350, 300, 250, 200, 150, 100, and 50 volts potential between rail and trolley wire. With three or four 50 volt, and the others 110 volt lamps, a very good combination could be made with close readings of the higher voltages.

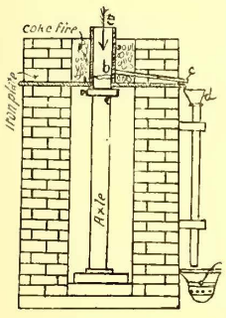
SUPERINTENDENT.

Casting a New End on an Axle

BOSTON, MASS., Dec. 14, 1897.

EDITORS STREET RAILWAY JOURNAL:

The accompanying illustration shows a method of casting a new end on a car axle. The object of casting the end in this form was for experimental purposes. A brick wall was built up and around the axle as shown in the sectional view. The lower end of the axle rested upon a firm base also of brick. A collar was set-screwed to the axle as shown and a plate iron disk set in the brickwork just above. The hole in the disk was the same size as the outside diameter of the axle, and the axle was held in position by this means. The plate formed the bottom support of the mould, *e*, also the bottom of the fire chamber.



Previously to adjusting this mould, a coke fire was made in the chamber and the end of the axle, *b*, was brought to a high heat. Then the fire was drawn, all foreign matter removed from the end of the axle, the mould put in place, a new coke fire made around the mould and the hot metal poured in as the arrow indicates. There was a drain at *c*, leading from the bottom of the mould, through which the hot metal escaped to a ladle through the tunnel, *d*. This was kept up until the hot metal softened the end of the axle, *b*, when the outlet was plugged and the mould filled.

After cooling, and removing the axle, the point of union of the two metals was turned down and tests proved the axle to be as strong at that point as elsewhere. F.

A Poor Piece of Engineering.

Nov. 20, 1897.

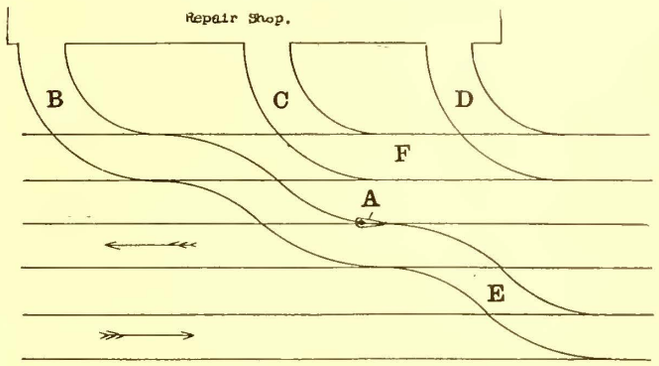
EDITORS STREET RAILWAY JOURNAL:

During a recent visit to a repair shop, a fully loaded car came down the track, struck a partly open switch at *A*, and went almost into the repair shop before its headway could be stopped. The track, *F*, is known as the "shop track," and is entered only by the single switch shown, which by some oversight, was placed to open as shown, instead of in the opposite direction as it should. The arrows indicate the direction of travel.

Orders have been issued against fast running past this switch, but it is one thing to issue orders, and another to make motormen obey them every time—and it was one of the odd times when the car ran into the shop in my presence. No one was hurt, but the passengers received a bad shaking as the car rushed around the heavy reversed curves, and the strain upon the motor machinery must have been damaging.

The switch, *A*, should be pulled out at once, and turned around so that cars to get into the shop, must back off, instead of running in as they do now. If, from any cause, it is not expedient to do this, a spring switch should be put in at *A*, and a man stationed to "hold off" every time a car goes into the shop. But not even spring switches can be trusted implicitly, especially in the vicinity of a shop where nuts and other small bits of scrap iron are flung around promiscuously.

The crossover from *A* should be turned around and



put to the right of crossover *E*, so that a car would have the command of the three tracks, *B*, *C* and *D*, instead of being in between them as now located. J. F. H.

The Babbitting of Boxes

BY B. F. FELLS.

The babbitting of boxes for railway work is not very difficult if the proper tools are used. Fig. 1 is a simple babbitting mandrel, made by turning down the ends of a piece of common steel shafting. Then a jig like that shown in Fig. 2 should be made. The base, *a*, is of cast iron, into the edges of which holes are bored and tapped for the screws that hold the end bearings, *b b*. The mandrel is adjusted in this jig as shown.

Next, a pair of heads is made, one solid or plain, as in Fig. 3, and the other cupped as in Fig. 4. Each is provided with a set-screw. The bore in each must fit the mandrel. Next comes the anvil. This is shown in Fig. 5. It can be made from iron and interchangeable to suit boxes of different sizes. Bolts *a a* hold the anvil to the base piece of the jig as shown.

The jig ready for pouring is shown in Fig. 6. It can be seen that the box to be lined is held very securely and true. The metal is poured through a hole cut for the purpose. The jig may rest upon wood cross pieces or upon a bench. In pouring the metal be sure to have the mandrel

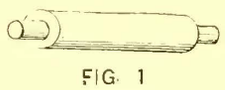
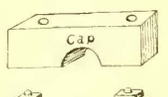


FIG. 1

FIG. 3



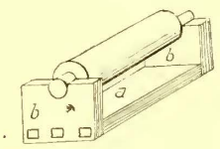


FIG. 2

FIG. 4.

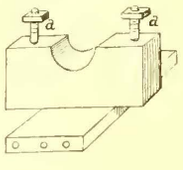


FIG. 5

and box warm, and the metal hot enough to run in without clogging. After the box is full let it stand until it has cooled some, but do not wait until it gets cold; then remove the box, and drive the mandrel out with a copper hammer. A good job usually results.

Much of the babbitting done in the shops relates to the relining of worn boxes in which case the old metal must be melted out. Fig. 7 is a sectional drawing showing how to put up a melting crucible for this purpose. The crucible is provided with a bottom outlet and a plug. The latter is operated by the shaft, *a*, which when lifted draws the plug and permits the molten metal to flow out at *b* to a ladle. By this method the scum and foreign matter that is on the surface and which would be taken up by a ladle, is kept from the mould. Both old and new metal can be melted to advantage in this way.

After the worn lining in old boxes has been melted, the boxes themselves must be cleaned preparatory to rebabbitting. This can be done most effectively by means of common scratch brushes. Care should be taken to remove dirt, clogged spots, and all foreign substances previous to relining.

While the presence of greasy matters in a box or on a

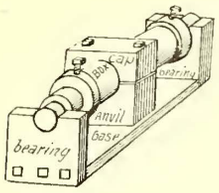


FIG. 6

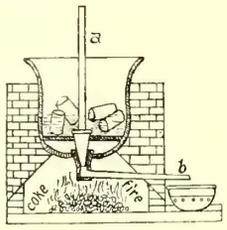


FIG. 7

mandrel, seldom does any harm when the hot metal is being poured, many a man has been shocked and in some cases has received injury from explosions caused by pouring the hot metal into a box containing moisture. See that the parts are perfectly dry before pouring.

Bonding vs. Connecting Rails

By E. T. Birdsall, M. E.

The subject of electrically connecting the rails and tracks of an electric tramway system is of interest from two standpoints. First, the saving of power and copper which results from a very low resistance return. Second, the prevention of electrolysis, and the consequent damage. It is hardly necessary to go into details on the first point, as the subject is familiar to every one connected with street railway work and the advantages of good bonding would seem to be obvious. If we define "bonding" to be the joining together of rails electrically, so that the joint will carry the return current without sufficient drop to appreciably divert the current from the rail; then what we have been calling "bonding" was only "connecting" or "contracting."

In the early days a No. 4 iron wire, fastened to the rail with $\frac{5}{16}$ in. rivets, was thought to be ample. The railway signal people had found this bond a good one so it was adopted for traction work. Now we have progressed to the dignity of No. 0000 copper bonds; but the fact that the track is one-half the total length of circuit does not seem to be even yet fully appreciated in many localities.

There seems to be an unwillingness to believe that a contact of uncertain resistance has not infinite carrying capacity. Even after these facts are received and acknowledged, consistent action upon them seldom follows. The cars run, and the drop is not greater than upon many other roads, so it follows the bonding must be good enough, and a No. 0 wire and two corroded rivets are somehow or other doing the work.

A short time after the adoption of the overhead trolley system of tramways in cities having gas and water pipes buried in the ground, it was found that the pipe joints began to fail. The defective joints were not broken by mechanical stress, but were corroded entirely away. Lead covered cables owned by the telephone and tramway companies also had their lead coverings destroyed. As the laws of electrolysis were well understood it was seen at once that these effects were due to the action of the current, which in returning to the power house, did not keep to the rails; but, obeying the laws of shunts and divided circuits, distributed itself through the earth and the metallic structures buried therein, according to their relative resistances.

It was agreed that less trouble would be experienced if the negative pole of the generators was connected to the ground and this has proven to be the case and is now the universal method of operating. It was also found that the lead service water pipes to houses were most affected, as the iron main was in nearly all cases protected at the expense of the lead service. It has also been found that cast iron pipes of a certain quality are quite unaffected with any currents that have yet been observed while wrought iron is badly corroded.

The amount and rapidity of the corrosion depends upon the difference of potential between the pipe and the rails and the direction of flow of the consequent current, for although the negative pole of the dynamo is always connected to earth, yet the current may leave and return to the rails and pipes several times before reaching the power house.

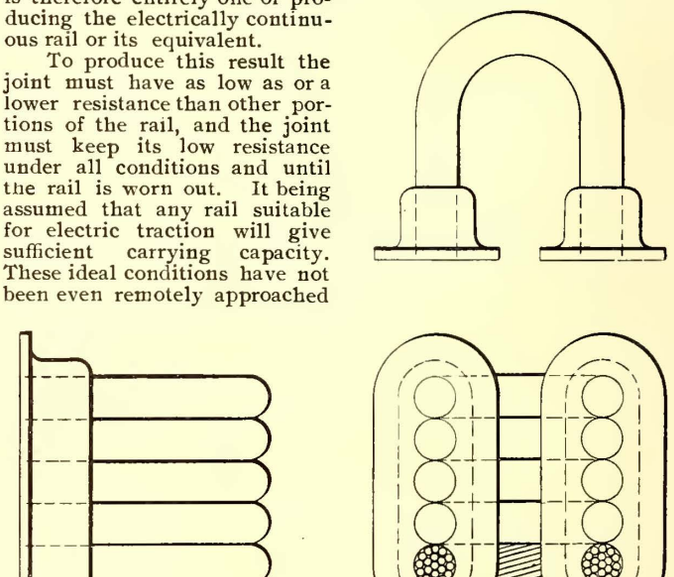
The amount of current that will leave the rails and return by way of the piping systems depends upon the relative resistances of the rails and the adjacent earth and its contents. Therefore, broadly considered, we have a generating station delivering current to an insulated overhead network of wires. The current from these wires is taken off at numerous and widely distributed points by the cars and delivered to the rails. These, if of infinitely low resistance, would deliver all the current back to the power station.

If the rail system was without joints and homogeneous throughout there is little doubt but that its resistance would be so low, relatively to the ground and its contents, that the current entering and leaving the buried piping systems would be quite harmless if not inappreciable. The actual conditions that maintain however are, that the rail lengths being very imperfectly connected electrically (bonded) at the joints of which there are 355 per mile of single track, the amount of current that actually comes back to the power house without ever leaving the rails must be an extremely small fraction of the total amount.

To illustrate the magnitude of the currents carried by the pipes, it was found in one city, before improvements were made in the rail return, that the difference of potential between the rails and the water pipes in one part of the town was as high as 5½ volts, in several places it was 2 volts and the average over many square miles was ½ volt. In this case the bonding was of the old style and had been used for nearly two years. Since the tests were made the points of high difference of potential have been rebonded and the general conditions improved.

There is a general belief that the earth is of very low resistance, whereas experiments have proven that even moist earth is of comparatively high resistance. For example, the resistance between two ground plates, each of several hundred square feet area, buried in moist earth 4 miles apart was found to be 85 ohms, both plates being near a river. In another case, two plates placed 1000 ft. apart had 374 ohms resistance between them. In still another instance in a rocky country there was found several thousand ohms between two iron rods driven into the soil only a few hundred feet apart. Experiments conducted by reliable engineers in different parts of the country have proven conclusively that as a return conductor, except for telephone and telegraph currents, the earth is absolutely worthless. The conclusion at once reached is, that, given an electrically continuous rail system of low resistance it becomes advantageous in this case to have the earth of high resistance as it will then allow but a very small percentage of the current to leave the rails. The problem of pipe preservation in cities having overhead trolley systems is therefore entirely one of producing the electrically continuous rail or its equivalent.

To produce this result the joint must have as low as or a lower resistance than other portions of the rail, and the joint must keep its low resistance under all conditions and until the rail is worn out. It being assumed that any rail suitable for electric traction will give sufficient carrying capacity. These ideal conditions have not been even remotely approached until within the last two years, It will be at once seen that the usual riveted bond made of copper wire or rod is hopelessly inadequate to either maintain its contact at a low resistance or to equal the conductivity of the rail.



SIDE AND END ELEVATIONS AND PLAN OF BOND

If, as sometimes asserted, we have now at hand methods of bonding that will give us an electrically continuous track; and if, as shown in the early portion of this article, it is almost a certainty that an electrically continuous track will reduce the corrosion of water and gas pipes from electrolysis to an inappreciable amount; why then, it will be asked, does electrolysis continue to give trouble and cause damage in many places? The answer is, because the street railway companies will not pay for a bond that will do the work; because they do not properly test each joint at frequent intervals and keep a record of the same; because, except in one or two cases, no electrical survey is made of the tracks and vicinity of the generating stations and well planned and directed efforts made to improve the conditions.

Lest it should be thought that some of the bonds on the market are sufficient for the purpose, a little calculation will show that for the average 9 in. girder rail having over 8 sq. ins. of cross section it will require a copper bond having a cross section of 1½ sq. ins., and each end of the bond should have an actual contact surface with the rail of not less than 8 sq. ins. If any rails have been bonded with a bond having these dimensions they are yet to be heard from.

If an engineer uses two No. 0000 bonds it is at present looked upon as the height of extravagance, although the latter have a sectional area of but one-third of a square inch, or are nearly five times too small. When it is remembered that the majority of the tracks in use are bonded with wire much smaller than this, the favorite being a No. 0 wire riveted to the web of the rail, with a joint that is of low resistance, for only the first few months of its life, it will be seen that there is ample reason for the electrolytic corrosion of water and gas pipes. The great demand seems to be for a bond that does not cost over thirty cents and can be applied with a hammer.

The writer confidently predicts that in the near future larger bonds will be more universally used, a more careful testing and maintenance of the track return will be the rule rather than the exception, and that on well managed roads careful and periodical measurements of the resistance of every joint will be made, all tending to make and keep the track electrically continuous and of equal carrying capacity throughout.

The accompanying sketch shows a bond designed by the writer and now being installed upon two roads. It is soldered to the underside of the foot of the rail by means of a special clamp and large torches, the rail ends being surfaced and tinned before spiking and fastening. This bonding can be done or renewed at any time without disturbing any part of the track. The carrying capacity is eqnal to that of a 70 lb. rail and the ends of the wires being in contact with the rail the cast copper has but a small part of the current carrying to do. It is very flexible, being designed for 60 ft. rails, and will allow of the displacement of the rail ends for a considerable distance in any direction. In spite of many opinions to the contrary a bond can be successfully, easily and quickly soldered to the rail, and they do not come off or increase in resistance in three years, at the least, under ordinary conditions.

The above bond costs about $1.25 applied, or about $225 per mile of track using 60 ft. rails.

Notes on Rating Electric Power Plants upon the Heat Unit Standard

An editorial reference was made last month to a paper on the above subject, read by Prof. W. S. Aldrich before the American Society of Mechanical Engineers, Dec. 2, 1897. Since the advance sheets of this paper were distributed, the author was requested to present some examples of rating central stations on this standard. He stated that while other data had been collected and reduced, yet on such short notice he could but turn to the National Electric Light Association Reports on Data, and did so, especially as these had been discussed previously in the body of the paper. In the 1897 report, the feedwater consumption per kilowatt hour is given for nine of the stations reporting. In addition, six of these report the temperature of feedwater. The two preceding data, with the steam gage pressures, furnish the means of determining the total heat in B. T. U., supplied to the system—that which is required to raise all of the feedwater from its temperature to that of the steam at the boiler pressure. The results are given in the table in the next column.

TABLE SHOWING EXAMPLES OF RATING ELECTRIC POWER PLANTS ON THE HEAT-UNIT STANDARD. REDUCED FROM 1897 REPORT OF COMMITTEE ON DATA OF NATIONAL ELECTRIC LIGHT ASSOCIATION

Station No. in 1897 Report N.E.L.A.	TYPE OF ENGINE	Pounds Feed-water per Kw. hour at best Efficiency	Temperature of Feed-water Fahr.	Steam Pressure (Gage) Pounds sq. in.	Total heat B. T. U. in Feed-water per pound	PLANT RATINGS: Kw. hours per 1000 lbs. water at best Efficiency	Kw. hours per 1,000,000 B. T. U. at best Efficiency	Rating at best Efficiency, water per I. H. P. hour	DYNAMOS: Method of Driving Dynamos	Daily Output, Watt hours	Kind of Service—Daily
4	Vertical triple expansion, four-valve	23.50	. . .	160	. . .	42.60	. . .	15	Direct connected	200,000,000	Incandescent, 24 hours.
14	Tandem compound condensing Double tandem compound, non-condensing Cross compound	26.65	120	115	1100.0	37.55	34.14	17.5	Belted to jack shaft " dynamos	124,000,000	Arc and incandescent, 24 hours.
1	Vertical compound non-condensing, four-valve	37.50	212	125	1009.5	26.70	26.45	25.8	Direct connected	13,600,000	Incandescent, 24 hours.
10	Compound condensing Simple non-condensing	38.10	. . .	112	. . .	26.30	. . .	28.5	Belted to dynamos	3,400,000	Arc and incandescent, 24 hours.
2	Horizontal cross compound condensing High speed, single valve, automatic	39.30	212	125	1009.5	25.50	25.26	25.7	Belted to dynamos	1,400,000	Incandescent, 6 to 12 hours.
7	Simple non-condensing Compound non-condensing	45.00	180	135	1053.20	22.20	21.08	28.0	Belted to dynamos	13,000,000	Incandescent, 24 hours.
8	Cross compound condensing Tandem compound	45.00	. . .	160	. . .	22.20	. . .	28.0	Direct connected Belted to dynamos	12,400,000	Arc and incandescent, averaging 17 hours.
5	Simple non-condensing Compound non-condensing	47.70	208	125	1013.50	21.00	20.72	29.1	Belted to dynamos	15,600,000	Arc and incandescent, 24 hours.
9	Single-acting compound condensing Simple automatic non-condensing	53.27	140	120	1080.70	18.80	17.39	28.0	Belted to dynamos	2,700,000	Arc and incandescent, 24 hours.

The Multiple Unit System of Electric Car Operation in Chicago

Announcement has already been made of the contract for the equipment of the South Side Elevated Railroad, of Chicago, with the Sprague multiple unit system of car control. Last month a trial test extending over several weeks, was made for the company of five cars. The test was made on the Metropolitan line, as the South Side line is not ready for electric operation, and was eminently satisfactory. Owing to the delay, however, in the building of the company's power station, the South Side line will be operated by steam until at least February, when it is thought the station will be completed. When equipped, the line will have 120 motor cars and 60 trail cars. The present Sprague train will be continued on the Metropolitan road until the system can go into effect on the South Side line.

In the reconstruction of the cars, McGuire trucks, each carrying a G. E. 57 motor, are used. The motors on each train are operated by K2 controllers, which are horizontally suspended from the vestibule roof of each car so that each is operated independently. The controller on each car is operated in unison with the others from the motorman's cab in the forward car, by means of small electric motors, which are connected by bevel gearing to the controller shaft, the principle being similar to that of the control of the Sprague electric elevators. A spring coupling is inserted in the controller shaft between the controller and the driving motor, so that the handle will remain on a notch until the compression on the springs is sufficient to carry it with a snap to the next notch. In this way the handle of any controller cannot be stopped between notches. Other essential features of the equipment are reversing devices on each car, operated in unison, and automatic cut-outs for each position of the controller. The couplers between the cars contain each five wires, and connection is made as easily as with an ordinary air brake coupling.

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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.

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Some of the most interesting types of engines in the market to-day are discussed by Dr. Emery in the second of his series of articles appearing elsewhere in this issue, and it is needless to say that these engines are described and commented upon in an interesting way.

There are signs of some revival of interest in storage batteries for traction purposes, and it is by no means certain that batteries have not of late been brought to a degree of perfection such that experiments for special conditions of service, such as, for example, crosstown lines in New York City, may not be well worth while to undertake.

Now is the time to calibrate wattmeters, and in fact all instruments where accuracy is of importance. Station wattmeters are delicate pieces of mechanism, and will by no means run forever and give accurate readings without occasional cleaning, adjusting and calibrating. A little friction in the jewelled bearings may mean that a wattmeter will register 10 or 15 per cent less than it should. Take care of your apparatus and it will give you good service.

The promptness with which the annual reports of the American Street Railway Association and the Association of Street Railway Accountants of America have been issued, bears testimony to the efficiency of the administration of the secretary's office in each case. In this year's Association report appear fine steel engravings of Robert McCulloch, William J. Richardson and T. C. Penington. In other respects the report is well printed and in good shape.

Street railroading in the city of Mexico is a decidedly different thing to-day from what it was two years ago before Mr. McLean took charge of the property. Though horses have not yet given place to electricity, the service has been enormously improved, and the increase in receipts reminds one of the increases common in this country when electricity is introduced. Mr. McLean has been able to organize and handle native labor with excellent results, and the force under his control is efficient and reasonably satisfactory to him.

Our readers will notice a few changes in the arrangement of the matter in this issue, but these changes are hardly worth special notice, as in all material respects the same classification of articles as has been made in the past is, and will be hereafter followed. The several department headings, "Operation," "Construction," "Street Railway News," "Science, Engineering, Invention" and "Finance," have served their purpose in bringing about an understanding by our readers of the general arrangement of the paper, and now disappear in the interests of simplicity.

A most peculiar and unprecedented "accident" took place on one of the Chicago elevated railways, the other day, in the form of a "short circuit" brought about simply by the simultaneous starting up of nearly all the trains on the road. Such a contingency is always possible in electric railway operation, for no power station aims to furnish current enough for the starting of all its cars at a given instant. Nevertheless the mathematical chances against this occurring in practice are almost infinitely great, and the experience of the Metropolitan West Side road is not likely to be repeated for a generation.

We very much hope that a large number of street railway power stations will be tested during the coming year by the heat unit method, referred to in this and last issues, and in that of June, 1897. The method is so simple that it can be applied in any station possessing a wattmeter, and although it does not separate the efficiency of boilers from that of engines, or of engines from generators, it does make it possible to compare the general results obtained from a large number of stations of different types. The difficulties in the stations of low efficiency may then be "run down" by more elaborate tests. Syndicates or in-

dividuals interested in various street railway systems can bring up the general efficiency of all their power stations by applying the heat unit test and correcting the imperfections in the poorer ones.

The committee appointed by the Governor of Massachusetts, according to a special act of the legislature, to investigate the relations between the street railway companies and municipalities, has been obtaining some very interesting information in its public hearings. There have been presented to it arguments of every kind and degree of strength from the rankest socialistic ravings, to the clear, calm and dispassionate statement of facts made on Dec. 3 by Everett W. Burdett, Esq., counsel for the Massachusetts State Street Railway Association. Mr. Burdett's argument, which has been reprinted, should be in the hands of every street railroad manager whose relations with his city council are at all strained, for it is, certainly as applied to conditions found in Massachusetts, almost completely unanswerable.

Reports from a large number of the prominent street railway companies of the United States, which are abstracted in another column, seem to show that considerable new and extension work and improvements are to be carried out during the coming year, if financial conditions remain even as favorable as now. If they improve, there is no doubt the list of new enterprises will be greatly increased, and that, in especial, the plans of many of our great steam railroad systems for a commencement of electrical equipment of their suburban and branch lines will be, at last, carried into effect. It is generally understood that the most important group of railroad bankers and capitalists in the country, headed by J. P. Morgan, have become so thoroughly convinced of the value of electricity in such territory as that of New England, New Jersey, portions of Pennsylvania and New York, that they will undertake the electrical equipment of portions of the steam railroad systems controlled by them upon a very large scale when the money market becomes permanently easier.

It is with a feeling of regret that electric railway managers and engineers will see, with the beginning of the year, the disappearance as an operating company of the West End Street Railway Company, of Boston, as the result of its lease to the Boston Elevated Railroad Company. To those especially who were engaged in any part of the development of electric railroads the name of the West End Company brings up a host of recollections of pioneer work, boldly carried on by the managers at a time when many of the principles of the application of electricity to traction were but dimly understood and when many able financiers and engineers were pronounced in their scepticism of the favorable outcome of the venture. The debt of all electric railway companies to the West End Company and its early managers can hardly be overestimated, but it is a satisfaction to know that those who were most prominent in instituting the trial in Boston have lived to see the predictions of disaster unverified and the adoption of the overhead system practically universal with the other street railway companies in this country.

It is a curious thing, this changing over of a cable road to an underground electric, and one which is almost unintelligible to European engineers. How it can be profitable to throw away a large investment in power station, conduit and car machinery to put in electric dynamos, motors and a copper feeder system underground, is difficult for anyone to understand who does not know from experience how quickly the public—an American public, at least—will respond to even minor improvements in riding conditions. It is hard to get a foothold on one of the new Madison Avenue electric cars to-day in spite of the fact that they are run at very short intervals, and we predict that the Lexington and Third Avenue cable lines which parallel it, will before long be changed to electric, if they are not to see a large portion of their traffic diverted from them. The people will have the best and nothing but the best as soon as they find out what it is, and corporations have to bend to their will or stand the consequences.

This is, by the way, one of the things which the advocate of municipal ownership of street railways does not take into consideration either when he urges that street railway companies do not properly serve the people, and are making excessive profits, or that municipalities would serve the people better. What thoughtful person believes that these great public improvements would ever be brought about with as little friction and inconvenience to the public as has been done in New York City, or that when great investments are once made by a municipality, there would ever be a thought of changing them for something better and more expensive, except under the greatest pressure and after years of "experiments." No; with municipal ownership and operation the people must "grin and bear" whatever inconveniences "the public good" requires to be placed upon their shoulders, and they are to a certain extent estopped from "growling," by the fact that their own pockets will be the sufferers.

The amount of misinformation and of half-information which is being carefully given out by those who have become prominent in the advocacy of municipal operation of street railway properties, is something astonishing. In the *New Time* for November, Prof. Frank Parsons gives a table purporting to represent the rates of fare for "short distance" and "long distance" rides in some eight foreign cities and four American, to the disadvantage of the latter. He makes no mention of the difference in the sizes of the respective city systems, nor of the differences in each city in what may be called a "short distance ride," and he even goes so far as to say that "in Glasgow the general rate is 1 cent per half mile, but a number of long runs are established at a 2 cent fare without regard to distance." Now we have pointed out many times the fact that in most foreign cities there is no such thing as a "long run" as we know it in America, and if the published schedule of fares in the last annual report of the Glasgow Corporation Tramways be examined, and the distances measured on a map of that city, it will be found that what Professor Parsons calls a "long run," costing 2 cents, rarely, if ever, exceeds 1½ miles, so that his phrase, "without regard to distance," is positively ridiculous when we

consider that in American cities "long runs" mean 8, 10, 15 and even 20 miles.

Europe has six times the population of the United States of America (including Alaska), contained in almost exactly the same area. Naturally one would suppose that the railroad mileage of Europe would be, not perhaps six times that of America, but certainly three or four times as great, in order to properly serve the people. The fact is, however, that Europe has actually 16 per cent less mileage than America, or 1 mile for every 2500 inhabitants, as against 1 mile for every 350 inhabitants here. To what can we attribute this great difference in railroad facilities, unless it be to the conservatism, not to use a harsher term, which goes with the government ownership of railroads in Europe? Two-thirds of the railroad lines in Austria, Hungary, Belgium, Denmark and Italy are owned by the respective governments; the German government owns nine-tenths of its railroads; the Netherlands, Portugal and Russia one-half each of theirs; Sweden, one-third; France, one-tenth, and Norway nearly all. Capital has been given practically a free hand in America, and has created railroad facilities immensely superior to those of European countries, while freight and passenger rates are far lower. Here is food for thought by those who advocate municipal ownership of street railways.

The flagrant injustice of the daily press of certain of our cities in contests waged against street railways cannot be more strikingly illustrated than by the action of the Chicago papers some time ago during the consideration by the Illinois Legislature of the so-called Humphreys Bill. It will be remembered that all the newspapers in Chicago opposed this bill, and by every means in their power sought to prejudice the public against it, and with success, as the bill was finally defeated. It appears that at no time during the controversy was the bill itself actually printed in the papers as a whole, and the fact has been lately brought to our attention that this was not a mere happening, but that every paper in Chicago without exception refused the request of the street railway companies that the bill be spread before the public in its columns, although the companies even offered to pay for the space taken at the rate of $500 per page. In other words, the Chicago papers refused to allow the people to understand that, by the provisions of the Humphreys bill, the city was to receive not less than $8,000,000 from the street railway companies during a specified term of years. Such action on the part of any decent newspaper is almost unbelievable, but when it is charged against the united press of a great city like Chicago, there is but one conclusion to be arrived at, namely, that *all* the papers are firmly in league with politicians of the worst type.

In a case like this the street railway companies have a remedy in their own hands, though, so far as we are aware, that remedy has rarely been used. In every city of the land there are probably more street railway passengers in a day than there are newspaper readers. This is the opportunity. *Fight the newspapers with their own weapons.* Prepare a circular letter addressed to the public; explain in simple, straightforward language the actual facts in the pending controversy; state, above all, and in emphatic language, that the newspapers refuse to publish these facts. Print the letter in large, clear type, and hang eight or ten bundles on the window posts of every car in the city. The people will take and read these circulars, will talk over the arguments among themselves, and, in nine cases out of ten, the American love of fair play will turn the tide of public sympathy against the papers and in favor of the companies, certainly if right and justice are on the side of the latter. Use the advertising racks as a whole, if necessary, to present some fundamental proposition, and in preparation for such a contingency reserve the right of doing so when letting contracts for advertising privileges. One or two experiences of the power of street railway companies to reach the people in this way will, we think, serve to bring the papers of a city to reason; and in no other way can this be so effectively done. The press too often believes itself to be omnipotent, and in the discussion of municipal ownership and the lowering of rates of fare which is now going on in various cities of the country, one side only as a rule is given in its columns. "The policy of the paper" is against printing the other side. Why may not the above plan of reaching the public independently be of immense value here?

One great enemy of economy in electric railroading has always been the fluctuation of the load on the station, and if this difficulty can be eliminated or reduced by the use of storage batteries, as would seem to be possible from the experience in Pittsburgh, as described elsewhere, and at Philadelphia, as shown by Mr. Hewitt's paper at the Niagara Falls Convention, an important step forward would seem to have been attained. Storage batteries have been employed to a considerable extent in this country in electric lighting central stations, but as yet by only a few railway managers, possibly because the early experience of the latter with batteries on cars proved so disastrous. But whatever may be the present status of batteries for individual cars, it is certain that there is a field for them as current regulators. In this capacity, circumstances will determine whether their better location is at the station or at some point on the line where they will act as boosters in maintaining the line potential. The gain in economy in reducing the C^2R loss in line, motors and return, through keeping the potential constant, is generally understood, though perhaps all do not realize that if a car requires 50 amps. at 500 volts to ascend a certain grade, it will need at 450 volts 56 amps. and that the heat loss in the feeders and motors will, in consequence, be increased about 24 per cent, assuming the resistance of the conductors to be constant. As, however, the resistance increases with the temperature, the aggregate loss will be considerably more. Important as this factor is in operation, it is not in it, but in the increase in station capacity, that the chief advantage seems to lie. The gain in output secured from the generators at Pittsburgh is given elsewhere, and, somewhat strangely, exceeds the rated capacity of the batteries, owing to the fact that the latter remove the momentary peaks and fill up the intervening valleys in the load line. The general verdict of the companies making the installation in Pittsburgh is decidedly in its favor, and while the service has extended over only about six months and while troubles may develop in time, the experience of lighting companies would indicate that these will not be serious.

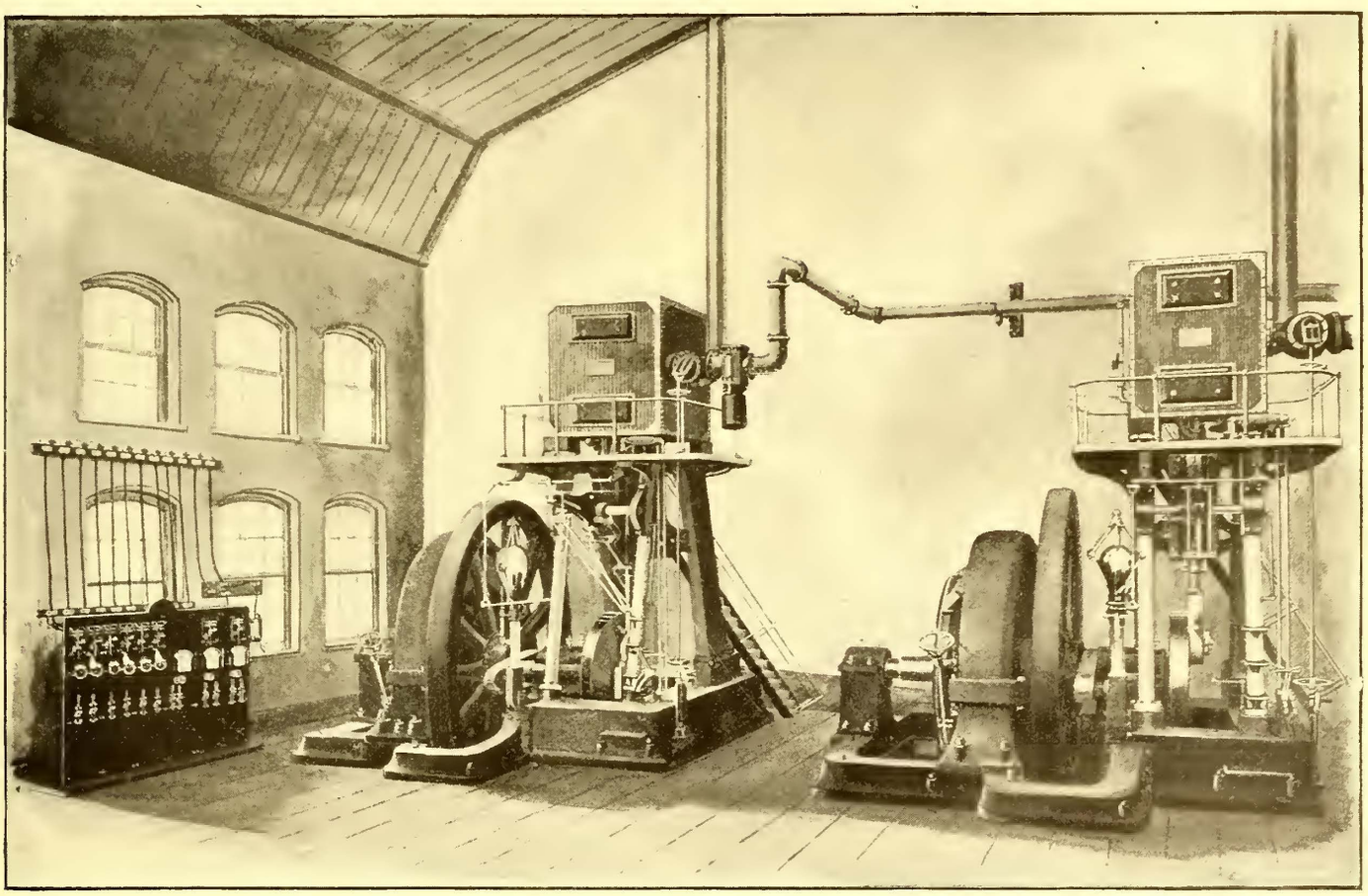
Engines for Electric Railway Power Stations*

BY CHARLES E. EMERY, PH. D.

The first paper, independent of general discussion, treated specifically of large cross-compound Corliss engines. Instead of following directly with Corliss engines of other kinds, which would have shown very many features in common with those already described, it has been thought that it would be of greater general interest to take up in this paper the subject of intermediate or medium speed engines, or those which are run faster than has been customary with the ordinary long stroke Corliss engines and slower than those previously designated "high speed engines."

The increase in the speed of revolution has been of gradual growth through a series of years, influenced generally by commercial considerations, for the reason, first, that with higher speeds a smaller engine is required, which may be made heavier proportionately and still be cheaper than a slow speed engine of the same grade and power, and, second, that the higher speeds reduce materially the cost of direct connected electric generators. Moreover, the success of special engines built to run at high speeds caused a feeling that higher speeds were practicable even with engines of sizes that had previously been run at slow speed. The writer in the previous article pointed out the lessons learned on board steamships, and from the entire discussion it may be inferred that the limit of speed may well be fixed at a point where the working parts of an engine can readily be inspected by the eye and hand of the engineer, while the engine is in operation. It has been pointed out that the speed even of Corliss engines may be increased, there being no difficulty whatever in caring for such engines when running at 100 to 105 r. p. m., at which the disengaging gear of ordinary type operates with certainty and reliability. This speed, moreover, has for a number of years been very considerably exceeded in a Corliss engine in use in one of the Trenton (N. J.) rolling mills. The term "medium" or "intermediate speed engine" is, however, more especially applicable to a class of engine in which an automatic cut-off is provided with positive, as distinguished from disengaging, valve gear, capable therefore of operation at any speed for which the engine may in other respects be adapted.

It is always difficult to select the head of a list, when a commercial question is in any way involved. An alphabetical arrangement, though a compromise, frequently gives rise to most flagrant inequalities, so we find it necessary in this case, as has been done with the Corliss engines, to arrange the different engines, so far as practicable, on an historical basis, adding, what should be unnecessary, that this arrangement is not intended to indicate in any way the relative merits of the different engines.



PORTER-ALLEN ENGINES IN POWER STATION OF NEW YORK AND BROOKLYN BRIDGE RAILWAY

An intermediate speed engine corresponding to the above definition was brought to the attention of the world at the Paris Universal Exposition of 1867, in complete operative form, which still preserves its identity. It was known as the Porter-Allen engine and was first developed in the United States. J. F. Allen, the inventor of many of the original features, became associated with Charles T. Porter, to whose business energy and mechanical and inventive skill was due the development of the engine in a practically perfected form some thirty years ago.

There were three of these engines exhibited at Paris. The largest was a condensing engine with cylinder 12 ins. diameter and 24 ins. stroke, and was run regularly at 200 r. p. m., or at a piston speed of 800 ft. per minute. A rod extended through the rear head of the cylinder and operated directly the single acting plunger of the air pump. The plunger was provided with a conoidal head, and the weight was made the same as that of the water it displaced. Two smaller engines were shown, one in section being moved by the other, so as to show the operation of the valves. These engines were driven at times up to a piston speed of 1400 ft. per minute. All the engines and

*Continued from the STREET RAILWAY JOURNAL of October, 1897.

the long stroke, full speed air pump, operated quietly and satisfactorily. The engines were built by the Whitworth Company, of Manchester, England, with which Mr. Porter was at the time associated.

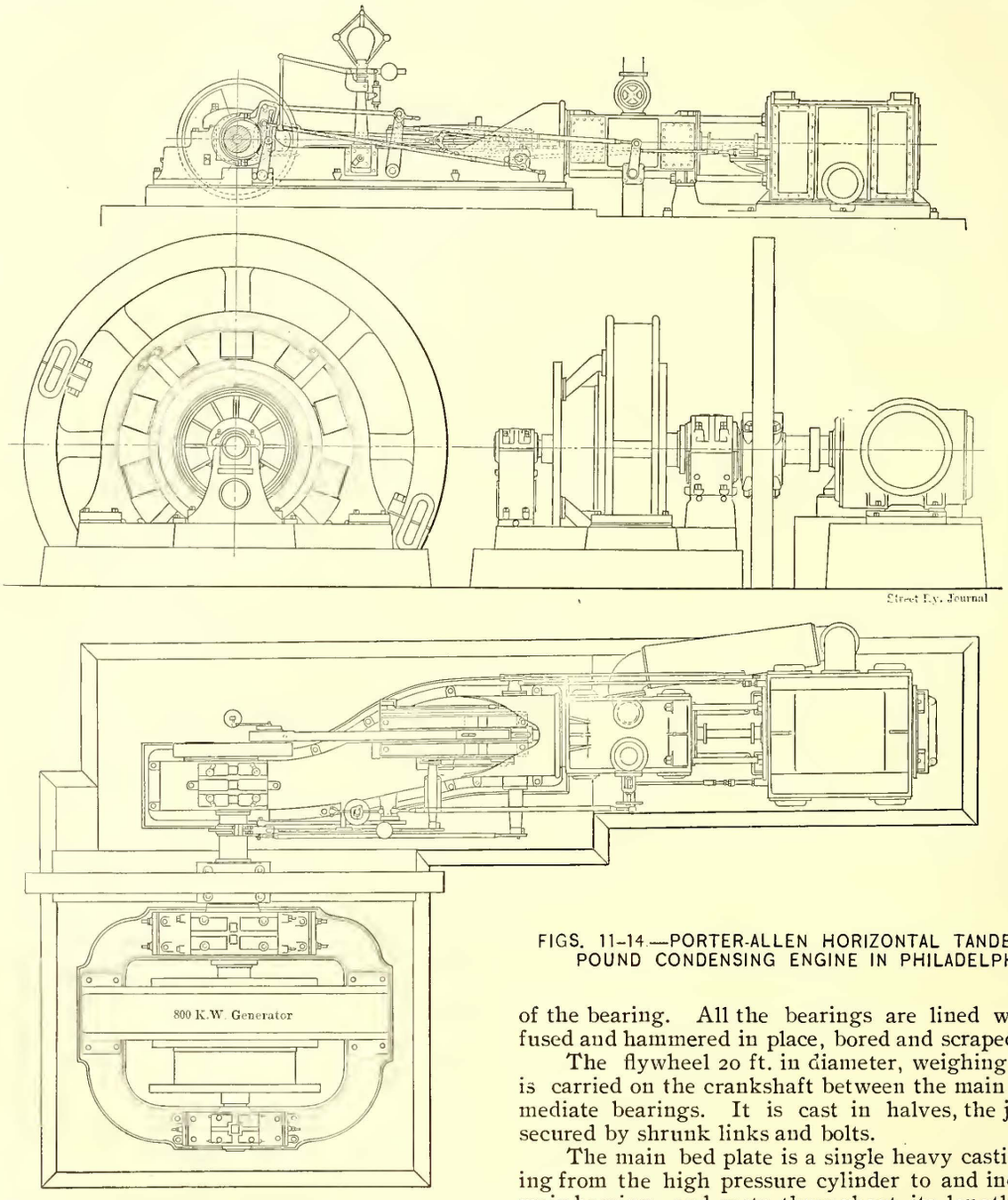
THE PORTER-ALLEN ENGINES OF THE SOUTHWARK FOUNDRY & MACHINE COMPANY.

This firm manufactures the Porter-Allen engine of to-day as well as engines of various kinds, many of them embodying the principal features of the Porter-Allen valve gear. The firm reports that it has built the Porter-Allen compound engine in sizes up to 40 ins. and 75 ins. × 66 ins., having a rating of 3500 h. p. and a maximum capacity of 4700 h. p. for rolling mill service; that it has also built vertical quadruple expansion engines for electric lighting service of 2250 rated h. p. and a maximum capacity of over 2900 h. p.

We select for illustration two engines built by this firm, one horizontal and one vertical.

Fig. 11 shows a plan view of one of four horizontal, tandem compound, condensing Porter-Allen engines built for the Delaware Avenue power house of the Union Traction Company, of Philadelphia; Fig. 12 is a side view; Fig. 13, an end view; and Fig. 14, an end view of the outer bearing, flywheel and dynamo.

These engines have cylinders 24 ins. and 46 ins. in diameter by 42 ins. stroke, and are designed to operate at a speed of 120 r. p. m. with a steam pressure of 125 lbs. Each engine is directly connected to a 800 k. w., multipolar railway generator. The crankshaft is carried in three bearings, viz., one main bearing and two outboard bearings, one at each side of the dynamo, all adjustable both vertically and horizontally. The main bearing is of the quarter box type, being adjustable forward and backward by means of broad wedges extending the full length



FIGS. 11–14.—PORTER-ALLEN HORIZONTAL TANDEM COMPOUND CONDENSING ENGINE IN PHILADELPHIA.

of the bearing. All the bearings are lined with babbitt fused and hammered in place, bored and scraped to fit.

The flywheel 20 ft. in diameter, weighing 60,000 lbs. is carried on the crankshaft between the main and intermediate bearings. It is cast in halves, the joints being secured by shrunk links and bolts.

The main bed plate is a single heavy casting extending from the high pressure cylinder to and including the main bearing, and rests throughout its length upon the foundation. The guides are of the four bar type. The connecting rod is forged solid at the crank pin end and is strapped at the crosshead ends. The boxes are made adjustable in such direction as to maintain a constant length between centers.

The distribution of steam in each cylinder is effected by means of four independent flat balanced valves, two for admission and two for exhaust, as shown in Fig. 15, which is a horizontal section of a typical Porter-Allen cylinder. Each valve is in the form of a hollow rectangle scraped to the valve seat and covered by a plate scraped down on the valve and, for the steam valves also, upon inclined side bearings so that, as shown in Fig. 16, which is a cross section of a typical Porter-Allen steam cylinder, the cover plate may be lifted slightly by means of set-

screws beneath the chest, thus permitting the valve to move freely between the seat and plate and yet remain steamtight. On the exhaust side the cover plate is screwed fast at the sides as shown, so that the valve will not be lifted by the pressure in the steam cylinder, freedom of the valve being secured by scraping. Referring to Fig. 15, it will be seen that the ports at the valve seats are wide

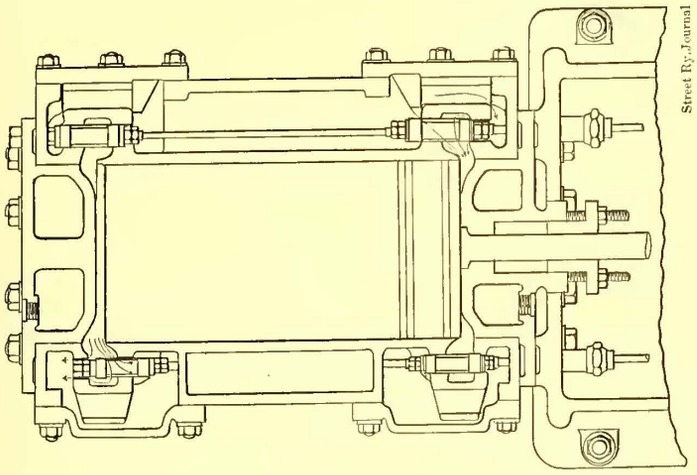
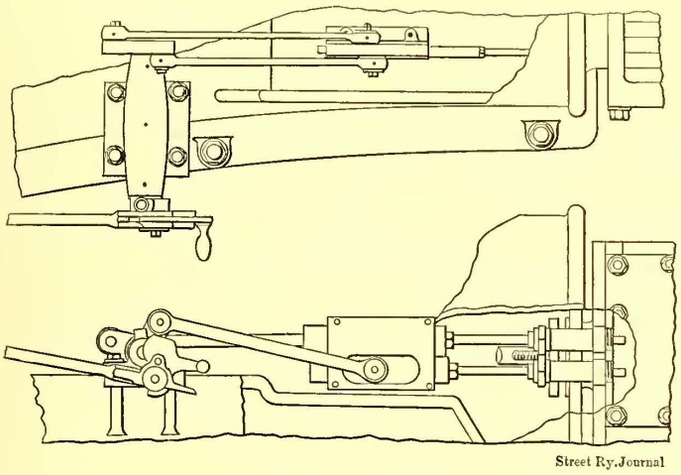


FIG. 15



FIGS. 17 AND 18.

FIGS. 15-21.—DETAILS OF PORTER-ALLEN ENGINE.

and that there is a corresponding cavity in each cover plate communicating with the port through the center of the valve. As a valve is moved to one side, steam is admitted both to the port and to the cavity in the cover plate at *both* ends of the valve so that at the moment of opening there are practically four ports which operate to make the admission, cut-off and release very prompt and effective. The two steam valves are operated by separate valve stems connected through links to levers at different angles on a rockshaft, as shown in plan in Fig. 17, and in elevation in Fig. 18, thus securing for these separate valves, the prompt action in opening and slight motion when closed, due to the wrist motion of the Corliss valve gear. The two exhaust valves for each cylinder are connected together and operated independently. In the tandem compound engine shown, the admission valves of the high pressure cylinders only are controlled by the Porter governor, while those of the low pressure cylinder are adjustable by hand. The exhaust valves of both cylinders maintain a constant release and compression.

The governor shown in Fig. 19 is of the Porter type, in which small balls lift a heavy weight so that a high speed is required, which causes the governor to be quite powerful. The motion is regulated by a dash pot, as shown.

The governor varies the valve gear by shifting the block in a peculiar form of stationary link. The ordinary link motion has two eccentrics, one attached at each end of the link, and in the usual form the link is shifted over the block. In the stationary form, now rarely seen, the link is suspended at the center, and thus is called stationary, and the block is swung. This was the form of link originally used by Mr. Allen. Mr. Porter afterward designed the link, of which a side view is shown in Fig. 20 and an edge view in Fig. 21. The link is brought close up to the shaft and forms part of the eccentric

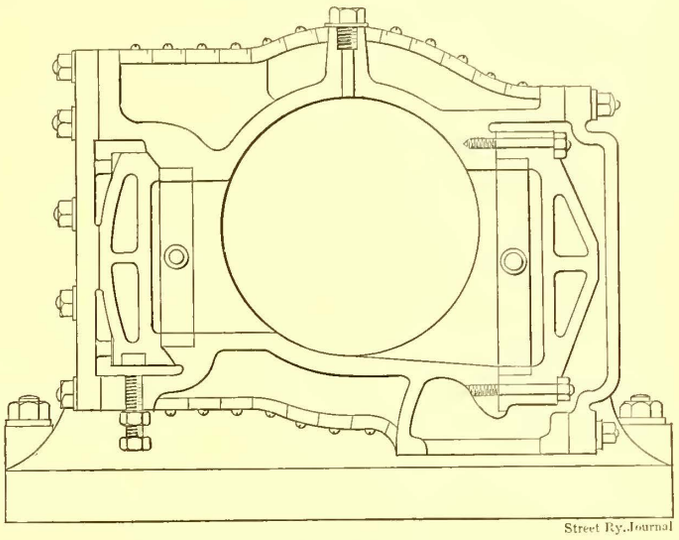


FIG. 16

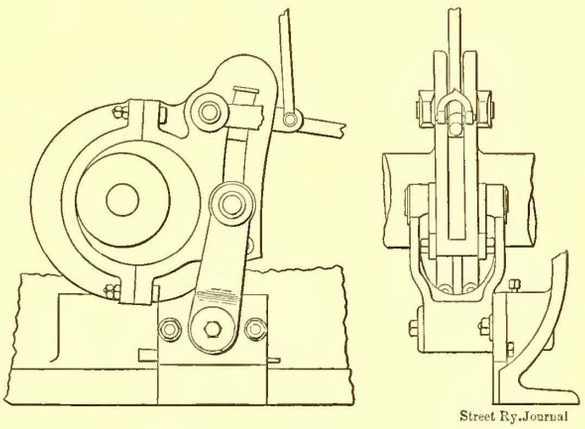


FIG. 20 FIG. 21

strap. It is supported opposite the center by arms connected to the engine frame, but the lower half, not being needed for reversing, is omitted. The consequence is that the throw of the eccentric opposite to the point of suspension gives full lead, and at any distance out from the center the combined lead and a motion at right angles thereto is taken from the link, the same as from any other link, although the construction is very much simpler. The cut-off valves are driven from the shifting block; the exhaust valves are generally driven from the side of the link. These engines are designed to develop about 1100 h. p. at the most economical point of cut-off with a maximum capacity about 50 per cent greater.

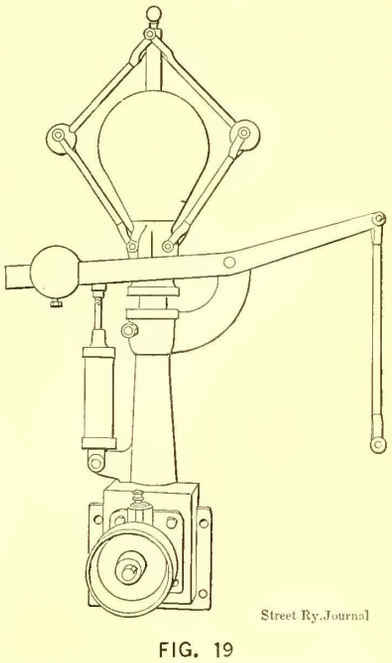


FIG. 19

On page 23 is an illustration of the engines built by this company, directly connected to dynamos for furnish-

ing current to switch the cars for the New York and Brooklyn Bridge and operate the same at night or in case of emergency. Fig. 22 is a vertical elevation, Fig. 23 a side elevation, and Fig. 24 a plan view of the same. Each has a steam cylinder 30½ ins. diameter by 36 ins. stroke, and

The special feature of this engine is the valve gear. The valves are of the Porter-Allen type already described. The governor is also of the Porter-Allen type shown in Fig. 19. The link motion is, however, of the radial type which derives its motion entirely from a point in the connecting rod intermediate between the crank-pin and crosshead. The governor shifts the block as in the other

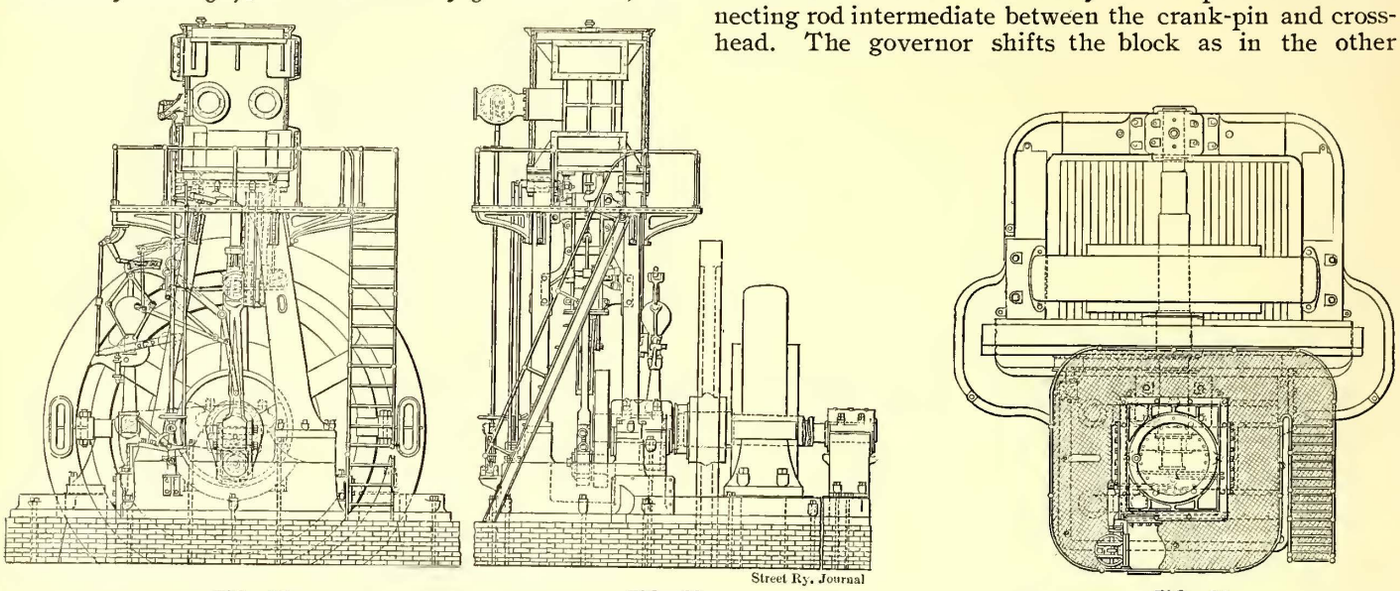
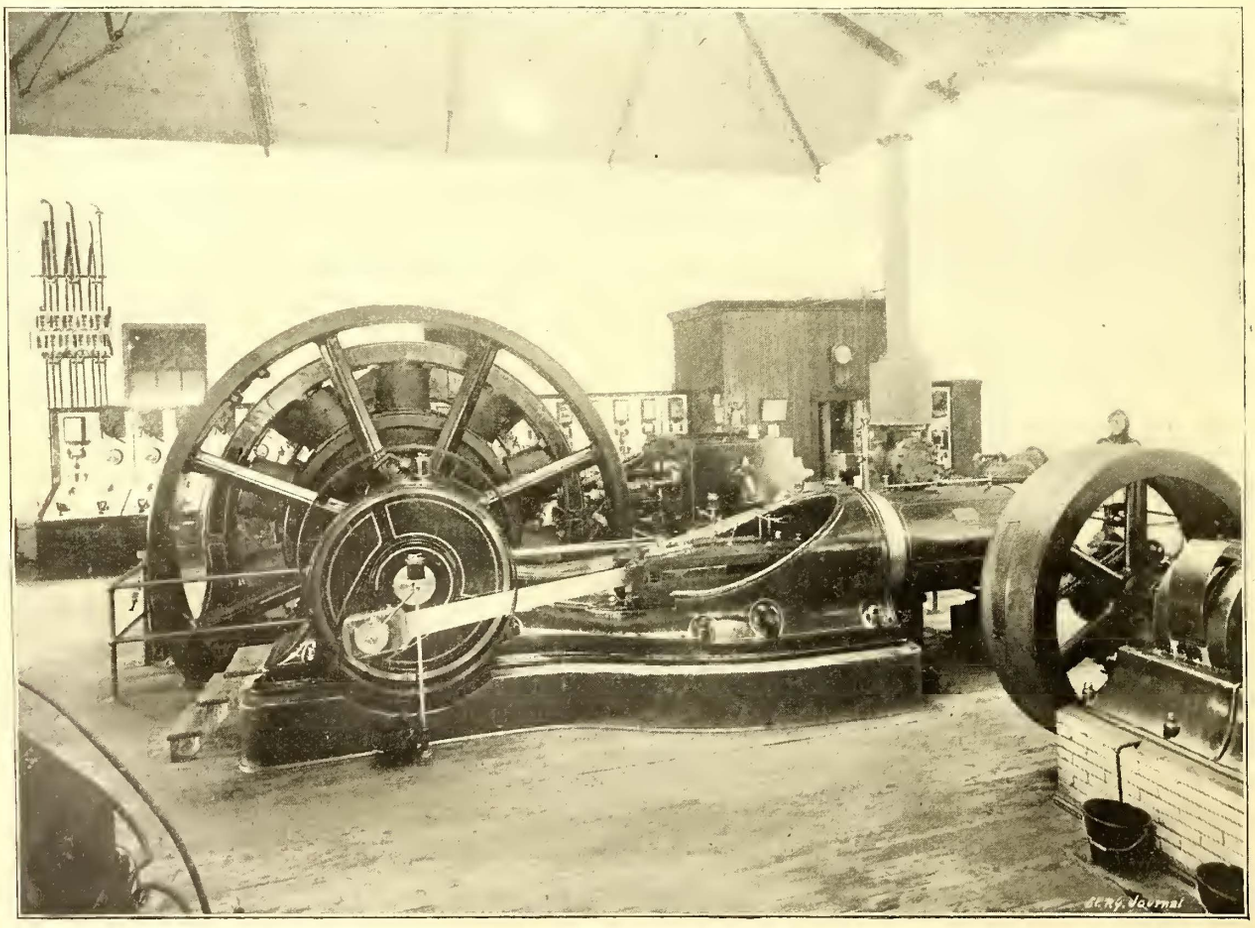


FIG. 22 FIG. 23 FIG. 24

VERTICAL, NON-CONDENSING PORTER-ALLEN ENGINE—NEW YORK AND BROOKLYN BRIDGE

is designed to run at a speed of 100 r. p. m. with a steam pressure of 100 lbs. Each is provided with a flywheel 16 ft. in diameter and weighing 36,000 lbs. The crankshaft is carried in two bearings which are connected to

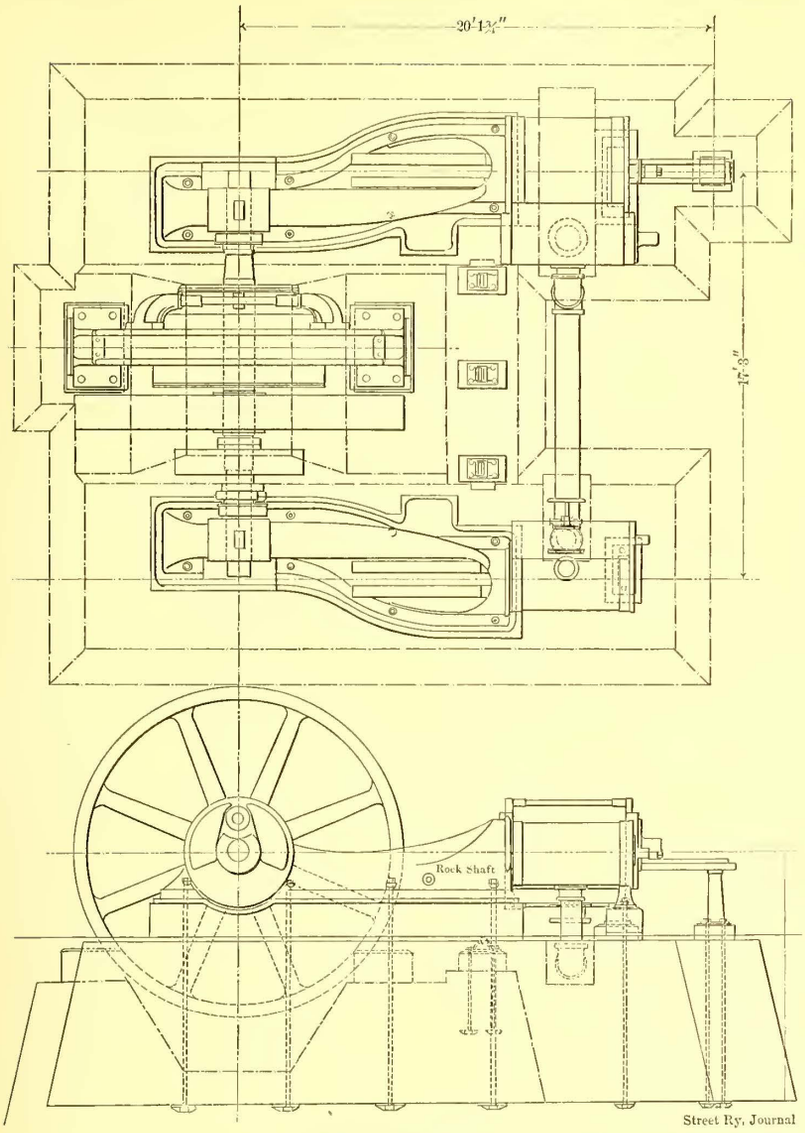
case, the principal difference being in the manner or way the link is operated. The exhaust valves give a constant release and compression as in the other case. The housings consist of a heavy cast iron rear column car-



"BUCKEYE" CROSS COMPOUND ENGINE IN STATION OF THE CALUMET ELECTRIC RAILWAY CO., CHICAGO

each other by a continuous bed plate which also carries the fields of a generator. The armature of the same is located on the shaft between the flywheel and the outboard bearing.

ried forward at the top to form an entablature to which the steam cylinder is bolted, and a turned column in front, which may be removed without displacing the steam cylinder, in case it becomes necessary at any time to remove



FIGS. 25 AND 27

and cut-off eccentrics. The cut-off is regulated by a shaft governor which adjusts the cut-off eccentric around the shaft through a prearranged angle. The Buckeye cut-off, being adapted for all speeds, has been used in engines which may severally be classed as slow speed, high speed and intermediate speed. The typical engines are, however, of the intermediate speed variety. The firm built its first compound engine in the year 1879, since which the circulars show its adaptation in various forms to all classes of work.

We select for illustration one cross compound horizontal engine, one tandem compound horizontal engine and a high speed vertical engine.

On page 26 is an illustration of the station of the Calumet Railway Company, of Chicago showng a cross compound engine engine hereinafter referred to.

On page 27 is a similar view in the electric station of the Dayton Electric Street Railway Company, showing tandem compound engines built by the Buckeye Company.

On page 29 is an illustration of a high speed

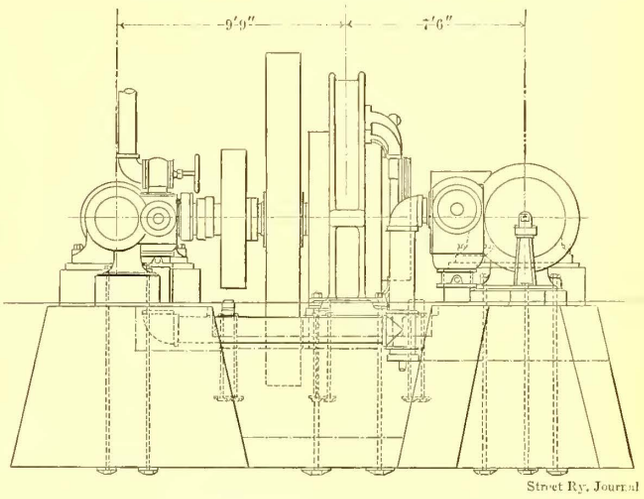


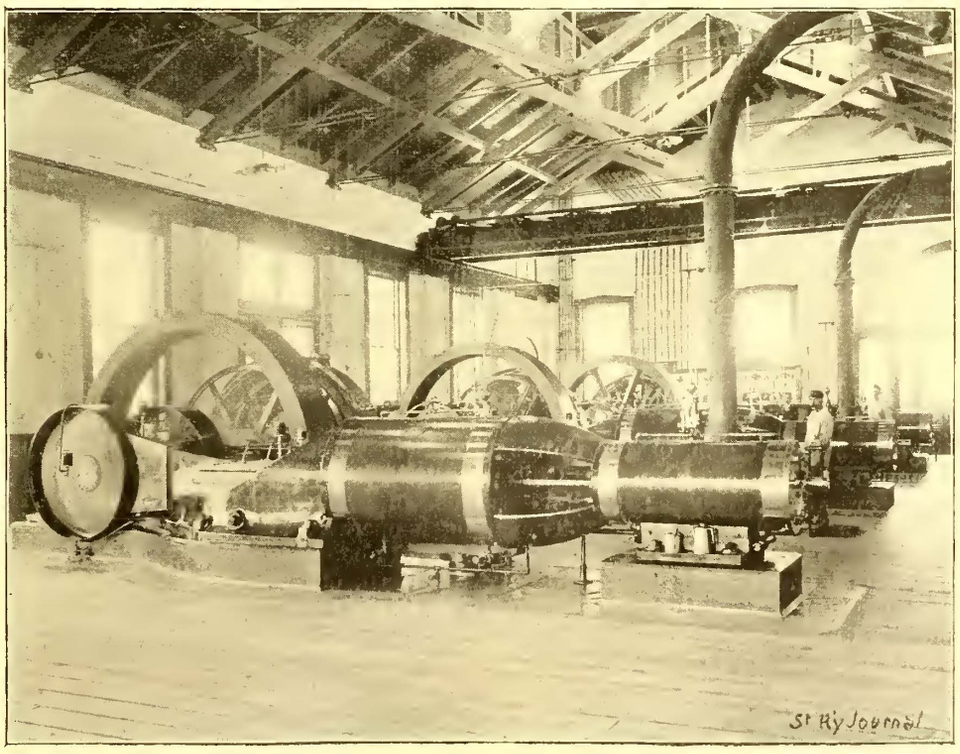
FIG. 26

"BUCKEYE" CROSS COMPOUND ENGINE IN STATION OF CALUMET ELECTRIC RAILWAY CO.—CHICAGO

the shaft. The crossheads are of the slipper pattern fitted with a forged steel pin which is secured by taper and nut and permits the connecting rod to have a solid forged crosshead end. The manufacturers claim that the valve gear used on these engines is capable of cutting off at a much later point than the ordinary gears—an important consideration where the average load is but a small percentage of the maximum capacity of the engine.

ENGINES OF THE BUCKEYE ENGINE COMPANY

The Buckeye Engine Company is believed to have put on the market an engine answering the description given of an "intermediate speed" engine at an earlier date than other builders, with the exception previously referred to. Its automatic valve gear is of the positive type. The steam is distributed by a main valve, thus securing uniform steam lead, release and compression. Expansion is effected by a riding cut-off operated by the combined movements of the main



"BUCKEYE" TANDEM COMPOUND ENGINES IN STATION OF THE DAYTON (O.) STREET RAILWAY CO,

vertical engine in the station of the Fall River Electric Light Company, built by the same company.

Fig. 25 is a side elevation, Fig. 26 an end elevation, and Fig. 27 a plan view of the Buckeye cross compound

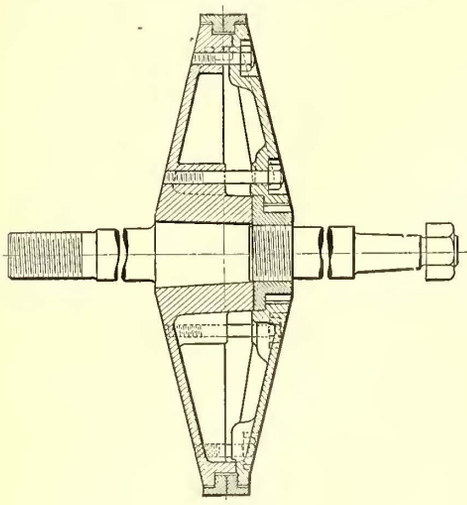
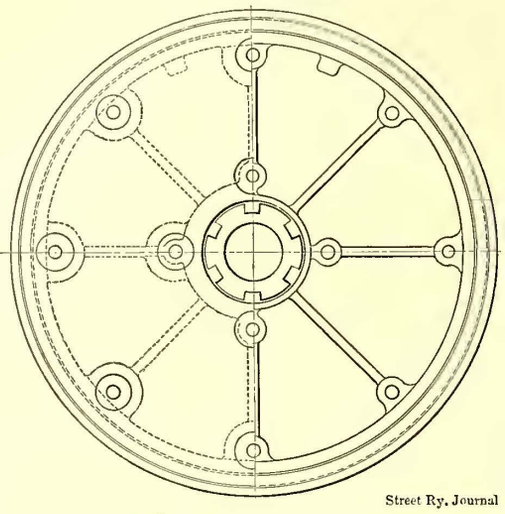


FIG. 28

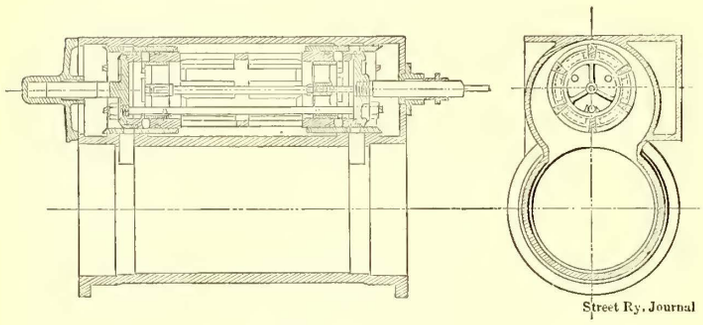


Street Ry. Journal

FIG. 29

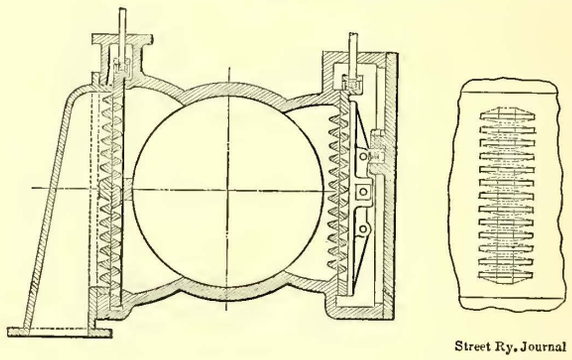
Fig. 28 shows a cross section of a piston used at times by the Buckeye Company, and Fig. 29 a face view of the same, part with the follower in place and part with the same removed. As shown, the piston is made deeper in the center than at the edges. The piston body is of single web type and covered by a follower of the same type, but of less depth, secured on two diameters with 1⅛ in. tap bolts. The piston rod is secured in the piston body by taper and a nut, which latter is in part covered by the follower. The double rings, as shown, extend the full width of the face of the piston which is 4 ins. in this case, and are provided centrally with interior flanges which engage between the follower and piston. The rings for this particular piston are of cast iron and are held in place by their own elasticity. The piston is provided with a tail rod to carry the weight.

The valves of the Calumet engine are of the piston type. The arrangement for the high pressure cylinder is shown in Figs. 30 and 30A. As will be seen, the valve chamber is bushed at the ends, and the interior of the bushings forms the valve seats of



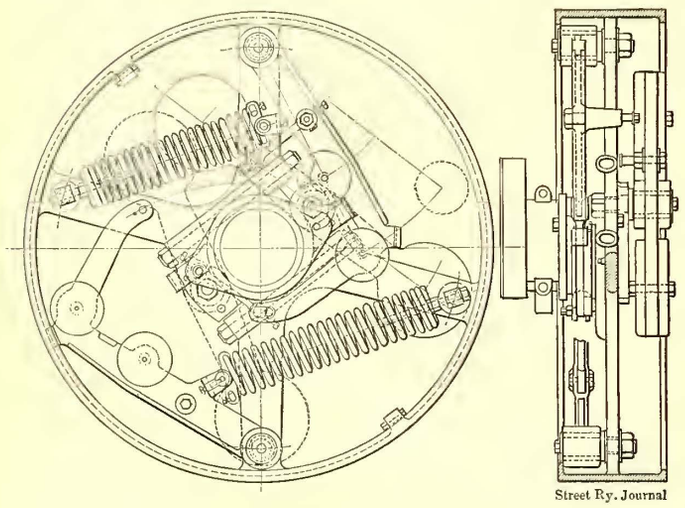
Street Ry. Journal

FIG. 30 FIG. 30A



Street Ry. Journal

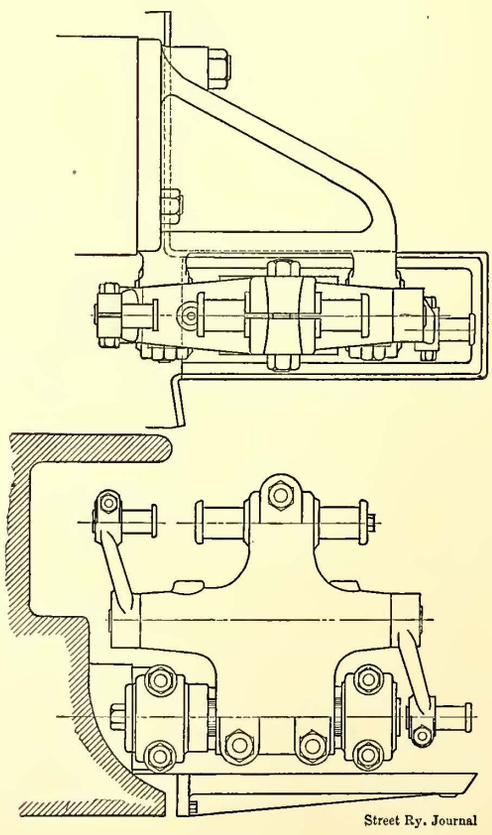
FIG. 31 FIG. 32



Street Ry. Journal

FIG. 34

FIGS. 28-34.—DETAILS OF "BUCKEYE" ENGINES



Street Ry. Journal

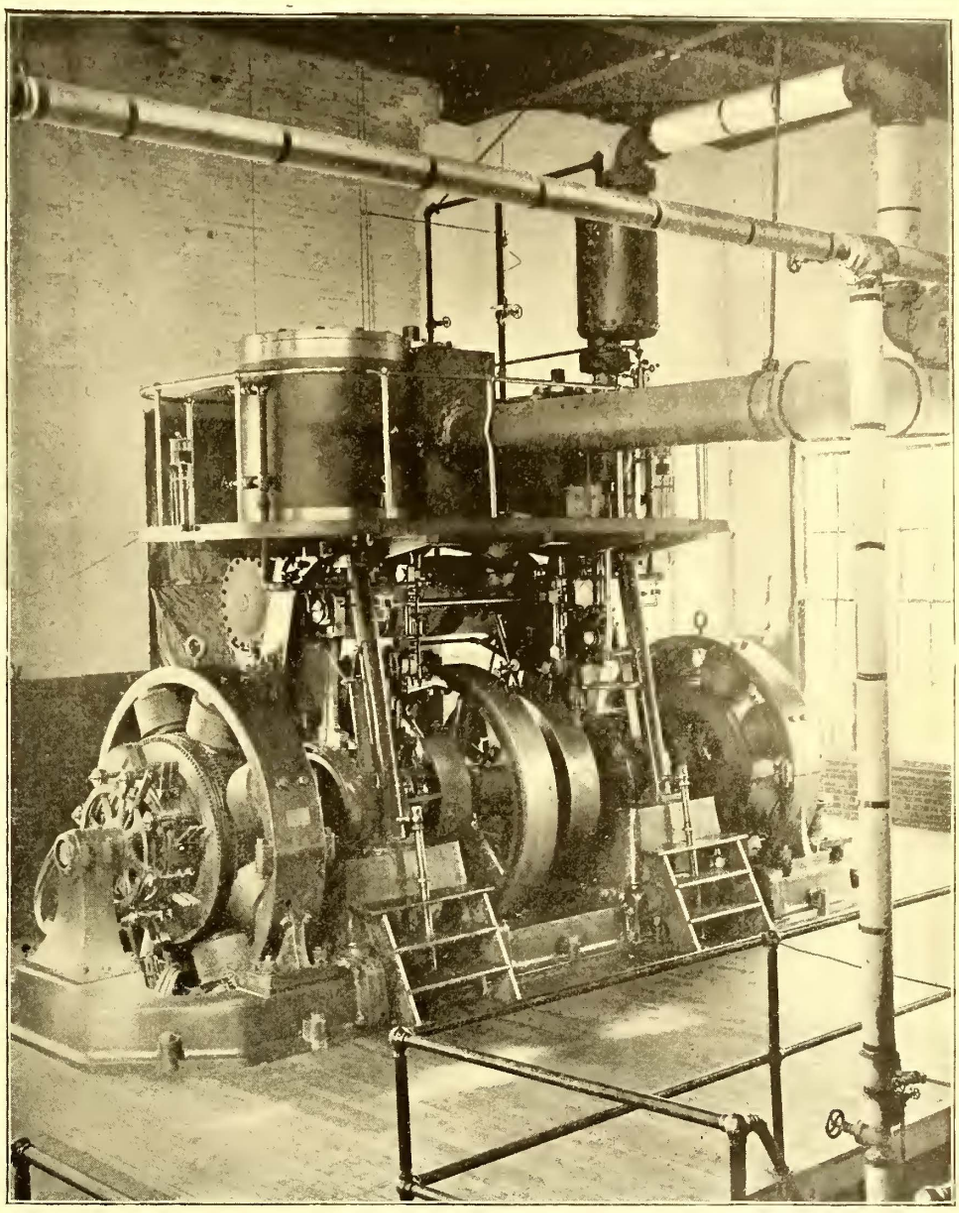
FIGS. 33 AND 33A.

engine in the station of the Calumet Electric Railway Company, at Burnside Crossing, Chicago, Ill. The cylinders are respectively 22 ins. and 42 ins. in diameter with 33 in. stroke of pistons. The engine is operated at a speed of 130 r. p. m. with a steam pressure of about 120 lbs. Each frame is of the usual Buckeye pattern, of box section, curving in outline from the cylinder to the pillow block with base broadened out and secured to the foundation the whole length. The guides are of the four bar type secured in a depression in the frame. The cylinder is attached to one end of the frame, and overhangs, but there is a sliding support, on a special foundation at the outer end. The flywheel, electric generator and governor wheel are arranged on the shaft in the space between the two bearings.

the main valve which is itself hollow, and the interior forms the seat of the piston cut-off valve. Both valves are provided with packing rings and are severally operated by separate eccentrics through concentric stems, the action of the cut-off valve being precisely the same as described in relation to the slide valve, with riding cut-off, first developed and still used by this firm. In some of the larger engines, not illustrated, gridiron valves are employed, as shown in Figs. 31 and 32. The gridiron steam and exhaust valves are moved at right angles to the axis of the cylinder and the cut-off valve parallel therewith.

Fig. 33 shows the main valve rocker arm which vibrates at the bottom in capped bearings brass lined, the rocker arm being clamped to the shaft. Near its center it carries the bearing of the cut-off rocker arm. The upper inner arm operates the cut-off, the lower outer arm receives motion from the cut-off eccentric operated by the governor. The motion imparted to the cut-off valve is therefore compound, being in part derived from the main valve and part from the cut-off eccentric which is angularly adjusted by the governor.

Fig. 34 shows a new long range inertia governor manufactured by this firm. It is stated by the manufacturers that it will carry the cut-off through three-fourths stroke or more, and that it is so regulated that there is no change of speed between full load and no load, except the temporary variations due to sudden large changes of load. The manufacturers claim that with this particular valve gear the cut-off is, under most conditions, as sharp as that of a disengaging cut-off; that the distribution of steam is as perfect; that the compounding of the motion through the rocker arm causes the valves to maintain the same extent of travel, which is favorable to uniform wear and tightness, and that the governor, being direct acting, controls the engine promptly so as to prevent many of the disastrous accidents which have occurred with engines having the governor operated by a belt.



"BUCKEYE" HIGH SPEED VERTICAL ENGINE.—FALL RIVER, MASS.

THE ENGINES OF MCINTOSH, SEYMOUR & COMPANY

This firm manufactures several types of engines. Some are for high speed, but the more distinctive are horizontal and vertical engines for medium or slow speeds. The prominent special features of the engines last referred to are stated by the manufacturers to be the "gridiron valves driven by a valve motion which is positive throughout; the shaft governor which operates the cut-off valve and controls the speed; the frame which is of massive form and rests throughout its entire length upon the foundation, and the main bearings which are self-oiling and provided with water jacketed removable shells." "The valve gear of these engines will operate equally well at any speed." These engines have been classed as intermediate speed engines, for the reason that many have been operated at speeds intermediate between those of high and low speed engines, though equally well adapted for any speed. A large number of the engines have been applied in electric railway power stations, but there has been selected, for special illustration and description in this article, an engine by this firm recently erected in the new Brooklyn Edison station, which may be described as a double tandem compound, horizontal, side crank engine, with flywheel between the frames, direct connected to a 2000 k. w. General Electric alternator. The engine is provided with cylinders 24 ins. and 48 ins. diameter, with 66 ins. stroke, and is operated at a speed of 75 r. p. m. with a boiler pressure of 165 lbs. This particular engine is therefore not an intermediate speed engine strictly, but the details are precisely the same as would be used for that purpose, and the engine is selected on account of the general interest that attaches to this large station, the first of those in which alternating current is to be generated by steam power at a convenient location—in this case on tide water in the outskirts of the city—and distributed at high tension through transformers to rotary converters at different substations in the city proper and its suburbs, from which low tension direct current on the three wire system is to be distributed to consumers in the usual way, alternating current being also available for power purposes.

The illustration on page 30 is a perspective view of the engine. On page 30 is a side view of the cylinders and valve gear.

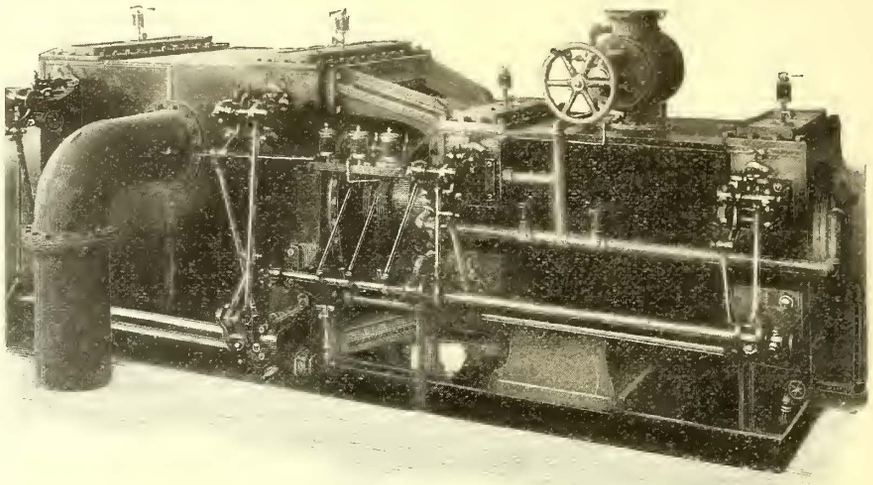
Fig. 35 is a side elevation and Fig. 36 a plan view of the engine. The frames are bolted throughout their entire

lengths to the foundation, and the two vertical members forming the sides of each frame are connected by a continuous horizontal web from one to the other, giving lateral stiffness. The cylinders overhang the ends of the frame so as to permit free expansion, but the small cylinders are provided with sliding supports. The crossheads are of the old fashioned four bar type with ample surface. The high and low pressure cylinders are connected through an intermediate chamber common to both engines, and contain 1500 sq. ft. of surface in the form of small brass tubes heated with live steam. It is expected that this surface will be sufficient to superheat the steam passing to the larger cylinders. Stop valves are provided so that either engine may be run separately.

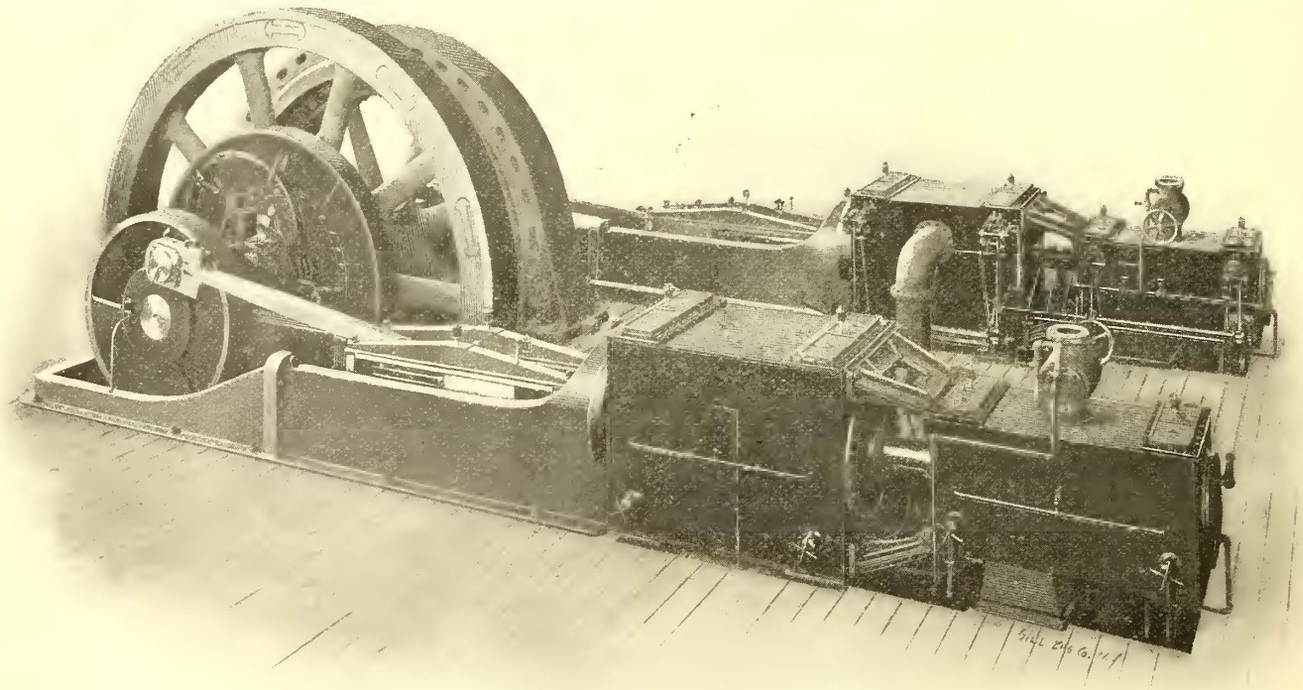
Fig. 37 is a cross section of a typical cylinder made by this firm, including a longitudinal section of the gridiron valves and a side view of the valve operating gear. Fig. 38 is a half length longitudinal section of the cylinder showing an end view of the steam and cut-off valves and the exhaust valve chamber, and a half longitudinal exterior view of cylinder showing also the valve operating mechanism. The high pressure cylinder is jacketed with live steam both on the barrel and heads. From the several views it will be seen that for each tandem engine the main and cut-off valve eccentrics on the main shaft, through suitable connections, operate longitudinal rockshafts supported near the base of the engine frame and larger cylinder, and that arms on such rockshafts, through suitable connections and bell crank levers, impart motion to the main and cut-off valves of that cylinder. Motion is also imparted from these rockshafts to secondary rockshafts run alongside the smaller cylinder, upon which arms are arranged to operate the main and cut-off valves of that cylinder through connections and bell crank levers. The operating levers are arranged at such angles that the valves open and close quickly and rest with little motion in the closed positions on the principle described in relation to Corliss engines.

As will be seen, there is, at the top, a gridiron induction valve at each end and a cut-off valve riding on the same, such valves being operated through separate stems and connections from independent rockshafts. The exhaust valve at each end is below the cylinder, in a suitable chamber, with the seat facing upward and the valve lying upon the same so that the steam pressure always tends to keep the valve to its seat. The gridiron type of valve, in addition to the advantages which have been set forth in the general discussion, has also the advantage that the steam valves will lift in case there is water in the cylinder and permit its escape back into the steam pipe, thus in many cases avoiding accident, and it has been found that even in extreme cases only the valves themselves, which are easily renewed, have been broken instead of the larger and more expensive castings. There is, however, provided a poppet relief valve closing an opening in the exhaust port from each end of the cylinder, opening by pressure from the cylinder directly to the exhaust cavity, the pressure being resisted by an adjustable spring.

Figs. 39 and 39A show the shaft governor used for operating the cut-off valves. It consists of heavy revolving weights, the centrifugal force of which is resisted by plate



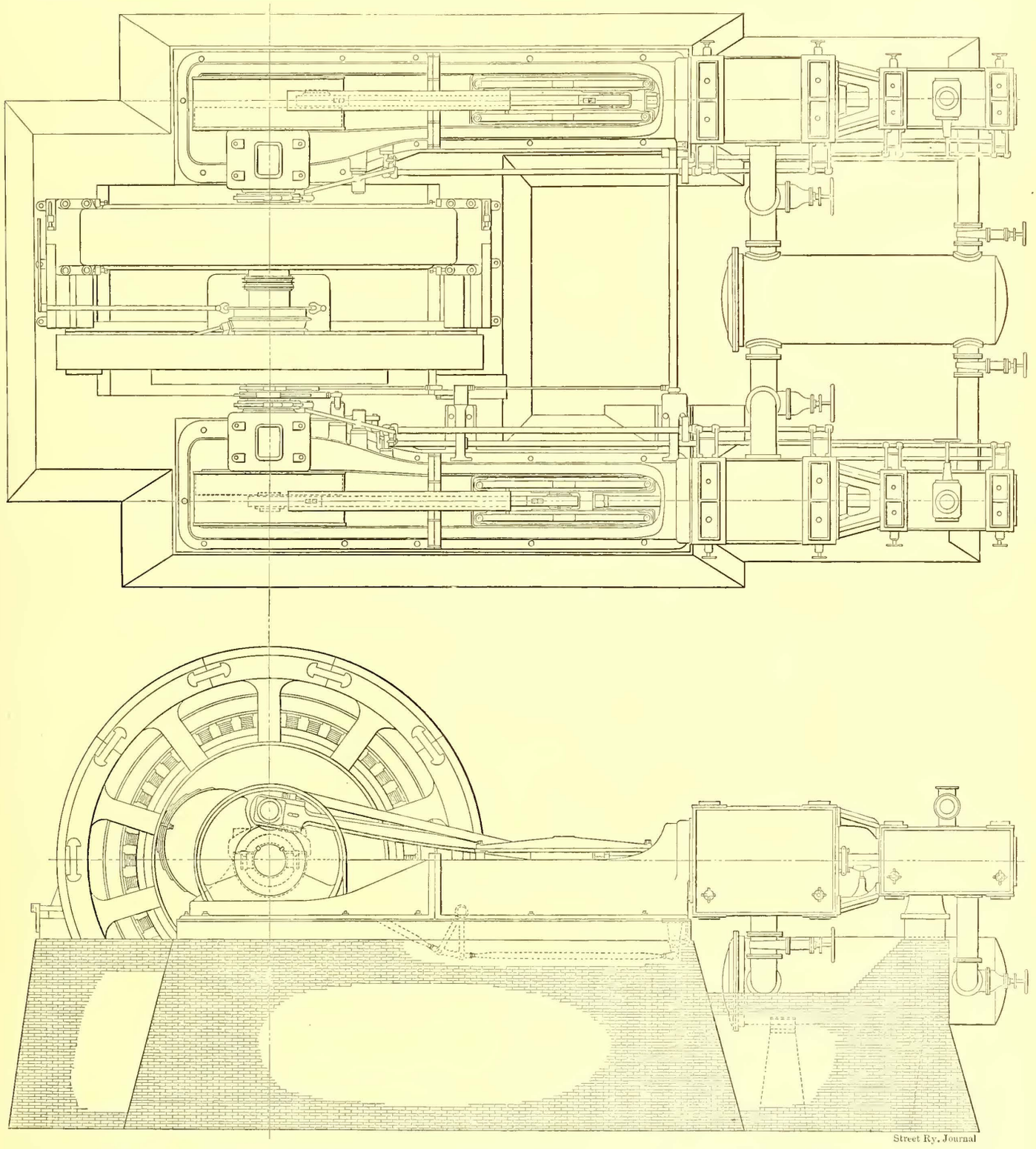
CYLINDERS AND VALVE GEAR, "BROOKLYN EDISON" ENGINE—McINTOSH, SEYMOUR & CO.



THE "BROOKLYN EDISON" ENGINE—McINTOSH, SEYMOUR & CO.

springs through adjustable hardened steel pins with a cup bearing at each end. Dash pots are provided to give stability to the governor. The speed is regulated by changing the weight of bushings applied in openings in the weights. The governor operates to revolve the cut-off eccentric on its shaft. On this particular engine, there is an auxiliary governor spring controlled by a sliding collar actuated by a hand wheel, by which the tension on the main spring can be increased or diminished, thus varying the speed of the engine while it is running. The alternators are to be run in parallel, and the device for changing the speed of the engine will be a convenience in throwing part of the load on another engine dynamo and in properly distributing the load between the several dynamos when in regular operation.

Fig. 38 shows also the form of piston adopted for the large cylinder of this engine. There is a single central packing ring which is gripped by making the piston in two transverse halves clamped together by the central nut on the piston rod. The loosening of this nut is prevented by a clamp ring thereon lying in a circular recess and held by a screw.



FIGS. 35 AND 36.—PLAN AND ELEVATION, "BROOKLYN EDISON" ENGINE—McINTOSH, SEYMOUR & CO.

Fig. 40 shows the flywheel. It is of a built-up pattern with each segment of the rim cast integrally with one arm, thus preventing undue shrinkage strains. The segments are joined by arrow head links and the inner ends of arms clamped by reamed bolts between disks forming hub plates, which are forced on the shaft by hydraulic pressure. The wheel is turned true and balanced.

Fig. 41 shows one of the main bearings with remov-

able shells. The side gibs are set up by wedges operated by screws extending through the cap. The lower shells may be revolved out by slightly lifting the shaft in any manner after removing the cap and gibs. The shells are made hollow for water circulation. Rings upon the shaft at

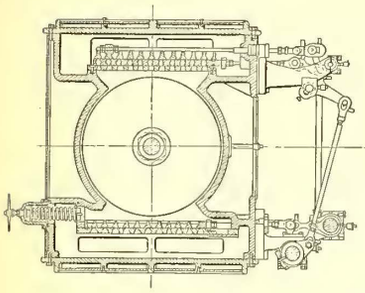


FIG. 37

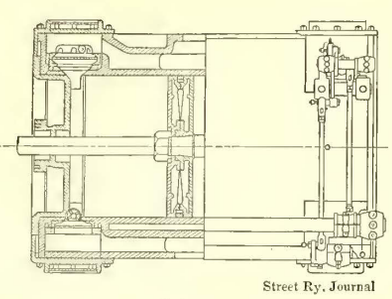


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FIG. 38

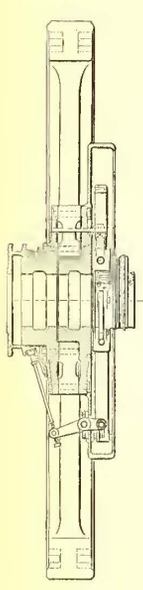

FIG. 39A

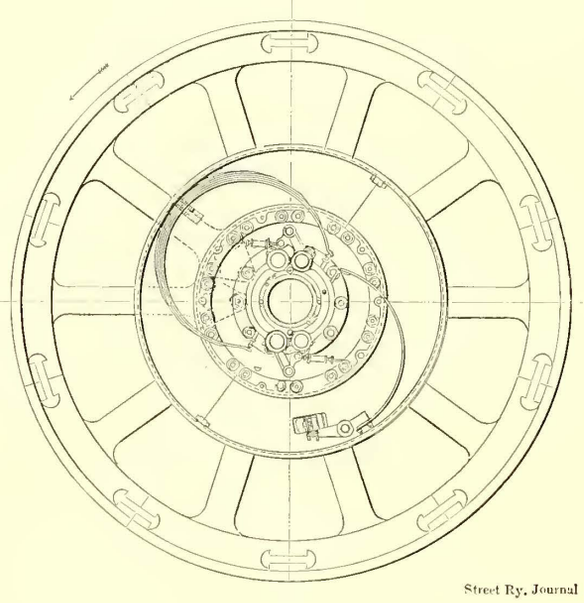

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FIG. 39

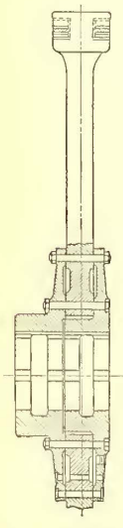
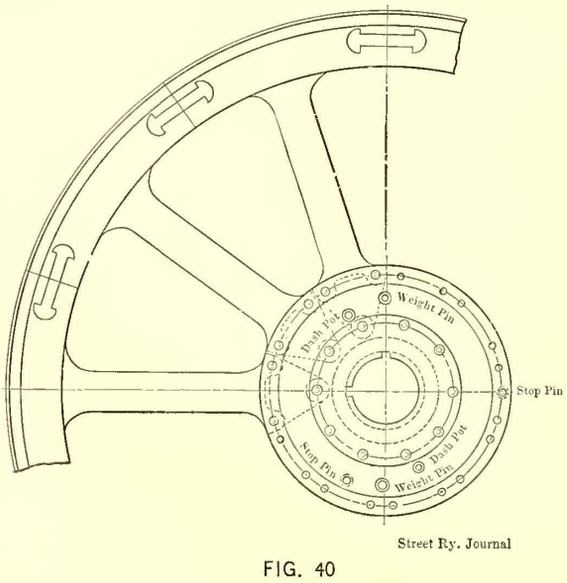


FIG. 40A



Street Ry. Journal

FIG. 40

ends of bearings throw the escaping oil into shields provided for that purpose, from which it is conveyed to suitable settling reservoirs underneath. A small pump operated by the valve gear forces a continuous supply of oil from the reservoir upon the bearings, thus keeping them constantly flooded.

Fig. 42 shows in section the sleeve extending over the piston rod, between the high and low pressure cylinders. It is babbitted and bored out to fit the rod. An adjustable support is provided under the sleeve to adjust for wear and support the piston centrally in the cylinders so that only the piston rings will bear on the cylinder. A stuffing box, accessible from the outside, is provided between the packing tube and high pressure cylinder.

The circulars of the company show that a very large number of horizontal and vertical four valve engines, of the type described, have been introduced for operating mills, electric apparatus and machinery of all kinds, with satisfactory results as to capacity, economy, smoothness of operation and adaptability for the purpose.

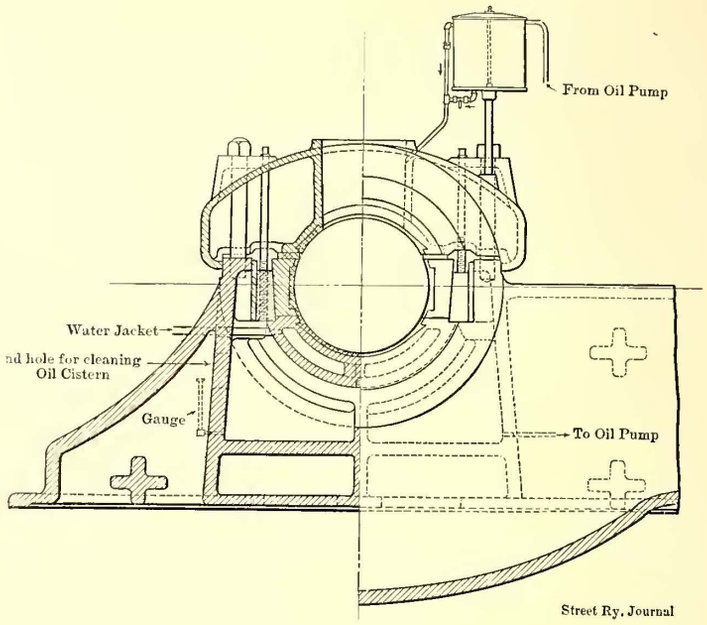


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FIG. 41

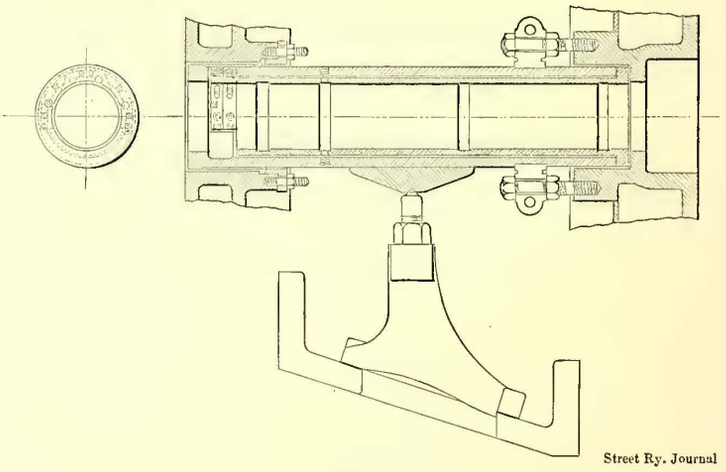

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FIG. 42.

FIGS. 37-42.—DETAILS "BROOKLYN EDISON" ENGINE—McINTOSH, SEYMOUR & CO.

THE ENGINES OF THE BALL & WOOD COMPANY

The Ball & Wood Company several years ago developed a vertical engine for direct connection to electric generators which should be classed with the medium or intermediate speed engines, in accordance with the definition we have given. Ten of these engines, of 600 h. p. each, have been installed by the Edison Electric Illuminating Company, of Paterson, N. J., nine of which have been in use for two years. The station supplies current for three classes of work, to wit: incandescent and electric lighting and electric railways, each requiring several units, so that the floor space had its influence, with other considerations, in the selection of the vertical type of engine.

A perspective view of one of the Paterson engines, showing particularly the front with one end, is given in Fig. 43. The engine is rated at 600 h. p. and is in this particular view shown directly connected to two 200 k. w. railway generators.

Fig. 43A is a perspective view showing the rear end of a similar engine of 450 h. p. directly connected to two 100 k. w. incandescent dynamos.

Fig. 44 shows a front view, and Fig. 45 a rear view of the cylinders of an engine of this type with attached valve gear.

Fig. 46 shows a front elevation, and Fig. 47 a side elevation of one of the Paterson engines.

The engines are of the vertical, cross compound type with Corliss valves and positive valve gear, with cylinders 17 ins. and 36 ins. in diameter, with 24 in. stroke of pistons,

As shown in Figs. 46 and 47, the engine is supported by a deep bedplate provided with four bearings. The outer two of the three spaces thus provided are occupied by the engine cranks, the intermediate one by the flywheel. The armatures of the two generators overhang the outer bearings. When desired, however, an electric generator can be placed between the engines and the fly and governor wheels at the ends. Each cylinder is supported by a cast iron, channel shaped column, carrying inside guides and attached to the rear of the bedplate. There are also two diagonal wrought iron columns for each engine extending from the front of the cylinder to the front of the bedplate.

The Corliss valves in the heads of the cylinders are arranged transversely to the direction of the main shaft and are operated by central rockshafts between the two cylinders containing arms corresponding to the ordinary

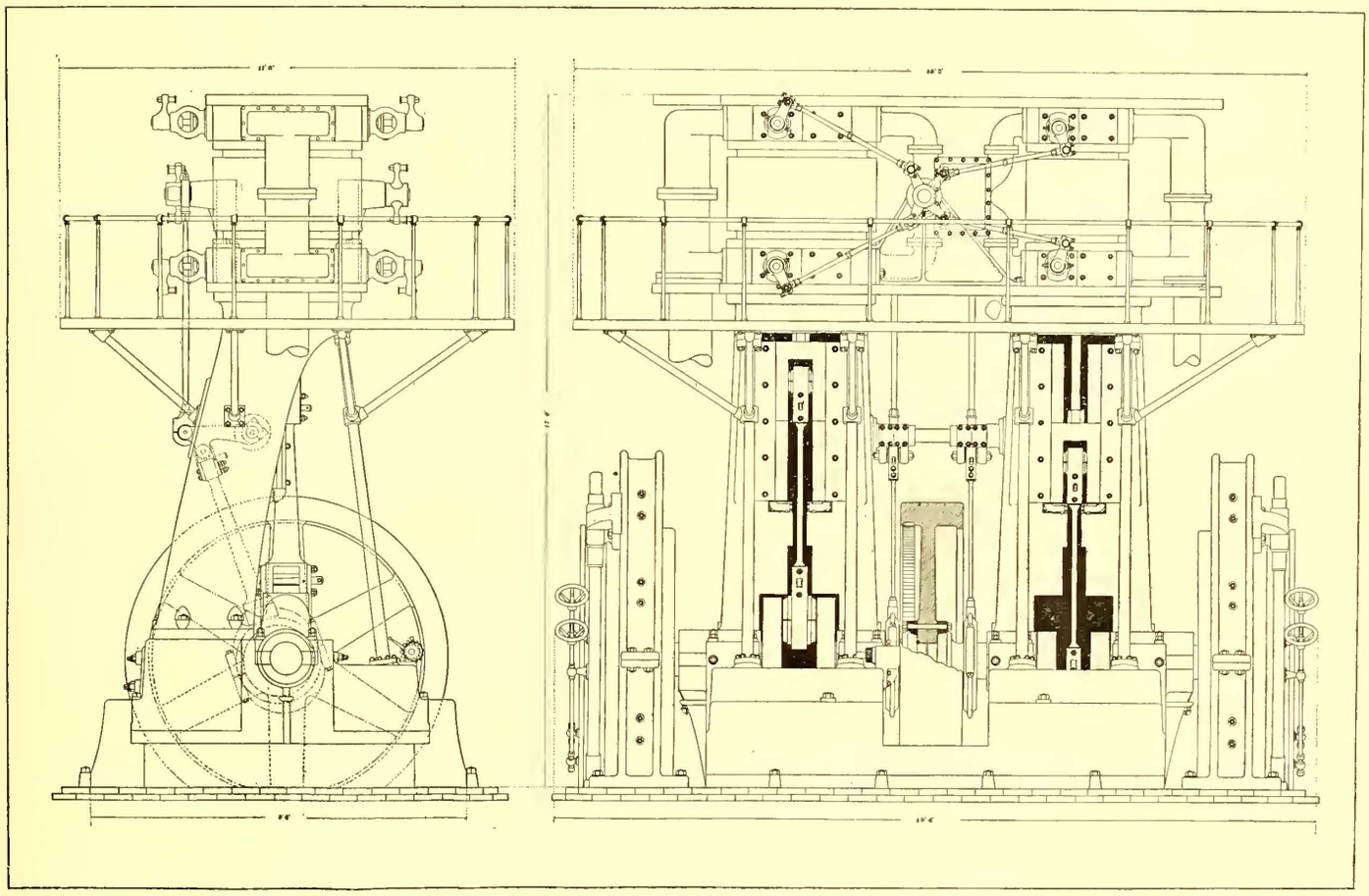

FIG. 47 FIG. 46

600 H. P. COMPOUND CONDENSING ENGINE, PATERSON, N. J.—BALL & WOOD CO.

operated at 150 r. p. m. with a steam pressure of 140 lbs. The Corliss valves are situated in the heads of the cylinders, thus reducing the clearance spaces to a minimum.

Fig. 48 is a top view of a cylinder bottom showing the way in which the ports enter the cylinder.

Fig. 49 is a central cross section of the cylinder bottom, valve chambers and stuffing-box.

Fig. 50 is a side view of the cylinder bottom.

A diagrammatic sectional view of the cylinders, illustrating the general arrangement, is shown in Fig. 51, from which it will be seen that the steam passes from a side pipe through the steam valves in the heads to the high pressure cylinder and from thence through the exhaust valves in said heads to the intermediate receiver containing heating coils, from thence through steam valves in the heads to the low pressure cylinder, and is finally discharged through the exhaust valves in such heads and another side pipe to the atmosphere or condenser. These views also show the double ported steam valves operating in connection with the ports shown in Figs. 48 and 49. The receiver is provided with a pop safety valve which limits the pressure.

Corliss wrist plate, from which connections run directly to the valves, the connections for the exhaust valves being on one front of the cylinders and those for the steam valves on the other. The exhaust valves are operated by a separate eccentric maintaining constant release and compression independent of the point of cut-off. The steam valves are operated by an eccentric which is swung transversely across the shaft to adjust the cut-off and regulate the speed by a flywheel governor arranged in one side of the main flywheel.

An elevation of the flywheel governor is shown separately in Fig. 52. It is, as is customary, provided with two weights, which tend to fly outward by centrifugal force, resisted by leaf springs. There is in addition a loaded arm which acts by its inertia to shift the eccentric for sudden changes of speed, shortening the cut-off if the engine plunges ahead and lengthening the same if the engine is suddenly retarded. This movement is modified by the centrifugal force of the other revolving weights until balanced by the tension on the springs as the engine settles to regular speed. The manufacturers in describing the gov-

ernor state that "the eccentric is part of an inertia mass distributed in the wheel so as to be extremely sensitive to the slightest change of speed. This mass is pivoted on trunnions, which are carried in bearings on the shaft of the engine provided with arrangements for taking up the wear. This construction dispenses entirely with all overhang, and the thrust of the valves is received between the two bearings. The centrifugal force for determining the speed of the engine is developed by a weight pivoted so as to be also acted upon strongly by its tangential inertia, and is therefore extremely sensitive to the slightest change of speed and at the same time very stable in its action. The pivot of this centrifugal weight is provided with a graphite bushing and is made very large in diameter so that the wear will be inappreciable. The only other working joints in the governor are the trunnions of the eccentric which are carried in adjustable boxes. This construction insures freedom from lost motion and also from repair bills."

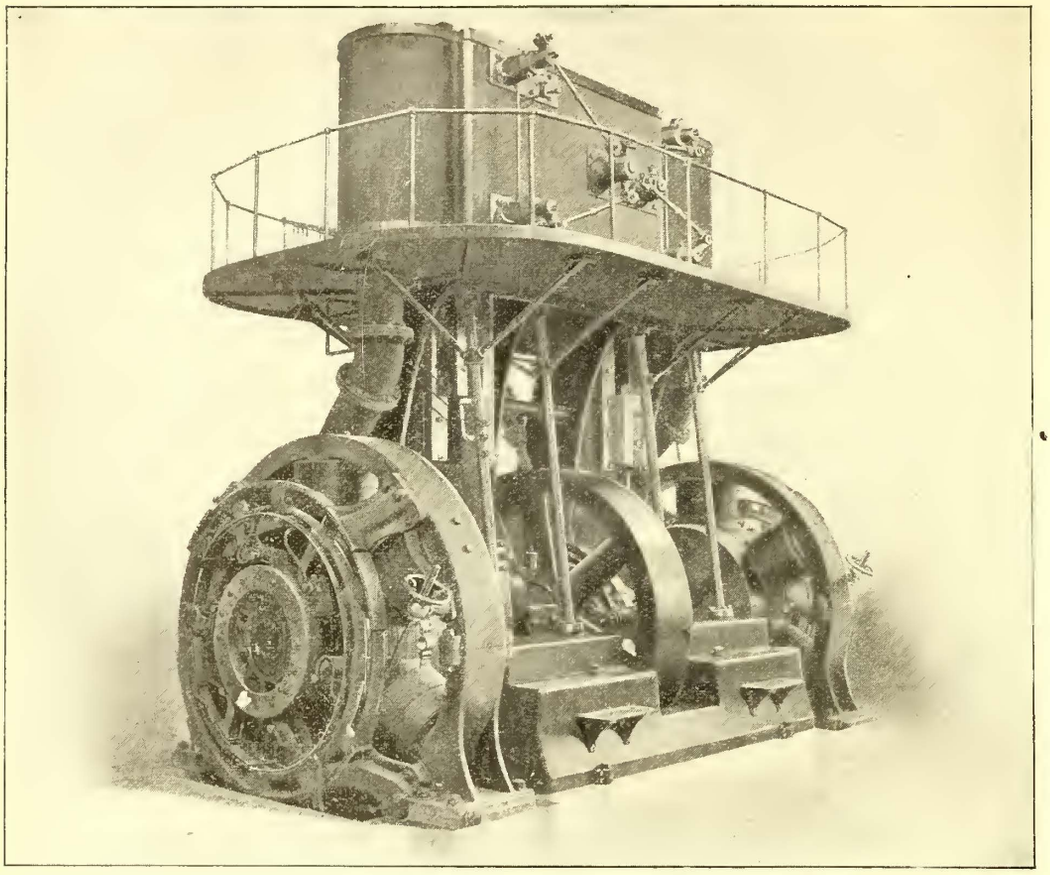

FIG. 43.—PERSPECTIVE VIEW 600 H. P. PATERSON ENGINE—BALL & WOOD CO.

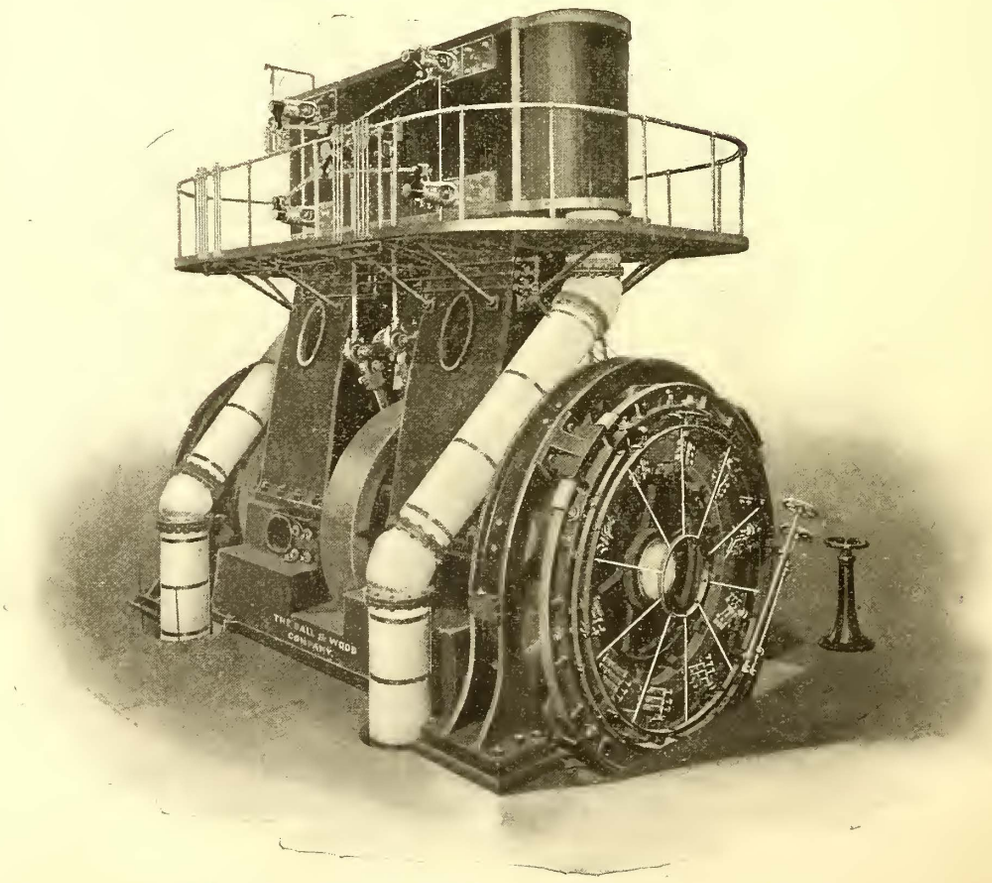

FIG. 43 A.—450 H. P. VERTICAL ENGINE—BALL & WOOD CO.

The cylinders are also provided with steam jackets, and in connection with the intermediate space are enclosed in lagging, which with the finished arms, connections and levers of the Corliss valve gear, gives a pleasing appearance.

The pillow blocks for supporting the shaft are provided with removable babbitted liners which are interchangeable. The two center pillow blocks are provided with double wedges underneath for vertical adjustment to secure alignment at all times. At the other end of each pillow block a special oil catching ring is provided to prevent the oil from following out on the shaft. The crankshafts are made of the best quality of steel with integral flanged couplings and heavy fillets. The crank pins are provided with automatic centrifugal oiling devices. The piston rods are of special hammered steel, threaded and screwed into the crossheads and locked fast with special nuts counterbored at the end to cover threads, finished and case hardened. The other ends of the rod are screwed into the pistons and are locked with a nut. The pistons are fitted with two rings turned eccentric, cut open at the thinnest parts, the ends being halved so as to lap when in position. The oil is fed from one central point to the wearing surfaces through oil pipes connecting with adjustable sight feeds.

The manufacturers "guarantee that these engines will regulate within 1¼ per cent under changes of load within range of the governor, and that no reduction of boiler pressure shall reduce the speed until the latest point of cut-off is reached; that the steam consumption when the engine is developing its rated power at 150 lbs. pressure and 26 ins. vacuum shall not exceed 14 to 15 lbs. of dry steam per indicated horse power per hour with a clearance of about two per cent."

The operation of the engines in the station of the Edison Electric Illuminating Company, at Paterson, N. J., has been very highly complimented by William M. Brock, the manager, who states that they are "reaching pretty close to 300 watts (actual conditions) per pound of buckwheat anthracite coal," whereas he states "85 per cent of the electric stations reported are below 150 watts and 60 per cent are below 100 watts." He ascribes a "good portion of the glory obtained" to the "type of engine employed."

[AUTHOR'S NOTE.—The author takes pleasure in calling attention to Fig. 53, from a photograph sent by the Edward P. Allis Company, and which, it is stated, represents "the original model of our 1890 type engine frame, which was designed by Edwin Reynolds, of our company, in February, 1890." It is claimed that this frame was original with Mr. Reynolds, and the author's impression was originally to this effect, but the use of a similar frame in several of the other engines made him fear the possibil-

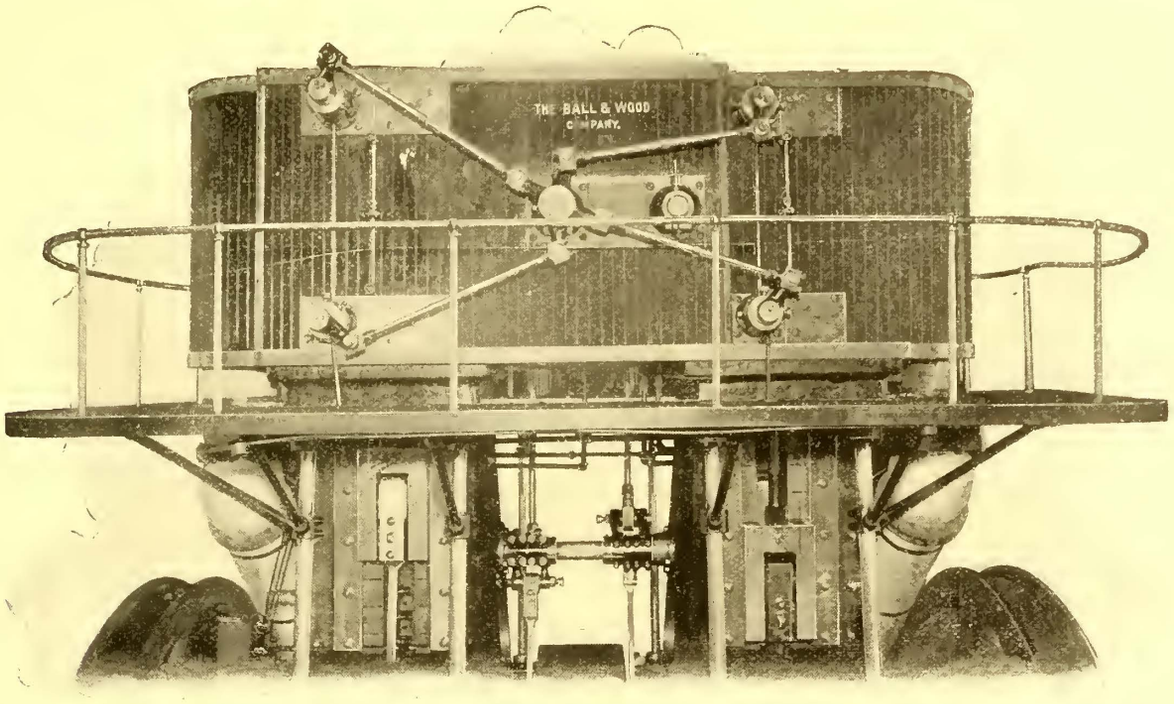

FIG. 44.—DETAIL OF VALVE GEAR, PATERSON ENGINE—BALL & WOOD CO.

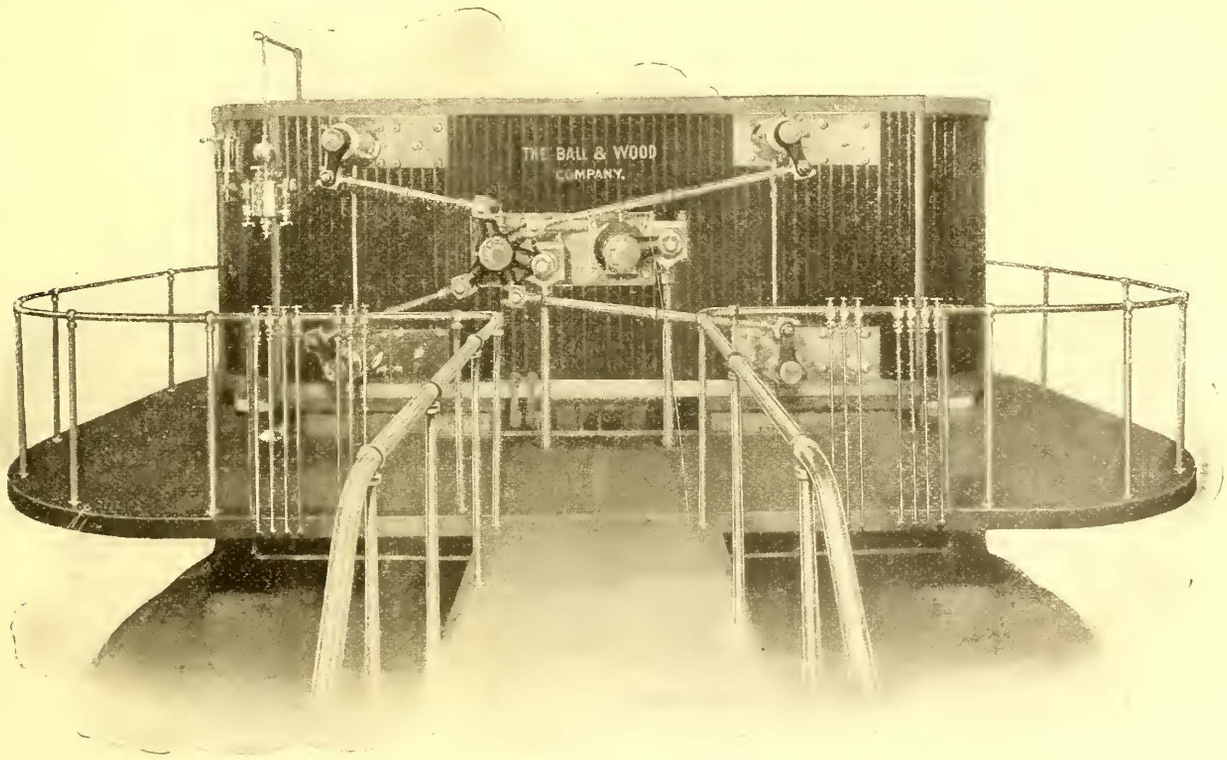

FIG. 45.—DETAIL OF VALVE GEAR, PATERSON ENGINE—BALL & WOOD CO.

ity of a mistake, as no reference was made to it by the Allis Company in its original communication. The author not only takes pleasure in giving full opportunity in this place for the statement above made, but desires in the same connection to acknowledge the very valuable services of nearly all the prominent builders of Corliss engines in this country.'"

The author will be pleased to make any further corrections presented over a responsible signature by those interested.]

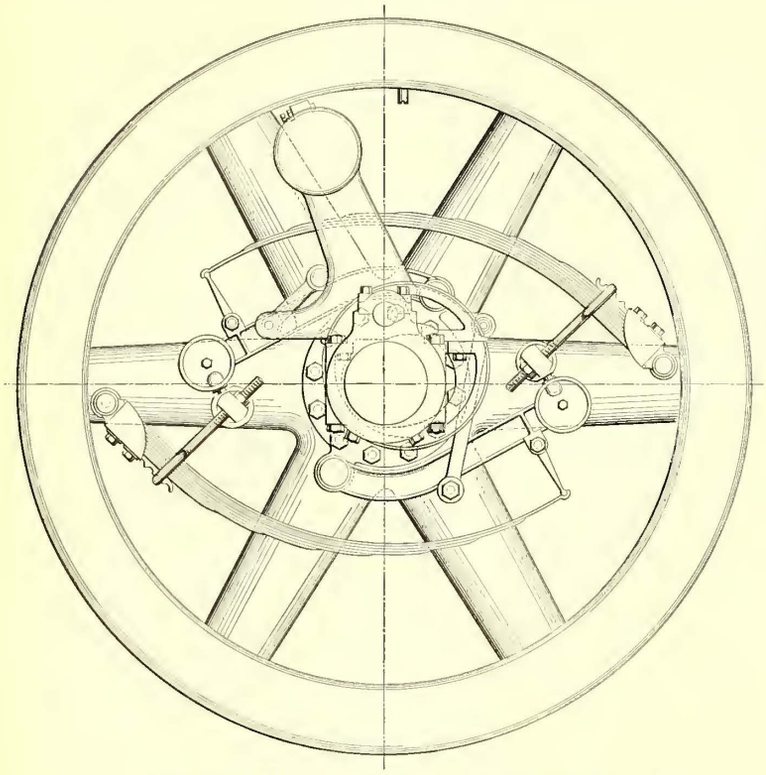

FIG. 52.—BALL & WOOD SHAFT GOVERNOR

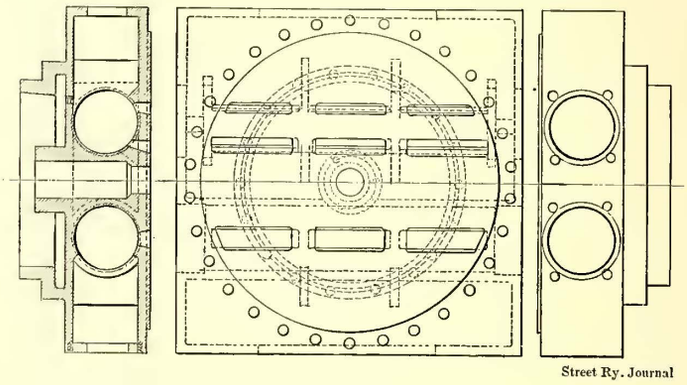

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FIG. 49 FIG. 48 FIG. 50

DETAILS OF PATERSON ENGINE—BALL & WOOD CO.

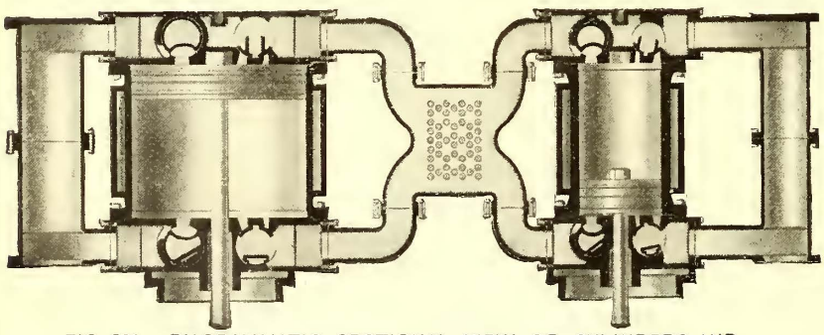
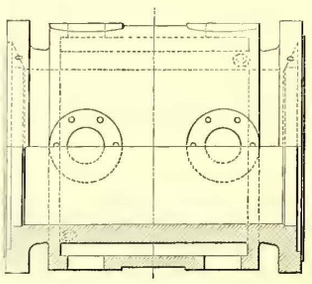
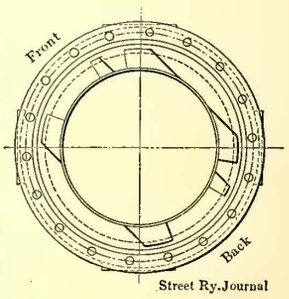


FIG. 51.—DIAGRAMMATIC SECTIONAL VIEW OF CYLINDERS AND INTERMEDIATE BALL & WOOD VERTICAL COMPOUND CONDENSING ENGINE





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BALL & WOOD CYLINDER

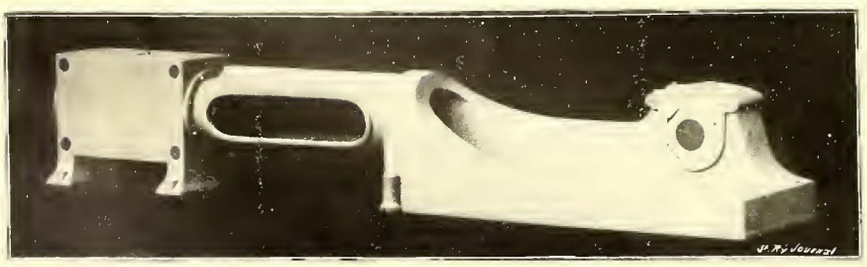


FIG. 53.—THE REYNOLDS-CORLISS "1890 FRAME"

Edwin Reynolds in the development and perfection of the details of the Corliss engines, and in the perfection of the steam engine in general. The company also states:

"It may be of interest for you to know that the award given Mr. Reynolds, at the World's Fair of 1893, was worded thus:

"'For excellence of a type of engine releasing gear which has shown its exceptional merit not only by the success attained in its use on engines of the inventor's own design, but by being copied in all essential features by

Three-Phase Mountain Railway in Switzerland.

The first trial trips on the electric railway up the Gorner Grat, near Zermatt, were carried out recently in the presence of the inspectors of the Swiss Railway Department. The section already completed has a length of about a mile and a grade of 12 per cent. The tests were satisfactory, both the ascent and descent being effected without the slightest difficulty, the motors holding the locomotive perfectly to its proper speed. Starting on the maximum grade with a fully loaded train was also effected with great facility. This is a rack railway, the total length being 6 miles, and the maximum grade 20 per cent. The power is derived from the Findelenbach, which drives four turbines of 250 h. p. each, coupled directly to three-phase alternators of 5000 volts. The potential on the trolley line is 550 volts. Each locomotive is equipped with two three phase 90 h. p. motors.

A New Transmission Plant

A new hydraulic electric plant of 3000 h. p. will be installed at Chambers Creek, 8 miles from Tacoma, Wash., in the early spring of 1898. The plant will be installed by the Chambers Creek Power Company, of Tacoma, Wash., and it will contain at first, three 750 k. w. three-phase generators, direct coupled to water wheels. The company has a fall of 115 ft. available for power purposes, with a flow of 200 foot-seconds. The current will be transmitted to Tacoma at a pressure of 10,000 volts, and will be purchased by several street railway companies. Almost the entire capacity of the power plant has been contracted for in amounts ranging from 100 to 500 h. p.

Changing a Cable Conduit to an Electric Conduit

As announced in a recent issue of the STREET RAILWAY JOURNAL, the Capital Traction Company, of Washington, D. C., whose cable power station was recently destroyed by fire, has decided to replace the cable on the main line with the underground electric system. The line in question extends from the Navy Yard to George-

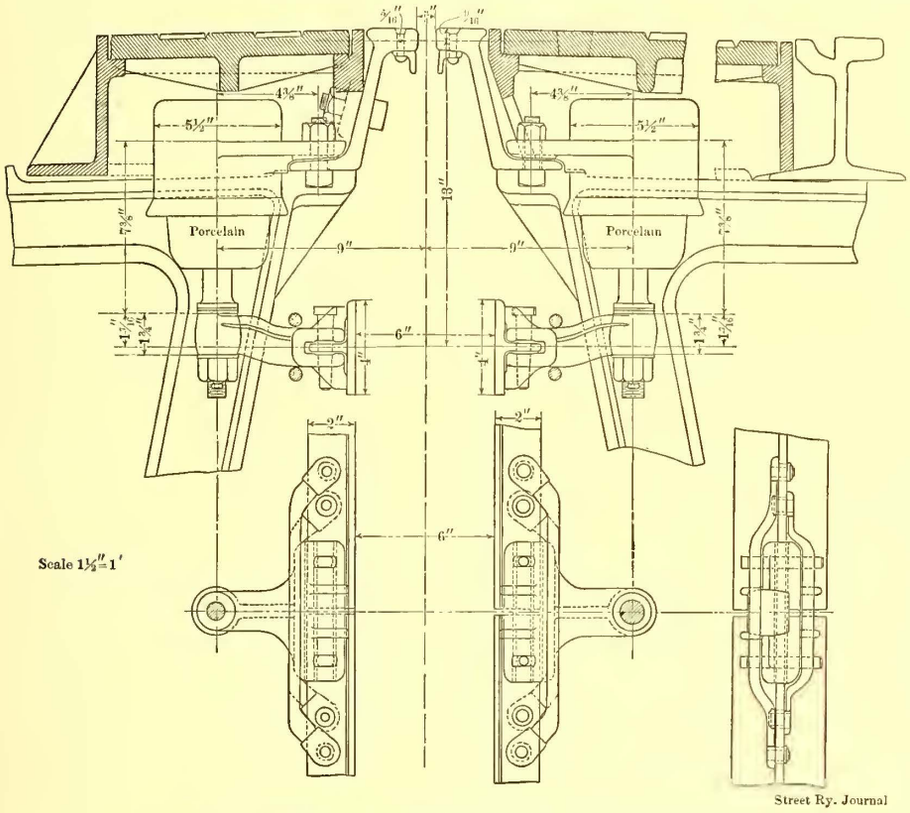


FIG. 1.—PLAN AND SIDE ELEVATIONS OF INSULATORS.

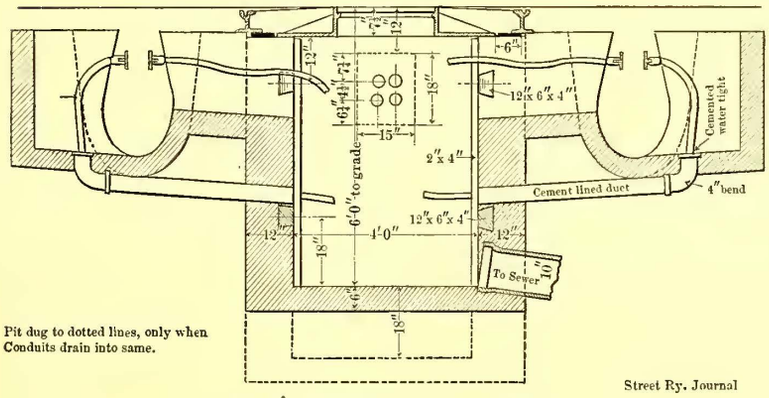


FIG. 2.—SECTION OF MANHOLE

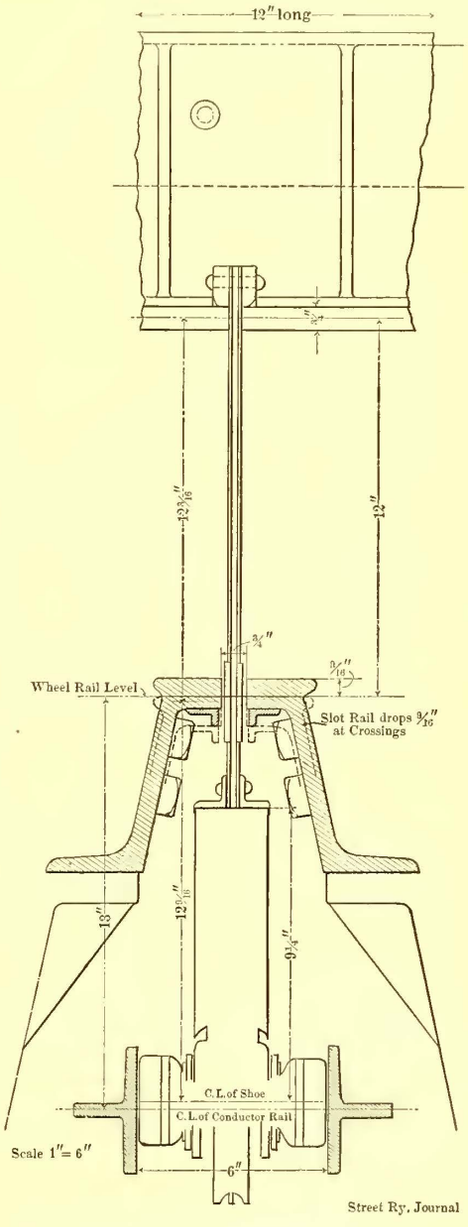


FIG. 3.—SECTION SHOWING POSITION OF PLOW IN CONDUIT

town, and traverses the entire length of Pennsylvania Avenue, the most important thoroughfare in the city. This line is now being operated by horse power, but the work of making the necessary changes in the conduit to adapt it to electrical service is being carried rapidly forward and the new apparatus is being installed in the power station. The company has also decided to convert to electricity its Seventh Street cable line, making a total of 10.8 miles to be changed from cable to electric power.

The company's station will be located on Grace Street, between Thirty-second and Thirty-third Streets, and will occupy a building formerly used as a mill and warehouse. It is on the Chesapeake & Ohio Canal, from which water will be taken for condensing purposes. The engine equipment will be Allis tandem compound, 800 h. p. engines, with cylinder dimensions 20 ins. × 40 ins. × 42 ins., and running at 100 r. p. m. Each will be connected to a G. E. 550 k. w., 600 volt generator. The boilers will be of the Cahall Babcock & Wilcox type, with 21,485 sq. ft. of heating surface. Four batteries will be installed. They will be equipped with Roney mechanical stokers and Deane of Holyoke pumps and condensers. Coal handling machinery will be used, but the type has not yet been decided. In addition to the railroad generators, the company will install three G. E. boosters of 100 k. w. each, guaranteed to develop at full load 550 amps. at 180 volts. The stack, which will have a height of 150 ft. above the base, and a diameter of 9 ft., will be mounted on a base 20 ft. high above the boiler room floor. The station will supply current to all the lines of the company, except the end of the Rock Creek line at Chevy Chase.

The most interesting portion of the construction, however, is that of converting the present cable conduit to an electric conduit. This portion of the work is fully illustrated in the accompanying engravings. The most laborious portion of it was that of adding a lip to the slot rails to divert the drip from the electric conductors. As it was practically impossible to replace the slot rail with one having a drip rolled on it, the bold plan was adopted of riveting on each slot rail for the entire length of the line a 1 in. × 1 in. angle bar. The rivet holes are $\frac{11}{32}$ in. in diameter,

and one is drilled at each end of the rail, and others at intervals of 4 ft. apart between the ends.

As the slot rail is 1 in. in thickness, and as the work of drilling and riveting has to be done from the top, special tools had to be devised for drilling and riveting. The drill, which was invented by the company's master mechanic, H. P. Clark, is an exceedingly ingenious device, and can be locked in position on the slot rail from above. The work of setting the drill is simplified by substituting wedges and thumbscrews for bolts; this saves the workmen from the necessity of carrying wrenches with them in their work. The drill is driven by a crank, and is so arranged that when the hole is finished, the crankshaft is engaged with the vertical feed, throwing up the drill instantly so that it can be readily set for the next hole. In a test, holes have been drilled by hand in 21 seconds, and the instruments can be easily set and holes drilled in 40 seconds. All keys which hold the machine in position under the slot rail are fitted with lugs, so that when they are loosened they cannot fall out into the conduit. This prevents a delay of work through possible carelessness on the part of the workmen.

After the drilling has been completed, the next undertaking is that of riveting the drip rail to the slot rail. As this work also has to be done from above the slot rail, a special apparatus had to be devised for the purpose. The instrument employed is shown in Fig. 8. It consists of a block of cast iron faced with steel and fitted to slip under the slot rail. By means of the lever, which is about 33 ins. long, the rivets can be held in position while being headed.

The conductor for the railway current is of T shape, of channel iron, and weighs about 21 lbs. to the yard. It is bonded with No. 0000 bonds. The insulators are of porcelain, cemented into iron caps.

The cars are mounted upon Lord Baltimore trucks, made by The Baltimore Car Wheel Company. These trucks have integral side frames made of steel T beams, 5 ins. deep × 4 ins. wide at top, and brought to the requisite shape by hydraulic pressure; the sides are reinforced from a point 15 ins. inside the center of the axles to the ends by steel yokes, which are accurately fitted to the beams, taking a bearing at bottom and top, and making a practically indestructible side frame. Jaws are formed on the yokes, with side pockets in which fit graduated springs, which rest on the side wings formed on the axle boxes. These springs carry the entire weight of the trucks and car bodies, and a large part of the weight of the motors, thoroughly cushioning all and relieving rail joints from undue pounding.

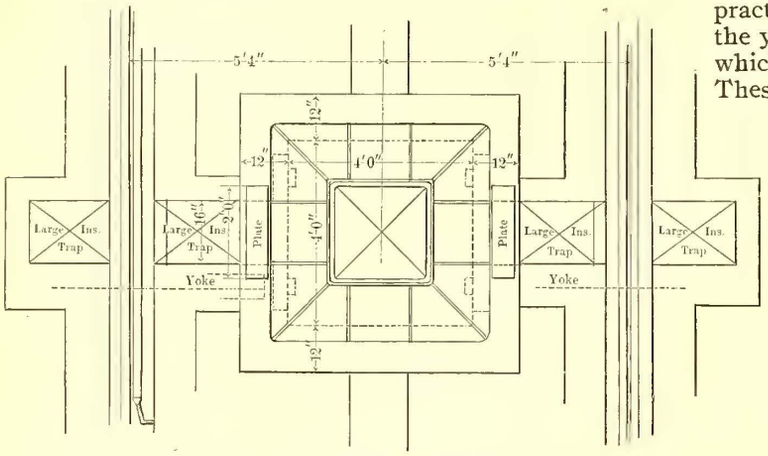


FIG. 4.—PLAN OF MANHOLE

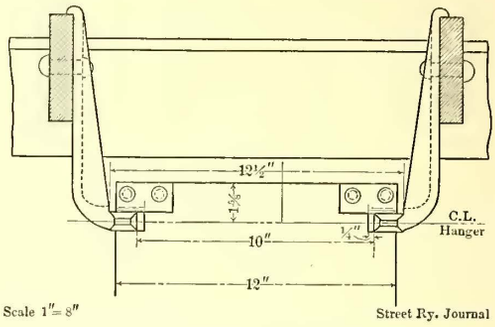


FIG. 5.—SIDE ELEVATION OF PLOW HANGERS

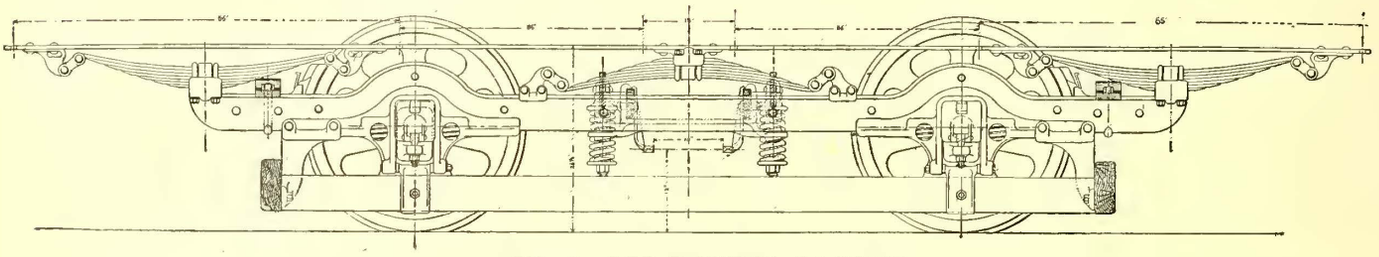


FIG. 6.—SIDE ELEVATION OF TRUCK

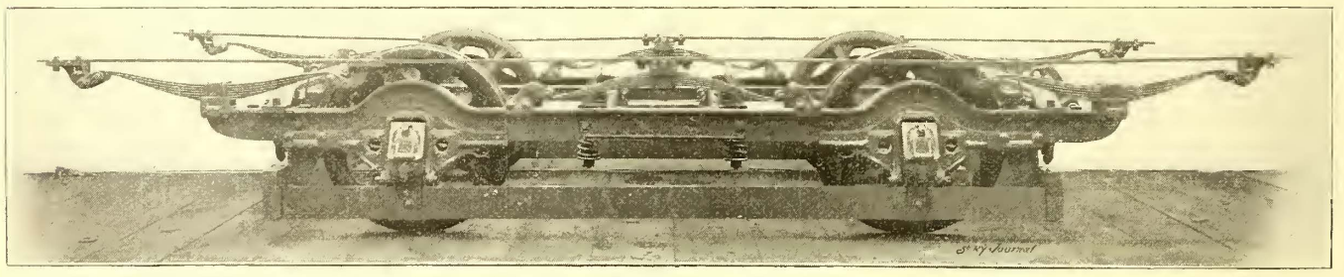


FIG. 7.—SIDE VIEW OF TRUCK

The brakes are equalizing, extremely powerful, have very few parts, and are fitted with a particularly convenient method of adjustment. All wearing points are fitted with case hardened bushings working on case hardened thimbles, and all brake mechanism is carried above the axles; this prevents the possibility of breakage from contact with any obstruction on the truck, and obviates the necessity of disturbing the brake mechanism when removing wheels for renewals. The brake levers have equalizing levers interposed between the pull-off rods, to the brake staff. These are connected to the brakes on trailers by long rods, so arranged that two-thirds of the pressure is exerted upon the motor car brakes and one-third upon the trailer brakes, and permitting both to be operated from the front platform of the motor cars.

The car body is carried upon six half-elliptic springs 36 ins. long, to which it is flexibly connected. These compensate readily for varying loads and prevent jar at curves and crossings. By their use the car body is sup-

ported for a distance of 16 ft. 3 ins., the wheel base being 6 ft. 6 ins.

Each truck carries two G. E. 1000 motors upon 4 in. cold finished steel axles. The journals are 3⅜ ins. in diameter by 7 ins. long, and the journal boxes are absolutely oil and dusttight. The wheels are 30 ins. in diameter, and have special flanges to suit the grooved rail used, and are also made by the Baltimore Car Wheel Company; the center suspension for the motors is so made as to form a stiff diagonal brace for the truck, which effectually prevents the frame from ever getting out of line. In addition, the end tie bars are milled out where they fasten to the side frames, which are machined to fit them, making an absolutely perfect machined scarf joint, and taking all strain off the bolts. This same construction is applied to the fitting of all joints. All the trucks are fitted with

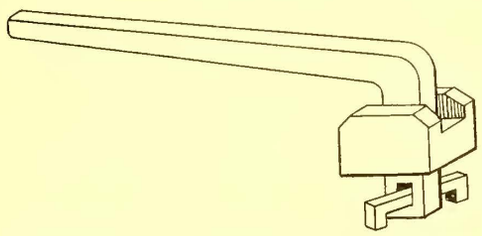


FIG. 8.—DEVICE FOR RIVETING ANGLE TO SLOT RAIL

hangers to carry the plow through which the electric connection is made, which are of a design patented by W. B. Upton, the first assistant engineer of the Capital Traction Company, and so constructed that the plow can readily be removed without taking out a single bolt.

All construction has been carried on under the general supervision of the construction committee of the board of directors, composed of G. Dunlop, president of the company; Henry Hurt, ex-president, and S. L. Phillips, a large stockholder, and formerly president of the Metropolitan Railroad Company, of Washington. The engineers in immediate charge of the work are D. S. Carll, A. S. C. E., chief engineer of the company, assisted by W. B. Upton, A. S. M. E. Louis Duncan, Ph. D., is electrical engineer of the company, and E. Saxton has the contract for all the street work.

The Use of the Brooklyn Bridge by the Transportation Systems of Brooklyn

For the last two years, persistent requests have been presented to the Trustees of the New York & Brooklyn Bridge to permit the elevated railway companies of Brooklyn to operate their cars over the Brooklyn Bridge, thus giving transit without change between any station in Brooklyn on their lines and the New York terminal of the Bridge. In answer to this demand, the Trustees of the bridge properties about a year ago appointed a committee of outside experts to make an investigation of the whole subject. This board made its report in February last, and recommended that the necessary permission be given under certain restrictions, the principal ones being: first, that equal permission to cross the bridge should be granted to the surface and elevated railway companies; and second, that the construction of the track and the operation of the cars on the bridge should be under the direct supervision of the bridge management.

Under this proposition, the plan of caring for the elevated railways was a simple one. The board of experts recommended that all the cars of the two elevated railways in Brooklyn—the Brooklyn Elevated Railroad Company, and the Kings County Elevated Railway Company—should enter and leave the bridge at the same terminus, near the corner of Tillary and Fulton Streets; and the trains should run over the present bridge tracks, interposed between the regular bridge trains. They should be switched as are the present bridge trains at the New York terminal, but should use the north platform exclusively for the receipt and discharge of passengers.

In regard to the surface roads, the board of experts recommended that the latter should all approach the bridge structure on Washington Street, and should pass on to the track at Sands Street, and keep along the northerly side of the present roadway, returning along the southerly side of the southern roadway. In leaving the bridge, the cars which go up Fulton Street should pass directly to that street; and those which go up Washington Street should go down Fulton to Adams, and then up Washington, to prevent congestion on Sands Street. In New York the Board recommended the installation, as the tracks approach the New York terminal, of double tracks and two loops on the level of the present switching tracks of the bridge, across and beyond these tracks, extending out towards City Hall.

The plans as recommended by the experts in regard to the New York terminal were not practicable, as in the first case they meant a change in the position of the present City Hall terminal of the Manhattan Elevated Railroad Company; second, the surrender of half the facilities of the bridge switching tracks, whether the traffic should be divided equally or not; third, the Bridge Trustees were prevented by law and by contract with neighboring property holders from projecting their structure beyond Park Row. The entrance at Brooklyn suggested for the elevated railroad trains was prohibitive also, on account of the grades necessary. The plans were therefore modified.

Under the revised plans the Brooklyn Elevated Railway is to approach the bridge property through private right of way, between Concord and Nassau Streets and over Washington Street, the Kings County Elevated Railway to pass on to the bridge as first proposed. To prevent the threatened decrease in platform facilities in New York for the bridge cars, it was decided to allow the Kings County Elevated to operate its cars from the bridge platforms, and to lay an additional platform for the Brooklyn Elevated Railroad in the unoccupied space of the station between the switching tracks.

The changes in the proposed plan for the surface lines were more radical. In the first place it was decided to elevate the surface railroad tracks to a higher plane than the elevated railroad tracks. As it was realized that passengers would not ascend any considerable number of steps to reach the cars, it was proposed to install twelve passenger elevators having a capacity of 1000 passengers per hour.

In August 1897, contracts were entered into with the different companies and the elevated railroad companies were given practically one year to complete their part of the construction. As yet practically nothing has been done by them. The Brooklyn Elevated Railroad Company has commenced the process of obtaining the necessary property for its right of way, but has encountered legal difficulties which have blocked further work. Both of the elevated companies are in the hands of receivers and just how much they will be able to accomplish, on account of the expense involved, is hard to state. The president of the Brooklyn Elevated Railroad Company is quoted as saying that it will cost that company $1,000,000 to equip its cars with the necessary grips, and with side doors similar to the bridge cars, and to supply the requisite electric motors and equipments as specified in its contract with the Bridge Trustees.

Another complication to the situation not already considered is that of income to the railway companies and to the Bridge Trustees. During the early discussion on the subject of adopting the report of the experts, the legislature of New York passed what is known as the Brush Bill, which provided that in case the outside companies cross the bridge they were to charge their passengers for transportation over the bridge no addition to the regular 5 cent fare. On the other hand, if they use the bridge the surface companies are to pay the Bridge Trustees 5 cents a car for each round trip, and the elevated railroad com-

panies 12½ cents per car for each round trip. This, it is estimated, will mean a decrease in the bridge income of about $750,000, out of a total, for the year ending Dec. 1, 1897, of about $1,250,000.

Upon the assignment of the proposed plans to the engineering department of the Brooklyn Bridge, it was soon perceived that the provision made for the surface railways was inadequate. Since the Trustees had determined to make such concessions to the surface railways as would largely limit the capacity of the bridge roadways for ordinary traffic it was felt that as compensation to the public the latter should have as much in return as possible. It was moreover felt that for such an enormous traffic the operation of elevators as proposed was in a certain sense experimental, and that they certainly presented some inconveniences. It was therefore determined to place the surface railway loops on the promenade or street level. This involved the placing the tracks along the inner margin of the roadways on the bridge structure instead of on the outer, and of giving up to the use of the surface cars a part of the New York terminal now employed by foot passengers over the bridge. While this involved an interference with pedestrians over the bridge, it was seen that it would not be a serious inconvenience to the total bridge traffic, since while during the busy periods of the day, the average number of persons traveling by rail over the bridge is 19,000 per hour, the average number of foot passengers is only 1600.

It was therefore decided to lay four loops on the level of the foot approach as shown in the engraving, and provide gates on each side to stop the passage at that point of foot passengers while the cars are loading. Four cars will load at a time, and as soon as they pass, the gates will be thrown open and the pedestrians will be allowed to pass through. It is estimated that the foot passenger traffic will be interrupted in this way for intervals of only about one minute at a time, and during the busy portions of the day for only about one-third of the aggregate time. If, however, it should be found that this arrangement presents a serious inconvenience to any pedestrians, the latter can take the present mezzanine floor, which is level, and can then descend by steps into Park Row. As in going to Brooklyn they are not obliged to descend any steps after passing over the cars this arrangement would not necessitate any additional physical exertion, a series of steps being substituted for an ascent on an inclined plane. While this plan seems to be a feasible one, the execution of it is at present being prevented by an injunction recently secured, on the grounds that the plans of the Trustees are dangerous to life. The suit is now being adjudicated, and if favorable judgment is rendered, the work of track construction on the surface roads of the bridge, which is being carried on by the associated companies, will be prosecuted to completion.

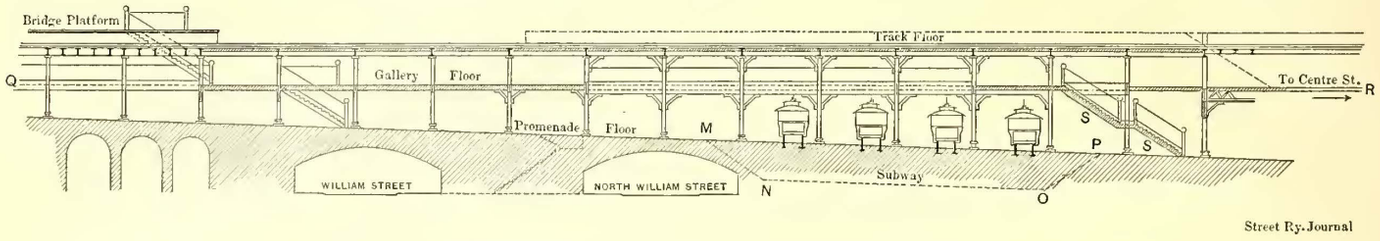


FIG. 1.—LONGITUDINAL SECTION OF NEW YORK TERMINAL

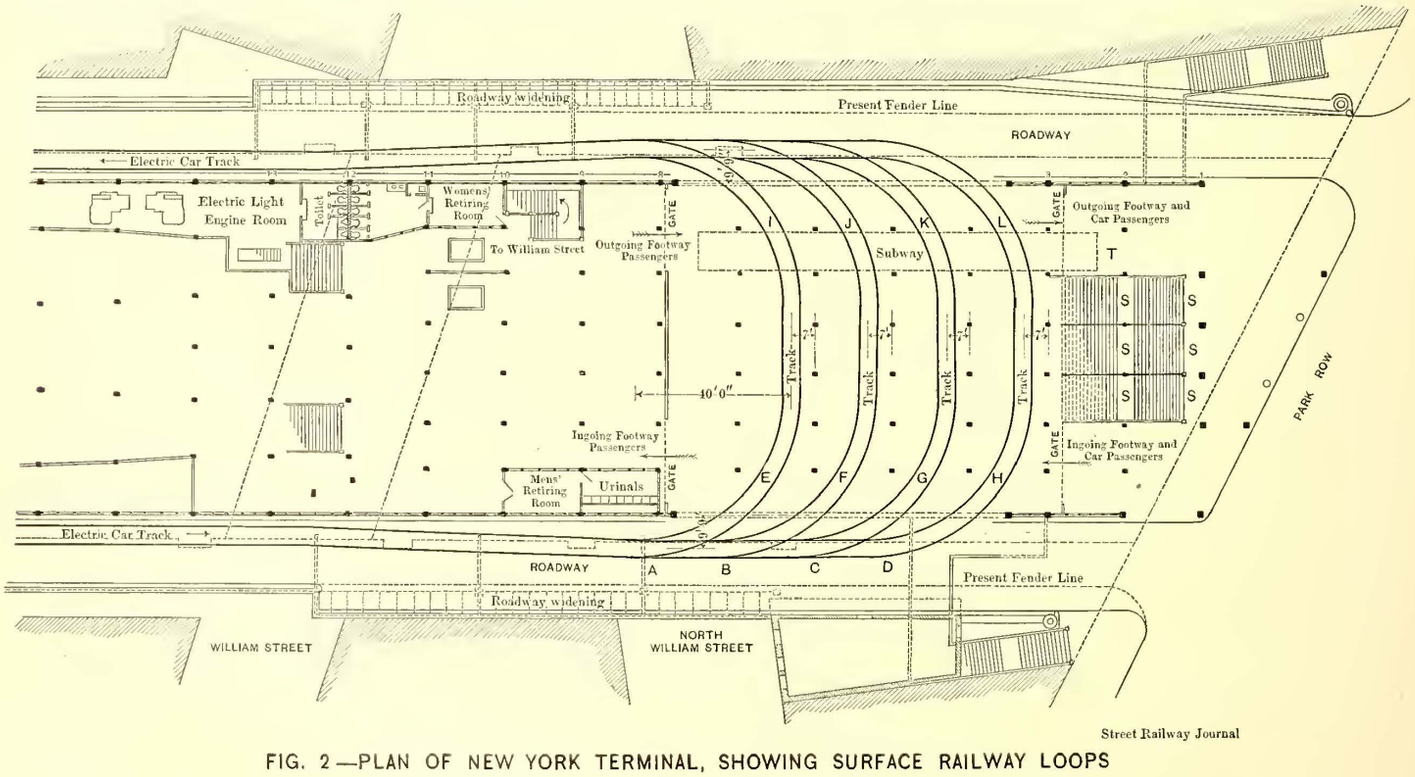


FIG. 2.—PLAN OF NEW YORK TERMINAL, SHOWING SURFACE RAILWAY LOOPS

Acting under right secured Dec. 31, the work on one of these loops was finished sufficiently to allow two cars of the Brooklyn Heights Railroad Company to make the trip on that day. The car carried President Rossiter of the Brooklyn Heights Railroad Company; President Johnson, of the Nassau Railroad Company and a number of the officials of both companies and invited guests.

M. E. INGALLS, president of the "Big Four" railroad system, in the course of a recent address said: "Probably locomotives propelled by electricity will come in the future. If not, something else may. We cannot tell what the next years have in store for us in the way of improving our railway facilities, but it is necessary to this country of ours that the railways should be encouraged so that they may go on improving their systems."

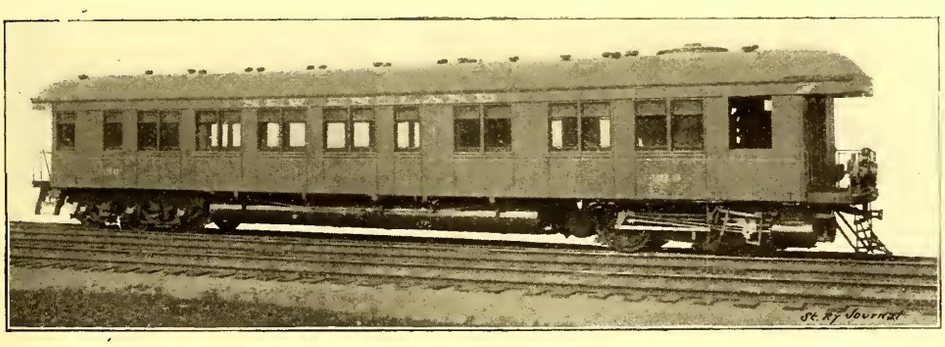
Steam Dummy Car

C. Peter Clark, Jr., general manager of the New England Railroad, at a meeting of the New England Railroad Club, Dec. 14, described a type of self-propelled car which his company has found useful for certain classes of work. The car, which is termed the composite, is designed for passenger service upon steam lines wherever the traffic can be increased by operating single cars on a shorter headway than would be possible with regular trains, and where the traffic is not great enough to warrant the introduction of electricity. For suburban business, with 15 minute's service, Mr. Clark considers electricity to be cheaper; with infrequent trips, the locomotive. The composite, weighing about one-third of an ordinary passenger train, with seats for sixty passengers and ability to haul an additional car, should, he thinks, materially reduce the fuel bill of the locomotive.

The composite is designed to burn coke, thus avoiding smoke and cinders; can run where wanted, being free from power house restrictions, and will carry as many passengers as steam roads average, except on express trains and suburban runs near large cities.

The New England road hauls on an average 7500 lbs. of dead weight to accommodate each passenger, and some trains on branch lines figure 50,000 lbs. for each passenger. The demand for a cheaper train unit is apparent, and the composite was designed to decrease such absurd waste. It was constructed from an old dining car, easily runs 40 miles per hour, stops comfortably in less than 500 ft. and develops a speed of 30 miles an hour in one minute from a dead stop.

The driving machinery and boiler are carried on the forward truck, which is swiveled to the car on a ball bearing consisting of 125 1½ in. steel balls. The cylinders are 12 ins. × 16 ins. stroke, and the driving wheels 42 ins. diameter. The boiler is vertical, carries a pressure of 200 lbs. per square inch, is equipped with a Reagan water grate and is fed by two Hancock inspirators. There are two water tanks, each 24 ins. diameter × 30 ft. long, suspended under the car floor by leaf springs. The car is equipped with Westinghouse brakes and "Compo" cork brake shoes. The record speed of the car is a mile in sixty-one seconds, but its schedule speed will be kept below 45 miles per hour. The water carried will last for a run of 50 miles, and coke for one of 100 miles. The car has run 12 miles without having the door of the firebox opened. This indicates little need for a fireman. The machinery was supplied by the Schenectady Locomotive Works.



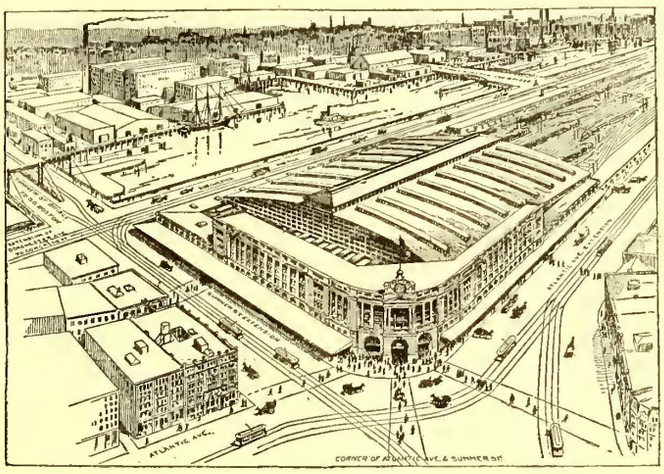
STEAM DUMMY CAR

Storage Batteries for Buffalo

The announcement was made last month that the Buffalo Railway Company would install at once a set of storage batteries at its Niagara Street power station to act as a station auxiliary. There will be about 290 cells, which will be contained in a fireproof structure built especially for the purpose. The building will measure 40 ft. × 70 ft., and the Buffalo Railway Company expects to have the installation in operation early in March.

Large Terminal Railway Station in Boston

The accompanying engraving gives a birdseye view of the new southern Union station in Boston and adjacent streets as they will appear when the work has been completed. The view, which is taken from the Boston *Herald*, is supposed to be taken from a point above the junction of Summer and Purchase Streets. The roof area of the main station and connected buildings is 700 ft. × 650 ft., making the largest railway roof in the world.



BIRDSEYE VIEW OF BOSTON TERMINAL STATION

The peculiar interest which attaches to this station, from an electric railway standpoint, is the fact that it is the first great terminal station ever built in which provision is made for the use of electricity as motive power, as well as steam. There are two track levels, the upper containing twenty-eight stub tracks, capable of holding 350 passenger cars. The tracks on the lower level are arranged upon the loop system, for use by the electric suburban service. One train a minute can be sent out, if necessary, on these loop tracks, to upward of 2000 trains in and out in each day of eighteen hours. The platform area devoted to the electric service contains sufficient room for 25,000 people. Both levels are entered from the street by inclines, without any steps.

The Terminal Company has already expended up to date the sum of $8,000,000, and it is estimated that its total expenditures before everything is completed will amount to between $10,000,000 and $11,000,000. The contract price of the main station building alone is $1,100,000.

30 Ton Electric Locomotive in Hoboken

On Jan. 4, an interesting test was made in Hoboken, N. J., of a 30 ton electric locomotive recently built by the General Electric Company for the Hoboken Railroad, Warehouse & Steamship Connecting Company. The tracks of the latter corporation extend parallel to the Hudson River and connect the wharves with the tracks of the several trunk lines which have terminals in Hoboken and Weehawken. The locomotive is equipped with four G. E. 2000 motors and an electric air compressor with automatic regulator for braking purposes, and weighs 57,000 lbs. The cab is spacious and is tastefully fitted up. The controller takes up but little space considering the size of the equipment for which it is intended.

During the trial test, which was witnessed by a large number of invited guests, the locomotive drew a train of freight cars from Hoboken to Weehawken. The guests were hospitably entertained later at Meyer's Hotel.

Rail Bonding*

By Walter E. Harrington.

It is a difficult matter to determine which rail bond is the best adapted to one's conditions; what may possibly answer under certain conditions will not answer under others. The majority of bonds are designed to make lateral contact with a hole in the web of the rail; this at once defines the necessity of good, clean, uniform surface in the hole in order to insure good contact. While it may seem an easy matter to obtain good, clean, uniform surfaces, the fact is that in the majority of instances holes are not true and are full of ridges. The writer has frequently removed bonds, where it seemed as if every precaution possible had been observed to make good contact, with barely more than 10 per cent of contact; in some instances the bonds could be readily pulled out of their holes.

Further, rails will be either punched or drilled for bonds at the mill and the holes will frequently become coated with rust before the rails are placed, resulting in either the necessity of using a file or reamer, making the holes larger than they should be. I do not wish to convey the impression that good contact cannot be made with bonds making connection through a hole in the web of the rail, as such can be done, but the frequent bad contacts upset our confidence in them.

The use of the Edison-Brown amalgam to improve the contacts of copper bonds showed some very interesting results. Used with the Crown bond, it showed a decrease of 24 per cent in the resistance by amalgamating, whereas the Columbia bond showed a decrease of only 5 per cent, proving conclusively that the form of contact made by the Columbia bond is far superior to the Crown; this is substantiated by the data in atttached table which shows that the Columbia bond has a resistance of 53 per cent of the Crown, neither amalgamated.

The troubles incident to making contact in a hole in the web of the rail led to the trial of the Bryan bond. This bond consists of a large number of parts and is open to the objection that a bronze casting is used as part of the conductor. The bond consists in brief of two No. 0000 copper wires, clamped by bronze and iron castings, the bronze casting in contact with a corrugated copper washer which is in contact with a freshly made contact surface upon the face of the rail, the whole held together by a 1 in. bolt and nut with a lock washer. This bond overcomes the radical objections inherent in the type such as the Crown and Columbia, depending upon their contact with the sides of a hole. The resistance of such a bond without the Edison-Brown alloy is very high; comparing it with two Crown bonds non-amalgamated shows a resistance 146 per cent higher, but the amalgamation makes a remarkable difference. Comparing it with the non-amalgamated Crown bond makes a difference of just 42 per cent in favor of the Bryan (when amalgamated), whereas with two Crown bonds, amalgamated, makes a lesser difference of 23 per cent in favor of the Bryan bond amalgamated, with a still further advantage of permanency.

The great objection to the Crown and Columbia, etc., type of bonds consists chiefly in the mechanical defects inherent in them. The vibration of the rail, with the play of the rail joint, results in a continual stress upon the small area of the contact, followed by the final loosening of the bond.

The writer has removed bonds of the above types, which had been in service only a couple of years, that had become loose and the continual movement had worn the bond approximately ⅛ in. smaller in diameter in places. The Bryan bond and those types which are flexible, and particularly the Edison-Brown type, are free from such mechanical defects.

While it was not the purpose of the writer to make the tests herein outlined to demonstrate the virtues of the Edison-Brown, still the results were so pronounced that especial stress is laid upon them, particularly since practical experience has demonstrated their permanency. It will be noticed the "plastic cork" type of Edison-Brown bond gave the lowest resistance of any of the bonds tested.

Conclusions.—The Edison-Brown plastic cork bond is the best.

The Standard bond under fishplate is excellent, but is difficult to place.

The Bryan bond is the best around fishplate type of bond—both electrically and mechanically—provided, however, that the bond is thoroughly amalgamated with the Edison-Brown alloys.

NEW CAST AND STEEL RAIL JOINT

The Crown and Columbia types of bonds would not be so objectionable if stranded, and the strands protected from electrolysis.

The Crown type of bond is rendered materially efficient by the use of the Edison-Brown alloys, while the Columbia type is only benefited slightly. In both instances the Columbia is the better.

Iron wire bonds are highly inefficient.

Any method of testing wherein drop in potential measured from some contacts through which current flows to make measurements leads to false readings, as the measurements include the drop in the contacts.

DISCUSSION

The geueral trend of the discussion following the reading of this paper, was to the effect that rail bonds under fish plates, while good so far as electrical results were concerned, were hard to place owing to mechanical difficulties. The discussion further brought out the fact, which was not mentioned in the paper, that the schedule or table of tests was in each instance made from an average of ten tests each, upon each of the bonds.

Kiud of Bond	Ohms	% Res. = A/B	Current carrying capacity without heating	Center to center of contacts	Length of Bond	Size of Contact	B. & S. Gauge	Number of wires in bond
Joint only—no bond	.00071		0 amperes	36 inches				
Iron Channel Pin	.00049	69 %	15 "	45 "	48 inches	⅜-inch pin	0	1
Bryan Iron Wire	.000286	40 %	36 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	½ inch	2
Crown	.000247	34 %	161 "	30 "	36 "	⅞-inch head	0000	1
Bryan Iron Wire (Amalgamated)	.000224	31 %	46 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	½ inch	2
Crown (Amalgamated)	.000185	26 %	210 "	30 "	36 "	⅞-inch head	0000	1
Bryan Copper Wire	.000175	24 %	386 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2
Columbia	.000131	18 %	161 "	30 "	36 "	⅞-inch head	0000	1
Columbia (Amalgamated)	.000126	17 %	170 "	30 "	36 "	⅞-inch head	0000	1
Stranded Crown	.0001	14 %	161 "	5 "	7 "	⅞-inch head	0000	1
Plastic Socket	.000093	13 %	400 "	3½ "	4¼ "	One square inch	= 000	
Bryan Copper Wire (Amalgamated)	.000071	9 %	1030 "	36 "	39 "	Plate 2¾ inches d., 1-inch hole in it	0000	2
Plastic Cork, under one angle plate only	.00006	8 %	1200 "	9 "	.....	Two square inches	6 0000	.....
Plastic Cork, under both angle plates	.00003	4 %	2400 "	9 "	.....	Four square inches	12 0000	.....
Solid rail—no joint	000013	.....	1200 "	There were holes in web 18 inches between contacts.				

Tests made on Penusylvania Steel Co. 7 inch girder rail, No. 238. (A=Resistance of Bond. B=Resistance of Joint only).

New Cast and Steel Rail Joint

A new cast welding process has recently been placed upon the market by the Milwaukee Rail Joint & Welding Company, and the company operates under the Austin patent. This joint is made by running molten metal into a stationary steel sleeve in such manner as to make a complete fusion between the steel sleeve, the metal and the rail, by means of which is obtained an electrical bond of extraordinary conductivity as well as a joint that, by recent tests, has shown a strength of 180,000 lbs. downward pressure on a joint weighing 67 lbs. and placed on blocks 27 ins. apart.

* Abstract of a paper read before the Elect. Sect. of the Franklin Institute, November 27.

The cuts on the opposite page show the joint in various stages of completion, the second showing a complete joint which, as will be seen, is neat and compact, the steel sleeve on the outside standing perpendicular on each side of the rail and parallel with it, presenting on both sides of the joint a surface without projections. It is claimed for this patent that the straightness of the perpendicular sides of the sleeve enclosing the joint is of the greatest advantage in paving and repairing the streets. It is further claimed by this company that its joint can be welded upon the track without disturbing the ties or removing the blocks or asphalt, excepting a few inches around the rail ends.

The left hand cut shows a section of a cast joint broken for the purpose of showing the complete fusion of the metals. The smaller part torn from the larger contains a part of the sleeve, the molten metal and the base flange of the rail perfectly fused together.

The Impossibility of Reducing Fares in Cleveland*

BY S. H. SHORT.

As street railway legislation is occuping the attention of our officials and business men at the present time, to the exclusion of most other topics, I should like to give the public a few facts with which they, most probably, are not familiar.

You will all remember that in the days of horse cars 2 or 3 miles out from the Square was the limit of railway service.

When electricity was first introduced the companies went to an enormous expense to better their service, and not only relaid their existing track with heavier rails and more substantial substructure; provided new and heavier cars fitted with the then very expensive motors; built large plants to furnish the power and erected the overhead construction for carrying the current, but they extended their lines in all directions; built up suburbs which had been inaccessible to business men heretofore, and added immense wealth to the entire city, as weil as to separate individuals who incidentally profited by their enterprise.

For the returns upon this large investment the street railway companies depended entirely upon the increased traffic and did not ask for additional fares from any of those who benefited by it. At various times since, it has become necessary in order to furnish good service to their patrons, for these companies to invest other large sums in new roadbed, power, motors, and extensions, until now Cleveland has as fine a street railway service as is to be found in the United States—which is equivalent to saying, in the world.

American enterprise is most excellently illustrated by this one branch of business. The largest city in the world, London, England, with over six millions of inhabitants, has 70 miles less of street railway track than Cleveland, with a population of 375,000.

The following table will be of interest in this connection, showing the number of miles of track in the larger cities of the United States as compared with those of Europe of about the same population. In nearly every case, however, the European city is somewhat larger than the American with which it is compared:

United States Cities	Miles of Street R.R.	European Cities	Miles of Street R.R.
New York City	461	Paris	206
Chicago	1,012	Berlin	272
Philadelphia	502	Vienna	166
Brooklyn	512	St. Petersburg	81
St. Louis	350	Liverpool	83
Baltimore	391	Brussels	82
Boston	452	Madrid	36
Cleveland	335	Dublin	82
Cincinnati	295	Lyons	66
San Francisco	271	Amsterdam	82
Pittsburgh	305	Leeds	17
Buffalo	150	Dresden	38
Detroit	221	Leipsic	99
Washington	157	Rome	18
New Orleans	209	Copenhagen	40

A glance at this table will show that the passenger in the American city is hauled on an average five times as far as in the European city.

Of course this greater extent of road has only been equipped by the expenditure of large sums of money which cannot possibly be returned to the investors, under long terms of years, and upon which a fair rate of interest must be paid in the meantime.

As the present agitation seems to have for its object a division with the city of the supposed large profits accruing from the operation of this admirable system of street railways in this city, let us see from what portion of our five cent fare the reduction can be secured. While I am not familiar with the earnings and operating expenses of the railways of the city of Cleveland, and therefore cannot give you their figures, the following table is an accurate statement of the results of the representative street railways of the United States:

Name of Street Railway Company	Passengers carried	Operating expenses	Interest on bonds	Operating expenses per passenger	Interest per passenger	Total cost per passenger
Union Traction Co., Philadelphia	206,904,193	$6,263,017	$1,791,175	.0302	.00865	.03885
Manhattan L, New York	185,138,636	6,209,681	2,161,675	.0339	.0117	.0456
Metropolitan Co., New York	100,024,440	5,379,516	1,317,660	.0316	.0077	.0393
West End Street Ry. Co., Boston	166,862,288	6 678,517	414,998	.040	.0025	.0425
Brooklyn Rapid Transit Co	122,127,066	3,260,604	921,750	.0267	.0076	.0343
Chicago City Railway	95,238,915	2,977,209	207,878	0313	.0022	.0335
West Chicago Railway Co	79 477,900	2,419,284	241,800	.0304	.003	.0334
North Chicago Street R.R. Co	56,523,620	1,394,387	524 231	.0246	.0093	.0339
Third Avenue Ry., New York	62 500,000	1,606,575	250 000	.0257	.0040	.0297
Twin City Co., Min'apolis, Minn.	40,758,700	933,957	705 891	.0229	0173	.0402
Brooklyn L, Brooklyn	35,575,514	1,228,515	641,450	.0346	.0183	.0529
Metropolitan Co., Kansas City	35,618,800	688,700	340 784	.0193	0096	.0289
United Traction, Providence	34,582,704	1,058,980	412,350	.0306	.0119	.0425
National Railway, St. Louis	30,379,669	893,518	377 413	0294	.0124	.0418
Buffalo Railway Co	39,571,328	760,567	282,870	.0192	.0072	.0264
New Orleans Traction Co	25,969,538	877,757	296,996	.0338	.0114	.0452
Nassau system, Brooklyn	28.776,233	971,357	267 080	.0338	.0093	.0431
Toronto Railway	23,537,911	507,760	126,000	.0216	.0054	.0270

From this table it will be seen that the average total cost of carrying each passenger on nineteen different roads of about the same magnitude as those of Cleveland is about 3.8 cents for each person carried.

Now, should our railway companies sell six tickets for a quarter, the gross receipts for each passenger would be $4\frac{1}{6}$ cents.

Deducting the cost per passenger of 3.8 cents, there would be $\frac{86}{100}$ of 1 cent, or about one-third of a cent, with which to pay dividends or interest on the money invested by the stockholders, and make extensions and improvements in the service.

Therefore in order to reduce the fares further on our street railways and still allow investors to receive a fair interest it would be necessary to reduce the cost of carrying passengers.

The 3.8 cents—cost of carrying each passenger—is made up, as the table shows, of the following averages: $\frac{9}{10}$ of 1 cent interest on the bonded indebtedness and 2.9 operating expense, which operating expense covers labor, fuel, repairs, etc.

The interest being such a small proportion of the cost per passenger, if reduced even by a large percentage, would not materially affect the total cost.

In the operating expenses the fuel necessary to operate a car amounts to about 50 cents a day, while labor costs about $8 a day per car; therefore should some method be found by which the power could be produced on even half the fuel used now, its effects would hardly be noticed upon the cost of carrying passengers. Labor is the large item of expense in the operation of a street railway system, and it would be necessary to lower the wages paid to the motormen and conductors, track men, those in the car barns and power house, before the public could obtain any appreciable reduction in street railway fares. No good citizen of Cleveland would be willing to save the fraction of 1 cent for himself at the expense of every laborer employed by the street railways.

* A letter addressed to the Cleveland *Leader* of Dec. 13, 1897, endorsing the position taken by the street railway companies of Cleveland in opposing the passage by the City Council of an ordinance reducing fares.

Results of Storage Battery Traction in Chicago

The Englewood & Chicago Electric Street Railway Company has been actually in operation exclusively by storage batteries for slightly more than one year, and its cars have just completed 400,000 miles of service. It will be remembered that this road was built in the most solid and substantial manner expressly for storage battery work. [A full description appeared in the STREET RAILWAY JOURNAL, of December, 1896, page 748]. Late in 1896, a few cars from the Madison Avenue (New York City) line were put in service, but it was not until Jan. 1, 1897, that the first lot of new cars, built expressly for the road, commenced running. This number was increased as rapidly as possible, and last summer, on the heaviest days, twenty 30 ft. motor cars, each with a trailer, have been required. The company owns forty-four sets of batteries, and up to the present time these batteries have averaged nearly 9500 miles of service each, the maximum being about 13,500 miles. So far, there is no perceptible depreciation of the plates, and to all appearances they have yet a long lease of life. Nothing has been spent on maintenance account.

The receiver, G. Herbert Condict, states that the entire operating expenses of the road in 1897 amount to but 8 cents per car mile, or 8½ cents including the expenses of the receivership. This is an extraordinarily low figure even for a trolley line, and one which has never hitherto beeu approached in storage battery work. The cars run about 200 miles each per day, which is responsible for the low cost per car mile of "car service" labor. Mr. Condict, who is most fair and conservative in his statements, is unwilling as yet to say positively that storage battery traction is on this road cheaper than the overhead system would be, but says that if the batteries, which, as before stated, are apparently in as good a condition as when first installed, will last for 8000 to 10,000 miles more, a distinct economy in comparison with the overhead system would be shown.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer, of the New York bar

The Courts and Rapid Transit in New York

Two important decisions have been handed down by the New York courts during the past month seriously affecting rapid transit in New York.

The first is from the Appellate Division of the First Department authorizing the construction of the system of rapid transit outlined by the Rapid Transit Commission. It has been heralded in the daily press as a great and conclusive victory for rapid transit, but, however much of a victory may be desired by the public a careful examination of the prevailing opinion, concurred in by four of the justices and the dissenting opinion of one justice, shows that the victory, if it is one, is an unsubstantial one.

The most serious objection urged against the approval of the plan of the Rapid Transit Commissioners arises out of the constitutional prohibition forbidding any city "to become indebted for any purpose, or in any manner, "to an amount which, including existing indebtedness, "shall exceed 10 per cent of the assessed valuation of" its taxable real estate. The prevailing opinion asserts that "although the report of the Supreme Court Com- "missioners concedes and the argument of counsel in favor "of the application admits that if the total cost of the "building of the proposed road is to be deemed as incurred "by the city at the time of the making of the contract "that that cost," added to all the indebtedness of the new city of New York, will exceed the limit of indebtedness.

But, it was urged, that, perhaps some of the existing indebtedness might be excluded in ascertaining the limit of indebtedness. On what ground it is not suggested.

It was also suggested on the argument, but the suggestion is repudiated by both Justice Ingraham and by the majority opinion that it might be possible not to charge at the outset the whole cost of the road as an indebtedness, but to charge a certain proportion of it each year. This the court says may be reasonable, but adds that the question of reasonableness does not arise in the case of a constitutional prohibition. The city cannot contract for only a portion of the road, for that would be useless. It would be a mere hole in the ground, subserving no purpose and benefiting the city not at all. The city must agree to pay the entire $35,000,000, or possibly more than that, as determined by the contracts for the building of the whole road.

In view of these facts and conclusions, all of them admitted by the prevailing opinion and insisted on and relied upon in the dissenting opinion, it would seem difficult to see how the court could have approved the plan. Their own words furnish the explanation that is forthcoming: Whether any of the elements of present indebtedness "can be excluded in determining as to the legality "of any contract which the Rapid Transit Commissioners "might make or promise to make for the building of this "road, present serious questions of law, which, in my "judgment, ought not to be determined upon this appli- "cation; for the reason, that, if the court on this applica- "tion should come to a conclusion upon these questions "adverse to the legality of such proposed contract, no "review could be had of its determination, although "involving only questions of law."

In other words, by the statute no appeal can be taken to the Court of Appeals. But as Justice Ingraham points out, the question is before the appelate division for decision and it is doubtful, at least whether the majority are justified by the excuse quoted from deciding the question presented.

Another question will arise, even should it appear that the indebtedness of the city can be increased by thirty-five or more millions of dollars. For, if that increase of indebtedness too nearly approaches the limit, then the city's ability to provide for other municipal improvements and for necessary municipal expenses would be seriously and fatally crippled.

Looking at the matter, therefore, from a purely legal standpoint, it is not time for the enthusiast for rapid transit to throw his hat in the air, if he relies upon any supposed decision of the courts which is final, or which in any way passes upon the most vital question involved. The decision merely says, when translated into common speech: "We "would like to approve the plan, but a very serious con- "stitutional objection is raised which may, and probably "will, make any contract the city may make void and in- "operative, but since, if we should so decide on this appli- "cation the Court of Appeals could not pass upon "our decision, we prefer to wait until the question again "arises at some future stage of the proceedings. Then in "all probability the question will come before us upon an "appeal which can be carried to the higher court; mean- "while we give our formal approval of the plan."

The other notable decision during the month is the refusal of the Court of Appeals to hear a reargument of the case of the *Colonial Traction Company against the Kingston Railway Company*. The previous decision (153 N. Y., 540) stated emphatically with a considerable amount of cogency that under the constitution and statutes of New York one street railway cannot extend or operate its line over the track of another street railway without first taking all the steps that it would have to take were it constructing new tracks. In other words, it must first obtain the consent of a majority of the property owners along the line and the consent of the local authorities, or in lieu thereof, procure an adjudication from the Appellate Division of the Supreme Court as to the desirability of the extension; and this, not because of a legislative, but of a constitutional prohibition. The ground of the decision is, that the constitutional prohibition is in the disjunctive form and forbids the road from constructing *or* operating the road in any street without fulfilling these conditions precedent.

In the Kingston case the road, desiring to extend its lines, proceeded to condemn the use of the tracks of the other road, and the Court of Appeals denying the motion for a reargument of the case, suggests that, where there are existing contracts, under which one railroad is using a portion of the tracks of another road or where a contract between the roads is contemplated, the manner of obtaining a new franchise is an open question, notwithstanding their decision where the right was based upon condemnation proceedings alone, and the court will hear that question when it may be presented.

This undoubtedly has some reference to the pending case of *Ingersoll vs. The Nassau Electric Railroad* in Brooklyn, where the General Term decided, with a dissenting opinion by Pratt, J. (89 Hun., 213,) that no consents of property owners or local authorities were necessary where a road extended its lines over the tracks of another road. The fact that that case has never been reached and will scarcely be reached before next June or October in the Court of Appeals, is an instance of one of the crying evils of our courts in New York—the crowded condition of our calendars. It has now been practically overruled by the Kingston case, unless it is to be distinguished by reason of the fact that the consent of the road owning the tracks had been obtained.

No one, however, can read the opinion in the Kingston case without feeling convinced that the reasons there given for the decision in that case would obtain with equal force in the case where a contract between the roads had been made or was contemplated.

The effect of the doctrine of the Kingston case is plainly twofold. It is an additional incentive to consolidation, assuming that by consolidation the objection raised by the court could be avoided, and, on the other hand, it militates against the convenience of the public who use the street cars, in that it prevents the lines from extending their operation without consent, which in many cases

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

would be impossible to obtain. It is not necessary to add that it has a third effect in protecting property owners from having the streets in front of their premises overcrowded with cars, by allowing an indefinite number to pass over the same tracks in front of their doors.

CHARTERS, ORDINANCES, POWERS, ETC.

NEW JERSEY.—An ordinance of the township of East Orange, in the county of Essex, adopted by the township committee of that township, entitled "An ordinance to regulate the running of electric wires in the township of East Orange," which provides "that no person shall trim, cut, or break any tree, limb, or twig thereof, standing upon a public street or highway of the township, without first obtaining permission of the township committee or their authorized agent," and providing for the imposition of a penalty of $25 for a violation of such provision of such ordinance, is a valid and reasonable exercise of the police powers vested in a municipality, under the statutes P. L. 1867, p. 124, P. L. 1873, p. 324, which authorize the township committee to provide by ordinance for the regulation of the use of the public streets, and "to direct and regulate the planting, rearing, trimming, and preserving of shade trees in the streets and public places of said township; and to authorize or prohibit the removal or destruction of said trees and to restrain and punish persons injuring or defacing the same."

Permission by an ordinance, or agreement with the township authorities, to an electric street railway company to operate its cars through the streets, is not a grant, ipso facto, of the right of the township to the trees standing in such street, nor does it divest the properly constituted municipal authorities of the reasonable control over such trees as a part of the street; and a reasonable regulation or ordinance controlling the company in the use of such trees in the operation of the street railway will be upheld as an exercise of the police power of the township.—(State v. Township of East Orange, 38 At Rep. 803.)

TENNESSEE.—Where the charter of a street car company provides specifically over what streets its lines shall run, a city ordinance giving such company authority to construct lines materially different from the charter lines is void, since charter and ordinance must conform in order to constitute a valid grant.

Act 1885, c. 8, § 18, subsec. 29, incorporating the city of Knoxville, and providing that the mayor and aldermen may by ordinance grant street railroad companies the right of way in the streets of the city, does not give power to grant a right of way materially different from that named in the company's charter.—(Citizens' Ry. Co. v. Africa, 42 S. W. Rep. 485.)

U. S. COURT.—Under the New Jersey statute providing for the incorporation and regulation of street railway companies, approved Apr. 6, 1886, which provides, among other things, that no company incorporated under the act can begin to build its road until the whole amount of its capital stock has been subscribed for by responsible parties, and 50 per cent of each share has been paid in cash, that bonds secured by mortgage can only be issued to the amount of the capital stock, and for the purpose of aiding in the construction of the road, such bonds issued before the whole amount of the capital stock of the company has been paid in cash, and expended in the construction of the road, are illegal, and are void, except so far as they are held by bona fide purchasers for value without notice, but, where so held, constitute a valid claim against the property, in the hands of a receiver, for the amount actually received therefor by the company.

A contract by which a street railway company, in order to procure a right of way over streets running through lands owned by a land company, guaranteed that certain lots of the land company would become worth a certain price, and agreed to pay the difference between such price and what the lots would bring at auction, is not ultra vires.—(Vandeveer v. Asbury Park & B. St. Ry. Co., 82 Fed. Rep. 355.)

NEW YORK.—A company owning a tract of land near a city agreed with another company, formed to purchase it, to construct and operate an electric street railroad over said land, connected with the street railroad of said city, and operate its cars "as often as once every half hour from 7 A. M. to 8 P. M. of each day, as such street railroads are usually run," and that on failure to do so it would restore the purchaser to the position occupied by it when the contract was made, and pay $5000 as liquidated damages. *Held*, that the vendee was entitled to a specific performance of said alternative covenant where the vender performed its covenants, except that during one winter, when there were unusually heavy snows, accompanied by high winds, blockading the road, no cars were run over the line for several days, though the vender did not willfully neglect its duties under the contract.—(Buffalo & L. Land Co. v. Belleville Land & I. Co., 47 N. Y. Supp. 721.)

LIABILITY FOR NEGLIGENCE

ILLINOIS.—Evidence on the part of plaintiff showing that she allowed an east bound street car to pass before attempting to drive northward over defendant's tracks, and that as she approached she looked to the east, but could see nothing but the east bound train, until she reached the north track, when she then discovered a train coming from the east, and for the first time heard the bell sounded, and other evidence showing that a large wagon moving in front of the west bound car obstructed the gripman's view until the wagon cleared the track, and that then the speed of the west bound train was suddenly increased, and just at that moment the gripman discovered plaintiff's buggy 12 ft. away, and could not prevent a collision, is sufficient to sustain a verdict for plaintiff.—(West Chicago St. Ry. Co. v. McCullum, 48 N. E. Rep. 424.)

ILLINOIS.—It is not negligence *per se* to attempt to board a moving cable car, but the question is for the jury, where there is any evidence that the one making the attempt was exercising due care.

The court says: "In large and populous cities, where cars are constantly receiving and discharging passengers at crossings, it is a well known fact that many of such passengers board cars and alight therefrom before such cars have come to a full stop, and that they do so usually with perfect safety. It is well known, also, that street car companies tacitly invite many passengers to board and alight from their cars by checking up to a slow rate of speed, and immediately starting up at greater speed when the passenger is safely abroad or has alighted. It would be impossible for a court to lay down a rule as to what particular rate of speed would be sufficient notice to a passenger that, if he attempted to get on or off, he would be held guilty of contributory negligence. It would also be a great hardship, and unjust, to lay down a general rule that a passenger attempting to board a street car while in motion at all should be held in contributory negligence."—(North Chicago St. Ry. Co. v. Wiswell, 48 N. E. Rep. 407.)

NEW YORK.—Plaintiff, while waiting for a surface car, saw that there were vehicles standing not far up the avenue. He boarded an open car going up town, and, though he might without difficulty have walked into the car, he remained standing on the footboard, which ran along lengthwise, and he was struck by the hub of one of the vehicles he had seen, and was injured. *Held*, that plaintiff did not show freedom from contributory negligence.—(Caspero v. Dry Dock & E. B. R. Co., 47 N. Y., Supp. 961.)

MARYLAND.—Where a passenger on an electric car was injured by the breaking of the trolley wire, which fell upon him while on the back platform of the car, if the accident was caused by a latent defect, which defendant could not discover by reasonable examination, and it employed suitable contractors to erect the wire, and proper material and a skillful method of construction, plaintiff could not recover.—(Baltimore City Pass. Ry Co., v. Nugent, 38 At. Rep. 779.)

NEW JERSEY.—It is not contributory negligence *per se* to alight from a slowly moving horse car, and, when personal injury and a suit for damages result from so doing, it should be left to the jury to determine, from all the evidence, whether the proximate cause of the accident was the plaintiff's own negligence, or a want of proper care in the control and management of the car.—(New Jersey Tr. Co. v. Gardner, 38 At. Rep. 669.)

NEW YORK.—A brake of a surface car had been out of order for more than a month, and the driver had notified the company several times. Through its defective condition, plaintiff, a passenger, rightfully riding on the platform was injured. *Held*, that the company was liable. Van Brunt, P. J., and Ingraham, J., dissenting.—(Weber v. Met. St. Ry. Co., 47 N. Y., Supp. 812.)

A Notable Book

"Carriers of Passengers" is the title of a work in two volumes, which has just been published by the West Publishing Company, of St. Paul, by Norman Fetter, Esq. The work does not treat of all the subjects which its title might cover; for it is confined to the mutual duties and obligations which exist between the passenger and the carrier, and does not treat of the obligations which exist between the carrier and the state, or the obligations between rival or competing carriers of passengers. Hence, we find nothing of the law of franchises, nothing upon the consolidation of companies or the contracts between railroad companies, except so far as they affect the contract between the carrier and the passenger.

The work gains point and directness by this limitation of its scope and is notable for its clear and concise statement of the law. As a book of reference it fulfills the first requirement of usefulness in that, one can turn almost immediately to any subject, and find a clear and concise statement of what the author believes to be the law established by the decisions. It is the law of the decisions, rather than the law, as it ought to be, from the commentator's standpoint, that is to be found within the covers of the work. As a book to stand upon the shelves of the loss department of a street railway, we know of no better upon the subject of which it treats. No work, dealing as it does with the mass of law upon negligence, which has grown up since the Civil War, can be beyond criticism. Too little space it seems to us, is devoted to the action arising out of death caused by negligence; e. g., there being no discussion at all of the question of what are excessive and what are inadequate damages in that action. It will not do to accept the author's excuse that the statutes, creating and regulating this action, are not confined to passengers, for the same could be said of all actions for personal injuries and would exclude most of the contents of the book.

We note too, that while false imprisonment is treated of, the action of malicious prosecution is not referred to, although there are a number of decisions relating to the passenger's right to bring such an action.

Criticism might also be passed upon the author's spelling of the word "wilful."

The work is one that we can recommend as useful because it is clear, because it is concise, and because great judgment has been exercised in the choice of citations.

Prospects for New Business in 1898

In pursuance of a desire to learn approximately the American business immediately in sight for manufacturers of street railway apparatus and material, letters have been sent by the editors of the STREET RAILWAY JOURNAL to a large number of the most prominent street railway companies throughout the United States, asking their plans for extensions and improvements during the coming year. Replies from many of these companies follow, together with a statement of the new enterprises known to be actually under way, and probably to be constructed in 1898. The following list, however, is not by any means complete, as many of the companies written to have replied that their plans were not yet perfected, and no information could at the moment be given out. Moreover, a large number of new enterprises are waiting only for franchises to be perfected before commencing work, the capital having been subscribed and everything being otherwise in shape. Nevertheless, the following statements will give some idea of the distribution of new work in the different states of the Union.

ALABAMA

The Birmingham Ry. & Electric Co. is putting new equipment on the Ensley Division, and should conditions justify, it is the company's intention to electrically equip the road to Bessemer in 1898.

The East Birmingham line of the Birmingham Traction Co., will probably also be equipped for electrical operation.

ARKANSAS

A franchise has been granted for an electric street railway line in Little Rock, on the north side of the Arkansas River in what is known as North Little Rock. Full particulars may be obtained by addressing Maxwell Coffin, presideut, Bank of Little Rock.

The Fort Smith Street Ry. Co. expects to equip its road with electricity by May, 1898.

CALIFORNIA

The Oakland, San Leandro & Hayward's Ry. Co. will add to the two parks already established and maintained, a third which will be exclusively for recreation purposes, and will contain a six lap velodrome, a four lap cinder track, and baseball and football ground, No extension or improvements otherwise are contemplated.

The Market St. Ry. Co., of San Francisco, will change its Park & Ocean double track steam line, 4 miles in length (8 miles single track basis), and its Eighth Street horse car line, ½ mile of double track, to electric lines. The salt water pipe line used for condensing purposes will be extended from the Bryant Street power house, 1 mile further to the Market and Valencia Street power house, at a cost of about $40,000. Other changes and improvements may possibly be made during the year, but nothing further is at present in mind.

The Pasadena & Los Angeles Electric Ry. Co. states that it will build a 5 mile extension in Pasadena. The company also intends to add to its power station considerably more power and to change from a direct to an alternating current. The company will spend about $38,000 on this work. Some of the contracts have already been let.

COLORADO

Franchises have been granted for an electric railway from Colorado Springs to Cripple Creek, and construction work has just commenced. The frauchises have been granted to Irving Howbert, president of the First National Bank of Colorado Springs. The road will be about 30 miles long.

Contracts have been let for the construction of an electric railway to run from Canon City to Cripple Creek. Chas. W. Hascall, of Cripple Springs, is one of the promoters.

CONNECTICUT

The Hartford St. Ry. Co. is building a large carpenter shop and adding to the power house capacity. It has not yet been determined whether or not extensions will be made in 1898.

The Fair Haven & Westville R. R. Co. and the Winchester Ave. R. R. Co., of New Haven, the Norwalk Tramway Co., the Derby St. Ry. Co., the Middletown St. Ry. Co., and the Portland St. Ry. Co. report that no extensions or new work are contemplated.

The Norwalk St. Ry. Co. states that it is probable, though not certain, that its system will be extended to Roton Point early in the spring, about 3 miles of double track being required.

The Hartford-Berlin third rail installation will probably be somewhat extended during 1898, but no definite information is yet ready.

The Meriden, Southington & Compounce Tramway Co. intends commencing coustruction of about 12 miles of road about Mar. 15. Six electric cars will be required. John A. Hurley, of Meriden, Conn., is treasurer.

The Bridgeport Traction Co. will extend its lines from Southport to Westport, a distauce of 2¾ miles, forming a connecting link from Bridgeport to Stamford, and also from Paradise Green along the River Road to Shelton, a distance of 9 miles, forming a connecting link between Bridgeport and Ansonia.

The New Haven St. Ry. Co., has purchased Cosy Beach, and will fit it up as a park and pleasure resort. It is now extending its tracks from East Haven to this beach.

DELAWARE

The Wilmington St. Ry. Co. does not intend to increase its mileage or to make marked improvements in any direction.

DISTRICT OF COLUMBIA

All or nearly all the street railroads in Washington have bills before Congress asking for extensions. Should these become laws, there will be a great deal of work done.

The Capital Traction Co. will complete in 1898 the process of changing its cable lines to underground electric.

The Washington, Arlington & Falls Church Ry. Co. will probably add 3 miles to its trackage, in addition to double tracking a small portion of its present lines. Standard steam railroad requirements are to be followed for track, roadbed, wheels and axles. Additional equipment of motors, trucks and car bodies will be purchased.

The Key West Electric Light & Ry. Co. is preparing to enlarge its lighting plant, rebuild and extend the street railway system and operate its cars by electric power.

The Pensacola Electric & Terminal Co. has purchased a power house and commenced work on the construction of an electric railway in Pensacola. The road will be 6½ miles long and will operate seven cars.

GEORGIA

The Atlanta Consolidated St. Ry. Co. intends to extend its West End line 2 miles to Fort McPherson, its Pryor Street line 1¾ miles to Lakewood, and its Edgewood Avenue line 2 miles to Kirkwood.

The Augusta Ry. & Electric Co. will double track about 2 miles of road with rails now on hand. It will put in an additional turbine water wheel and a 500 h. p. three-phase generator.

ILLINOIS

The City Electric Ry. Co., of Decatur, contemplates a ½ mile extension in the spring, but nothing definite has as yet been decided.

The Bloomington City Ry. will add 2 miles to its system, and will probably increase its equipment.

The Aurora St. Ry. Co. will make no change of importance in its city lines, but will extend its interurban line (The Aurora & Geneva Ry.) from Batavia to Geneva, a distauce of 3 miles. This work will be done in the spring or as soon as a Supreme Court decision can be obtained on the point whether a street railway company organized under the general law has the right of eminent domain. This distance from Batavia to Geneva is the only gap in an electric line 28 miles long, joining Aurora and Elgin, and passing through eight smaller towns.

The Joliet Ry. Co. intends building 4 miles of track, and will add to the power house a 600 h. p. engine and generator.

The Springfield Consolidated Ry. Co., the Rockford Traction Co. and the South Chicago City Ry. Co. report no prospect of extension.

The Chicago City Ry. Co. will build 12 miles of double track road and purchase fifty closed electric cars. No new buildings or other equipmeut are in prospect.

The Englewood & Chicago Electric St. Ry. Co. will probably build 5 or 6 miles of new track in the spring.

The Calumet Electric St. Ry. Co. is now erecting a car house 250 ft. × 400 ft. with a capacity of 100 cars. This is the only improvement intended for the coming year.

The Alton Ry. & Illuminating Co. may possibly purchase two complete car equipments and install an additional generator, but this is not yet certain, and no other railway improvements are in contemplation, though the gas system owned by the company may be extended, and an exhaust steam heating system installed.

The West Chicago St. Ry. Co., the Chicago & Jefferson Urban Transit Co., the Ogden St. Ry. Co. and the Cicero & Proviso St. Ry. Co. have not yet determined what new work will be done in 1898.

The Aurora, Yorkville & Morris Electric Ry. Co., expects to commence construction on a new 36 mile electric line, the first part of January, 1898. N. J. Aldrich, of Aurora, Ill., is interested in the road.

The St. Louis & Belleville Electric Ry. Co., of East St. Louis, Ill., expects to construct a 14 mile electric railway in 1898. John A. Day, of Belleville, Ill., is president of the company.

The Peoria & Pekin Traction Co. has let contracts for the construction of an electric railway between Peoria and Pekin, a distance of 10 miles. W. T. Irwin, of Peoria, is interested.

The North Shore Interurban Ry. Co., successor to the Bluff City Electric St. Ry. Co., of Waukegan, intends to extend its line to Evanston.

INDIANA

The Indiana Traction Co., which has succeeded to the property and franchises of the Indianapolis, Anderson & Marion Ry. Co., will commence work on its line from Marion to Alexandria, as soon as the weather permits, and expects to have it in operation by June 1.

About 4 miles of track have already been laid, and one power house is being equipped.

The Lake Cities Electric Ry. Co., of Michigan City, does not intend building new mileage or making improvements otherwise.

The Evansville St, R. R. Co. reports that no new mileage or new equipment is contemplated.

The Michigan, Indiana & St. Louis Electric Ry. Co., of Goshen, Ind., intends to build a 40 mile electric railway from Goshen to St. Louis, Ind. F. Gilmore, 59 Dearborn, St., Chicago, Ill., is interested in the enterprise.

IOWA

The State Electric Co., of Clinton, will make no extensions, but will relay a part of its tracks with a heavier rail.

The Dubuque St. Ry. Co. will extend its lines 2 miles into the suburbs to a park resort now being laid out.

The Des Moines City Ry. Co. has no extensions in contemplation.

The Boone Electric St. Ry. & Light Co. will add 4 miles to its system early in 1898, building a line to the Des Moines River to reach a 40 acre park to be opened this year. There will be added to the company's equipment one 45 ft. motor car with two 50 h. p. motors, one 32 ft. car with two 35 h. p. motors, six open trailers and one 100 h. p. generator. The track will be of standard gage, and the rail will be 60 lb. T. Chicago bonds and the West End overhead construction have been adopted. The new improvements will cost approximately $40,000.

The Omaha & Council Bluffs Ry. & Bridge Co. will build no new track or construct new buildings in 1898, but will re-equip the power house with new machinery, calling for about 800 h. p. in engines, generators and boilers. It will purchase in the near future sixteen heavy motor equipments for interurban traffic between Omaha and Council Bluffs.

The Sioux City Traction Co. will rebuild about 2 miles of the existing track, the material for which is already on hand. No new equipment or buildings are in contemplation.

The Tri-City Ry. Co., of Davenport, will replace the equipment of its power station in Rock Island, with new dynamos and engines.

The Burlington Electric Ry. Co. expects to make an extension to West Burlington during the coming summer. This extension will be about 3½ miles long. The company is also going to add a 500 k. w. machine to its power station equipment.

KANSAS

The Pittsburg, Froutenac & Suburban Ry. Co. intends extending its line to Fleming, Weir City and Scammon, a distance of 12 miles. This will necessitate adding to car and power equipment. The survey for the line has already been made, and the right of way partially secured.

Willard E. Winner, of Lansing, Kan., has secured a franchise for an electric railway between Leavenworth and Lansing. Assurance is given that this road will be built.

The Wichita Ry., Light & Power Co., will rebuild its road, equip with electricity and double the number of cars.

KENTUCKY

It is stated that the Ashland & Catlettsburg St. Ry. Co., will extend its lines from Catlettsburg to Huntington, W. Va.

The Paducah St. Ry. Co. will build something over 1 mile of track, and is now erecting a new central power station for the purpose of consolidating the two stations at present operated separately. The Park Theatre will be remodeled and enlarged in the spring.

The Louisville Ry. Co. is not contemplating any important extensions, but now has under construction a large machine and repair shop which will be ready for occupancy within a few months. The capacity of the power house will be very materially increased by the addition of large generators and engines.

The Passenger & Belt Ry. Co., of Lexington, has no new work in contemplation.

LOUISIANA

The Orleans & Jefferson Ry. Co., of New Orleans, has let contracts for the construction of a 17 mile electric railway in New Orleans. Robt. R. Zell, is chief engineer of the road.

MAINE

The Penobscot Central R. R. of Bangor, expects to build to Charleston (Me.) in the spring. All rights are granted, and the line will run from Bangor to Kenduskeag, Corinth and Charleston, a distance of 26 miles. F. O. Beed, of Bangor, is interested.

The Bangor, Hampden & Winterport R. R. Co. expects to extend to Winterport—18 miles. It now runs to Hampden, a distance of 6 miles.

The Portland R. R. Co. will build some new track in 1898, but how much is as yet uncertain. A new car house of about seventy-five cars' capacity will be constructed, and ten new cars will be added to the equipment. Some slight additions will be made to the park property.

The Portland & Yarmouth R. R., which is now nearly completed will be opened in the spring.

The Portland & Cape Elizabeth R. R. Co. has not yet fully determined the extent of its track work to be done this year, but the probabilities are that no more than ½ mile will be built, of which all the material is now in hand. No additions to power station or equipment will be made.

The Somerset Traction Company, of Skowhegan, is contemplating no new work.

MASSACHUSETTS

The Hingham St. Ry. Co. will spend about $6000 in extensions and improvements of its track.

The Newton St. Ry. Co, has plans on foot for extensions, but franchises are not yet secured.

The Globe St. Ry. Co., of Fall River, and the Interstate Consolidated St. Ry. Co., of North Attleboro, have no new work in contemplation.

The West End St. Ry. Co., of Boston, will perfect its plans for the coming year withiu the next sixty days.

The Worcester Consolidated St. Ry. Co. is intending to extend its tracks 8 miles to the town of Grafton. Contracts have been made for a 1000 h. p. Lake Erie engine, and 800 k. w. General Electric generator.

The Lowell & Suburban St. Ry. Co. and the Lowell, Lawrence & Haverhill St. Ry. Co. are co-operating in the building of a line between Lowell and Lawrence, through the towns of Tewksbury and Andover on the south side of the Merrimac River. This line will be operated jointly. About 7 miles of track will be built, and cars and feed wire, but no power station equipment, will be required.

The Brockton St. Ry. Co. will probably build a short section of track in some locations in Brockton.

The Boston, Milton & Quincy St. Ry. Co., of Milton, has applied for franchises to construct a line connecting the Brockton system and the West End system of Boston, by which there will be completed a direct line from Brockton to Boston. There is a strong possibility that this line will be built this year.

The Lynn & Boston R. R. Co. will substitute about 12 miles of 9 in. girder rail for the present flat rail; will run additional feed wires in parts of its system, and will add a 1150 h. p., direct coupled engine and generaror in the Chelsea station.

The Northampton St. Ry. Co. will build about 2 miles of track, but no additional equipment will be required.

The Northampton & Amherst St. Ry. Co. will probably build and equip a 7 mile line between the two cities named.

The Bridgewater, Whitman & Rockland St. Ry. Co. will expend about $85,000 in the construction of its road.

The Woronoco St. Ry. Co. will extend its lines through Westfield.

The Quincy & Boston St. Ry. Co. will extend its lines and erect a new car shed.

The Worcester & Clinton St. Ry. will probably be constructed in the spring. Chas. E. Dresser, Leominster, Mass., is secretary.

The Framingham Union St. Ry. Co. will probably equip its horse car lines with electricity in the spring.

MICHIGAN

The Michigan Traction Co., of Kalamazoo, will probably build about 1½ miles in Kalamazoo, and is now arranging for material, etc., necessary to connect Kalamazoo and Battle Creek, a distance of 23 miles. A resort company at Gull Lake will probably invest about $20,000 in buildings at that place in the early spring.

The Ann Arbor & Ypsilanti Electric Ry. Co. does not intend building new track, but will secure a Detroit terminus through the new line of the Detroit, Ypsilanti & Ann Arbor R. R. Co., J. D. Hawkes, president, who may be addressed at the Peninsular Savings Bank Building, Detroit, Mich.

The Muskegon St. Ry. Co. has no intentions in the line of new work.

The Consolidated St. Ry. Co., of Grand Rapids, has deferred action upon work until learning the decision of the Common Council in regard to its application for changes in its franchise.

The Bay Cities Consolidated St. Ry. Co. expects to rebuild about 3 miles of track, to buy some new rolling stock, and make some improvements on Winona Beach.

MISSOURI

The Southwest Missouri Electric Ry. Co. contemplates no extensions or improvements during the coming year.

The Metropolitan St. Ry. Co., of Kansas City, will purchase additional machinery at a cost of about $75,000, and will change the motive power of its Fifth Street line from cable to electricity.

The Northeast Electric Ry. Co., of Kansas City, will build a 6 mile extension.

The Metropolitan St. Ry. Co. reports that it has not fully decided just what improvements will be made but it is probable that it will change one cable line to electricity, build 8 or 10 miles of new electric construction and increase the generator capacity of its power house.

NEBRASKA

The Omaha St. Ry. Co. has made contracts for forty new cars and motor equipments, and one 850 k. w. generator, direct connected to Allis engines. Considerable new mileage will be built, all to be completed before June 1.

NEW HAMPSHIRE

The Laconia St. Ry. Co. has no new work in contemplation.

The Nashua St. Ry. Co. will probably spend about $35,000 in extensions.

NEW JERSEY

The Camden, Gloucester & Woodbury St. Ry. Co. has no new work in contemplation.

The Camden & Suburban Ry. system will probably be extended to Haddonfield, and also along the river front for some distance east of the city.

The Trenton Passenger Ry. Co. expects to lay 2 miles of track.

The Brunswick Traction Co., of New Brunswick, will extend its road to Perth Amboy and to Dunellan, to connect with Plainfield.

The Consolidated Traction Co., of Jersey City, will build about 10 miles of new line in Jersey City.

The Paterson Ry. Co. has under consideration several extensions, but is unable to give definite information at this time.

NEW YORK

The Metropolitan St. Ry. Co. of New York City, expects to complete its underground conduit work on Madison Avenue, Eighth Avenue, Second Avenue, Thirty-fourth Street, and Twenty-third Street in 1898. It is possible that compressed air cars will be put in operation on Twenty-eighth and Twenty-ninth Streets.

The Third Ave. R. R. Co. will complete the underground conduit system of its Forty-second Street line, and on its Dry Dock & East Broadway line; and it is probable that the legal difficulties in connection with the securing of the Kingsbridge franchise will be settled in such a way as to permit the construction already commenced to be completed in 1898.

The Buffalo, Tonawanda & Niagara Falls Electric R. R. Co. expects to build in the summer a second line of road between Buffalo and Tonawanda along the Niagara River; to double track the present line of the Tonawanda St. Ry. Co. through North Tonawanda, and to build a double track road to the New York State Reservation Park at Niagara Falls, making a complete double track system between Buffalo and Niagara Falls—44 miles in length, including the 9 miles now operated by the Tona wanda Electric Ry. Co. and the Tonawanda St. Ry. Co. These 9 miles will be thoroughly overhauled and improved.

The Binghamton R. R. Co. has no definite intentions to build new track, but has a franchise for a line from Union to Maine which may possibly be constructed. There will be some additions to the power station equipment, but to what extent is not yet decided.

The Lewiston & Youngstown Frontier Ry. Co., of Lewiston, will construct a freight yard at Youngstown, with trackage of about 800 ft. in length. The company desires to lease its park to responsible parties, to be equipped with various kinds of summer amusements.

The Niagara Falls & Suspension Bridge Ry. Co., the Middletown-Goshen Traction Co., the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Co., the Fonda, Johnstown & Gloversville R. R. Co., and the Jamestown St. Ry. Co. have no new work in prospect.

The Port Jervis Electric Ry. Co. is at present building a part of its road, which will eventually extend to Milford. W. P. Richardson, of Goshen, should be addressed.

The Mountain Lake Ry. Co., of Gloversville, is now building.

The Brooklyn Heights R. R. Co. will equip for electric operation the recently purchased Sea Beach Ry., formerly operated as a steam road, extending from Sixty-fifth Street, Brooklyn, to Coney Island. The company will purchase 100 cars for its general and summer business. Two 2000 h. p. engines and two 1600 k. w. generators are now under contract and will be installed in the eastern power station early in the year. Work may be commenced on two extensions, amounting to 20 miles of single track, in the early spring.

The Elmira Municipal Improvement Co. intends building 1860 ft. of new track as an extension of the West Water Street line, which will open up park property recently purchased.

The Greenbush & Nassau Ry. & Power Co., will build its line in 1898.

The New York, Elmsford & White Plains will probably build from White Plains to Mamaroneck.

The Buffalo & Depew Ry. Co., will construct a line at once. Geo. A. Ricker, 703 Ellicott Square, Buffalo, is chief engineer.

The Catskill Electric Ry. will probably be built in the spring. Louis E. Robert, 290 Halsey Street, Brooklyn, is president of the company.

There will undoubtedly be an immense amount of street railway material required within a radius of 100 miles of New York City, in Brooklyn, Westchester County and New Jersey, but it is impossible to state anything very definite at this time.

NORTH CAROLINA

The Winston-Salem Ry. & Electric Co., will substitute for steam power in the station now running its lines, electric power from Yadkin River through a 10,000 volt transmission system.

The Morgantown & Blowing Rock Electric Ry. Co. expects to build a 30 mile line soon. W. C. Ervin, of Morgantown, is secretary.

OHIO

The Toledo & Maumee Valley Ry. Co., and the Toledo, Bowling Green & Fairmount Ry. Co. will erect a power station to be in operation about Sept. 1. This station will be equipped with two 40 in. turbine wheels, two 150 k. w. generators and one 150 h. p. booster. The station will be located on a 68 ft. water tower, the water coming from the Cincinnati and Erie Canal. The current will be carried about 15 miles.

The Springfield Ry. Co. is now erecting a 33 ft. × 70 ft. paint shop, will install a 250 h. p. engine and generator shortly, and will extend its line about 3 miles in Springfield and vicinity.

The Mahoning Valley Ry. Co., of Youngstown, will extend its line in the early spring 2½ miles from Haselton to Struthers, and will install additional boiler, engine and generator units in the power station at Niles.

The Cincinnati St. Ry. Co. does not intend making extensions this year, but will reconstruct from 30 to 40 miles of existing tracks with heavy rails.

The Akron St. Ry. & Illuminating Co., the Columbus Central Ry. Co., the City Ry. Co., of Dayton, and the Cleveland City Ry. Co., do not intend making extensions in 1898.

The Columbus St. Ry. Co. and the Zanesville Ry. & Electric Co. have not completed their plans for the coming year.

The Toledo Traction Co. may make some additions to its park property at the opening of the season and may decide later to purchase some cars, but nothing definite has as yet been settled upon.

The Cleveland Electric Ry. Co. does not expect to make any extensions, nor to add much to buildings or power station properties.

The East Liverpool, Fredericktown & Lisbon R. R. Co., will construct an 18 mile electric railway in the spring. Daniel Moynahan, of Niles, O., is interested.

The Tri-City Electric Interurban Ry., of New London, O., will probably build 16½ miles of its line at once. B. J. Hauk, of New London, is engineer.

The Cincinnati & Hamilton Electric St. Ry. Co. is planning to build a long interurban road.

The Dayton & Western Traction Co. has let contracts for an electric railway between Dayton and Eaton.

PENNSYLVANIA

The Scranton Ry. Co. will construct from 2 to 4 miles of new track and may possibly build a new car house.

The Lehigh Traction Co., of Hazelton, has not decided upon any extensions, but certain ones may nevertheless be built if business conditions improve.

The Union Traction Co., of Philadelphia, does not intend making any additions to its equipment during the coming year.

The New Castle Traction Co. does not propose making extensions or constructing new buildings, but important additions will be made to the park features in the way of a large lake, summer theatre and baseball park.

The Schuylkill Valley Traction Co., of Norristown, contemplates an extension of 14 miles to Ambler, Royersford and Spring City. If this is made, an additional engine, generator and boiler 300 k. w. capacity will be required.

The Wilkesbarre & Northern R. R. Co. expects to change its motive power from steam to electricity, which will call for power house equipment, overhead construction, cars, etc. The power station and car house are already built.

The Fairmount Park Transportation Co., of Philadelphia, will make no extensions, but will add to its pleasure park a new casino, costing $30,000, and a bicycle track. The contract has been let for the casino.

The Roxborough, Chestnut Hill & Norristown Ry. Co., The Erie Electric Motor Co., the Pennsylvania Traction Co., of Lancaster, the United Traction Co., of Reading, the Williamsport Passenger Ry. Co., the Wilkesbarre & Wyoming Valley Traction Co., the Johnstown Passenger Ry. Co. and the Harrisburg Traction Co. do not intend making extensions or adding to equipment.

Construction work has been commenced on the Lewisburg, Milton & Watsontown Passenger Ry. The road will be 10 miles long.

The Philadelphia & Merion Ry. Co. is preparing to begin the work of constructing its road.

The Bucks County Ry. Co. is expecting to build a 12 mile extension. T. F. Deegan, 540 Drexel Building, Philadelphia, is contractor.

RHODE ISLAND

The Union R. R. Co., of Providence, has no new work in contemplation.

The Middletown & Portsmouth St. Ry. Co. has secured all franchises and expects to build an 18 mile line in the spring. Tucker, Anthony & Co., of Boston, are financing the work.

SOUTH CAROLINA

The Charleston St. Ry. Co. will add another generator to its power plant, but will not extend its mileage or construct new buildings.

TENNESSEE

The Chattanooga Rapid Transit Co. will build a 10 mile extension in the spring.

The Nashville St. Ry. has no new work in contemplation.

TEXAS

The Dallas & Oak Cliff Electric Ry. will make no changes of any kind in 1898.

The Dallas Rapid Transit & Terminal Ry. Co. will build no additional mileage nor erect new buildings, but may possibly add something to power station equipment and rolling stock, though nothing is definitely determined as yet.

The Galveston City Ry. Co. and the San Antonio St. Ry. Co. have no new work in contemplation.

UTAH

The Ogden Electric Ry. Co. and the Salt Lake City R. R. Co. have no plans for improvements or extensions at present perfected.

VERMONT

The St. Johnsbury St. Ry. Co. intends to construct its line and have it in operation by July 1, 1898. F. C. Kennedy, of Burlington, Vt., is president.

The Bennington & Hoosick Valley Ry. Co. will probably build its line.

VIRGINIA

The Norfolk St. R. R. will probably make some extensions of track, but to what extent is not yet decided. A contract will shortly be placed for fifteen to twenty new summer cars complete and for an extension to car house, giving an increased capacity of twenty-five cars, the construction to be of brick and iron. A condenser plant will also be placed in the power house.

The Richmond Traction Co. and the Roanoke St. Ry. Co. have no new work in contemplation.

WASHINGTON

The Washington Water Power Co., of Spokane, has no plans for new equipments or extensions.

WISCONSIN

The Milwaukee Electric Ry. & Light Co. will equip its new double track electric line from the terminus of its Oakland Avenue line to Whitefish Bay, a distance of 2½ miles; and its Lake Park electric line will be extended 1 mile north. Two 1000 k. w. engine generator units and a 2000 lamp arc light plant will be installed within the next six months in an addition to the present power house now building. In the River Street power house the present installation of eighteen marine boilers will be replaced with water tube boilers of large capacity. About $500,000 will be expended on the combined railway and lighting plant within the next year. The company has just secured control of the Milwaukee & Wauwatosa Motor Railway (dummy line); the Waukesha Beach Railway (running from Waukesha to Peewaukee Lake), and the North Greenfield & Waukesha Electric Railway, which is the connecting link between the Milwaukee system and the Waukesha Beach Railway. Track will be laid from North Greenfield to Waukesha, a distance of 13 miles, in the early spring, so as to open a through line between Milwaukee to Peewaukee Lake by May 30. The Milwaukee & Wauwatosa line will probably be equipped electrically, and in preparation for this a 2000 ft. viaduct over the Menominee Valley is being reconstructed and strengthened.

The Belle City St. Ry. Co of Racine, has no new work in contemplation.

The Milwaukee, Racine & Kenosha Electric Ry. Co. expects to extend its line through the city of Kenosha in the spring. This company's business is strictly an interurban business between Kenosha and Milwaukee. The company does not expect to add anything to its power station, but intends to develop a large park, midway between Racine and Kenosha on its lines.

CANADA

The Winnipeg Electric St. Ry. Co. and the London St. Ry. Co. have no plans for extensions or improvements.

The St. John (N. B.) St. Ry. Co. will probably make some short extensions. Work has been going on for more than a year in remodeling and extending the power house, and about $150,000 is being and has been expended in extensions to buildings, steam and electric piant.

The Niagara Falls Park & River Ry. Co. will build no new mileage, but is installing two 500 h. p. alternating generators for the sale of power for commercial purposes.

The Kingston, Portsmouth & Cataraqui Electric Ry. Co. will add about 2 miles of track to its system.

The Montreal St. Ry. Co. and the Montreal Park & Island Ry. Co. have no new work in contemplation.

NEWS OF THE MONTH

Two suburban cars, carrying some twenty passengers and both running at a speed of 25 miles an hour, collided on the Detroit (Mich.) & Oakland Electric Railroad on Dec. 4. Three men were instantly killed and a score of persons more or less injured. The exact cause of the accident is not fully known. According to the schedule a car leaves each end of the line Detroit and Pontiac, every hour, and there are three sidings along the road. On the day the accident occurred, the cars were behind time. The one bound southward for Detroit had passed an outbound car at the switch 2 miles from Pontiac, the crew apparently being ignorant of the fact that another outbound car was approaching them less than 2 miles distant. The weather was foggy and the rails slippery from the sleet which had been falling. The collision came near a gravel pit about midway between Pontiac and Birmingham, at the foot of two steep grades, down which the cars ran at full speed. The impact was terrific. The cars were driven half through each other and crushed to pieces. The superintendent of the line, John Savage, was one of the persons killed.

THE question of a 3 cent fare is again up for discussion in Detroit. A local Detroit paper says that a report comes to it from a high source that the Detroit Electric Railway Company (the 3 cent fare line) was unable to meet the interest on its bonds when the last payment became due. The paper quotes a business associate of Albert Pack, as saying that the experiment of 3 cent fares in Detroit has been a complete failure. On the other hand, Governor Pingree has given out a signed statement for publication, to the effect that in his opinion the 3 cent fare is a great success.

THE Road Commissioners, of Hamilton, Ont., have adopted a resolution creating a road fund to improve the roadways along which the street railway companies operate. The money derived from the companies' franchise rentals will be devoted to this purpose.

THE water power of the Yadkin River in North Carolina is to be utilized for operating the street railway in Winston-Salem through a 15 mile, 10,000 volt three phase transmission system. The power will be furnished on a meter basis and the price per horse power will be lower than the Winston-Salem Company is now paying for coal alone delivered at its railroad yards.

THE Ferry Street car house of the West End Street Railway Company, of Boston, Mass., was destroyed by fire at 3:30 A. M. on Dec. 24, together with ninety closed motor cars. The fire apparently started from an electric wire.

THE Employes' Association of the Metropolitan Street Railway Company, of New York, at its meeting on Dec. 4, was addressed by President Vreeland, who gave the men a most interesting and inspiring talk. Speaking of his own experience, he said that when he first entered railroad work it was as flagman "out on the plains," as it were, where he had to stay in a 5 × 4 ft. signal box all day long. He found not far away a small circulating library, and, making arrangements to get books regularly, he devoured everything he could obtain bearing on railroad practice. As a result of this and other experience, he stated that he was a firm believer in books and reading for men who wished to improve their condition, and at the close of his talk, he announced the gift by the company to its men, of the nucleus of what he hoped would become eventually a large library. This "nucleus" is a good sized one indeed, amounting to about 2000 volumes, all of which have been chosen with great care.

THE Albany (N. Y.) Railway has just issued an attractive little pamphlet giving the history of the company from the date of its organization in 1863 to the present time, with a list of all its directors and officers, the portrait of its first president, Mr. James Kidd, pictures of the old and new cars in Albany, financial changes from first to last, the bylaws, and other interesting information concerning this, one of the oldest companies in the state. The history was compiled by James H. Manning, a prominent citizen of Albany, and one of the company's directors.

THE Metropolitan Street Railway Company, of New York City, has had neat signs hung in the windows of all its cars reading, "This car is heated" or "This car is not heated." This system is appreciated by the patrons of the road, as a large number of passengers prefer to ride in an unheated car.

The Cincinnati Street Railway Company has issued a notice to its employes that it will provide, at its own expense, different colored stripes to be worn on the left sleeve, to indicate the number of years the employe has been in the service of the company. A light blue stripe will indicate two years' service; a light blue stripe, with a narrow scarlet stripe on each edge will indicate four years' service; a gold stripe laid on a light blue stripe will indicate five years' service; a gold stripe laid on a scarlet stripe will indicate ten years' service, and a gold stripe on an orange stripe will indicate fifteen years' service.

PRESIDENT Rossiter, of the Brooklyn Heights Railroad Company, is considering the use of double decked trail cars on the Sea Beach division next summer.

THE Board of Railroad Commissioners has granted the application of the Metropolitan Street Railway Company, of New York City, for permission to change its motive power from horses to the underground system of electricity on Thirty-fourth Street, between Second Avenue and the East River.

THE street railway mail system of St. Louis, Mo., has been taken from the control of the general superintendent of the railway mail service, and placed under the charge of the local postmaster.

THE Employes' Mutual Relief Association, of the Third Avenue Railroad Company, of New York City, will hold its annual vaudeville entertainment and reception on the evening of Jan. 28, 1898. This relief association is one of the strongest that has been organized among employes of any street railway company in the country, and, it is pleasant to note, has the hearty support of the executive officers of the railway company, John H. Robertson, superintendent of the road, being president of the association. The association has held its annual entertainment for a number of years and an extremely pleasant evening has always been furnished those who attend.

A NUMBER of street railway companies in different cities have recently passed rules preventing smoking on the platforms of the cars, and several companies have prohibited passengers from riding on the platforms at all, one of the latest companies to pass the latter rule being the Calais Street Railway Company, of Calais, Me. Some time ago the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., issued an order, forbidding smoking on the platforms of its cars. As a result of this order, the following petition is being circulated among the patrons of the road and will be presented to the officers of the company. "We, the undersigned residents of Brooklyn, hereby respectfully call your attention to the notice displayed in the cars of your company, prohibiting smoking on the rear platforms of said cars, and hereby protest against same. If this measure is to remain in force, we would ask, for the benefit of the smoking patrons of your road, who are in the majority, that a system of smoking cars be established or the above mentioned rule recalled."

IT is stated that the Consolidated Traction Company, of Jersey City, N. J., has decided to put vestibules on all its motor cars, for the protection of its motormen.

THE one man power of blocking railway construction, which the laws of Pennsylvania allow, sometimes brings about great public inconvenience. An example of this is found in Ambler, whose people are earnestly in favor of an extension of the Schuykill Valley Traction Company's line through that town, but one man, Mr. Bergner, a Philadelphia brewer, obstinately refuses to allow the road to pass his property, and under the laws he is apparently able to prevent action indefinitely.

THERE appears to be a strong probability that the property on which the Tennessee Centennial Exposition was located will be converted into a public park, covering nearly 100 acres of ground. Local committees have been appointed to bring this about.

THE Albany Railway, of Albany, N. Y., has voluntarily decided to increase the pay of its motormen and conductors as follows: For all such employes after three years' service, 18½ cents an hour instead of 16½ now paid to all, and after five years' service 20 cents an hour. This pay will equal the best wages received by motormen and conductors anywhere. The company is also proposing to establish rooms where the men can have the benefits of baths, companionship, cheerful and comfortable surroundings and good reading matter during that part of their time off duty which they do not care to pass at home or elsewhere.

PENNSYLVANIA Railroad officials deny that they have decided to use the overhead trolley system for the equipment of many of their branches. Their experiments on the Mount Holly line have shown that trains must be run very close together in order to make electricity economical as a motive power.

AN important decision, affecting the plans of the Rapid Transit Commissioners of New York City, was handed down on Dec. 18, 1897. The decision was made by the Appellate Division of the Supreme Court, and affirms the report of its special Rapid Transit Inquiry Commission, appointed some time ago. The confirmation is made dependent, however, upon the filing of a stipulation by the Rapid Transit Commission that the contractor's indemnity bond shall be fixed at $15,000,000. The point upon which the scope and immediate effect of the decision hang, in the opinion of the counsel representing the Rapid Transit Commission, deals with this $15,000,000 bond stipulation. Edward M. Shepard, one of the counsel, points out that doubt exists whether the court intends to stipulate that the $15,000,000 bond shall be given for the period covering the construction of the road, or for a very much longer period of time covering the operation of the road. If the latter is intended, it seems, to Mr. Shepard's mind, to put an end to all the plans of the Commission, since he believes that no company or individual could furnish so unprecedentedly large a bond for such a length of time. Mr. Shepard, however, thinks the court intends the bond to cover only the time of construction, believing that the Justices do not require what is seemingly an impossibility.

THE stockholders of the West End Street Railway Company have ratified a lease of the entire property of the company to the Boston Elevated Railroad Company. This lease is a modified form of a lease that was drawn up last September, between the two companies, but which was not approved by the Board of Railroad Commissioners. The principal changes made in the new lease for the purpose of meeting the objections of the Commissioners to the old lease, are a change from 8 to 7 per cent in the guaranteed dividend on the common stock, and a change in the life of the lease from 99 years to 24 years, 9 months and 10 days. This new form of lease has been approved by the Railroad Commissioners and the lease goes into effect Jan. 1.

AT the last annual meeting of the New Jersey State Grange Association held in Trenton, in December, a resolution was passed instructing the legislative committee to endeavor to have repealed the law that prohibits the carrying of freight on street railway lines in New Jersey. The farmers consider it detrimental to their interests, inasmuch as it prevents their making use of what would otherwise be a cheap method of sending their produce to the cities. In the discussion following, it was brought out that in several states, and especially in Connecticut, farmers are enabled to ship directly from their farms to market by trolley at much less rates than by the steam railroads.

THE statistics of the street railroads of Pennsylvania for the years ending June 30, 1896 and 1897 (the latter figures just received from the Department of Internal Affairs) are as follows:

	1896	1897
Capital Stock	154,973,293	$143,489.309
Funded Debt	41,036,790	42,812,430
Current Liabilities	25,638,969	34,266,976
Total Liabilities	221,649,052	220,568,715
Cost of Road and Equipment	116,290,535	118,250,014
Gross Receipts		27,396,489
Operating Expenses	10,621,691	10,075,644
Interest on Funded Debt	1,822,303	1,919,084
Taxes	1,183,343	1,567,335
Rentals	5,889,965	7,736,525
Other Expenses	17,450,190	942,481
Dividends	3,548,035	5,214,874
Deficit		59,454
Total Mileage	1,562	1,552
Number of Cars	3,853	5,413
Number of Employes	8,394	12,079
Wages paid Employes	3,666,710	6,920,692
Passengers Carried	376,502,551	409,723,418
Passengers Killed	32	18
Passengers Injured	532	519
Employes Killed	10	4
Employes Injured	67	71
Others Killed	76	
Others Injured	394	
Total Killed	118	
Total Injured	993	

POSTMASTER GENERAL GARY states that the greater expedition to the mails secured through transportation on electric cars has created an increasing demand for the extension of the service. There are more applications now pending in the Postoffice Department for the establishment of electric car mail service than can be met from the appropriation for the current year. The annual rate of expenditure for the electric and cable car postal service on June 30, 1897, was $183,038.43. Uniform rates of pay have been adopted, based on space and mileage.

THE Chicago City Railway Company has recently created a new department that promises to effect a considerable saving in operating expenses. The company has installed at its Dearborn Street shops, a complete laundry for the purpose of washing the curtains used on the open summer cars, and also the towels used by the office force and conductors. The compauy has about 11,000 soiled curtains each season to wash, after the summer cars are taken off, and in former years it has taken four men all winter to wash these curtains alone, and the results were far from satisfactory. With the new arrangement it is expected that one man, giving but part of his time each day will be able to do all the work, with far better results. The equipment of the laundry consists of a washing machine and wringer, and an ironing room is now being fitted up. The washing machine consists of a barrel shaped receptacle for the articles to be washed, revolved upon an axle supported by a frame. At one side is arranged the driving mechanism. This includes three pulleys, the middle one being connected to the axle, which turns the machine and belted to a shaft overhead when it is desired to operate. The scheme is the invention of C. E. Moore, master mechanic of the company.

THERE is considerable talk on the Canadian side of the Niagara River, of erecting a generating plant for the purpose of taking power from the Whirlpool Rapids. It is claimed that this power can be successfully transmitted as far as Toronto.

IT is stated that two of the largest grain elevators in the world, built in Buffalo, N. Y., during the summer, at a cost of nearly $1,000,000, are now successfully using large quantities of the Niagara Falls power. The new extension to the central power station of the Niagara Falls Power Company is now nearly completed, and will be delivering power within a few weeks. The length of the original section was 140 ft., and that of the extension is 286 ft., making the present length of the power house 426 ft.

THE New York & Brooklyn Bridge earned in tolls $1,240,861 gross in 1897, as against $1,201,758 in 1896. Of this amount $1,150,-064 was earned by the railroad, and $90,797 by the carriage ways. To these earnings should be added $111,419 for rents of store houses and other privileges controlled by the Bridge, and $11,450 miscellaneous receipts.

A MINIATURE electric street railway was put in operation in the Circuit Court of Appeals at Cincinnati last month, in order to illustrate certain mechanical features in a patent suit brought by the General Electric Company against the Springfield (O.) Electric Street Railway Company.

AT a meeting of the Social Reform Club, of New York City, on Dec. 21, Prof. Frank H. Parsons, of Boston, presented an argument in favor of municipal ownership of street railways, and Edward E. Higgins, editor of the STREET RAILWAY JOURNAL, an argument in favor of private ownership.

THE Cleveland Electric Railway Company by its vice-president, James Parmelee, has written to the Municipal Association of Cleveland, a long letter setting forth facts and figures in support of the contention of the street railway company that the proposed reduction of fares is unfair and impossible to be granted by the street railway companies. The Cleveland Chamber of Commerce has since requested the Common Council to defer action upon the bills, and to appoint three members from its number to act upon a commission of nine, three others to be appointed by the Chamber, and three by the street railway companies, to investigate street railway conditions in different cities.

THE presidents of the principal railroads in St. Louis, Mo., were arrested late in December charged with having failed to provide vestibules for the protection of the motormen, as required by a statute enacted at the last session of the Missouri Legislature. This is the beginning of what will probably be extended litigation on the question of the right of the legislature to pass a bill of this character.

THE Third Avenue Railroad Company, of New York City, is experimenting with a long combination of open and closed cars of a rather novel pattern. The car is made by splicing an open and closed car end to end. In this way the company will get twice the seating capacity without the use of trailers, thus saving the expense of an extra conductor, and the expense and annoyance of handling the trail cars.

IT is understood that the Nassau Electric Railroad Company is about to be reorganized for the purpose of consolidating all the street railway companies which it now controls. It is understood that the idea is to incorporate a new company that shall include all the smaller companies, for the purpose of effecting a saving in the fixed charges of the road and also in the operating department. The new company will probably have $15,000,oco capital stock, half of which will be preferred, and $15,000,000 funded debt will be authorized.

J. F. WALLACE, who resigned the position of chief engineer of the Illinois Central Railroad, in August last, has returned to the company, accepting the position of assistant to the second vice-president. This is construed as indicating a determination by the directors to take immediate and favorable action on the subject of electrical equipment. Mr. Wallace has been for some time an advocate of this change, but the board of directors has not until now endorsed his position in the matter.

THE syndicate of capitalists controlling the Metropolitan Street Railway Compauy, of New York, is seriously considering the question of making a bid to the Rapid Transit Commissioners to construct the projected underground railroad in New York, and the company's engineers are now preparing a report to the syndicate upon the plans of the commission in order to determine the basis of such a bid. William C. Whitney and John D. Crimmins state definitely that if the enterprise can be made profitable, the syndicate will give the necessary bonds, and will construct the road.

THE taking of evidence by the Commission on the 4 cent fare ordinance in Milwaukee is going on, and experts are being produced by the company to prove that it is impossible to reduce fares as desired by the city. Among those who have testified to this effect is M. R. McAdoo, manager of the Paterson (N. J.) R. R. Co.

THE Dry Dock, East Broadway & Battery R. R. Co. has practically decided upon an elaborate experiment with storage batteries. Its officers have visited the Englewood & Chicago Electric Ry. and examined into its workings very carefully. It is understood that they were so much impressed with what they have seen there that they have arranged with the Chicago company to ship to New York immediately four of the Englewood cars for continued use in New York, and if after a further period of experiment, everything is satisfactory, an order for more cars will be given.

COLUMBIA UNIVERSITY has accepted the offer of the Edward P. Allis Company, to equip a steam laboratory in the Department of Engineering, to be known for all time as the "Edward P. Allis Memorial."

THE Common Council of Pottstown, Pa., has recently passed an ordinance reducing the electric car tax from $25 per car to $10 per car. At the hearing on the subject the following interesting information was brought out relating to the car tax, which is paid in a number of the smaller cities and towns of Pennsylvania. Lebanon charges $5 per car, but does not collect it; Washington, Pa. has no tax; New Castle, $8 per car; Mauch Chunk, $5; Allentown, $25; Johnstown, $100 for all the cars; Pottsville, $10; Hazleton, none; Mahanoy City, $5; West Chester, $5; Altoona, $200 for all cars; Chester, $10; Beaver Falls, $10, for regular cars; Oil City, $10.

It is stated that the officials of the Metropolitan Street Railway Company and the Third Avenue Railroad Company, of New York City, have reached an agreement looking to the cessation of legal difficulties existing between the two companies. It is not known just what concessions were made on each side, but it is understood that the Metropolitan Street Railway Company will be permitted to cross the tracks of the Third Avenue Railroad Company at several points, and the Third Avenue Railroad Company will meet with no more opposition in securing its Kingsbridge Road franchise.

The Chief of the Bureau of Railroads of Pennsylvania, suggests legislation permitting operating and lessee street railway corporations in that state to consolidate. He states that this will result in eliminating from corporate existence one half of the street railways reporting to the Bureau. He also recommends the enactment of a law providing grade crossings in all future construction of either street or steam railroads, at least outside of municipalities.

It is said that the street railway franchise of the Columbus Central Railway Company, organized by J. J. Shipherd, of Cleveland, have been declared illegal by the Courts.

Important New Work in Milwaukee

The Milwaukee Electric Railway & Light Company has within the past two months partially graded the roadbed for a new double track electric line from the terminus of its Oakland Avenue line to Whitefish Bay. This distance is approximately 2½ miles, requiring about 5 miles of single track. Whitefish Bay has heretofore been reached by a dummy line, the operation of which will be discontinued when the electric line is put into operation, which it is hoped, will be about the first of June, 1898. When the operation of this dummy line is discontinued the company will extend its Lake Park electric line 1 mile north to accommodate the most thickly settled part of the territory through which the dummy line passed. This, with some minor changes of track and short extensions of several of its lines to keep up with the growth of population in the suburbs, covers all that this company now expects to do in the way of track extensions during the year 1898.

The company has recently acquired, adjoining its present River Street power station, an additional lot fronting 100 ft. on River Street and extending about 135 ft. on Oneida Street to the Milwaukee River. This lot the company is now excavating preparatory to driving piles all over the lot at 3 ft. centers for the purpose of erecting an addition to its present power house. In this extension the company will install within the next six months two new 1000 k. w. railway generators, direct connected to vertical engines. The company will also likewise install in this building an entirely new arc light plant of not less than 2000 lights capacity (of 2000 c. p. each) to commence with, for the purpose of abandoning the station of the old Badger Company built some ten or twelve years ago and from which the company now furnishes all the street lights for the city and commercial arc lights aggregating some 1600 or 1700.

It is the intention of the company to gradually change its present River Street power house to harmonize with the new addition now proposed to be built. In making these changes the company will immediately replace the present installation of eighteen marine boilers with water tube boilers of large capacity, it being the intention of the company that the new station shall be equipped with every modern and approved appliance for generating electric current at the least possible cost. With the acquisition of the lot above referred this company now has a plot of ground fronting 240 ft. on River Street with an equal frontage on the Milwaukee River by about 135 ft. in depth, the location being very nearly central to both its railway and lighting loads. On the additions and improvements to its power house the company will probably spend during the coming year about $500,000. The addition to its power house above referred to will provide for the installation of two additional 1000 k. w. railway generators. The plans now in preparation for the power house will contemplate the ultimate expenditure within the next ten years of possibly $1,000,000, and the officers believe this will provide for all the wants of the company so far as pertains to power for many years to come.

During the past month there has been transferred to the Milwaukee Light, Heat & Traction Company (the entire capital stock of which is owned by the Milwaukee Electric Railway & Light Company) all the franchises, rights of way and property of the Milwaukee & Wauwatosa Motor Railway Company (the dummy line running from Milwaukee to Wauwatosa) all the franchises, rights of way and property of the Waukesha Beach Railway Company (the line running from Waukesha to Peewaukee Lake, about 6 miles in length) all the franchises, rights of way and property of the North Greenfield & Waukesha Electric Railway Company (the corporation organized to obtain the right of way from North Greenfield to Waukesha, and being the connecting link between the system of the Milwaukee Electric Railway & Light Company and the Waukesha Beach Electric Railway.) The grading on this right of way from North Greenfield to Waukesha, a distance of about 13 miles, has been actively prosecuted for the last sixty days, work on which is still being pushed for the purpose of being able to commence laying track on it as early as possible in the spring, as the company is going to make every effort to open the through line from Milwaukee to Peewaukee Lake, May 30 next (Memorial Day), to do which, in this severe climate where the frost does not get out of the ground until late in April, will require some record breaking work.

The company will also probably equip electrically the Milwaukee & Wauwatosa motor line which at the present time has between 7 and 8 miles of single track. Preparatory to doing this, the company is reconstructing and strengthening the viaduct, over 2000 ft. in length and 90 ft. high, crossing the Menominee River and Valley. All of this construction work is being done by the Milwaukee Electric Railway & Light Company which company will also operate the properties when completed.

Street Railway Accountants' Association

Interest in the work of the Street Railway Accountants' Association is still increasing, and it now looks as if the association would soon include among its members, all the important street railway companies in the country. Since last month the following roads have become members of the association: Brockton Street Railway, Brockton, Mass.; Capital Traction Company, Washington, D. C.; Detroit Citizens' Railway Company, Detroit, Mich.; Atlanta Railway Company, Atlanta, Ga.; St. Joseph Railway, Light Heat & Power Company, St. Joseph, Mo.

Calenders for 1898

The calenders for 1898, which have already been issued by manufacturers in the street railway field, are particularly attractive and artistic. Among those which should receive special mention are: one by R. A. Keasbey, bearing an artistic representation of a basket of strawberries; one by the Shultz Belting Company, bearing the portrait of a beautiful woman; one of the American Electrical Works, giving a view of its extensive factory for bare and insulated electric wires at Providence, R. I., and one by the Leschen-Macomber-Whyte Company, bearing a handsome half-tone engraving.

An "Accident" Claim

The following curious and highly interesting letter has recently been received by the Middletown-Goshen Traction Company, and promptly forwarded by it to the Electric Mutual Casualty Association which is "responsible" for the settlement of this claim.

To Tee Middletown-Goshen Trenston Co.
Dier Sirs:

not hiring from you as to damag i received by the troly car Oct. 11, 1897, i will commense soot in fiew day as to my demand is wose then i though they woad bee my nee is very sor and swelon and paines me most of the tim.

you
D. A. S.

Mr. Urban,
Dear sir :—

i have not hurd from yo sence yo call on me to settl this clame i have gans the trolie rod if we can settl this with out trouble or law i————(?) do sow if we can get to gether i am willing to do wat is all rite i hav bin laid up with rumitisum for the last two week i hav not bin able leave my room i hav it in my legs and feet hoping to her from yo or the compeny.

yo
D. A. S.

Annual Report of the North Shore Traction Company

The North Shore Traction Company, which owns the capital stock of the Lynn & Boston Railroad Company, of Lynn, Mass., reports earnings for the year ending Sept. 30, 1897, as follows:

Gross earnings from operation		$1,425,211
Miscellaneous receipts		6,725
Total income		1,431,936
Operating expenses (57.44 per cent.)		818,626
Net earnings		613,310
Interest, charges, taxes and rentals		415,016
Surplus		198,294
Extraordinary deductions.		
Expense refunding bonds	$ 437	
Reconstruction during the year	29,167	
Payment to North Shore Traction Co. on account commissions on bonds sold	65,000	
		94,604
Net divisible surplus		$103,690

Alternating Apparatus for Power Transmission

The tendency to build long electric railways has made alternating apparatus a most important factor in electric railway work. The system of transmitting to long distances by alternating currents, and the conversion of that energy into direct current at railway pressure, is conceded to be a most valuable economy in many cases. In order to supply the demand for such apparatus the Walker company has perfected and is prepared to furnish alternate current generators up to 1600 k. w. capacity, and rotary transformers. The company has adopted the inductor type of alternator in which the armature is stationary. This permits a high armature insulation to

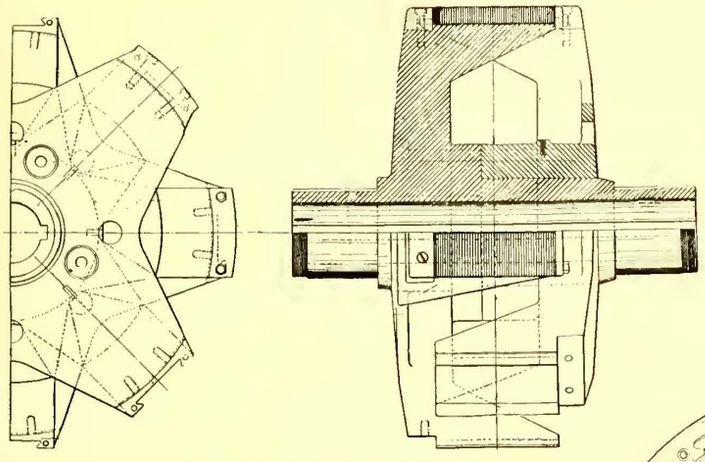


FIG. 1.—REVOLVING FIELD MAGNET

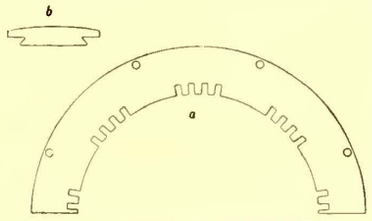


FIG. 2.—ARMATURE SEGMENT

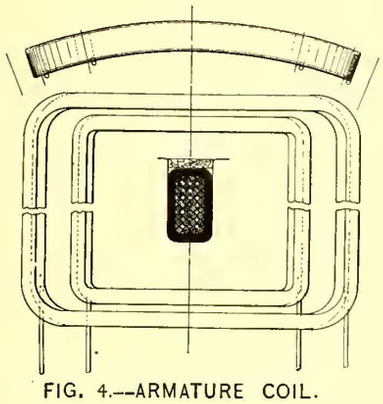


FIG. 4.—ARMATURE COIL.

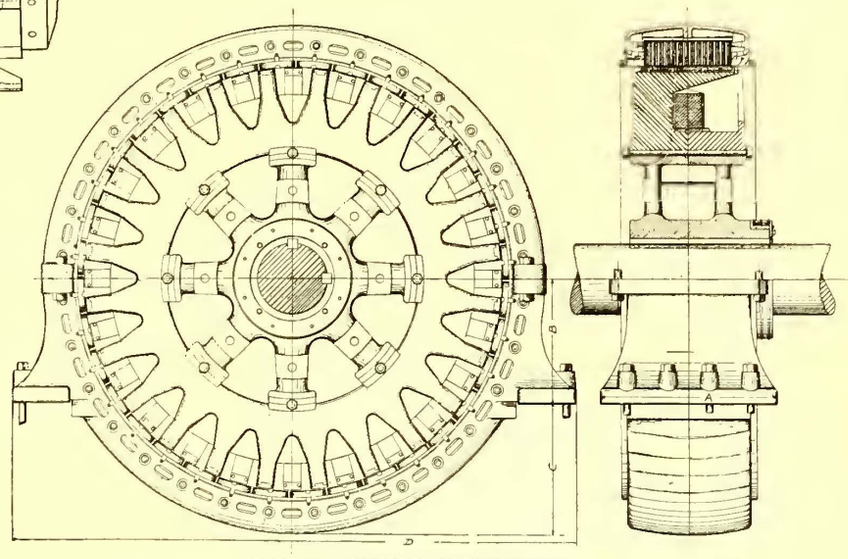


FIG. 3.—POWER ALTERNATOR

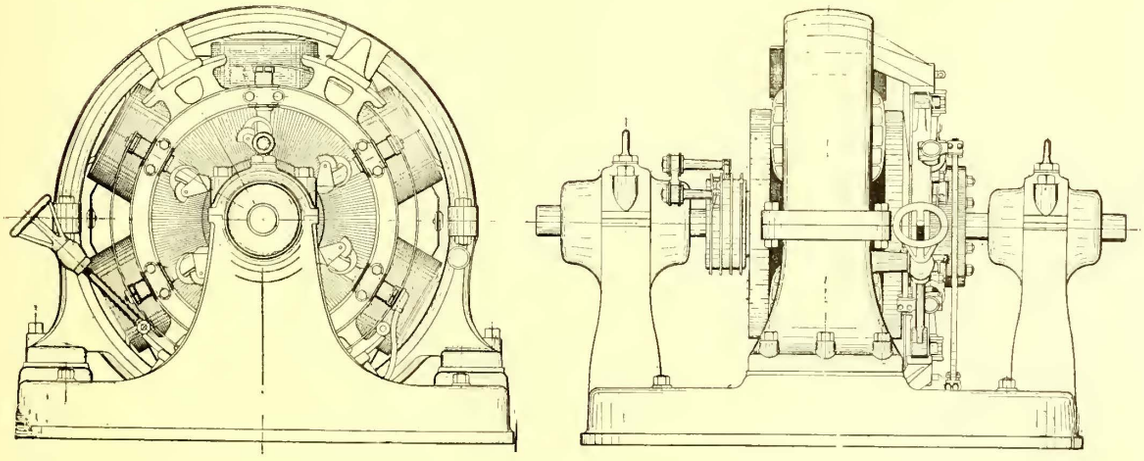


FIG. 5.—ROTARY TRANSFORMER

readily withstand a working pressure of 10,000 volts, and by using these machines the first cost and subsequent losses of step-up static transformers are avoided.

The revolving field magnet of the Walker alternator is shown in section and diagram in Fig. 1. A single coil, concentric with the armature shaft, magnetizes a branch magnetic circuit, the branches of which are suitably disposed so as to carry properly shaped laminated pole pieces on the periphery of the revolving member. The field magnet is cast in two parts, one of which slips on the hub of the other, and thus the field coil can be readily removed if necessary. It is however a comparatively low voltage coil and consequently is very durable and seldom requires to be disturbed.

The exciting current in these machines is extremely small and claimed to be much less than that of any other machine of similar capacity. When adapted for lighting work, the field coils of these machines are compounded so as to raise the pressure as the load comes on.

The armature is a laminated construction built in sections with internal teeth as shown in Fig. 2. Fig. 2, illustrates a stamping for single phase work. For two phase work, the rest of the internal part of the segment would be punched out, thus making a series of uniform teeth. The armature is amply ventilated by means of air ducts passing through its mass through which a continuous stream of air is forced by the fanning action of the rapidly revolving arms on the inductor.

The armature laminations are assembled in an iron frame, which rigidly supports them and securely fastens them together. This frame, which in its exterior lines reminds one of the Walker direct generator, can, like these latter machines, be slid sideways, thus exposing both armature or field for inspection or repair. The armature coils are rectangular in shape, as shown in Fig. 4, and are slightly curved to fit the frame. They are wound on forms and are most liberally insulated; in fact the design of the machine is such that there is almost no limit to the possibilities in this direction. The coils are readily removable. The winding is of the concentrated type, and therefore the coils do not interfere with each other, and an individual coil can be renewed without disturbing any of its mates.

These generators will be supplied to deliver one, two or three phased currents as required, and will be wound for any voltage up to 10,000. They are supplied in frequencies of 125, 60, and 30 cycles per second, according to the nature of the work that they have to perform.

The rotary transformers, which are illustrated in Fig. 5, are not difficult of description, for the reason that they employ all of the excellent features of the Walker direct current railway generators, and aside from suitable alterations in the winding and subbase, and the addition of suitable collecting rings, they are very similar in appearance to the direct current machines.

These machines being the product of a company which has successfully competed in that most conservative of all electric fields—

the electric railway—may be expected to produce results of the very highest grade.

New Vestibule Door

In the accompanying illustration is shown a new vestibule door, which has been patented by Charles F. Agard. The principal object in this invention has been to provide a vestibule door that may be opened by moving it edgewise towards and against the adjacent angle of the vestibule without swinging it inwardly, thereby enabling it to be opened without encroaching upon the room or space of the vestibule. Fig. 4 shows this door as applied to one of the side doors of a street car vestibule, the door being open and inside the vestibule. A plan of the door and track rail and plans and elevations of the swiveling hangers and the device for guiding and steadying the lower portion of the door are also shown.

It will be seen that the swiveling door hangers are so arranged that they will align themselves to the curvature of the track. The door at the bottom is guided by a guide fastened to the door and consisting of two rolls which engage the guiding rail on each side. One roll is on a flexible arm, being forced against the rail by a spiral spring which prevents any rattle of the door, and allows the door to run smoothly and with very little friction. The guiding rail is placed up and away from the floor, thus leaving the floor free from any track or obstruction. The door when closed shuts into a rabbet, making the vestibule tight and as warm as the rest of the car. This device has been in use on the lines of the Hartford Street Railway Company for about two years, and the company's officials state that the doors have given entire satisfaction. The fixings for the door are manufactured by Jas. L. Howard & Company.

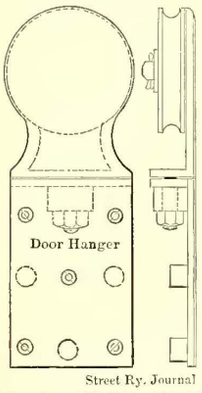


FIG. 1.—DOOR HANGER

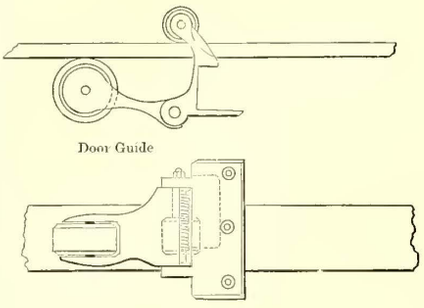


FIG. 2.—DOOR GUIDE

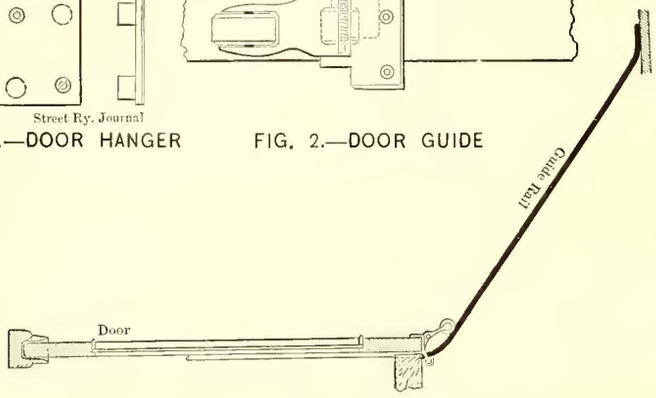


FIG. 3.—PLAN OF DOOR AND GUIDE RAIL

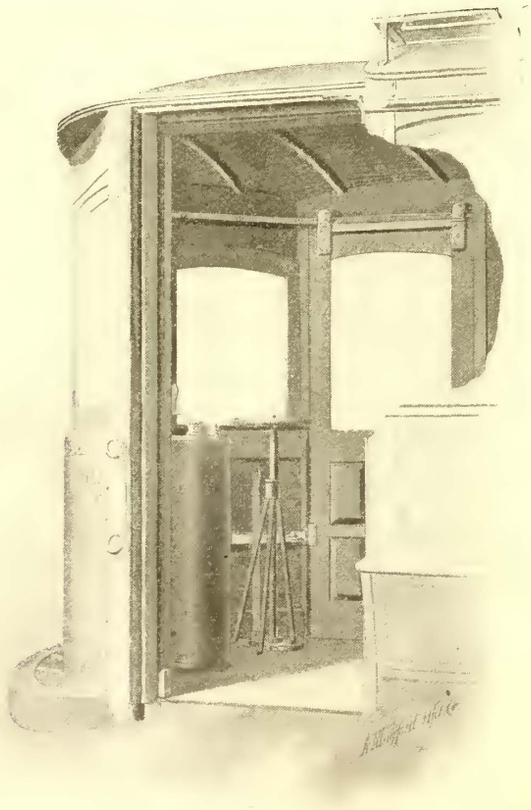
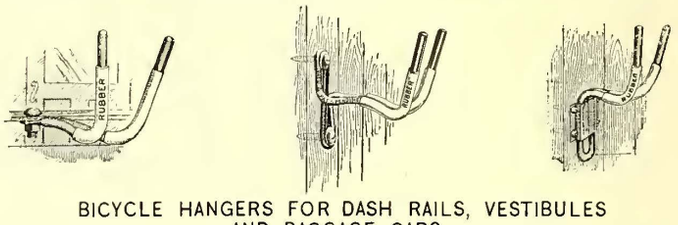


FIG. 4.—SLIDING VESTIBULE DOOR

New Bicycle Holder

One of the strongest competitors that the street railways of the country have had to contend with in the last few years has been the bicyle. For this reason, street railway managers have for a long time been studying the problem of recovering a part of this lost traffic, by furnishing accommodations so that the bicyclist will find it more convenient to use the street cars, when looking for good roads, when caught in a storm or when his wheel has become damaged by an accident. To provide this accomodation, the "Dubleook" bicycle holder, manufactured by the Graham-Woodward Equipment Company, has been placed on the market.

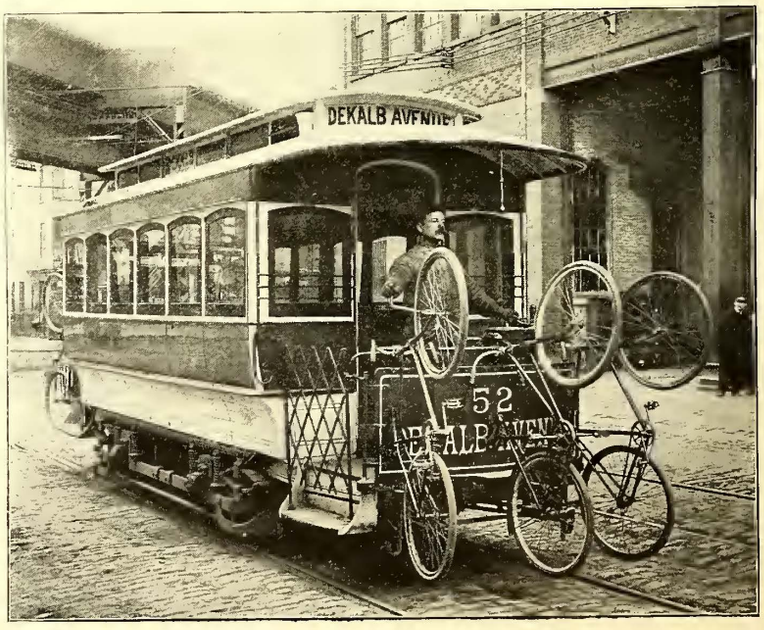
This holder is made in three styles and is furnished either in nickel or enamel of any desired color. The first style is stationary for closed front street cars, and baggage cars; the second is stationary for open front street cars, and the third style is removable, with socket, for baggage cars. The device is made of the best of steel and consists of hooks encased in rubber, and designed to be fastened to the front or rear dashboards of street cars or to the interior sides of a baggage car. Bicycles are suspended from these hooks by the handle bar, and ride perfectly rigid. When placed upon the dashboard of a car, the wheel does not in any way interfere with the brake handle.



BICYCLE HANGERS FOR DASH RAILS, VESTIBULES AND BAGGAGE CARS

The holder has been introduced on a number of lines and is giving entire satisfaction. The Market Street Railway Company, of San Francisco, states that on one of its lines an average of 1800 bicycles were carried per month. This, at five cents for the wheel and five cents for the owner, would make a revenue of $180 per month, which is unattended by any increase in the operating expenses, whatever. The New York Central Railroad has adopted the device for carrying wheels in its baggage cars, and other companies are employing it as well.

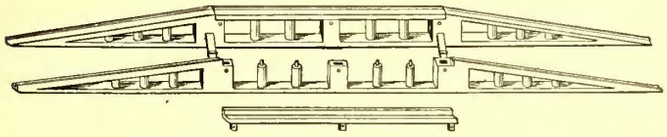
The accompanying illustrations show the different types of the hanger and also the method of applying the bicycles to the car.



CAR CARRYING THREE BICYCLES AT EACH END—BROOKLYN

A Street Railway Hose Bridge

One of the most annoying causes of delays on street railways is the necessity of running fire hose over the tracks in case of a conflagration along the line. In this way it is not an unusual occurrence for a road to be tied up for from fifteen minutes to half a day for the want of some method of getting over the lines of hose of the fire department. The time thus lost is a very serious matter to the street railway companies, both because of the loss of revenue and also in the disarrangement of the running schedule—a matter of serious importance. To meet the demand for a means of preventing these delays, the Rochester hose bridge has been placed upon the market by the Rochester Hose Bridge Company. This bridge is made of two parallel trusses working over a center by means of a double hinged joint. It is built to standard gage and immediately adjusts itself to any style of rail—either the T, flat or grooved rail, with



TRACK HOSE BRIDGE

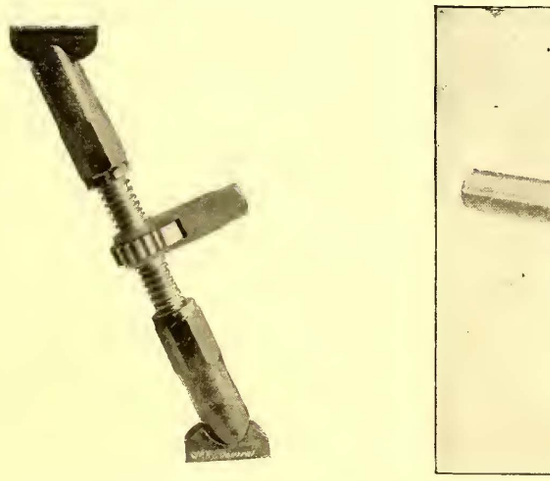
equal facility. The bridge, though built throughout of the best steel and second growth oak, weighs considerably less than 200 lbs., and is easily handled by the ordinary repair wagon crew of two men. As the machine can be contracted to 9 ins. in width, four of them may be easily carried on the ordinary emergency wagon, and the crew can adjust the bridge to the track in thirty seconds.

The usual style of the Rochester hose bridge gives accommodation for the reception of six lines of hose, and by simply removing two pins from the upper chord of the truss, this top may be removed without disturbing the bridge on the track, and the hose may be shifted from one pocket to another, taken out entirely, or new lines placed in, all without uncoupling a single joint of the hose. This feature will commend itself especially to the attention of the fire departments. The flange or lug that engages the track is milled; being designed to take hold of the rail in order to prevent the bridge from being moved when a car crosses over it. A number of practical tests have been made of this bridge upon a number of street railways, and it seems to be giving entire satisfaction. A particularly severe test was made upon this hose bridge recently on the lines of the Consolidated Traction Company, of Newark, N. J. The general superintendent of the road states that the fire department was required to place the hose across the tracks at 9:09 P. M. The cars were blocked eleven minutes, when the hose bridges arrived, which were immediately put into service and kept in service, enabling the traffic to move without interference until midnight, when the hose was removed. During that time, 143 cars passed over the bridges.

A Car Replacing Jack

One of the most necessary appliances in the operating department of a street railway company is a strong and durable jack, and one that is adapted to replacing derailed cars is particularly essential. A jack that especially recommends itself to street railway companies, and one that should be on every car, and particularly on every long suburban car, is the Pearson jack, which is manufactured by the Pearson Jack Company. This jack embodies a number of novel features in its construction, and a number of strong points are urged for it by the manufacturers. The Pearson jack possesses the peculiar power of lifting and pushing at an angle with the same force as at the perpendicular, and this movement is of particular advantage in replacing a derailed car. It will be seen from the accompanying illustration that this appliance has a peculiarly shaped head with a line of corrugation at the top. This head is movable, and the socket on which it moves enables it to do its pushing from a center and at a straight line, thereby always presenting a level head and foot, no matter at what angle the jack is working, thus making the strain equal over the whole machine. The jack is manufactured with a spring ratchet, if desired, which will be found to be very quick working and easily handled. This jack is made in various sizes and is extensively used upon steam railroads as well as street railways.

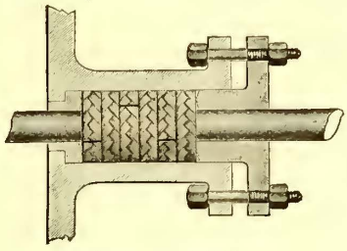
The simplicity of construction and the ease of manipulation of the Pearson jack will recommend it to all managers. The company will send on approval a pair of the jacks to any road desiring to test their merits.



RATCHET JACK

Metallic Packing

Duval metallic packing has been on the market for the last seven years, and in that time has been thoroughly tried by many of the representative concerns in the country, including railroads, steamship lines, water works, manufacturing plants and stationary plants. This packing is particularly adapted to high pressure work, both steam and hydraulic, and in many cases has been in continuous use for five years without renewal or attention. For this reason it is an exceedingly economical packing. The Duval metallic packing is made of fine white brass wire of special composition, arranged to give the maximum degree of toughness and strength, at the same time being of such hardness that should any wear occur, it will take place in the packing and not on the rods. Because of its composition this packing is not affected by acids or rust, and is therefore of great service for use in connection with fire pumps and other machinery which stand idle a portion of the time. This packing is made in strips and is adapted to be used in the same manner as soft packing.

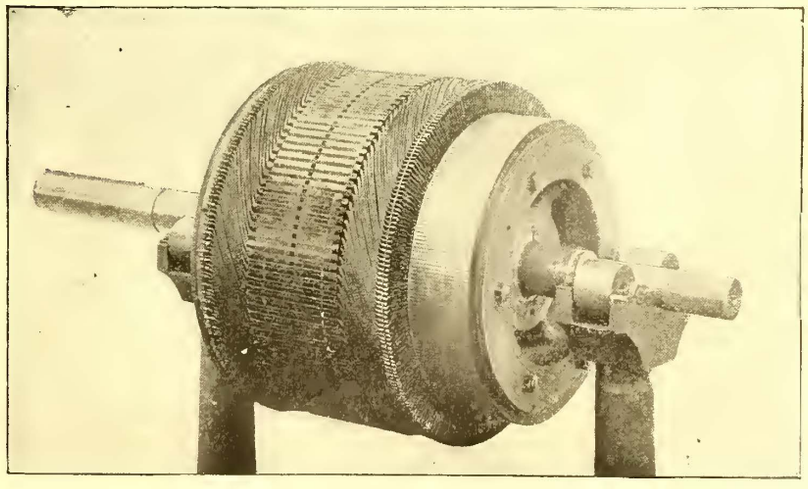


METLIC PCKIG

A New Belt Driven Generator

So rapid has been the development of the railway generator directly connected to the driving engine, and so extensive its adoption, that the railway public is liable to lose sight of the fact that the belt driven generator is still greatly in demand. Many cases exist in which the conditions do not warrant the installation of direct connected apparatus, and to these cases the belt driven generator is more applicable.

Improvements in belt driven generators have kept pace with those in all other classes of electrical apparatus, and the distinguishing features of excellence of the General Electric Company's direct connected apparatus have been incorporated in its new line of belted machines. These are all six pole generators, built in five sizes ranging from 110 k. w. to 500 k. w. That shown in the illustration on the next page is a 110 k. w., six pole, 500 revolution machine.



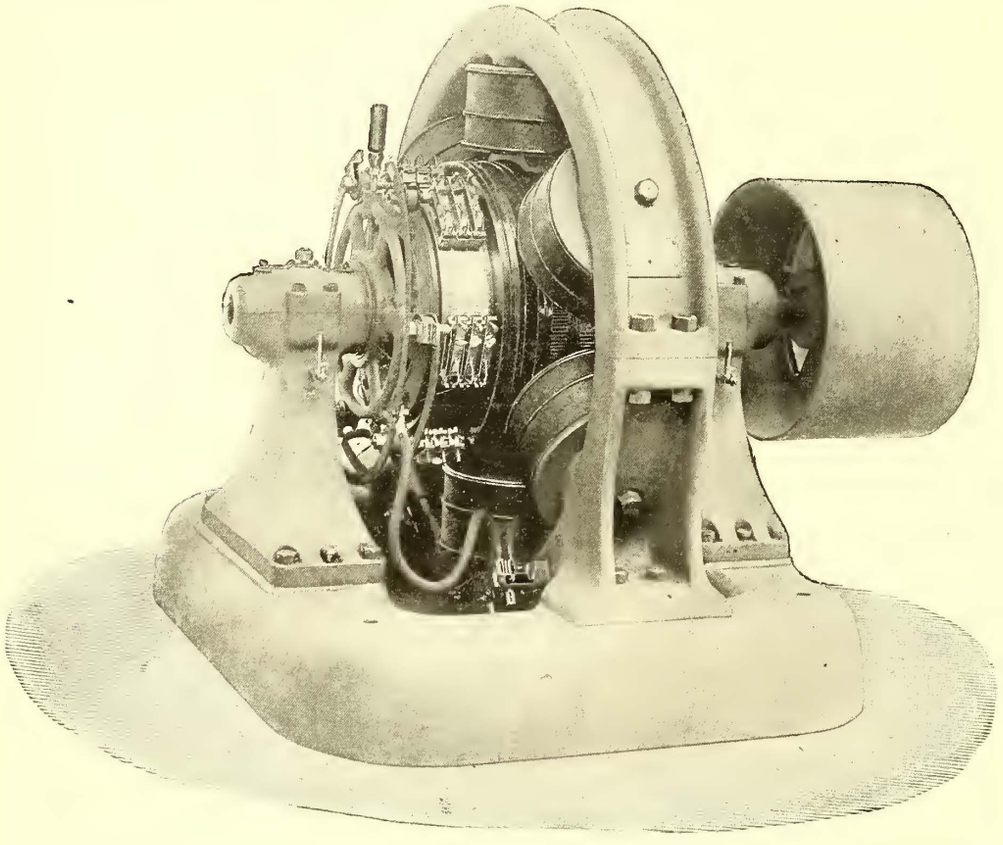
ARMATURE OF BELT DRIVEN GENERATOR

The magnet frame is of cast steel heavily ribbed, making it both light and compact, while the magnetic efficiency is kept highest. The bearings are built upon the ball and socket principle, are self-aligning and self-oiling. The armature shaft has been increased in size and the bearings lengthened, two features substantially guaranteeing cool operation. The steel poles and pole pieces

are cast in one piece and so bolted to the frame that they may easily be removed without disturbing either the armature or the frame.

The series winding of the field coils is of flat copper ribbon, the shunt winding of wire. Instead of winding the series coil on the field spool and covering it with the shunt winding, both windings are placed side by side on the pole, and, being entirely independent, either may be removed without disturbing the other. This feature will be readily appreciated when compared with the methods heretofore in use. It is no longer necessary with this new method to remove the shunt winding to reach the series winding.

The armature is of the barrel wound type, such as is used in the General Electric direct connected generators. This method of winding gives the smaller number of joints, and facilitates any necessary repairs, as few coils need to be removed to reach any particular one incapacitated for service. The cast iron flange, bolted to the armature spider at each end of the core, forms a support as well as a cylindrical receptacle for the projecting ends of the coils. The coils are secured firmly in the slots of the core, and the cross connections are made on the barrel flange. The projecting ends of the coils in the flange are thoroughly insulated and held in place by steel bands. The flange extension also protects the windings from any oil that may be thrown from the bearings. The surface of the interior of the armature is perfectly smooth, offering no opportunity for the collection of oil or dust.



BELT DRIVEN RAILWAY GENERATOR

Ventilation is effected by the use of specially constructed vanes forming air ducts between the laminæ of the core. These convert the armature into a blower, and create a strong draft through the windings. The commutator leads are taken directly from the coil to the segment immediately beneath it. The construction of the commutator is similar to that of the direct connected machines. It is ventilated by air drawn through the body and discharged through air ducts in the core. The small difference of potential between the segments secures the permanence of the insulation and freedom from sparking. The strength of the magnetic field in these generators is so proportioned to the armature reaction that a constant brush lead and neutral point are ensured even with heavy overloads.

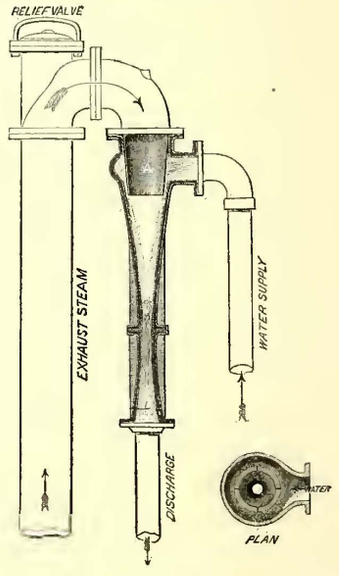
The General Electric belt driven generators have been only recently introduced, but up to Oct. 1, over fifty-five machines have been sold, aggregating considerably over 10,000 k. w.

A Gasoline Brazer

One the best appliances for brazing copper wire bonds on electric railway tracks is the gasoline brazer manufactured by the White Manufacturing Company. This machine has a tank made of galvanized boiler iron, tested to 200 lbs. pressure, and designed to hold 5 gals. of gasoline. The brazer is equipped with an indicator and a metal pump, with solid brass connections; it can thus be charged in a few minutes without trouble. The burners can be operated independently and regulated to any size blast. They produce solid blue flames of 2200 degs. F., intensity, which are entirely devoid of smoke. There is a cut-off valve at the top of the tank, which enables the burners to be cleaned without losing the air pressure. To braze readily a pressure of 40 lbs, is required. The burners are provided with swinging joints, allowing the operator to raise or lower the flame if necessary while in operation. This machine is made especially for electric street railways, and is guaranteed to give satisfactory results.

An "Injector" Condenser

In the accompanying illustration is shown a condenser in which is employed the combined action of an injector and syphon. It is the invention of Henry W. Bulkley, by whom it has been manufactured for some years. In this condenser the condensing water enters at a side opening, and passes downward around the exhaust nozzle in a thin circular film. The exhaust steam is thus condensed within a hollow cone of falling water, which by its velocity through the contracted neck of the condenser expels the air and vapor into the discharge pipe below. The column in the discharge pipe being long enough to overcome the pressure of the atmosphere, the water is delivered into the hot well by gravity. A very high vacuum is thus maintained, and may be formed before the engine is started, or while it is standing. Should the vacuum be lost, the automatic relief valve, shown at the top, will open and allow the engine to exhaust freely without stopping. The Bulkley injector condenser will syphon the water from a head of 10 ft. or more after starting, or it can be supplied by an ordinary pump, either air or steam.



AN INJECTOR CONDENSER

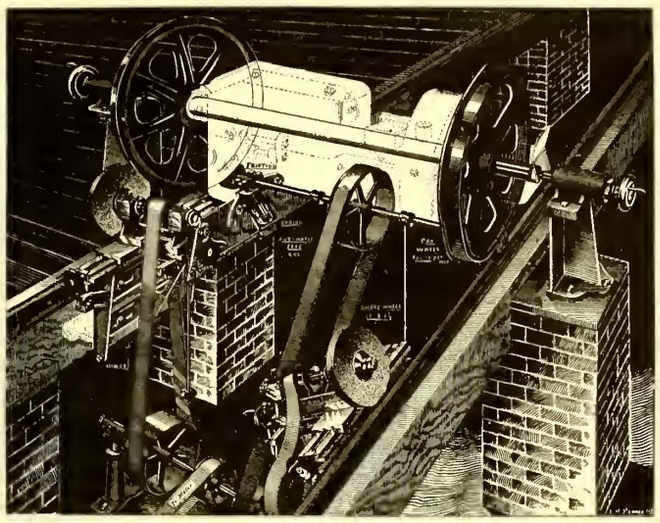
When the condenser is supplied by a pump, it is connected with the exhaust pipe of the engine at a height of about 34 ft. above the level of the hot well, which is placed as low as possible. A light discharge pipe extends from the condenser nearly to the bottom of the hot well, and is always sealed by the water in the same. In this case the action is continuous, the water discharging into the hot well by gravity. The area of the neck of the condenser is greater than that of the water in the inlet above, and the height of the water column overcomes the pressure of the atmosphere without. This construction makes it impossible for water to be forced or drawn into the cylinder of the engine, no matter how the engine may be handled in starting or stopping. This condenser is conveniently attached to vertical engines, in this case being placed at a height of about 34 ft. above the hot well overflow level. The Bulkley condenser is in use in a large number of rolling mills, blast furnaces, electric light and power stations, cotton mills, etc., and is especially adapted for use in street railway plants.

It is claimed that the small number of parts and simplicity of construction make this one of the cheapest and best condensers that can be installed in a large sized plant.

IT is interesting to note that as far South as Charleston, S. C., electric heaters are appreciated by the public and are being installed in the closed cars for use on chilly days.

Machine for Grinding Car Wheels

The economy of grinding car wheels and keeping a true surface is beginning to be realized quite extensively by the street railway companies of the country. It is undoubtedly true that the unequal size of car wheels is often the cause of burning out armatures, while the rocking strain to which the car bodies are subjected with unevenly worn wheels, plays a large part in the item of maintenance. The accompanying illustration shows the Hampden car wheel grinder, which is manufactured by the Hampden Corundum Wheel Company.



CAR WHEEL GRINDER

The manufacturers of this grinder have had fifteen years' experience in car wheel grinding in the steam railroad field, and have embodied in their grinder for street railway wheels a number of important improvements that have been brought out by their previous experience. This company works on the theory that the car wheel must be revolved at a very slow speed in order to secure the best results. From 3 to 20 r. p. m. are the minimum and maximum speeds which it employs. The car wheel is held rigidly in place, and the emery wheel is revolved at a high speed in a substantial frame and with dustproof bearings in order to secure durability in the machine. The grinder is shown herewith with one side in position ready to grind, and the other side dropped below on a double hinge. When the machine is lowered in the pit, a car can be run over the machine without any interference. When raised to position the grinding head is brought solidly against the frame on a double bearing and bolted with swivel bolts. The machine is fastened solidly to the stringer, and when in operation there is no tremble or vibration. The emery wheel is fed across the face of the car wheel with an automatic ratchet feed.

Trucks for Double Deck Cars

The modern electric railway truck is the result of a great deal of thought and study which have been put upon this important part of electric railway rolling stock. So much attention has been given to this branch of the subject that the principles are now pretty generally understood, and inventors have now reached a point where the improvements will be more in the way of detail and not in radical departures from existing standards. There is one phase of the subject, however, to which attention has not been generally directed in this country, and that is to the use of trucks under double deck cars. The universal use in America of single truck cars postponed, to a certain extent, the study of this branch of the subject, but with the increasing use of electricity as a motive power for street railways abroad, the subject of the best truck to use under double deck cars has become one of considerable moment.

A cursory examination of the problem will disclose the fact that the difficulties attending the proper design of a truck under a car increase rapidly with the elevation of the load. Where part of the load, as with a double deck car, is carried on the roof, the center of gravity of the entire car is raised a material distance. Fig. 3 is a diagram from which this proposition will be apparent. It shows the skeleton of a standard 16 ft. double deck car, similar to that used on the electric lines of Leeds, England. The outside dimensions of the car body are 16 ft. 4 ins., and length over all 26 ft. 6 ins. The center of gravity of the car, loaded inside, but without deck load, would be 4 ft. 6 ins. above the surface of the track. With deck load, however, the center of gravity would be raised 30 ins., or would be 7 ft. above the surface of the track. In the sketch, of course, the centers of gravity are only approximated. As the tendency of a car flexibly supported on a truck is to oscillate around its center of gravity, the action of the car under these conditions can be likened to that of a balance wheel in a watch, in which, in the first place, the wheel has a radius of 4 ft. 6 ins., and in the other case of 7 ft. Lengthening the car body or enlarging the platform would, of course, have the same tendency as that of carrying a load on the roof, i. e., toward increasing the moment of inertia, which must be counterbalanced by the spring system.

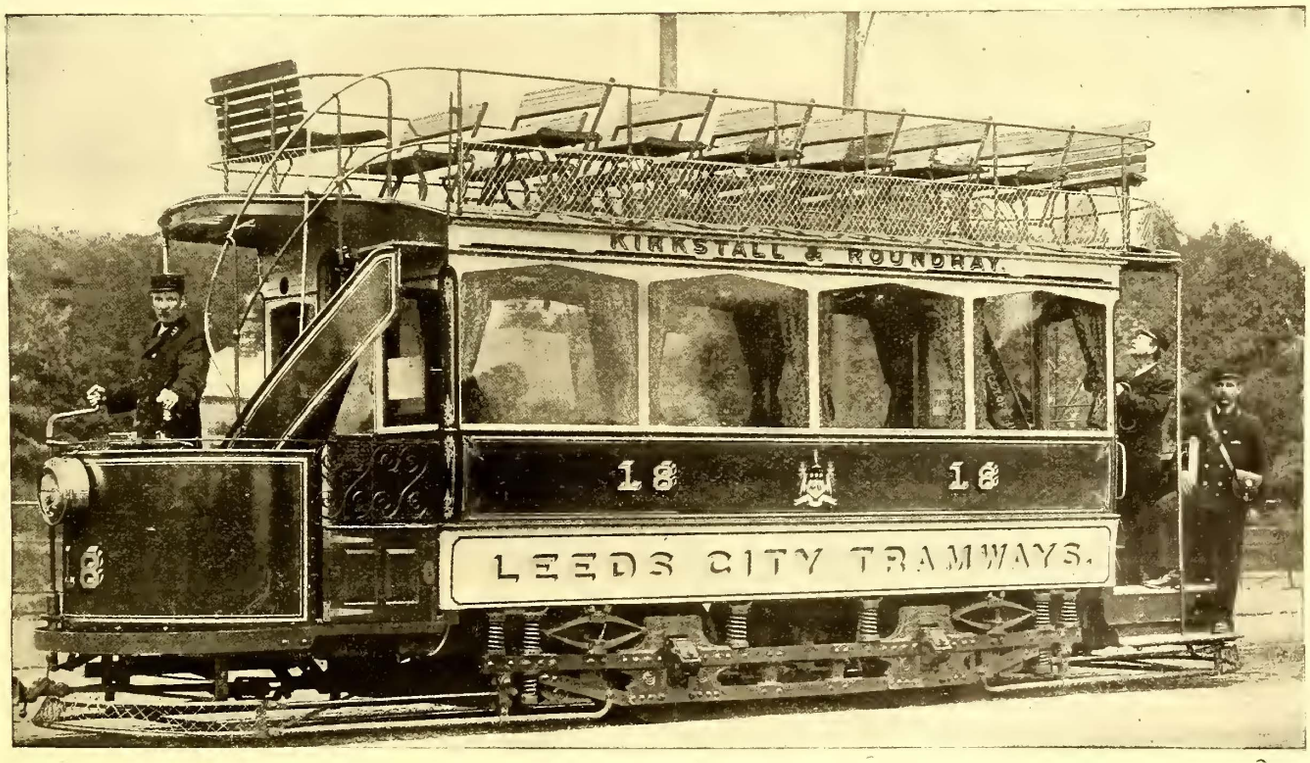


FIG. 1.—DOUBLE DECK CAR AT LEEDS, ENGLAND

The moment of resistance to oscillation can be increased in four ways. First, by increasing the stiffness of the outer springs; second, by increasing the distance of the springs from the center of gravity of the car body and load; third, by increasing the wheel base (distance from center to center of wheels); and fourth, by counterbalancing the ends by the weights of the motors, wheels and axles, so that a tendency of either end of the truck to rise will be checked by the weight of these parts, which will keep it down.

If we assume the spring system to be sufficiently strong to support the car body and load at rest, it is undesirable to increase the stiffness of the springs in such a system, as increasing their stiffness

will tend to make the car ride hard; consequently, in order to obtain, with the same spring system, sufficient resistance to oscillation and sufficient flexibility to insure ease of riding, it is necessary to make the spring base, as well as the wheel base, as long as possible, thus obtaining from a set of springs with a given weight sustaining power, the greatest possible amount of resistance opposed to the oscillations of the car body.

The exact relation between the length of spring base to the tendency to oscillation is shown mathematically in Fig. 2, in which B, is the center of gravity of the car body and load, A D the axis of the end supporting springs, F A E the arc of oscillation around this center of gravity, and A C a tangent drawn to this arc at the point, A. The moment of resistance of any given spring to oscillation therefore equals $W \times A\ C \times \cos C\ A\ D$, in which W equals the resistance per inch of spring compression, and A C is measured in inches. As the angle, C A D, increases, that is, as the distance of the spring from the center of the truck increases, cos C A D approaches unity, consequently the tendency to oscillation is reduced.

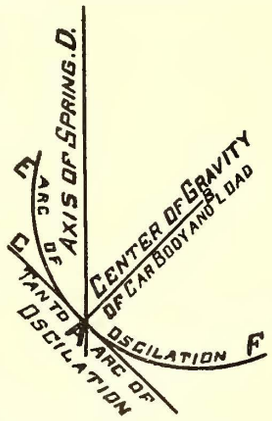


FIG. 2.—STRAIN DIAGRAM

While a long spring base with a proportionate wheel base will offer the necessary resistauce, with a wheel base less than 7 ft., it is impossible with even a long spring base to prevent the oscillation of double deck cars. To overcome this with the wheel bases met in ordinary European tramway practice, which is usually 5 ft. 6 ins. to 6 ft., the Peckham Truck Company has been successful in applying the counterweight principle of balancing the weight of the car, when it tends to oscillate, by that of the motors, wheels, axles and side frames, as outlined. This is used on the Peckham Standard and Extra Long trucks, which have been adopted by the Bristol, Coventry, Guernsey, Leeds and Dublin tramways. The latter company has now in use about forty-five of these trucks, and has recently ordered 150 more.

The construction consists in the combination with the outer end truck spiral springs of under tension springs which compress when the load is applied by the attempt of the car to oscillate, and relax when the load is applied to the upper spiral springs. In the Standard truck four of these tension springs (one at each corner of the truck frame), and in the Extra Long truck eight (two at each end of the truck frame), are generally used. The latter trucks are recommended for long double deck or high speed single deck cars. By the use of these tension springs, the car body is so firmly secured to the extreme end of the truck frames that should it tend to rise, the under springs will compress and tend to raise that end of the truck with its weight of motors, wheels and axles around the other axle as a fulcrum. The average weight so applied to each end of the car (one motor, one pair of wheels and axles, and one-half of the weight of the side frames) is about 2500 lbs., and as the leverage through which these act is from two to three times that tending to raise them, their effective weight for balancing the car is largely increased.

In the Peckham-Standard cantilever truck the spring system is so arranged as to permit about 1½ ins of compression to the entire system when the car is at rest. For the resistance to oscillation the end spiral springs give a compression of about ¼ in. per 100 lbs. load, while the counter springs give ⅛ in. per 100 lbs. load. Of course the four elliptic springs and the four springs in the center of the truck all aid to resisting oscillation as well as compression, but being located nearer the center of the truck they do not act as strongly as the springs at the ends. In the Extra Long truck four more counter springs are added as stated. These four more counter springs add 400 lbs. per ⅛ in. compression. The resistance varies directly with the distance through which the end of the car body moves, but the arrangement of counter springs, acting against the upper spiral end springs, is such that not only is the lifting power of the truck springs under the rising end of the body entirely eliminated, but the retarding power of the springs at the rising end of the body comes into play immediately to resist the tendency of the car to oscillate. This is accomplished by fastening the caps holding the upper end springs and the counter springs on one bolt, and by screwing up on this bolt so as to get the initial compression of both springs equal to, or nearly equal to, the compression due to the weight of the car body and load on the other truck springs. This results in an end spring system, which has the same resistance to depression as though it were made of springs of power equal to the sum of the power of the truck springs and underlying compression springs, and likewise a resistance at the rising end of the car of the same amount.

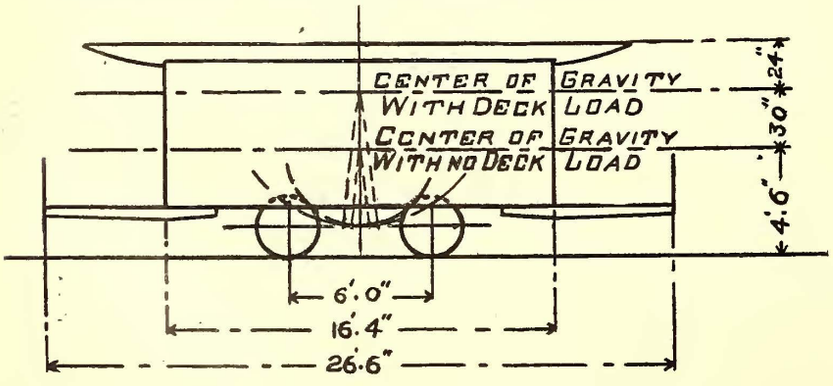


FIG. 3.—DIAGRAM OF DOUBLE DECK CAR

New Type of Rail Bond

The accompanying engraving shows a type of rail bond which is manufactured by James Bryan & Company, and which has been giving excellent results on a large number of roads. The inventor, Mr. Bryan, is connected with the Consolidated Traction Company, of Pittsburgh, Pa., and the bond is employed as standard on all the lines of that company, as well as the United Traction Company, of the same city. It is also in use by the Pittsburgh & Birmingham Traction Company, the Camden & Suburban Railway Company, Camden, N. J., the Louisville Street Railway Company, Louisville, Ky., and many others.

One main object sought by the inventor is to give the bond a sufficient area of contact with the rail to compensate for the lower conductivity of steel, as compared with copper; thus, the bond terminal using two No. 0000 wires is 2¾ ins diameter; with web of rail ⅜ in. thick, the area of steel through which the current must pass is the circumference of the bond terminal times the thickness of web of rail, which equals 3.138 sq. ins., equal to 3,995,400 c. m. Two No.

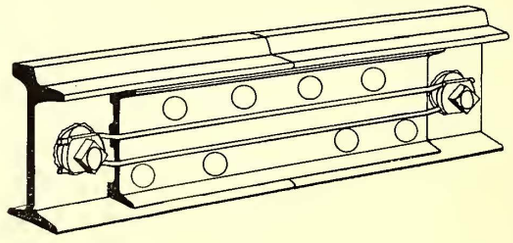


FIG. 1.—SIDE VIEW OF BOND

0000 wires have an area of 423,000 c. m. Thus the ratio of steel at point of contact with bond terminal of rail to copper of bond wire is 9.46 to 1.

The construction of the bond is clearly shown in the section (Fig. 2). The wires are held between a washer of steel, which is directly under the bolt head, and one of copper which is separated from the web only by a thin corrugated plate of copper. The bond is applied by first cleaning the rail, then placing the parts in position and screwing up the bolt in the way a joint angle plate would be bolted up. The immense pressure thus put upon the bolt crushes out the corrugations of the thin washer, and makes a good union between the parts, and perfect electrical and mechanical contacts. Bonds which have been buried in the ground for over two years do not show any signs of deterioration, and, in fact, the surface of the rail under the bond appears brighter than when the bond was first put in place. This is explained upon the theory that the slight vibration occasioned by the travel of the cars, produces a rubbing between the steel of the rail and the copper washer. The engineers of the Consolidated Traction Company report a large saving in the return circuit by the use of this bond, amounting in some cases to as much as 20 per cent.

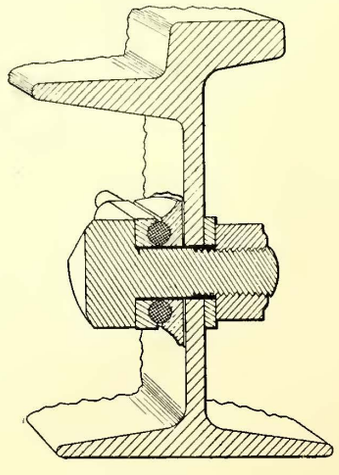


FIG. 2.—SECTION OF RAIL WITH BOND

Mechanical Trolley Pole Catcher

The accompanying illustrations show exterior and interior views of a mechanical device for catching the trolley pole when the trolley wheel leaves the wire. As will be seen, the device depends upon the centrifugal force developed by the sudden revolution of the dogs when the wheel leaves the wire. It will catch the pole the instant the wheel leaves the wire and will hold it securely until released by the conductor, thus preventing all damage to overhead construction, and to the trolley wheel itself. The catcher is regulated by a long clock spring, to which is attached a reel, which takes up the slack rope and feeds it out to the trolley pole as the varying height of the trolley wire above the ground demands. It is only when the pole rises very suddenly, as when the wheel leaves the wire, that the device will catch and hold the trolley cord.

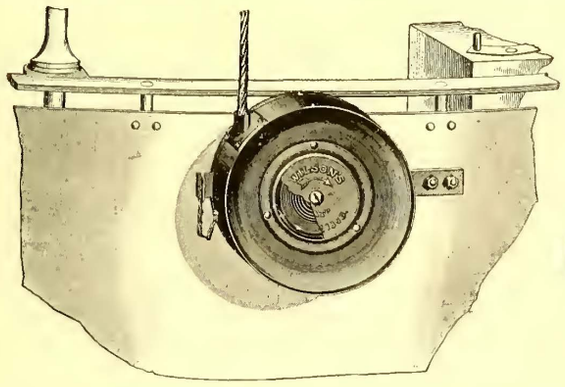


FIG. 1.—CATCHING DEVICE ON DASH

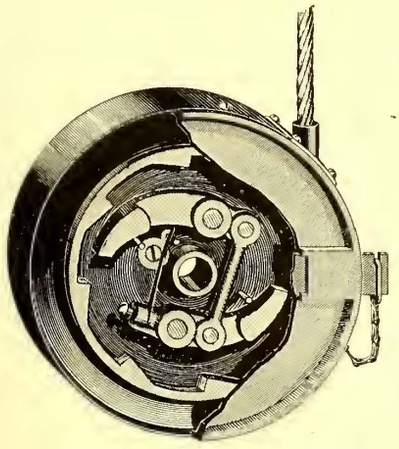


FIG. 2.—INTERIOR OF CATCHER

The engraving (Fig. 1) shows the catcher in proper position upon the dash; this, however, is only one of several ways of applying it. In this application it is assumed that one catcher will suffice for a car. The loop or chain being removed from end of strap, the catcher is readily removed and carried to the other dash and slipped onto a similar iron strap. On busy roads, however, two catchers are advisable, one on each dash.

This catcher has been run for one year upon five different roads; so the experimental stage has been passed and the makers of the device now court investigation and trial. The catcher is manu factured by Wilson, Thomson & Company.

The Steel Motor—30 H. P.

That the new types of Steel motors are fulfilling the strong claims which were made concerning them is attested by the convincing reports which the Steel Motor Company state are being received from time to time from those who are using them. The recent convention at Niagara Falls, at which the company had an excellent opportunity of exhibiting three standard sizes of motors, was of very great importance to the Steel Motor Company.

A short time ago a description appeared in the Journal of the 50 h.p. Steel motor, and a description follows herewith of the 30 h. p. Steel motor, both of which are built on the same general principles.

A feature to which the company invites particular attention is the light weight of this motor—only 1200 lbs.—which is claimed to be considerably less than any motor of the same capacity ever placed on the market.

The motor case is made of low carbon cast steel in two sections, cylindrical in form, with smooth exterior surface, and contains four poles symmetrically located, each provided with its own field coil. All of the motor parts being encased, they are protected from water, grit, etc.

Specia lattention has been given to compactness and the elimination of all inert material, enabling the production of a motor of lighter weight than any heretofore produced and of such dimensions that there is ample clearance when mounted on trucks as narrow as one metre track gage, and upon wheels of 30 ins. diameter.

The axle bearing brackets extend over and rest upon the top of the axle. These together with the armature bearing caps, are cast integral with the top half of the frame. All of the principal bolts are identical, and the removal of four allows the lower half of the motor to swing down by link support from lugs fastened to the upper half (Fig. 2). As it swings away from the axle the motor is readily accessible from the end of the car. By unhooking the link the lower half may be removed entirely, the armature being meanwhile retained in either half of the motor.

The poles are of laminated wrought iron with serrated face. They are of substantial construction and are bolted into place upon seats bored out in the same operation with the armature bearings, assuring perfect alignment. As each pole is provided with its own field coil, distortion of the field by the armature current is prevented.

The armature (Fig. 1) is of the well known drum type, small in diameter, of light weight and simple construction. The core is hollowed out sufficiently to cut down the distorting effect of the armature on the field of the motor. This hollowing out of the core has also the important effect of ventilating and cooling the armature, the type of winding being conducive to the same result. The core contains but thirty-three slots, which admits of large substantial teeth not easily damaged by rough usage.

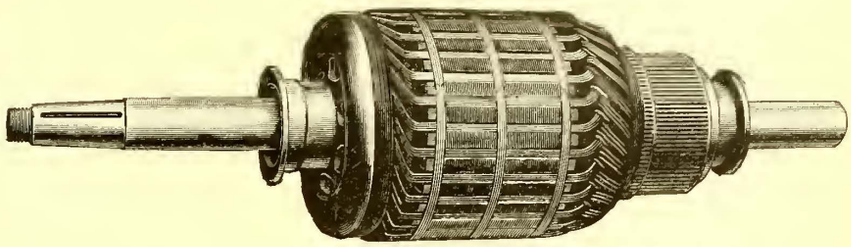


FIG. 1.—ARMATURE 30 H. P. MOTOR

The entire winding consists of thirty-three of these coils inserted in an equal number of slots in the cores and only a few coils are in any event removed when it is necessary to make repairs.

The commutator is of the undercut bar type. The bars are milled to receive the armature leads, which are tightly driven to place and swaged to ensure perfect contact. No solder is required or used to effect electrical connection. The commutator fits a tapered seat on the extension of the armature head and is, therefore, easily removed.

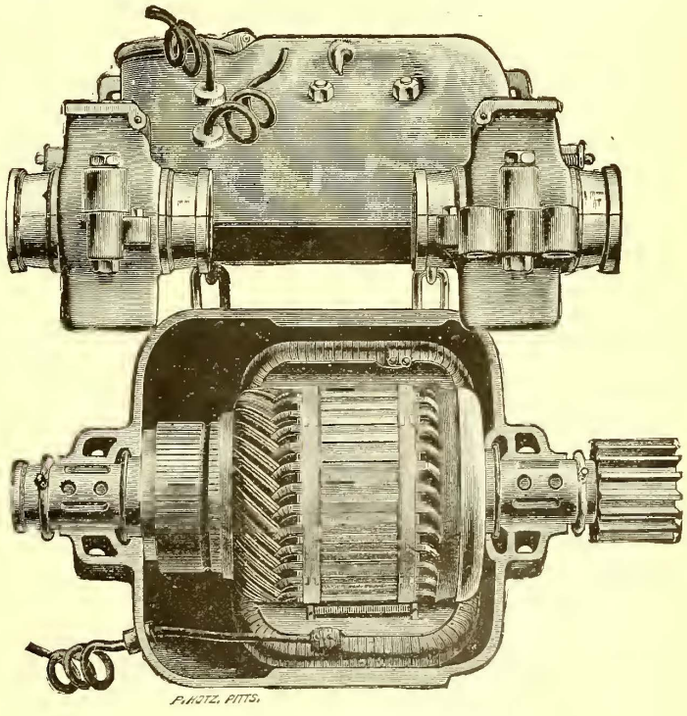


FIG. 2.—30 H. P. MOTOR CASE OPEN

The field coils are of the "mummified type," and are interchangeable. They are securely held in place by spring holders inserted between them and the pole pieces.

The axle bearings are lined with babbit. They are extra large in size and interchangeable. Grease pockets are provided on top from which grease is introduced to the axle through two slots 30 degs. apart.

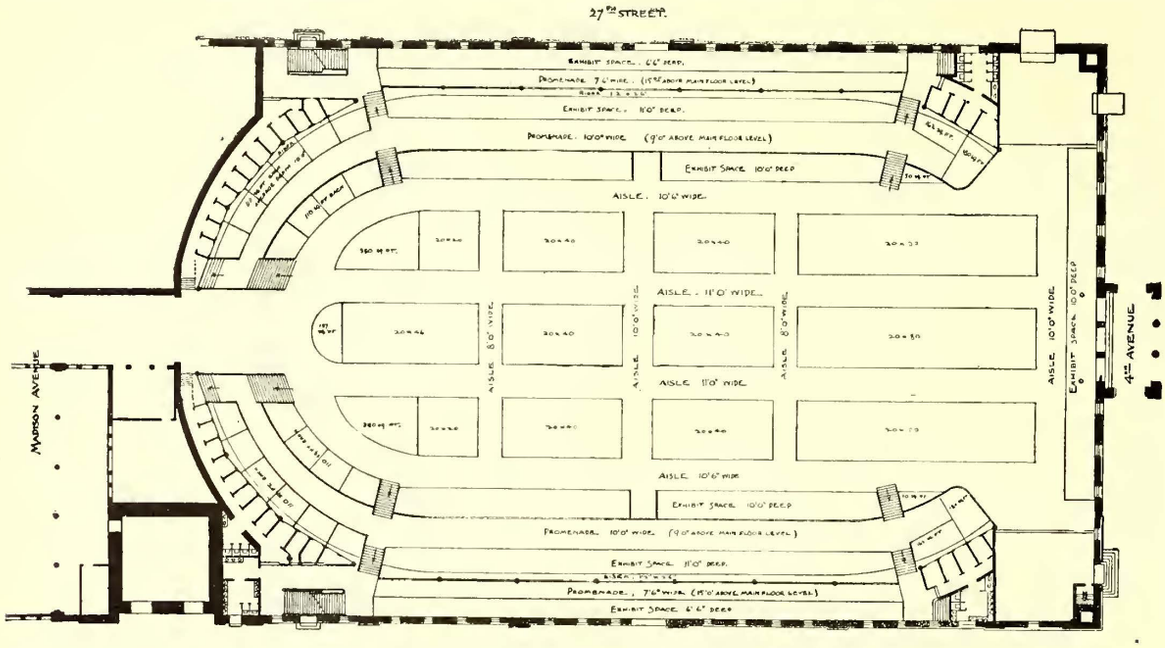
The armature bearings are also lined with babbitt and are interchangeable, except when the motors are required for service on track of one metre gage when a shorter bearing is used on the commutator side.

The motor is arranged for either nose or side bar suspension.

The Steel Motor Company manufactures motors constructed on the same general principles from 25 h. p. up to 150 h. p.

Electrical Exhibition in Madison Square Garden

Interest in the next electrical exhibition to be held in the Madison Square Garden in May has already gone beyond the electrical into kindred trades and is surprisingly strong in all branches of the railway business. Everybody remembers the success of the exhibition in 1896. Though it was held in a building comparatively unknown for such exhibition purposes, it attracted not only the trade, but great throngs of people from the territory within 100 miles of New York. The exhibitors themselves were paid many times over in business for the cost of their respective exhibits, and the best evidence of this fact is in the early demand from former exhibitors for increased allotments of space. Contracts are already in for more than one-half of the total space sold in 1896 and when it is remembered that the exposition is yet five months away and that more space was sold just before the opening in 1896 than in several months before, it will be readily seen that the space at the disposal of the company is likely to be entirely taken.



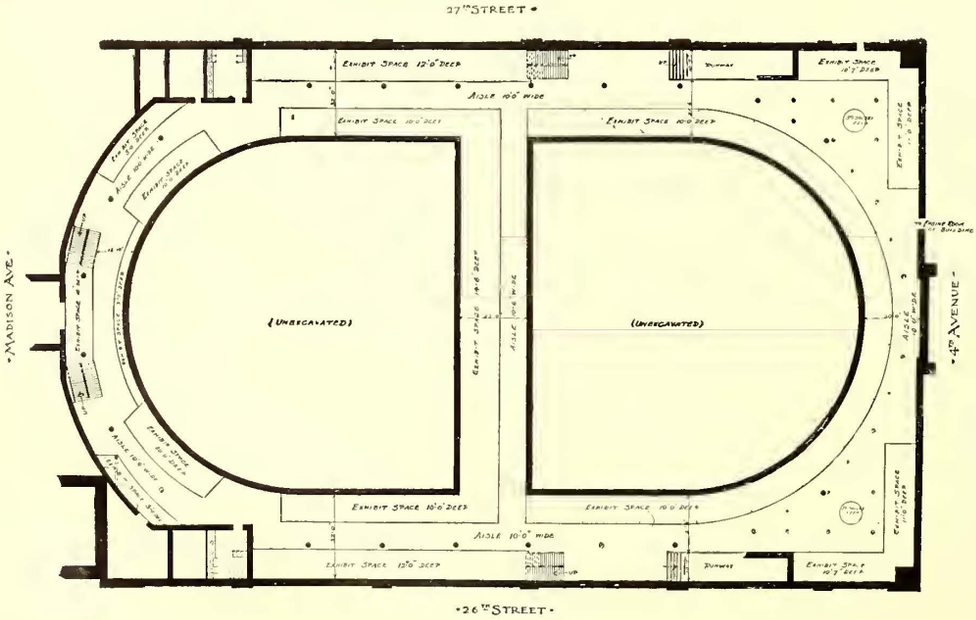
PLAN OF AMPHITHEATRE AND ARENA CIRCLES—ELECTRICAL EXPOSITION

Railway apparatus and supplies people will get in the 1898 exhibition their first good chance to demonstrate what is being done in those lines. The changes in motive power now being made by street railways in and around the city, and the interest taken in electric traction by short steam railways will have a double effect; they suggest to the trade that the active demand for apparatus and supplies will bring to Madison Square Garden great numbers of buyers, as well as curiosity seekers; and there will be a stimulating of public interest in the new modes of generating and applying power to street railways. There is little doubt that the railway exhibit can be made, and no doubt will be made, one of the most attractive features of the exhibition.

When the management took a lease of Madison Square Garden it was thought to be rather a bold step. As the plans are now developing it is evident that a building as large as this is absolutely necessary. The exhibitors can but profit by the larger, finer, better known and more centrally located building. With this advantage of location and building, there will come an increase both in variety and number of exhibits which will certainly draw a much larger crowd. There were over 300,000 admission tickets sold in 1896, and it seems reasonable to expect that the number will run to far larger figures in 1898.

Other comparisons with the last exhibition show increases quite as great. For instance, there was only one battery of boilers in operation in the 1896 exhibition. From the arrangements already made there will be at least three in Madison Square Garden. The engine and dynamo exhibits will also exceed those of 1896 in the ratio of about three to one.

All these things suggest to the intending exhibitor, the importance of speed in securing space. While the Garden is very much bigger than the last Exhibition building, the demand for space is even greater in proportion than the increase of space, and, of course, the walls of the Garden put an unyielding limit to the supply. The accompanying diagrams show proposed arrangements of exhibits in the amphitheatre of the Garden where apparatus, supplies, etc., will be located, and the basement in which will be the generating exhibit and steam specialties. It seems proper to say a word about this generating exhibit. In the old building with a smaller and less interesting plant and only one entrance by an obscure stairway from the main hall, it proved to be a feature of public as well as trade interest. Enough interested people found their way to it to make it profitable to the exhibitors.



PLAN OF BASEMENT—ELECTRICAL EXPOSITION

In Madison Square Garden not only will the exhibits be larger, more varied, more interesting, but they will be more accessible. There will be at least four entrances from three sides of the building, and with care and skill in placing the exhibits, pointing out the features and properly advertising them, influences which made the last operating exhibit successful, the exhibition of 1898 ought to be highly profitable to every exhibitor.

ON Jan. 1, 1898, the fine water power plant at the St. Anthony Falls, Minneapolis, which has been building during the last 2½ years, was turned over to the Twin Cities Rapid Transit Company. The station, which has been described in the STREET RAILWAY JOURNAL, contains ten pairs of 500 h. p. turbines, making a total of 10,000 h. p. The turbines operate under a head of from 18 ft. to 20 ft., depending upon the height of the water. The present generator plant consists of two 600 volt, 700 k. w. generators for the neighboring lines and five 3450 volt, 700 k. w. alternating dynamos for the distant lines, the current being converted to direct current by rotary transformers at substations near the point of use. The plant will reduce considerably the cost of operation of the system, and the actual showing made will be awaited with interest.

An Automatic Oiling System

Since the invention of the steam engine, one of the hardest problems that the steam engineer has had to contend with is the trouble arising from poorly oiled bearings, and a great many devices have been brought out for reducing the cost for properly lubricating these bearings. The system illustrated herewith has been devised by the Q. & C. Company, and a number of strong points are urged in its favor. The manufacturers claim that this system will save labor, oil, life and accident, fuel and machinery, besides greatly reducing the fire risk and enabling the engine room to be kept scrupulously clean.

Briefly described, the course of the oil from the delivery wagon is as follows: the oil passes into the building through a line of 2 in. piping directly into the main filter, where it is freed from any original impurities, and then passes into the main oil receiving tank,

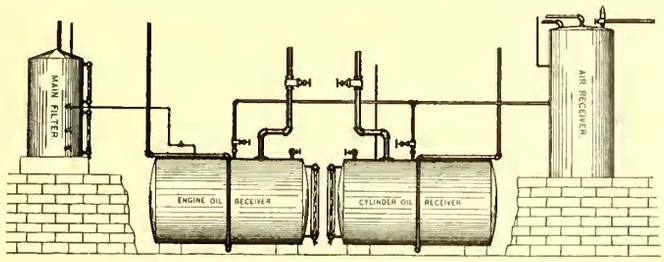


FIG. 1.—LUBRICATING SYSTEM AT CHICAGO

which may be placed in any part of the building desired. Near this tank are placed two air compressors and pump, which furnish the power for forcing the oil around the building. About 60 lbs. air pressure is used. By means of a specially constructed valve, the oil is admitted from the main tank into a fountain head, from which it is distributed into the pipes of the system. The fountain head is usually filled with oil enough to run the engines of the system for ten or twelve hours. If the engineer wishes to discharge the oil to

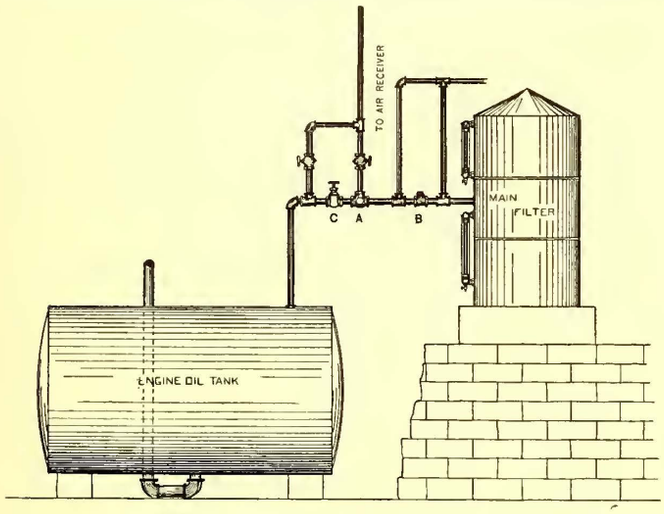


FIG. 2.—LUBRICATING SYSTEM AT BALTIMORE

the cups on the engines, a valve in the air supply pipe to the fountain head is opened. This supply pipe is connected to the main air reservoir, but instead of using the full maximum pressure of 60 lbs., a reducing valve is used for reducing the pressure to 20 or 25 lbs. This amount of pressure is generally sufficient for conveying purposes.

The air pressure, passing into the fountain head from the supply pipe, forces the oil down through the main feed pipe in the center of the fountain head to the pressure filters, where it is cleansed of any straggling impurities. It is then fed directly into the distributing pipe system, and carried to the cup of each set of bearings in the building. After passing through the bearings, the oil is collected into a return pipe, through which it is carried back to the main reservoir. In this way the loss of oil is reduced to a minimum, and the same oil is used over and over again.

In Fig. 1 is shown the arrangement in the basement of the main engine oil reservoir, main air reservoir, main cylinder oil reservoir and main filter. This view was taken in the power station of the Edgewater Electric Railway, of Chicago. Fig. 2 shows the complete system installed in the power station of the Belt Line of the Baltimore & Ohio Railroad.

The Manufacture of Brake Shoes

An important consolidation of interests has been effected between the Sessions Foundry Company and the Composite Brake Shoe Company, whereby the former company has secured the exclusive right to manufacture and sell what is known as the "Compo" brake shoe, in the state of New York except west of Syracuse, the state of Pennsylvania except west of Harrisburg, the states of New Jersey, Delaware, Maryland, Virginia and District of Columbia. The foundry of the Sessions Company is the largest general castings foundry in the Eastern States, and is also the most modern and best equipped in the country.

Remarkable results have been obtained in steam railroad service by the use of cork in the "Compo" brake shoe. The cork withstands the heat generated in brake shoes in such service, the heat causing the cork to swell or expand. This feature, with the shoe's increased retarding or braking advantages, and its greater elasticity, brakes a car or a train smoothly and effectively without gripping the wheel and overcomes the usual bucking or jerking effect. The Composite Brake Shoe Company has decided to ultimately use cork in the place of wood for inserts in all its brake shoes, including those for street railway service. The Sessions Foundry Company will at once adopt corks for every kind of railway service. During the past two years this brake shoe has established a high reputation for quick and effective braking without gripping the wheels, which certainly is an important feature when the question of public safety and comfort is considered. The company claims that the railway systems using this shoe are running their cars more smoothly and with less accidents than with any other brake shoe.

By this new association and the adoption of cork inserts in place of wood plugs, the Composite Brake Shoe Company is enabled to offer an improved brake shoe, without adding to the cost to the consumer; and the Sessions Foundry Company has exceptionally good facilities at its works at Bristol, Conn., for manufacturing these shoes and for shipping them to all points in the territory specified.

A New Car Wheel Manufacturing Plant

The Pennsylvania Car Wheel Company has recently been formed at Pittsburgh for the purpose of manufacturing and selling high grade car wheels for both steam and electric service. The plant, which will be located at Pittsburgh, will have a capacity of 85 tons per day, which will probably be increased before many months. The capital stock of the company is $100,000, and the enterprise has the backing of some of the most prominent manufacturers and financial men of Pittsburgh. Among the stockholders are Charles V. Slocum, formerly of the New York Car Wheel Works, of Buffalo; J. D. Rhodes, formerly of the Pittsburgh Car Wheel Company; William E. Elkins, formerly president of the Pittsburgh Traction Company, and A. W. Slocum, formerly of the New York Car Wheel Works. A. W. Slocum will be superintendent of the new plant. The promoters of this enterprise are very sanguine of its success, there being a very large market in the vicinity of Pittsburgh for car wheels. It is also believed that car wheels can be manufactured cheaper in that locality than in any other part of the country. As will be noted, most of the gentlemen interested in the enterprise have already had considerable experience in the manufacture of car wheels, and the company will undoubtedly find a large field for its products.

Removal of a Brake Company

The Standard Air Brake Company, has moved its offices from 100 Broadway to 168 Broadway, in New York City, As stated in another column, E. J. Wessels has severed his connection with the company as managing director, and his successor, Joseph R. Ellicott, undertakes the management of the business on Jan. 1. Mr. Ellicott has been associated with street railway interests for a long while, and has large business acquaintances among managers in all parts of the country. The company's business is in a highly prosperous condition and the number of inquiries for air brakes, and of orders placed, has never been so large as during the last few weeks. These orders come from the United States and from foreign countries, and show that street railway managers are beginning to realize the necessity of some form of brake more powerful and instantaneous in action than the old style of hand brakes. In addition to the present axle compressor and electric motor systems which have been put out by the company, it will immediately place upon the market certain new devices which will command wide attention and be thoroughly appreciated by managers.

Visit of a Prominent British Contractor to America

Justus Eck, managing director of Laing, Wharton & Down, Ltd., who came to America on Nov. 10, returned on the steamship "Britannic" on Dec. 22. The firm of Laing, Wharton & Down, was, until its incorporation last year, the oldest private firm in its line in the city of London, having been engaged in the electric manufacturing and contracting business for nearly twenty years. Mr. Eck became connected with the firm in 1889, shortly after his graduation from Peterhouse, Cambridge, University, and rapidly gained ground in the concern, until, on the formation of the present company, he was made its managing director. About a year ago the company became the British representative of the Walker Company, and has been doing most active and successful work in this and other agency directions.

The purpose of Mr. Eck's trip to this country was to make arrangements with other American houses to represent them in Great Britain, and in this he has been highly successful. Among the new

agencies secured is that of the Ward-Leonard Company, manufacturers of Carpenter enamel rheostats and other appliances; that of the Wagner Electric Manufacturing Company, of St. Louis, for its alternating current apparatus of all kinds; that of the Q. & C. Company for its rail sawing apparatus, and that of the Pearson jack. The Buda track drill, for which the company has been for some time agent, has been quite largely sold in Great Britain through its efforts. Mr. Eck also made arrangements for establishing a permanent purchasing agency in New York for any supplies needed in this country for carrying out the extensive work which Laing, Wharton & Down are now organizing to undertake in Great Britain and elsewhere.

While in this country, Mr. Eck was notified by his London office that the company had obtained an important construction and apparatus contract for the equipment of a railway system for the Halifax Corporation, in Yorkshire, and for an arc and incandescent lighting plant for Barking. The former contract includes a complicated switchboard for three generators, including arrangements for handling booster and storage battery circuits. The company has recently secured an order for forty Walker controllers and lightning arresters for use with motors made in Great Britain for a certain railway installation. Other important contracts have recently been taken in Leeds, Oxford, Tunbridge Wells, London (County Council), Hackney Vestry, for the British Admiralty and War Office, for Jersey, the British Post Office, Bath and Battersea.

During Mr. Eck's trip to this country he visited the cities of New York, Boston, Hartford, New Haven, Buffalo, Niagara Falls, Cleveland, Chicago, Milwaukee, St. Paul, Cincinnati, Pittsburgh and Philadelphia.

Personals

Mr. R. Semmes, general manager of the Mobile Street Railway Company, has been quite ill with yellow fewer, but is now recovering.

Mr. John L. Heins was elected president of the Coney Island & Brooklyn Railroad Company at the last meeting of the stockholders.

Mr. James Sullivan was elected general superintendent of the Coney Island & Brooklyn Railroad Company at a recent meeting of the stockholders.

Mr. M. K. Bowen, general manager of the Chicago City Railway Company, and Mr. W. B. Walker were elected directors of the company last month to fill the resignations of Mr. E. M. Phelps and Mr. James C. King.

Mr. James Todd, president of the Sterling Varnish Company, Pittsburgh, Pa., was married on Dec. 7 to Miss Mary Louise Slagle, daughter of Judge Jacob F. Slagle. Mr. Todd's many friends extend their congratulations and wishes for a very happy future to the young couple.

Col. W. A. Bancroft, who is mentioned as the probable president of the Boston Elevated Railway Company, the lessor of the West End Street Railway Company, of Boston, has acted as mayor of Cambridge for two terms and has been connected for some time with the West End system.

Mr. J. M. Dennison has severed his connection with the St. Louis Car Company, to accept the position of general sales agent of the E. T. Burrowes Company. He has had a long experience in car construction, and this, with his large acquaintance in the street railway field, will make his acquisition a valuable one to the Burrowes Company. He will make his headquarters at present in Chicago.

Mr. R. E. Danforth has been appointed superintendent of the Buffalo Railway Company, and of the Crosstown Railway Company, to succeed Mr. P. C. Deming, who has resigned. Mr. Danforth was formerly superintendent of the Buffalo, Bellevue & Lancaster Railway Company, and was previously connected with the engineering department of the Buffalo Railway Company. Mr. Deming, it is understood, will continue in the street railway field, and has the best wishes of his friends for his future success.

Mr. Thomas H. McLean, president and general manager of the Ferrocarriles del Distrito Federal de Mexico, S. A., the company operating the street railways of the city of Mexico, spent a few weeks in the United States last month, visiting New York and Chicago. Under Mr. McLean's management the service in Mexico has been greatly improved, and the financial showing of the company during this time has been most satisfactory. Some of the improvements introduced by him, and the general features of the line in Mexico are described elsewhere. Mr. McLean is enjoying excellent health.

G. Herbert Condict, now receiver of the Englewood & Chicago Electric Street Railway, has accepted the position of chief engineer of the Electric Vehicle Company, of New York, and has arrived in New York to commence upon his new duties. Mr. Condict has been for many years identified with electric street railway development in this country. In 1884-5 he was associated with C. J. Van Depoele, and put up in South Bend, Ind., what he believes to be the first trolley wire ever erected in the streets of a city for commercial operation. In 1886 he became interested in storage battery work, and in 1889, with Reckenzaun, equipped and took charge of the operation of the Lehigh Avenue Railway in Philadelphia, a storage battery road which aroused among street railway managers of that day the keenest interest. In 1893 he became chief engineer of the railway department of the Electric Storage Battery Company, and in 1896 was requested by the latter to take charge of the Englewood & Chicago road, then commencing operations with storage batteries. The Electric Vehicle Company, with whom Mr. Condict is now to be associated, at present operates twelve hansoms and one brougham in New York City. The company has now under construction fifty hansoms and fifty broughams which will soon go into service. There is undoubtedly an enormous field for electric vehicles, and Mr. Condict is but continuing his pioneer electrical work in developing it.

Charles E. Emery

Charles E. Emery, Ph. D., one of the best known steam and electrical engineers in America, was bornin Aurora, N. Y., March, 28, 1838. In July, 1861, he entered the United States Navy, as assistant engineer, serving on the "Richmond" during engagements at Pensacola and at the Mississippi River passes, and finally, on the same vessel under Farragut, participating in the capture of the forts below New Orleans and in engagements at Vicksburg and Port Hudson, on the Mississippi River. He resigned from the service in January, 1869, and soon afterwards opened an office as consulting engineer in New York City. He was consulting engineer of the United States Coast Survey for about twelve years, and of the United States Revenue Marine for about twenty-one years.

When Elder was attempting the revival of the compound engine in England and urging its adoption because of the saving in fuel in steamers which he had constructed, which saving might very easily have been due to increased steam pressure, Dr. Emery, in his capacity as consulting engineer of the United States Revenue Marine, put three types of engines in three revenue steamers of the same size, and these engines were tested by United States naval officers, associated with himself in such a way as to definitely show the relative advantages of compound engines in comparison with high

CHAS. E. EMERY

pressure condensing engines and low pressure condensing engines. Dr. Emery's paper in the *Transactions* of the American Society of Civil Engineers, which appeared in *Engineering* in 1875, and was abstracted in D. K. Clark's manual, "Cotterill on the Steam Engine" and many other works in various countries, was the first definite, detailed information available on the subject and was so well appreciated by the professors of engineering at Columbia College, that at their request the degree of Doctor of Philosophy was conferred upon him by the College of the City of New York, there being no provision at their own institution for conferring that degree for practical work of established merit, as is the custom of many Continental universities.

Dr. Emery was one of the judges of the Centennial Exhibition at Philadelphia. He built the first plant of the New York Steam Company at an expense of nearly $2,000,000. He has been in charge of important work on Government buildings and has been consulting engineer of several of the principal plants of the Edison Electric Lighting Company and for a committee of the trustees on the terminal facilities of the New York and Brooklyn Bridge. He lectures at Sibley College, Cornell University, once a year and occasionally at other places. He has become a well known expert in suits involving the condemnation of water power, and also acts as expert in patent suits. Of late years he has continued his habit of investigation by taking up the study of the subject of electricity, and has written some articles on the subject. He was one of the judges in the Department of Electricity at the Columbian Exposition, and was assigned as chairman of a committee to make tests of the larger engine dynamos. His papers on the cost of steam power are among his best known works. He is a member of the (Brit.) In-

stitution of Civil Engineers, of the American Society of Civil Engineers, of the American Society of Mechanical Engineers, of the American Institute of Mining Engineers, and of the American Institute of Electrical Engineers.

Resignation of E. J. Wessels

The resignation of E. J. Wessels, managing director of the Standard Air Brake Company, was made in December, to take effect Jan. 1. For the past three years, Mr. Wessels has been identified with the street railway air brake industry in this country and abroad, and its most aggressive advocate. It was in 1894 that he first undertook the work of placing on a firm foundation and building up the business of the Genett Air Brake Company, which for several years previous to that time had been at work, with more or less success, upon a system of braking street cars. On assuming the management of this company, Mr. Wessels immediately instituted important economies. Within the next three years he created and supplied a demand for an axle compressor system, and an electric motor compressor system, and sold a large number of equipments in America, Europe and Australia. The foreign demand became so large that strong agency connections were formed in Great Britain, Germany, France and Australia. The organization of the Standard Air Brake Company (successor to the Genett Air Brake Company) is a tribute to Mr. Wessels' ability as a manager, and the large gross sales of the past two years to his ability as a salesman and careful and judicious advertiser.

Mr. Wessels is a man of indomitable energy, resolution and persistence. Everything which he undertakes is carried through with a care and attention to detail which is in itself almost a guarantee of success. His ability is unquestioned, and while he, in common with all strong men, may have made enemies, it is certain that he has a host of warm friends, who will wish him success in whatever work he may undertake.

Death of George R. Blodgett

On Dec. 3, the startling news was telegraphed from Schenectady, N. Y., to all the New York daily papers that George R. Blodgett, counsel for the General Electric Company in patent matters, had been killed by a burglar early the same morning. The following information concerning this sad event has since been received:

About 2:45 Friday morning, Dec. 3, Mrs. Blodgett was awakened by the flash of a dark lantern and a man's voice at their bedside. She instantly awakened her husband, just as the robber ordered them to throw up their hands. In response, Mr. Blodgett sprang up, saying to his wife "I am no coward," but he was hardly on his feet before the man fired, from a distance of less than 6 ft., and ran. Mr. Blodgett, unconscious of his wound, pursued the burglar downstairs and out of the front door, where the burglar disappeared in the darkness.

Mr. Blodgett returned upstairs and reached his room before discovering that he was injured. He then succumbed to his wound and, as the cries of Mrs. Blodgett and the servants were ineffectual in arousing the neighbors, she hunted up her husband's revolver and fired it several times out of the window, slightly injuring her hand in so doing. This aroused the neighbors and in a short time local physicians were at hand. They immediately summoned Dr. Vandeveer from Albany by telephone, who came at once on a special locomotive. Before five o'clock, efforts had been made, without success to locate the bullet by probing and by the X-rays. Mr. Blodgett remained conscious during the forenoon, and it was hoped that no vital injury had been done, but a rapid rise of temperature in the afternoon led the physicians to decide at once upon an operation, which revealed the fact that the ball had entered the lower abdomen and, striking the pelvis, had been deflected and then pierced the intestines at three points. The X-rays had failed to disclose the ball, by reason of its being hidden by the pelvic bone. Mr. Blodgett survived the operation and rested comfortably until Saturday afternoon, when he rapidly failed and died about two o'clock in the afternoon. The murderer has not yet been apprehended, but the General Electric Company immediately offered a reward of $5000, and the county offered an additional $2000. Mr. Blodgett leaves a widow, and one son two and one-half years old.

Mr. Blodgett prepared for college at Andover and took a high stand during his college course. He became examiner in the United States Patent Office soon after graduation and, studying law, was admitted to the bar, and in 1888 began practice in New York. He soon removed to Boston and became a member of the patent law firm of Bentley & Blodgett, who were counsel for the Thomson-Houston Electric Company and, subsequently, for the General Electric Company. When the General Electric Company, in 1893, removed its headquarters to Schenectady, Mr. Blodgett moved thither and took charge of the patent department of the company. Aside from his immediate important duties, he had, at the time of his death, attained a position of much influence in the company and had become one of its most trusted and respected advisers. He had been unusually successful in his private practice, and, besides having a profound knowledge of patent law and electrical science, he was a man of sound judgment and much executive ability. He was a man of most attractive personality and, while winning substantial success in his profession, he had gained a host of friends, who have been deeply moved by his most untimely and shocking death.

Early History of the Nuttall Company

W. S. Patterson, who has been master mechanic of the Salt Lake City Street Railway since 1890, occupied the same position with the Federal Street & Pleasant Valley Railway Company, of Allegheny, Pa., previous to that time. In that capacity he had many interesting experiences in early electric railroading, among others that of being the one who induced R. D. Nuttall to engage in the manufacture of street railway supplies. He tells the story as follows:

W. S. PATTERSON

"While master mechanic of the Federal Street & Pleasant Valley Railway Company, Allegheny, Pa., I called Mr. Nuttall's attention to the fact that there was a good opening for some one in the manufacture of street railway supplies. I told him what our company was paying for some of the goods used; and especially the price paid for split axle gears. I felt satisfied that the gears could be built for a great deal less, and if we hoped to be successful in the street railway business we would have to cut expenses in the way of supplies. After talking the matter over with Mr. Nuttall he agreed with me that the gears could be made for less money, but stated that he had no gear cutter and that it would not pay to attempt to cut on a milling machine. He advised me that a gear cutter would cost about $1200, and upon my agreeing to give him an order for $1200 worth of gears, decided to make the venture. It was but a short time before the machine arrived and gears were being furnished us at the Pleasant Valley shops at about one-half what we had been payiug. The first trolley bases built by R. D. Nuttull were desigued by Mr. Emmett, who was working in the Pleasant Valley shops at that time. Later, Mr. Nuttall designed the trolley the company is now building, called the Union Standard trolley."

AMONG THE MANUFACTURERS

The Walker Company, of Cleveland, O., has recently opened a branch office at No. 912 Ellicott Square, Buffalo, N. Y. R. A. Byrns is in charge of the office.

Harold P. Brown, of New York, has received a third order for his plastic bonds from the Dublin (Ireland) United Tramways Company. This order is for 10,000 plastic bonds.

The Consolidated Car Fender Company, of Providence, R. I., has issued a pamphlet giving an interesting summary of the accidents which its fenders have, on a number of prominent lines, kept from being serious.

The General Electric Company, of Schenectady has recently published a very tasteful catalogue on its incandescent lamps. The pamphlet is from the company's own press rooms, and is exceedingly tasteful typographically.

The India Rubber & Gutta Percha Insulating Company, of New York, extended a pleasant entertainment to its friends, at its office, 15 Cortlandt Street, on Dec. 31. Messrs. Habirshaw, Godfrey, Harrington and Olson acted as hosts.

The Bethlehem Iron Company, of South Bethlehem, Pa., has issued in handy pocket form a folder giving the weight of round steel per running inch in different diameters from $\frac{1}{16}$ in. to 36 ins. The weights are given for each $\frac{1}{16}$ in. between these limits.

John T. McRoy, of Chicago, Ill., manufacturer of vitrified clay conduits, presented his friends and customers with a very acceptable Christmas gift, in the shape of a fine fountain pen. This firm reports business in good shape and is now laying thousands of feet of vitrified clay conduits in New York City.

The Ball & Wood Company, of New York City, has opened a sales office at 44 Merchants' Bank Building, Providence, R. I. Mr. Jeremiah Miller will have charge of this office, and will be glad to receive all the old friends of the company in addition to any one desiring information regarding engines.

The American Electrical Works, of Providence, R. I., has sent a "Christmas Reminder" to the trade, consisting of a list of the various persons who expect presents on Dec. 25. As for the managers of that company, they say they need not be considered, as all they ask for is orders for their wires, cables, etc.

Henry L. Shippy, of the John A. Roebling's Sons Company is sending to his friends with his good wishes for the New Year, an extremely ingenious little novelty in the shape of a pocket corkscrew. The corkscrew is gold plated, and will be highly appreciated by all those who are fortunate enough to secure one.

The Williams & Moore Manufacturing Company, of Chicago, lately assigned, has sold out its entire interests to the O. & C. Company, of Chicago. The rail jack known as the Williams & Moore

will hereafter be manufactured by the Q. & C. Company; also the Williams drill will hereafter be manufactured by the same concern.

Wendell & McDuffie, of New York, have recently sold the West End Company, of Boston, five additional Taunton snow plows, making a total of thirteen ordered from them this season by that company. If the best evidence of merit is a duplication of orders, this popular firm has every reason to receive congratulations.

The Murray Iron Works Company, of Burlington, Ia., has brought suit against Dun & Company, for $20,000 damages for false report by the latter of its financial condition. The company is naturally annoyed at being quoted as issuing a trust deed with preferred creditors when it has no debts, and consequently no creditors to prefer.

Robt. A. Keasbey, of New York City, has issued a very artistic catalogue stating the strong points of his Magnesia blocks and pipe covering for preventing loss of heat by radiation. This covering consists of 85 per cent carbonate of magnesium mixed with asbestos fibre, which is used as a bond. It is moulded in sections to fit all sizes of pipes and fittings, and is enclosed in a neat jacket of canvas.

Ira Abbott, of New York City, has taken the agency for the Central Electric Company, of Chicago, and will hereafter represent that company in the East. The appliances of the Central Electric Company are well known to street railway managers, and Mr. Abbott will be glad to meet all of the old friends of this company, as well as anyone seeking information regarding the Central Electric Company's products.

Geo. W. Patterson has recently been appointed Western representative in charge of the well-known office of the American Circular Loom Company, at 1114 Marquette Building, Chicago. Mr. Patterson is known to the trade through his connections as Western agent for the Gordon-Burnham and Law primary and Ohio storage batteries, and Medbery knife switches and overhead railway material, which companies he will still represent. Mr. Patterson reports business good for the season.

The Springfield Manufacturing Company, of Bridgeport, Conn., whose works and patterns were destroyed by fire some weeks ago, advises us that it is again filling orders for its wheel grinders. The company has made some important changes in its machines and will hereafter furnish machines for grinding either two wheels or one wheel at one time, as may be desired, the latter type being considerably cheaper than the double machine and quite fully meeting the requirements of small roads.

The Corporation of Henry R. Worthington, of Brooklyn, N. Y., is contemplating enlargements of its present storage capacity for castings for its standard sizes of pumps. This company now carries in storage from two to three months' supply of all standard castings of six inch stroke pumps and smaller sizes. It is now proposed to extend this system to standard pumps of much larger sizes. With the new addition to its plant, this company's output will be increased about 30 per cent.

E. F. De Witt & Company, of Lansingburgh, N. Y., report that the prospects for business during 1898 are very bright. This company manufactures the De Witt "Common Sense" sand box, which is now in use on a great many of the leading street railways of the country. The manufacturers state that they are constantly receiving duplicate orders, and often triple orders from old users of this box, and the company has received a large number of very fine testimonials stating that the box is giving entire satisfaction.

The American Woodworking Machine Company, of Jersey City, N. J., has been organized for the purpose of manufacturing woodworking machinery of all kinds. This company is a consolidation of a number of woodworking establishments that hitherto have been working independently. All the improvements that have been brought out by the different companies will be combined, and it is expected that the new company will be able to place upon the market an exceedingly complete line of woodworking machinery.

The Swarts Metal & Refining Company, of Chicago, has just closed a large order for brass ingots for Japan, which is one of the first of this kind ever placed in this country. The company is working night and day to keep up with its home business, and reports that the new and commodious quarters, into which it moved last spring, are being tested by its increasing trade. The company has just renewed its contract with the well-known firm of J. H. Leonard & Company, Pittsburgh, Pa., who will handle all Eastern business.

J. A. Fay & Company, of Cincinnati, O., have secured the entire contract for the wood-working department of the new shops being constructed at Lima, by the Cincinnati, Hamilton & Dayton Railroad. These shops will be fitted up with the latest and most improved machinery, and will be one of the most complete works of the kind in this country. This contract is a straw which shows that prosperous times are rapidly approaching, for when the railroads begin making improvements, it is usually a sure sign of business revival.

Riter & Conley, of Pittsburgh, have secured the contract for the erection of the steel building and stack for the power house of the Dublin Tramways Company, which is changing from horse power to electricity. The building will be 250 ft. × 80 ft. and 30 ft. high. It will contain an electric traveling crane of 15 tons capacity, improved coal conveyers, a cold storage plant and large boiler rooms. With it will be two steel stacks, 12 ft. in diameter and 200 ft. high. This firm has also secured the contract for the erection of two 25,000 barrel oil tanks at Rotterdam, Holland, for the Pure Oil Company, of Pittsburgh.

Alexander Gordon, president of the Niles Tool Works, of Hamilton, O., has just returned from a business trip to Europe. He said, "We are running our mills night and day, double turn, and cannot keep up with orders. We are getting orders from Bohemia, Italy, Norway, Russia, Spain, France, and almost every other European country. I have been in nearly every country of Europe within the last few months, and I have been stunned by the way American goods have taken precedence over others. Almost all the street car equipments, electrical fittings and general machinery now being purchased in Europe are of American manufacture."

The Joseph Dixon Crucible Company has sent out to its friends a most acceptable "Christmas Card" in the form of a box of pencils, crayons and erasers of various kinds, including the "Dainty" tapered and rubbered boudoir pencil, the heavy, triangular red and blue pencils, the handsome "Ambassador" pencils for those who like to hold something substantial in the writing hand, crayons with metallic holder for artists' use, and that pencil best of all for ordinary office and newspaper work known as "Crayon 342." Those who were fortunate enough to be favored by the Dixon Company with this box will, for some time to come, know the pleasure of using good pencils.

The Western Electric Company, of New York and Chicago, reports increased sales in both its standard solid and spoked ribbed W. E. trolley wheels during the past month. Both types have been carefully designed and no expense spared, to make them most desirable. The metal used is a composition distinctly the company's own, and the result of exhaustive actual service tests made to ascertain the metal giving the best all around results. The company has been made exclusive agent for the Tuerk alternating current ceiling fan in the territory west of Pittsburgh. It has also been made exclusive agent for the car heaters and office heating devices manufactured by the Globe Heating Company.

The Ohio Brass Company, of Mansfield, O., has recently made a valuable acquisition to its engineering department in the shape of a special testing set from which graduated voltages as high as 10,000 can be obtained. This set will be used in testing insulating materials and will be put to a two-fold use; one for experimental purposes, such as determining the quantity of insulation required in connection with any devices of new design which may be composed of insulating material, either in whole or in part; the other will be in connection with the electrical tests which every stock piece of insulating material which this company manufactures will be subjected to before being shipped from the factory.

The New Haven Car Register Company, of New Haven, Conn., reports that the demand for the New Haven car register is constantly widening, and that the company is making special preparations for promptly meeting this rapidly increasing domestic and foreign trade. The New Haven Car Register Company carries an unusually complete line of fare registers for street railways. The popularity of the various styles of these registers, and the fact that this company has received a number of medals and diplomas at the several international expositions of the past five years, including the World's Exposition at Chicago in 1893, and at Atlanta in 1895, is conclusive evidence of the high character of these machines which, with accuracy, reliability and durability, also combine elegance of design and finish.

The Sargent Company, of Chicago, reports a gratifying increase in business during the past year over previous ones. The company has found that the street railways as well as the steam roads have been buying much more freely than previously, especially during the last six months of the year. The company has had many new customers among the street railways, and is constantly receiving inquiries from all parts of the country, which fact leads the managers to believe that there will no falling off of the demand for some time to come. In its open hearth and crucible steel departments the company has been very busy, last month having broken its record for tonnage in these departments. It has recently been obliged to make changes in its plant in order to handle its increased business.

The McGuire Manufacturing Company, of Chicago, has closed what the company reports has been an unexpectedly prosperous year. The business the first eight months of 1897 was not all that was to be desired, but the business of the last four months of the year certainly offset this. This increase is, of course, due to the immense trade in sweepers and car stoves. Although it is a trifle late, the company has shipped during the past month 31 sweepers and 475 "New Columbia" car stoves. In addition to this, it has been making daily shipments on a number of large orders for trucks. The company has on hand enough work to keep its works busy a large part of next year, and in general the outlook is so encouraging that the managers contemplate an addition to their works in the shape of a three story and basement brick building, 116 ft. × 160 ft. The business in the company's "Star" grain doors and other steam specialties has been the best in years.

The Standard Paint Company, of New York City, reports that notwithstanding the increased number of insulating paints which are constantly being brought before the public, the demand for its products is rapidly increasing in all parts of the country. This company not only manufactures insulating paints, but makes a specialty of preservative paints as well. The company thinks that its "Universal" coating is without an equal for use on conduits and all general iron work. This coating flows as easily as varnish, and

gives a smooth, even surface unaffected by changes of temperature. It is entirely free from tar. Just at this season of the year The Standard Paint Company is making a specialty of rubberoid motor cloth and P. & B. tape. The motor cloth possesses extreme elastic properties, is very pliable, is absolutely waterproof, and will not deteriorate with age. The company will send a full sized motor curtain to any street railway company free of charge.

The General Electric Company, of Schenectady, N. Y., has recently issued an incandescent lamp catalogue, which is something of a departure, and which should be especially interesting and valuable to all lamp users. This catalogue contains descriptions of the classes of lamps used by isolated station plants. The omission of all other types of lamps has made this catalogue a simple, concise pamphlet. It is excellently gotten up, typographically, and contains a folder giving prices of the various lamps. The General Electric Company has endeavored to send copies of this catalogue to every isolated plant in this country, and will be glad to furnish copies to any plants desiring the same. Such a useful treatise should be in the hands of all purchasers of incandescent lamps, and retained by them as a book of reference. The General Electric Company has also issued a very attractive pamphlet on the operation of electric mining plants, giving details regarding the electrical mining and pumping machinery which it manufactures.

A. O. Schoonmaker, of New York City, dealer in solid sheet India and amber mica, has received a number of excellent testimonials from customers who have used his solid sheet mica segments built up and gaged to thickness. The Atlanta Consolidated Street Railway Company, of Atlanta, Ga., writes him as follows: "In regard to your mica, we can say that we have been using this mica for some five or six years and have no complaint whatever to make. It has given us satisfaction wherever it has been used. Our orders have always been well taken care of and filled promptly and correctly. Enclosed we hand you herewith our order for 20 lbs. of mica segments." The Trenton Passenger Railway Company, of Trenton, N. J., writes: "Your built-up solid sheet mica segments, which we have been using for some time past, have given us perfect satisfaction." Johnson & Morton, electrical engineers and contractors, of Utica, N. Y., write: "We have used your solid sheet mica commutator segments in all our work and they have given entire satisfaction to ourselves and our customers."

William Wharton, Jr., & Company, of Philadelphia, have made the important announcement that they have been appointed by the Carnegie Steel Company, Ltd., its general agents for the sale of girder and other special rails used by street railways, for the manufacture of which that company has fully equipped its works. Rolls are now being prepared for a first class up-to-date suite of sections (including guard rails), 9 ins., 7 ins. and 6 ins. in height, with wide base flanges. These rails will be made of the high carbon, low phosphorus steel which street railways are now demanding. Wharton & Company also state that having greatly enlarged their own manufacturing facilities, they are prepared to furnish promptly special work of the highest class. In its manufacture these high carbon rails will be used, and as the guard sections will exactly splice with the straight track rails they can furnish street railways with complete track, including special work, without a compromise joint from one end to the other. Communications addressed to them, to any of their agents, or to the nearest office of the Carnegie Steel Company, Ltd., will receive immediate attention.

The Walker Company, of Cleveland, O., has recently secured a large order from the Metropolitan West Side Elevated Railroad Company, of Chicago, for additional motors. The Walker Company has also received a substantial order from the New York, New Haven & Hartford Railroad Company. Among the foreign orders that are being filled by the Walker Company at present, may be mentioned four special belted type generators of 38 k. w. capacity each, which are being built for the town of Lecce, Italy, to be used in connection with a storage battery plant for electric traction. In addition to this order, the Japanese Government has ordered, for its own use, a 100 h. p. stationary motor for power, designed to run at 300 r. p. m., on a 200 volt circuit. The Walker Company has recently issued an exceedingly artistic catalogue giving illustrations and a description of the new type "S" solenoid blow-out controller, which it has recently placed on the market. This device contains in its construction a very valuable discovery in the form of a solenoid blow-out which extinguishes the arcs formed between the controller fingers and the segments of the cylinder where the circuit is broken.

The Murphy Manufacturing Company, of Pittsburgh, Pa., reports an excellent business in the sale of its car wheel grinder. This device, as is well known, grinds the car wheels without removing them from the car, and is the invention of a practical railway manager. A representative of this paper recently saw a machine at work in the shops of the Consolidated Traction Company, in Pittsburgh, Pa., by which a pair of wheels is ground in from fifteen to thirty minutes, depending on the amount of metal to be removed. The machine will not only grind the wheels of motor cars, in which the car axle is revolved by the motor while the wheels are being ground, but it will also grind trailer wheels; this is accomplished by turning the belts on one set of emery wheels, so that the wheels will revolve in the opposite direction. The company reports recent sales of four car wheel grinders to the Consolidated Traction Company, of Pittsburgh, and equipments to the Cleveland City Electric Railway Company, Mason City (Ia.) Electric Railway Company, Cape Town Tramway Company, of Cape Town, South Africa, and the Port Elizabeth Tramway Company, of Port Elizabeth, South Africa.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received the contract for the extension of the generator plant of the Flushing Gas & Electric Company, of Flushing, L. I. This extension will be built in a fireproof manner, having steel framework and trusses covered with corrugated iron roofing. This company has also received a contract from the Jackson & Woodin Manufacturing Company, of Berwick, Pa., which is extending its foundry building by an addition which covers practically one-half the ground of the original foundry. The construction of the new portion will be similar to that of the present building, having steel trusses supporting the roof and carrying the trolley for transporting material over the foundry floor. It has given the contract for furnishing and erecting the steel work to the Berlin Iron Bridge Company. The works of the company at East Berlin were the scene of great festivity on Dec 15. The occasion was the fifth annual oyster roast of the company. The banquet was largely attended by prominent persons from all parts of the state, and it is estimated that fully 1800 persons were present and partook of the hospitality of the Bridge Company. The guests later inspected the extensive works of the company.

The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., is at the present time very busy on a number of electrical machines, intended for Niagara Falls and vicinity. About six months ago, the Cataract Construction Company contracted with the Westinghouse Company for an enormous addition to its power station, consisting of five 5000 h. p. generators, of the same pattern as the three first installed. In addition to these five machines, which are now under way, the factory is also building exciters, representing a capacity of 675 h. p. The switchboard with necessary appliances controlling the five 5000 h. p. generators is also being made now, and all of these machines will be applied to the Niagara power house as soon as required. The Niagara Falls Hydraulic Power & Manufacturing Company some time ago, contracted with the Westinghouse Company for six 750 h. p. direct current generators, 300 volts, 250 r. p. m. These generators will be direct connected to Leffel turbines, and they will be used for generating current that will be supplied to the aluminum factory, of the Pittsburg Reduction Company at Niagara. The Westinghouse Company has also constructed two 300 h. p. two-phase induction motors contracted for by the Buffalo, Niagara Falls Electric Light & Power Company. These motors will be used for driving alternating current generators, direct current generators, arc machines, etc. Among the other orders, is one from the Niagara Electro-Chemical Company for three 235 h. p., two-phase rotary transformers, and one 175 k. w. rotary transformer supplying current for the reduction of metallic sodium from caustic soda; also an order from the Acetylene Light & Power Company, and the Mathieson Alkali Company. These facts are the best evidence of the growing activity manifesting itself in the use of electrical apparatus at Niagara Falls, all of which has been occasioned by the erection of the large power station of the Cataract Construction Company, the generators for which were installed by the Westinghouse Electric & Manufacturing Company.

New Publication

LA TRACTION MÉCHANIQUE DES TRAMWAYS, by Raymond Godfernaux. Published by Baudry et Cie., Paris and Liège. 372 pages, 182 illustrations. Price, 20 francs.

This is the largest and best work on the subject of motive powers for tramways which has been published on the continent of Europe, and Mr. Godfernaux has shown himself a close student of the improvements which have been introduced in tramway matters on both sides of the Atlantic. The subject is treated in a broad and comprehensive way, the different motive powers being taken up in the following order: cars which produce their own power, as in the Rowan and Serpollet systems; cars which carry power produced in a central station, as fireless locomotives; compressed air cars, storage battery cars and gas motor cars; cars which depend on power constantly received from a central station, as in the cable, trolley electric, conduit electric and surface contact electric railway systems. Two final chapters are added on "brakes" and on a "comparison of the different systems." The author does not confine himself in each subdivision to descriptions of the applications made of the various powers, but gives as well a critical discussion of the amount of power required per car kilometer by each method as well as the cost of installation and operation. The summary in the final chapter does not purport to demonstrate that there is a best system for all conditions, but gives the special advantages of each. In the portion relating to the cost of operation, the author gives the following table for an average 18 mile road operating 620,000 car miles a year with twenty cars in use and ten cars as reserve:

TOTAL COST PER CAR MILE.

	Operating Cost.	Interest and Depreciation.	Total Cost.
Rowan system	$.113	$.035	$.148
Serpollet "	.097	.035	.132
Gas motors	.140	.035	.175
Compressed air	.135	.048	.183
Storage batteries	.110	.042	.152
Trolley	.100	.055	.155

The trolley system, as will be seen, while showing the lowest cost of operation, is yet higher than the Rowan, Serpollet and accu-

mulator systems when the interest and depreciation account is considered. The latter is estimated in all systems as 10 per cent per year on the initial cost (track construction being excluded in each). As a large part of the trolley investment is stationary, while in other systems it is rolling, this blanket charge is somewhat disadvantageous to the trolley system. Again, the cost of the plant for the latter is given as $332,000, a price which could be fairly reduced somewhat, we think, at present prices.

Trade Catalogues

Catalogue. Published by the Consolidated Car Fender Company, Providence, R. I. Eighty-two pages.

House Heating Hints. Published by Robt. A. Keasbey, of New York City. Seven pages. Illustrated.

Walker Controller. Published by Walker Company, of Cleveland, O. Seventeen pages. Illustrated.

Edison Incandescent Lamps. Published by General Electric Company. Twenty-three pages. Illustrated.

Operation of Electric Mining Plants. Published by General Electric Company. Thirty pages. Illustrated.

List of Street Railway Patents

U. S. Patents Issued Nov. 23, to Dec. 14, 1897, Inclusive

Nov. 23.

Trolley.—Robert W. Clarke, Victoria, Canada. No. 583,984.

Indicator for Underground Railways.—Harry C. Reagan, Jr., Philadelphia, Pa. No. 594,122.

Railroad Switch.—Archie F. Rairigh, Barnards, Pa. No. 594,215.

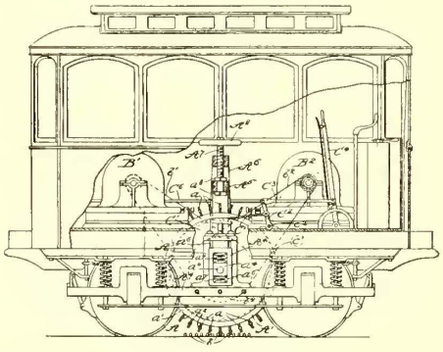
Car Bearing Adjuster.—Clarence V. Greenamyer, Los Angeles, Cal. No. 594,359.

A car bearing adjuster comprising a pair of equalizing bars tied together by a connecting device which allows independent movement of the bars, but prevents them from spreading apart under the pressure of the springs.

Nov. 30.

Brake.—Walter S. Easton, Elk Lick, Pa. No. 594,388.

Traveling Contact Device for Electric Railways.—Myron D. Law, New York, N. Y. No. 594,406.



PAT. NO. 595,156

Car Fender.—Earl Sherwood, Brooklyn, N. Y. No 594,434.

Hose Bridge for Railways.—Frank Crane, Philadelphia, Pa.—No. 594,465.

In a hose bridge, in combination, a center span having a chair adapted to be supported by and secured to a railway track, a pair of approaches adapted to be supported by and secured to said railway track and having their abutments in engagement with said center span, and archways formed by said abutments and chair, whereby a hose passage is formed on each side of said chair.

Track Cleaner for Street Railways.—George A. Parmenter and Stephen H. Pierce, Cambridge, Mass. No. 594,552.

Track Cleaner.—Edward W. Sims, Fort Assinniboine, Mont.—No. 594,571.

Electric Brake.—Wm. Weihl, New York, N. Y. No. 594,665.

In a brake for electrically propelled vehicles, the combination of electromagnets mounted to vibrate, an operative connection between the same and the brake beam, means for closing a circuit through the electromagnets, a hand brake provided with a gear wheel, a brake rod connected with the operating lever of the electric brake system and provided with a rack engaging with the gear wheel on the hand brake, and a ratchet wheel and pawl in connection with said hand brake, substantially as described.

Emergency Brake and Fender Combined.—Francis A. Hite, Pittsburgh, Pa. No. 594,693.

Electric Railway.—Robert Lundell, Brooklyn, N. Y. No. 594,702.

Switch Operating Mechanism for Cars.—Marcel M. Tremblay, Springfield, Mass. No. 594,715.

Trolley Guard.—Lyman H. McNett, Eldora, Ia. No. 594,807.

Dec. 7.

Car Fender.—Carl E. Brown, Columbus and George H. Smith, Santa Fe, O. No. 594,851.

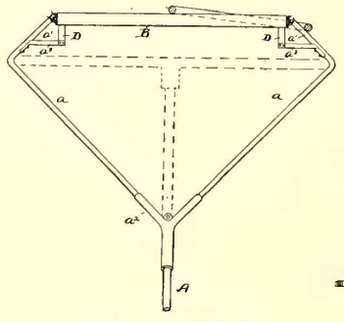
Fender for Tram Cars.—William J. Calvert, New York, N. Y.—No. 594,855.

Fender for Street Cars.—Charles D. Dorman, Clinton, Mo.—No. 594,938.

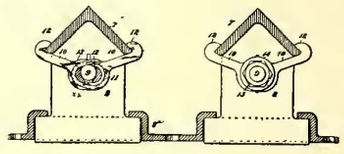
Car Fender Brake Alternating Mechanism.—Wm. C. Ferguson and Geo. P. Glenn, Jacksonville, Fla. No. 594,940.

Electric Railway.—George Westinghouse, Pittsburgh, Pa., and Wm. Chapman, Washington, D. C. No. 595,008.

In an electric railway, a contact rail formed of channel or angle iron, in combination with insulating supporting blocks and longitudinally extending rods or bolts, one for each block, provided with laterally extending clamping devices, whereby the rail is held against lateral movement.



PAT. NO. 595,080



PAT. NO 595,008.

Railroad Brake.—John Bray, Boston, Mass. No. 595,013.

Trolley Arm for Electric Railways.—Sidney H. Short, Cleveland, O. No. 595,080.

The combination of a trolley arm, and two fork arms with a Y-shaped connection uniting said arm and fork arms, and a roller mounted in the upper ends of said fork arms.

Car Fender.—Wm. L. Dickerson and John A. Toune, Oakland, Cal. No. 595,095.

Car Fender.—Oscar F. Jarvis and Harry C. Jones, St. Louis, Mo. No. 595,105.

Hose Bridge.—James O. Campbell and James W. Shields, Pittsburgh, Pa. No. 595,144.

Vehicle Propelling Machine.—Charles B. Fairchild, New York, N. Y. No. 595,156.

In a vehicle propelling mechanism, the combination with a suitable motor or motors, carried on said vehicle, of a traction wheel, consisting of a rigid hub or body in which are secured a plurality of resilient teeth capable of endwise compression, said traction wheel being so supported that the free ends of said teeth will engage the roadbed and driving connection between said motor or motors and said traction wheel.

Track Cleaning Device for Street Tramways.—Louis Lege, Hanover, Germany. No. 595,183.

Device for Operating Switches.—S. R. Norris, Auburn, Me. No. 595,197.

Underground Trolley System.—L. E. Walkins, Springfield, Mass. No. 595,224.

Dec. 14.

Electric Railway.—John R. Farmer, St. Louis, Mo. No. 595,293.

Fender for Tram Cars.—Owen A. Sutherland, Keeler, Cal. No. 595,356.

Fender for Tram Cars.—John F. Ayers, Alloway, N. J. No. 595,362.

Car Fender.—James A. Farlow and John Strayer, Brooklyn, N. Y. No. 595,375.

Electric Railway System.—M. J. Wightman, Scranton, Pa. No. 595,590.

Hose Bridge.—James F. Morrison, Pittsburgh, Pa. No. 595,645.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Building, New York.