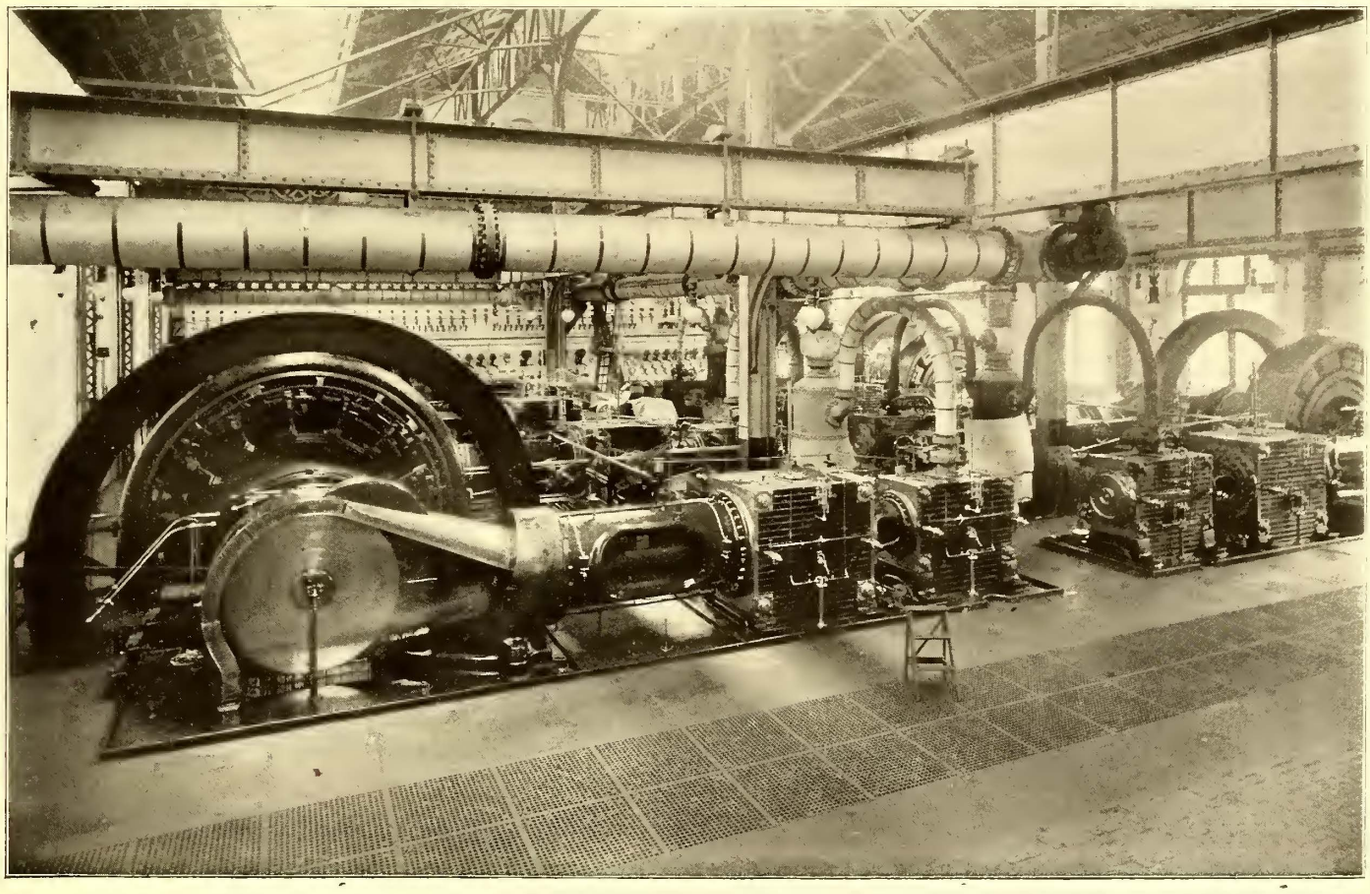
Street Railway Journal

VOL. XIV. NEW YORK AND CHICAGO, NOVEMBER, 1898. No. 11.

ORGANIZATION AND OPERATING METHODS OF THE UNION TRACTION COMPANY OF PHILADELPHIA

The Union Traction Company, of Philadelphia, operates, through consolidations and by leases, about 450 miles of track in the city of Philadelphia and its suburbs, and earns nearly $11,000,000 gross. It is the largest single street railway property in the world. It is a consolidation by lease and merger of the People's Traction system and the Electric Traction system, which together operated under lease prior to the consolidation fourteen street railway lines in Philadelphia. The consolidation was effected in 1895, and to the Union Traction Company was leased for 999 years the property of the Philadelphia Traction Company, which operated under lease twenty-one smaller lines in Philadelphia. On Jan. 1, 1898, the company secured the one remaining important line in the city, the Hestonville, Mantua & Fairmount Passenger Railway Company, by a 999-year lease, and now controls practically the entire transportation system of a city of 1,250,000 inhabitants.

From time to time during the past four years there have appeared in the columns of the STREET RAILWAY JOURNAL the engineering plans and construction methods followed in rebuilding and equipping for electric operation these four constituent properties. The consolidation has brought about great changes in operating methods and a unifying of engineering practice, and a general description of the complete system as now operated will be of special interest in view of the magnitude of the enterprise, the financial problems which have had to be solved, and the remarkable results which have been achieved by the present management.



THIRTEENTH & MOUNT VERNON STREETS POWER STATION—UNION TRACTION COMPANY

PLAN OF ORGANIZATION

The company's operating organization, as shown in the accompanying diagrams, is extremely simple. The president, who now acts as general manager, is the source of all administrative authority, subject only to the Board of Directors.

There are three department heads reporting to the president and acting as its technical advisers on matters of detail as well as performing to a certain extent administrative functions. These are the chief engineer, the superintendent of transportation and the claim agent. In addition to

these department chiefs are the general counsel, two master mechanics, a special agent and the president's clerk, who has charge of purchases under direct instructions from the president.

In the engineering department are found an electrical engineer, in charge of dynamos and connections in the power station only, including switchboards; a superintendent of lines and cables, who is in charge of the distribution system, both overhead and underground, from the switchboards; a superintendent of motive power, who has charge of station steam plant; and an engineer of way, who is in charge of maintenance of track and roadway, conduits and general street work.

The care of all rolling stock, including car bodies, trucks and motors, is in charge of the two master mechanics, one at each of the company's repair shops.

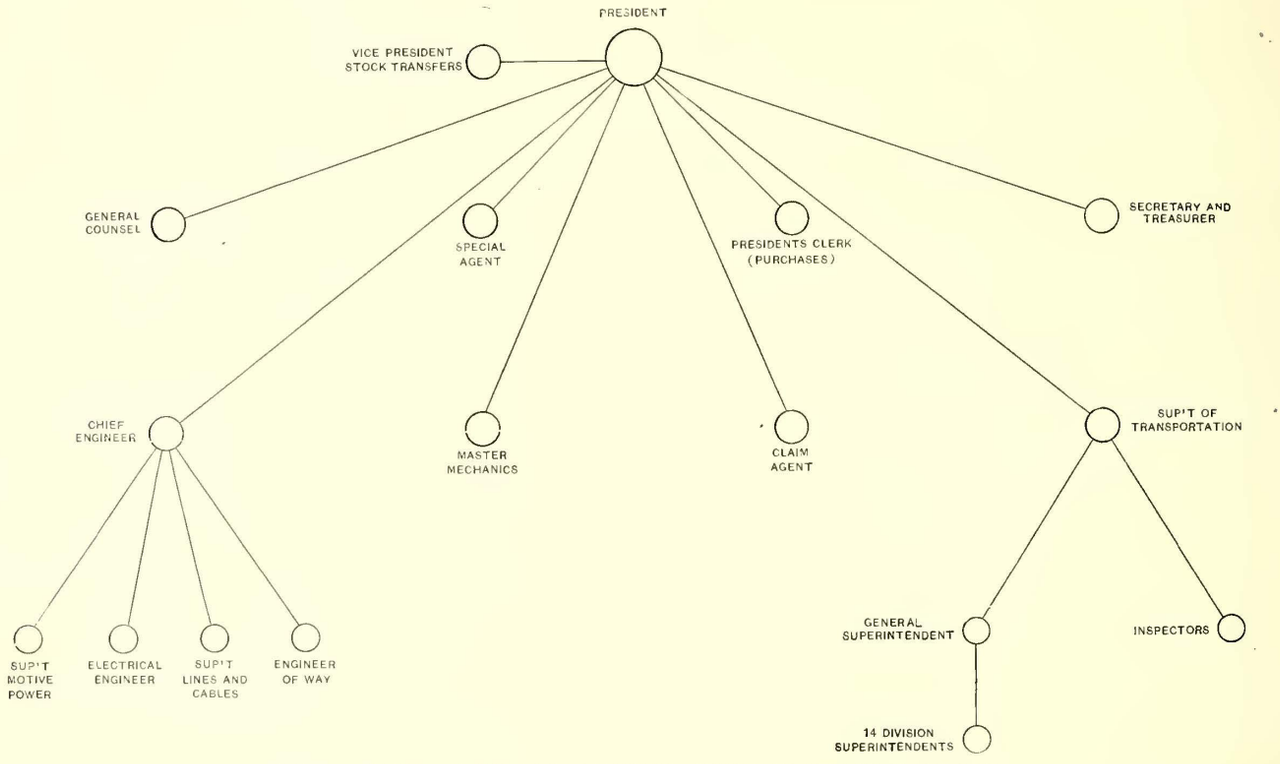


FIG. 1.—DIAGRAM OF ORGANIZATION—UNION TRACTION COMPANY

The superintendent of transportation is in charge of all time tables, of which a large variety has been prepared for use with the varying requirements of traffic. This officer has charge of the records and of the corps of inspectors, who report to him concerning the efficiency of service, conditions of traffic, etc. In the transportation department is also the general superintendent, who reports to the superintendent of transportation, and is in direct charge of conductors and motormen through fourteen division superintendents. The latter carry the discipline of the men to the point of discharge, but discharges are made by the general superintendent upon the recommendation of the division superintendents. Engagements of the men are made by a special bureau, which receives all applications.

The company's vice-president acts in the absence of the president, and has direct charge of stock transfers.

The directors of the Union Traction Company are Thomas Dolan, William L. Elkins, Alexander M. Fox, James McManes, John B. Parsons, William H. Shelmerdine, Alfred Smith, J. J. Sullivan, P. A. B. Widener, George D. Widener and George W. Elkins. The officers and principal employees are: president and general manager, John B. Parsons; vice-president, George D. Widener; secretary and treasurer, C. O. Kruger; chief engineer, W. S. Twining; superintendent of transportation, James Bricker; claim agent, Nelson Sailor; general counsel, Shapeley & Ballard; comptroller, D. C. Golden; auditor, J. D. Hiestand; special agent, C. P. Weaver; president's clerk, W. L. Maize; general superintendent, Walter Ellis; engineer of way, H. B. Nichols; superintendent lines and cables, F. H. Lincoln; electrical engineer, Charles Hewitt; superintendent of motive power, W. J. Kerr; master mechanics, R. G. Oliver and Frank Wampler.

It is hard to see how this organization could be greatly simplified, and it is certainly efficient, judged by the results shown in the following comparative statement of operation for the last two financial years ending June 30. The present organization has been in force for about one year only:

	1897.	1898.
Gross earnings from operation	$10,381,015	$10,860,542
Operating expenses	4,949,850	4,456,375
Net earnings from operation	5,431,164	6,404,167
Other income, interest, etc.	99,630	110,895
Total net income	5,530,795	6,515,062
Deductions from income:		
Taxes and licenses	913,389	894,737
Interest and rentals	5,469,340	5,595,704
Surplus	851,934 (def.)	24,620

The operating expenses, including licenses and taxes, were in 1898 but 49.27 per cent of gross income, as against 56.48 per cent in 1897. The administration of John B. Parsons, who has been in active charge of the property since January, 1897, has been characterized by rigid but wise economy extending to every branch of the service. No change has been made or step taken without the most careful regard for consequences and for the effect upon the earnings of the system. The result is shown in an increase of nearly 5 per cent in passengers carried and gross receipts, a reduction of 10 per cent in operating expenses, an increase of nearly $1,000,000, or 18 per cent, in net income, and the turning of a deficit over charges of $851,934 into a small surplus, which is expected to be considerably increased during the coming year. A most careful and systematic study of traffic requirements and an adaptation of the time tables to them have been the most important

factors in the accomplishment of this remarkable result. Money has thus been saved by cutting off useless mileage, and to all appearances the public has been quite as well served, for certainly the relations between the public, the company's management and its employees have never been more satisfactory than is the case to-day.

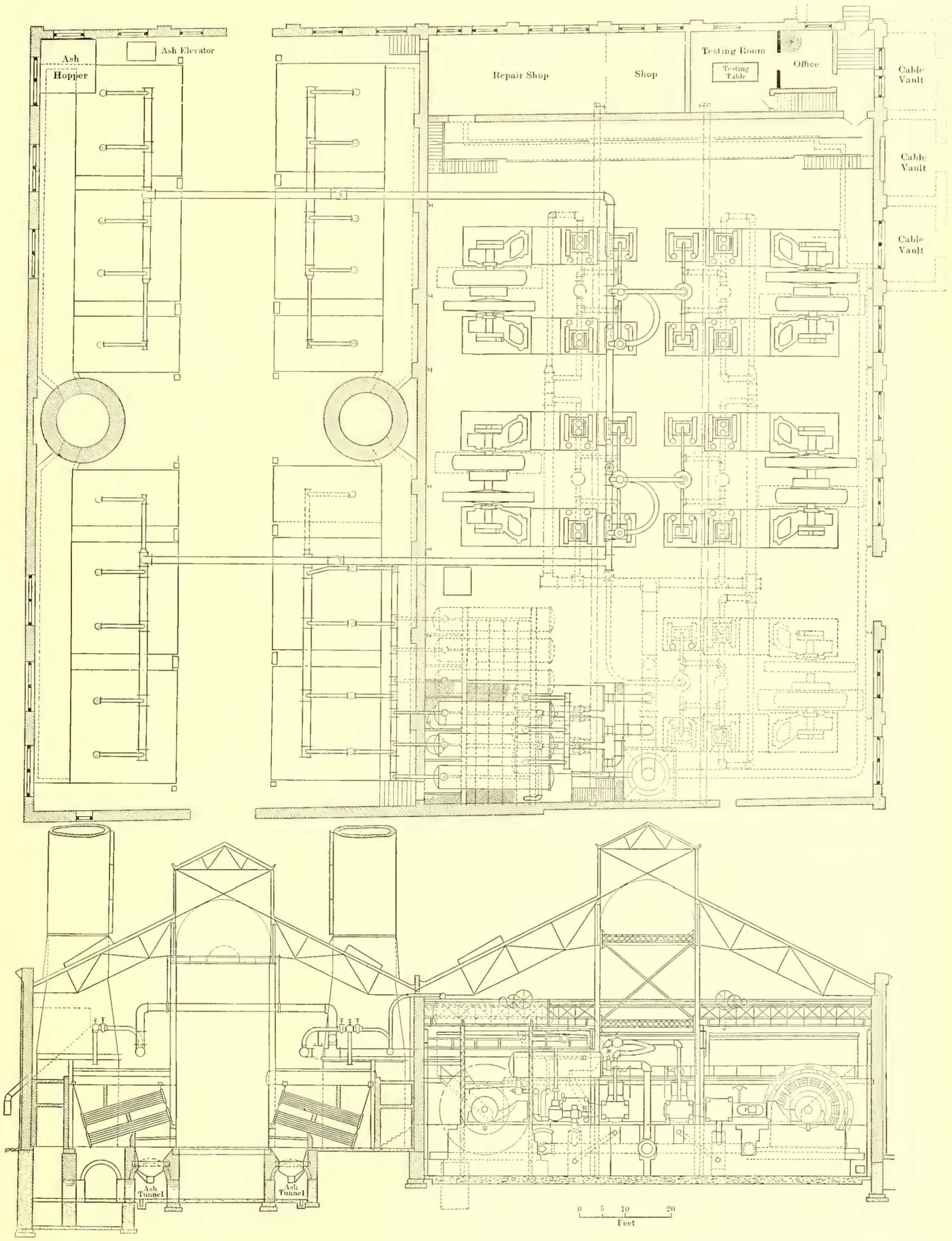


FIG 2.—PLAN AND ELEVATION OF 13TH & MOUNT VERNON STREETS POWER STATION

POWER STATIONS

Owing to the number of constituent companies and the

fact that the electrical equipment of their lines was carried on independently before the consolidation, the company now operates its lines from no less than seven main power stations and three sub stations, while three stations have been abandoned. The location of these stations is shown on the map, and the character of their equipment is shown in the accompanying table.

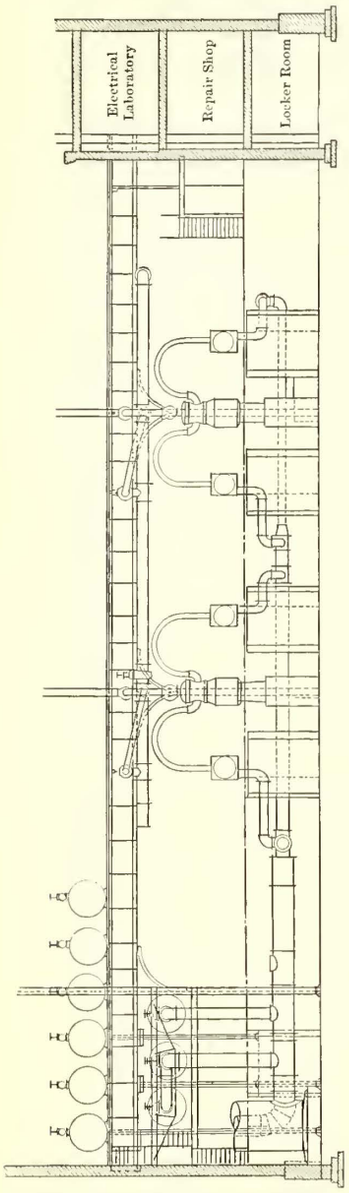


FIG. 3.—ELEVATION OF 13TH AND MOUNT VERNON STREETS POWER STATION

These stations are all connected together by special "tie lines" of large capacity, so that under varying conditions of load they can be made to assist each other. The exact method of doing this will be described later.

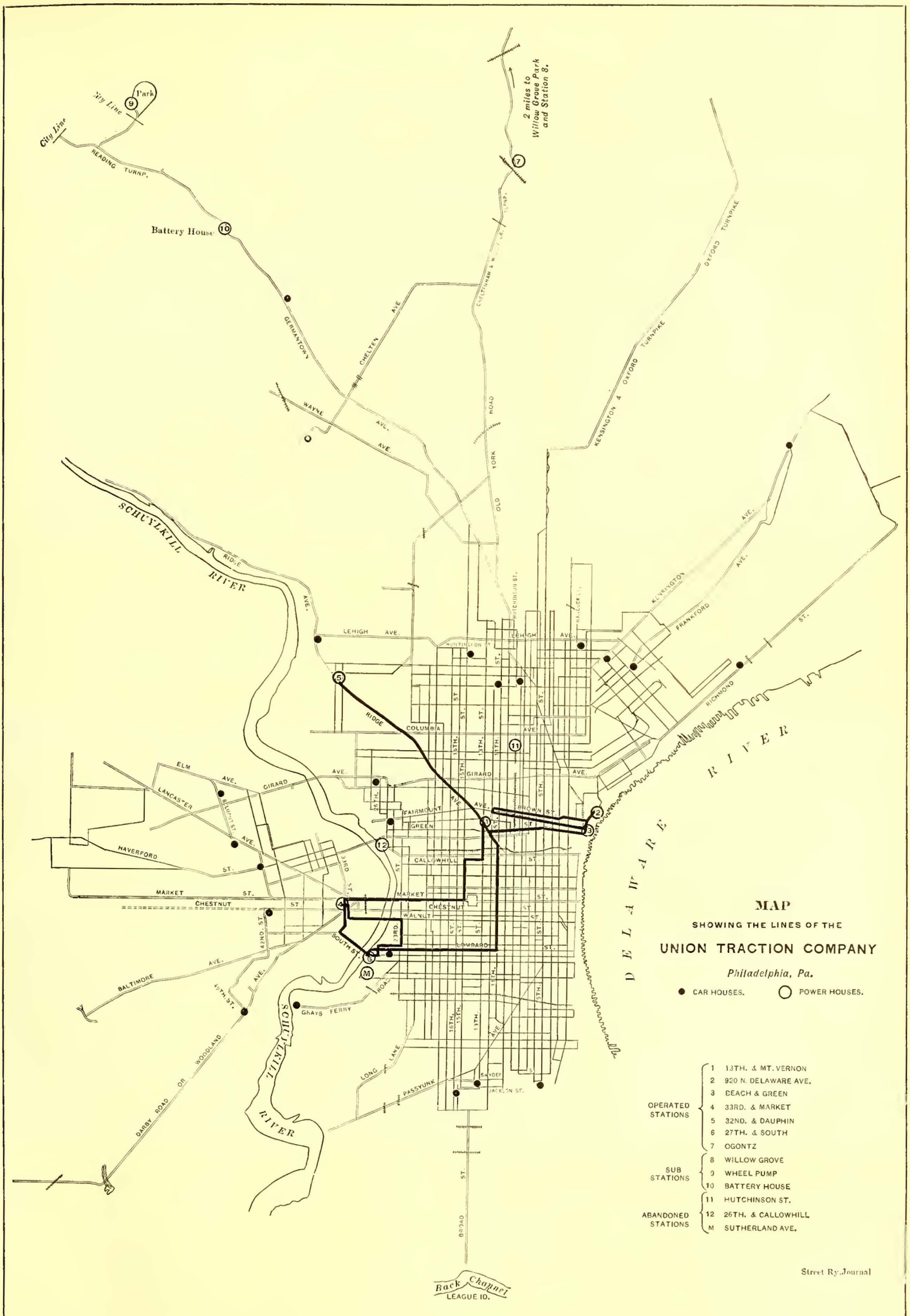
The largest of these stations is at Thirteenth and Mount Vernon streets, or "Station No. 1," and this is also the most recently constructed. The original station and equipment were greatly injured by fire about eighteen months ago, and the company in rebuilding utilized the opportunity thus presented to make some alterations in design—to eliminate some features which had proved undesirable—to better adapt the station to take its place as a main distributing point for the consolidated systems and to make it thoroughly fire proof. The rebuilding has been done on the plans prepared by the chief engineer, W. S. Twining, and as much as possible of the old equipment was utilized. Its main features are shown in the accompanying illustrations.

The boilers are part of the original equipment of the station, and were made by the Babcock & Wilcox Company. They are nineteen in number, each of 375 h.p., are of the well-known double-deck type, and there are no special peculiarities to be noted in their construction other than those which are to be found in the regular standard practice of the company.

The engines were made by Robert Wetherill & Company, of Chester, and passed through the fire which destroyed the original station. Three of these were considerably damaged by this fire, but the fourth was less injured than the others, and it was found possible to rebuild all of them in such a way as to make them throughly reliable and satisfactory. The chief damage was to the high-pressure cylinders and some of the small parts such as valve gear, governor, etc., though several of the steam cylinders, one bed plate and the engine were cracked by the intense heat. The high and low pressure cylinders are

TABLE SHOWING EQUIPMENT OF POWER STATIONS—UNION TRACTION COMPANY

No.	Station. Name.	Kw. Capacity.	No.	Electric Generators. Size in kw.	Type.	Maker.	Engines. No.	Size.	Speed in r. p. m.	Type.	Maker.
1	13 and Mount Vernon	6,000	4	1,500	D. C.	Westinghouse.	4-twin	26—40×48	80	Corliss—non-condensing	Wetherill & Co.
2	920 North Delaware Ave.	3,975	1	525	D. C.	Westinghouse.	4	24—46×42	120	Porter-Allen—condensing	Southwark Foundry & Mch. Co.
			4	800	D. C.	General Electric.	1	14½—26×24	200	Porter-Allen—condensing	Southwark Foundry & Mch. Co.
			1	250	D. C.	General Electric.	1	23—46×48	80	Corliss—condensing	Wetherill & Co.
3	Beach and Green Sts.	5,500	3	1,500	D. C.	General Electric.	3-twin	24—48×60	68	Corliss—condensing	E. P. Allis Co.
			1	500	D. C.	General Electric.	1	26×48	100	Corliss—condensing	E. P. Allis Co.
			1	300	D C.—Boosters.	General Electric.	1	20×48	40 to 90	Corliss—non-condensing (Booster)	E. P. Allis Co.
			1	200	D. C.—Boosters.	Excelsior.	1	15½×18	200	High-speed—non-condensing (Booster)	Fisher Foundry & Mach. Co.
4	33 and Market Sts	4,125	2	1,500	D. C.	Westinghouse.	2-twin	26—40×48	80	Corliss—non-condensing	Wetherill & Co.
			3	375	D. C.	Westinghouse.	3	23—40×20	200	High-speed—non-condensing	Westinghouse Mach. Co.
5	32 and Dauphin Sts.	1,575	3	525	D. C.	Westinghouse.	3	28—46×48	80	Corliss—non-condensing	Wetherill & Co.
6	27 and South Sts	1,700	3	400	D. C.	General Electric.	3	16½—32×24	150	High-speed—condensing	McIntosh & Seymour
			2	250	D. C.	General Electric.	2	14½—24×24	200	Porter-Allen—condensing	Southwark Foundry & Mch. Co.
7	Ogontz	2,550	3	850	D. C.	Siemens & Halske.	3	26—48×48	80	Corliss—condensing	E. P. Allis Co. (vertical-cross-compound)
	Sub-stations.										
8	Willow Grove	1,100	3	200	Belted	Westinghouse.					
			2	250	D. C.	General Electric.					
9	Wheel Pump	525	1	525	D. C.	Westinghouse.					
10	Battery House			500 amp. hour battery.		Electric Storage Battery Co.					



MAP

SHOWING THE LINES OF THE

UNION TRACTION COMPANY

Philadelphia, Pa.

● CAR HOUSES. ○ POWER HOUSES.

OPERATED STATIONS	1	13TH. & MT. VERNON
	2	920 N. DELAWARE AVE.
	3	BEACH & GREEN
	4	33RD. & MARKET
	5	32ND. & DAUPHIN
	6	27TH. & SOUTH
	7	OGONTZ
SUB STATIONS	8	WILLOW GROVE
	9	WHEEL PUMP
	10	BATTERY HOUSE
ABANDONED STATIONS	11	HUTCHINSON ST.
	12	26TH. & CALLOWHILL
	M	SUTHERLAND AVE.

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respectively 26 ins. and 40 ins. in diameter, and the stroke is 48 ins. The speed is 80 r.p.m., and the boiler pressure at which the engines are now run is about 150 pounds.

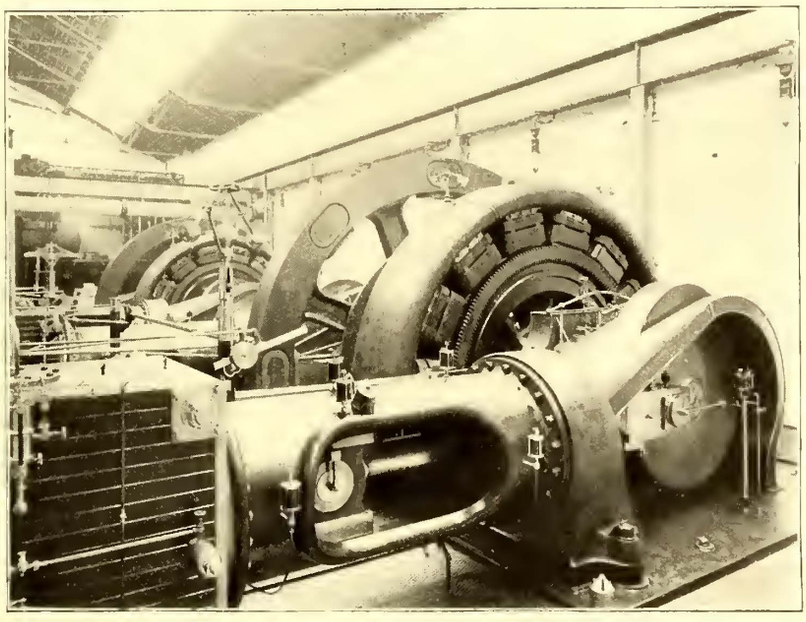
Under each engine has been placed a large sole plate which takes the place of capstones usually used, and which serves to catch all oil used on engines and from which it is led to the oil filters. A gravity system of oil supply to all cups is used.

Just previous to the fire it had been decided to replace the 4-1100 kw. machines of the old station with 4-1500 kw machines. This necessitated new shafts for the engines, and fortunately but one of these had been delivered at the time of the fire.

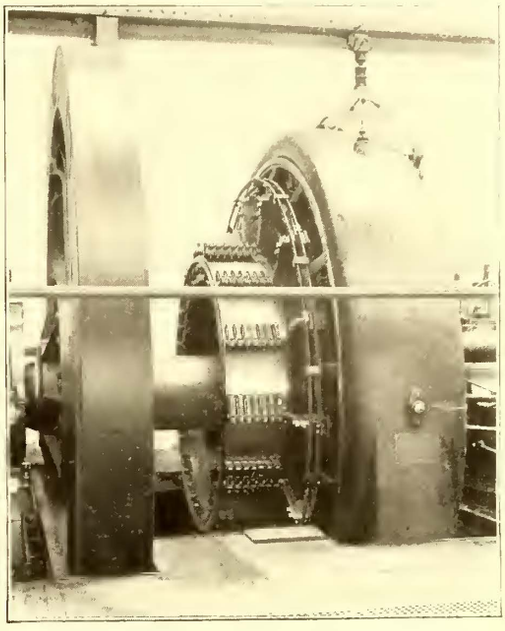
The dynamo-electric generators were built by the Westinghouse Electric & Manufacturing Company, and are four in number.

These machines are of the "Engine Type," and are rated at 1500 kw., 2730 amps. and 550 volts at 80 revolutions per minute. The field yoke is divided vertically, and rests on a cast iron base plate. The two halves of the field may be moved back from the armature to permit access to the armature and field winding. The field has 14 poles, built up of laminated steel and cast in the yoke. The yoke is of cast iron and of very large cross-section for mechanical strength. At the pole tips the corners of half the laminations are cut away, leaving but half the pole section at the edges, but with full section at the center. The proportions of the corners are such that the field distortion with load is comparatively small and the strengthening of the magnetic field due to the series coils is principally at the commutating pole tip.

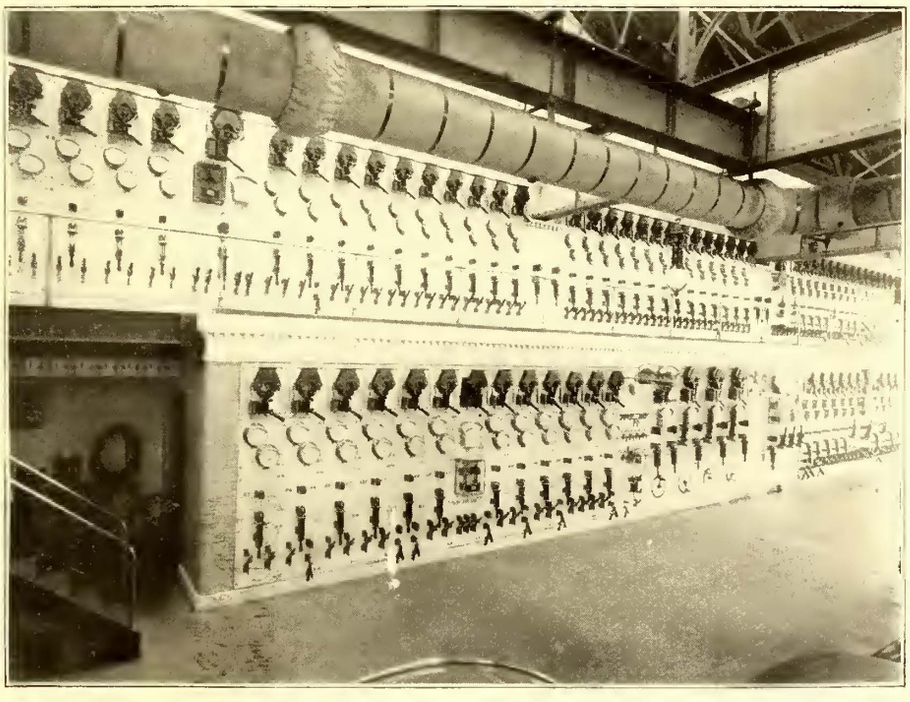
The series and shunt coils are separately wound and insulated, and have an air space between them when in position on the field. This prevents any heat from being conducted from one to the other. This construction of the coils allows examination of the inner as well as outer sur-

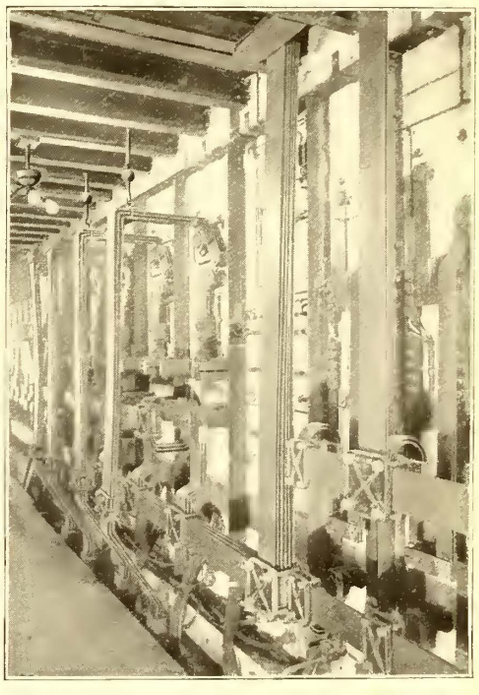


WETHERILL-WESTINGHOUSE DIRECT-CONNECTED UNIT



WESTINGHOUSE "ENGINE TYPE" DYNAMO





SWITCHBOARD 13TH & MOUNT VERNON STREETS POWER STATION—FRONT AND REAR VIEW

face in case of injury of any sort. The series coils are of copper bars wound on edge, with air spaces between the turns. Each series coil consists of $2\frac{1}{2}$ turns of $1\frac{1}{4} \times 2\frac{3}{4}$ copper bars.

The armature is 128 ins. in diameter, of the slotted type with bar windings. It is parallel wound, thus making

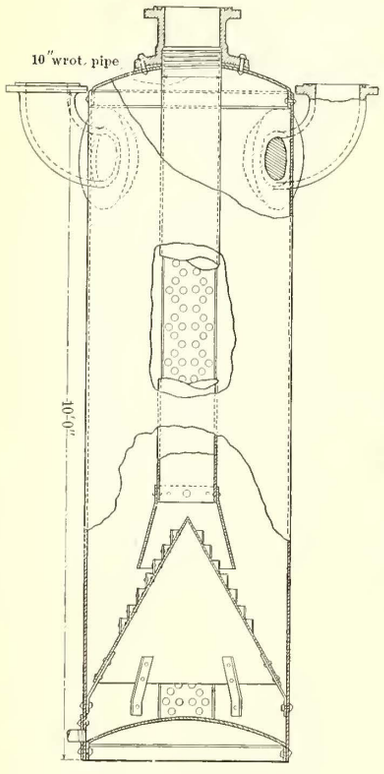


FIG. 4.—SEPARATOR

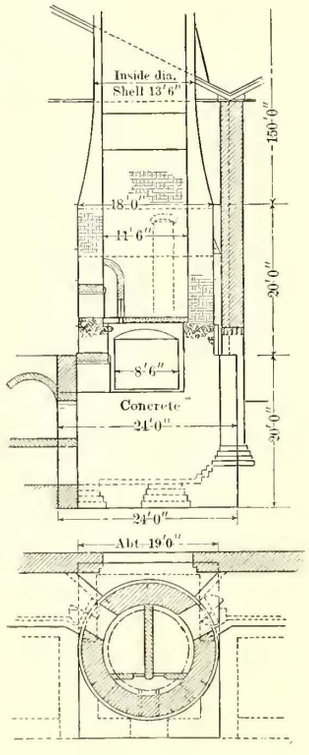


FIG. 5.—PLAN AND ELEVATION OF STACK

fourteen circuits. The coils are made of copper strap bent into the exact shape and insulated before placing on the coils. There are no joints in the coils. The armature winding is held in the slots by supporting wedges over the coils. At the rear end the shape of the coils is such that they fit together and become self supporting, thus doing away with any supporting clamps or bands. The armature core is built up of high grade, specially annealed steel. The construction of the core is such that no bolts are used in clamping the core or end plates. The commutators of these generators are very large, having a diameter at the wearing surface of 100 ins. The width is sufficient for eight brushes with the standard Westinghouse holder. The holders on the Union Traction machines are not the standard, but were built according to specifications and blueprints furnished by the Union Traction Company.

A characteristic feature of the armatures of these machines is the balanced condition of the magnetic circuits. By special construction the magnetic strengths of the different field poles are kept equal, independent of inequalities in the magnetic circuits. By this means the parallel wound armature is able to give equal e.m.fs. on all its fourteen circuits under any conditions. A field coil may be short circuited or even reversed and the machine will continue to operate well. The armature may be placed out of center in the field any amount with practically no effect on the commutation. A direct result of this balancing of the pole strength is that when the machine is running there is practically no unbalanced magnetic pull between the armature and field when the armature is out of center. The armature may touch the poles at one side, and there will be very little tendency to "hug" them.

The commutation of these generators is very good, and there is no change in lead. The brushes may be set for full load and the load may be increased to 5000 amps. with practically no sparking. With this load the circuit breaker may be opened up and there will be no flashing and the brushes will require no shifting. This result is due partly to the proportions of the field pole tips and to the low self induction of the armature coils under commutation.

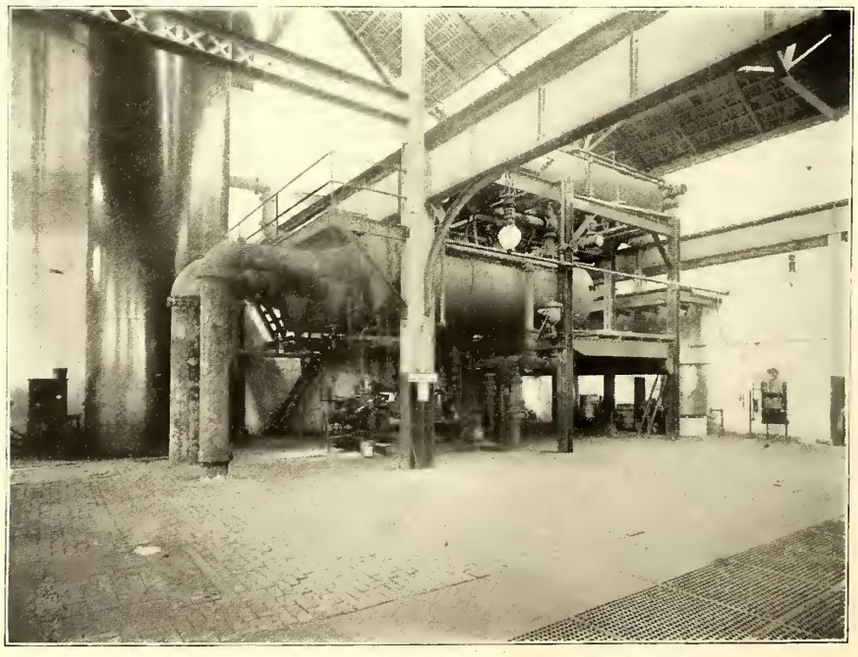
The weights of the parts of one of these generators is as follows:

Field frame, two halves	109,150 lbs.
Field coils (series and shunt)	10,150 lbs.
Arm. core without winding or commutator	46,000 lbs.
Armature copper	2,700 lbs.
Commutator with spider	16,450 lbs.
Armature complete	67,500 lbs.
Field complete, including brush holder and bed plate	140,720 lbs.

Bed plate 23 ft. long, 4 ft. 7 ins. wide.

In order to equalize the weight on the two main engine bearings as well as to protect the commutator from any danger from oil, these machines are placed on the shaft the reverse of the common practice—that is, the commutator is next the fly-wheel. The wheels will be encased to prevent any possible chance of accident from this arrangement, and steps carried on this casing will give access to the upper brushes. The armatures are very open and accessible for cleaning, and are thoroughly ventilated. The heating is remarkably low on these machines.

The main shafts of these engine generator units are worthy of special notice. They were made by the Bethlehem Iron Company upon the company's specifications. Two of these shafts are 20 ft. $5\frac{1}{2}$ ins. long and the other two are



PUMPS, FEED WATER HEATERS AND PURIFIERS

1 ft. longer. The weight of each of the two shorter ones is 29,600 lbs., and of the longer ones 31,500 lbs. The chemical composition of the shafts is as follows: carbon .35, phosphorus and sulphur less than .04. The tensile strength of the material was 85,000 lbs. per square in., the

elastic limit 35,000 lbs., and the extension 25 per cent in test specimens ½ in. in diameter and 2 in. long. The shafts are made of open hearth steel fluid pressed under 7000 tons hydraulic pressure and forged by hydraulic pressure under a 5000-ton press. They were subsequently annealed to relieve them of forging and cooling strains. The shape and diameters of the shaft are shown in Fig. 6.

The station is at present run non-condensing, there being no water available for condensing purposes. A system of direct feed is used by means of pumps 16 ins. and 9½ x 24 ins., built by the Buffalo Steam Pump Company. These are mounted on heavy sole plates, and are of the pressure pattern with outside packed plungers, and are constructed for heavy duty. They maintain about 160 lbs. pressure on the feed main, and are constantly in action, the speed being regulated by a Waters pump governor or pressure regulator. This regulator consists of three independent parts, the valve, the pressure cylinder and the intermediate frame, which contains a spring of special construction and an adjustable screw. The operation is very simple, the valve being controlled by the pressure which is designed to be carried. The piston is forced down when that pressure is exceeded and the valve closed. When the pressure in the cylinder is reduced, the valve is opened again by the action of the spring placed in the frame. The tension of this spring is adjustable and the pressure carried can be increased or diminished simply by turning the adjustable screw. The position of the valve is also adjustable by turning the stem, so that the valve may be placed in a favorable position suited to the conditions under which it is operating.

The separators for this station are unique, and are combined with the receivers close to cylinders of engines. They consist of concentric rings fastened to but held away from a cone, as shown in Fig. 4. The steam entering from the top rushes downward through an expanding nozzle upon the edge of these rings, which catch the water and pass it inward to the surface of the cone, whence it falls to the bottom of the separator, the dry steam meanwhile turning upward to the pipe leading to the engine cylinders.

On north side of room are installed three Hoppes open exhaust heaters of 2600 h.p. each, and immediately above them and supported by a steel framework are three Hoppes live steam purifiers of 1000 h.p. each.

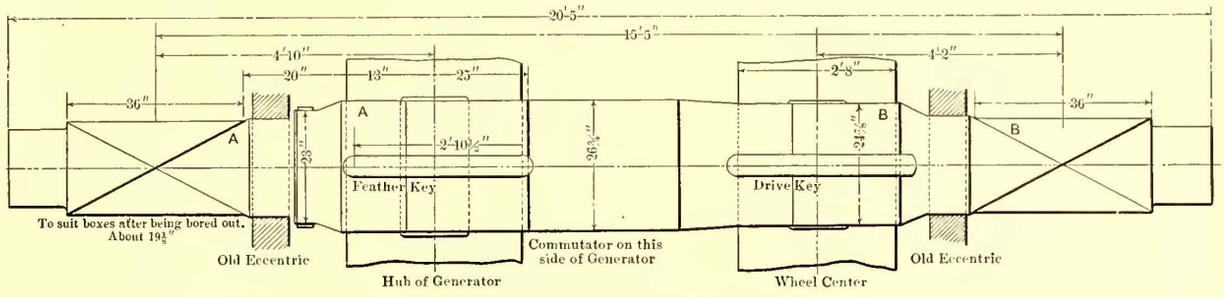


FIG. 6.—ENGINE GENERATOR SHAFT

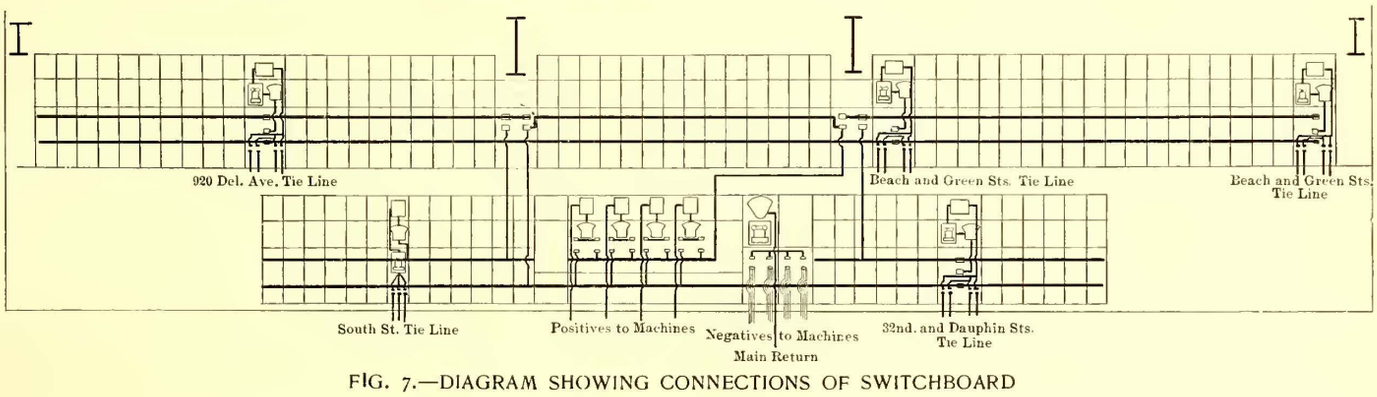


FIG. 7.—DIAGRAM SHOWING CONNECTIONS OF SWITCHBOARD

The steam piping in the station is simple and efficient. The disposition and connections of the pipes are clearly shown in the plan and elevations of the station, page 693. Any set of boilers can be so connected into the headers as to serve any pair of engines, and the maximum flexibility is thereby secured. The automatic globe valves used in the station were made by Schutte & Company, and are of three different types. The stop check valve on the boiler works automatically to prevent a back flow from the main steam pipe. Should the pressure in a particular boiler be less than in that pipe, as is frequently the case when starting a fire in the battery, by the use of this valve a fireman pays no attention to cutting in or out the boilers. The

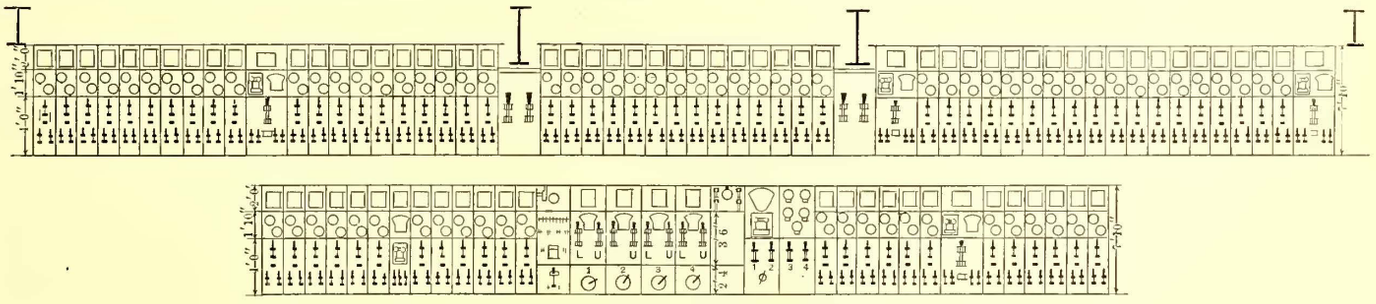


FIG. 8. SWITCHBOARD 13TH AND MOUNT VERNON STREETS POWER STATION

balance lever valves are used as a quick opening or shutting safety appliance in the main steam pipe, or as a throttle on the engine for its operation, in which case they are fitted with a quadrant. Small brass and bronze valves in the piping are also well made. The gate valves for both high and low pressure piping were made by the Chapman Valve Manufacturing Company, and are of their well-known standard types. The Chapman high-pressure steam valves are all constructed with removable and renewable bronze seats.

An interesting feature of the station is the system of ventilation by exhaust steam. The latter is carried from the low pressure cylinders into the base of the stack, and thence through an internal tube to a point about 12 ft. above the base, whence it passes into the chimney proper. The open space around this internal exhaust steam tube is connected direct with the basement of the station, which in turn has large air passages to the engine and dynamo room above through gratings and to the cable vaults and conduit ducts at the further end of the station. The passing into the chimney of the exhaust steam at a high velocity creates, of course, a powerful draught from all parts of the station, and the accumulation of gas in cable pits and conduits is prevented, while all overheated air in the station is removed and a fresh supply constantly drawn in from the outside.

The two smoke stacks are 10 ft. 6 ins. in diameter and 170 ft. in height. They are lined with brick on the inside. Their bases and foundations are of most novel form. Nine heavy "I" beams, 30 ft. in length, are built in concrete foundations to a depth of 10 ft., and so placed as to form with the outside plates, which are riveted to them, a circular base 18 ft. in diameter and 20 ft. high. On this the stack proper is placed, and firmly riveted to it. These beams are, in size and number, sufficient to carry the entire weight of the stack.

The station is equipped with two 30-ton traveling cranes, built by Alfred Box & Co., of Philadelphia. Each has a main trolley on the bridge proper, operated entirely from the platforms on each side of the bridge. There are no pendant chains on these cranes, as the company has found from sad experience that these are likely to come in contact with generators and other machinery. Much better speed and a more uniform movement is also obtained than where hand chains are used. The load is held by an improved automatic brake, which permits it to be lowered at any required speed. In addition to each crane, there is fitted on the inside of the main girders an "outrigger,"

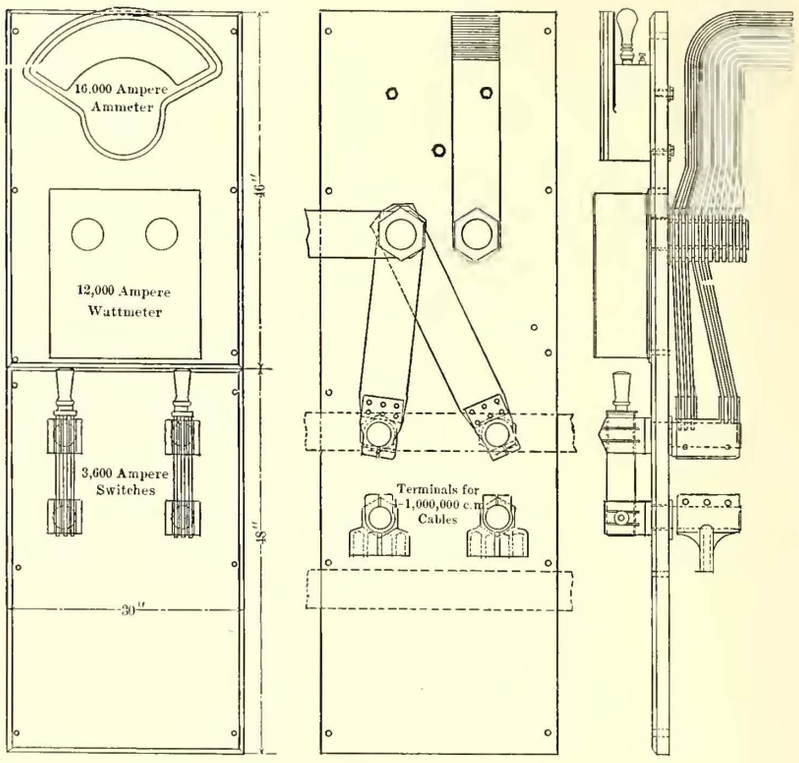


FIG. 9.—MAIN AMMETER AND WATTMETER PANEL

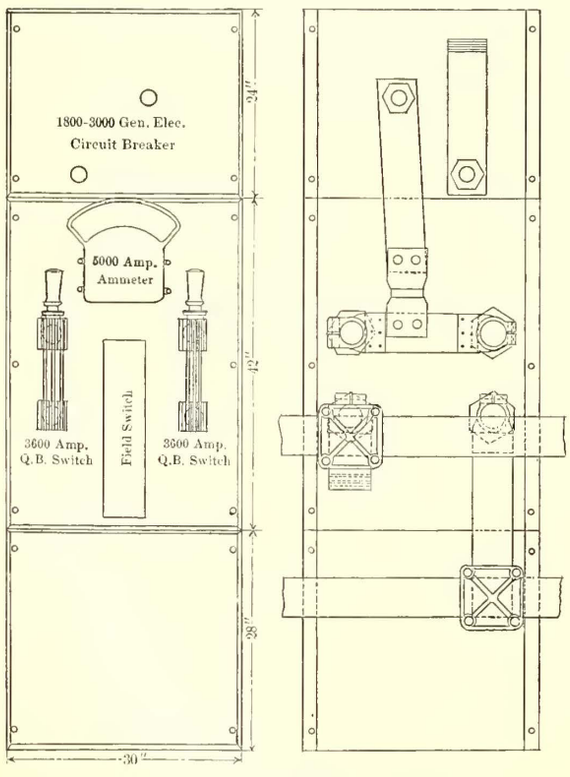


FIG. 10.—GENERATOR PANEL

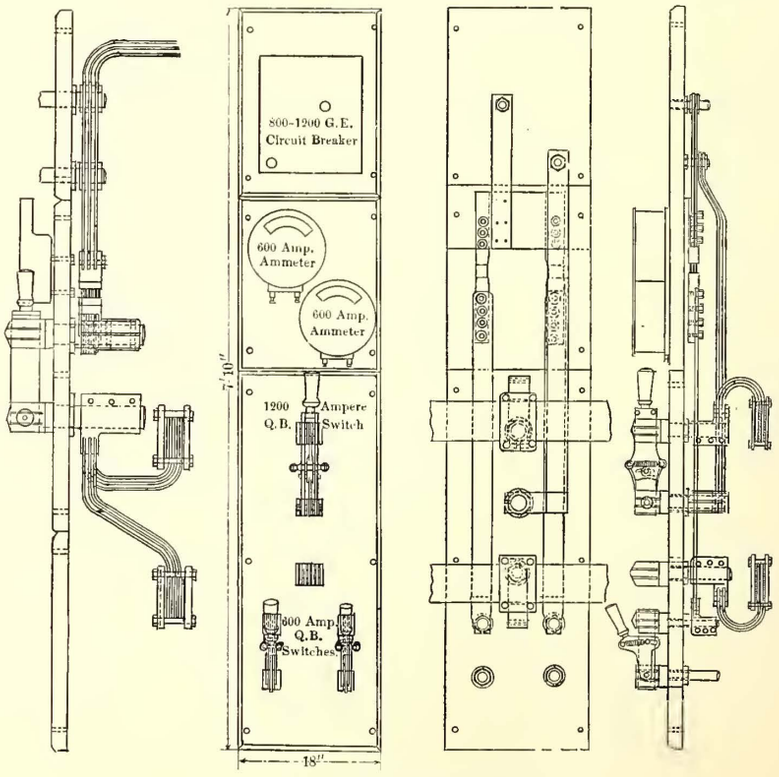


FIG. 11.—FEEDER PANEL

by which the center aisle is served by the same crane. This consists of two beams mounted on truck wheels and carrying an auxiliary hoist on the outboard end. This can be run out and in very quickly by means of a rack operated from the main platform.

At the south end of the station has been constructed one of the finest switchboards in the East. It is made up of five generator panels, eight instrument and tie line panels, and seventy-six feeder panels. It is of the two-bank type, a gallery running over the lower bank and giving access to the upper. The panels are of white marble bolted to an

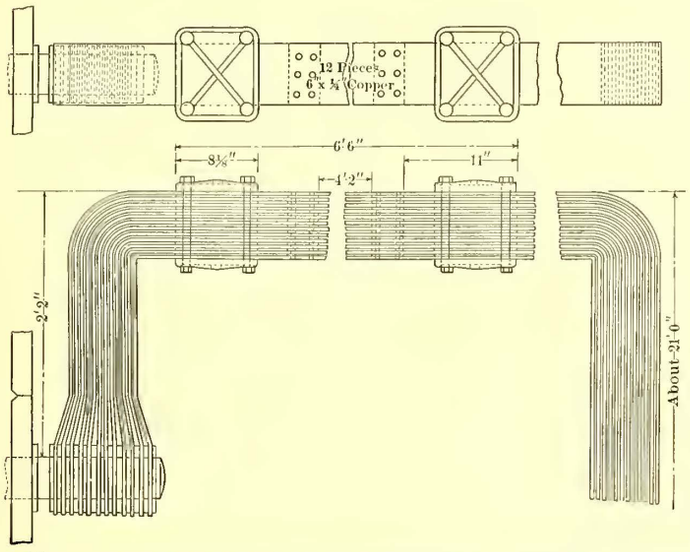


FIG. 12.—MAIN NEGATIVE BUS BAR SHOWING AMMETER SHUNTS

iron girder framework. The floor of upper deck is slate 2 ins. thick. All connections are made with heavy copper bars fastened together in parallel in such a way as to furnish sufficient carrying capacity so that there is not the slightest overheating, in spite of the heavy currents that pass over the different circuits. Illustrations and diagrams of this switchboard are given herewith, and some explanation of the circuits will be interesting.

This station serves as the general clearing house, as it were, for stations 1, 2, 3, 4, 5 and 6, as will be seen on the inset map. To a heavy bus bar sectionally divided are connected the other five stations through heavy copper mains made up as follows:

Connecting No. 1 and No. 2 are six cables with a total area of 5,000,000 c.m.

Connecting No. 1 and No. 3 are eight cables with a total area of 8,000,000 c.m.

Connecting No. 1 and No. 5 are four cables with a total area of 3,000,000 c.m.

Connecting No. 1 and No. 6 are three cables with a total area of 2,000,000 c.m.

Connecting No. 1 and No. 4 are two cables with a total area of 2,000,000 c.m.

Station No. 4 is tied to Station No. 6 by cables having a total area of 4,000,000 c.m., and Station No. 2 is tied to Station No. 3 with four cables, having a total area of 4,000,000 c.m.

There are two positive bus bars on the generator and feeder panels. The feeders can be connected at will to either of these bus bars, and all or any number of feeders can be served by the four generators in the Mount Vernon Street Station; while in case the station becomes overloaded in the heavy hours of the day, current can be drawn through the tie lines from one or more of the other four stations and connected to special banks of feeders, whose loads are proportionate to the amount which can be spared from the sending station. Conversely, the Mount Vernon Street Station can help out any of the other four stations at the time of their greatest load, sending current over the tie line, this circuit being used on special feeders in the receiving station.

All the current in the company's different stations is carefully metered at various points, so that the company's records are exceptionally complete, and its costs are reliable. Great care is taken to calibrate the wattmeters periodically, especially soon after a short circuit, as it has been found that the heavy currents going through the wattmeters will sometimes change the magnetic conditions to such an extent as to interfere with their accuracy thereafter.

The Mount Vernon Street Station switchboard is equipped with General Electric generator and feeder circuit breakers, Thompson wattmeters, Weston volt and ammeters, Bristol recording volt and ammeters, and Anderson knife switches of a peculiar pattern, built specially for the Union Traction Company. The 1200-amp. double-throw switch is illustrated in Fig. 13. The two outer blades carry the main current, and are connected to the inner blade by springs. The inner blade makes and breaks the circuit and carries the full current for the brief time necessary for such make and break only. By a peculiar arrangement of eccentrics on the inner blade, and a stop and spring connecting the outer blade thereto, all the blades are rigidly secured to the handle when the switch is closed on either of the two positive bus bars, above and below the pivoting point, but the center blade yields only when the switch is open, thereby providing a quick break for each side.

The Bristol recording instruments show the fluctuations in the current and voltage during the day, and the charts which are obtained by them are exceedingly interesting, and serve as a check upon the electrician in charge of the station.

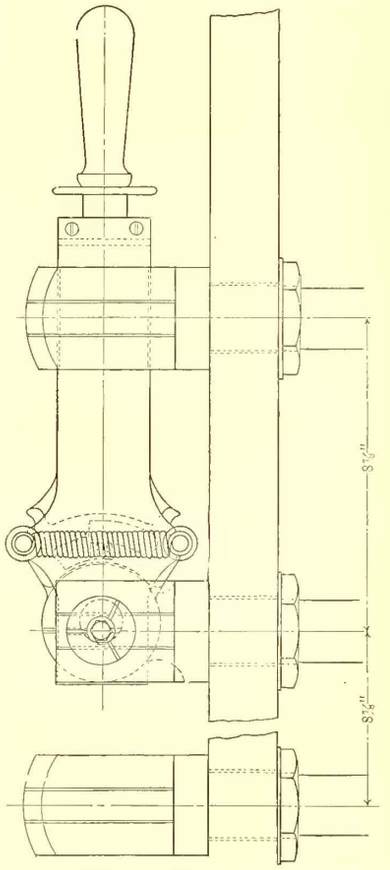


FIG. 13.—SIDE VIEW OF 1,200 AMPERE DOUBLE THROW SWITCH

At the Mount Vernon Street Station wash and toilet rooms have been provided; also a large locker-room containing seventy-two steel lockers, enabling each man to have his own locker. The men work in three eight-hour shifts, from 7 A. M. to 3 P. M., 3 P. M. to 11 P. M., 11 P. M. to 7 A. M.

THE DISTRIBUTION CIRCUITS

It will be inferred from the above description of the tie lines and the Mount Vernon Street switchboard that the company's stations are not operated in parallel to serve the general distribution system. This has been found impracticable, not only because of the number of stations to be so connected, which would naturally introduce complications, but also because the stations are so near together that

any practicable tie lines would be of extremely small resistance, and the point of zero difference of potential between the current output of the several stations could not be confined to the distribution circuit, but would inevitably work back into the stations themselves and reverse the generators. The alternative plan indicated above has therefore been adopted of grouping feeders so that they can be served from any of the stations—not alone that to which the feeders are directly connected. On account of the enormous area covered by the city of Philadelphia and by the company's lines, the "load peaks" of the different stations are some distance apart in point of time, and for this reason it is possible for one station running below its maximum load to help out another which may be at the same time overcrowded. The Mount Vernon Street station, for example, being in the heart of the business district, naturally requires help during that hour in the afternoon when the rush of homeward travel begins, while a little later it may help out some outlying station whose cars are crowding in upon its feeders.

Practically the entire distribution system of the company is carried under ground, there being only a few short sections in the outlying districts where the feeder wires are on poles. Nearly a thousand miles of lead-covered insulated cable of all types of manufacture are carried in the company's conduits, together with a very large mileage of bare copper wire forming the rail return circuits. Supplementary wires in the track itself are but little used, the rail conductivity being maintained by a thorough system of bonding, while the return feeders carry the bulk of the return current. The company is now using for regular bonding work a special modification of the Atkinson horse-shoe bond, and for its special work and cross bonding it is using the Columbia bond, made by the Roebling Company. Owing to the station tie lines and improved methods of distribution, the company has considerably more underground cable in service than is now or will be required for some time in the future, and no large purchases will probably be made for several years to come.

The conduits, which are of practically all existing types —cement-lined iron pipe, vitrified clay and creosoted wood —have all given good satisfaction, but the company is using vitrified clay on all new extensions. There is very little trouble from any cause with the underground distribution system. Great care is taken to keep the lead sheathing of the cable always negative so as to prevent electrolysis, and an inspector is constantly making tests all over the system to accomplish this result.

The company has had in service on the Chestnut Hill line for nearly two years a large 500-amp. hour storage battery, built by the Electric Storage Battery Company, of Philadelphia, of its type G-13. There are thirteen plates in each of the 250 cells, and the normal rating is 120 amp. for eight hours or 500 for one hour. This battery has been of great service in equalizing the load on the Chestnut Hill line. The storage battery plant, including real estate, battery and building, together with a special generator and its engine at the power station, cost less than half of what a separate station would have cost at the Chestnut Hill end of the line, and hardly a tenth of what the necessary copper cables and conduits would have cost. The actual annual operating cost of the battery has proven to be far less than interest upon the necessary copper invested, and much less also than the cost of running a separate station of the size which would be required for this line. The company seems perfectly satisfied with the results obtained from the battery, and will no doubt install more of them when similar conditions justify their use.

ROADBED

By the terms of the franchises for electrical equipment obtained by the Philadelphia companies, the latter were obliged to repave with improved pavement all streets through which their tracks ran, from curb to curb. The result is that the Union Traction Company, their successor, finds itself in possession of one of the finest roadbeds to be found anywhere in this country. The pavements, while exceptionally good, are as a rule of types such that pleasure riding, whether by carriage or bicycle, is not a prominent feature of Philadelphia life, and the narrowness of the streets tends still further to throw the burden of regular daily transportation upon the company's lines.

The company has lately standardized its special work most carefully, and now has regular charts and tables by which all curves, crossovers and switches are laid out. The special work is particularly good, and with the exception of some heavily worked track in the heart of the city, the joints and rails throughout the system are in fairly good condition, and will stand several years' further service. Much of the repair work is being done with the Falk cast welded joint. Detailed descriptions of the track construction of the constituent lines have already appeared in the Street Railway Journal.

ROLLING STOCK

The company owns nearly 3000 motor cars. These are nearly all from 18 ft. to 22 ft. in length and are equipped with single trucks, although there are a few double-truck cars. The car bodies were made chiefly by the St. Louis Car Company, Jackson & Sharp Company, Laclede Car Company, American Car Company, and J. G. Brill Company.

The trucks were made by the Peckham Motor Truck & Wheel Company, the McGuire Manufacturing Company, the J. G. Brill Company, and the Bemis Car Company.

The standard colors adopted by the company for car painting are white and yellow, and a simple form of lettering is used. The company will probably not be in the market for large purchases of cars for several years, as its equipment is considerably greater than its present operating requirements.

Of the 6048 motors in service 4180 were made by the General Electric Company, and are chiefly of the G. E. 800 type, and 1868 were made by the Westinghouse Company. The General Electric type K controller and Westinghouse G controller are used. The efficiency of the motors is such that under the conditions in Philadelphia the current output of the station is equivalent to about 1.3 kw. hours per car mile operated in summer months, and 1.5 kw. hours per car mile operated in the winter, when heaters are used.

CAR HOUSES

The company owns no less than twenty-six car houses, with a total storage capacity of 3000 cars. Its two repair shops are located at Ninth and Dauphin Streets and Kensington Avenue and Cumberland Street, and are well equipped for economical repairs.

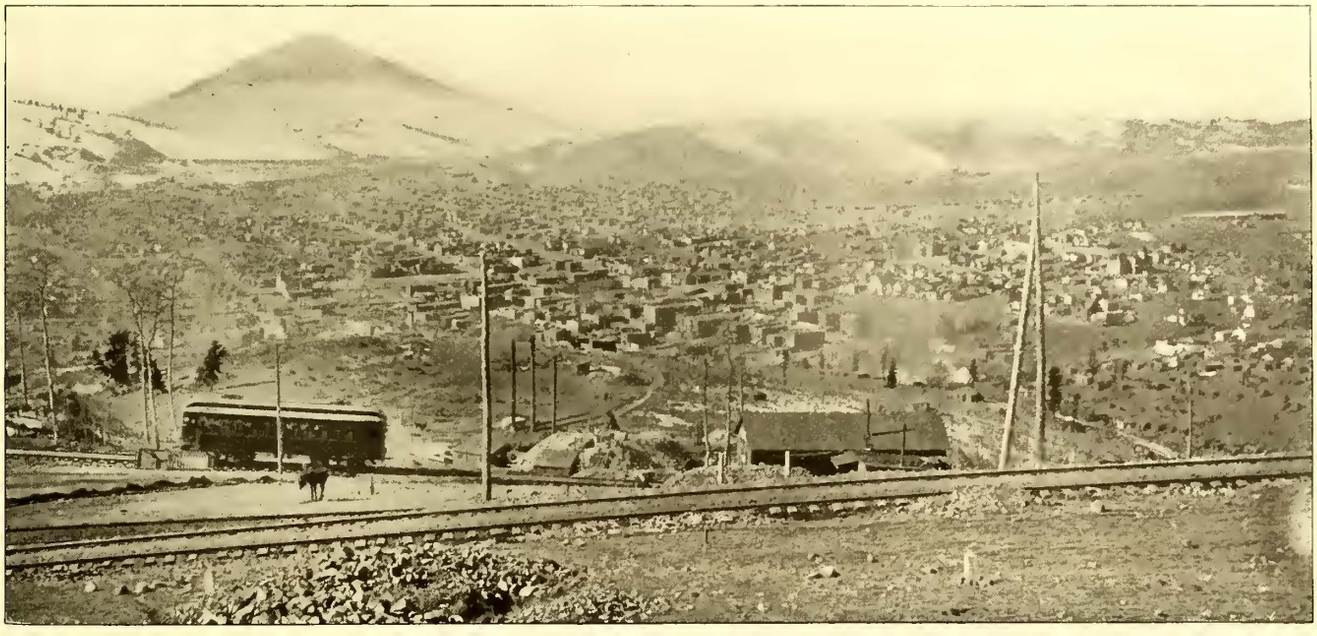
"The general standard of street railway employees for faithful service and fidelity to their trust has more than kept pace with the wonderful changes and improvements that rapid transit has brought about, and they will be found vieing with their brethren in other pursuits in their devotion to the best interests of their employers."—Montreal, 1895.

"Every employee of a street railway should be considered as an agent with possibilities of harm to his employer. It is not enough that he be intelligent, sober and industrious. He should be of good judgment and sound thinking; and neither communistic, socialistic or anarchistic in his views; not discontented and at cross-purposes with the whole social order, but of cheerful disposition and content to make the best of life as he finds it."—St. Louis, 1896.

Interurban Railroading at Cripple Creek

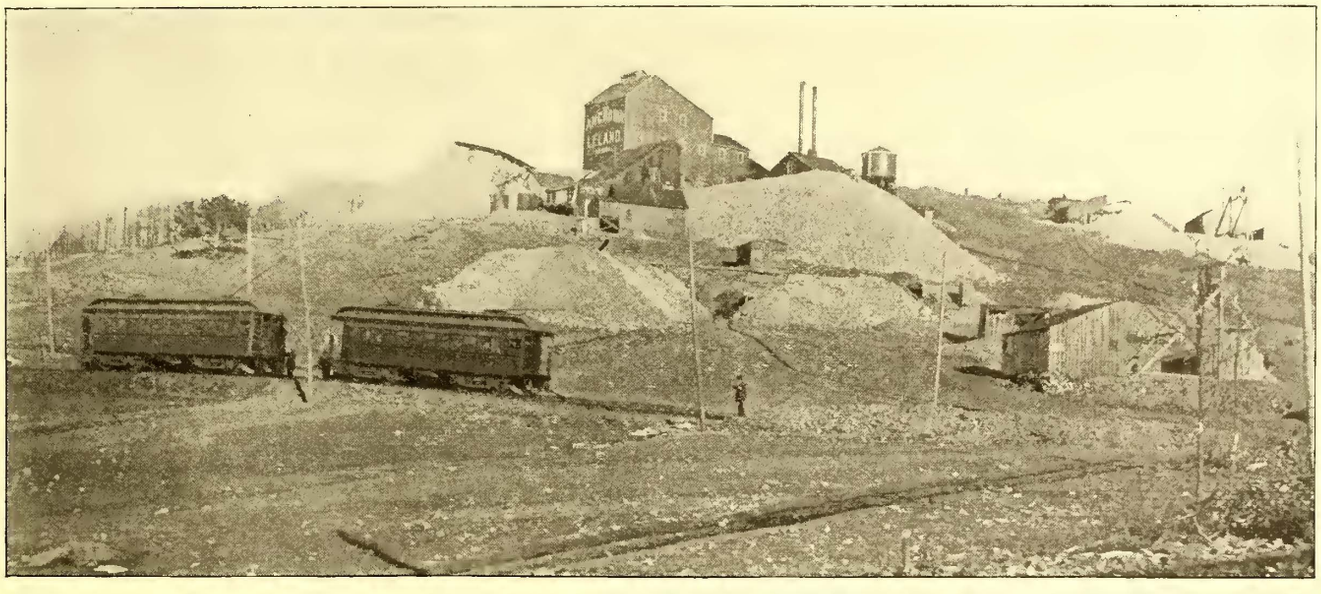
Among the mines of Colorado, as well as in the metropolitan streets of New York, the three phase system is proving an important factor in the question of power distribution for railways. But while the New York installations have not yet been put in operation, the value and practicability of the system is being shown on distant and smaller roads, so that no doubt as to its efficiency under proper conditions can be entertained. High tension, three-phase alternating current reduced in transformers and changed in converters to low tension direct current for use with ordinary electric street cars was first employed in this country at Portland, Ore. At Lowell, Mass., this method was first adopted for the operation of long interurban electric railway service with gratifying success, and since then, in almost all cases involving a transmission of power, beyond the economical limits of the directly generated direct current, three-phase systems similar to those at Portland and Lowell are employed. For the operation of the Barre-Montpelier railway, described in the STREET RAILWAY JOURNAL for September last, for several small European electric railways and for the great underground electric road in London the three-phase system will also be used.

From Cripple Creek to Victor, in Colorado, runs the recently installed road of the Cripple Creek District Rail-



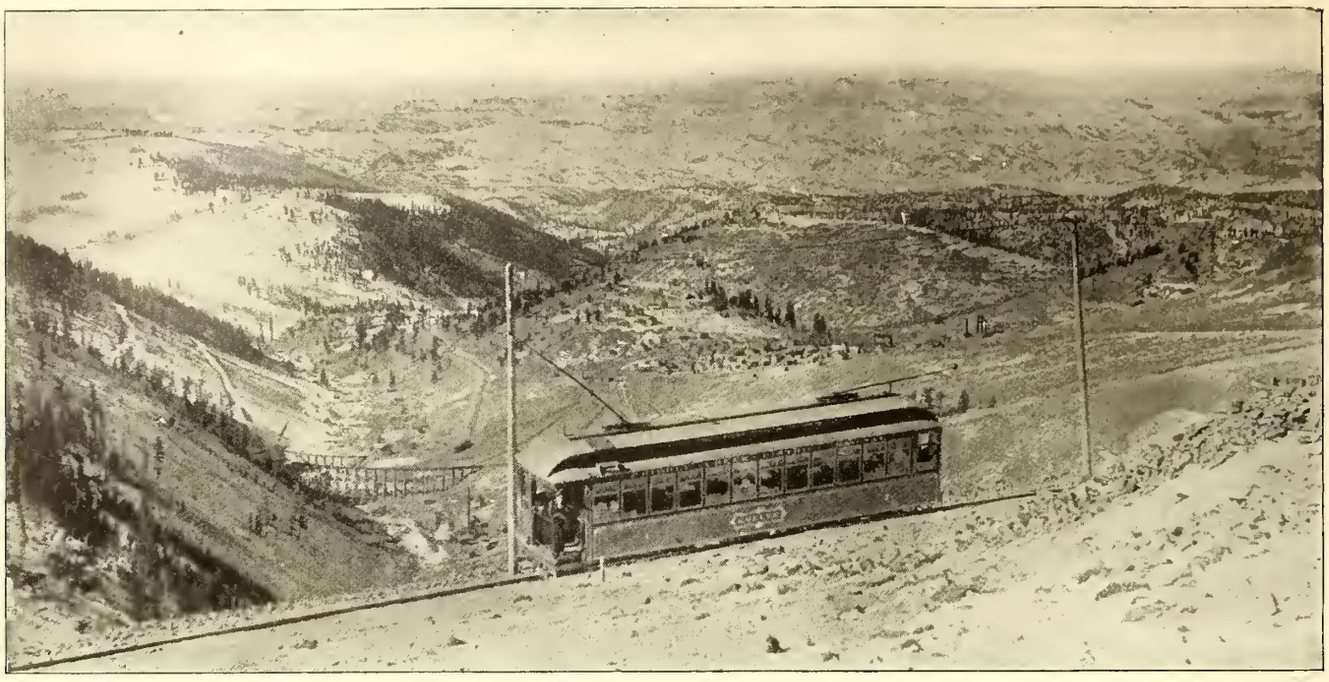
VIEW OF CRIPPLE CREEK FROM THE RAILWAY LINE

way, first division, a line some 6 miles long—the first installment of an interurban network, which will eventually connect many of the busy mining towns of Colorado. As the road will ultimately cover long distances, the three-phase system with current generated at high pressure, transmitted, reduced and converted has been adopted as most suitable to the eventual demands. The source of the power is the flow from the different watersheds from Pike's Peak. The site of the power-house is located a few hundred feet above Lake Moraine, in close proximity to the cog road leading from Manitou to Pike's Peak.



PASSING THE ANCHORIA—LELAND MINE

The water is brought through a riveted steel pipe line about 2700 ft. long to a 4-ft. Pelton water-wheel, running at 500 r.p.m. under a head of 700 ft. To the wheel is directly

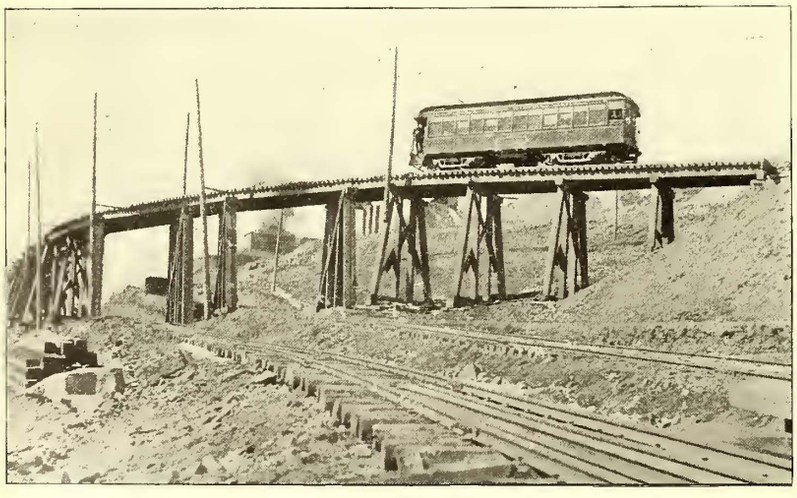


DESCENDING THE DIVIDE

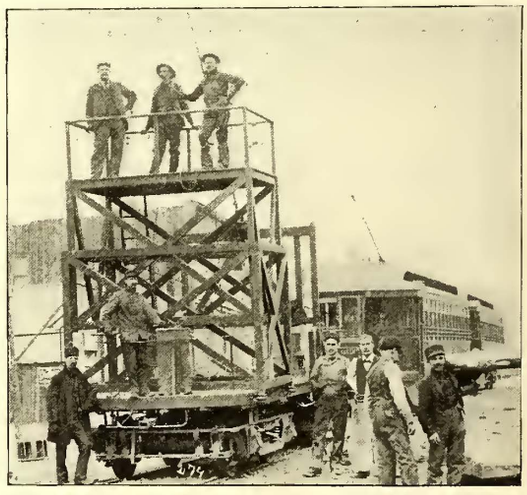
connected a General Electric 225-kw. three-phase alternator, wound to deliver current directly to the line at a pressure of 6300 volts and a periodicity of 25 cycles. The exciting current is obtained from a General Electric multipolar direct current generator, directly connected to an 18-in. water motor running at 1400 r.p.m.

Previous to the installation of the three-phase generating plant, continuous railway current was furnished directly to the trolley line at 550 volts from the Cripple Creek lighting station, where the railroad company installed a General Electric 225-kw. multipolar direct current generator driven by an Armington & Sims compound engine. This steam plant will be held as a reserve upon which to call in case of emergency.

The generating station switchboard is built of two blue Vermont marble panels, one for the generator and one for the exciter, equipped with the usual indicating, measuring and controlling instruments. The high potential switches are of the type adopted by the General Electric Company for use in all its high potential installations. They are of the extremely quick break type, and are unprovided with handles, the opening of the blade being effected by means of a long stick with a hook at the end, which hook is inserted in an eye in the free end of the switch. The switch blades are separated from each other by marble barriers to eliminate all chance of arcing between the blades. In order to bring the blades away from the board both hinge and clips are mounted on corrugated rubber cones about $3\frac{1}{2}$ ins. high. Similar pyramids intervene between the back of the board and the high potential connections. G. E. ball lightning arresters are used, one set being placed in the generating station itself, and another in a lightning arrester house a few feet distant from the station. As the station and line are situated in a locality some 10,000 ft. above sea level, where electric storms are frequent, the necessity for reliable lightning arresters is forcibly brought home to the station manager at oft-recurring intervals. So far the ball type has proved highly successful.



TRESTLE CONSTRUCTION



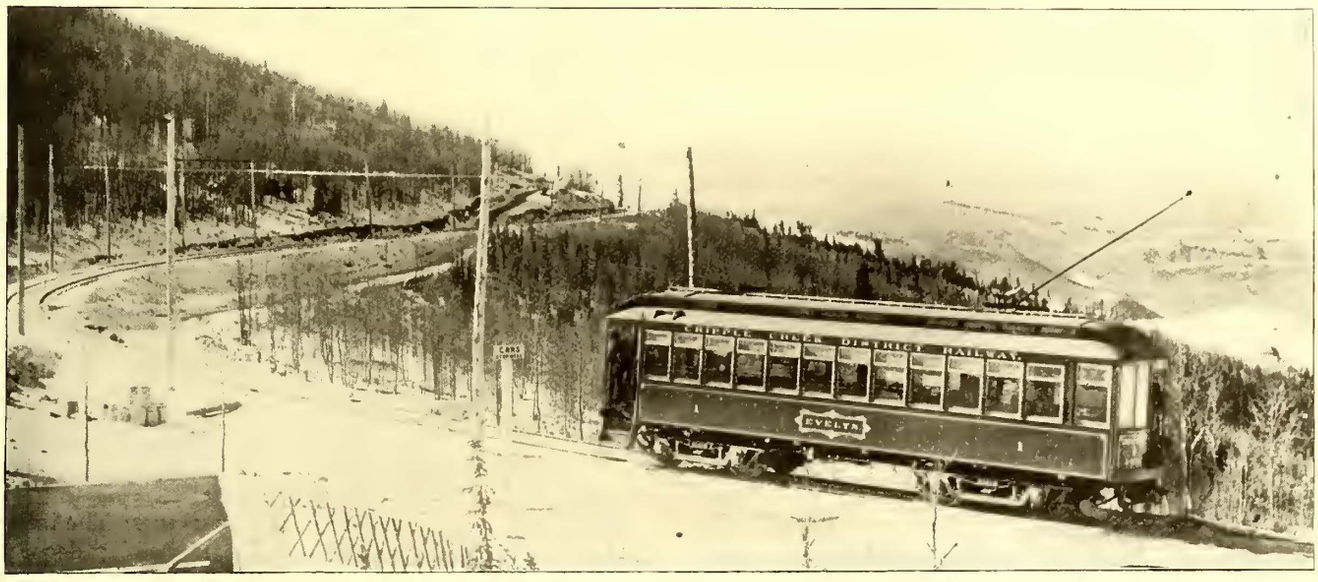
TOWER CAR

From the power-house the circuits run over a pole line as far as the Horseshoe Pass, the wires being strung on Locke tripple petticoated high-potential insulators. Along the tops of the poles runs a bare iron wire grounded every few poles, as an additional protection against lightning.

The total length of the transmission line is about 9 miles.

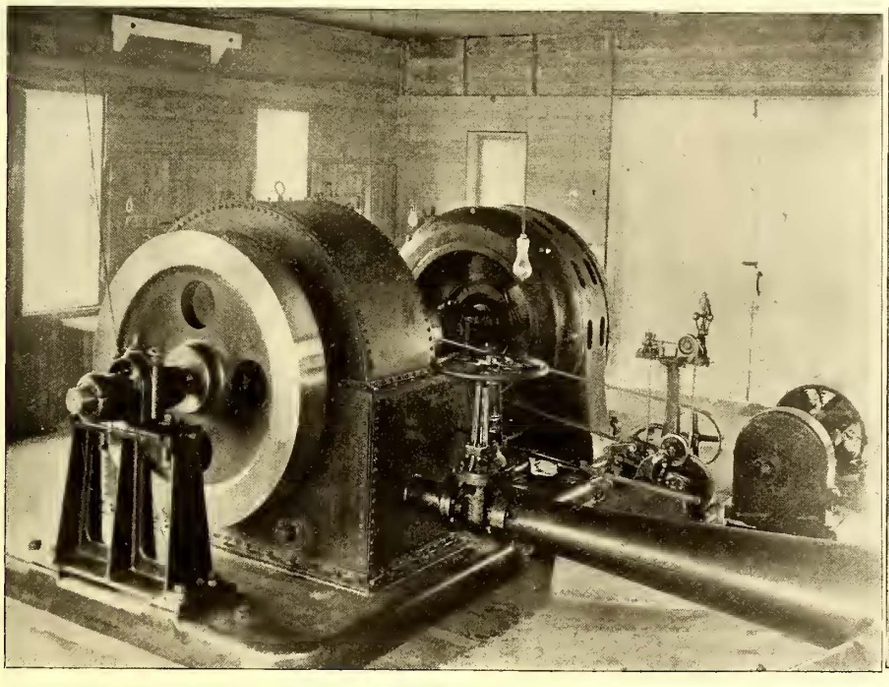
The transformer and converter sub-station is located at

Horseshoe Pass, at the station of Midway, half way between Victor and Cripple Creek and about midway between the terminals of the first division of the railroad. The reducing transformer equipment consists of three 75-kw. General Electric transformers, cooled by a current of air forced up

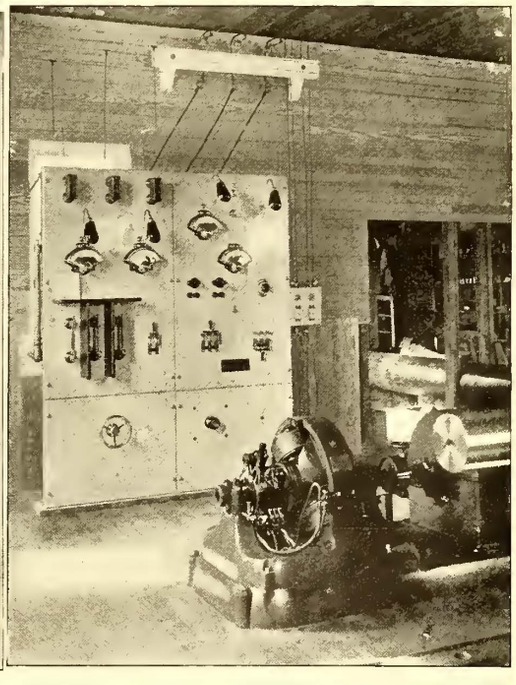


ASCENDING THE MOUNTAIN

through the core and windings. In these the pressure is reduced to 350 volts, and at this pressure the three-phase current passes to one 200-kw. General Electric rotary converter of standard construction, running at 750 r.p.m., and



RAILWAY GENERATOR AND WATER WHEEL



SWITCHBOARD AND EXCITER

issues to the trolley wire from the commutator side direct railway current at a pressure of 550 volts. The switchboard in the sub-station consists of a single panel fully equipped with the necessary apparatus.

The line is 6.25 miles long, single track, with two turnouts and three spurs. It is the highest electric railway in the world, and runs from Cripple Creek to Victor directly over the top of the mountains, with terminal facilities, car barns and offices at the former town. The illustrations show clearly the nature of the country through which it

passes. It may be said to be made up entirely of grades and curves, and, indeed, according to an engineer who recently inspected it, "there is not enough straight track on the whole road to make a decent crowbar." Curves as sharp as of about 100 ft. radius are frequent; the average grade between Cripple Creek and Midway Station is 6.09 per cent, the maximum rising to 7½ per cent, the rise being about 1000 ft. at an altitude of 10,500 ft. Between Midway Station and Victor the average grade is 4.68 per cent. The track is laid with 60-lb. T rail, on ties closely laid and well ballasted. It is bonded with terminal bonds of two 0000 copper wires. Track and roadbed have apparently been laid down with the sole end in view of permanency of installation and solidity of construction.

The rolling stock consists of three 40-ft. closed vestibuled double-truck cars, manufactured by the Barney & Smith Car Company, for the passenger service, and one 33-ft. 6-in. double-truck baggage and freight car. Each passenger car is equipped with two G. E. 57 motors, with

two "K"-11 controllers, and the baggage car, with four G. E. 1000 motors and two controllers. All the cars are provided with Christensen air brakes and air whistles.

The road has been in operation since Jan. 3, 1898, on a strictly railroad basis, with fixed time schedules. Since traffic was inaugurated no trip has been lost, nor have any difficulties been encountered not already provided for before actual operation was begun

The road has five stations—the terminals at Cripple Creek and Victor, and Anchoria, Midway, Windy Point and Dyer stations in the order named from Cripple Creek. The round trip is at present made in 1 hour and 29 minutes at an average speed of about 10 miles an hour, but this speed will shortly be increased to make a round trip between Cripple Creek and Victor in one hour. The road was promoted, constructed and is under the general management of L. D. Ross, vice-president of the company. Only passenger traffic has been handled up to the present time, but the road was built and equipment has been ordered to haul ore and other freight in the district. The road is building and will have in service within sixty days four more passenger cars to take care of the passenger traffic alone.

Special Cars in Brooklyn, N. Y.

The Nassau Electric Railroad Company, of Brooklyn, has in operation on its lines a number of specially designed cars, several of which are extremely novel and ingenious.

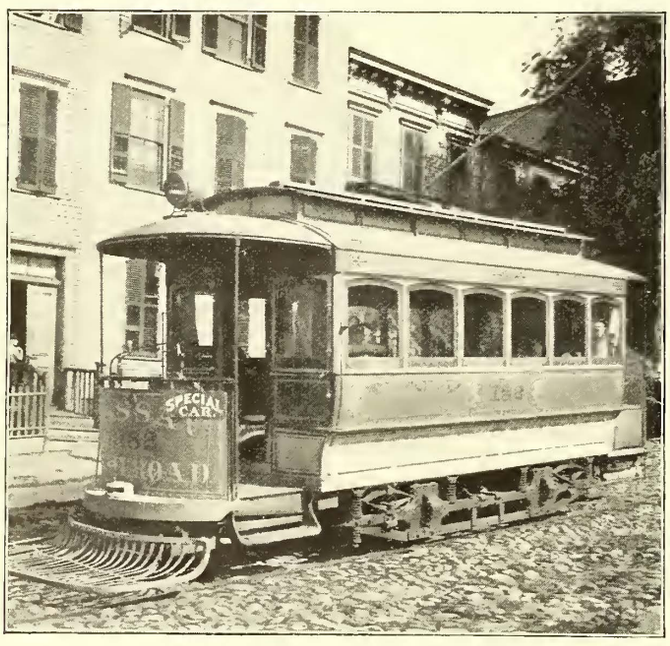


FIG. 1.—EXTERIOR OF OFFICE CAR

These include an office car, a tower car, two parlor cars and a new type of convertible car of which about 250 are now in operation on the road or in process of construction.

The office car, which is shown in Figs. 1 and 2, was designed by F. S. Drake, superintendent of the Nassau system, and he spends about three-fourths of his time in it, traveling from one point of the road to another. Mr. Drake states that this car has come to be an almost indispensable part of the road's equipment, as it enables him to make inspections and perform work that it would be extremely inconvenient to do without it. As will be seen from the illustrations, the car is an ordinary one, with 16-ft body, from which the seats have been removed. It is fitted with arm chairs, a large desk, rack giving the names of conductors, hanging shelf, etc. There is a five-light cluster over the desk. Johns' heaters are used, and the body is mounted on a Peckham truck. The car has a regular motorman and conductor who are detailed to the service, and of course it runs as a special at all times. By this arrangement the superintendent is enabled to keep under inspection the entire 150 miles comprising the system, and he can visit the different depots, of which the company has six or seven, as frequently as he desires and without losing any time. He takes a clerk with him in the car, and does most of the office work connected with his position while going from depot to depot, such as auditing bills, making timetables, assigning conductors, etc. Another advantage of the car is that the superintendent can take the heads of departments over the different divisions and call their attention to any desired changes or improvements. The car is equipped with Westinghouse motors and General Electric controllers.

The parlor car shown in Figs. 3 and 4 is known as the Pontiac, and is used exclusively by Hon. T. L. Johnson, treasurer of the Nassau Company, for the personal use of himself and family. It was originally a 16-ft car, but has been rebuilt in the shops of the Detroit (Mich.) Citizens' Street Railway Company, and has been made somewhat shorter and provided with very long platforms. The exterior is painted white, with gold trimmings. The interior is finished in light mahogany with white ceiling decorated in gold. The windows are beautifully draped with green curtains. Steel motor equipment is used, and the body is mounted on a Dupont truck.

The car is equipped with a very ingenious portable turntable by which it can be switched from one track to another at a crossing where there are no connecting curves. This has been found very convenient in transferring from the

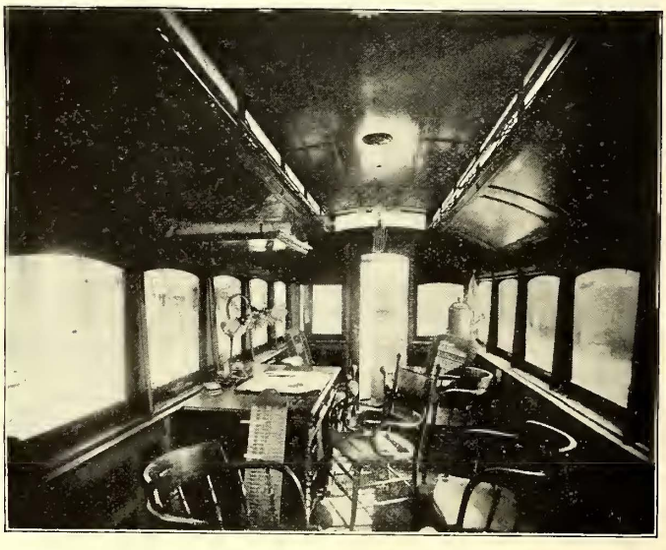


FIG. 2.—INTERIOR OF OFFICE CAR

Nassau system to some of the other railways in Brooklyn The device employed consists of a hydraulic jack, located under the car, and upon which the entire car can be raised off the track. The car is run to the center of the crossing and is lifted by the hydraulic jack until the wheels clear the rails. It is then swung around to an angle of 90 deg., if the crossing is a right-angle crossing, and then lowered so that it can operate on the other track. This is the first application of this principle, so far as it is known, and it was invented by T. L. Johnson. It is shown in detail in Fig. 10.

Fig. 5 shows the private car of the president, A. L. Johnson. This is used by the president and directors, and is also employed for carrying distinguished persons over the road. It is a 22-ft. car, 8 ft. wide, or 8 ins. wider than the ordinary cars. Steel motors are employed, and the car is

mounted on a Dupont truck. The interior is elaborately decorated, and large plate glass is used in the windows, which are tastefully draped with rich curtains. A buffet is provided, so that luncheon can be served en route if desired, and the car contains several large wicker arm chairs and a comfortable sofa.

Figs. 6 to 9 illustrate a very unique tower car, which was designed by the superintendent, F. S. Drake. As will be seen, it is a box car upon which has been mounted a movable tower and platform. The tower is raised by a windlass and wire ropes. The platform can be revolved to any position and locked, enabling the car to stand on one

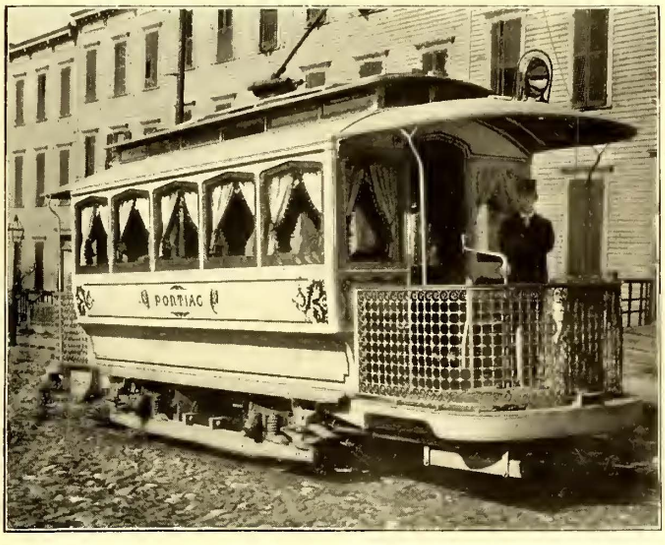


FIG. 3.—EXTERIOR OF PARLOR CAR, PONTIAC

FIG. 4.—INTERIOR OF PARLOR CAR, PONTIAC

FIG. 5.—INTERIOR OF PRESIDENT'S PARLOR CAR

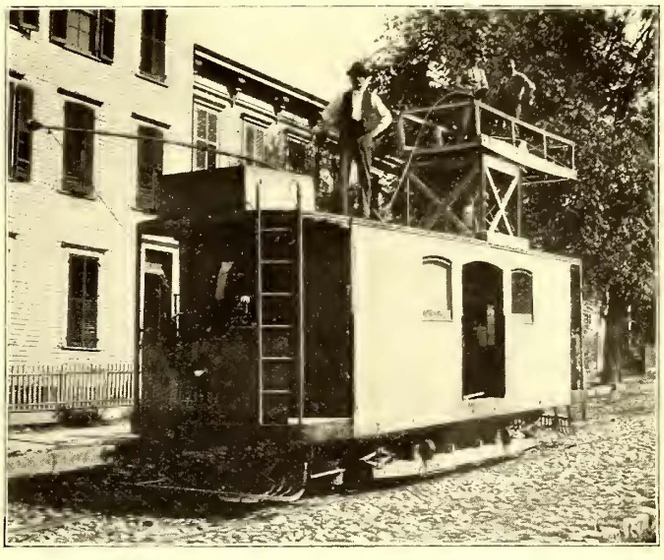


FIG. 6.—STRINGING NEW TROLLEY WIRE FROM TOWER CAR

track while the men are repairing the overhead appliances on the other track of a double-track road. The car contains apparatus for raising poles, jacks, digging tools for repairing washouts on the line or breakdowns, in fact apparatus of every description for making repairs, and is a miniature repair shop on wheels. It also contains testing apparatus, a water rheostat and electric heaters, and is fitted with a trolley pole and motors so it can go to any part of the system.

The car is also equipped with apparatus for stringing trolley wire when operating under its own power. A large reel of trolley wire is located inside the car, and the loose wire is led out through the top of the car over a brass pulley. The end of the wire is then clamped to the end span or anchor and the car proceeds reeling out the wire. The wire is alive, and the reel and all points of contact with it are carefully insulated. When stringing new wire the current is not taken to the motors through the trolley pole, but through a brass pulley which bears on the wire at the point where the latter passes through the roof. When the car reaches the first span it is stopped and the men on the platform make the connection between the wire and its hanger and they then proceed to the next span. A force of men can thus string and put in position a mile of wire in less than twenty minutes. In this way the wire can be strung on a line upon which cars are running, and if the regular service is on a headway of twenty minutes the construction car can take down the old wire and put up new wire for a distance covering a mile before it has to get out of the way of the regular cars. Fig. 9 shows the tower lowered to the roof, Fig. 6 shows the car as it appears when stringing new wire, and Fig. 8 illustrates the platform swung round for working over the opposite track. Fig. 7 is a diagram showing the interior arrangement of the car.

In Figs. 11, 12, and 13 are shown views of a recent convertible or combination car which has been designed by T. L. Johnson. It is intended for both winter and summer use, and is, in the main, constructed nearly on the plan of a regular open summer car of ten cross seats. The eight seats between the ends are arranged in four compartments

and turned to face each other in pairs, making four open spaces. One side of the car is constructed of panel work, with large glass windows from the level of the top of the seatbacks to the roof. The glass is not fitted with sashes, but is designed to be taken out altogether in warm weather. On the side of the car which runs nearest the sidewalk there are four doors on rollers, opening into the four compartments. The doors slide back and, when open occupy

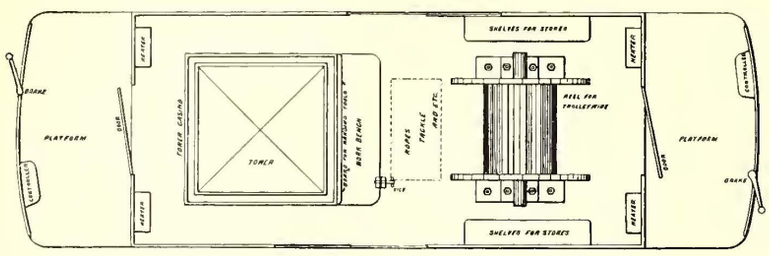


FIG. 7.—PLAN OF INTERIOR OF TOWER CAR

the space at the side corresponding to the room between the backs of the seats. The doors are made so as to fit the shape of the side of the car, the lower part being bent in toward the center of the car. The doors are fitted with automatic catches which keep them closed or open as the case may be without letting them move backward or forward on account of the jerks of the car when in motion. All dimensions are exactly the same as those of an ordinary ten-seat open car, with the exception that the distance between the seats in the four compartments is somewhat wider, being 25 ins., and the space between the backs of the seats is accordingly narrower, there being only 4 ins. between the uprights of the backs of the seats. The additional space secured between the edges of the seats gives

FIG. 8.—TOWER CAR WITH PLATFORM AT RIGHT ANGLES

more comfort to the passengers sitting opposite each other. At both ends of the car there are two large glass windows which can be raised or lowered and can be held in three different positions by catches similar to those used on steam railway coaches. Under each seat is placed an electric heater of the H. W. Johns Manufacturing Company. These heaters are away from the passengers and cannot possibly come in contact with their clothing.

The running board or step on the side that is closed in is taken off, as the entrances are only on one side. This necessitates the car being run from one end always, and in order to do this the company is making arrangements to have loops or Y's at all termini of its lines.

All parts of the car are built in a substantial way, so that in winter when the doors are closed and heat turned on the

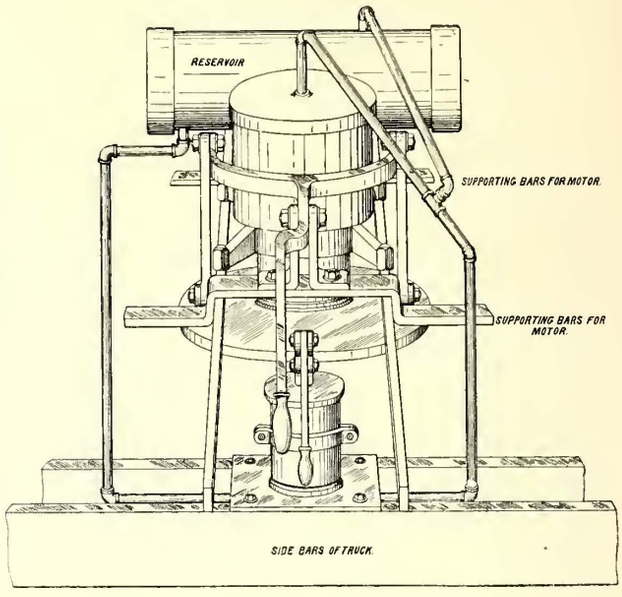


FIG. 10.—HYDRAULIC LIFTING JACK

car will be warm and comfortable. In summer, on the other hand, when the end windows are lowered, the doors and all roof ventilators open, and the glass taken out of the enclosed side, the car is practically an open one, with the advantage of being easily changed to a closed car in case of a sudden storm or change of weather. On a single roller on the outside of the enclosed side is hung a large

FIG. 9.—TOWER CAR WITH PLATFORM LOWERED

curtain, which is worked by the motorman and conductor in case of rain, when the glass windows are not in place. The inside of the car is fitted with straps for the use of the passengers obliged to stand.. These straps are hung on cross rods attached to the upper part of the car.

The car body is 21 ft. 7 ins. long, inside dimensions, and 31 ft. 10 ins. over all. It is 7 ft. 6 ins. wide. The seating capacity is forty passengers inside and ten passengers on the two outside seats, one of which is at each end. Fig. 13 is a diagram of the seating arrangement and the doors.

The advantages claimed for this type of convertible car were clearly pointed out by Mr. Johnson at the meeting of the New York State Street Railway Association at Manhattan Beach on Sept. 13. Mr. Johnson's remarks made at

The Nassau Electric Railroad Company also possesses a novel rail car which was constructed in its own shops along lines suggested by Mr. Drake. Considerable difficulty had been experienced in distributing 60-ft. rails to outlying dis-

FIG. 11.—VIEW OF CONVERTIBLE CAR SHOWING DOORS CLOSED

that time will be found in the STREET RAILWAY JOURNAL for October, 1898. For summer use the car is the same as the regular open type, but for winter use it will seat fifty

tricts, and in order to facilitate the work of carrying these long rails an ordinary flat car was obtained and remodeled to suit the conditions. The platform of the car is about 40

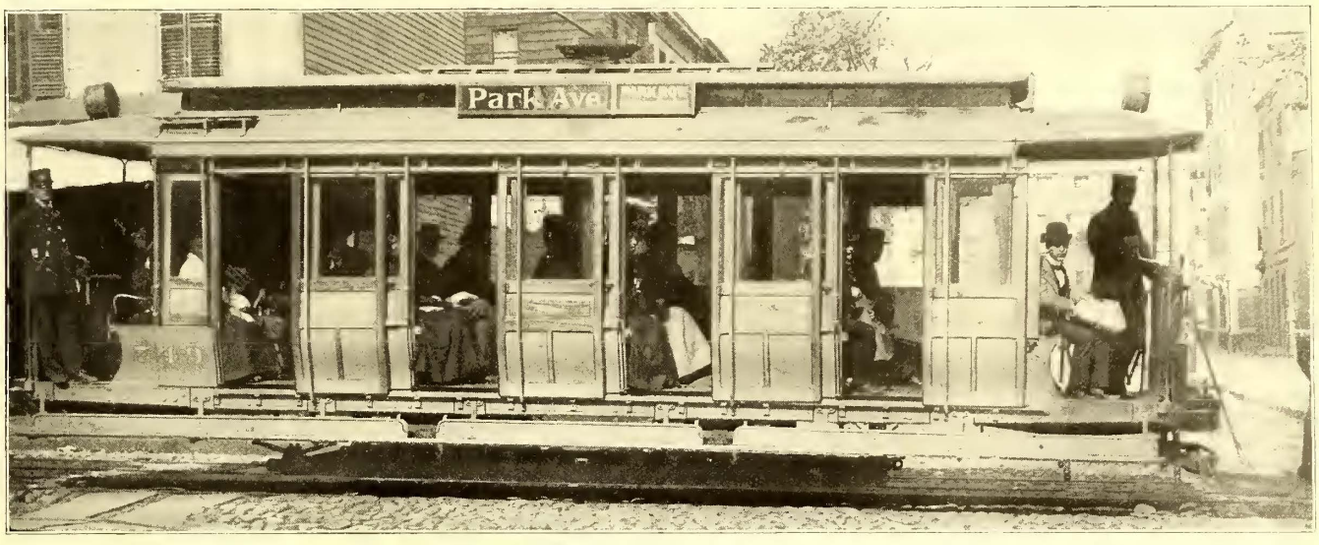


FIG. 12.—VIEW OF CONVERTIBLE CAR SHOWING DOORS OPEN

passengers, whereas the ordinary box cars can seat but thirty. In addition, the car is in use all the year round, whereas regular open and closed cars are only earning

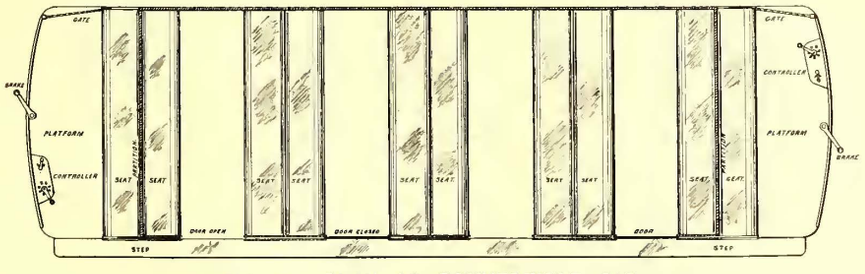


FIG. 12.—PLAN OF CONVERTIBLE CAR

revenue for six months of the year. The Nassau Company has built sixty of these cars itself, it has changed about 130 ordinary open cars to this type, and has had about sixty additional ones built by the St. Louis Car Company.

ft. long, and is mounted on two swivel trucks with very small wheels. The car has a long drawbar at each end, and when moving rails two motor cars are employed, one to push the car and one to pull it. These tend to prevent possible accident if one of the drawbars should break on a grade. Each drawbar is about 15 ft. long. This car will carry eighteen rails of 60 ft. lengths and weighing 90 lbs. to the yard, and will do the work of five six-horse teams with a great deal less trouble and in less time.

There can be no established method to guide all companies and localities as to the advisability of the adoption of a transfer system, and each company must act wholly on its local conditions and requirements in the introduction of the same.—From address at the Montreal Convention, 1895.

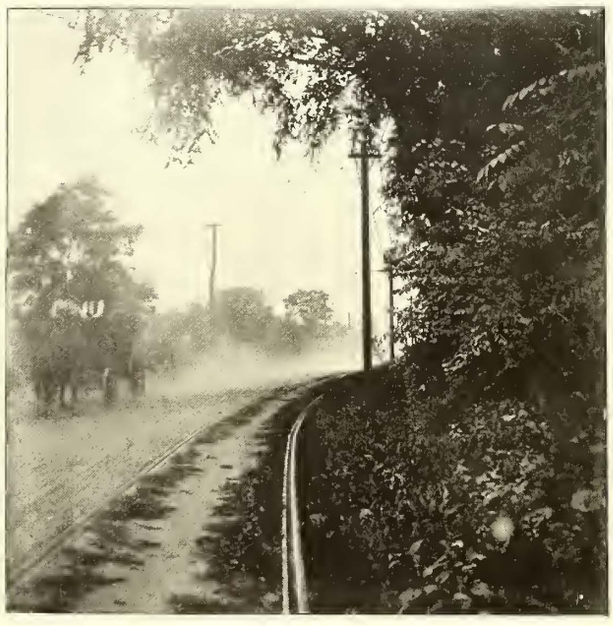
LETTERS AND HINTS FROM PRACTICAL MEN

Bad Track

Mount Vernon, N. Y., Oct. 11, 1898.

Editors Street Railway Journal:

The accompanying engraving shows a section of track that is in constant use, and which contains an innocent-looking but very bad feature, namely, the break in the curvature at the rail joints. Owing to the inability of the camera to "see around the corner," the succeeding similar joints cannot be shown, but the fact is that this curve is laid out with rails, bent with a radius larger than the curve,



POORLY BENT RAILS ON CURVE

the connection being made at the joint by setting over the rail to make up the difference in curvature. This is very poor engineering practice. In the first place it is an abomination to the passengers, but leaving that out of consideration, the damage done to the rolling stock, slamming around such a turn, is very serious; it racks the trucks, until the whole car loses its rigidity.

The photograph sent shows, not a backwoods line, but one near a large metropolis; a road with a heavy twelve-month traffic, and enough business for a double track. When the line was built the poles were set very close to the track, so near that the open car, as now built, cannot be operated. This is a losing investment for summer travel.

It seems almost unnecessary to call attention to such items as these, but the appearance of such errors on otherwise well built roads necessitates cautioning managers against the money-eating powers of a few faults in track.

F. W. Brady, M. E.

Cleaning Cars

South Covington & Cincinnati St. R. Co.,
Covington, Ky., Sept. 19, 1898.

Editors Street Railway Journal:

Answering your inquiries about our method of cleaning cars, would say that our master mechanic, George J. Smith, reports that we have been using the "Modoc Liquid Cleaner" for the past four years, and when it is properly applied we consider it the best article that there is for the purpose intended, particularly varnished surfaces. It not only removes dirt and grime without injuring the surface, but imparts a luster to the varnish. Of course, this does not apply to a surface on which the varnish is a year or more old, as you understand that the luster of a varnish becomes dim after that time.

To secure good results this cleaner must be properly applied and given proper attention. You appreciate that there is an impression that a "cleaner" should remove dirt without labor; some do, but the alkalies remove the varnish also. We apply the "Modoc" cleaner as follows: The car cleaners take clean waste and wipe off all loose dust; this, of course, removes much grit; the rubbing must be done lightly, as the grit would scratch the varnish. When this is completed the car cleaners each take as much clean waste as can be held firmly in the hand, and saturate it with the cleaner; if the car is very dirty they go over the entire car first, and then commence on a panel, and clean it thoroughly by rubbing; the cleaner is then wiped off with clean white waste. Care must be taken to have the dirt thoroughly loosened before wiping off, otherwise the labor is triple the next time the car is cleaned. Care must also be taken to remove all of the cleaner; if it is not done the dust will adhere to the panels of the car. It takes about one quart of cleaner to clean a 30 ft. box-car.

T. M. Jenkins,
Superintendent.

American Engine Design from an English Standpoint

Cole, Marchent & Morley,
makers of engines, pumps, etc.,
Bradford, Eng., Sept. 23, 1898.

Editors Street Railway Journal:

Having occasion recently to visit the United States, I took the opportunity thus afforded to look through a number of the power-houses connected with electrical installations (principally for traction), and to study American practice in Corliss engine building.

First, let me say that I was astonished at the kind manner in which I was received on all hands, and the freedom with which the engineers I met discussed all sorts of details; seldom did I meet anyone who appeared reluctant to exchange views. Now everyone knows that it is impossible for anybody, of whatever business, to examine many productions of contemporary firms without learning something or other, and I must confess to having acquired many useful bits of information. However, it would be little service to mention these, especially to the people from whom they were learned, hence I propose to briefly refer to one or two points of design in which I thought American engine builders might take a hint from our English practice.

Perhaps the most important parts of a steam engine are its cylinders, and there can be no doubt as to the necessity for the construction of these being the best that can be designed, as the failure of a cylinder is a serious matter. It is also often difficult to repair, and, if not properly reparable, the substitution of the cylinder by a new one is usually, in large engines, a work of considerable time. The importance of good design, then, makes it unnecessary to offer an apology for remarking on cylinder design..

I give at Fig. 1 a rough sketch of what seemed to me to be the prevailing general design of Corliss steam cylinders with American builders, while in Fig. 2 I give a section through a cylinder of the standard design of the firm with which I am connected, and I believe this latter may be taken as fairly representative of English practice on large

engines. One great difference between these two designs lies in the fact that the steam connection between each pair of valves is, on the American engine, by means of passages cast on the cylinder, while on the English engine it is by separate pipes of circular section. The arrangement shown at Fig. 1 prevailed in England some years ago, but experience with cracked cylinders owing to the large flat-sided steam chambers has resulted in a preference for the separate pipe connection. Similarly the writer knows of cracked cylinders caused by the differential expansion produced, owing to the chamber connecting the exhaust

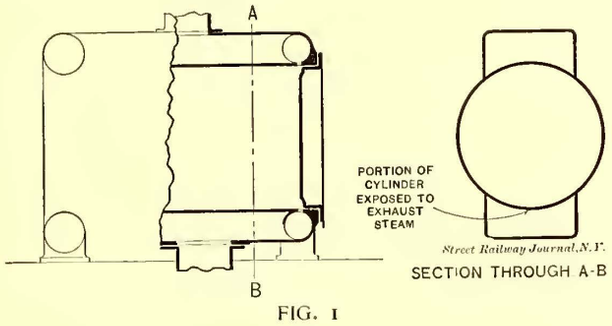


FIG. 1

valves at the opposite ends of the cylinder being cast with the cylinder.

The cast on the exhaust chamber was the first to disappear, and after this the top steam chamber was succeeded by the separate pipe. I quite agree that the top connecting pipe is somewhat unsightly, but appearance must take second place to safety.

Among the different power-houses I visited, I happened to see about half a dozen engines with cylinder covers removed, and therefore had an opportunity of examining the steam ports. Respecting these I noted that in all cases the corners of the ports were quite sharp, instead of well rounded. This may appear a very trifling matter to men-

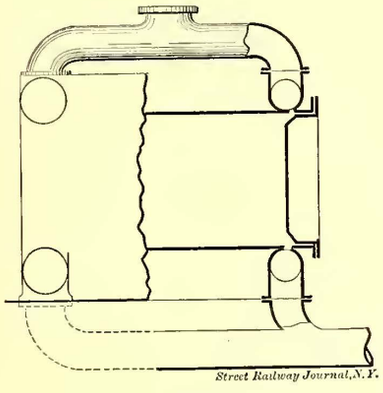


FIG. 2

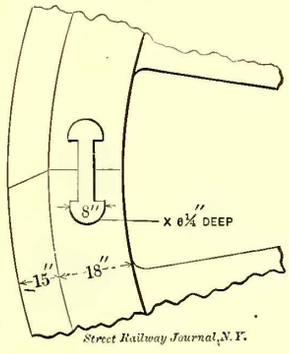


FIG. 4

tion, but I consider it worthy of remark, having known more than one case of cracking of the bars across ports, in consequence of the leaving of sharp corners, through either moulders' or draughtsmen's oversight. A glance at a section through the steam ports of a Corliss engine gives one an idea of the necessity for such bars to be very sound and capable of taking a large pull, also of supporting the metal between the port and the cylinder end.

Leaving cylinders and turning to fly-wheels, I was rather surprised to find how many firms adopt what I believe is called in America the "arrow-head" construction in built-up wheels.

Looking back over English practice, this, or an almost identical construction, will be found to have prevailed many years back, and many fly-wheels of this design can be found on old beam engines. These wheels, however, were found to give trouble at the bolts in the center, more especially if the wheel had teeth on its circumference and geared into a toothed pinion. Withdrawal of the bolts, rimering out of the bolt holes and fitting in of new bolts were not unknown jobs on these wheels. A later development of this wheel had stout radial ribs, and the arms were fitted between these ribs, thus relieving the bolts of much of the shearing stress, but demanding much skill in fitting in the arms. A natural development of this is shown in Fig. 3, where the arms are turned at the end and arranged to drop into bored recesses in the boss, or wheel center. Here none of the driving force is transmitted through bolts, and wheels of this construction have been doing arduous work in England for many years.

Again, in the fly-wheels of many Corliss engines with electrical generators fixed on the crank-shaft I noticed that the sections were joined together at the rim by hoops, or T-head ties, and that in each case these ties were sunk into the body of the rim, thus greatly reducing the net section of cast iron at the rim. In several that I measured,

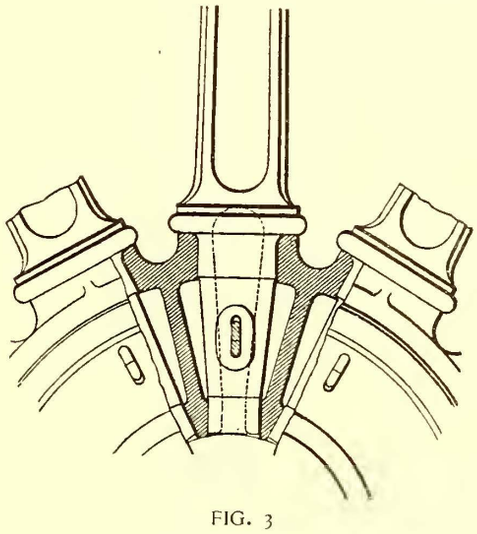


FIG. 3

the section to be torn through in case of bursting of the wheel was only a little over 60 per cent of the normal rim section.

As an instance of this, I give in Fig. 4 a sketch of one, which I measured. Here the normal rim section is 15 ins. x 18 ins., or 270 sq. ins., but across the recess for the head of the shrunk tie it is diminished by 8 ins. x 6¼ ins. on each side, or 100 sq. ins., which is a reduction of rim strength of 37 per cent. Further than this, the joints are made midway between the arms, or at the point of maximum stress.

Another point I noticed with some little surprise was that the governors on many of the Corliss engines were of the old-fashioned, slow-speed type, instead of the more modern high-speed governor with lighter balls and spring centre load, giving greater sensitiveness for the same power and having less inertia.

As already stated, I saw several things to admire, but the object of this letter is rather to draw attention to some items about which experience in England differs from what appears to have been the case in America.

CHARLES DAY.

I believe we can trust the public. I believe there is no antagonism, or ought not to be, between the railway company of a city and the public, and I believe if we do trust them—if we are not so dreadfully afraid they are going to beat us some way, as sometimes the feeling is, if we extend to them the very best accommodations that we possibly can, I believe it will pay.—From address at the Montreal Conventon, 1895.

Recent Improvements in Mechanical Traction for Railways

Upon this subject E. A. Ziffer, civil engineer of Vienna and president of the Bukowinaer Localbahnen, read a very interesting paper before the International Street Railway Association at its tenth annual meeting in Geneva, during August last. The object of the paper, as expressed by Mr. Ziffer, was to rehearse briefly the improvements made during the last two years, since the presentation of his paper on the same subject before the same society in Stockholm in 1896. This paper was published in the Street Railway Journal for January, 1897. A digest of Mr. Ziffer's last paper is given below:

STEAM MOTORS

No special improvements are to be reported in the Brunner, Belpaire, Thomas and Rowan systems.

Rowan System.—The Rowan System is in use on several tramway lines in Berlin, Moscow, Copenhagen, Stockholm, Tours, Lyons and Paris. The cost of operation per car km.. based on a traction resistance of 17.5 kg. per tonne, as given by M. Godfernaux, are as follows:

Coal, 2.98 kg. at fr. 0.04 per kg.	fr.	0.119
Oil and water	"	0.017
Maintenance, material and labor	"	0.110
Wages	"	0.080
Miscellaneous	"	0.920
Total	"	0.346

Serpollet System.—Certain changes have been made in this system so that it is now adapted to trunk line service. The Serpollet motor car, which was built for the Wurtemburg State Railways at the Decauville Works at Corbeil at a cost of fr. 28,060, has seating places for thirty-two passengers and standing places for ten, and is mounted on four wheels. The car carries a supply of water and coal for running 30 km. The cylinder dimensions are 210 mm. x 300 mm. stroke; diameter of wheel, 1 m.; weight of car loaded, 20 tonnes. It operates at a speed of from 35 to 38 km. per hour on a grade of 1 per cent with one trail car, and consumes from 3 to 3.5 kg. of fuel (coal briquettes) per train km. The expenses of operation per train km. are given as follows:

Fuel	pfg.	5.10
Oil and grease	"	1.33
Wages (conductor and motorman)	"	8.83
Total	"	15.26

Sixty motor cars are also in use in Paris on the lines of the General Omnibus Company. The latter company made some tests of the cost of operation of these motors on an average grade of 1.15 per cent, and found that the consumption of water per h.p. hour varied between 1.7 and 2.06 litres. The temperature of the steam was 230 to 240 deg. C. and the consumption of steam per car km. varied between 6 and 7.2 kg. Another car of this type is in use on the Northern Railway of France and for a speed of 24 km. per hour consumes about 7 litres of water and 2 kg. of briquettes. The company proposes to equip its new cars with condensers.

Clark System.—Under this title the author describes the composite car of C. Peter Clark, of the New England Railroad, described and illustrated in the Street Railway Journal for January, 1898.

STORED STEAM LOCOMOTIVES

Lamm-Francq System.—No change has been made in these motors recently. The tramway company of the Department of the North, which operates the lines from Lille to Roubaix and Tourcoing, France, reports the cost of operation for the year 1897 at fr. 0.266 per motor-car km. and fr, 0.204 per car km. The cost of operation of Lamm-Francq locomotives on the St. Germain and Poissy line near Paris, which draws three cars, is fr. 0.420 per train km. and fr. 0.139 per car km.

Dodge System.—The Kinetic motor, as manufactured by the Kinetic Manufacturing Company of New York, possesses all the advantages of the stored steam motor and, while differing in details from the Lamm-Francq motor, is similar in principle, but avoids some of the objections belonging to the latter. The equipment of the car includes a small steam engine with cylinders on each side of the car with boiler for storing hot water, a condenser and a small furnace for maintaining the temperature of the water in the boiler constant. The boiler, which is located under the car, is charged with hot water at a temperature of 380 deg. F., consequently no space useful for carrying passengers is required for the machinery. The condenser is carried on the roof and the car is operated from the front platform. Four wheel cars of this type are in use on the Babylon Street Railway, of Babylon, N. Y., and double truck cars are being built for the Detroit and River St. Clair Railway of Detroit, Mich. The cost of operation is given as 4.3 pfg. per car km. Fuller particulars of this system have appeared in recent issues of this paper.

COMPRESSED AIR MOTORS

The Mekarski System.—The most recent type of Mekarski motors, as employed on the Nogent tramways, have nine reservoirs carried under the car and stored to a pressure of 50 atmospheres. The total weight of the motor car is 14.38 tonnes, divided as follows: Car proper, 10.5 tonnes; air, 180 kg.; water, 200 kg.; 50 passengers, 3.5 tonnes. Such car is capable of drawing two trail cars, and costs between 22,000 and 25,000 fr.

Popp-Conti System.—The most recent motors of this system are in use on the St. Quentin tramway, France; all the machinery is carried under the car. It consists of eight reservoirs, having a capacity of 250 litres each, and stored to a pressure of 25 atmospheres. The motor is placed under the center of the car, and on each side is a reheater by which the air is heated to a temperature of 140 deg. C. before passing into the cylinders. The pressure of air used in the latter is 9 atmospheres. The weight of the motor car with equipment and fifty passengers is 10.8 tonnes.

American Air Power Company's System.—Under this heading the author describes the Hardie and Hoadley-Knight motors as employed in New York and described in the Street Railway Journal for May and August, 1897.

CABLE RAILWAYS

The European railways discussed by Mr. Ziffer are those at Glasgow and Edinburgh, which are referred to only briefly. The cost of the former, which is in a subway composed of two Greathead tunnels, is given at £1,100,000, or about £170,000 per mile. The Edinburgh installation will comprise about 124 km. of track when completed. Other cable railways in operation or in course of construction are those at Montmartre and Ménilmontant in Paris. He notes the tendency in America to change cable to electric railways.

GAS, BENZINE AND PETROLEUM MOTORS

Luhrig System.—The manufacturers of this system are still engaged in endeavoring to remove the objectionable features, which are principally the vibration of the car body during stops, the odor of the oil, the space taken up by the machinery and the cost of maintenance. These, it is thought, will be overcome, and the system has given proofs of some value, notably in experiments carried on in 1897 on the Warmbrunn-Hirschberg line. Motors using benzine are employed to quite an extent in agricultural and other industrial purposes. At Dessau, Germany, one Lührig locomotive equipped with a 10 h.p. motor has run 61,000 km. The consumption of benzine gas is from 500 to 650 litres per car km., and for a 25 to 30 h.p. motor 1000 to 1100 litres per car km. The cost for motive power, viz.: Consumption of fuel, labor and material at repair shops and wages of conductor and motorman, are 14 to 15 pfg. per car km. On the Warmbrunn-Hirschberg line the motor cars are of 30 h.p., and each draws two trail cars. The cost of a locomotive of 20 h.p. is 13,500 marks; of 25 h.p. is 14,500 marks, and of from 30 to 35 h.p. is 15,500 marks. Motor cars of this system have also been put in use in Paris, on the line of the General Omnibus Company. The car is a double-decked one, carrying forty-two passengers, and weighs empty 7 tonnes, and loaded 10 tonnes.

Gasoline Motors.—The only company to use gasoline is the Hoskin Company, which has made some experiments in Dayton, Ohio. The gasoline gas is exploded by an electric battery.

Daimler System.—The Wurtemburg State Railways have been testing this system since 1893 for suburban traffic. The fuel used is benzine, and the latest motor weighs 8.5 tonnes empty, is equipped with 14 h.p. motor, carries thirty-two passengers and has a speed of 25 km. on a level. From twelve months of service, during which the motor ran 30,000 km. without requiring repairs of consequence, the cost of operation was found to be: Material (oil for fuel and lubrication), pfg. 7.57; wages, pfg. 5.64; maintenance, pfg. 2.10; total, pfg. 15.31. The car averaged 88 km. per day and cost 17,000 marks. The Daimler Motor Company is now building a 20 h.p. car, capable of carrying forty passengers, with a speed of 40 km. on a level.

Diesel Motor.—In this motor the fuel, which is petroleum, is injected into a reservoir containing compressed air under pressure of 40 atmospheres and produces an explosion undergoing changes somewhat similar to those of the Carnot cycle. The motor differs from other explosion motors in that it does not require any special apparatus for producing the explosion. This simplifies the con-

struction and the operation is said to be more regular, easy and without jarring. According to M. Diesel, the motor consumes only 215 grammes of petroleum per h.p. hour. No mention is made of the application of the system to any street railway.

ELECTRIC TRACTION BY ACCUMULATORS

Comparatively few changes have been made in the actual status of storage battery traction during the last two years in spite of radical improvements made in the construction of the batteries themselves. These improvements have been mainly in reducing the weight of the battery cells and increasing their output. The weight of the battery, with all accessories, capable of operating a double truck car weighing 12½ tonnes for a distance of 15 to 20 km., is 1.2 tonnes. The experiments so far conducted have not been such as to prove the application of storage batteries to tramway service to be entirely satisfactory, in spite of favorable results secured in certain cities.

In Paris on the Madeleine-Levallois and Neuilly lines thirty-five storage battery cars are in use. The weight of the charged car complete with fifty-two passengers is 14 tonnes, of which the total weight of the batteries themselves is 3.5 tonnes. Each car is equipped with two Brown-Boveri motors of from 15 to 18 kw. each. The batteries are charged quickly, commencing at 490 volts and 150 amps. The time of charging lasts between eight and twelve minutes. For the round trip of 14 km. the current consumption is 20 amp. hours. If the motor car draws a trail car, the consumption is 40 amp. hours. As the capacity of the battery is 54 amp. hours, there then remains a margin of 14 amp. on the return trip. If the car is charged at each end of the line, the drop in the feeder at the further end is 20 volts. Mention should also be made of the Ostende Tramway System, operated by accumulators, installed by the Westinghouse Company. The Ribbe Accumulator, which has been tested on one of the lines in Berlin, also deserves mention. Instead of heavy lead plates, this battery employs very thin sheets of lead, strengthened by ribs made of celluloid, preventing buckling. This accumulator is lighter than the usual type, and the weight of a battery having a capacity of 300 amp. hours, at a pressure of 260 volts, is 3.4 tonnes.

Mr. Ziffer also refers briefly to the experiments on the Chicago and Englewood Railway and storage batteries described in the STREET RAILWAY JOURNAL for December, 1896, and which he says attracted much favorable attention in Europe. Experiments are also being made in Frankfort, and on the Berlin-Charlottenburg Line, which seem to have given stisfactory results.

The Wurtemburg State Railways are making an important test of the value of storage batteries for traction purposes, and have put in operation, on a line 23 km. in length, near Stuttgart, a storage battery car supplied by Actien-Gesellschaft Elektricitäts (vormals O. L. Kummer & Co.), of Dresden-Niedersedlitz, and the Accumulatoren-Fabriks-Actien-Gesellschaft, of Hagen i. W. The maximum grade on this line, which has five intermediate stations, is 10 per cent. The car is of the III class type with seats for forty-eight passengers and is mounted on two double trucks, one equipped with brakes, the other with two electric motors of 35 h.p. each. The battery has 188 cells, type III G. O. 83 and weighs 5.8 tonnes. The battery is charged at 240 volts and discharged at 340 volts, and has a capacity of 16,000 watt hours. In a test made Sept. 19, 1897, with this car, which weighed, with passengers, 28.75 tonnes, the current consumption was from 19.59 to 20.30 watt hours per tonne km., while making an average speed of 30.9 km. per hour, a result not unfavorable. Similar experiments are being carried on in Belgium on the Brussels-Liége Line.

Since March, 1896, two accumulator cars have been in use on one of the narrow (1 m.) gage lines near Darmstadt. The cars carry thirty-two passengers, sixteen seated and sixteen standing, and weigh, without passengers, 8.1 tonnes, of which the battery weighs 2.3 tonnes. The plates are of the Planté type and have a capacity of 30 amp. hours with 420 volts average e.m.f. From April, 1896, up to the present time these cars have made an average of 100 km. per day and the consumption of current has been 400 watts per car km. As up to the spring of 1897 no trouble had been experienced with these cars, the Railway Commissioners decided to install some larger cars which will soon be put in operation.

In May, 1897, two 24.4 tonne motor cars were put in operation on the Ludwigshafen-Neustadt and Ludwigshafen-Worms line. These lines have a length respectively of 30 km. and 22 km., and the weight of the car is divided as follows: Car proper, 11 tonnes; battery, 9.3 tonnes; motors and accessories, 4.1 tonnes. Each car was equipped with two motors furnished by the Electricitäts-Gesellschaft, vorm. Schuckert & Company, of Nuremburg. The battery consists of 124 elements, composed of seven plates each, and have a capacity of 200 amp. hours, and a current output of 150 amps. at an average potential of 225 volts. This charge allows them to make one round trip at an average speed of 25 km. per hour. Each car carries thirty-six passengers and draws one trail car, carrying fifty passengers. The cost of operation, including fuel, wages of conductor and motorman, and oil and waste, is 12.2 pfg. per train km.

An accumulator car equipped with the Pollak type of batteries is in use on the Frankfurt a. M. tramway. The anodes of these batteries are made under the Pollak patent, by means of which the grill and the active material are cast at the same time under pressure. The grill is then of pure lead and the active material of spongy lead. A battery, consisting of eighty-four cells, has a capacity of 120 amp. hours with five hours discharge. It weighs 2 tonnes, and the car empty, excluding the battery, weighs 6 tonnes. The battery is stored in from four to five minutes, and this charge lasts for a short round trip which has a duration of half an hour.

A storage battery locomotive is about to be put in operation on the Munich tramways to draw a trail car or a trolley car within the city where overhead system is not allowed. It has the advantage, of course, that the passengers are not incommoded by the acid vapors, and the cost of maintenance ought to be less than with a motor car.

ELECTRIC TRACTION BY OVERHEAD WIRES

This system is so widely used and so much is known about it, in the writer's opinion, that he did not occupy much time and space in discussing it. As compared with horse traction, experience has shown, he thinks, that the gross receipts increase about 50 per cent and expenses of operation decrease about 30 per cent.

ELECTRIC CONDUIT SYSTEMS

The following statement of the cost of conduit construction, based upon the expenses of the Budapest railways, and officially verified, as compared with the cost of a trolley road using iron poles, are given on the authority of Mr. Hohenegg, and are considered authentic:

	Cost in florins per km. of single track.	
	Underground Conduit.	Trolley.
Material for track	11,470	10,300
Subconstruction, conductors and insulators	11,770	1,000
Conduit	5,900	----
Poles and supports	----	5,060
Labor of installing track	3,000	2,220
Drains and manholes	850	----
Guard telephone protection	----	420
Paving, 2.5 m. wide (material not included)	1,500	1,500
Total	34,490	20,500

The cities in Europe using the underground conduit system are:

PLACE.	SYSTEM.	Length of Line.	Track.
Blackpool	Holroyd-Smith System	3.20	4.10
Budapest	Stadtbahn-Gesellschaft (Siemens & Halske)	----	26.35
Budapest	Strassenbahn-Gesellschaft (S. & H.) 1. In operation	2.36	4.60
	2 In construction	9.75	19.50
Berlin	Electrische-Bahn (Siemens & Halske)	2.20	4.40
Berlin	Grosse Berliner Pferdebahn Gesellschaft (Union Electricitäts-Gesellschaft)	0.876	1.75
Dresden	Deutsche Strassenbahn-Gesellschaft (Klette System) 1. In operation	0.70	1.40
	2. Not in operation	0.70	1.40
Brussels	Brussels Tramway (Union Electricitäts-Gesellschaft)	7.90	----
Carlsruhe	Projected	----	----
Paris	Paris Montmartre(Siemens & Halske) in construction	3.00	----

Klette System.—This system, which is actually in use in Dresden, permits easy reconstruction of a horse car line to an electric conduit line built by utilizing the existing track. This is accomplished by the employment of conduits 9.75 ins. in width and 25.35 ins. in depth which are located between the two tracks, or at the side of a single track line. Moreover, in this system there is easy access to the current conductors without the necessity of removing the paving, since the conduit is covered entirely by iron plates. The conduit is of the ordinary slotted type and drained. At Dresden one pole of the generator is connected to earth and the conduit carries only a single conductor. The apparatus for taking the current is a spring, which, by a special arrangement, enters and leaves the conduit automatically, avoiding in this way switches and crossings, which the cars pass, by momentum. This arrangement also permits an easy change from the overhead to the conduit system, and vice versa. Mr. Klette reports that the length of line, on which his system has been in use since Jan. 16, 1897, has a length of 500 m. of double track. The short circuits which have taken place have been unimportant, and have not interfered with the regular operation of the road. The expense of maintenance of the conduits is about two and one-half times more than that of the overhead system. The construction is being slightly changed by enlarging the conduit and making other alterations.

MIXED ELECTRIC TRAMWAY SYSTEMS

These may be divided into two classes: combination of accumulators and overhead system and combination of conduit and overhead system.

Combination of Accumulators and Overhead System.—This system has been installed during the last two years in several German cities, of which the first was Hanover. The Hanover system was put in operation Jan. 1, 1897, and comprises 21.4 km. overhead conductors and 17.7 km. operated by accumulators. All the cars contain two longitudinal seats, under which are placed 208 accumulators having a weight of 2.6 tonnes, furnished by the Accumulatoren Fabriks-Aktien-Gesellschaft, of Hagen. On the platform is a switch to change the connections of the battery from charging to discharging and vice versa, as well as a regular motor controller. Frederick Ross, upon invitation of the Hanover Tramway Company, made a careful investigation of the cost of operation, and has reported an average expense of 1.31 per car operation, and has reported an average expense of 1.31 pfg. per car km. for maintenance of the batteries, to which should be added a certain sum for interest and amortising fund. Estimating these two at 10 per cent on 5000 marks per car, the figure of 2½ pfg. per car km. is obtained. If to this should be further added the outside expenses of maintenance and loss of power through its conversion in the battery, the additional expense for the operation by accumulators should not exceed 5 pfg. per car km. The total cost of the system it is thought is undoubtedly less than that with the underground conduit. The length of time required to charge the batteries should not be more than thirty minutes to secure a charge sufficient for a run of 20 km., and less than when operating entirely by storage batteries.

According to the report of the Hanover Traction Company for the year 1896, accumulator traction has given satisfaction in all particulars, and the experience secured during that time has been sufficient so that a just appreciation of its value has been secured and some of the inconveniences connected with the system have been removed. The expense of maintenance during the year was minutely determined since, commencing with March 1, 1896, the maintenance of the batteries was in the entire charge of the company. This maintenance has averaged 40 marks per car per month, which corresponds to 0.75 pfg. per car km. in the mixed service. This expense will probably increase a little, but should never exceed 60 marks per car per month, even in those years where it would be necessary to renew the plates. The cost of maintenance of the batteries depends also upon the proportion between the length operated by the overhead system and that operated by the accumulators. Admitting the figures shown by experience, 6 per cent for the amortizing fund for the batteries, and 50,000 to 55,000 km. per year as the distance run by a car, the expense of traction by the accumulators should not be more than 2 pfg. per car km. run more than by the overhead system. But if we take into consideration that the cost of the maintenance of the overhead system is also considerable (it varies from 0.3 to 0.5 pfg. per car km.), and that the apparatus for taking the current is not used while the cars are operating by the accumulators, it is an undoubted fact that the increased cost for accumulator traction in the mixed system in Hanover does not exceed 1 pfg. per car km. run. As for the expense of electric traction, it should be observed that during the first part of 1896, before accumulators were introduced, the records of the company showed that 1 kg. of coal produced 531 watts and a kw. hour cost 5.578 pfg. After the introduction of the mixed system this figure was reduced to 4.903 pfg. and then to 4.5 pfg. during November and December, 1896. According to the last report of the company the mixed system had been applied before the end of the year 1897 to the entire system, having a length of 130.55 km. The cost of maintenance of the accumulator traction amounted, according to the last figures, to 46.18 marks per car month, or 1.22 pfg. per car run. The per cent. of operating expenses to gross receipts was 63.8 per cent as compared with 68.2 in 1896.

In Paris the same system has been established on the line between the Place de la Republique, Pantin and Aubervillers. This line has a length of 14.65 km., of which 7.87 km. are operated by trolley and 6.78 km. by accumulators. The line was opened to traffic in the end of 1897; the rolling stock consisted of thirty-three double-deck motor cars, carrying a total of fifty-six passengers. The batteries are composed of 224 cells, each carrying seven plates, and weigh 3.8 tonnes. The installation was furnished by the French Thomson-Houston Company for the Tramway Company of Paris and the Department of the Seine.

Combination of Underground Conduit and Overhead Trolley System—A system of this kind has been worked out by the Siemens & Halske Company and has given excellent results in Budapest. A 500 volt circuit is used, and the ground return is used on both the overhead and conduit system.

The combination system of traction, as applied in Berlin, Budapest, Dresden and Brussels, works with entire satisfaction. According to the estimate of Mr. Braun, Berlin government engineer, the cost of installation of a mixed system of electric traction by trolley and accumulators ought to be about the same as that with trolley and conduit system. The expense of operation of the first is a little more than half that of the second.

SURFACE CONTACT SYSTEMS

Claret and Vuilleumier System.—A short section of this system has been in operation since June 1, 1896, on one of the lines in Paris. Contact is secured through blocks placed on the street between the rails and so spaced that the car reaches a second before leaving the first. Connection is made from the car through sliding or rolling contacts carried underneath the car floor. The return is made through the rails. The contact blocks are excited only upon the passage of the car. From figures given by the promotors, the cost of installing the system (including the feeders, connections and blocks) amounts to 2,154.70 fr. per km. of single track.

It is also stated that this system will be employed in Zurich. The length of the cars between buffers will be 7.5 m. that of the contact rails, 5 m., and the latter are spaced 2 m. apart. Each group of twenty contact rails is served from one distributing box, so that the latter are located every 66.50 m., when the ordinary distance between the cars is 70 m. The boxes can be located closer together, however, when the cars can operate under a shorter headway. The cars are all equipped with trolley poles so that they can also use the overhead system.

Third Rail System.—This title is generally applied to those systems in which the third rail, from which the current is taken, is always kept alive. The system is applicable only to roads operating over their own right of way, where the rail is inaccessable to persons and animals. Reference is made to the use of the system by the New York, New Haven & Hartford Railroad Company, as described in the Street Railway Journal for June, 1897, to the elevated railways in Chicago, Brooklyn and Liverpool and the underground railways in London. The system will also be tried in Vienna on the Heilingenstadt and Michelbeuern Railway, and on a branch line, 20 km. in length, of the Paris, Lyons & Mediterranean Railroad, extending from Favet to Chamounix.

GENERAL

The system most generally in use in Europe as well as in America is the overhead trolley, which in Europe on Jan. 1, 1898, was employed on 172 lines out of a total of 204 employing electric power. Mr. Godfernaux, in his book "Mechanical Traction for Tramways," gives the following theoretical comparison of the cost of the different systems, including 10 per cent of amortising fund, on the capital invested, and based upon an annual traffic of 1,000,000 car km. The figures are in francs per car km.

System of Traction.	Expenses.		
	Operation.	Amortization.	Total.
Rowan	0.35	0.11	0.46
Serpollet	0.30	0.11	0.41
Gas motor	0.43	0.11	0.54
Compressed air	0.42	0.15	0.57
Electric accumulators	0.34	0.13	0.47
Trolleys	0.31	0.17	0.48

Mr. Schiemann, who has made a thorough study of the operation of electric lines in Germany and Austria, concludes that of the three electric systems (trolley, underground conduit and accumulators) the trolley is the most economical and accumulators next, and the combination of the trolley and underground system is always more satisfactory than the combination of trolley and accumulators.

CONCLUSIONS

Steam motors have been much improved recently in America. They are important factors for branches of steam railways as well as for tramways where the traffic is not sufficiently important and remunerative to warrant the operation of locomotives and complete trains and where the local conditions are prejudicial to an electric system. Among the steam motors, the Serpollet has certain advantages which have resulted in its extended adaptation, particularly in France, but there are nevertheless certain inconveniences attached to the system which the manufacturers are making an effort to overcome, notably the discharge of steam into the atmosphere. One disadvantage which it is impossible to remove is the location of the boiler adjoining the apartment for passengers, who are thus incommoded by smoke fumes, hot air and exhaust steam for the cylinders. If it were not for these points the system would be well applicable not only to suburban tramways but also to short feeders of trunk lines.

The use of fireless, or stored steam, locomotives has not increased sensibly during the last two years. The results from operation by these are not particularly favorable. The system is especially adapted for the suburbs of large cities. The Dodge motor (termed also the Kinetic motor) properly belongs to this class. It is being tried on several lines in America and, as compared with other motors of the same category, presents the advantages of great simplicity of construction and ability to carry in the motor car itself sixty passengers. While the system may be improved, it promises success.

The extension of the compressed air system has made little progress in Europe during the last two years, although it has certain conspicuous advantages. On the other hand this system is being considered favorably in America, and an effort is being made to test its value on a considerable scale. The use of compressed air motors would be preferable to steam motors if they could be run as economically.

The cable system should not be considered as entirely abandoned; on the contrary it has been tried with success in England recently, in spite of the high cost of installation, rapid wear of the cable and loss of power through friction. The system has the advantage of enormous capacity and low operating cost when traffic is extremely heavy.

Gas, benzine and petroleum motors have been improved considerably during the last few years, and the recent gas locomotives merit particular attention because with a greater tractive power they are more economical than gas motor cars. This system would be especially suitable for the operation of tramways in small towns as well as for long lines with light traffic, since the installation is simple and not expensive and fuel is easily obtainable. It has not yet been possible to avoid entirely the disagreeable shaking of the cars and the penetration of the gas odors into the passenger compartment. The gasoline motor is still in the experimental stage. Benzine motors have been perfected to a greater extent, but their use on the Wurtemburg State Railways for suburban traffic has not been for a sufficient length of time to determine their practical utility.

Accumulator traction, which might be considered the ideal, is still in the experimental stage, in spite of the good results already obtained. It continues to be a subject of great interest, and has a hopeful future.

The trolley system is the most widely adopted, the most economical, and its status has been most clearly determined. It is mechanically and electrically correct in principles, and from a commercial standpoint has an economy which can never be surpassed by accumulator. The æsthetic objections to its installation are not as great as they were, because the general public is becoming accustomed slowly to the changes which the system effects in the appearance of the streets.

The underground conduit system has made many advances and secured many advocates who believe that it has a field, in spite of its high cost of installation and maintenance.

The mixed system by accumulators and trolley has been adopted in a number of places, and is interesting from a technical and financial standpoint wherever rights to install a trolley wire can be secured.

The mixed trolley and underground conduit system has less to recommend it than the mixed trolley and accumulator system, since the advantages of the underground conduit do not sufficiently compensate for its disadvantages. However, the data as to its use are rather meager. Again, it must not be forgotten that the later introduction on these roads of trolley, accumulator or other cars would render useless the conduit, and, consequently, the cost of its installation would be lost.

The surface contact electric system presents serious difficulties in the way of keeping the contact blocks free from moisture or other short circuiting agents which might prevent successful operation. The progress made in this department, however, gives hope that the system has a certain future.

The third rail system is the least expensive to install of any, and where a railway operates over its own right of way, and particularly for elevated and underground railroads, it has given excellent results in practice, and upon such roads the system will have a wide application.

To say which among all the mechanical systems of traction is the most desirable from an engineering and economical standpoint is of course a very difficult thing to do, as can be easily seen, and the writer states that he would consider himself extremely presumptuous to endeavor to give definite conclusions as to which should be installed in every case. It is necessary to take up each condition individually and weigh carefully all the relative circumstances in construction and operation. When all is said, however, it is undoubtedly true, he concludes, that the overhead trolley system is the one most generally adopted not only in Europe but America, and it is the most simple, the most economical and the one which has given in practice the best results up to the present time.

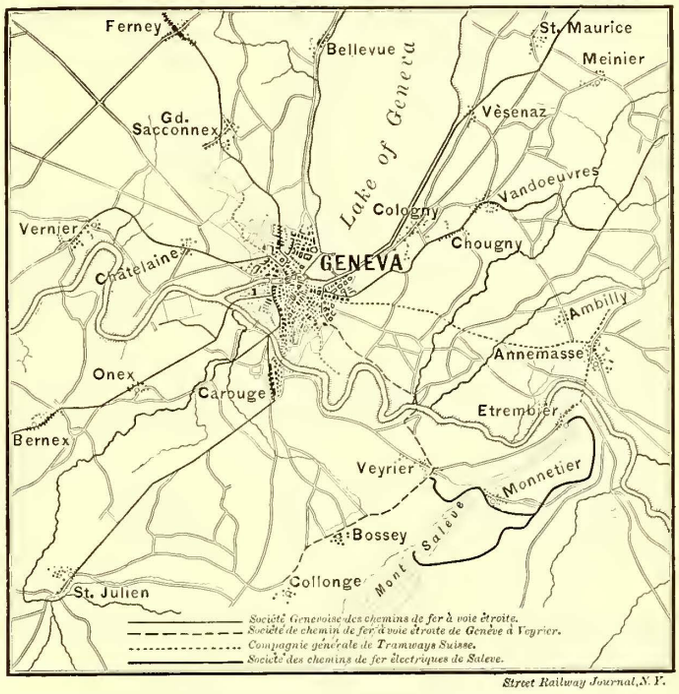
Tenth Convention of the International Street Railway Association

BY E. A. ZIFFER

The International Street Railway Association, which was founded in the year 1886, is composed of 388 members, of whom 148 are street railway and interurban railway companies; 181 are individuals, and 59 firms interested in the tramway industry. The tenth convention of this association was held Aug. 24-27 in Geneva, Switzerland. This meeting was attended by eighty-two members of the association, who came from Belgium, the various German States, England, France, Italy, Holland, Russia, Sweden, and Norway, as well as Switzerland.

The headquarters of the association were at the hall of the Geneva Literary Society.

Geneva is located on the Lake of Geneva, at the source of the Rhône, and is 375 meters above the sea. It contains, with its



GENEVA AND ITS RAILWAYS

suburbs, 78,482 inhabitants. It is the third largest city in Switzerland; has a metropolitan character, and is noted for its fine and healthful climate. It possesses many industries, and its inhabitants are prosperous.

The railway system of Geneva and its environs is shown in the accompanying map, and is comprised of four different interurban and tramway companies, to wit.:

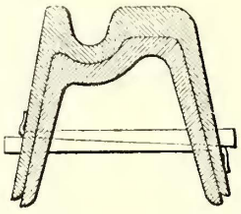
1. The Société Genevoise des chemins de fer à voie étroite. This is a steam line, construction on which was begun in 1889 and finished in 1891. It is 74 km. in length, and has a gage of 1 m. The track in the city is laid with 32-kg. Demerbe groove rails laid in cement, as shown herewith, and that in the suburbs with 20-kg. T rails. The rolling stock includes twenty-two six-wheel, 16-tonne locomotives of 75 h.p., each capable of drawing four cars of 28 tonnes weight. The company proposes to equip a section of 6 km. of its system with electric power.

2. Société de chemin de fer a voie étroite de Genève à Veyrier. This is a second steam railway, built in 1887, with a length of 6 km. and gage of 1 m. The rolling stock is similar to that mentioned above.

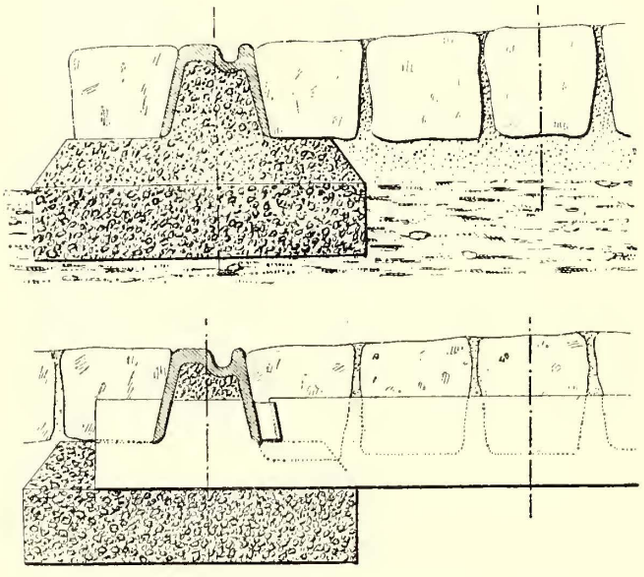
3. Compagnie générale de tramways Suisse. This tramway system, which was described in the STREET RAILWAY JOURNAL for February, 1897, operates 13 km. of track. It has been entirely equipped with electrical power since April, 1896, with the exception of a short line to Annemas, which is operated by steam. Power is taken from a water-power station driven from the Rhône River and located at Coulouvenière. The rolling stock consists of cars for forty passengers each, equipped with 30-h.p. motors, and each capable of drawing one trail car. The power station contains two generators of the Thury type, built by the Compagnie de l'Industrie Electrique of Geneva, and are direct connected to a 250-h.p. turbine.

4. Les chemins de fer électriques du Salève. This was the first mountain electric railway operated by rack and pinion. It is 9.1 km. in length and 1 m. in gage. A description of it will be given later.

On Aug. 24 the delegates met and made their first excursion. This was across Lake Geneva by boat to Montreux, where a collation was served. An excursion was made on the Vevey-Montreux-Chillon Electric Railway. This line has a length of 11 km. and a gage of 1 m., and connects with the interesting mountain cog railway to Territet. The Vevey-Chillon line is one



SECTION AT JOINT OF DEMERBE RAIL, GENEVA



SECTIONS AT AND BETWEEN TIE RODS, GENEVA

of the oldest electric railways, having been built by the Siemens & Halske Company some ten years ago. As will be remembered, it employs slotted conductors, with interior contact shoes and two conductors, one for the outgoing and one for the return circuit. The power station contains both railway and lighting generators. The cars are of the double-deck type. The section to Montreux is a single-track cog-rail system, with a gage of 1 m., is also operated by the overhead trolley system, and is especially noteworthy since there is a grade of 15 per cent. The cars have four compartments, and accommodate over eighteen seated and twelve standing passengers. The road from Territet to Rochers de Vaye is made up of two systems; first, a 690 m., long double-track cable road with a maximum grade of 57 per cent. The cars contain water compartments, which are filled at the top of the incline and emptied at the base, so work by gravity, the speed being regulated by brakes. The water tanks are carried on the trucks. Two cars are employed, connected by a cable, so that one descends while the other ascends. Safety is secured by the installation, also of a rack extending the entire length of the line, to which the cars are connected by cog wheels. Connecting with this railway at its summit is an Abt steam rack railway 7.68 km. in length. The car is mounted on double trucks, and carries forty-eight seated passengers and eight standing passengers. The maximum grade is 22 per cent.

On Aug. 25, at 9.30 A. M., the first regular meeting of the association was held. The proceedings were conducted in both the German and French languages. The hall in which the meetings were held contained also drawings and models showing the construction of the Geneva tramway, as well as other types of construction. Near the entrances to the hall were placed on exhibition different pamphlets descriptive of Geneva and an album exhibited by the J. G. Brill Company, of Philadelphia, showing the different types of tramway cars built by it.

The vice-president of the association, Johannes Röhl, manager of the Strasseneisenbahn-Gesellschaft in Hamburg, called the meeting to order and introduced to the delegates Henri Fazy, who, he announced, would extend a welcome to delegates in behalf of the Canton of Geneva.

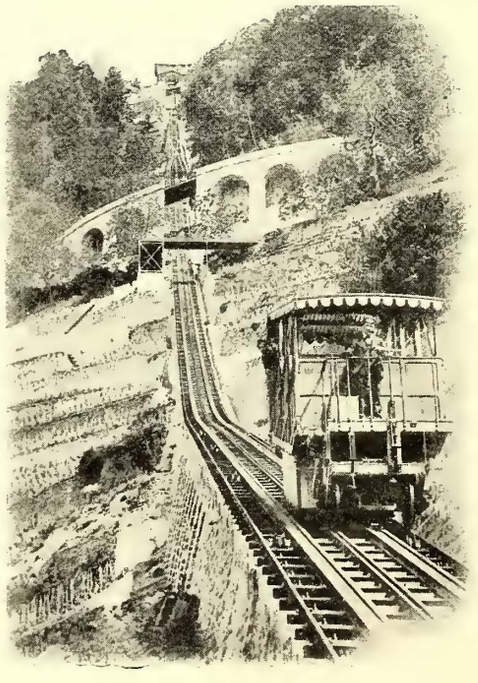
Staatrath Fazy, who is at the head of the department of justice of the Canton and Republic of Geneva, then made an interesting address, in which he welcomed the delegates to the city in the name of the State and city. He spoke of the interesting social changes affected by the development of the electric tramway system, and hoped that their deliberations would result in mutual benefit.

Vice-President Röhl responded to this address in a fitting way, after which the regular business of the meeting was commenced.

The first subject taken up was the report of the general secretary of the association, F. Nonnenberg, chief engineer of the Compagnie Générale des Chemins de Fer Secondaires of Brussels, on the condition of the association. He reported the various expenses amounted to 21,800 fr., leaving the balance for 1899 of 19,000 fr. The annual report was accepted. The next subject taken up was the rendering by the secretary of accounts for the year 1896-1897. According to this report, the receipts, including the balance from 1895, amounted to 36,500 fr., the expenses were 20,400 fr. The acceptance of this report completed the business part of the meeting. Vice-President Röhl then requested the chairman of the Geneva local committee, I. Rehfous, manager of the Compagnie Générale des Tramways Suisse, to take charge of the proceedings. The latter, however, declined, but stated that he followed with great interest all the questions to be discussed by the association.

The first question then taken up was "What are the proper dimensions to be accorded car bodies and platforms in electric cars in trolley, underground conduit and accumulator traction?" In the absence of Mr. Peiser, chief engineer of the Grosse Berlinger Strassenbahn, E. de Pirch, director of the Barmen-Elberfeld Strassenbahn, read the report on the subject, giving the results obtained from an investigation of the subject conducted by Mr. Peiser. Mr. Peiser reported that some tramway companies recommended that each platform be made half the length of the car body; others that they should not be over three-tenths the length of the body, e.g. for a car body length of 5 m., the platforms should be 1.5 m. long.

A discussion followed, in which the following took part: Theodor Krüger, of the Hanover Strassenbahn; J. Röhl, C. Thonet, chief engineer of the Compagnie Générale Francaise de Tram-



TERRITET CABLE INCLINE RAILWAY

way, of Paris; G. Soberski, engineer of the Elektricitäts Actien Gesellschaft in Nuremburg, F. Nonnenberg, L. Janssen, general manager of the Brussels Tramways. The opinions regarding the proper car types differed very much, and the result of this discussion was that a solution must be found according to the local conditions and the kind of operation.

Mr. Röhl stated that he thought that a clear determination had not been reached on this matter, and recommended that the discussion on the subject be continued at the next annual meeting of the association, and further that information would be secured from the other members of the association as to what their experience had been on the subject.

The next subject brought up for discussion was "What are the advantages and what the disadvantages of using double-truck passenger or freight cars in local railway operation? How can a reduction of the net weight of the rolling stock be made with an increase at the same time in carrying capacity? Do you use cars with radial axles, and what results have you obtained with this kind of rolling stock? Give description and drawing of the systems used." The report on this subject was to have been rendered by M. Dumonceau, chief engineer of motive power of the Société Générale des Chemins de Fer Economiques of Brussels. In his absence, Jules Kessels, director of the same company, gave the conclusions reached by M. Dumonceau, and described the system of radial truck cars employed on his road. This is the de Richter system, and gives sufficient liberty of lateral movement to the axles to permit them to assume radial positions when passing around curves.

The paper was followed by an interesting discussion, in which the following took part: Messrs. Krüger, Röhl, Soberski, Nonenberg, Graziadel, of Rome; A. Trautweyler, of Strassburg; de Burlet, of the Société Nationale des Chemins de Fer Vicineaux, and Leon Moreau, civil engineer of Brussels.

The general conclusion reached by the association on this subject was that from the reports given the use of radial axles have important advantages under certain conditions of traction. Without expressing an opinion as to the practical effect of the use of these axles, it is undoubted that their merits should be carefully considered.

The next report, which was that on the subject of brakes, was rendered by H. Fromm, the manager of the Deutsche Gasbahn Gesellschaft at Dessau, and resulted in an interesting discussion, in which Messrs. Krüger, Thonet, Nonnenberg, Janssen, Trautweyler, de Burlet, Soberski, Röhl, Clauss, of the Dresdener Strassenbahn, Kessels, de Perch and Blauel, manager of Gbr. Hofmann & Company, car builders, of Breslau, took part. The general conclusions of the discussion were as follows:

1. For horse cars, the ordinary hand brakes are sufficient.

2 *a*. For electric operation, with only one car, two brakes are desirable, of which a hand brake (with crank handle, lever or hand wheel) is necessary, while a mechanical brake (electrical, magnetic or air) is desirable. The electric brake is to be commended in most cases on account of its simplicity and safety, and is desirable as a brake for general use. On steep grades (viz.: 10 per cent or above), the use of a third system of braking, either a track brake or some type of road-bed brake, such as a screw-fork or road-bed shoe, is very advisable, although up to the present there does not seem to be any uniform or standard brake adopted for this work, as indicating the most suitable system to employ.

2 *b*. For electric traction in trains on steep grades a positive power system of braking, either electric or air, for simultaneous operation on all the cars, is necessary.

3. For steam tramway service, where high speeds are maintained, automatic power brakes, operating the shoes on all the cars, are to be recommended.

This finished the programme for the day.

After lunch the delegates visited the water-power plants of the City of Geneva at Coulouvrenière and Chèvres. The former utilizes the water power of the Rhône River for pumping, lighting and tramway purposes. Here are installed twenty sets of pumps and turbines. These are of from 210 to 400 h.p., operate at at 26 to 33 r.p.m., and each is directly connected to a set of horizontal pumps. In addition to the equipment described, the station contains a hydro-electric power set of 1000 h.p. and 544 r.p.m. The motor is of the asynchronous type, and operates at 2500 volts. For tramway service there are two sets of turbines and generators of 225 h.p., 360 r.p.m., 250 amps. and 560 volts, and three rotary transformers of 150 kw. and 345 r.p.m. For lighting, there are also two alternating dynamos of 225 h.p., of the single-phase, alternating type, and distributing current at 2500 volts.

The entire station at Chèvres will be completed in 1899, and will supply a two-phase alternating current for lighting and power, and it will contain three sets of turbines and generators of 150 h.p. each, and fifteen sets of 1200 h.p. each. The head of water is 4.5 m. in summer and 8 m. in winter, and the power capacity of the fall is between 9600 and 18,000 h.p. At present there are two sets of direct-current turbines and generators of 150 r.p.m., and five sets of alternating of 80 r.p.m.

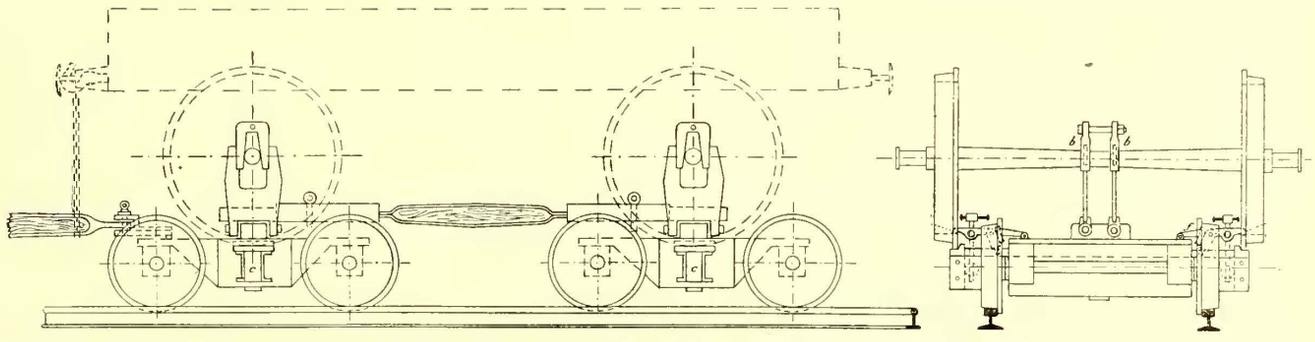
On the return from Chèvres, an inspection was made at the Geneva Railroad station of a dummy truck for carrying railroad cars over a railroad of different gage. It was stated that a car of standard gage could be loaded on this narrow-gage truck in two minutes, and taken down in five minutes. The construction of the truck is shown in the accompanying engraving.

In the evening a reception was tendered to the delegates at the Eynard Palace.

SECOND DAY'S PROCEEDINGS

The second regular meeting of the association was held Aug. 26, and the chair was occupied by T. Laval, chief engineer of the Compagnie Générale des Tramways Suisses. The first subject to be discussed was "What are the proper sizes of boilers and engines to be installed in a tramway power station?"

In the absence of Mr. van Vloten, electrical engineer, to whom this report had been assigned, a paper on this subject was presented by E. d'Hoop, superintendent of the Brussels Tramways. Mr. d'Hoop stated that in small stations, by which he meant those



TRUCK FOR CARRYING STANDARD GAGE CARS ON NARROW GAGE RAILWAYS.

of 560 h.p. or less, where future extensions of any considerable amount are not planned, the proper unit to select is half the power generated under normal conditions, and the station should be supplied with three of these units, one of which should be kept in reserve. If important extensions are planned for the immediate future, is it well to select larger units in equipping the station in the first place, and to choose for this purpose a unit which will answer all the normal demands for power, installing, consequently only two such units, one of which would act as reserve. Under certain conditions, however, if it is thought that the future extensions will not be considerable, it is better to install at the beginning either two or three units in the power station, as previously prescribed, and then use a storage battery if more power is required to overcome the peaks of the future load. Finally, it is often of advantage, in any case, to employ a storage battery for reducing the cost of installation. In medium-size plants, viz., those from 600 h.p. to 1200 h.p., where it is thought that the capacity of the station will not have soon to be increased to provide for increased traffic, the writer believes three units should be installed, as before, each capable of carrying half the normal load, so as to keep two in operation and one in reserve. Where important extions are expected, the author still recommends the division into three units already given, but the installation of two units, each capable of carrying the entire load, may also be made. For this power station the installation of accumulators as station auxiliaries is of no very great value, as the load on the generator is equalized by the large number of cars in service. In large power stations, viz., those from 1200 h.p. to 2400 h.p., the writer recommends the use of two units, each capable of carrying half the load, and as a reserve, two other units, each with half the capacity of the larger engines. For very large power stations, viz., those of over 2400 h.p., it is impossible to lay down any regular rule, but an arrangement similar to that already mentioned is often desirable.

In the discussion which followed the following gentlemen took part: Messrs. d'Hoop, Fromm, Krüger, Thonet, and Nonnenberg. In general, they coincided with the report, but laid great

stress on the fact that the cost of current generation, the fact whether the station was condensing or non-condensing, and the current-distribution system, were also important factors in deciding the question. It was then decided that the subject be continued at the next general meeting.

The next subject on the programme was "What is the best method of bonding the track?" A paper on this subject was read by Mr. Thonet, and in the discussion which followed Messrs. Röhl, Krüger, Trautweyler, Hue, and Géron took part. The chief rail bonds discussed by Mr. Thonet were the Chicago and Atkinson, whose advantages consist in their cheapness and low electrical resistance. The Falk system of cast welded joint was also referred to, and some interesting facts were brought out as to the use of the latter in Lyons on the Lyons-Oullins Railway. The latter has a trolley line, and the managers made some tests recently to determine the resistance for 1 km. of single track, connected with different systems of bonding. The weight of the rails, which were of the Marsillon duplex type, were 18 kg. per m. each (72 kg. per m. of single track), and the electrical resistance without joints for 1 km. of single track was figured at 0.019 ohms; with joints and one channel-pin connection the resistance was 0.03245 ohms, and with two channel-pin connections, 0.02665 ohms; when joints were made of two Chicago rail bonds the measured resistance was 0.0216 ohms, and when with the Falk joint, the resistance was 0.0189 ohms. T. S. Edstrom, of the Zurich Strassenbahn Railway, explained by means of models the Bryant rail bond, which has been in use for five years in Pittsburgh. The bond has also been employed for a section of track 10 km. in length in Zurich, and has given the best of satisfaction.

The conclusions reached by the speakers on Mr. Thonet's report were as follows: The Chicago rail bond and bonds of a similar character are those generally employed; the Crown type of rail bond, which is located between the web of the rail and the angle plate, seems to be more preferable for new construction; a section of 100 sq. mm. seems to be ample for the cross section of the bond, and finally, the Falk cast welded joint makes an excellent electrical bond and strong joint support.

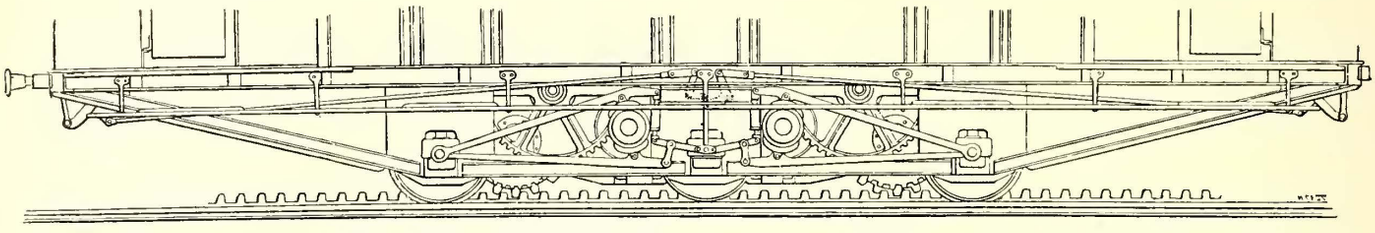
The next subject discussed by the convention was that of "What kind of switches are in use, and what are the most satisfactory?" The report was rendered by the secretary of the association, Mr. Nonnenberg, and in the debate on the subject, Messrs. Krüger, Trautweyler, Thonet, Pétregin, of Lyons, and Vrancken, of the Athens Tramway Company, took part. The resolution passed as a result of this paper, and discussion was: "The proceedings have shown that the general practice is toward the use of rail steel in switches, and that for mechanical traction, switches with two movable points are preferable to those with one moveable point."

After the meeting, the delegates took a trip on the steam tramway to Etrembière, and from there, by means of a rack-and-pinion railway, up to the Treize Arbres, a plateau about 1171 m. above the sea, where a beautiful view was obtained of the Mont Blanc group, the Arve Valley, Lake Geneva, the Rhône Valley and the City of Geneva. Lunch was served here, and the return trip was made by means of the mountain railway to Veyrier, and thence to Geneva by the narrow-gage Geneva-Veyrier Railway.

The rack-and-pinion railway to Mount Salève was extremely interesting, as electricity is used as a motive power, and the grades reach as high as 25 per cent. The length of the line is 9.1 km.; it has a gage of 1 m., and the smallest curve radius is 50 m. The track construction consists of Vignole rails, weighing 15.3 kg. per m. They are bolted at intervals of 0.9 m. to iron ties, 1.75 m. in length and 25 kg. in weight. Instead of overhead conductors, a third rail is used, carried on the ties at the side. The third rail is an inverted Vignole rail of the same section as that used for the car wheels, the contact shoe of the car sliding on the top of the base of the rail.

Midway between the two service rails is an Abt rack, which has a height of 50 mm., and is bolted to the ties. The track construction, with conductors and two rack rails, weighs 117.5 kg. per m., and with one rack rail, 106 kg. per m. The power at station is 1800 m. from the railway, and is on the Arve River, near Arthaz. It contains two sets of machines, consisting of turbine with vertical shaft operating under a height of fall of from 2.7 to 3.3 m. directly connected to the generators. The latter are of the Thury multipolar type, and under normal conditions develop 1000 h.p. at 180 r.p.m. The rolling stock consists of twelve six-wheel motor cars with platforms at both ends, and measure 8.51 m. between buffers. Each contains seats for thirty-two passengers, and standing places for eight additional passengers, and are equipped with two Thury electric motors of 20 h.p. each. The cars are also fitted with electric heaters. The motor cars, when loaded, have a weight of about 14 tonnes, of which the car body and truck weighs 4.4 tonnes and the motor and gearing, 6 tonnes.

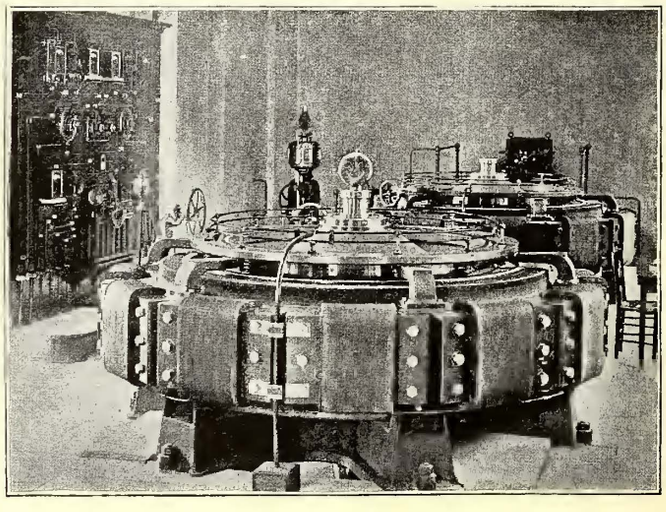
Besides the electrical brake, which is operated by making the motors operate as generators in descending, there are on each car two strong mechanical hand brakes, which work against special braking drums. The equipment was supplied by the Compagnie de l'Industrie Electrique in Geneva. Some of the details of the road are given in the accompanying engraving.



SYSTEM OF GEARING EMPLOYED ON MT. SALEVE RAILWAY

THIRD DAY'S PROCEEDINGS

The third and last meeting of the association was held on Aug. 27, and commenced with the reading of a report on the following subject: "The status of the storage battery in electric railway operation, its efficiency, cost of maintenance, economy and practical value." In the absence of Mr. van Loenen-Martinet, engineer of the Netherlands Railways, to whom a paper on this subject had been assigned, Dr. T. Otten, manager of the Batavia elektrischer tramway Gesellschaft, spoke on the subject. A discussion followed, in which the following took part: Messrs. Krüger, Röhl, d'Hoop, Clauss, Géron, Janssen, Saborski, Thonet and van Hagen, representative of the Accumulatoren Fabriks Gesellschaft, of Berlin. Mr. Krüger gave a very interesting and instructive report on the use of storage batteries on the cars of the Hanover street railway. These batteries were installed by the Accumulatoren Fabriks-Actien Gesellschaft, of Berlin (formerly of Hagen, i. W.), and are of the Tudor type. These are located under the seats of the car, and consist of 202 cells, with a capacity for 25 amp. hours at 25-amps. discharge. Each cell is composed of positive Planté plate, with a surface of 85 sq. cm., and on each side of the positive plate is a negative plate with 300 grammes of active material, each. The complete battery weighs from 2 to 2.5 tonnes, according to use of the plates The average cost of maintenance and renewal of batteries from Aug. 1, 1896, to Aug. 1, 1898, in spite of unfavorable conditions, amounted to only 2.093 pfg. per motor-car km.; the average life of the batteries was 37,700 motor-car km.; the average power consumption per tonne was 70 watt hours, and the cost of the power, without amortizing charge, was 5 pfg. per kw. hour. The author further stated that the mixed system is employed in Hanover, was considered successful,



POWER STATION AT ARTHAZ

and that during the two years ending Aug. 1, 1898, 4,296,442 motor-car km. were run on the accumulator section. Upon this basis the figure of 2.093 pfg. for battery maintenance per car km. is based. If the total distance run on the mixed system (8,166,888 km.) be taken as a divisor, the cost is reduced to 1.109 pfg. Mr. Krüger stated that with the accumulator system the "diseases of children" had been overcome, and during the course of the next year they expected to lower the cost of maintenance of their batteries. They would do this by pasting and forming the necessary plates themselves, making the acid, utilizing the old material by melting it down and recasting it, and finally, that traction by storage batteries would cost only ½ pfg. more than the overhead system. These remarks were favorably received, and a resolution of thanks was offered Mr. Krüger. Mr. Clauss, of Dresden, remarked that of two evils it was better to choose the least, and then stated that in Dresden his company had been obliged to give up the conduit system on account of the troubles and complications at switches and curves; that accumulators did not show this disadvantage, but that in Dresden their cost was twice that found in Hanover, namely, was 4 pfg.

In the discussion which followed it seemed to be brought out that electric accumulator traction has not made much progress during the past year. The conclusion finally reached was that this method of traction had not advanced yet far enough to admit of a full critical examination, and it was therefore resolved to place the subject on the programme for next meeting.

The next subject brought up for discussion was "What advantages and what disadvantages have been found in practice in the different systems of electric operation?" The report on this subject was rendered by E. Á. Ziffer, civil engineer and president of the Bukowinaer Lokalbahn. Mr. Ziffer presented some information and results secured in directions outside the reach of the association, and gave as well some quotations from technical works and periodicals to be used as a basis for further study. He stated that a remarkable development had taken place in electric railroading in the United States from 1890 to 1897, in which time the total number of electric lines had reached the number of 953, and the total mileage, 25,149 km. The total length of electric railways in Europe in 1897 was 1459 km., and this had increased during the present year to 2289 km., or 57 per cent. The total number of electric cars had increased from 3095 to 4514, or 58 per cent. The greatest development has occurred in Germany, which possessed 1138 km., or about 50 per cent of all the electric track in Europe. After Germany came France, with 397 km. and 664 cars; Great Britain and Ireland, with 157 km. and 252 cars; Switzerland, with 146 km. and 237 cars; Italy, with 133 km. and 311 cars; Austria-Hungary, with 106 km. and 243 cars; Belgium, with 69 km. and 107 cars; Spain, with 61 km. and 50 cars; Russia, with 31 km. and 65 cars; Sweden and Norway, with 24 km. and 43 cars; Servia, with 10 km. and 11 cars; Roumania, with 6 km. and 15 cars; Holland, with 3 km. and 14 cars, and Portugal, with 3 km. and 3 cars. The report of the advantages and disadvantages of the different systems included a discussion of traction by accumulators, overhead wires, conduits and mixed systems and surface conduit systems. The general conclusions reached by Mr. Ziffer were as follows:

1. Accumulator traction seems to have improved, as some manufacturers have succeeded in producing lighter and more durable batteries. The system may have a future on account of the independence of the cars from each other; from the fact that no street structure is required, and because there is no interference with telegraph or telephone wires or trouble with return circuits. The station required is not so expensive as with a system of direct supply. The disadvantages are the weight of the car, the depreciation of the accumulators, and the greater cost of maintenance. Further experience with the system may throw more light on the subject.

2. The overhead trolley system has received the widest adoption; is the most economical, and has been the longest tested. Æsthetic objections to the use of overhead wires, danger to street traffic and electrolytic troubles in subterranean gas and water pipes are mostly exaggerated, and can probably be entirely prevented by suitable measures. The use of storage batteries as station accumulators is somewhat expensive, but of great advantage in equalizing the load line. Opinions differ in regard to the relative advantages of the trolley and the sliding-arch system of contact. The latter is less apt to slip from the wire, but its wear is said to be greater than with the trolley wheel. Other systems of contact have not been tried sufficiently to give a definite opinion.

3. The conduit system does not affect the appearance of the streets, but has a high cost of installation, and the conduit is difficult to keep clean and drained.

4 *a*. The mixed system of trolley and accumulators, whose installation is made with the object of avoiding overhead wires in crowded city districts, is giving satisfactory results, but is of advantage only where the length of line operated by accumulators is greater than that operated by the trolley.

4 *b*. The mixed system of conduit and trolley is superior to that just mentioned so far as operating expenses are concerned. The cost of installing the conduit, however, is considerable, and is lost in case of change to any other method of traction. For short connecting sections between trolley lines it is better to employ the conduit than accumulators.

5. Surface contact systems with sectional conductors. This system has the æsthetic advantages of the conduit in preserving the appearance of the street, and lower first cost. There is difficulty, however, in protecting the system against leakage, and keeping the apparatus and contacts in good condition. The installations of this system so far made have been merely experimental.

6. The third-rail system is cheaper than any other, but can only be employed by railways operating over their own right-of-way, and is particularly adapted to elevated and underground roads. It is satisfactory, but there are very large losses through leakage.

7. The alternating-current system constitutes an important innovation in the electric traction field, and will extend the application of polyphase currents. It will be used especially in the future in connection with lighting and power distribution, with two-phase and three-phase currents, from large power stations, and will also have a field for small roads near large cities, lying within the limits of profitable three-phase distribution from existing stations in those cities, but outside the economical limits of direct-current distribution from such stations.

8. The monophase alternating-current system is also an innovation which merits particular attention, as the monophase alternating motor has all of the advantages of the inductive motors as regards simplicity and capacity for regulating. Monophase alternating motors seem now to be built capable of starting any load. The future will throw more light on the practical value of this system.

Mr. Ziffer then referred to a system which was not mentioned in his report, but which he thought should be mentioned, and this was the Thury constant-current series system of power transmission. The generators are connected in series, and the motors for utilizing the power are also operated in series. Mr. Ziffer then read a communication from Emil Gerard, Government Railway Commissioner at Brussels, which discussed the Dickinson side-contact system. This, Mr. Gerard said, avoids some of the objection to the ordinary overhead system. In England the Dickinson system has been in use since 1892, and is installed on twelve tramway lines of 240 km. in length. It is also used in France on seven lines, in Germany on two lines, in Austria-Hungary on two lines, on two lines in Belgium, and on one line each in Spain, Italy and Algiers. Mr. Gerard laid stress on the fact that each innovation had found opposition at first, and has had difficulties to overcome. The road with which he was connected in Brussels had been a good school, and had finally resulted in an excellent service on account of the experiences passed through. He then discussed the question of cost, and ended by saying that it might be expected that the Dickinson system in the mixed system, viz., accumulator and overhead system, which had given good results at Hanover, would also answer to the requirements of most city communities.

At the end of his report, Mr. Ziffer referred to the Burgdorf-Thun Railway, of Switzerland, 40 km. in length, and gave a brief description of it. He also mentioned that he would not ask that the conclusions given in his paper be made a resolution of the association, but hoped that his report would be considered a small contribution to the valuable data which the association has secured so abundantly during the past twelve years.

Referring to the information contained in Mr. Gerard's paper communication on the good results secured by the Dickinson system, Messrs. de Burlet, Jannsen and Thonet stated that according to their experiences the Dickinson system did not show the advantages which Mr. Gerard had claimed for it.

The next subject was "Recent communications on the use of mechanical motors for tramways." An extended abstract of this paper, which was read by E. A. Ziffer, is given elsewhere in this issue. The association thanked the author for his instructive report, and requested the delegates present to continue their studies on this subject.

The next subject on the programme was the presentation of the budget for 1898-1899. According to this the receipts were estimated at 29,000 fr., and with the balance for 1897, this sum will make a credit balance of 48,000 fr. The expenses are estimated at 24,000 fr., so that it is estimated that there will be a balance for the year 1900 of 24,000 fr. The statement was accepted.

The next subject on the programme was the election of three members for the executive committee to take the place of the positions made vacant by the expiration of the terms of office of

Messrs. Röhl, Kessels and Nonnenberg, and for the place made vacant by the resignation of Mr. Favcraux. The first three were then re-elected by acclamation, and Mr. Broca was elected for the fourth place. The executive committee will then consist of the following members: G. A. Broca, technical and operating manager, Tramways de Paris et du Département de la Seine of Paris; H. Géron, manager, Kölnische Strassenbahn Gesellschaft of Cologne; Léon Jannsen, general manager and director, Tramways Bruellois of Brussels; Jules Kessels, manager Société Générale des Chemins de Fer Economiques of Brussels; Mr. Köhler, manager, Grosse Berliner Pferde-Eisenbahn-Gesellschaft of Berlin; F. Nonnenberg, chief engineer, Compagnie Générale des Chemins de Fer Secondaires, and manager of several tramway companies in Brussels; H. K. Schadd, manager, Amsterdamische Omnibus Maatschappij of Amsterdam; E. A. Ziffer, president, Bukowinaer Lokalbahnen of Vienna.

Vice-President Röhl then stated that as it had been decided that meetings of the association should occur only at intervals of two years, the by-laws of the association should be changed, so that the terms of office of three of the members of the executive committee expire every two years. This was put in the form of an amendment and passed.

The report of the committee on nominations for the ensuing two years was then presented. It was as follows:

For president, Léon Jannsen, general manager of the Tramways of Bruxellois.

Vice-president, Johannes Röhl, manager of the Strasseneisenbahn-Gesellschaft of Hanover.

Secretary, F. Nonnenberg, chief engineer of the Compagnie des Chemins de Fer Secondaires, Brussels.

The nominations were received with applause, and the gentlemen were duly elected.

The final business before the association was the appointment of place and date for the next general meeting to be held in 1900. Paris was the city selected by the executive committee, and its report was unanimously adopted. The precise date for the meeting was left to the executive committee, to be announced later.

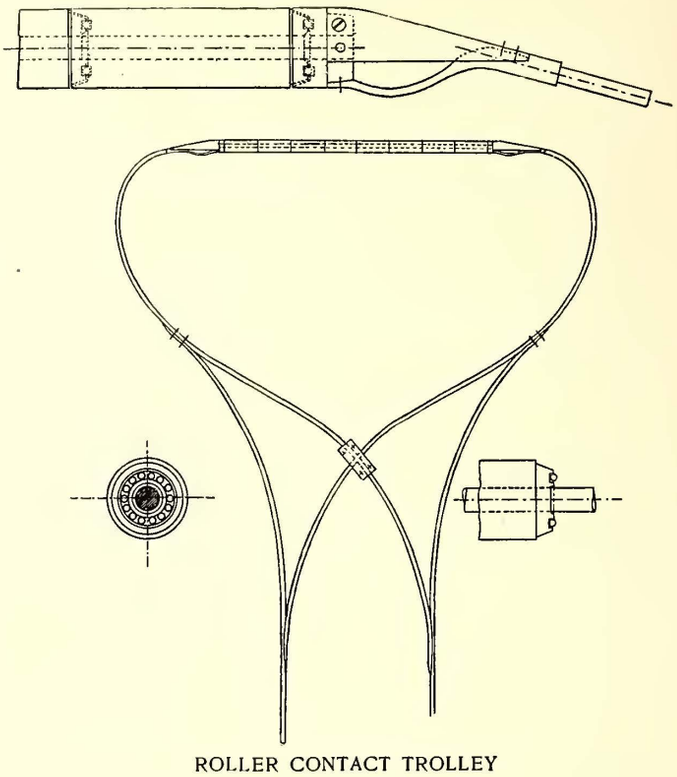
The association then voted, as usual, its thanks to the Geneva Municipality, the officials of the Geneva railway and tramway systems, the president of the association, the local committee and its president and the speakers for their efforts in making the meeting a success. The association then adjourned.

At the close of the meeting, E. Penning-Depuis exhibited a roller contact device for electric trolley roads. This appliance can be well understood from the illustration presented herewith. It will be seen that the trolley device is in the form of a bow, but instead of having a sliding contact it has a rolling contact furnished by a long cylinder mounted on ball bearings. In this way it is claimed that the advantages of both the trolley wheel and the sliding-arch contact are retained while the disadvantages of both are eliminated.

The delegates then inspected, by invitation, the large works of the Compagnie de l'Industrie Electrique of Geneva. This company is an extensive manufacturer of electrical apparatus for lighting, long-distance power transmission, railway service, electrometallurgy, etc., and much interest was expressed by the delegates in the trip through the company's works. Finally, an excursion was made by water to Ariana Park, where the Ariana Museum, belonging to the City of Geneva, was visited. This museum contains valuable collections of china and ceramic ware, weapons and coins, etc., as well as works of art of the Middle Age and Renaissance style. It should be mentioned that the ladies who accompanied the attendants at the conventions had been invited to all of the excursions, and took part in them.

In the evening the final banquet took place in the Hôtel Beau Sejour. It was extended to the association by the tramway and narrow-gage railway companies of Geneva, and by the Geneva Veyrier Railway Company. Besides the delegates to the convention, the banquet was attended by several prominent Government and city officials. After the termination of the banquet proper, Vice-President Röhl made an address, in which he referred to the high admiration with which Switzerland is regarded by all the neighboring countries for its heroic fight for liberty in former times, and at the termination of his speech, toasted the County and City of Geneva. The toast was answered by Staatsrath Fazy, who said that the public appreciates the importance of the work aimed at by the International Tramway Association, and that tramways are important agents in solving the many sociological questions presented in municipal life. Mr. Jannsen, the newly elected president of the association, was then called upon, and expressed his thanks for his election to the presidency of the association. He then spoke of the immense possibilities of electric power, not only in the tramway and railway field, but also in that of general power distribution and other directions, which cannot now be fully appreciated. It was the duty and privilege of all engaged in the development of the electrical industry, he continued, to impart their experience and observations to the community, and this, in fact, was the purpose of the International Tramway Association. Finally, the motto of the association should be "Union gives power," as well as that of free Switzerland: "One for all, all for one." In the name of the reception committee, Mr. Rehfous then toasted the executive committee of the association and the ladies in attendance.

The following morning most of the delegates left Geneva,



ROLLER CONTACT TROLLEY

though some remained in Switzerland to study the recent electric railway installations in this country, which presents so many instructive examples.

The proceedings of the tenth meeting of the association exhibited again the importance of the association's international character, as well as the high value and great influence of the interchange of ideas and establishment of personal relations as effected by it in the prosperous development of street and similar railways.

At the end of this report I express the hope that the suggestions given by the association, and the resolutions passed by it will help to improve the science of tramway construction and operation.

Programme of the Franklin Institute

Among the lecturers before the Franklin Institute for the coming year, as shown by the programme just issued, are found the following:

A. J. Wurts, of the Westinghouse Electric Company, will lecture, Oct. 25, on "Lightning and Lightning Arresters." J. F. Stevens, president Keystone Electrical Instrument Company, Philadelphia, will lecture Nov. 8 on the subject "Concerning Electrical Instruments," and on the same evening William A. Rosenbaum, electrical expert and patent solicitor, of New York, will lecture on "The Status of Electrical Invention." Nov. 22 C. J. Reed, of Philadelphia, will lecture on "Thermo Electricity," and William Baxter, Jr., of Jersey City, on "Electrical Elevators." T. Commerford Martin, editor "Electrical Engineer," of New York, will lecture Feb. 10 on the subject of "Electric Power Transmission." On Feb. 14 Albert B. Herrick, of New York, will lecture on "The Electric Inspection of Street Car Equipments." On Feb. 28 Edward E. Higgins, editor of the Street Railway Journal, New York, will lecture on "Some of the Larger Transportation Problems in Cities."

Other lecturers in the electrical section whose subjects and dates are not announced are A. Langstaff Johnson, of Richmond, Va.; F. B. Badt, of Chicago; W. J. Hammer, of New York; J. Appleton, of the Electric Storage Battery Company, of Philadelphia, and W. E. Harrington, general manager of the Camden & Suburban Railway Company, on the subject of railbonding with special reference to cast weld joints.

Rapid Underground Conduit Railway Construction in New York

In the spring of 1898 there faced the management of the Metropolitan Street Railway Company the problem of changing the motive power from horses to the underground electric system on 17.36 miles of track on its Sixth and Eighth Avenue lines in New York city, lines which pass through the great shopping district of the West Side. It was necessary that the work should be done with the greatest possible rapidity, so as not only to minimize the loss of traffic, but also to prevent great public inconvenience. More than a year before, all, or nearly all, the material and supplies necessary for this new construction had been purchased with the expectation that it could be used immediately, but litigation of the Sixth and Eighth Avenue franchises prevented this use, and much of the material had been diverted to the building of the Second Avenue line.

With new supplies obtained, the work was carefully laid out from start to finish, and the material distributed as far as possible along the line of the road. The horse cars were withdrawn on July 20 from about 75 per cent of the entire mileage to be converted, and the work of taking out the pavement and the old tracks and making the necessary excavations for the new construction was instantly commenced.

On Aug. 20, thirty-one days later, the Metropolitan Street Railway Company's famous "free service" on Sixth Avenue was commenced, three horse cars being put on for the convenience of shoppers over one-half mile of completely finished new work, from Fourteenth to Twenty-third Streets. No fares were charged on these cars. On Aug. 28, eight days later, the Eighth Avenue line was reopened with horse cars from Fifty-ninth Street to Twenty-eighth Street, and three days later, Sept. 1, horse cars were running on the Sixth Avenue line from Fifty-ninth Street to Fourth Street. Thus, forty-two days after commencing work, the old horse railway track had been taken up and a new underground conduit construction of the most complete and perfect kind had been put down on 9.2 miles of track, or over 50 per cent of the entire mileage to be converted. Moreover, the street had been thoroughly "cleaned up," and no débris was left to call attention to the great achievement.

On Sept. 7 the Eighth Avenue horse-car service was extended to Twenty-third Street; on Sept. 19, to Fourteenth Street; on Sept. 28, to Horatio Street, and on Oct. 9, to Canal and Hudson Streets. On Sept. 15 the horse cars were operated on the Sixth Avenue line through lower Sixth Avenue to Desbrosses Street Ferry. On Oct. 1 electric service was commenced from Fifty-ninth Street to Fourth Street on the Sixth Avenue line, and on Oct. 25, electric service was commenced on the Eighth Avenue line from Fifty-ninth Street to Ninth Street. In ninety-five days a 10½-mile underground conduit electric railway had been built and put in operation in the busiest streets of one of the busiest cities in the world.

From Twenty-fourth Street to Fifty-ninth Street on Eighth Avenue, one of the city's heavy water mains lay under the outer edge of the company's track. Rather than run the risk of having its conduit construction interfered with through repair excavations, the company moved this pipe at its own cost (about $65,000) to a point nearer the curb.

The Metropolitan Street Railway Company has also commenced the conversion of its Broadway cable line to electricity, the first step being the placing of the underground conduits for feeders. Forty-eight ducts are being laid down Broadway, and the work is being prosecuted with great vigor. The next step will be the bolting on of the insulators to the interior of the present cable conduit, and for these insulators a special support has been devised, by means of which the change from cable motive power to electricity can be made as gradual as may be desired, and it will even be possible to run electric cars in with cable cars during the process of changing. This is accomplished as follows: for the cable grip and mechanism 6-in. leeway is required in the conduit. The insulators for the electric conductors will be first placed so that the conductor bars will be 8 ins. apart, thus avoiding all contact with the grips. A special plow will be used on the electric cars, with springs such that the contact plates may extend to a width of 8 ins., thereby making contact with the conductors, or may be compressed to a narrower width after the conductors are all placed in their final position 6 ins. apart, and the cable service discontinued. The electric cars will run first at the 8-in. width between conductors, but the latter with their insulators will be then moved together by means of a second bolt-hole in the insulating support to a 6-in. space, so that an electric car going down the road with these special plows may run at both widths during the process of changing.

Much comment has been excited in the press of New York City upon the large conduit capacity being installed by the Metropolitan Street Railway Company, and the simultaneous incorporation of an electric lighting company with $25,000,000 capital to carry on business in Greater New York has given rise to rumors that this conduit will be used for light and power service, as well as street railways. The officials of the Metropolitan Street Railway Company have denied their intention of entering upon any business of this character, and state that they cannot do so under their charter.

The opening of the Madison Avenue, Second Avenue and Sixth Avenue lines has imposed heavy burdens upon the company's two power stations, and it is at times and in places difficult to obtain the requisite power with the present equipment. The Twenty-fifth Street power station contains four 850-kw. generators, and has a maximum output of 7000 amps. This station, together with two more 850-kw. generators near by, serves all the lines south of Eighty-sixth Street. The lines north of this point are served by 146th Street power station, which contains three 850-kw. and two 400-kw. machines, with about 7000-amp. output capacity also. The load peaks of these stations come from 5 to 7 o'clock at night, when there is a general rush of homeward-bound travel northward, and in order to take care of these peaks and at the same time to actually increase the average power-generating capacity of the stations, the company is installing two large storage battery plants, one in the Thirty-second Street car-house, and the other in the West Twenty-third Street car-house. These batteries, which were made by the Electric Storage Battery Company, are of 550-amp.-hour capacity each, and will deliver a maximum of 3000 amps. each for one hour. This is equivalent to an increase in the present capacity of the stations of about 33 1-3 per cent at the time of the peak load. These batteries will eventually find a place in the permanent distribution system of the company as load equalizers, and it is probable that several more batteries will be used in various parts of the city.

The company's new Ninety-sixth Street power station, which will be the largest in the world, having a capacity of at least 70,000 h.p., is not yet above the foundations, there having been delay in receiving the structural ironwork. The chimney is, however, practically completed, and will be the largest in this country. It will be 353 ft. high and 65 ft. in diameter at the base, with an internal flue 22 ft. in diameter.

STREET RAILWAY JOURNAL

NOVEMBER, 1898.

PUBLISHED MONTHLY BY
THE STREET RAILWAY PUBLISHING COMPANY,
HAVEMEYER BUILDING,
26 CORTLANDT STREET, NEW YORK.

WESTERN OFFICE:
MONADNOCK BLOCK, CHICAGO, ILL.
EUROPEAN OFFICE:
39 VICTORIA STREET, WESTMINSTER, LONDON, ENGLAND.

Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / £1 5s 0 / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

EDITORIAL NOTICE.

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

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

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

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

Address all communications to
The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

We warn our friends to keep away from Cuba, "The Queen of the Antilles," for awhile at least, in spite of their natural desire to take early advantage of opportunities for investment. Before this island can be made safe as a place of residence and work, or even for temporary visitation, it has got to be thoroughly cleaned up and the terribly unsanitary conditions existing at present improved. The reports which we receive from those who have recently been there are revolting and fear inspiring to a degree. That it should be possible for a man's dead body to lie uncared for for days in the open streets of any modern city is unbelievable. For a yellow fever hospital to be placed next a railroad station is almost equally so. For a people on the verge of starvation to be cursed by an administration which deliberately and for purposes of revenue only prevents the importation of food and other needed supplies by a practically prohibitory tariff is a monstrosity. The Spanish forces and officials should be made to evacuate the island at the earliest possible moment, and this winter should be given up to thoroughly cleansing it of its worst blots upon civilization.

The International Street Railway Association, which embraces tramway and interurban railway managers throughout Europe, has a larger membership than the American Street Railway Association, and is an important factor in the advance of the science and practice of street railway operation abroad. The last meeting of the association, which was held at Geneva, is particularly interesting from the fact that subjects connected with mechanical traction occupied a much more prominent place than ever before in the history of the association, and, in fact, practically monopolized the attention of the delegates. While conditions differ so materially between the operation of tramways in Europe and in America that practice often cannot be copied bodily between them, this difference is much less than when horses were used, so that the deliberations and papers read before each association must necessarily be of value to the members of the other. For this reason we devote considerable space in this issue to the report by Mr. Ziffer of the meeting, and also to the extended paper by the same author upon recent improvements in mechanical traction for tramways. The latter gives an excellent summary of the status of independent motors, as well as of the mixed systems of electrical operation, with which little has been done in America. The practice of the International Street Railway Association to embody in a resolution after the reading of a paper and the discussion upon it the consensus of the opinions of the delegates as to the question at issue, where such a decision can be given, has much to be said in its favor. The next meeting of the association is to be held at Paris in 1900, at the time of the international exposition in that city, so that it is extremely probable that more Americans will attend that convention than any previous one.

The engineering practice of the Union Traction Company, of Philadelphia, has been, since its organization in 1895, a sealed book to outsiders, the reason being the perfectly natural one that, in the process of welding together the four constituent companies into one united organization, new standards had to be established, and the better practice selected from the worse as a result, in many cases, of experience with all. It gives us special pleasure, therefore, to present to our readers this month the first general account which has yet appeared of the plan of organization and operating methods of this the largest street railway company in the world. For the past eighteen months reports of the fine work done upon this system by Vice-President (now President) Parsons in reducing expenses, increasing earnings and smoothing away the rough points of contact between the company and the citizens of Philadelphia, have resulted in an increase of confidence by the local stock market in Union Traction securities, but the company's annual statement has come as a surprise even to those who have been its best friends, for it shows an overturn in financial conditions by which nearly $1,000,000 has been added to net earnings applicable to fixed charges and dividends. This result has been brought about in part by simplifiying the organization and

introducing many minor economies, but chiefly by most careful study of schedules and traffic requirements to the end of cutting off all unprofitable car mileage without diminishing the real service to the public. Much study has been given also to the transfer system, always the most difficult and complicated problem for any manager to solve, particularly in the case of so large a system. There are practically no free transfers in Philadelphia, a ride and transfer costing eight cents, or an average of four cents for each of the two lines. These transfers are good at any time, and it is said to be not uncommon to see a passenger enter a car and gravely examine a bunch of transfer checks, removing that which is good for the particular trip. It would seem as if this practice would lead to a serious reduction in the company's revenues, but, oddly enough, a great many transfer checks are never used, but in some mysterious way disappear from sight, in spite of the fact that they have cost the purchaser three cents The company's latest power station, with its four 2000-h.p. engine generator units and its magnificent switchboard, is in most respects a model, and its plans are worthy of careful study. Its distribution system, too, is one of the best in America. All positive feeders and mains are of lead-covered cables of large sectional area, and are sufficient in size and number to prevent excessive losses.

While many railway companies are enthusiastic over the profit secured by the establishment of street railway parks, others believe that a very conservative policy should be followed in this branch of the business. The arguments for this latter position are well summed up in a paper read by E. H. Davis, general manager of the Williamsport Passenger Railway Company, of Williamsport, Pa., before the last meeting of the Pennsylvania Street Railway Association. Mr. Davis properly says that parks which are maintained by private capital or by the municipality add to the earning power of the street railway company near whose line they are located, but that it is a question whether the street railway property, which cannot be made profitable without a park, is a desirable property. The opinions, as brought out in the discussion of this paper by the association, coincided in general with that expressed by the speaker, and summed up seem to be that the benefit of the doubt should be against, rather than in favor of, park investments. Undoubtedly much money has been spent unadvisedly in establishing resorts of this character, we will not say wasted, although some has undoubtedly been sunk so deeply that no return can be expected from it, directly. The large majority of the street railway parks have been established during the last two or three years, and every rapid development of this kind is followed by a natural reaction, of greater or less extent. As might be expected, this is particularly true of the park question, because when first established a park has the charm of novelty, but as this wears off the travel to it naturally decreases. This, then, is the condition reached in many cities, and where this exists the street railway company owning the park sees before it a certain visible outgo for park maintenance, and to balance it an induced traffic more or less uncertain in amount to make up for the park expenses. As the tangible makes more impression than the uncertain, especially when the former is expenditure and the latter receipts, the first impulse is to consider the expenditure made for parks as too great for the income derived. While we believe that money spent in inducing traffic should show a return equal at least in amount to the expenditure, there are other advantages, in establishing parks, which are often overlooked. In the first place, it is the natural tendency for the number of pleasure seekers in every city to increase, and where the natural advantages possessed by a park in the neighborhood of the city are considerable it will appeal to a continually enlarging number of persons. It must be also remembered that the real value of property of this kind increases with its accessibility, the size of the city near which it is located and the familiarity of the inhabitants with it. Consequently, as practically all American cities are increasing yearly in population, the "unearned increment" of park property should be considered as part of the profits secured from it by its owners.

Comparative Costs and Profits of Cable, Electric and Horse Railway Operation in New York City

Through the generous kindness of H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, we are enabled to give to the street railway world a transcript of the private cost sheets and other records of this great company, by means of which, for the first time in the history of street railroading, a true comparison of the relative cost of operation of cable, electric and horse railways in a single city and under substantially the same conditions can become generally known. We need not point out how important will be these comparisons to railways, particularly in foreign countries, whose managers are contemplating a change of motive power, and who are anxiously seeking all the light possible on the question of the best one to select. In the honesty of these figures and the accuracy of their distribution among the several branches of the service we have entire confidence, based on a somewhat intimate knowledge of the careful methods of administration and of bookkeeping pursued by this company in the management of the local transportation of over 250,000,000 passengers per annum.

Disregarding details for the moment, we may say on broad lines that the company's experience points unmistakably to the great superiority of electricity over both horses and cable not only in traffic handling capacity but in economy. This will come as a surprise to many who have believed that the cable system, certainly in its own peculiar sphere of great traffic density, is the cheapest and best motive power extant. The rapid disappearance of the cable system in America has been attributed by most foreign engineers and not a few Americans to a desire for unification of motive power or to the greater popularity and traffic-earning capacity of electric cars in competition with cable lines. Few have ventured to assert, in the absence of definite figures, that electric cars replacing cable over heavy traffic routes could be operated at a less cost per car mile, but the figures here given show conclusively that from economical considerations alone there is no place for the cable in modern street railroading.

Before considering these figures in detail, the present condition of surface railway transportation in New York

City should be clearly understood. On Jan. 1, 1893, the entire street railway system of New York City was operated by horses. In the spring of that year the Broadway cable line from Fifty-ninth Street to the Battery, 10.2 (track) miles in length, was put in operation. In 1895 15 (track) miles additional on Columbus, Ninth and Lexington Avenues were opened through streets most of which had previously had no horse railway service except for a short time preceding the actual starting of the cable lines. Cable construction then stopped and electric began. The company had several times attempted to install the overhead electric system in the city, but owing to extreme popular prejudice against all overhead wires, due largely to an unusual and indefensible abuse of their privileges by a number of electric light corporations, which had, in previous years, stretched their wires in New York City to such an extent as to be a positive menace to its safety as well as an intolerable eyesore, permission to adopt this system was refused. The importance of doing away with horse traction, in the interests of both the city and the company, became so great, however, that it was at last determined to try the underground conduit electric system, which had previously been a failure in this country wherever installed, owing partly to climatic conditions and partly to an attempt to use too shallow and cheap a conduit. The experiment was first made on the Lenox Avenue line in the northern part of the city, and a conduit was constructed which in point of size and cost was practically equal to that necessary for a cable system, the intention being, should electricity prove a failure, to change to the cable. After some experimenting with insulators this line proved to be an entire success and has been steadily and regularly operating ever since, with a rapidly increasing traffic and a quite remarkable economy. Encouraged by this experiment, the company's engineers devised a form of conduit which, while considerably cheaper to build, possessed, it was believed, all the necessary qualifications for success on a large scale, and during the last fifteen months nearly 35 miles of double track have been converted from horse to underground electric traction on Second, Madison, Sixth, Eighth and Amsterdam Avenues—all great through north and south routes paralleling the Broadway cable line, and intended to relieve it to a large extent of its enormously congested traffic—and on Fifty-ninth Street.

Now construction work of this kind means, of course, great interruption to traffic and a temporary diminution of receipts during the construction period, together with an increase in the operating expenses over what would be required were the roads in their final condition. Moreover, in this particular case, power for the new electric lines has been obtained from temporary power stations, and, although these have been fairly large and the production has been reasonably economical, it is certain that the new 70,000 h.p. station now being constructed on Ninety-sixth street for the service of the entire city through high tension primary lines and low tension secondary circuits, will greatly reduce the cost of power.

During the fifteen months covered by the annual and quarterly statements presented herewith the company's cable lines have not been interfered with in any way, and their receipts and expenses are normal. On June 30, 1898, there were about sixty (track) miles of electric railway actually running, but nearly all of this had gone into operation during the year. The Fourth Avenue line was opened in successive stages from Nov. 1 to Dec. 16, 1897; the Second Avenue line from March 22 to April 3, 1898; the Fifty-ninth Street line from March 20 to May 21, 1898; the Amsterdam Avenue line from Feb. 3 to March 20, 1898, and the Eighth Avenue line, on May 7, 1898, from 155th Street to Fifty-ninth Street. During the last quarter, ending Sept. 30, the Sixth and Eighth Avenue lines from Fifty-ninth Street south have been torn up and traffic discontinued, a portion only being put in service in August and September over the new construction by horses and electricity. It is evident that the company's total earnings for the year and quarter, though considerably larger than the last year and quarter respectively, should be greatly exceeded in 1898-9, when the conditions on the lines at present converted are more settled, and that not until the conversion of the system is completed will the full earning power of the property be anywhere near in sight, both because of the increases due to the introduction of new motive power, and because of the doing away with the loss of traffic coming with reconstruction.

We will now take up the figures of the accompanying annual and quarterly reports. It will be seen that during the twelve months period the company operated 34.2 per cent of its car mileage by the cable system, 20.2 per cent by the electric system and 45.6 per cent by horses. During the last quarter, however, the proportions were greatly changed, the cable mileage being only 27.4 per cent of the total, the horse 33.7 per cent, while the electric had risen to 39.1 per cent.

The relative traffic densities measured by the receipts per mile of track and per car mile as shown in the quarter's report are as follows: cable, $39,000 per mile of track and $.333 per car mile; electric, $17,000 per mile of track and $.260 per car mile; and horse, $8,000 per mile of track and $.288 per car mile. The average earning power of the entire system was about $14,000 per mile of track and $.29 per car mile. These figures per track mile are for the quarter only—annual figures would be somewhat more than four times as large. Henceforth the cable and horse lines will undoubtedly show a decreasing traffic density, owing to the competition of the electric roads parallel to them, the electric lines will show an increasing density, while the earnings per mile of track for the entire system will increase with a growing disposition of the public to ride upon clean and rapidly moving cars and by diversion of traffic from the elevated lines in competition. For a time the earnings per car mile of the entire system may not increase rapidly as new electric lines are put in operation, for the public will not respond immediately to the improved service. Eventually, however, the earnings per car mile will be much greater than at present as population increases.

Another gage of traffic density is found in the statement that the 11 per cent. of the company's entire mileage which is operated by the cable system is earning 28 per cent of the total passenger receipts; the 28 per cent which is operated by the electric system is earning 32 per cent of the total passenger receipts; and the 61 per cent which is operated by horses is earning but 30 per cent of the total passenger receipts.

For the year, the operating expenses of the cable lines were 16.42 cents per car-mile, of the horse lines 17.87 cents, and of the electric lines 10.23 cents. For the three months period, which is more favorable to electric operation for reasons already stated, the cable lines cost 17.55 cents, the horse 17.89 cents, and the electric 10.06 cents.

RECEIPTS AND EXPENSES OF THE METROPOLITAN STREET RAILWAY COMPANY, OF NEW YORK,

For the Year Ending June 30, 1898.

SHOWING THE RELATIVE COSTS AND PROFITS OF CABLE, ELECTRIC AND HORSE RAILWAY OPERATION.

ITEMS.	CABLE.		ELECTRIC.		HORSE.		TOTAL.	
	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount.	Per Car Mile.	Amount	Per Car Mile.
GENERAL EXHIBIT.	$	Cents.	$	Cents.	$	Cents.	$	Cents.
Total passenger receipts	4,130,225	34.42	1,918,873	26.99	4,375,597	27.35	10,424,695	29.70
Operating expenses	1,970,486	16.42	727,406	10.23	2,858,235	17.87	5,556,127	15.83
Earnings from operation	2,159,739	18.00	1,191,467	16.76	1,517,362	9.48	4,868,568	13.87
OPERATING EXPENSES IN DETAIL.								
MAINTENANCE OF WAY.								
1 Repairs roadbed—track, labor	41,447	.35	6,153	.09	72,928	.46	120,528	.34
2 " " material	6,673	.06	*105	....	7,549	.05	14,117	.04
3 " " steel rails	200	....	954	.01	705	....	1,859	....
4 " " switches, cstgs., spikes, etc	10,108	.08	3,128	.04	5,567	.03	18,804	.05
5 " " ties and timber	287	....	148	...	2,304	.01	2,739	....
6 Repairs overhead and underground construction	80,787	.67	5,779	.08	165	...	86,731	.25
7 " and renewals of cable	189,391	1.58	.....	....	.....	...	189,391	.54
8 " tube cleaners	11,758	.10	4,230	.06	.....	....	15,988	.05
9 " oilers	40,708	.34	12	....	.....	...	40,720	.12
10 " gearsmen and splicers	21,240	.18	.....	....	.....	....	21,240	.06
11 Repairs of buildings	4,099	03	821	.01	17,262	.10	22,182	.06
12 Removal of snow and ice, and street cleaning	15,328	.13	2,731	.04	9,666	.06	27,725	.08
Total	422,027	3.54	23,851	.33	116,145	.72	562,024	1.60
MAINTENANCE OF EQUIPMENT.								
13 Repairs of cars and vehicles	68,768	.57	28,687	.40	61,449	.38	158,904	.45
14 " " electrical or cable equipment of cars	42,287	.35	29,952	.42	8	....	72,247	.21
17 " " tools and machinery	1,714	.01	152	....	328	...	2,195	....
Total	112,770	.94	58,792	.83	61,784	.39	233,345	.66
POWER.								
15 Repairs of steam plant	15,147	.13	2,042	.03	9	...	17,197	.05
16 " " electrical or cable plant	12,395	.10	824	.01	3	....	13,221	.04
18 " " harness	458	....	584	....	15,361	.10	16,404	.05
19 Stable equipment supplies, etc	174	....	424	...	12,206	.08	12,805	.04
20 Renewals of horses	550	....	3,030	.04	62,440	.39	66,020	.19
21 Horse shoeing	571	....	2,477	.03	80,933	.51	83,981	.24
22 Cost of provender	3,432	.03	14,010	.20	445,183	2.78	462,624	1.32
23 " " feedmen—wages	92	...	1,687	.02	40,419	.25	42,198	.12
24 " " removing manure	60	....	*85	...	7,109	.04	7,084	.02
27 Hostlers, hitchers and stable help	2,485	.02	12,795	.18	347,855	2.18	363,134	1.07
28 Engineers, firemen and power service	65,262	.54	20,662	.29	240	....	86,163	.25
32 Fuel, power houses	104,912	.88	51,015	.72	455	....	156,381	.45
33 Light and other supplies at power house	15,471	.13	5,370	.08	59	...	20,900	.06
34 Water tax	21,775	.18	5,842	.08	11,138	.07	38,754	.11
Total	242,784	2.02	120,675	1.70	1,023,408	6.40	1,386,867	3.95
TRANSPORTATION.								
25 Conductors, drivers, gripmen and motormen	711,630	5.93	353,127	4.97	1,156,395	7.23	2,221,151	6.33
26 Inspectors, starters, switchmen, etc	143,512	1.20	50,292	.71	119,400	.74	313,204	.89
29 Car house exp. watchmen, car cleaners, oilers, etc	36,820	.31	27,392	.39	63,245	.40	127,457	.36
30 Car service—car lighting	39,227	.33	1,142	.02	11,690	.07	52,059	.14
31 " " oil, waste, etc	12,932	.11	5,158	.07	7,191	.04	25,281	.07
Total	944,120	7.87	437,111	6.15	1,357,921	8.49	2,739,153	7.81
GENERAL EXPENSES.								
35 Salaries of officers and clerks	30,359	.25	11,051	.16	41,938	.26	83,348	.24
36–40 Injuries and damages	150,325	1.25	43,829	.61	79,076	.49	273,229	.78
41–48 Other general expenses	68,099	.57	32,100	.45	177,962	1.11	278,162	.79
Total	248,784	2.07	86,978	1.22	298,976	1.87	634,738	1.81
Total Operating Expenses	1,970,486	16.42	727,406	10.23	2,858,235	17.87	5,556,127	15.83
Car mileage	11,991,404		7,110,090		15,994,912		35,096,406	

* Surplus Account.

PASSENGER RECEIPTS AND EXPENSES FOR THREE MONTHS ENDING SEPTEMBER 30, 1898.

	CABLE.		ELECTRIC.		HORSE.		TOTAL.	
GENERAL EXHIBIT.								
Total passenger receipts	944,985	33.27	1,056,866	26.03	1,009,100	28.82	3,010,951	28.95
Operating expenses	498,318	17.55	408,250	10.06	626,521	17.89	1,533,089	14.74
Earnings from operation	446,667	15.72	648,616	15.97	382,579	10.93	1,477,862	14.21
OPERATING EXPENSES BY DIVISIONS								
Maintenance of way	136,704	4.81	13,553	.34	24,036	.69	174,294	1.68
" " equipment	36,689	1.29	38,420	.95	14,280	.40	89,389	.86
Power	58,085	2.04	56,203	1.38	241,686	6.90	355,974	3.42
Transportation	226,225	7.98	262,889	6.47	288,701	8.25	777,816	7.48
General expenses	40,614	1.44	37,184	.91	57,818	1.65	135,616	1.30
Total	498,318	17.55	408,250	10.06	626,521	17.89	1,533,089	14.74
Car mileage	2,840,383		4,059,756		3,501,088		10,401,227	

The electric lines during the twelve months period earned 16.76 cents net per car mile, or but 1.25 cents less than the cable system, in spite of the fact that the latter has 7.43 cents per car mile greater receipts; while for the three months period the net earnings of the electric lines per car mile were actually greater than the cable lines by .25 cents, and greater than those of the horse lines by 5.04 cents.

How have these surprising results been achieved, and are they a true measure of the permanent relative earning powers of the different systems?

From a careful study of these figures, we believe that were all the lines in New York City to be equipped with a single motive power, electricity would have a permanent advantage over the cable of at least 3.5 cents per car-mile in maintenance of way; a slight disadvantage in maintenance of equipment; and an advantage of at least 1.25 cents in power, of 1.5 cents in transportation, and of .5 cents in general expenses; a total of nearly 6.75 cents per car-mile. In comparison with horse traction, electricity would be at a disadvantage of perhaps .5 cents per car-mile in maintenance of way, and .5 cents in maintenance of equipment; while it would have an advantage of at least 6 cents in motive power, 1.5 cents in transportation, and 5 cents in general expenses; a net difference of 7 cents. Besides this, electric cars would earn more than either horse or cable cars with equivalent mileage.

The Broadway cable line has now been in operation for five years and the Lexington and Columbus Avenue lines for nearly three and four years respectively. In that time the track has, of course, deteriorated and repairs have been necessary. We find that $58,715, or .49 cents per car mile have been spent on track repairs during the year. The electric lines, which are, of course, almost entirely new, have cost for repairs only $10,278, or .14 cents per car mile. The horse railway track has cost $89,053, or .56 cents per car mile. Now the cost of maintenance of electric track in this current year is obviously far too small, while that of the cable and horse railway track is probably smaller than average renewal and repairs for a long period of time, since there has been practically no renewal so far of the cable track, and horse railway track repairs have naturally been reduced to a minimum in the expectation that the railway would be converted to electricity. Electric traction will be harder on rails than cable traction, and far harder than horse traction, the reason being, of course, that electric cars do not, as in the last two systems, simply roll over the track, but actually grind it out in exerting tractive effort, while the electric motor cars are, moreover, heavier than either horse or cable cars and deliver a more severe hammer blow to the joints. An expenditure of .75 cents per car mile for 40,000,000 car miles would be equal to $300,000 per annum, or $1,400 per mile of track per annum for the complete system, and this should be an ample figure for repairs and renewal of track were the whole system electric. The electric figures on the accompanying statement are therefore too small by perhaps .6 cents.

Repairs of underground and overhead construction show a great difference in favor of electric traction over cable, and this is quite reasonable, since the amount of moving mechanism in the cable conduits is enormous, while the electric has none. Nevertheless, .08 cents for this account in the electric column is possibly too small and may be slightly raised as the system grows older.

Accounts number 7, 9 and 10 for renewals of cable, wages of oilers, gearsmen and splicers, amount in the aggregate to 2.10 cents per car mile, and are found only in the cable system with no corresponding charge in the electric. This is a very important saving indeed. The renewals of cables alone cost much more per car mile than will be the entire cost of electric power under final conditions!

Cleaning the tubes will cost slightly less for the electric system than for the cable, but repairs of buildings, removal of snow and ice, and street cleaning should be, under normal conditions, approximately the same.

The repairs of cable cars exclusive of equipment will probably be greater per car mile than the repairs of electric cars, owing not only to the greater speeds possible with electric cars, which increases the service divisor, but also because of the greater jerking which the cable gives to its cars than is the case in electric traction. The repairs of the electric car equipment should be, on the contrary, greater, as there is much more mechanism in the electric equipment than in cable. The expenditure of .42 cents per car mile for this item in the electric column, though very large for a new road because of inexperienced motormen rapidly put into service during the last year, is probably smaller than the permanent average, but the latter should not exceed .60 to .75 cents.

It certainly overturns all our established ideas to find that two temporary electric power stations can actually produce power for heavy electric cars 22 to 28 feet in length at a cost less by 30 per cent (in the quarterly statement) than can be done in two cable power stations which operate cables so heavily loaded as to make the proportion of live to dead weight greater probably than that of any cable railway system in the country with the possible exception of the State Street line of the Chicago City Railway Company. The new electric power station will do much better than this, and it is obvious on examination of the different items in power account that while repairs of plant will undoubtedly be greater per car mile on an average in the electric stations than they have been this year, when equipment is new, there are other items temporary in character in the electric account which will disappear in the final plant, so that the total cost of motive power will be reduced, perhaps even to .75 cents per car mile.

The large expenditures for provender and care of horses in the electric column are not properly chargeable to electricity at all, being due to a short horse line, feeding the Madison Avenue electric line.

But 1.38 cents per car mile looks small in comparison with the 6.90 cents charged to motive power on the horse system (in the quarterly statement), and those of our foreign friends who still cling to horse power may well examine these figures with interest to see wherein lies the enormous saving in electricity over horses, upon the claims for which they have looked for so many years with suspicion.

In the transportation expenses we find again that electric traction is the cheapest of the three motive powers, and the reason for this is found chiefly in the greater speeds of car possible with electric traction, which, as above stated, increases the service divisor. The part which this speed element cuts in transportation expenses is indicated by the difference between the cost per car mile of conductors, drivers, gripmen and motormen in the electric system against the corresponding charges for the horse

system, these differences amounting to 2.26 cents per car mile in spite of the fact that motormen are paid 25 cents more per day than horse car drivers.

In the department of general expenses everything possible has been charged directly to the different motive powers affected, but salaries of general officers and other similar charges impossible to handle directly have been pro rated on the basis of passenger earnings. The only item here which has special interest is that of injuries and damages, which can be, of course, directly charged to the motive powers which cause them. We find that, as is natural, horse traction has cost the company the least for injuries, while the cable appears to have cost more than twice as much as electric traction. It is probable that the charge of 1.25 cents per car mile on the cable system, amounting as it does to 3.6 per cent of the passenger receipts, is a fair average for a carefully operated line in Broadway, and, considering the greater safety of the electric car through its better means of control in emergencies, the average cost for injuries and damages on the electric lines will certainly be much less than with the cable system.

In the quarterly statement it will be seen that, in every grand division of operating expenses, electricity has a decided advantage over the cable system, and in every division except maintenance of equipment it has an advantage over the horse system.

During the twelve months period, the cable lines operated at 47.7 per cent of their passenger receipts, the electric lines at 37.9 per cent, the horse lines at 65.3 per cent, and the entire system at 53.3 per cent. During the three months period the cable lines operated at 52.7 per cent. of their passenger receipts, the electric lines at 38.6 per cent, the horse lines at 62.1 per cent, and the entire system at 50.9 per cent.

The Metropolitan Street Railway Company in 1893 controlled directly and through lease 122.82 miles of track. In each of the five succeeding years additions have been made to this system by the lease of other lines and by extensions, and the management has sometimes been criticised in financial circles for the large rentals which have been guaranteed in order to secure operating control of these properties, the fear having been expressed that the company was assuming too heavy burdens. The accompanying table has been prepared to show the influence upon gross and net earnings in toto and per mile of road operated of these successive acquisitions. It will be seen that the gross receipts have increased from $4,022,723 to $10,779,087 (excluding Second Avenue); the earnings from operation have increased from $1,326,396 to $5,289,982; and while the fixed charges have shown a large increase, the earnings over charges applicable to dividends on the Metropolitan Street Railway Company's stock have increased from $117,794 to $1,787,651, a figure in 1898 more than fifteen times as great as in 1893. Moreover, the gross receipts per mile of road, which is a good test of the wisdom of these purchases, has shown a regular and successive increase from $32,753 to $56,294; the earnings from operation per mile of track have fluctuated somewhat, owing in part without doubt to loss of traffic through reconstruction, but are now between two and three times the earnings per mile in 1893, while the net earnings per mile over charges have increased from $958 to $9,359.

It must not be hastily assumed from the remarkable showing in these statements that the underground electric system could be adopted with financial or engineering success by street railway companies in general. New York City and Washington, which have the only electric conduit roads of any size found in America, are peculiarly favored in the matter of climate and cleanliness of streets, the rainfall and snowfall during the year being extremely small. Moreover, the conduit system, even in its cheapest form, is enormously more expensive than the overhead electric system, costing from $50,000 to $100,000 per mile of single track, according to the pipes and other obstructions which have to be removed. Only the very largest cities of the world, where the traffic densities are extremely heavy, can afford such initial costs, and not only would the street railways of smaller cities, particularly those which have spent large sums for the overhead electric system, be financially ruined by the forced adoption of the underground conduit system, but extensions into and development of suburban areas would be greatly hampered, while, even if overhead rights should be conceded for suburban lines, the inconvenience to the public through transfers would be very great.

We feel that the thanks of all who are seeking light upon this complicated problem of motive power for our great city transportation systems are due to Mr. Vreeland for his generous and broad-minded action in allowing his brother managers to have, in so complete a form, the results of his experience.

Six Years' Statement Showing Increase of Earnings of the Metropolitan Street Railway Company, Due to both Consolidations and Traffic Increases.

	1893.	1894.	1895.	1896.	1897.	*1898.
Totals.						
Gross receipts	$4,022,723	$5,398,466	$6,432,933	$8,173,332	$9,706,598	$10,779,087
Operating expenses	2,696,326	3,223,956	3,389,814	4,189,145	5,090,016	5,489,104
Earnings from operation	1,326,396	2,174,510	3,043,119	3,984,186	4,616,581	5,289,982
Fixed charges	1,208,602	1,859,971	2,070,958	2,517,339	3,226,592	3,502,331
Net earnings	117,794	314,539	972,161	1,466,848	1,389,990	1,787,651
Dividends paid	None.	328,000	405,000	1,252,500	1,200,000	1,500,000
To surplus	117,794	† 13,461	567,161	214,348	189,990	287,651
Per Mile Road Operated.						
Gross receipts	32,753	41,229	46,032	47,555	50,692	56,294
Earnings from operation	10,784	16,599	24,213	23,163	24,171	27,696
Fixed charges	9,826	14,198	14,793	14,636	16,893	18,337
Net earnings	958	2,401	6,944	8,528	7,277	9,359

*Excluding Second Avenue earnings, which form a part of system for three months only in this year. † Deficit.

Honolulu and Its Street Railways

BY FRANK X. CICOTT

When Capt. Cook landed in the Sandwich or Hawaiian Islands in 1774 they were estimated to have at that time a population of 260,000. The census of 1896 shows authentically a deplorable decrease of 229,000 natives in 122 years, not counting the elimination of the natural increase during that period, making the present number of native Hawaiians only 31,000. Capt. Cook at that time was in command of an English expedition in search of a passage from the Pacific Ocean to the Atlantic. By accident he sighted the Hawaiian group, and in honor of the Earl of Sandwich, the first lord of the Admiralty, he christened the group "The Sandwich Islands."

The inception of civilization in Hawaii contaminated the health of the natives. The marks of hereditary scrofula are plainly visible, and it seems to be generally distributed among the present generation. Leprosy and other chronic diseases were brought to Honolulu by the crews of visiting ships coming from various ports abroad. Owing to this condition of tainted health and to their languid methods of life, the native Hawaiians will gradually become extinct. The census carefully enumerated in 1896 shows in round figures: native Hawaiians, 31,000; half castes, 8500; Japanese, 24,500; Chinese, 21,600; Portuguese, 15,200; other Europeans and Americans, 10,000; aggregating 110,800.

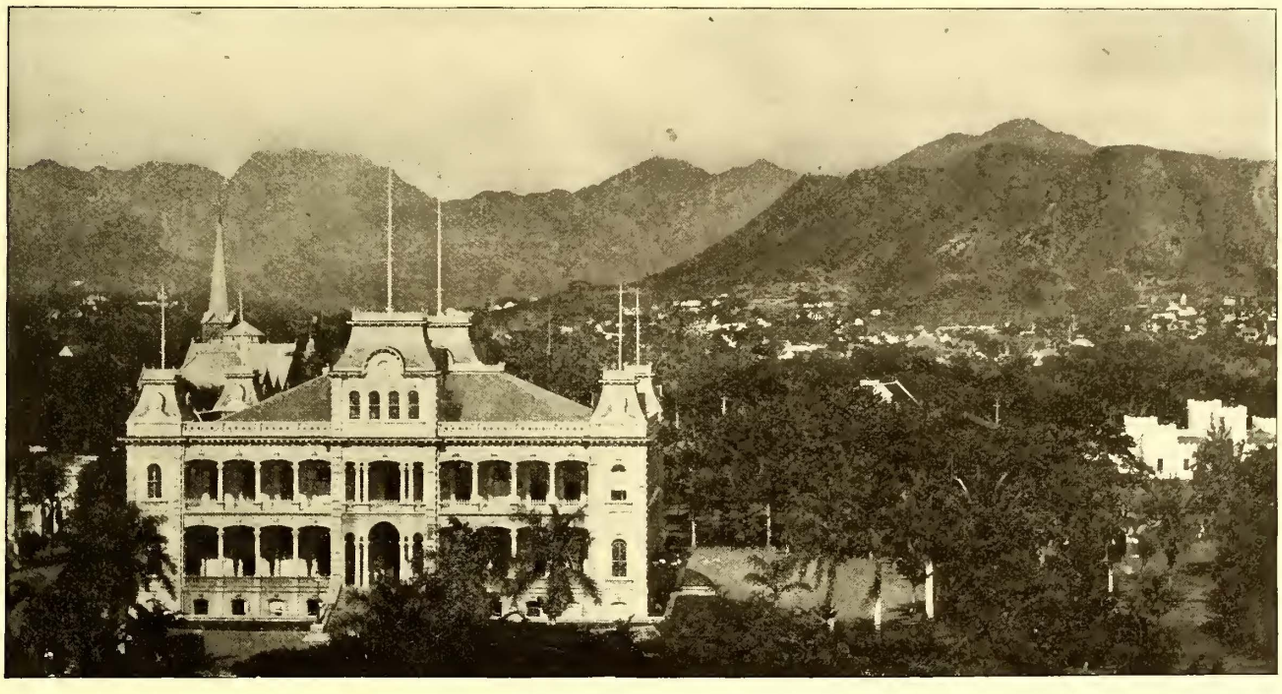
The Americans and Europeans constitute the commercial energy, political influence and the wealth of the community. The Portuguese make good citizens, are industrious and possess the requisites for a desirable class of laborers.

The Hawaiian Archipelago is of volcanic origin, consisting of eight islands, which lie within the limits of the tropics. They cover an area of 7000 sq. miles, and have 1200 miles of sea coast. They extend from latitude 18 deg. to 23 deg. north, and from longitude 154 deg. to 162 deg. west from Greenwich, and lie about 2100 miles from San Francisco, 3820 miles from New Zealand, 4450 from New South Wales, 3400 from Yokohama, 4000 from Manila and 4800 from Hong Kong.

Hawaii is to the West what Ceylon is to the East, an oceanic central station for general trans-shipment of goods and passengers to and from various marine destinations. The vegetation and products are similar; Hawaii grows sugar, coffee, rice, and tropical fruits. Ceylon grows tea, rice, coffee, and tropical fruits. The two archipelagos are geographically similar in the East and the West, occupying two formidable naval positions belonging separately to the Anglo-American nations.

The particulars of annexation of the island group are of so recent occurrence that it is needless to refer to the subject only to state that the United States will profit immensely by their acquisition. Annexation has brought about a stable government, and things in general are on the American plan. This sudden change of government—although expected for many years in the past—has already given an impetus to prosperity and the immediate adoption of methods of modern practice, especially electric traction, a much-felt want in Honolulu.

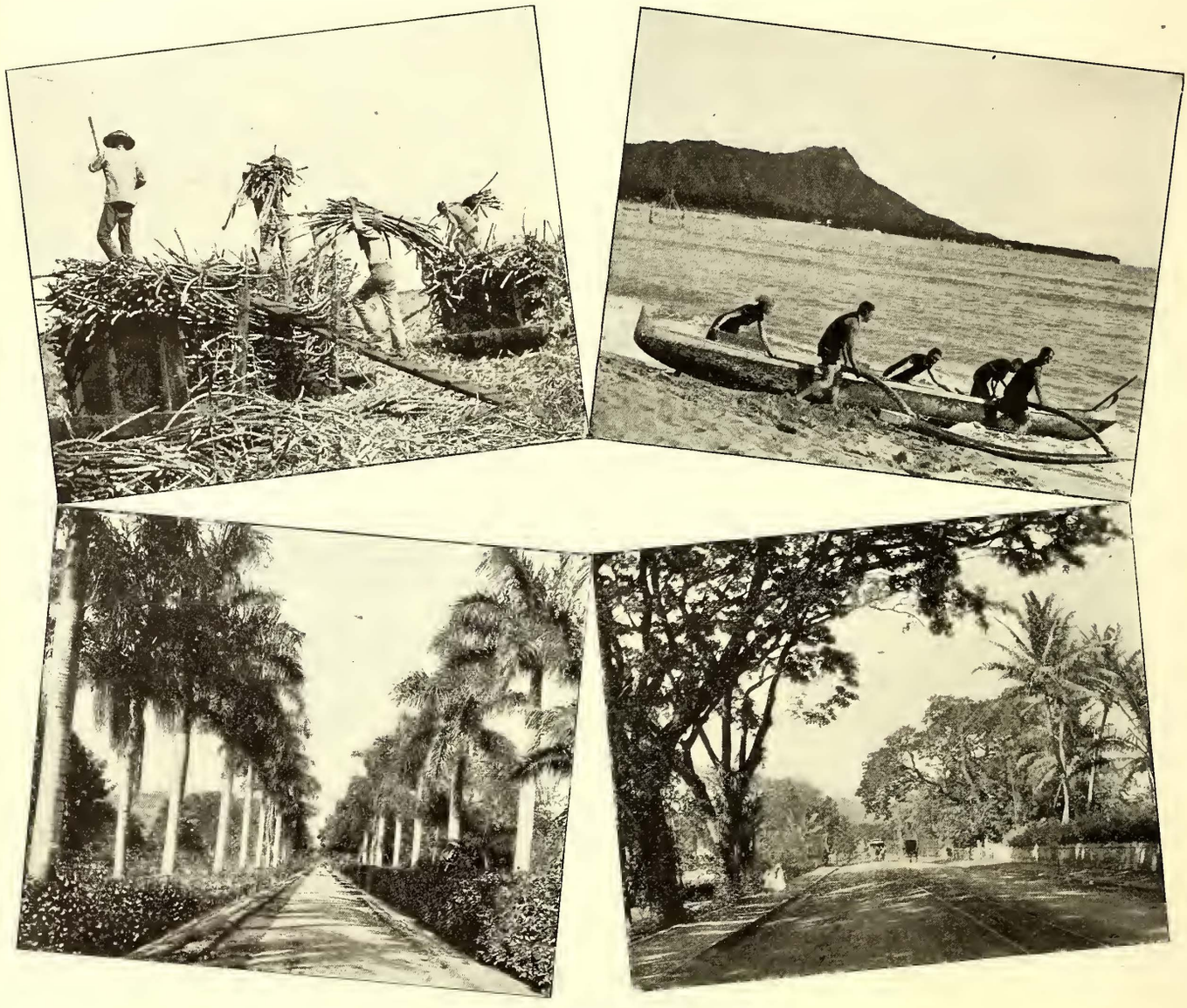
The Hawaiian Tramways Company, of Honolulu, obtained in 1884 concessions from the local Government for the period of thirty years, to operate a tramway. In 1887 about 15 miles of single narrow-gage track were constructed of light grooved rails. Animal power is employed. The rate of fare is five cents for a local ride and ten cents beyond certain districts to reach the termini.



GOVERNMENT BUILDINGS—HONOLULU

The public has been greatly dissatisfied for many years with the slow and irregular service given, and have repeatedly petitioned the Tramways Company for an improvement. Application has also been made to the Legislature, asking its aid to compel the tramway company to supply better service. The Government promptly granted the latter generous privileges as an incentive for it to install mechanical methods for rapid transit, but it did not comply with the conditional concession offered, and forfeited its rights under it. The determination of the prominent citizens for rapid transit was so sincere, and the opposition of the Government was so strongly manifested against the Hawaiian Tramways Company that a new company was organized under the name of the Honolulu Rapid Transit & Land Company. The Legislature of the Hawaiian Republic granted the new corporation what might be called a "blanket" concession, allowing it perpetual rights to con-

struct and maintain a rapid transit railway in Honolulu and suburbs. The privileges of the concession are broad to a degree, granting discretionary power of carrying the proposed electric railway to any quarter of the city, subjected, however, to certain regulations for the property owners, the Government and the Rapid Transit Company. The officers of the company are: President, L. A. Thurston; vice-president, James B. Castle; secretary, Joseph A. Gilman; treasurer, J. H. Fisher; directors, the above, with Chas. S. Desky, J. A. McCandless, and Theo. F. Lansing. C. G. Ballentyne, general manger, who has taken the lead in the plan of supplying rapid transit for the city, was the unanimous choice of all parties interested. The preliminary work for construction has already commenced. The surveyors are now at work; there are no "ifs" and "ands" regarding the construction of the new system; it will be energetically pushed and completed as early as practicable.



VIEWS ABOUT HAWAIIAN ISLANDS

Mr. Ballentyne is about to make an extensive trip to the States to inspect the various modern improvements in traction, and after he has satisfied himself with the best equipment suitable for the climatic conditions of Honolulu and other essentials involved, he will invite tenders for structural material and contracts will be awarded.

The municipal portion of the Honolulu Rapid Transit Company will cover a route of 20 miles for a starter. The population, on the basis of a moderate estimate, is 32,000. This population of 32,000 for Honolulu will seem rather small to those in the traction business in American cities aggregating 100,000 and more inhabitants. But the climatic conditions and habits of the people, dwelling as they do, in a salubrious temperature averaging 71 degs., compel them to live continuously, so to speak, on the streets, and indulge extensively in bathing and canoe surf riding. Crowds of people visit the city and suburban parks tri-weekly to listen to the Hawaiian band, and go to other resorts situated behind lofty hills and on the sea front, so that there is a large riding population. Again, the climate of the islands is such that it will be sought by those who require mild and equable temperature, which is never oppressive, and where constant breezes invigorate a tropical atmosphere. It is reasonable to expect that a large number of people of independent means will eventually make Honolulu or Pearl City their home for a portion of the year at least.

Pearl Harbor, the finest harbor in Oahu, the chief island in the Hawaiian group, is about 10 miles distant from Honolulu. The United States Government for over twenty years has held a concession of this harbor for naval and military purposes. The banks are so precipitous that vessels drawing six fathoms or more can safely tie up to the shore without difficulty. This is particularly the case on the peninsular, where the proposed United States military and naval station will be situated. Another peninsular, together with the highlands back of it, has been laid

out in building lots by the Oahu Railroad Company, and the track named Pearl City. The harbor of Honolulu is limited, and unquestionably the increasing commerce will eventually overtax its capacity, and the excess cannot avoid seeking Pearl Harbor.

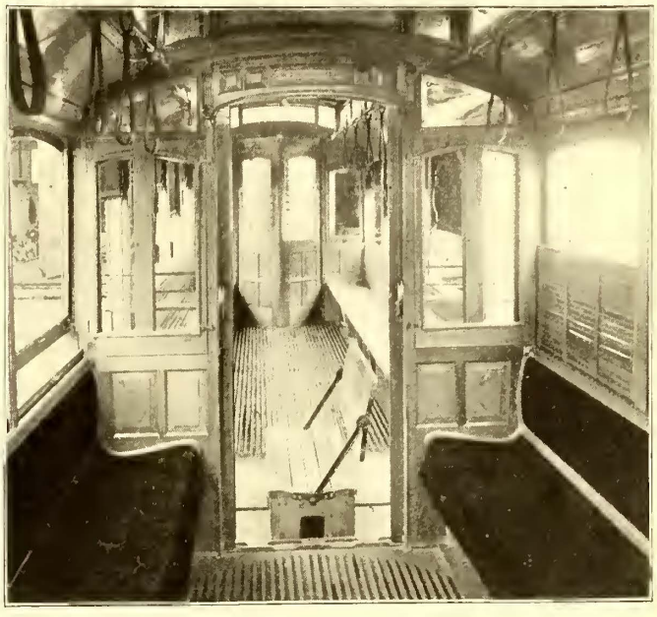
It is now contemplated that the Honolulu Rapid Transit Railway and the Oahu Railroad, which is a steam railroad 70 miles in length, making a partial belt of the island, will join in operating the Pearl City division, for the purpose of interchanging traffic from Honolulu to Pearl Harbor. The majority of the shareholders of both companies seem to be personally identified in this proposition, having a common interest to serve for frequent rapid communication by electricity. This innovation will accommodate the navy and army stationed at Pearl City and at the garrison in the vicinity of Diamond Head, Honolulu, and supply the demands of the community.

New Cars for Liverpool, England

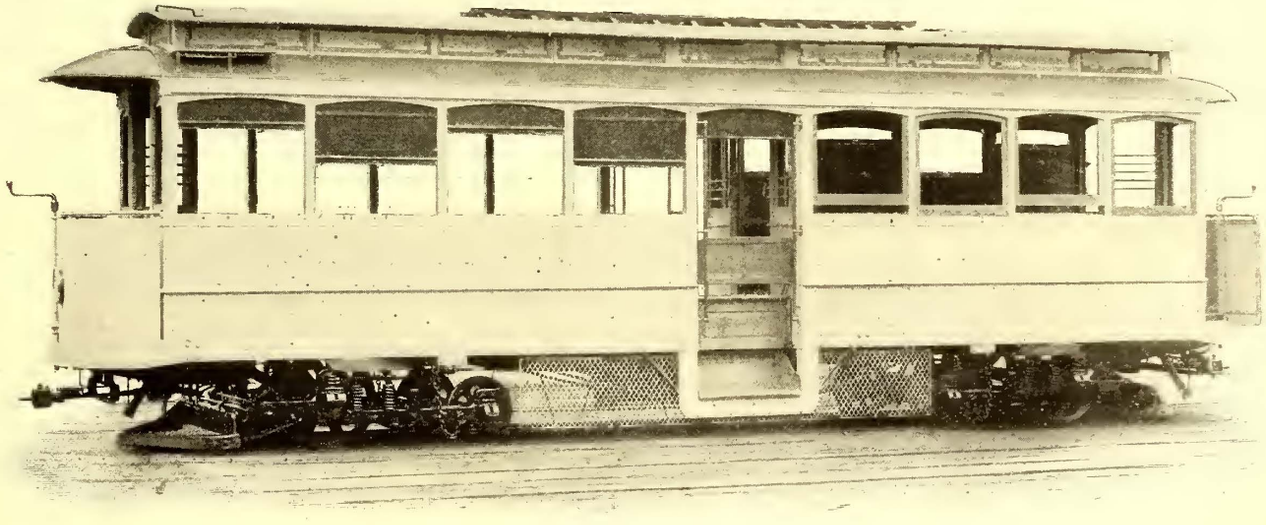
A type of car involving some novel features has recently been built by the J. G. Brill Company for the Liverpool Tramways Company. The first and most noticeable point from the outside is the fact that the open compartment has its side raised to the same height as that of the closed compartment. This gives a greater protection to the open seats and increases the strength of the side by using two panels of the usual width instead of one. The compartment is practically quite as open to the air as if there were no sides. The next feature is the arrangement by which a single step places the passenger practically within the car. This result is obtained by dropping the floor of the center vestibule down to the level of the bottoms of the sills. A step 14 ins. from the ground with a 13-in. riser gives access to the vestibule floor. Having reached this point a passenger enters either of the compartments by a 9-in. step. As slight as this change may seem, yet it will undoubtedly greatly increase the speed of the car. There is also a transverse seat in the vestibule; this is furnished with a reversible back and accommodates two persons. The tracks on which the seat slides are now made flush with the vestibule floor.

A car somewhat similar to that illustrated was built by the J. G. Brill Company for the Liverpool Tramways Company some time ago, and has been in use on that road. The experience with that car has suggested certain modifications in details which have added to the convenience of the car.

The yoke and the framing by which two parts of the car are united have been somewhat modified, and the bracing and angle iron transoms now make this portion of the car lighter and stronger than before. Slight modifications have been made in the platforms, one of these being a narrow opening in the dasher, so that the motorman can reach his place without passing through the car or climbing over the dasher. As in the previous case, the car is mounted on a pair of Eureka Maximum Traction trucks. The closed compartment is practically the same as a standard American closed car, while the open compartment has slat seats and is without sash. In the engraving showing the interior of the car, the movable seat is shown slid into the center of the doorway.



INTERIOR OF CAR

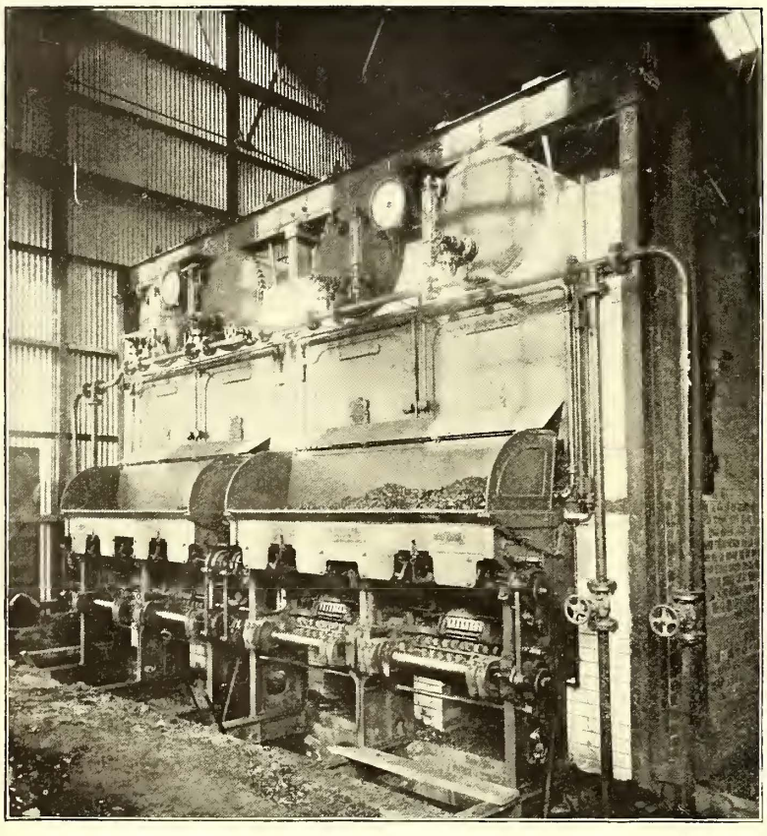


NEW CENTER VESTIBULE CAR—LIVERPOOL

The general dimensions of the car are 29 ft. 6 ins. length of body, width over all 6 ft. 8 ins. total length 33 ft. 6 ins, closed compartment 12 ft. 8 ins. long, and open compartment 13 ft. 10 ins. long. The platforms are but 2 ft. in length. The improved form of car seems to meet many if not all objections which have been made to the style of car previously used. As will be seen from the engraving, the car was shipped "in the white," this saving a great deal in protecting paint and varnish, while the packing was much more close.

Electric Railways in Glasgow, Scotland

The readers of the STREET RAILWAY JOURNAL are familiar with the fact that the tramways in Glasgow, Scotland, are owned by the municipality, and that some time ago contracts were given out for the electric equipment of part of the system with the trolley. These contracts were the result of a tour of inspection made by representatives of the municipality to the principal electric railways then in operation in Europe and America. The gentlemen visiting America were John Young, general manager, and William Clark, engineer of the Corporation Tramways. At the same time the "Glasgow Herald" sent a representative to America to conduct an independent inquiry as to the results secured by the trolley system. Messrs. Young and Clark reported in favor of the systems, and this was finally adopted by the municipal authorities, public opinion having been influenced to its favor, largely through the very strong testimony given by the "Herald" correspondent, Alexander McCallum, as to the desirability of this system of power.



BOILER ROOM

VIEW ON WEST NILE STREET

Through the kindness of Mr. Young, the STREET RAILWAY JOURNAL is enabled to present views of a section of the line just completed. This has 2½ miles of double track or 5 miles of single track, and extends from the heart of the city to a suburb, Springburn.

The contract for the equipment was let last November on specifications prepared by Messrs. Young and Clark. The main contract was awarded the Westinghouse Electric Company and Macartney, McElroy & Company, Limited, were appointed subcontractors for the overhead construction.

The grades on the division equipped are generally easy, the maximum being 5 per cent. There are several curves, that of shortest radius being 37 ft. 6 ins. The narrowest width of roadway on the route is 31 ft.

The track is 4 ft. 7¾-in. gage and is laid with a 6¾-in. 100-lb. grooved girder rail supplied by the Barrow, Haematite Iron & Steel Company. The base of the rail is 6½ ins., and the portion built is laid in 45-ft. lengths, though 60-ft. lengths are now being employed. The fish plates are 24 ins. in length, and have six 1-in. bolts. Steel tie bars, 2 ins. x ⅜ in., are used, spaced every 7 ft. 6 ins. The rails rest on a concrete base 6 ins. thick, and are double bonded with No. 4 B. & S. wire extending around the fish plate, and are cross-bonded every 135 ft. with wire of the same size.

The trolley wire is a No. 00 B. & S., and is carried mostly by side suspension, although there are a few center poles. The poles were supplied by Morris, Tasker & Company, and have a length of 31 ft. and depth in the ground of 6 ft. 6 ins. They will also be employed for electric lighting. The brackets on the bracket poles are of wrought iron, are extremely ornamental, and the double arms measure 11 ft. 6 ins. in length. Where the roadway is very narrow, as in West Nile Street and Parliamentary Road, wall rosettes are used.

The feeders are carried entirely under ground, and are tapped into the trolley wire every half mile. They were supplied by Siemens Brothers.

The power station is within a half mile of the northern terminus of the line at Springburn, and is a brick building with temporary end wall of corrugated iron and measures, inside dimensions, 61 ft. x 36 ft. The chimney is of brick, 100 ft. in height, and measures at the top 8 ft. outside diameter, 5 ft. 8 ins. inside diameter, and at its base 12 ft. outside diameter and 6 ft. inside diameter. The boiler room contains two Babcock & Wilcox boilers of 250 h.p. each. They have a heating surface of 2530 sq. ft. and a grate area of 51 sq. ft., and are equipped with Vicar's automatic stoers; Worthington condensers, and Blake-Knowles pumps are employed.

The engine room contains three McIntosh & Seymour horizontal tandem compound engines, purchased through R. W. Blackwell & Company. They have cylinder dimensions of 11 ins. and 22 ins x 24 ins., operate at 200 r.p.m.,

and have an i.h.p. each of 300 to 450. They are supplied with a steam pressure of 170 lbs., and are direct connected to the generators. The latter are of the Westinghouse eight-pole, 200 kw. type, with 380 amps. at 550 volts. The switchboard is also of the Westinghouse type, and contains three feeder, three engine and two Board of Trade panels. It is equipped with Weston voltmeters and ammeters and recording voltmeters, as well as the other usual appliances.

The rolling stock of the company consists of twenty-five cars, of which twenty-one are single-deck and four double-deck; twenty-three of the cars are mounted on double trucks and two on single trucks. The cars in use were designed and built by the Glasgow Corporation, have a steel frame with side and corner pillars of ash and have a steel frame with side and corner pillars of ash and inside finish of mahogany, and the double-truck cars measure 33 ft. 6 ins. over all. Chilled iron wheels 30 ins. in diameter are employed, and each car is equipped with one hand and electric brake, the Van Dorn coupler, Ham sand box, and fender of the cradle type. The entrance to the car is on the side.

CENTER POLE CONSTRUCTION ON SPRINGBURN ROAD, GLASGOW

Each car is equipped with two Westinghouse No. 39 motors with Westinghouse controllers, switches, circuit breakers, lightning arresters, etc. The cars are run on an average headway during the day of 2½ minutes, and have an average speed of 7 miles per hour. A graded system of fares is charged; one-half penny will carry a passenger an average of .6 miles, one penny 1.81 miles, and 1½ pence the entire length of the road, or 2½ miles.

The officials of the company are: Chairman, ex-Bailie Walter Patton, J. P.; general manager, John Young; traffic manager, J. B. Hamilton; engineer, William Clark; electrical engineer, A. E. Le Rossignol.

The Electric Railway Between Gratz and Maria Trost

Gratz is the chief city of the Dukedom of Steiermark, which contains 125,000 inhabitants, but, until recently, possessed only one tramway. This is operated by horse-power, and has a total length of 22.758 km., extending over 10.875 km. of street. A new electric line has recently been installed, however, connecting the city with Maria Trost, passing the pleasure resort of Hilmertcich. At the same time the horse railway is also being changed to electric power. The construction was recently commenced, and the total electric system will be completed about April 1, 1899. The line from Gratz to Maria Trost is single track, and has a length of 5.2 km., a gage of 1.0 m., and a maximum grade of 3.9 per cent. There are many curves having as low a radius as 50 m. In the city a grooved rail is used; outside the Vignole T-rail is employed.

The overhead system and ordinary rail return has been adopted. The overhead wire is supported in the city on Mannesmann poles with ornamental brackets, and in the suburban line wooden poles with iron brackets are employed.

The power station for this electric system is located in the wooded and beautiful valley of the Foelling, not far from the Church of Maria Trost, an objective point for many pilgrimages. It contains two six-pole compound wound Thury generators, with an output of 135 amps. at 600 volts, operating at 450 r.p.m. The current is delivered to the feeders at a working voltage of 450 by means of an automatic potential regulator designed by Mr. Thury, who is chief engineer of the Compagnie de l'Industrie Electrique, of Geneva. Mr. Thury has done considerable work in the transmission of continuous current at high voltages, his method being to operate continuous current generators in series, and to utilize the current by motors in series, the amount of current remaining constant, while the voltage varies with the work performed. Full particulars of this system are given in a paper recently read by Carl Wieshofer before the Electrotechnische Verein, at Vienna, and published in the "Zeitschrift für Electrotechnik."

The rolling stock consists of eight motor cars and four trail cars, as well as three coal cars. The passenger cars were supplied by Johann Weitzer, of Gratz, and each contains two longitudinal seats, and has a seating capacity for fourteen passengers. With the platform, the cars have a total carrying capacity of twenty-eight passengers. The cars are equipped with two motors of 20 h.p. each, which are geared to the axles with a ratio of 9 to 41. The speed of the motors is regulated by rheostats. Hand brakes and electric short-circuiting brakes are used.

The entire plant was built by the Société de l'Industrie Electrique, of Geneva. The engines were supplied from the Andritz Machine Works, of the Austrian Alpine Montan Company. They are of the high speed, compound type, of 130 electrical h.p. each. The cylinder dimensions

are 280 mm. and 400 mm. x 220 mm. stroke, and they operate at 220 r.p.m., and are connected with the engines by link belts of about 1 m. face. The engines are well built, regulate closely, and have given no trouble.

Steam is supplied by two Durr boilers, each having a heating surface of 91 sq. m., and supply steam at a pressure of 12.5 atmospheres. They are fitted with Kausch super-heaters of 23 sq. m. heating surface, which raise the temperature of the steam from 185 degs. C. up to 250 degs. C. The boilers were supplied by Durr, Gehre & Company, of Mödling.

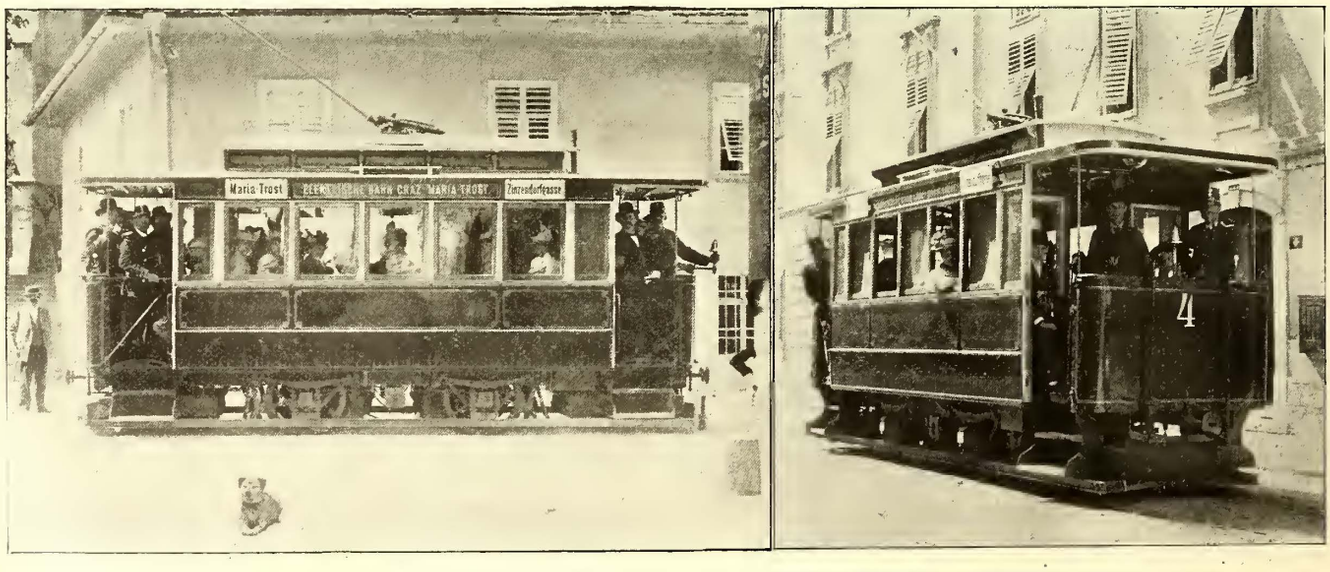
The road was projected and built by Franz Andrea, of Gratz, and completed within the space of ten months, and in spite of several obstacles, opened for traffic on Jan. 29 last. The cars run at a headway of 12 minutes from 6 A. M. to 10 P. M. There are thirteen stopping places and turnouts, and the fares are based on the zone system, varying from 3 kreuzers to 18 kreuzers, according to the distance traveled. The road is doing a good business. The type of car used is illustrated above.

Opening of New Line at Bradford, England

The Great Horton route of the Bradford (England) Corporation Electric Tramway, which was described in the September issue of the Street Railway Journal, was formally opened recently. Two cars, loaded with the mayor and other distinguished guests, made a successful trip over the line from its commencement to Bank Top, Great Horton. The engraving shown here gives a view of the two cars with the invited guests at Bank Top. After the opening ceremonies luncheon was served at the town hall, at which a number of the aldermen, members of the tramway committee, etc., were present.

OPENING TRIP—BRADFORD

A large car house has just been completed at the terminus of the line. It has a storage capacity of twenty cars. The cars owned by the company are mounted on Peckham standard trucks and are fitted with roller bearings supplied by the London Roller Bearing Company. The cars have a capacity for fifty-one passengers, of which twenty-two can be carried on the inside and twenty-nine on the outside



MOTOR CAR ON GRATZ-MARIA TROST RAILWAY

The Voucher System of Bookkeeping

BY A. O. KITTREDGE, F. I. A.

Every public accountant is asked from time to time concerning the voucher system of bookkeeping, and, in common with others, I encounter this quest for information in various directions. I have recently been asked about the voucher system of accounts with particular reference to street railway work.

The voucher system of bookkeeping, so called, is a thoroughly advertised affair. It is an excellent example of those things which are widely advertised by fortuitous circumstances and an appeal to popular fancy, but which, when careful investigation is made, fail to reveal themselves. The idea of almost everyone who asks about the voucher system of bookkeeping is that it is the acme of perfection, and that it is one of those exalted things to which everyone should aspire, but which possibly is only in the reach of those most fortunately situated. Since, as it is commonly assured, it is something which cannot possibly benefit those laboring under ordinary circumstances, comparatively few take the trouble to make their investigation exhaustive or to reach a real conclusion. They stop short and let their imaginations supply the facts. Therefore, the idea continues to prevail that the voucher system of bookkeeping is a most excellent thing, and something to which everyone should aspire, in that far-off period in the future, when the office man is to have everything arranged just as it should be.

With this much of an introduction I am going to venture to put into print that which every experienced accountant knows to be true, but which very few, according to my observation, seem willing to admit as such, even in conversation—much less to publish to the world. It is summed up in the broad assertion that there is no such thing as "the voucher system of bookkeeping." The voucher system of bookkeeping is simply a myth or a delusion or a snare, just as the reader may see fit to look at it. It is something that does not exist. When I say there is no such thing as the voucher system of bookkeeping, I mean that it is impossible to satisfactorily manage the accounts of any business by vouchers exclusively. I want to be understood to say that vouchers cannot advantageously take the place of accounts, even to a limited extent, while to supersede accounts entirely by vouchers and still have a proper showing from time to time is entirely out of the question.

All bookkeeping systems should be supplemented by vouchers. Well-devised voucher schemes, thoroughly administered, should be features of bookkeeping systems in general. Without a voucher properly approved by some one duly qualified for the responsibilities no money whatsoever should be paid out. But all this does not constitute a voucher system of bookkeeping. It only shows what useful adjuncts to a good accounting system vouchers are.

From what precedes it will be seen that the idea I desire to combat is the popular misconception of what the voucher system is. I do not intend in the least to undermine popular faith in vouchers, nor in systems of vouchers; nor yet do I lose sight in the least of the fact that instances may be found in various lines of industry, of the use of vouchers upon so extensive a scale as to warrant the assertion that a certain class of accounts are kept upon the voucher plan. But a single class of accounts does not by any means constitute an accounting system.

If we examine into a case where all of the accounts of a given class are carried on vouchers we shall find, first, that the only accounts so kept, or attempted to be kept, are the accounts payable, including those of purchases of materials, disbursements for expenses and the like. It would be manifestly impossible to manage other classes of accounts upon this plan, as, for example, the accounts receivable. It also remains that the general accounts of the business, those which really find place in the statements or balance sheets which are put out from time to time, require books, or the equivalent of books, for their proper conduct.

From this it is fair to infer that the voucher system of bookkeeping, in its broadest and best application, is limited to a single division of the accounts which must be maintained in any business. Let us consider the advantage or disadvantage of the system in this respect. Primarily, the voucher system of bookkeeping, so called, anticipates the absence of all liability accounts. Instead there is to be prompt payment of every amount owing. These payments are to be evidenced by vouchers properly approved and signed. So much for the theory.

The first step after the vouchers are made is the distribution of their amounts according to the expense classification of the business. We are at this point introduced to a wide-page book or a broad sheet of paper called a voucher-distribution book or sheet, as the case may be. On this, whichever form is employed, the amounts of the vouchers are distributed under various heads corresponding to the expense and disbursement accounts of the enterprise. Sometimes the vouchers themselves are provided with a distribution scheme printed upon either face or back, corresponding to the columns in this book. The book then becomes a summary of the divisions shown in the voucher itself. Finally, when the voucher has been thus recorded and its amount properly pro-rated among the accounts to which it belongs, it is filed away in proper alphabetical position.

To use the voucher system in this form, as must be evident to everyone who considers the matter for a moment, there must be in the treasurer's hands an amount sufficient to pay all bills at sight. Otherwise there will be accumulated at times a considerable indebtedness of which there will be no record at all. To get upon the books a proper showing of the expenses of the enterprise by the voucher system the bills must be paid without any delay whatsoever. Now it happens in the very best regulated establishments that occasionally it is inconvenient to pay so promptly. The delay of a week, and more particularly of a period longer than a week, thus serves to disarrange the statistical records of the business, and to make a false showing so far as the general accounts are concerned.

For this reason and for others many firms and companies, among them some of the most prominent establishments in their respective lines throughout the country, who have introduced elaborate voucher schemes, upon the supposition that the voucher system would save the necessity of ledgerizing accounts payable, have more recently modified their plans to such an extent as to restore to use the accounts payable ledgers they had discarded. They have not abandoned the vouchers in themselves, but, realizing that by the so-called voucher system, when depended upon alone, the conditions were equivalent to having the cart before the horse, they have retained the voucher plan, so far as the public is concerned, but by restoring the ledgers have reversed the order, and have got the horse in front of the cart.

When a bill comes in is the time when its amounts can best be distributed. It is then that the bill should be charged to the proper expense or disbursement account, leaving the payment to be arranged as may suit the convenience of the treasurer. In thus returning to ledgers these typical establishments have not become less prompt in their payments, but they have materially assisted their

accounting departments in being up to date with their statements and in being more correct in their analysis of expenditures.

Take another view of the case. Consider the voucher plan on the mere plane of general utility. The voucher system is a poor indexing system for everything except the names of the people from whom purchases are made and to whom money is paid. For the invoices to be filed away with the vouchers—since the voucher is essentially a financial record or a treasurer's record, while the invoice belongs more to the other departments of the business, and is frequently wanted by superintendents, foremen, bookkeepers, etc.—is decidedly inconvenient. The invoice by rights should be in one place, and the receipt for the payment should be in another. There is a loss, therefore, rather than a gain in making the treasurer's department the filing place of the invoices. The answer to this point may be that instead of the original invoice being filed with the voucher it is only a duplicate that is filed there. Even so; what follows? With the original left behind for the convenience of superintendent, purchasing agent and others, it becomes necessary to introduce another index system in addition to the alphabetical filing of the vouchers. But, as a fact, no index for invoices has ever been invented that is in all respects quite as satisfactory as ledger accounts. Hence it is in part that many large concerns who are using vouchers of the most elaborate type, and are making payments ostensibly by vouchers alone, still maintain equally elaborate ledger systems.

It would be impossible, for reasons already expressed, to conduct the accounts of a street railway enterprise on a voucher system exclusively. On the other hand, every street railway enterprise, as well as every other enterprise, whatever may be its character, should make all disbursements upon a voucher system. The general accounts of a street railway corporation must be maintained irrespective of the plan of managing various details. Accounting is far more than the mere record of what is owing to us and what we are owing. We need accounts in a cash business quite as much as in a credit business, but not quite so many. A well-managed street railway is as nearly a cash enterprise, both in receipts and disbursements, as almost any business undertaking with which comparison could be made. At certain dates in each month it owes nothing, but this fact does not dispense with the need of accounts. Accounts with purchase creditors would seem to be unnecessary, and yet in many cases in street railway work, for reasons stated above, a ledger system is the cheapest plan of indexing these accounts that can be employed.

I advocate the use of vouchers. I urge upon everyone with whom I come in contact a well arranged voucher system, thoroughly administered, but at the same time I am in the habit of warning every client that vouchers are not to be depended upon to the expulsion of accounts. I carefully point out that the ledger accounts almost always save much more than their cost of maintenance in mere convenience of looking up items.

The tornado which on Sept. 26 destroyed a great deal of property in Tonawanda, N. Y., did not injuriously affect the high potential transmission line of the Niagara Falls Power Company, across which it passed. Not only was the continuity of the current not interrupted for one second, but not even a single insulator was destroyed, although several houses and barns in the neighborhood were blown down and several lives were lost. This is a high testimonial to the strength of the construction employed, and, indirectly, to the builders of the line, J. G. White & Company.

LEGAL NOTES AND COMMENTS*

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

CHARTERS, ORDINANCES, FRANCHISES, ETC

ALABAMA.—Contract—Construction.—A contract that complainant street railway company should construct a track, and bear all expense of repairing it, and that defendant, for running it, should pay annually 10 per cent of half the original cost of the part it used, so long as the use continued, having been made when both parties used horse cars, does not contemplate a change to steam power, so that, such change being made, requiring a heavier track, four times as expensive, use thereof cannot be had for such rent.—(Highland Ave. & Belt R. Co. vs. Birmingham Union Ry. Co. et al., 23 So. Rep., 785.)

DELAWARE.—Charter—Conditions—Amendment.—A street railroad charter (Laws, vol. 79, c. 713) required the line to be completed within two years from the grant, otherwise the charter was to become void, and all rights, privileges and franchises therein granted were to wholly cease. A supplementary charter (Laws, vol. 20, c. 91), passed two years later, granting the right to construct a branch line, provided that the corporation should have all the rights and privileges, and be subject to all the duties and responsibilities, which devolved upon it with respect to the road constructed and maintained under the original charter. Held, that a failure to construct the branch line within two years from the passage of the supplementary charter worked a forfeiture of the rights granted by it.—(Williamson et al. vs. Gordon Heights Ry. Co., 40 Atl. Rep., 933.)

ILLINOIS.—Municipal Corporations—Powers—Negligence—Evidence—Harmless Error.

1. A municipality cannot define by ordinance what shall be negligence of an electric street railway company operating cars on its streets.

2. The admission of an ordinance erroneously attempting to define the duties and degree of care required of a street railway company is harmless error, in an action for injuries negligently inflicted by a car, where the instructions fully and clearly set out the law applicable, and the duty of the jury

3. Testimony of persons who were formerly employed about a certain street car, as to its defective condition at times prior to an accident alleged to have been caused by such defects, is admissible, though not confined to the precise time of the accident, where the condition of the car remained the same down to that time.—(Rockford City Ry. Co. vs. Blake, 59 N. E. Rep., 1070.)

IOWA.—1. Trolley Poles in Street—Petition for Injunction.—An abutting owner, though owning the fee of the street subject to the public easement, cannot complain of the erection and maintenance of electric street railway poles in the street in front of his premises if they were properly placed; this not being an additional burden.

2. A petition alleging that a trolley pole was placed in front of plaintiff's property without necessity therefor, to annoy them and injure the property; that it has depreciated the value of the same, and caused great damage to plaintiffs, and will continue to do so unless removed; and that they have not been compensated for the damages received,—states a cause of action for a removal of the pole; ultimate facts being all that is necessary to plead.—(Snyder et al. vs. Ft. Madison St. Ry. Co., 75 N. W. Rep., 179.)

LOUISIANA.—Conditions Precedent—Louisiana Law—Municipal Corporations—Grants to Railroads—Street Rights—Estoppel.

1. The "suspensive condition," under the Louisiana Civil Code (article 2021), is the equivalent of the condition precedent at common law.

2. A city granted to a railroad company a right to enter the city at a certain point, and to establish its terminus at a certain place in the city, with a further right to make certain "extensions" "from said terminus." The ordinance declared that these grants were on condition that the grantees should permanently establish "the terminus of said road within the city limits," and maintain the same during the existence of the charter. Held, that the terminus here referred to was the terminus previously fixed by the ordinance; that the construction of the terminus at that point was a condition precedent to the right to make the extensions; and that where the company laid tracks on the streets over which it was authorized to make the "extensions," but never

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constructed or maintained a terminus at the point fixed, it was in the power of the city to repeal the ordinances granting such street rights.

3. When a lessee has entered into possession under a contract making its rights dependent on a condition precedent, its possession is subject to that condition, and the lessor will not be estopped to set it up by accepting rent.—(New Orleans vs. Texas & P. Ry. Co. et al., 18 Supr. Ct. Rep., 875.)

MISSOURI.—Damages to Abutting Owners—Trial—Irregular Verdict—Appeal—Review—Agency—Questions for Jury—Instructions—Conclusiveness of Verdict.

1. In an action for tort against several defendants whose liability is joint and several, it is not reversible error for the jury to find against one defendant, and for the verdict to be silent as to the others, where the court entered judgment in favor of the others, and no complaint was made of the irregularity on the motion for a new trial.

2. In an action for damages for injuries to plaintiff's property from change of street grade by a street railway, although the contract for the work was made in the name of one corporation, where the evidence tended to prove that it was so made at the instance of defendant for its benefit, and the work was done under its direction, paid for with its funds, and the fruits were exclusively enjoyed by it, defendant is liable for the damages resulting therefrom.

3. Instructing the jury to disregard general benefits accruing to plaintiff's property in common with other property in the same community, instead of neighborhood or vicinity, could not mislead the jury unfavorably to defendant in an action against the street railroad for changing the grade of a street.

4. The determination of a jury as to the amount of damages awarded, if within the range of the testimony offered, is final.—(Berkson et al., v. Kansas City Cable Ry. Co. et al., 45 S. W. Rep., 1119.)

MICHIGAN.—Receiver of Street Railroad—Regulations—Rights of Employees.

1. Receivers appointed to manage and operate a street railway may exercise large discretionary powers as to details of management, and their judgment in such matters will not be interfered with by the court appointing them unless the act done is a manifest abuse of power.

2. An order by receivers of a street railway company requiring its conductors to carry boxes, into which passengers are required to deposit their fares, and forbidding conductors to accept money, is a proper regulation and safeguard for the collection of fares, and will not be set aside, on petition of an employee, on the ground that it tends to hold him up to the public as dishonest.

3. The relation of an employee of a street railway company in the hands of receivers to the proceeding appointing them is not sufficient to enable him to bring an action to review an order made by them, in the management of the road, claimed to be unreasonable and improper.—(Morley et al. vs. Snow, 75 N. W. Rep., 466.)

NEW YORK.—Contracts—Use of Tracks of Other Roads—Validity.

1. Laws 1839, c. 218, gave any railroad company power to contract for the use of the tracks of another company. This act was amended and re-enacted in Railroad Law 1890, sec. 78 (Laws 1890, c. 565), which provided that any railroad corporation in this State might contract with any other such corporation for the use of their respective roads or routes, or any part thereof, and thereafter use the same as prescribed in the contract. Laws 1884, c. 252, sec. 15, authorized any street surface railroad corporation to lease or transfer to any other such company the right to use any portion of its tracks, except companies owning or operating parallel roads in cities of over 300,000 population, but did not repeal chapter 218, laws 1839, supra. Const. 1874, art. 3, sec. 18, provided that no law should authorize the construction or operation of a street railroad, except on condition that the consent of property owners or of the Supreme Court be first obtained, which provision was re-enacted in the same language in Const. 1894, art. 3, sec. 18. Held, that the constitutional inhibition was prospective in effect, and did not affect the act of 1839; and, that act not being repealed by chapter 252, Laws 1884, a street railroad company incorporated prior to the enactment of Const. 1874 might legally contract for the use of the tracks of another company without first obtaining the consent of abutting owners or of the Supreme Court.

2. Same—Statutes—Repeal.—Laws 1839, c. 218, granting to any railroad corporation the right to contract with any other railroad company for the joint use of their respective tracks, and thereafter use the same as prescribed in the contract, was substantially re-enacted as a part of Railroad Law 1890, sec. 78 (Laws 1890, c. 565), and by section 180 of that act was repealed. Held, that the provisions of the two acts being substantially the same, sec. 78 of the railroad law must be construed as a continuation of the act of 1839, and not as a re-enactment thereof, notwithstanding the repeal.

3. Same—Vested Rights.—But, even if such re-enactment was not a continuation of the prior statute, the right acquired thereby, by a railroad company incorporated prior to its repeal, was a vested right, pertaining to its franchise, and was not affected by such repeal, since Railroad Law 1890, c. 565, sec. 181, provided that any accrued or vested right should not be affected or impaired thereby, but might be enforced to the same extent as if such law had not been repealed.

4. Same.—Railroad Law 1890, sec. 78 (Laws 1890, c. 565), providing that any railroad corporation in the State may contract with any other such corporation for the use of their respective roads, and thereafter use the same under the contract, applies to street surface companies.—(Rody vs. Brooklyn Heights R. Co. et al.; Schmidt vs. Brooklyn City & N. R. Co. et al., 52 N. Y. Suppl 885, affirmed 52 N. Y. Suppl., 1025.)

NEW YORK.—Charter—Amendment by General Law.

1. Under Const. art. 8, sec. 1, reserving to legislatures the power to alter stautes creating corporations, Laws 1890, c. 565, sec. 100, providing that any street surface railroad may operate its road by any power except locomotive steam power, and sec. 90, subjecting every existing street surface railroad to such provision, apply to a former special act of incorporation authorizing a street surface railroad to operate by dummy engines.

2. Same — Operation — Power — Kinetic Motors. — A kinetic motor, operated by steam, generated from water heated in a stationary boiler, and transferred to a reservoir under the car and the motor, and kept from cooling by a slow hard coal fire beneath the reservoir, is not the locomotive steam power contemplated by Laws 1890, c. 565, sec. 100, providing that a street surface railway may operate its road by any power excepting locomotive steam power.

3. Same.—The fact that a kinetic motor is still in its experimental stages, or that the company operating a street railroad company is controlled by persons interested in the motor system, is no ground for the railroad commissioners to withhold consent for the operation of the street railroad with such motors.

4. Same—Railroad Commissioners—Review of Decisions.—The action of the board of railroad commissioners in determining the right of a street surface railroad to operate its road with kinetic motors, based on a public trial, of which due notice to parties interested was given, and in which witnesses were examined, counsel heard on both sides, and judgment was pronounced, as provided by Laws 1890, c. 565, art. 6, making it a tribunal to hear such matter, is judicial in its nature, and is reviewable by the Supreme Court on certiorari.—(People ex rel., Babylon R. R., vs. Board of Railroad Com'rs. of State of New York et al., 52 N. Y. Suppl., 908.)

NEW YORK.—Nuisance—Injunction—Special Damages.

1. An owner of premises abutting upon a city street, and who has no interest in the street except an easement of passage, cannot, in the entire absence of proof of any special damage whatever, maintain an action to restrain a nuisance consisting in the unauthorized operation of surface cars through the street.

2. Same—Evidence.

But proof of special damage, however slight, would in such a case suffice.

3. Same.

Even if special damage were shown, it would still be within the discretion of the court to allow a reasonable time to obtain the requisite consents.—(Black vs. Brooklyn Heights R. Co., 53 N. Y. Suppl., 312.)

PENNSYLVANIA.—Turnpikes—Release of Franchises—Estoppel in Paris—Judgments—Conclusiveness.

1. Act April 5, 1870, authorizing the city of Philadelphia to grade and pave a street as soon as a turnpike company had released its interest in the portion of its road occupying the street, empowers such company to release both its charter right to operate a turnpike thereon, and the right to maintain thereon a street railway which it had acquired by purchase.

2. A turnpike company, authorized so to do, purchased a street railroad and its franchises, and removed it from a street on which it had been operated, a portion of which street was occupied by the turnpike. The company then executed a release to the city, reciting that, for the purpose of enabling the city to have absolute control of said street, it released and quit-claimed all of its road lying thereon within the city limits, and all title, interest, and corporate privileges therein, so that it should thereafter exercise no control over any portion of it. Held, that the release relinquished both the turnpike and the street railway privilege.

3. Where a street railroad company, having the option to surrender its right to maintain a railroad on its street, either tem-

porarily or permanently, made such surrender, and remained silent as to the character thereof for 28 years, and permitted the city to improve the street, and grant a franchise to operate a street railway thereon to another company, and such other company built its road at a great expense, it was estopped from claiming that the surrender was not permanent.—(West Phila. Pass. Ry. Co. et al. vs. Philadelphia & W. Turnpike Road Co., 40 Atl. Rep., 787.)

PENNSYLVANIA. — Franchises—Forfeiture—Constitutional Law—Judgment in Condemnation Proceedings—Effect.

1. Forfeiture of a corporate franchise can only be declared in a direct proceeding by quo warranto by the commonwealth.

2. By Const. art. 16, sec. 1, "all existing charters or grants of special or exclusive privileges under which a bona-fide organization shall not have taken place and business been commenced in good faith at the time of the adoption of this constitution shall thereafter have no validity." Held, that an active existing corporation, fully organized and doing business in good faith at the time of the adoption of the constitution, did not incur the penalty of forfeiture by a failure to exercise a privilege subsequently added to those with which it was originally clothed.

3. In a proceeding to condemn a right of way over defendant's turnpike by a street car company, it is no objection to the right of defendant to question the authority of the railway company to make its track on the turnpike that the question would involve the forfeiture of the railroad company's charter, which could not be considered in a collateral proceeding.—(In Re. Philadelphia & M. Ry. Co., 40 Atl. Rep., 967.)

TEXAS. — Municipal Corporations — Improvements — Assessments—Persons Liable—Constitutional Law—Obligation of Contracts.

1. Under Houston City charter, sec. 23a, providing that the costs of a street improvement shall be a charge against abutters, and that a street railway company shall be liable for costs of paving between the rails and for six inches on each side, such company is liable for paving to the extent stated, notwithstanding a resolution of the city council providing that the cost of the improvements shall be wholly defrayed by the abutters as provided in sec. 23a, the resolution referring to the cost of the portion to be paid for by the abutters.

2. Houston City Charter, sec. 23a, providing for street improvements at the cost of abutters, does not violate Const. 1895, art. 3, sec. 48, which provides that the legislature cannot levy taxes or impose burdens except to raise revenue for the administration of the government, this provision not referring to the action of the legislature conferring authority on a municipal corporation to levy taxes.

3. Under Const. 1895, art. 1, sec. 17, providing that no irrevocable or uncontrollable grant of special immunities shall be made, but all privileges and franchises created under the authority of the legislature shall be subject to its control, the legislature had the right to amend Houston City charter so that a street car company became liable for the cost of paving six inches on each side of its tracks in addition to its former liability of paving between the rails, and such law was not unconstitutional as impairing the obligation of a contract in reference to a prior mortgage executed while the constitutional provision was in force.

4. Under Houston City charter, sec. 23c, requiring the city engineer to prepare a roll showing the number of lots or blocks fronting on a street to be improved, the names of the owners, the number of feet frontage of such lot or block, and the proportionate cost, and the total cost to be borne by each; and sec. 23e, providing that delinquent assessments for such improvement shall bear 8 per cent interest—a street car company is not excused from being placed on the roll, and from paying 8 per cent interest by reason of its not being mentioned among the items of property to be placed on the roll of ownership, and because a part of the description required to be given could not be made to reply to it.—(Storrie vs. Houston City St. Ry. Co. et al., 46 S. W. Rep., 796.)

WISCONSIN.—Street Railroads—Municipal Regulations.

1. An ordinance requiring a street railroad charging 5 cent fares to sell 6 tickets for 25 cents, or 25 tickets for $1, is unreasonable, when the road is only making yearly net earnings of 3.3 per cent to 4.5 per cent on its bona-fide investment, and paying 5 per cent interest on its bonds, in a city where the current rate of interest on first mortgage real estate security is 6 per cent. Such an ordinance is void, under the fourteenth amendment, as depriving the company of its property without due process of law.

2. Same—Reasonableness of Ordinances.

The power of a municipality to regulate street railroad fares is subject to the limitations (1) that there is reasonable need on the part of the public, considering the nature and extent of the service, of lower rates and better terms than those existing; (2) that the rates and terms fixed by the ordinance are not clearly unreasonable, in view of all the conditions.—(Milwaukee Elec. Ry. L. Co. vs. City of Milwaukee; Central Trust Co. of N. Y. vs. Same, 87 Fed. Rep., 577.)

LIABILITY FOR NEGLIGENCE

COLORADO. — Nonsuit — Negligence — Carriers — Injury to Passenger — Alighting from Moving Car — Appeal — Review.

1. A nonsuit should be granted where the evidence, in the most favorable light for plaintiff in which the jury would be at liberty to view it, would not justify a verdict for him.

2. Plaintiff, in an action for damages for personal injuries caused by negligence of defendant, must first make out a prima facie case, and if he fails, or should affirmatively show that the proximate cause of the injury was his own lack of prudence, the action cannot be maintained as a matter of law.

3. Plaintiff fell from the lower step of a moving car, rolled under the step, and was injured by a bolt that supported the step and was underneath it. Held, that the evidence did not show negligence in the construction of the car.

4. Whether the act of alighting from a moving car is negligent is a question of fact, unless attendant circumstances, such as the speed of the car or the fact that the passenger is heavily incumbered, clearly stamp the act as negligent.

5. Plaintiff attempted to alight from a slowly moving car, and was seized by the conductor, and this, he testified, caused him to fall and roll under the car, where he was injured. Held, that it was error to order a nonsuit.—Potter v. Denver Consol. Tramway Co., 53 Pac. Rep., 391.

COLORADO.—Injury to Minor in Street Car—Negligence—Question for Jury—Evidence.

1. The negligence of a 13-year-old boy of average intelligence, alighting from a moving street car, is, when the facts would have conclusively shown negligence had he been an adult, a question for the jury.

2. A street-car company is charged with the negligence of its motorman in allowing a 13-year-old boy to ride upon his car and alight therefrom when in motion, without endeavoring to restrain him from such act.

3. A 13-year-old boy of average intelligence, warned of the danger of alighting from a moving street car, is guilty of negligence in so doing.

4. In an action for injury to a boy in alighting from a street car, evidence was given that soon after the injury he stated that he was to blame for it. He testified that he was under the influence of drugs at the time the statement was claimed to have been made. Held, that evidence offered to contradict his statement regarding the drugs was competent.—(Pueblo Electric St. Ry. Co. v. Sherman, 53 Pac. Rep., 322.)

DELAWARE. — Negligence—Contributory Negligence—Evidence—Burden of Proof—Opinions—Witnesses—Province of Jury—Death—Damages.

1. What would be a reasonable rate of speed for an electric car in a city cannot be shown by an ordinance of the city fixing the rate of speed for steam cars, for vehicles drawn by horses, and for horseback riders.

2. For purposes of impeachment, a member of a coroner's jury may testify as to his recollection of the testimony of a witness at the inquest.

3. A locomotive engineer of 14 years' experience, who is familiar with the effect of sand on a railroad track, is acquainted with the tracks in question, has frequently ridden on electric cars, and who knows something about them, through having made them and electricity a study, may testify as to whether an electric car may be stopped more quickly by the application of sand than without sand, nothwithstanding he has never operated an electric car.

4. Within the lines of a track of a street railway on a highway, the rights of the company are superior to those of other users.

5. All parties using a highway must exercise reasonable care to prevent accidents, and the degree of such care is in proportion to the danger accompanying the particular use in each case.

6. Contributory negligence on the part of plaintiff will relieve defendant of liability for negligence.

7. Where there has been mutual negligence, and the negligence of each party was the proximate cause of the injury, an action for such injury cannot be sustained.

8. A plaintiff guilty of negligence may recover for an injury caused by defendant's negligence if such injury was proximately caused by the failure of defendant, after becoming aware of plaintiff's danger, to use ordinary care to prevent the threatened injury.

9. In an action for damages, the question of negligence is for the determination of the jury.

10. The burden of proving negligence rests on plaintiff in an action for damages alleged to have been caused by negligence of defendant.

11. Where it is impossible for the jury to reconcile conflicting evidence, they should give credit to testimony which in their estimation is most worthy of belief; taking into consideration the intelligence, apparent truthfulness, bias, or impartiality of the witness, his manner and conduct while testifying, and his opportunity of getting correct information.

12. The measure of damages in an action for the loss of life is such a sum as deceased would probably have earned in his business during the remainder of his life, and which would have gone to his next of kin; taking into consideration the age of deceased, his ability, disposition to labor, and habits of living and expenditure.—(Maxwell vs. Wilmington City Ry. Co., 40 Atl. Rep., 945.)

DELAWARE.—Collision—Negligence—Contributory Negligence—Damages.

1. The right of a street railway company within the lines covered by its tracks is superior to that of other users of the street.

2. It is the duty of a street railway company to provide competent servants, and to use reasonable care in operating its cars, slowing up or stopping them, if need be, when danger is imminent.

3. It is the duty of people using the highway in common with a street railway company to use reasonable care, stopping, and, if need be, turning out and keeping off the tracks in the presence of danger.

4. What acts of precaution are necessary by persons who cross electric street railways must depend on the circumstances of each case, although persons crossing a highway on which cars are run at a high rate of speed and close together, or where the view is obstructed, or in a neighborhood where there is much noise and confusion, are required to exercise greater care than where the contrary facts are true.

5. A street railway company is held to greater caution in the densely populated portions of a city than in the less obstructed streets in the suburban parts.

6. Where there is contributory negligence, the proportion of negligence to be attributed to each party will not be measured.

7. In an action for injuries to a horse and other personal property, caused by a collision with a street car, the measure of damages is the actual injury to the property, besides compensation for the loss of its use and expenses incurred in doctoring the horse.—(Brown vs. Wilmington City Ry. Co., 40 Atl. Rep., 936.)

ILLINOIS.—Trial—Request for Verdict—Waiver—Negligence—Instructions—Appeal—Record.

1. A party's request for an instruction to find for him comes too late after other requests by him for instructions have been granted.

2. An instruction to find for plaintiff if her intestate lost her life through defendant's negligence "while in the exercise of ordinary care for her safety, and without fault or negligence on her part," is not erroneous as causing the jury to believe that it was incumbent on decedent to exercise care only at the immediate time of the accident.

3. An instruction to assess compensatory damages for negligence "not exceeding the sum claimed in the declaration" is proper.

4. The judgment of the appellate court, reciting that it had examined all matters assigned for error, conclusively shows that it considered an assignment alleging that the damages were excessive, though its opinion asserts the contrary, as the opinion is no part of the record.—(Calumet Electric St. Ry. Co. v. Van Pelt, 50 N. E. Rep., 678.)

LIST OF STREET RAILWAY COMPANIES IN THE UNITED STATES IN THE HANDS OF RECEIVERS

Name of Company.	Miles of Track.	No. of Cars.	Date of Receivership.	Funded Debt.	Gross Receipts.*	Name of Receiver.
Akron (O.) St. Ry. and Illuminating Co	20.0	55	Jan., 1898	$1,185,000	$210,247	Geo. W. Crouse, A. O. Beebe
Asheville (N. C.) Street R. R. Co	7.0	15	Mar., 1895	300,000	.....	J. E. Rankine
Austin (Tex.) Rapid Transit Ry. Co	13.5	24	.....	343,000	.....	I. H. Evans
Columbia and Maryland Ry. Co., Baltimore	110.0	..	Jan., 1898	*a* 6,000,000	.....	Nicholas P. Bond
Highland Avenue & Belt R. R. Co., Birmingham, Ala.	28.0	21	Apr., 1897	.....	.....	Philip Campbell
Braddock (Pa.) Electric Passenger Ry. Co	5.3	5	Oct., 1898	41,000	645	A. L. Sailor, W. M. Brown
Brooklyn Elevated R. R. Co	41.1	381	Mar., 1897	14,333,000	1,694,358	Frederick Uhlmann
Kings County Elevated Ry. Co., Brooklyn	28.4	198	Aug., 1896	10,964,550	756,319	Jas. H. Frothingham
Charleston (W. Va.) St. Ry. Co	4.0	..	.....	10,000	.....	C. B. Couch
Calumet Electric Street Ry. Co., Chicago	90.0	227	Apr., 1897	3,000,000	*b* 144,995	John McNulta
Metropolitan West Side Elevated R. R., Chicago	36.0	205	Jan., 1897	15,000,000	.....	Dickinson MacAllister
Columbus (O.) Central Ry. Co	35.0	60	.....	1,500,000	.....	Geo. H. Worthington
Defiance (O.) Light and R. R. Co	3.5	6	.....	100,000	.....	W. R. Faben
Denver (Col.) Lakewood and Golden R. R. Co	26.0	37	.....	627,000	.....	W. W. Borst
Dubuque (Ia.) Light and Traction Co	10.5	23	Dec., 1894	385,000	.....	Horace Torbert
Duluth (Minn.) Street Ry. Co	49.2	71	Aug., 1898	2,000,000	219,927	L. Mendenhall
Fort Wayne (Ind.) Consolidated Ry. Co	34.0	65	Sept., 1896	1,800,000	.....	J. H. Bass
Galveston (Tex.) City R. R. Co	35.9	73	Oct., 1897	1,075,000	215,299	R. B. Baer
Great Falls (Mont.) Street Ry. Co	8.7	11	.....	246,500	26,091	W. D. Dickinson
Fox River Electric Ry. Co., Green Bay, Wis	14.5	20	Jan., 1898	130,000	.....	M. Joannes, T. W. Spence
Harvey (Ill.) Transit Co	3.0	3	Jan., 1895	115,000	.....	Chicago Title & Trust Co
Jackson (Mich.) Street Ry. Co	7.0	18	.....	150,000	.....	W. A. Foote
Pennsylvania Traction Co., Lancaster, Pa	50.0	50	Nov., 1896	1,247,800	198,770	W. B. Given
City Electric Ry. Co., La Salle, Ill	12.0	8	Nov., 1896	.....	.....	Jarvis R. Burrows
Lawrence (Kan.) Transportation Co	5.5	9	.....	25,000	.....	
Lincoln (Ill.) Electric Street Ry. Co	6.0	6	.....	50,000	.....	Wm. H. Traner
Lock Haven (Pa.) Traction Co	6.5	8	Sept., 1897	250,000	17,288	W. B. Given
Logansport (Ind.) Ry. Co	5.5	12	June, 1895	.....	.....	D. D. Fickle
New Albany (Ind.) Ry. Co	7.0	29	Mar., 1894	230,000	.....	John MacLeod
Newark (O.) and Granville Electric Street Ry. Co	13.0	22	Apr., 1896	150,000	26,895	J. F. Lingafelter
New Paltz (N. Y.) and Walkill Valley R. R. Co	9.0	13	Aug., 1898	150,000	.....	Jas. G. Graham
Ogden Electric Ry. Co., Ogden City, Utah	12.0	14	Mar., 1898	.....	.....	Louis W. Hess
Lake Ontario and Riverside Ry. Co., Oswego, N. Y.	12.3	23	Oct., 1896	337,000	21,099	F. H. Tidman
Ottawa (Ill.) Street Ry. Co	8.0	12	Jan., 1898	75,000	.....	L. W. Hess
Pasadena (Cal.) and Mt. Wilson Ry. Co	9.0	11	.....	.....	.....	J. S. Torrance
Paterson (N. J.) Central Electric R. R. Co	8.0	18	Jan., 1898	46,000	14,001	Wm. Barbour, Chas. Curie
Petersburg (Va.) Electric Ry. Co	3.3	14	Apr., 1898	50,000	.....	W. P. McRae
East Side Ry. Co., Portland, Ore	22.0	24	.....	300,000	.....	C. H. Prescott
Radford (Va.) St. Ry. Co	3.0	3	.....	7,000	.....	G. T. Kearsley
Atlantic Highlands, Red Bank and Long Branch Electric Ry. Co., Red Bank, N. J.	20.0	23	May, 1898	.....	41,160	J. E. Degnan
Roanoke (Va.) Street Ry. Co	19.0	12	Feb., 1898	350,000	.....	David W. Fliekwir
Union Traction Co., Rutherford, N. J	12.0	7	Feb., 1898	590,000	14,772	Wm. N. Johnson
People's R. R. Co., St. Louis, Mo	10.0	95	Mar., 1897	200,000	*c* 176,686	F. B. Brownell
West End Street Car Co., San Antonio, Tex	5.8	6	Aug., 1898	100,000	.....	J. H. Clark
Alamo Heights Ry. Co., San Antonio, Tex	5.5	7	Mar., 1897	500,000	.....	W. H. Hume
Sandusky (O.) St. Ry Co	9.0	14	Jan., 1897	75,500	.....	Clark Rude
San Jose (Cal.) R. R. Co	17.0	27	.....	350,000	.....	Jas. Findlay, H. B. Alvord
Seattle (Wash.) City Ry Co	5.6	27	.....	443,000	.....	W. A. Underwood
Front Street Cable Ry. Co., Seattle, Wash	5.5	12	.....	.....	.....	O. D. Colvin
Ossining Electric Ry. Co., Sing Sing, N. Y	3.0	11	.....	100,000	20,019	John V. Cockroft
Syracuse (N. Y.) and East Side Street Ry. Co	7.5	12	May, 1898	250,000	34,810	G. D. Chapman, M. J. Myers
Consumers' Elec. Light and St. R. R. Co., Tampa, Fla.	24.0	27	Aug., 1897	.....	.....	Chester W. Chapin
Terre Haute (Ind.) Electric Ry. Co	24.0	59	Oct., 1897	900,000	.....	Joshua Jump
Belt Ry. Co., Washington, D. C	15.4	81	Sept., 1896	490,000	71,983	W. K. Schoepf
Superior Rapid Transit Ry. Co., West Superior, Wis.	26.0	35	Jan., 1896	250,000	92,370	S. T. Norvell
Zanesville (O.) Ry. and Electric Co	10.0	31	Jan., 1898	175,000	46,461	W. Christy

* For latest year obtainable. *a* Authorized. *b* Seven months. *c* Approximate.

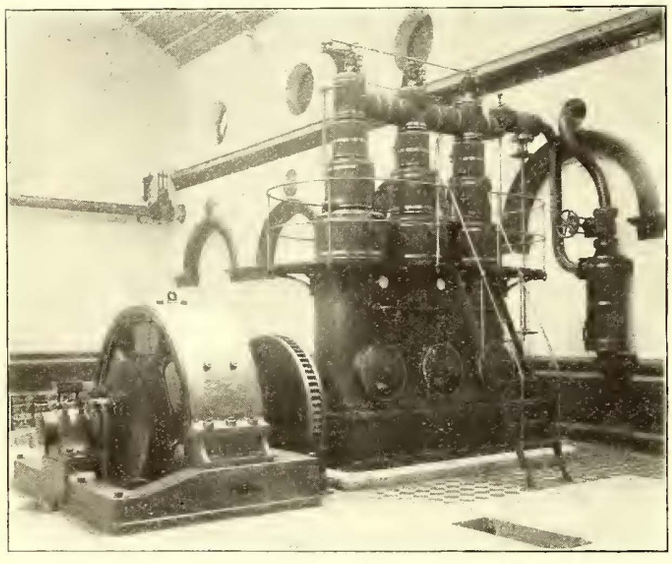
Funded Debt, total, $66,996,350. Funded Debt, Elevated Railways, $40,297,550. Funded Debt, Surface Railways, $26,698,800.

Willans Engines for Electric Traction

BY A. LAZENBY

Among the many questions which the rapid strides made by electric traction in England recently have brought to the front is that of the choice of engines for driving the generators, and it is only natural that these should be sought among the types which have done good service in electric lighting stations. But the almost universal practice in England of using high-speed engines directly coupled to their dynamos is so different from the lines upon which American engine building has developed, and it has become so customary to regard America as the home of the traction industry, that any departure from the methods practised there have been viewed with suspicion in many quarters, and various objections have been alleged against high-speed engines, by advocates of the older system. It has been stated that they would never stand the heavy work, that they would not govern, would always be breaking down, and were wasteful. These are the principal charges made against them, and especially against one of the most extensively used—the Willans central-valve engine—but experience with this type, at any rate, has proved to be unfounded, as it has worked most successfully in the stations where it has been put down, and bids fair to come into as general use for tramway work as it has done for lighting, for which engines to the extent of over 80,000 h.p. have been supplied, while the total power in use for all purposes exceeds 215,000 h.p.

Small as is the electric tramway industry in England and on the Continent at the present time, a large proportion of the work is being done by this type of engine; more than 6000 h.p. is in use and on order, although almost the whole of the demand has sprung up within the last two years. The first tramway plant with these engines was put down in 1893 at Hobart, Tasmania, three engines of 200 h.p. being supplied. They have run the line continuously ever since with complete satisfaction, and so perfectly have they met the conditions that no repairs have yet been necessary. The next was an installation of three engines of 170 h.p. for



DIRECT COUPLED UNIT—BRADFORD

the Dublin trams, which have now been at work for about two and one-half years. They have also worked without hitch the whole time, but, being coupled to dynamos of about twice their capacity, they have naturally had to run under very adverse conditions, and this circumstance is principally responsible for the report, which has naturally been made the most of by advocates of other systems, that high-speed engines would not govern, the real reason being that they were grievously overloaded. The City and South London Railway has one engine of 240 h.p. running in parallel with several slow-speed vertical rope driving engines, and its quick response to the governor was at first the cause of some difficulty, for, when the load suddenly increased, it used to take it up, in advance of the others, with the result that the interrupters were constantly being thrown out. This difficulty has been met by setting them for a 50 per cent overload, since when there has been no trouble. There are also installations varying from 200 to 700 h.p. at Hartlepool, Paris, and Liège, at which last place governing guarantees rivaling those often stipulated for in America were demanded and have been successfully kept, the authorities having expressed great satisfaction at the performance of the engines.

Latterly the demand has been for larger engines, owing to the activity among municipal authorities; one engine of 1500 h.p., running at 200 r.p.m, has already been ordered by the Liverpool Corporation, and several more are in contemplation, including one of 2400 h.p. The Bradford Corporation is also putting down two engines of 700 h.p. running at 300 r.p.m.

It is not proposed here to give a detailed description of the Willans engine, the principle and construction of which are well known, but rather to offer some remarks on its particular qualifications for traction work.

Economy.—Mr. Willans's historic experiments have placed the Willans engine beyond doubt on an equality with the most economical types of engine in existence, and prolonged experience in commercial central stations has confirmed the results of the testing room. This economy is principally due to three things—the short steam passages, the perfect system of drainage, and the small range of temperature in each cylinder. In many engines it is impossible to avoid long passages, but in the Willans the passages of the steam are reduced to the smallest possible limits owing to the use of the central valve arrangement, the only engine to compare with it being probably the Corliss.

Drainage.—The best-drained double-acting engines are probably horizontal engines with separate Corliss, or similar, exhaust valves beneath the cylinder. The water lying on or draining down toward the cylinder bottom is pushed along by the piston until it reaches the exhaust port, but unfortunately only just before the moment of closing; however, it fills the port, and lies in it until the exhaust opens again—ready, it is to be feared, to rob the incoming steam of some of its heat during the next admission. In vertical engines at the bottom end of the cylinder the drainage may act continuously, so far as gravity can effect it, during the whole exhaust stroke, but in the upper end the water will rest on, and be carried up by, the piston until it rises above the port, when, as in the horizontal engine, only a very brief time is available for it to run away; much water probably lies permanently upon the piston, with injurious results from the point of view of initial condensation. If the exhaust port is also the admission port, the water cannot even lie there until the next exhaust; it is thrown back into the cylinder by the incoming steam. In none of these cases is the drainage satisfactory.

The drainage arrangements in the Willans central-valve engine offer a striking contrast to the foregoing. The piston is dished downward in the center, not so much with the idea that the water lying on the piston will drain into the center by itself, but to utilize the inertia of the water to drive it toward the center during the rapid up-stroke of the piston. There is a ring of ports in the trunk or hollow piston-rod, flush with the surface of the piston, and, of course, moving with it and during the whole exhaust stroke there is a rush of steam from the sides toward these ports in the center, sweeping over the face of the piston and assisting the action last referred to. In fact, the exhaust port is always in the best possible place for drainage; it is as though the exhaust port in the horizontal Corliss engine moved along the cylinder bottom so as to be always just ahead of the piston. It is an ideal exhaust arrangement, and there is no apparent possibility of applying either it or anything else as good to a double-acting engine. It is probable that it involves a saving of about 15 per cent in the steam consumption, in comparison with other vertical engines in which ordinary slide or piston valves are used, common to admission and exhaust.

The small range of temperature in each cylinder is due to the fact that the Willans engine works throughout on the Cornish cycle.

The "Cornish Cycle."—In the Cornish single-acting pumping engine the steam acts only on the top of the piston, the space below being at the time in communication with the condenser. To develop the power of the engine it would only be necessary to open communication during the up-stroke between the upper end of the cylinder and the condenser, and to maintain communication permanently between the lower end and the condenser, the piston would ascend in equilibrio, with vacuum on both sides of it. Viewing the upper end of the cylinder by itself, this is exactly what takes place in every ordinary double-acting engine, while the whole arrangement described, including permanent vacuum below the piston, is the most obvious and natural arrangement for a single-acting engine. In Watt's Cornish engine there is, however, another valve which cuts off the space below the piston from the condenser, at the moment when the steam above the piston commences to exhaust, and the exhaust takes place from above the piston into the space below it, and not direct into the condenser; the piston still ascends in equilibrio, but with higher pressure steam on each side of it. By this system Watt raised his pumping engine to a pitch of excellence never attained by his later double-acting engines; in fact, so economical (for a simple engine) is the old Cornish engine that in the controversies attending the intro-

duction of the modern compound engine, the former was quoted to show that a simple engine could work as economically as a compound. The claim was excessive, except at very low pressures, but neither side realized that the Cornish engine is *not* a simple engine—it is halfway to a compound. Fig. 1 is a theoretical diagram from a simple engine in which the working cylinder opens alternately to the boiler and to the condenser. If it is also single-acting, and advantage is taken of that fact to introduce the Cornish cycle, the two diagrams given in Fig. 2 are obtained from

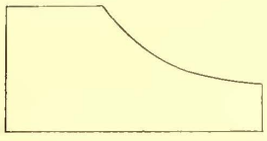


FIG. 1

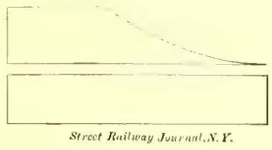


FIG. 2

the two ends of the cylinder, instead of the single diagram in Fig. 1. There is the same expansion in a single cylinder, but the range of temperature in it is only from admission temperature to release temperature, and not to condenser temperature. In other words, though the expansion is in one stage, the fall in temperature is divided over two; hence a great reduction in initial condensation, and marked economy.

This cycle is applied when the engine is compound, or triple expansion, in the intermediate and high pressure cylinders, the low pressure and intermediate cylinders taking the place of the condenser. It is, however, frequently omitted from the low pressure cylinder which then exhausts directly into the condenser from the working end of the cylinder. But the Willans engine, even if the last stage is not used, has always one definite source of superiority over other engines working with the same number of expansion-stages (i. e., compound or triple), namely, in respect to the smallness of its temperature-range in each cylinder. The explanation is that, in all the expansion-stages except the last one (i. e., in the high pressure and intermediate stages), the Willans engine works necessarily upon the Cornish cycle. In double-acting engines the exhaust steam passes direct from one cylinder to the next, placing the two more or less in communication through the receiver, and therefore exposing the first of the two to the same temperature as the second; in the Willans engine each cylinder exhausts successively in the Cornish manner, and the power developed in each is represented, as in the Cornish engine, by two diagrams—that from the cylinder proper, and that from the "receiver." The effect is that the temperatures of the high pressure and intermediate cylinder, for instance, do not overlap, as in other engines they do, and the range in each is consequently smaller.

While it is not necessary to give figures for consumption in an article such as the present, it may not be out of place to say that a triple expansion Willans condensing engine will use about 12½ lbs. of steam per i.h.p hour, and a compound non-condensing one. about 20 to 21, under suitable conditions.

Durability.—The idea that because a machine makes many revolutions a minute it must wear out more rapidly than a slow-running machine, seems to have the force of an axiom for some minds. Yet there is nothing axiomatic, nor even, to the instructed, probable about it. In the first place, high speed is a very winnowing fan in the matter of workmanship. It is surprising what a slow speed engine can endure for a season in the way of bad workmanship; but not so the high speed engine. In the next place, the piston speed is very much lower than in slow-running engines, owing to the short stroke; about 525 ft. a minute is the highest piston speed in any single-acting electric light engine. The wear of piston rings and cylinders is bound, other things being equal, to be proportional to the piston speed, and this applies also to valves and glands. In one important point, however, other things are not equal, but are largely in favor of the single-acting engine. The system of packing rings used in the Willans engine, which cannot be used in double-acting engines without much complication, has decisive effect upon cylinder wear, and even if one went back to the records of the old vertical beam engines, which used to steam at 30 lbs. per square inch, or less, and have been described as "revolving occasionally," it may be doubted whether such evidence of good wear could be found as is now to be quoted in favor of the fastest running engines.

The makers of the Willans engines have for some years past lost no opportunity of obtaining and recording exact measurements of wear, where they have been called in to carry out overhauls or examinations. The results are systematically recorded, and they show, speaking generally, an absence of wear beyond all claims made or expectations formed by those interested in the engine. On March 9, 1895, a 80 i.h.p. compound non-condensing engine used for lighting one of the largest hotels in London, and stated to have run (at about 400 r.p.m.) for fourteen hours per day, including Sundays, was taken down for overhaul—never having been so much as taken down for examination since its erection, in five years previously. The report states that "all the parts were carefully measured, and the h.p. and l.p. trunks showed no perceptible wear, and were replaced the same as they were taken out. On measuring the h.p. cylinders, we found they were 2-1000ths of an inch larger than our standard size, and the l.p. cylinders were the same; still they were quite round. All piston rings and gland rings were replaced without any repair whatever. The whole of the repairs to this engine, including taking down and re-erecting, were executed in twenty-four hours." Similar instances of practically no wear are shown in cotton mill engines.

Unfortunately none of the engines doing traction work has yet been systematically overhauled, but there is no reason to believe that the wear is any greater than in the instances given above, and the fact that they work well is proof conclusive of their power

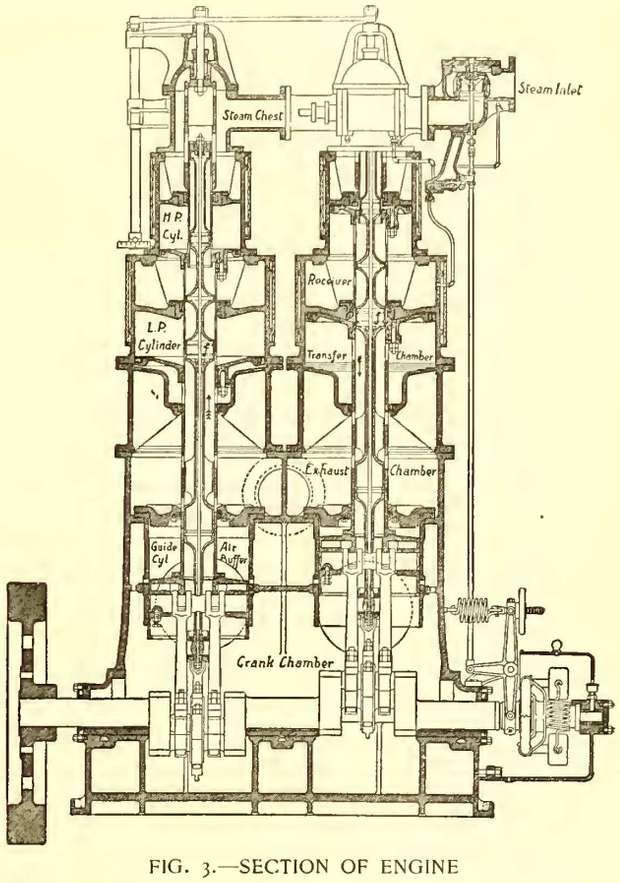


FIG. 3.—SECTION OF ENGINE

to deal with rapidly changing loads. It seems to be often assumed that an electric traction engine is exposed to exceedingly violent shocks, and that the high speed engine with its light moving parts must be unable to sustain them. In reply to this it must be noted first of all that the shocks are much mitigated if not entirely absorbed by the fly-wheel, which affords complete protection to the engine, and that the parts exposed to damage are the armature and armature shaft. This was proved beyond a doubt at Hobart, where more than once the shafts were twisted off between the armature and the fly-wheel during short circuits. The trouble was cured by increasing the size of the shaft, and diminishing the weight of the fly-wheel. The illustration in the description of this station which appeared in the STREET RAILWAY JOURNAL of August, 1894, shows to what mere discs the wheels were reduced. In no case did the engine sustain damage. In the second place, it is sometimes forgotten that even in ordinary running, whether the load varies or not, the moving parts have to be entirely stopped and restarted many times a minute. For instance, in a 450 h.p. engine the reversals amount to 700, and even in a 800 h.p. engine to 540 per minute. It is hardly to be supposed that the stresses put upon the reciprocating parts of the engine by changes of load are going to be more violent than those caused by these reversals, which form part of its every day work. This is as regards the piston rods, and pistons principally. The effect of the inertia is eliminated from the crank shaft by the well-known air cushioning arrangement which keeps the connecting rod brasses constantly pressed down upon the crank shaft, and the crank shaft upon the journals, whether the load be heavy or light, and this is the reason of the extraordinary freedom from wear which these parts exhibit.

Variable Expansion Gear.—It was at one time objected that the Willans engine was entirely unsuited for traction work because it had no variable expansion gear. It was quite true it had not, but the reason was that up till then it had not been wanted. Mr. Willans proved that the economic advantages of variable expansion gear had been considerably overrated, and was of opinion that for lighting work, at any rate, it was recognized that the conditions were altered, and that variable expansion gear was necessary, not so much for economic reasons, as to enable the engine to deal instantaneously with rapid changes of load. An ingenious modification of an old form of gear was devised and adopted, and how rapidly and effectively it works as a means of keeping the speed steady was shown at the City & South London Railway, referred to above.

Interchangeability and Repairs.—Reference has been made to the numerous cylinders of the Willans engine, due to the practice of erecting a complete engine over each crank. By adding to the number of pistons and valves the ring friction is, of course, increased, and it is equally certain that condensation is increased, and economy affected unfavorably, owing to the larger aggregate surfaces of the two or three small cylinders which take the place of what might otherwise be a single large one. On the whole, however, the advantages appear to outweigh the drawbacks. The first and most obvious is even turning moment. Whatever the change in load, in pressure, or in cut-off, it is at least certain that the cranks will be driven equally, and this is an advantage not to be lightly surrendered for only a small gain in economy. But the same tandem arrangement of cylinders is also the condition of the complete application of the Cornish cycle to all the cylinders except the low pressure one; the perfect separation between the temperature ranges of the successive cylinders is impaired if their strokes do not succeed each other at intervals of exactly a revolution as they now do in the tandem pattern; even economically, therefore, there is something to be said in favor of the many small cylinders. Turning to other considerations, it may be thought at first that the large number of small cylinders and multiplication of parts must lead to increased weight and cost, as well as to difficulty in dismantling and overhauling. As to weight, it is almost certain that it is not increased. Cylinders weigh roughly in proportion to volume, but the weight of a piston tends to increase faster than the area; three pistons, each of 1 sq. ft. area, will weigh less than one of 3 sq. ft. area. To cylinder covers the same consideration applies. Piston rods, connecting rods and crank shaft should be unaltered. There may be some saving in machine work, but small pieces are after all easier to machine than larger ones, and pieces which are made in batches of, say, thirty-six, are more economically manufactured than larger pieces made in batches of twelve only. Then the identity of the several lines of parts, and their interchangeableness, are often helps to the user (especially in case of repairs), while the lightness of the individual pieces and the regular and simple routine in removing them make dismantling easy.

Vibration.—The increase of town traction stations gives great importance to this subject, but, as it has recently been somewhat fully dealt with in a paper contributed by Mr. Robinson, conjointly with Captain Sankey, R. E. to the Institution of Naval Architects, it is not proposed to treat it at length on this occasion. Briefly, however, it may be stated that the principal cause of vibration is the alternate increase and diminution of the pressure of the engine upon its bed-plate, due to the alternate upward and downward inertia of the reciprocating parts. In an ordinary vertical side by side engine this cannot be eliminated without considerable complication in bob weights, ets., if at all, but where the tandem arrangement is adopted, as in the Willans engine, with the moving weights on each crank equal, the problem is simplified, and with a three-crank engine with cranks at equal angles the vertical forces are entirely eliminated and nothing remains but a very small couple tending to rock the engine endways. This has been proved in practice to be a negligible quantity. With a two-crank engine, with cranks opposite to one another, the vertical forces do not entirely disappear, though they are very much smaller than those in an ordinary engine. This extraordinary freedom from vibration given by this system is now generally recognized, and the majority of Willans engines are now being built with the three cranks, and several of the large stations in crowded localities are even replacing two-crank Willans engines by those with three.

Governing.—In addition to the foregoing matters, it might be of interest to say something about the governing of central-station engines. This subject, however, needs a paper, to say the least, to itself; moreover, experience with single-acting engines can teach no lesson substantially different from what may be learned from double-acting engines, unless it be that the former, by reason of high speed and many impulses per minute, and the small amount of steam contained within the engine at any one time, are somewhat easier to govern. As regards steady running, in the sense of smallness of variation in speed during each revolution, the high speed engine has, of course, enormous advantage. The engine before referred to as driving a flax mill in Belfast gives an almost perfectly straight line upon the recorder, although the instrument used is so delicate that it will show the change of speed during each revolution of even a high speed engine. In this engine, with three cranks, there were 900 impulses per minute, all exactly equal, and it was not wonderful that with a pulley fly-wheel weighing only 6 tons, and of 5 ft. diameter, better results were attained than in slow-running engines with fly-wheels several times as heavy.

Meeting of the Pennsylvania State Street Railway Association

The seventh annual meeting of the Pennsylvania Street Railway Association was held in Scranton, Oct. 19. The meeting was called to order in the Board of Trade rooms, at 11 A. M., by Frank Silliman, Jr., general manager of the Scranton Railway Company, who presided in the absence of the president, R. E. Wright, of Allentown. After a brief address of welcome by the secretary to the Mayor of Scranton, the roll was called and showed about fifty delegates present, the following cities being represented: Allentown, Altoona, Carbondale, Erie, Philadelphia, Easton, Harrisburg, Greensburg, Johnstown, Lehigh, Lebanon, Middletown, New Castle, Lancaster, Scranton, Norristown, Girardville, Pottsville, Reading, Wilkesbarre, Williamsport, Warren, Washington and York. After a short intermission for lunch, the regular business was taken up. Papers were read by E. H. Davis, general manager of the Williamsport Passenger Railway Company, on "Parks and Amusements," and by A. F. W. Walter, secretary and treasurer of the Allentown and Lehigh Valley Traction Company, on "A System of Collecting Fares and Checking of Employees." These papers will be found elsewhere in this issue.

The secretary then read the report of the committee on standing rules of government of conductors and motormen which was made at the annual meeting of the American Street Railway Association at Boston, last September. The treasurer's report showed a balance of $1,694 in the treasury. A vote of thanks was tendered to the Board of Trade for the use of the rooms, and to the Scranton Railway Company for its courtesies.

The election of officers resulted as follows: President, Frank Silliman, Jr., of Scranton; first vice-president, William B. Given, of Lancaster; second vice-president, Dallas Sanders, of Girardville; secretary, S. P. Light, of Lebanon; treasurer, W. H. Lanius, of York; executive committee, Frank Silliman, Jr., S. P. Light, E. C. Felton, of Harrisburg; W. H. Lanius, C. P. King, of Pottsville. The next meeting of the association will be held at Lancaster.

In the evening a complimentary banquet was given to the delegates and visitors by the Scranton Railway Company. The programme was an impromptu one. Mr. Silliman acted as chairman and the dinner was served in the Board of Trade rooms. On the morning of Oct. 20 an excursion was arranged over the lines of the Scranton Railway Company.

The only extensive exhibit of street railway apparatus was made by Elmer P. Morris at parlors in the Hotel Jermyn. Samples of the various lines of supplies handled by Elmer P. Morris were shown. Mr. Morris and Mr. Harrington entertained all visitors in the royal style for which they are famous and their parlors were a general rendezvous for all the delegates and visitors during the convention.

NEWS OF THE MONTH

The Lindell Railway Company, of St. Louis, had a peculiar accident on one of its lines on Sept. 17. A car left the track at the corner of Taylor and Cottage avenues, crossed the street and sidewalk and struck the front of a drug store. The car was running at a high speed and the momentum forced it half way into the store. Two passengers on the car escaped injury by jumping and the motorman was only slightly hurt.

The Hartford Street Railway Company has had a new electric construction car built at the Vernon Street shops. The car is painted red, the same as the regular passenger cars of the company. It has a box compartment with a movable platform on top. The car will be used principally for making repairs on the suburban lines, and plenty of room is afforded for carrying tools and all things neeessary for making repairs.

A committee on standards of measurement, appointed by the American Association for the Advancement of Science, has recently made a number of experiments looking to a redetermination of the ampere in the terms of the electro-chemical equivalent of silver. The experiments were carried on at Ann Arbor, Mich., by Prof. Patterson and Dr. Guthe. It was found that the value of an ampere should be one part in 1,000 to one part in 800 larger than the present accepted value; that is, the electro-chemical equivalent of silver should be increased from Lord Rayleigh's value (the one usually employed heretofore) of 0.001118 to 0.0011191 or 0.0011194.

It is officially stated that control of the Nassau Electric Railroad Company, of Brooklyn, has been sold to the interests controlling the Brooklyn Heights Railroad Company.

The Black River Traction Company, of Watertown, N. Y., has inaugurated an express and baggage service on its lines. The packages will be carried on the regular cars, and a charge of ten cents will be made on all packages under 100 lbs. in weight. The Black River Traction Company has had a large number of stamps printed which are sold for ten cents each. The stamps are designed to be pasted on all bundles and packages carried by the cars of the company. This system of using stamps will greatly facilitate the collection of express charges, as it relieves the conductors from the necessity of keeping records and making change, etc. The new arrangement is proving very popular with the public.

The Hagerstown Street Railway Company, of Hagerstown, Md., has a large force of men at work clearing away the débris which covers a large amount of valuable machinery at its power house. On Oct. 19 a heavy wind storm blew down the sides of the power station, completely covering the generator, shafting, belting, belts, tools, etc. The power station was a new one and the roof had not yet been placed on the building, although a temporary covering had been erected to protect the machinery. The officers of the company are of the opinion that most of the machinery can be repaired without much difficulty.

The North Birmingham electric division of the Birmingham (Ala.) Traction Company was officially opened for traffic on Oct. 15. Several prominent people were taken over the line and the initial trip was thoroughly enjoyable to all present.

Judge Sewall, of the Superior Court at San Francisco, Cal., has decided that only municipal authorities have the power to fix the rates to be charged on street railway lines. He also holds that the term "railroad" in the statutes does not apply to the surface railways.

The Brooklyn Elevated Railroad Company has had a number of cars built with cross seats entirely, instead of the usual method of having eight cross seats in the center and the rest along the sides. The new cars are equipped with the Hale & Kilburn "Walk-over" seats.

Ordinances have been passed by the Cleveland (O.) City Council requiring the Cleveland Electric Railway Company to sell seven tickets for twenty-five cents on its Cedar Avenue line and the Cleveland City Railway Company to make similar rates of fare on its Kinsman Street line. The question of lower rates in Cleveland has been agitated for some time, but the above ordinance is the first time that the matter has come to a decisive vote in the Common Council. The street railway companies will undoubtedly carry the matter to the courts in order to test the validity of the Council's decision.

It is announced that a syndicate composed of prominent gentlemen has been formed to build a steam railroad from Canton to Han Kow, China. This road, in connection with a railroad which a Russian-Belgian syndicate is to build from Han Kow to Peking, will give direct connection with the capital and the interior provinces of the Chinese Empire, which will be of immense value to the government, as well as tending to develop the populous and fertile region through which the road passes. W. B. Parsons, formerly chief engineer of the Metropolitan Street Railway Company and also engineer of the Rapid Transit Commission of New York City, has been engaged as engineer for the American syndicate and sailed from San Francisco for China on Oct. 10. Ex-Senator Calvin S. Brice, of New York, has been the chief promoter of this enterprise and the shareholders in the syndicate include the Standard Oil Company, the Rockefellers, Levi P. Morton, George T. Bliss, J. P. Morgan & Co., and many other prominent officials of large trust and banking companies. It is expected that the road will cost between $40,000,000 and $50,000,000.

At the annual meeting of the Toledo Traction Company, held Oct. 11, the following officers were elected: Chairman board of directors, Norman B. Ream; president, Albion E. Lang; vice-president, Thomas H. McLean.

The employees of the Lowell (Mass.), Lawrence & Haverhill Street Railway Company went on strike recently and caused considerable trouble by interfering with the operation of the cars, which were run by new men.

An electric car of the Montreal Park & Island Railway Company which had been fitted with roller bearings was tested on the track a few days ago, and the system was pronounced very satisfactory by a number of railway men and experts who were present.

Official announcement was made last week that the directors of the Fair Haven & Westville and the New Haven (Conn.) Street Railway companies have agreed upon consolidation of their lines under the management of the former corporation. This brings practically the entire street railway service of New Haven under one management. The two roads have a combined length of about 50 miles.

The street railway companies at Chicago and Philadelphia have been taxed to their fullest capacity during the past few days to handle the large crowds attending the Peace Jubilees at those cities. These jubilees were very successful, and were attended by visitors from miles around. One of the principal features at both cities was the effects secured by thousands of plain and colored incandescent lamps arranged in many different designs, and it is undoubtedly true that Chicago and Philadelphia during the jubilees were the most brilliantly and artistically lighted cities in the world. The street railway companies in both cities aided in many ways by extra lights, special decorations, etc., to increase the display. The companies in Chicago were particularly active in this respect, all the cars carrying flags and colored lights. The incandescent bulbs in the interior of the cars were colored red, white and blue, this giving a very pleasing effect.

The following application for a position on the Cleveland, Berea, Elyria & Oberlin Electric Railroad was received recently by A. H. Pomeroy, the president of the company: "Mr. Poumroy Dear Sir I am Straencher to you But Here is a few Lines From me to you I have taken The upeertueneta to Be a Employe of The Eleaghttery rod from Cleveland to Oberlin, Or as it Reeds Cleveland Brea, Elyria & Oberlin, I have Ben to Roackport this Morning And, Wanted to put in aplercaion But the Superintend told me they Ded not take Enny Applercaion ther So it was not counvenet for me to Come to the City to See you, So I aesk the Superinten A Bout Rightin to you and he Saes Send in your aplercaion a Long in With your Letter. Now Mr. if you if you will Except My Aplercaion And give me a Joup I will Aes Near Right as the Neaxt Best Man. My Aplecation is for Mouterman if it is Near er. I will Send a Reachemond But you Might inQuier off Mr W. Len Mouterman off this Road. My State ment I Doen't Drink Nor Smoke, My Age is 27 Wate 165 Hieuth 5.10 feet, Light Blue Iyes Good Nateur and Steadey at My Weark. I think is all Let me hear from you Ples Yours truly —— —— I am Marred"

The second annual entertainment of the Metropolitan Street Railway Association was held in Carnegie Hall, New York City, Oct. 1. One of the pleasant features of the entertainment was the presence of twenty-eight of the employees of the road who served in the late campaigns in Cuba and Porto Rico. The association was organized two years ago by the employees of the Metropolitan Street Railway Company for the purpose of securing a mutual improvement and sick benefit fund. During the last year it has collected dues to the amount of about $14,000, and the total income was $22,800. Sick benefits were paid to the amount of $9,255;

death claims, $3,547, and medical fees, $2,257. The president of the Metropolitan Street Railway Company is the president of the association.

The Brooklyn Heights Railroad Company, of Brooklyn, N. Y., is operating on its Third Avenue line a new combination open and closed car which is designed both for summer and winter service. The car was built by the J. G. Brill Company, of Philadelphia, Pa.

The Central Passenger Railway Company, of Baltimore, Md., is installing a generator which is to act as a booster in connection with the storage battery plant at the power station.

An interesting decision has just been handed down in a Brooklyn case brought against the Brooklyn Heights Railroad Company. The suit was brought by a gentleman who secured a transfer from one of the company's lines to an intersecting line. It was during the rush hours and all of the cars were crowded to the doors. The gentleman holding the transfer determined to have a seat, and he waited for half an hour before a car which was not crowded came along. He boarded the car, but the conductor refused to accept his transfer ticket on the ground that the time limit had expired. The court holds that the plaintiff had a right to wait all day if necessary until he could get a seat.

An unusual incident is reported from Springfield, Mass. According to the usually veracious Springfield "Republican," a letter box that was attached to an electric light pole on the corner of Main and Worthington streets became so charged with electricity that it was impossible to remove the mail at the time of the regular collection.

H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, has received a letter from the Seventy-first Regiment Veteran Association conveying its keen sense of appreciation and heartfelt thanks for the services given to the sick and enfeebled men of the Seventy-first Regiment by the Metropolitan company upon the return of that regiment to New York. Mr. Vreeland's company placed a large number of cars at the disposal of the volunteers when they arrived and the soldiers were carried from the Battery to their armory without charge.

It is announced that the Dry Dock, East Broadway and Battery Railway Company, the Union Railway Company and the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, of New York City, have been consolidated with the Third Avenue Railroad Company, which already owns most all the stocks of these companies. These stocks amount to about $5,700,000. The Third Avenue Railroad Company will issue $2,000,000 additional stock for the purpose of retiring the stock of the other companies and also as preliminary to changing the equipment of the road to electricity.

A company has been formed for the purpose of building a narrow-gage electric railroad from San Luis Potosi, Mex., to the mining district of Rio Verde, 6 miles distant. The name of the company is the Potosi & Rio Verde Railway Company. It has a capital stock of $200,000. The directors are George F. Peabody, Edward M. Shepard, A. Foster Higgins, Chas. J. Nourse, Jr., Herbert H. Dean, Samuel H. Ordway and Francis N. Holbrook, all of New York City, and Donald C. Brown and Robert S. Towne, of San Luis Potosi.

The employees of the street railway company at Waco, Tex., struck on Oct. 5 for shorter hours. The men now work twelve hours a day and receive $1.50 therefor. They demand that nine hours be considered a day's work, with the same pay. The company secured new men and endeavored to run its cars, which resulted in several small riots.

A daily newspaper of New Orleans, La.. prints the following interesting statistics relative to the street railway systems in that city: In the past ten years the number of passengers carried annually has increased from 26,340,000 to 43,037,691. The equipment of the different lines with electricity has reduced the distance to the limits of the city from an hour and a half to thirty minutes, and has enabled the building of homes by business men in rural suburban districts which were previously inaccessible. The five different companies in the city paid in taxes and in licenses during the year 1897, $168,900; in improving the streets, $70,612; miles of new track laid, 9; total cost of new track, $130,040; total number of men employed, 2020; total number of new cars, 24; total cost of new cars, $72,100.

A Delightful Trip

On Sunday, Sept. 25, General Manager John I. Beggs, of the Milwaukee Electric Railway & Light Company, assisted by Herman Falk, of the Falk Manufacturing Company, extended a pleasant excursion to a number of street railway friends from Chicago. The weather man did his part well and provided a most delightful day. The guests left Chicago by private car, via C. & N. W. Ry., at 8:30 A. M., arriving at Milwaukee at 10:50 A. M. As the train pulled into the railway station on the lake shore Mr. Falk's beautiful steam yacht, "Eva," dressed in gala attire and anchored a few hundred feet from the shore, fired a welcoming salute. After greetings had been exchanged, the entire party boarded a special car which was waiting at the door of the railway station and started for Waukesha and Waukesha Beach. The car was one of the new double-truck, cross-seated cars which Mr. Beggs has adopted as the standard for the Milwaukee system. It was built by the Barney & Smith Car Company and was equipped with Christensen air brakes; the appointments were completed by spacious hampers and a table at one end of the car, from which a "dutch lunch" was served after Waukesha was passed. On arrival at Waukesha Beach the party was given a steamer ride around Pewaukee Lake, after which the car was again taken for the return trip to the city.

The keenest interest was taken in this interurban line from Milwaukee to Waukesha. It leaves Milwaukee via National Avenue and, from the western limits of the city, parallels the C. & N. W. Ry. through a beautiful rolling country. With the exception of two or three kinks, which, however, are now being taken out, the line is straight and laid upon a private right of way. When completed it will be double tracked its entire length but at present only the first track with sidings is laid. The grading has been done with great care and neatness and the side poles supporting the overhead work are set at exact intervals of 100 ft., with a uniform rake, and neatly painted. The track is laid with 56 lb. T-rail in 60 ft. lengths, connected with Weber joints, and No. 000, figure-8 hard drawn copper is used for trolley wire. The construction and equipment of the line in entirety and detail evidences the most careful design and workmanship. It was the unanimous opinion of all present that this is the finest interurban electric line yet constructed. On the return trip an effort was made toward speed and the first 11.58 miles on the Waukesha end of the line were covered in 22 min. flat. The entire 26 miles from the beach to the Pfister Hotel were covered in 55 min., notwithstanding the fact that in the last 2 miles the car was delayed by the regular city cars.

On returning to the lake front, the party started for Whitefish Bay, a portion going with Mr. Beggs in the special car and the remainder with Mr. Falk on the "Eva." On arrival at Whitefish Bay those who had gone up on the yacht returned on the car and vice-versa and the party reunited again at the Hotel Pfister where an elegant dinner was served. The tables were set in the shape of a T and were laid for 28 covers. At the close of the dinner James R. Chapman, on behalf of the West and North Chicago Street Railroad systems, G. O. Nagle, on behalf of the Chicago City Railway Company, and H. M. Sloan, on behalf of the Calumet system, expressed their appreciation of the delightful entertainment and hospitality. Mr. Beggs replied with a few brief remarks in which he stated that the distinct purpose of it all had been to bring the railway men of the two cities into closer acquaintance so that each could be more helpful to the other. That his idea was apt and opportune was certainly felt by all present and the sentiment was most heartily applauded. The party then left for the Northwestern Depot where the guests bade adieux to their hosts and Milwaukee. So charming had been the hospitality that it was the one theme of conversation during the return journey to Chicago and many are the delightful memories of the day that will long be carried by each of the party. As H. M. Sloan expressed it "the entertainment was unique in its way, and, as it was designed, will bear fruit in doing considerable good."

The party comprised the following gentlemen: President M. K. Bowen, Secretary F. R. Greene, Treasurer T. C. Penington, Superintendent G. O. Nagle and Assistant-Superintendent A. C. Heidelberg, Chicago City Railway Company; General Manager J. M. Roach and Manager Electrical Department J. R. Chapman, West & North Chicago Street Railway Companies; Assistant-General Manager G. A. Yuille, Superintendent F. S. Fuller, Secretary and Treasurer L. S. Owsley, Engineer F. W. Carr and Pur-

chasing Agent E. A. Blodgett, West Chicago Street Railway Company; President John Farson, General Manager H. M. Sloan, and Engineer G. H. Binkley, Calumet Electric Street Railway Company; Superintendent Wm. Walmsley, South Chicago City Railway Company; Secretary C. S. Leeds, Suburban Railway Company; General Manager C. D. Wyman, New Orleans Traction Company; General Manager E. D. Downs, Citizens' Traction Company, Oshkosh; former General Manager C. P. Wilson, Sioux City Traction Company; General Manager J. I. Beggs, Vice-President H. C. Payne, Director Charles Pfister, Director F. G. Bigelow, General Superintendent T. E. Mitten, Auditor H. C. Mackay, Chief Electrician O. M. Rau and Surgeon C. H. Lemon, The Milwaukee Electric Railway & Light Company; President H. Falk, Vice-President A. Hoffman, Secretary and Treasurer E. A. Wurster and Superintendent C. C. Smith, Falk Manufacturing Company; Secretary C. L. Jones, Western Gear Company and J. L. George, of Chicago.

Parks and Amusements*

BY E. H. DAVIS

It has only been since the introduction of electricity as a motive power that street railway companies in this State have attempted to create travel, in addition to their regular patronage. This no doubt has been due to the fact that many street railways, after being equipped electrically, were not as profitable as expected, and so it became necessary, or was deemed advisable, to stimulate travel by new methods. In many cases, where electric street railways have been operated at a profit from their general business, they have not gone into the amusement business. But to have a park, and to furnish amusements, to create travel, has become fashionable, and like all luxuries, has in many cases proven expensive. Whether a street railway property that cannot be made profitable without a park is a desirable property, and whether a park can be made a source of profit from year to year, and thus keep the property alive financially, must be decided by investors in each case.

In a favored few cases public parks, or natural resorts, create travel at no extra expense to the street railways. In this event, or where private capital maintains a park, it is neither necessary nor advisable for a street railway to have its own park. Boston has but one park maintained by a street railway, and New York practically none.

Where no natural resorts exist, it has become quite customary for street railways to make parks and furnish amusements for the creation of travel. A danger to be avoided is the expenditure of too much money to make parks attractive, as the travel created by a new park is very large while the novelty lasts, and when curiosity is satisfied falls off very materially, more than one-half.

As regards the management of the park itself, when it is large, well laid out, attractive, and well equipped with the minor amusement features, the policy should be to permit entrance to the park free only to patrons of the road, charging others a small admission. The public should be educated to the fact that the railway park is not a public institution, but a business undertaking, and to be operated at a satisfactory profit, or not at all.

It has been the experience in many cases that the ordinary travel is not sufficient to pay for the proper maintenance of a park, and it therefore becomes necessary to hold and increase the travel created by the park itself by the furnishing of amusements. The amusements generally furnished now require the manager of the street railway to add to his few other duties that of a theatrical booking agent, and as bands and musical organizations in most cases will not prove profitable for a season, recourse has generally been made to theatrical entertainments, changing weekly.

It has been said of parks in Pennsylvania that they are not operated upon the most profitable basis; that all entertainments should be free and that the increased travel and receipts from park privileges would result in a greater profit than if an admission fee be charged to the attraction. However that may be, until satisfactory attractions can be secured at more reasonable prices than has been the case up to the present time, the experiment is not likely to be generally tried. The character of the amusements furnished must depend largely upon the tastes of the patrons of the street railway. In some cases a good opera company has been maintained throughout the entire season, and with success. In others, and the majority, cheaper vaudeville companies, changed weekly, have also been profitable. It has been endeavored to cheapen the cost by using the same attractions in a number of parks, but owing to the variety of public tastes it has been found difficult to make such plan successful.

* Paper read at the meeting of the Pennsylvania Street Railway Association, Oct. 19-20, 1898.

The custom has become general to charge a small admission fee to these amusements, and it is the intention and hope of each railway manager that such admission fee shall at least pay the cost of the amusements, but I doubt if such has been the general rule. In attempting to accomplish the desirable results two classes of amusements have been tried, one costing not over $250 a week, changing weekly, and another, of a much higher grade, costing $350 a week and over, and running a season or a number of weeks. Taking into consideration the loss due to bad weather and other attractions in the town or city, the first class is more likely to prove satisfactory.

The varied experiences of park managers and the difference of opinions as to the best kind of amusements afford some basis for the statement that parks and amusements do not secure an adequate return for the time and money expended by street railways, and that in smaller towns and cities with limited patronage investments in parks and amusements should be made only after the most careful consideraton, and the benefit of the doubt given against rather than in favor of such investments.

A System of Collection of Fares and Checking Employees*

BY A. E. WALTER

We may not be able to advance any new ideas upon the subject of collection of fares and checking the work of street car conductors, but we will endeavor to outline a system which we believe would give good results to any company adopting it. The system we shall describe is practically that in use on the lines of the Allentown & Lehigh Valley Traction Company, and we find that it gives very good satisfaction.

Each car should be equipped with two registers, one of which should be of particularly reliable manufacture, with plain, large figures, so that the state of the register as to the number of fares recorded at any point on each trip could be easily read at a glance. Upon this register nothing but cash fares or tickets representing exact cash fares should be recorded. The other register should, of course, be reliable, but if economy is necessary or desirable, one of less expense could be used. Upon this register should be recorded all transfer and complimentary tickets, also commutation tickets, if such are sold at reduced rates. Transfer and complimentary tickets should not be recorded on the same register with cash fares. Companies allowing this to be done place before their employees temptations which are not easily resisted by those inclined to do wrong. All street railway officers are familiar with the various methods by which their companies may be defrauded by improper use of transfer tickets by employees and other persons. By the use of the same register for cash and tickets, it is an easy matter for conductors to substitute transfers for cash by making proper punch records on transfers and exchanging with each other.

Conductors should be furnished a blank form of report on which to keep the records required by the company, local conditions as to what information is desired of necessity being considered. In the main, however, for each trip there should be ruled spaces for entering car numbers, time, places of starting and ending trips, reading of registers, number of fares, transfer and complimentary tickets and the amount of money collected. When starting on trips conductors should record in the proper spaces on report blanks place and time of starting, car number and reading of cash register. The reading of the ticket register should be kept on envelopes in which transfer and other tickets are to be enclosed and reported each trip. At the end of each trip the reading of the cash register should again be recorded, from which should be deducted the first reading, the difference being the cash fares collected. The amount collected should be carried in dollars and cents to a column for the purpose. This method of keeping records should be continued by conductors from the beginning of their runs until they go off duty.

As nearly as possible, every person boarding a street car should pay a fare of some kind and conductors should be required to register or report for each passenger carried. Officers of a company, or other persons entitled to free transportation, where it is not desirable to require them to pay fares and refund the money to them, should be furnished a complimentary ticket of some convenient form, which should be collected by the conductor and recorded on the ticket register. Some companies allow their officers and stockholders to use a small paper ticket with their name and official title with the company printed upon it, allowing conductors to collect and record these tickets with cash. We do not consider this a safe method, as there is danger of such tickets being dupli-

* Paper read at the meeting of the Pennsylvania Street Railway Association, Oct. 19-20, 1898.

cated and used by employees to balance registers, substituting them for cash fares.

Members of the uniformed organizations or persons wearing badges entitled to free transportation; that is, policemen, firemen, letter-carriers, or others, or the company's uniformed employees, may be allowed to pass when in full uniform or when prominently displaying a badge designed for recognition by the company, without a record of them being kept by conductors, the dress or badge indicating conspicuously to all other passengers the reason why no fare was collected and registered.

When passengers enter a car it should be the first duty of conductors to see that they are as comfortably accommodated as circumstances will permit, after which fare should be collected, never allowing any passenger to ride a greater time or distance than propriety might dictate before making the collection. If a single fare is paid and no change is necessary, one fare should at once be recorded upon the cash register. If it be necessary to make change, the conductor should receive the passenger's money, but before making change should record as many fares as the passenger wishes to pay, after which the change should immediately be made. Conductors should never be permitted to take money from passengers and go to some other part of or leave the car before recording the fares to be paid and giving passengers their change. One accustomed to the study of human nature and familiar with traveling people in general knows that when a conductor takes money from a passenger, promising "I'll bring your change to you directly," it usually produces a sort of uneasy feeling on the part of the passenger, opening a most favorable opportunity for an argument, also very frequently resulting in the conductor neglecting to register the fare. It is very seldom that a mistake in change is made, a dispute occasioned or failures to register fares occur if the conductor gives change immediately upon payment of fare.

Upon leaving transfer stations, conductors should begin at the front part of cars and collect through to the rear, registering all cash fares as they are collected, but transfer or other tickets not representing exact cash fares should not be registered during the collection. After the conductor has been through the car and all cash fares have been recorded on the cash register, all transfers and other tickets should then be counted and placed in an envelope, upon which should be recorded the number of tickets collected, the time, place, division and any other information desirable, including the signature or number of the conductor. The conductor should then go to the ticket register and record continuously the number of transfers and tickets placed in the envelope, which should finally be deposited at the end of the trip in a box at some convenient place near the main office or a prominent transfer station.

We shall say, for illustration, that conductors should carry $10 of their own money for making change. At the end of their runs they should place on the desk where they make their reports all the money they have with them, including their own money and that which they have collected for the company. They should never be allowed to carry any collections away from the office for making their reports after leaving their runs, but should be required to make out reports and deposit cash immediately upon leaving their cars. Their first duty after placing the money they owe to themselves upon the desk should be to take away the $10 used for change. The amount left belongs to the company, and if they have been careful and correct in registering all fares, making change and reading registers, it will exactly agree with the amount required by their daily reports. If the company has receiving clerks, the cash should be given to them; if not, it should be deposited in a receiving safe, which should, of course, be of such construction that when money is deposited in it it cannot be taken out except by means of the combination lock. Daily reports should not be enclosed with cash, but should be deposited separately. For depositing cash, conductors should be supplied with canvas bags, in which, with the money, there should be enclosed statements of cash on cash slip forms furnished by the company, same to be signed by the conductor. If the money amounts to more than their reports call for, the overage properly belongs to the company, the conductor having first been allowed to take away what belonged to him. All the money then should be deposited and a statement made on the cash slip that there is a certain amount more than the daily report calls for.

If all fares have been recorded the difference might be accounted for by the conductor having made change incorrectly, giving some passenger less than he should, in which case the money should be in the possession of the company to return to the passenger against whom the mistake was made should a claim be made with good proof of such an error. If too few fares have been registered, then surely the overage belongs to the company. At any rate, after the conductor has taken out his own money, considering him to be honest he will give to the company what is left.

On the other hand the conductor may give a passenger too much change, or may make an error by registering too many fares, or passengers may register fares, as often happens, on account of which in either case the conductor should have a shortage of money compared with the amount required by his daily report of registers. In case of shortage of cash in making reports, conductors should either take from their own money enough to balance with the amount required by the registers, or should deposit the amount left after taking out their own money, making a statement to the cashier that, according to their calculations, the registers require a certain amount of money more than deposited.

The first duty of the cashier of the company each morning should be to take the cash from the safe, and in counting the money of each deposit see whether or not the amount enclosed agrees with the statement, making a note of any overage or shortage. After thus checking the cash from each conductor, he proves his own work by adding the amounts of all the statements, thus getting a total result, which should balance with all the cash, considering, of course, the items of shortage and overage.

While the cashier is counting the money and checking the cash statements the run clerk should be checking the conductors' daily reports of registers, carefully auditing each report. The run clerk should begin by comparing the state of the registers as left by the conductors on the previous day, with a report of their readings as taken by the car starter or dispatcher, his statement being compared with the conductors' reports of the readings of registers when taking the cars out for service. If inspectors at the repair shops find it necessary to disturb the state of registers for the purpose of repairing them, a full report from the repair shops should be made to the run clerk, stating the readings of registers before and after repairing, also stating when registers out of order have been substituted in cars by those in repair. In this way there are at least three checks upon the state of the registers from the time the cars go off duty until they are taken out again. Starting in this manner, the run clerk continues to check from one conductor's report to another each register from the time of leaving the carhouse until the car returns, being careful to note whether or not the readings of registers are the same on the conductors' reports leaving cars as on those taking them.

The dispatcher should not allow conductors to examine his reports, but he should be instructed to make his report promptly to the main office for the run clerk.

In comparing one conductor's reports with another the run clerk may find an error which will explain the cause of shortage or overage in their accounts. If there is a shortage which cannot be explained by the checkings of the cashier and run clerk the conductor should be required to pay it. If the shortage is of any considerable amount compared with the money reported, the character and ability of the conductor should be taken into consideration and a thorough investigation made before deciding positively that he should pay it, giving him the benefit of all reasonable doubts that exist. We believe, however, that it is good practice to return to conductors whatever cash is paid into the office by them more than their reports call for and to require them to pay all shortages.

A very convenient manner for collecting shortages and returning overages is to furnish the cashier with a book of blank statements attached to stubs, which are duplicates something of checkbook form, requiring the cashier to send statements each day to all conductors in whose reports there are errors, keeping duplicates in the office. If a conductor's money is short of the amount required he should return the statement with his cash the following day, enclosing the amount of the shortage. If he has deposited more money than called for by his registers, he should then also return the statement with his cash the following day, receipted, keeping from the money of this deposit the amount of overage stated.

The run book should show as nearly a complete record of each day's business as possible to arrange in a condensed form. Each conductor's name and number should be entered with a record of all the cars used, the number of trips made, the miles of each trip and the total mileage of all trips, the number of cash fares, transfer and complimentary tickets collected, number of passengers carried, amount of money reported by each conductor and the total amount reported by all conductors, each division appearing separately, and finally stating the results from the operation of the entire system in convenient statistical form.

The register record is the companion to the run book, and in it the numbers of all the company's cars should be printed, grouping the numbers of closed and open cars separately. Opposite the car numbers should be ruled spaces in which to enter the reading of the registers of all cars before and after their daily service. Of any one car, by taking from the register reading at the close of the day what it was when entering service, the result is the number of fares registered during the day. This should be compared with the reports of all the conductors using that car, and if the registers

have been correctly read, the total number of fares reported by them will equal this difference.

The run book shows the number of fares registered by each individual conductor and the total of all conductors on duty each day. The register record shows the number of fares registered in each car and the total on all cars in service each day. The total fares registered as shown by the run book will agree with the total shown by the register record.

The run clerk should write at the bottom of the pages of the run book and register record on which the entries are made the amount of the gross receipts for the day, and the cashier, after carefully auditing all the entries, finally brings the work to a close by signing his name to the amount written by the run clerk, thus certifying to its correctness.

Electric Tramways for Newcastle, England

The tramway committee of the Newcastle, England, town council held a special meeting recently, at which the reports of Dr. J. Hopkinson and W. M. Colam, on electric or cable traction for the city tramways, which are to be acquired by the corporation on Jan. 1, 1899, were presented. Dr. Hopkinson recommended the overhead trolley system, offering the opinion that the car sheds might be distributed in different parts of the system, preferably in the outskirts of the city—furnishing one shed with a fitting shop for repairs. The power station could be most conveniently situated near Manor's Station, the stations being utilized for supplying current for lighting purposes. Dr. Hopkinson appended to his report four schedules. The first is an estimate of the capital outlay required for the 40 miles of single track proposed. This totals £358,877, and allows for 132 passenger cars carrying 51 persons. The second schedule gives an estimate of the cost of working per car-mile, which is totaled at 4.706d on the basis of 112,320 car-miles run per week. The third schedule gives the actual cost in pounds of the various items set forth in the second schedule, and on the basis of 5,840,640 car-miles being run per annum sets forth the total working cost at £114,559. Schedule four shows the estimated cost of maintenance per car-mile of track, machinery and rolling stock, this being put at 0.845d for track, 0.110d for machinery, and 0.382d for rolling stock per car-mile—a total of 1.337d.

Efficiency of a Well-Known Fender

The demand for the Providence fender, as manufactured by the Consolidated Car Fender Company, of Providence, R. I., is still increasing, and this type of life guard is now the standard on a large number of street railway systems in this country. As is well known, the Providence fender is of the cradle pattern, and in its normal condition is carried a few inches above the roadbed. It is so arranged that the motorman can cause it to drop to the rails by a slight pressure of his foot, thus enabling him to have both hands free for controlling the car. The front edge of the cradle is yielding and serves to cushion the blow against the object struck. All parts are interchangeable, are simple in construction and easy to repair, and all fenders for cars of the same company are interchangeable

The Consolidated Car Fender Company has recently introduced an automatic wheel guard as an additional protection in the very few cases where the person struck falls in such a way as to be thrown from the fender. This guard is a cradle similar to the main fender cradle and is hung immediately in front of the forward pair of wheels. By a simple connection with a swinging apron it is made to drop whenever the apron swings to the rear, which it must do when it strikes the body of a person under the car. In the great majority of cases the person struck by the fender will be caught in the main cradle and securely held there, but it sometimes happens that a person is so near the fender when he steps upon the track that the cradle cannot be dropped before he falls upon it. If in this case the car is moving very fast and the motorman applies his brake very vigorously, as he would be likely to do, the person would be thrown off the fender forward to the ground and the fender might pass over him. In addition to this it has happened in one or two instances that the car immediately after striking the person came to a curve and the person on the fender was thrown off. The automatic wheel guard is provided to save the lives of the very few persons struck in the above ways.

A number of interesting records, of which the following are examples, have been kept of the efficiency of the Providence fenders: Of 219 persons struck by cars equipped with these fenders in the cities of St. Louis, Newark and Jersey City, 150 were uninjured, thirty-nine were slightly injured, nineteen were not seriously injured, three were seriously injured and eight were fatally injured. The eight fatal accidents mentioned included two deliberate suicides and all but one of the eight were first caught by the fender and thrown off. When these records were made the automatic wheel guard had not yet been introduced. Equally encouraging records have been made in other cities where the Providence fender is in operation.

Among the latest orders received by the Consolidated Car Fender Company is one for the equipment of all the cars on the South Chicago City Railway and a large order from the Ottawa Car Company of Ottawa, Ont., for fenders to be placed on the cars of several street railways in Canada. The company is also still turning out fenders to equip all the electric cars in operation on the Metropolitan Street Railway system in New York City.

A New President for Union Traction Company of Philadelphia

John Lowber Welsh, who has been since its organization president of the Union Traction Company, of Philadelphia, resigned this position on Sept. 26, and was succeeded by John B. Parsons, who has been the company's vice-president and general manager for the past eighteen months. Mr. Welsh is one of the most prominent figures in Philadelphia's financial world, having been connected with the Drexels in their many important enterprises. Mr. Parsons is one of the best known street railway men in the country. He was formerly connected with the Philadelphia properties, but went to Chicago many years ago, returning to Philadelphia to manage this, the largest street railway property in the country, in January, 1897. A description of Mr. Parsons's work in Philadelphia and some idea of the results which he has accomplished will be found elsewhere in this issue.

New Equipment in Baltimore, Md.

The Baltimore City Passenger Railway Company has just placed an order for twenty 20-ft. box cars with the American Car Company, of St. Louis. It is expected that these cars will be among the finest in Baltimore. They will have plate glass windows and Hale & Kilburn rattan spring seats. The cars will be mounted on Brill No. 21E trucks fitted with the Pennsylvania Car Wheel Company's wheels, and will be equipped with Westinghouse No. 49 motors. This company has also recently purchased a new snow sweeper from the J. G. Brill Company.

The Baltimore City Passenger Railway Company is cast-welding joints on several miles of track, the work being done by William Wharton, Jr., & Company, of Philadelphia. The track being welded is cable construction, and on account of the traffic on this line and the weight of the rail an extra heavy joint is being used. The average weight of cast welded joints is about 125 to 130 lbs., but the joints being cast at Baltimore weigh about 160 lbs. The section of track is laid with 6-in. 75-lb. rail with yoke centers of 5 ft., and cars are run on a headway of twenty seconds.

Large Contracts in New York

Contrary to the statements appearing in several papers, it is officially stated that the contracts for the electrical construction work on the Third Avenue Railroad have not yet been let. The only contracts which have been signed are the following: The Johnson Company, of Johnstown, Pa., all the steel rails; Pennsylvania Iron Works, of Philadelphia, Pa., all castings, yokes, boxes, etc.; National Conduit & Cable Company, of New York City, and John T. McRoy, of New York City, all feeder conduits.

Test of Storage Battery at South Braintree, Mass.

An interesting test was recently made on the Hatch storage battery at the South Braintree station of the Quincy & Boston Railway, of Quincy, Mass. The battery was made by the Hatch Storage Battery Company, of Boston, Mass., and the installation was described in the STREET RAILWAY JOURNAL for September, 1898. The test was made for the chief engineer of the electrical construction division of the City of Boston. The battery consists of 260 cells of 440 amp. hours capacity each, and was installed about May 1, 1889. The battery plant is used as a balancing medium rather than as a simple storage system, thus tending to keep it constantly charged and ready for service.

The engineer who carried on the test found that the battery is doing excellent service, frequently carrying an overload of over 400 per cent.

Imitation Leathers

The American Pegamoid Company, of New York, manufactures a full line of imitation leathers for car curtains, upholstering seats, etc. The process of making these materials is the application in a liquid form of a composition which by impregnating the fibres or pores of the substances treated has the effect of water-proofing, strengthening, sterilizing and generally protecting the material used. It can be applied to cloths made from cotton, wool, silk, flax, jute, hemp or other fibres, and to all kinds of paper.

The "Pegamoid" imitation leathers are made from any of the above-mentioned cloths or paper and resemble various qualities and grades of different hides and skins in daily use. Not only is the rich surface appearance of the best leather imitated, but in many cases excelled, as effects are produced which are impossible on leather, while the "feel" of the imitation leather is equal to that of the real article. Imitation moroccos, pig skin and other hides can be made of any color and the special grain of each produced to perfection.

The special advantages of "Pegamoid" material for car curtains, upholstering, etc., are its durability and its water-proof and stain-proof qualities. The surface is firm, but flexible, and it can only be scratched with difficulty, while its wearing qualities are said to be greater than real leather. It stands extreme heat and cold, and it is claimed that the face does not become sticky nor will it peel off. The surface can be washed and scrubbed even with boiling water or disinfectant without injury, and it is not easily damaged by grease, acids or dampness.

The composition is known as "Pegamoid," and which is used in the process controlled by this company is also furnished in the form of paint. It can be applied to all iron, steel, wood and stone work, and it is claimed that structural work treated in this way is unaffected by the weather or changes in temperature and all rust and rot are prevented.

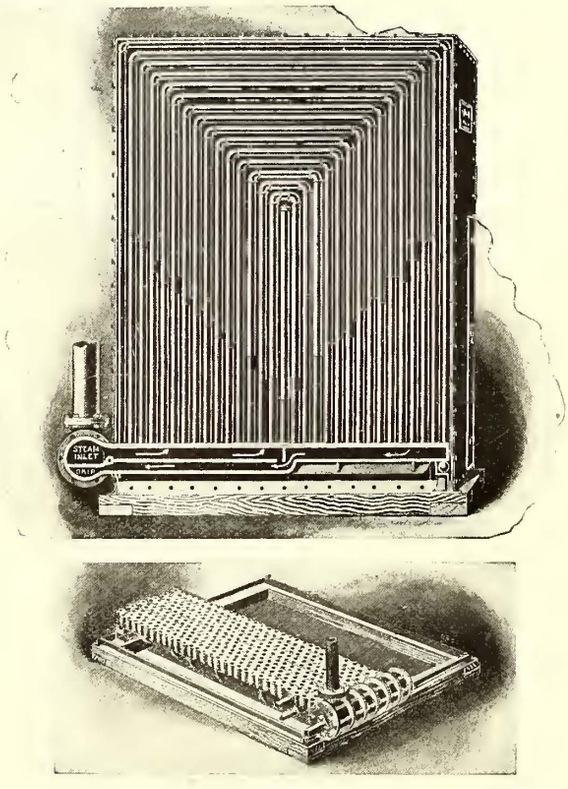


FIG. 1.—CORRUGATED SECTIONAL BASE HEATER

Special Catalogue

The Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., has issued a special catalogue entitled "Electric Street Railway History." The pamphlet contains a very full account of the development of the Westinghouse motors and generators from the No. 3 motor, which was brought out in 1890 and was a radical departure in street raliway motor construction, to the No. 49 motor, which represents one of the newest designs and which embodies the salient features of the best motors made by the Westinghouse Company.

The book shows that this company has 18,712 railway motors in operation at the present time exceeding 600,000 h.p., which gives some idea of the work that has been done in this branch of the electrical field. The pamphlet also illustrates and describes the usual type of generator built by this company for railway power stations.

Heating and Ventilating Apparatus

The difficulty of heating repair shops, car barns and other large rooms of like nature has led the B. F. Sturtevant Company, of Boston, Mass., to introduce a system of heating which is especially adapted to places of this kind. In this system exhaust steam can be employed and the apparatus is centralized and under one man's control. There is no steam piping scattered around the building, consequently there is no freezing or damage from leaky joints, valves or air-cocks.

Fig. 1 shows the Sturtevant patent corrugated sectional base heater. The foundation is constructed of angle iron, flanged and bolted. Upon this and the expansion balls rests a series of sectional bases. Each contains an inlet and outlet chamber with a separating diaphragm. The steam is admitted and the water removed from the same end of each section. The sides of the sections are corrugated. A circular flanged head forms the end of each regular section and the sides of the heads are planed; a blank flange is placed at one end, an inlet and a drip header at the other and special rubber composition gaskets between all surfaces. Through bolts draw all joints perfectly tight. The inlet and drip areas are very large and direct, giving opportunity for the use of exhaust steam without imposing back pressure on the engine.

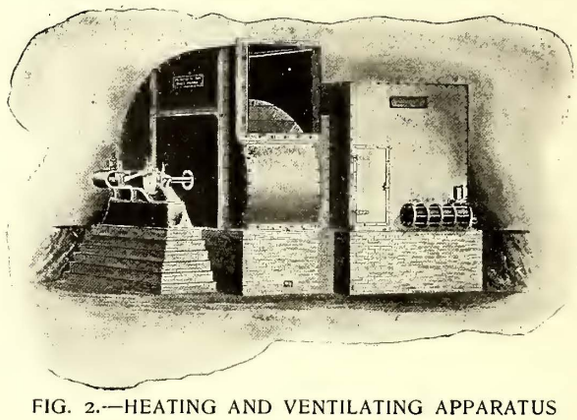


FIG. 2.—HEATING AND VENTILATING APPARATUS

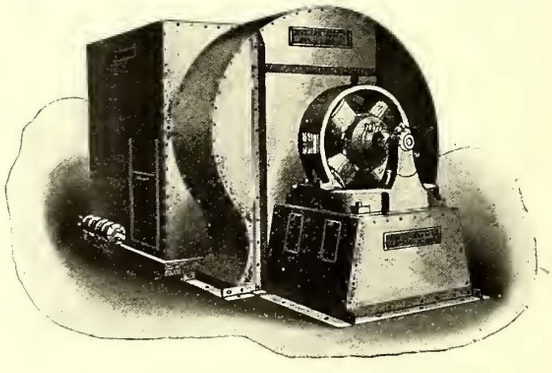


FIG. 3.—VENTILATING APPARATUS WITH ELECTRIC FAN

The B. F. Sturtevant Company also has a system of ventilating apparatus in combination with heating. Fig. 2 shows this heating and ventilating apparatus with three-quarter housing fan. The fan may be made to discharge in any direction and may be equipped with direct connected engine as shown in the illustration, or can be driven from a pulley. It can also be made to circulate either cold or hot air as desired. In the apparatus shown in Fig. 2 the bottom horizontal discharge permits the air to be delivered into a duct beneath the floor. The heater in connection with the ventilating apparatus is a "draw-through" device, usually consisting of a double group of corrugated sections placed end to end. The fans can be furnished in sizes ranging from 4 to 15 ft. and the size of the heater, of course, depends on the requirements. Fig. 3 shows the heating and ventilating apparatus with electric fan. This is designed for use where steam pressure is too low to permit of introducing an engine for operating the fan. This fan can be operated by an independent motor or by taking current from an available circuit and can be arranged to blow through or draw through the heater as desired. In Fig. 3 a multipole motor is shown supported on a substantial bed and having its shaft extended to carry the wheel.

Rail Bonds and Terminal Connectors

The rail bond and terminal connectors shown in the accompanying illustrations have been placed on the market to fill the demand for a bond that can be quickly applied and which can be placed in position by unskilled labor. These devices are fitted with steel expanding pins which are fast in the heads of the bonds and project about 3-16 in. The pins are designed to be driven into holes in the ends of the rails and are so formed that driving them in flush swedges the copper into perfect contact in the holes and turns a flange of copper from the heads out on the other side of the rails, making a strong locked connection. All this is done on the same side from which the holes are drilled, and it is claimed that the bonds and connectors can be placed in position in one-eighth the time that it takes with other devices. There are no special clamps or other parts to be handled, as the bond is in one piece, and thus the chance of losing parts is entirely done away with. The pins can be driven into place with a hammer by any ordinary workman. These devices are manufactured by James McLaughlin & Company, of Chicago, Ill.

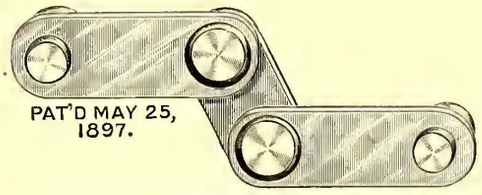


FIG. 2.—BOND WITH HINGED SECTIONS

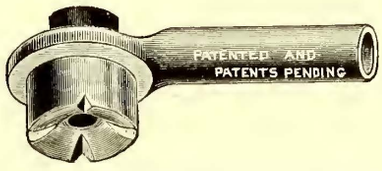


FIG. 3.—CONNECTION FOR LONG BOND

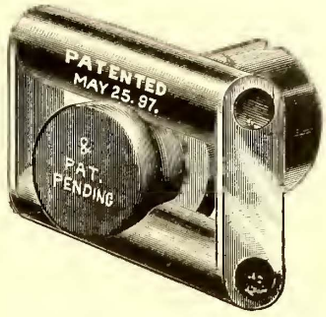


FIG. 4.—COPPER TERMINAL CONNECTOR

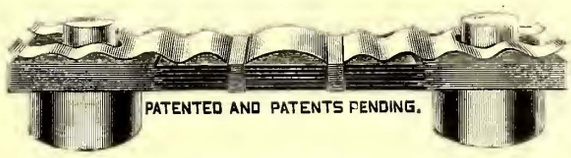


FIG. 1.—NEW RAIL BOND

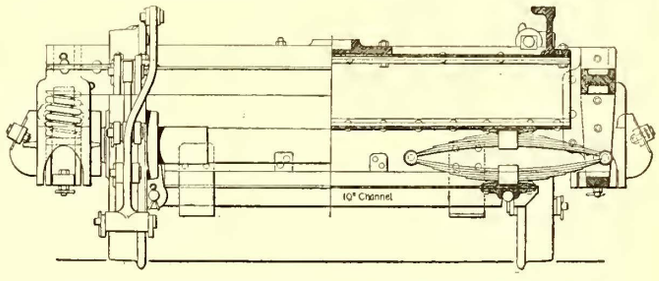
Fig. 1 shows the type of the McLaughlin bond which is designed for general use. As will be seen, the copper heads hold one end of the interlapping copper plates and the steel expanding pins, this connection makes a rubber contact on all the plates, and allows them to move freely with the rails. When the fishplates are screwed into place the sheet copper plates of the bond are pressed together as one solid piece by a spring shown on the top of the bond and which rests against the inner side of the fishplate. Fig. 2 shows a bond in which the sections are hinged together, which allows it to be used for rails having holes either 3 ins. or 4 ins. apart. This construction also allows the bond to move more freely with the rails. Fig. 3 shows a copper terminal which is designed to be used for joining the ends of long bonds to the rails. By the use of this appliance a company can use its old trolley wires for the bonds. Driving the steel pin shown in this illustration swedges the copper into contact in the holes, as in the case of the bond shown in Fig. 1, and in addition securely locks the wire composing the bond in the slots shown on the connector. Fig. 4 also shows a copper terminal connector of different pattern.

New Truck on the Chicago Lake Street Elevated

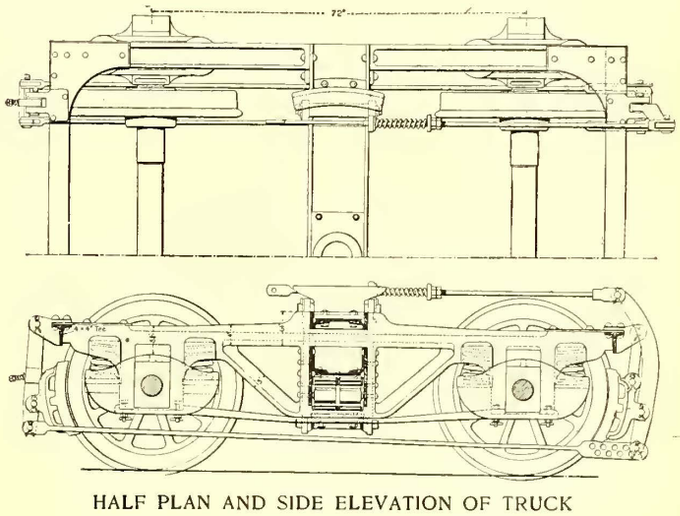
There has been running for some months on the Lake Street Elevated in Chicago a new truck which is a radical departure from existing designs in many respects. The idea has been not to produce a stronger truck than those now running, but one that will be strong enough to carry the weight of the heavy motors of the elevated service and which will at the same time be easy riding, of simple construction, and with plenty of room to get at the various parts. Its simplicity is illustrated by the fact that there are but three pieces and four springs in the side. The truck is shown in the accompanying illustrations, and in construction is briefly as follows:

The side frames are of steel, the columns, pedestal jaws and upper spring seats being cast solid with the frames. The side frames resemble the shape of a diamond, the upper member being an I section and the lower member a ⊥ section, while a flat steel bar is used for the tie. The crossbars at the ends of the frame are 4 ins. x 4 ins. Ts bent downward near the middle so as to clear the draft rigging, which, on the Lake Street Elevated cars, is quite low. A swing bolster, 10 ins. wide, is placed between the side frames, the bolster being made of steel channels with top and bottom cover plates. It rests on elliptic springs at either end, the springs being carried on a spring plank made of a 10-in. steel channel. The links are 24-in. long. Coil springs are placed one on either side of the pedestal in addition to the elliptic springs under the bolster, a very flexible spring arrangement being thus secured.

The brake rigging, etc., under the truck is so arranged as to give a large space for the motors, two of which are used, of the



CROSS SECTION AND END ELEVATION OF TRUCK



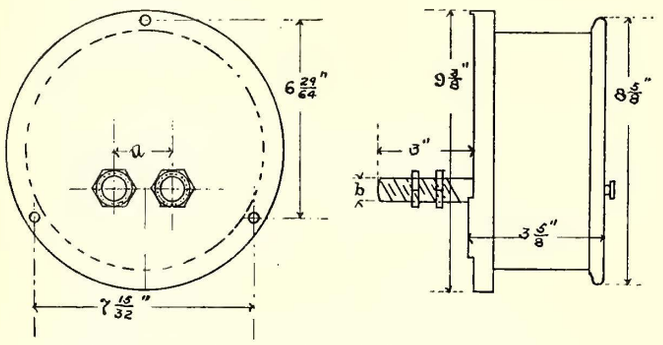
HALF PLAN AND SIDE ELEVATION OF TRUCK

G. E. 55 type, each of 155 h.p. The motor casing clears the ties by 3 ins. The wheels of the truck are 33 ins. in diameter, and the wheel base is 72 ins. The brake shoes are suspended by links, are hung on the outside, and the brake rigging on one side is independent of that on the other. No brake beams are used. The brakes are outside hung in order to protect the gears and bearings of the motors from the fine dust from the brake shoes, which was found to occasion considerable injury. The truck was designed by Frank Hedley, general superintendent of the Lake Street Elevated, and is manufactured by Fitzhugh & Company, of Chicago.

It is stated that the New Orleans City & Lake Railroad Company, the Crescent City Railway Company, and the New Orleans Traction Company will be merged into one corporation under the title of the New Orleans City & Lake Railroad Company. This it is believed will enable a considerable reduction in operating expenses to be made. The bonds and stock of the merged companies will be exchanged for new securities to be issued by the new company.

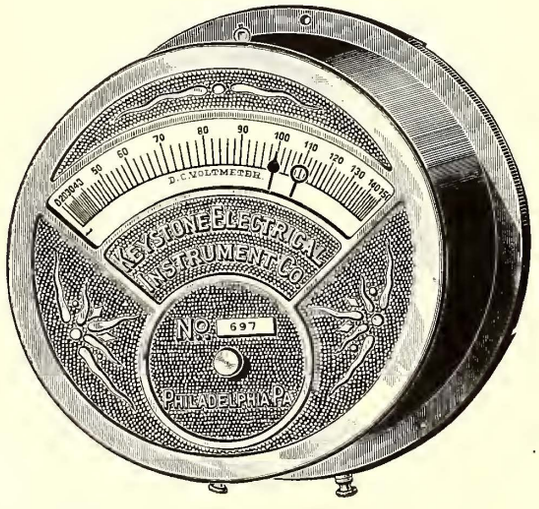
Instruments for Street Railway Switchboards

Among the many details which are essential to the successful operation of a modern street railway installation, none is of greater importance than the proper equipment of the switchboard, which has been aptly called the "nerve center of the whole system." If the switchboard is poorly constructed or badly equipped endless trouble ensues, no matter how well the balance of the system is designed and installed. Again, of all the switchboard apparatus the most important is the indicating instrument which silently performs its function of showing at every moment the exact condition of generators and line. Indicating as it does the exact performance of each generator or translating device, it is of prime importance that its selection should be governed by judgment and discretion. It must be accurate and it must be durable, fulfilling



STANDARD AMMETER

all the many requirements of practical use with scientific precision. The whole subject is one of very considerable scientific as well as practical interest, and treated in its entirety would require both time and space, but since it readily lends itself to subdivision the present article will consider merely the question of instruments adapted for use on feeder circuits. The engravings herewith illustrate the external appearance and, diagrammatically, the dimensions of the instruments manufactured for this class of service by the Keystone Electrical Instrument Company, of Philadelphia, and designated by that company its type "R" instruments.



EXTERIOR VIEW OF VOLTMETER

As may be noted, the instruments are of the round pattern, the body of the case being finished in black japan while the front is nickel plated. If it is deemed desirable to have all the apparatus on the switchboard present a uniform color or style of finish, cases finished in full copper or full nickel can be readily substituted.

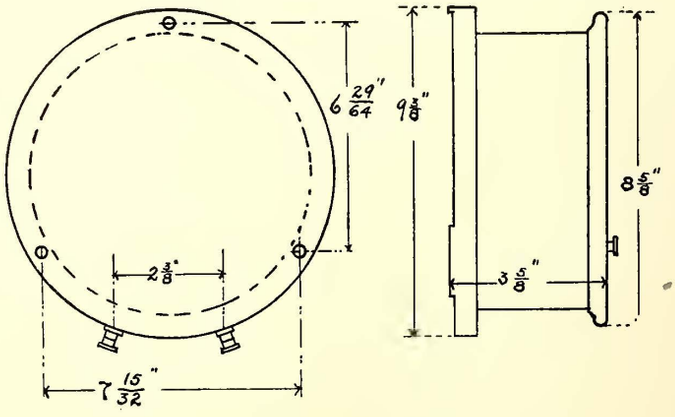
One of the first distinctive points is that the ammeters are of the series type; that is, the entire current which is to be measured passes through the instrument. They are not galvanometers measuring the drop in a resistance arbitrarily set in the line, but ammeters in the true sense of the word, and measure the total current passing through them and flowing out into the line. The galvanometer and shunt method may have its uses, and in some places local conditions render its employment advisable, but the Keystone Company claims that it has no place on the feeder panel of a railway switchboard. From either the scientific or practical point of view the series ammeter commends itself for such service, particularly in view of the modern methods of construction which place the positive busbar at the top of the board, which busbar is connected with the circuit breaker, ammeter and switch with the feed wire so that the ammeter fits in naturally as a connecting link. Connection to the ammeter is made by clamping the connection from the busbar between the two nuts with which each terminal is provided.

The principle of the instrument is purely electromagnetic, and no element is introduced which is subject to change or deterioration. The current to be measured passes in through one of the terminal studs, which consist of turned and threaded copper, to the actuating solenoid; this solenoid consists of one or more turns of pure copper, the number of turns being determined by the maximum current to be measured, not less than 500 amp. turns being employed; from the solenoid the current passes out into the line through the second terminal stud.

Within the actuating solenoid is suspended a carefully treated vane of magnetic metal which is attached to an axis of steel. This axis is threaded so that the vane can be secured to it by means of clamping nuts, and the ends are ground to a point and highly polished. The axis is suspended in bearings of polished sapphire jewels, so that frictional errors are entirely avoided. To this same axis is attached an aluminum pointer which traverses the scale and a counterpoise capable of adjustment in two directions, so that the instrument may be equalized and adjusted for its proper range. The dead-beat action is obtained by means of an aluminum vane moving in an air chamber, this method, it is claimed, producing the best possible result without introducing any possible error.

The magnetic vane within the solenoid is mounted with its axis eccentric to the axis of the solenoid, so that the action of the solenoid is to draw the vane from a position of lesser to a position of greater flux. The movement of the vane is proportional to the square of the current flow of the solenoid, and forms an absolute and accurate measure of the current flowing through the instrument, and consequently of the current in the circuit.

The composition of the vane and its treatment prior to calibration is such that errors of hysteresis or lag are entirely absent, fractional errors are avoided by the use of selected jewels and the proper polish of the pivot points on the axis, errors due to changes of temperature are obviated since the actuating solenoid is in series with the line, and heating in the instrument is avoided by providing a generous area of copper per ampere. Errors due to external fields are avoided by the use of a strong field in the actuating solenoid, this field being of sufficient strength to practically saturate the moving vane from the first reading point on the scale, and also by constructing the case of soft gray iron, which in



STANDARD VOLTMETER

itself is a magnetic shield. The energy consumed in operating the instrument is infinitesimal, being equal to the energy loss in about 1 ft. of busbar.

Since neither springs nor permanent magnets are employed, there is nothing which can deteriorate, and the whole system is so solidly constructed that, notwithstanding the lightness of the moving parts, it is difficult to injure it by even unusually rough handling. An accidental overload, even though it be several times the rated capacity of the instrument, cannot harm it, and the only observable effect would be to heat the solenoid and terminals. A very striking advantage of this type of instrument is the fact that

the same system may be calibrated for use on the alternating current and, when so constructed, will be as accurate and reliable as when calibrated for direct current.

The actual calibration of the instrument in the factory laboratory is effected by direct comparison with standards of current, the actual standard employed for comparison being a dynamometer, kept in absolute check by the well-known methods of measurement and comparison employed in physical laboratories. In the Keystone laboratory the calorimetric, drop-shunt, bridge and galvanometer or voltameter method is employed, depending on the character of the work for which the dynamometer is to be employed and the range of current to be measured. Each numbered point on the ammeter scale is found by actual comparison with the dynamometer which is connected in series with the ammeter in a circuit supplied by storage batteries or the secondary of transformers, depending on whether the instrument is being calibrated for direct or alternating current.

The scale points having been established, the actual divisions are put in by hand and the calibration curve of the instrument laid out. If this calibration curve shows any variations from its proper form, the points showing above or below the normal curve line are redetermined before proceeding further. The main and intermediate divisions having been drawn in on the scale, the instrument is again set up and the seal drawn into place, then every marked point on the scale is checked by comparison with the dynamometer and, if no errors are found, the instrument is ready for shipment; if errors are found a new scale is made to replace the one in error. The accuracy of each instrument is certified and a certificate sent with it, while the actual calibration record is preserved and filed for reference.

From start to finish every process is carefully inspected and every detail watched, so that this, in connection with a complete mechanical and electrical equipment, obviates all possible danger of errors in either mechanical construction or in actual calibration, and the consumer receives an instrument which he can depend upon to silently perform its functions under all conditions and with unswerving accuracy.

Smoke-Preventing Device

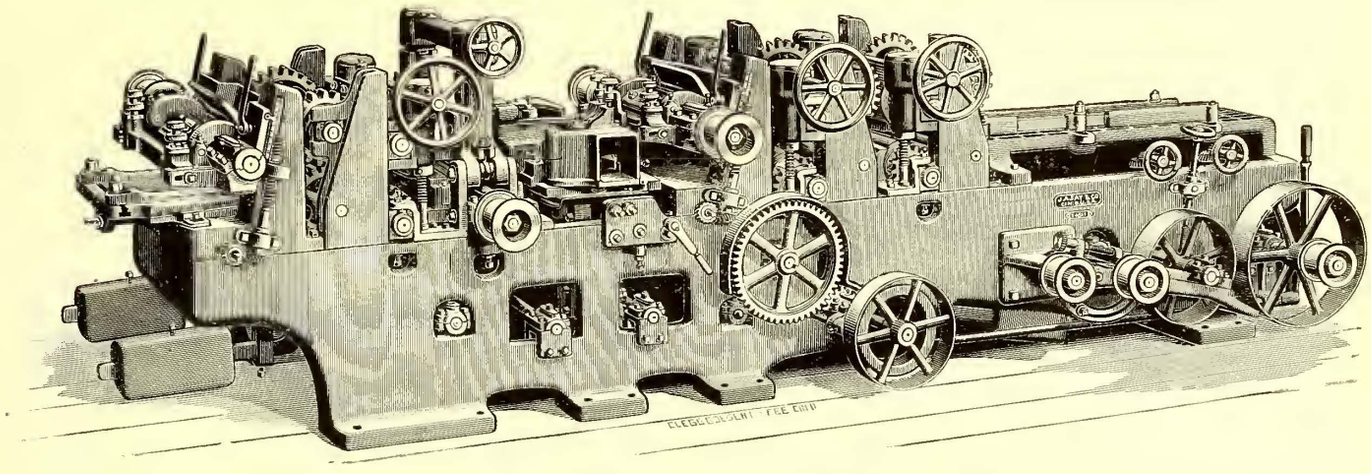
A description of the Arbuckle Sugar Refinery in Brooklyn was recently published in one of the New York City papers. One of the most interesting features of this plant is a tall chimney, but, contrary to expectation, smoke is never seen issuing from its top. For this reason it would seem to the observer that the factory was not in operation, but, as a matter of fact, forty-six furnace fires are continually burning and soft coal is used exclusively. The absence of smoke is accounted for by the fact that the fire boxes are all equipped with the American stoker, which feeds the coal from all the products of combustion. This stoker is manufactured by the American Stoker Company, of New York.

New Triple Cylinder Flooring Machine

A flooring machine, manufactured by J. A. Fay & Company, of Cincinnati, Ohio, has recently been brought out and contains many new and important improvements. It is designed for the use of all who are engaged in manufacturing flooring, ceiling, siding, casing, etc. This machine is made in two sizes, to plane four sides 10 in. and 15 in. wide and 6 in. thick. The framing is massive, strongly braced inside to resist all strains and vibrations; has heavy girts so placed as to come under the working parts of the machine, where there is the greatest resistance. All surfaces are accurately planed and securely jointed.

The cylinders are three in number, made from solid steel forgings of fine quality, and have four faces slotted to receive two or four knives, and chip-breaking lips for working cross-grained lumber. The first or main upper cylinder is mounted in a heavy yoked frame, has journals of 1½ ins. dia. and runs in self-oiling bearings 10½ ins. long. It has double flanged pulleys close to bearings on each end fitted on taper bearings, secured with wrought nuts. The lower cylinder is also mounted in a heavy yoked frame with 2½ in. journals running in 10½ in. self-oiling bearings, and is vertically adjustable at each end. It is driven by flange pulleys. The second upper cylinder is placed at the feeding out end of the machine and is intended for a light or skimming cut and constructed to revolve at a much higher rate of speed than the other cylinders.

The matching works are heavy. The arbors are of steel, 1¾ in. in diameter, where the cutter heads are applied and revolve in long self-lubricating bearings, both of which are adjustable vertically and horizontally and are rigidly locked in any desired position by a lever conveniently located outside the frame. The feed works consist of six large feed rolls, 8 ins. in diameter, driven by a train of powerful gearing, each gear on the shaft extending through the machine and running through the babbited bearings. The pressure bar before the first upper cylinder is adjustable to and from the cut, and has a chilled toe, reducing the wear to a minimum. The bar after the cut is adjustable for difference in thickness of material worked.



NEW TRIPLE CYLINDER FLOORING MACHINE

This machine is equipped with a new and improved bolt tightening apparatus for both cylinder and side head bolts, quickly adjustable while the machine is working. The machine will be sold under the trade name of the "Lightning" flooring machine.

Handling Meat in Buenos Ayres

An order, recently placed in Philadelphia from Buenos Ayres for meat boxes, trail cars and motor meat cars, amounting to upward of 350 in all, shows that in the modes of handling and distributing meat a number of the cities of South America are considerably in advance of many cities and towns in the United States. The slaughter of cattle in Buenos Ayres is entirely in the hands of the Government, which owns and carries on the abattoirs. No slaughtering is permitted outside of the established slaughter houses. This at once puts the character of the animals used for food within the control of the authorities. Immature or diseased animals cannot therefore be used for food. The abattoirs are located 14 miles from the city, and they not only provide all the meat used at home, but that which is exported in cold storage.

The means for distribution of the dressed meat to markets and butcher shops is exceedingly interesting. An electric railway of the city has a contract for the transportation of meat, and has special cars constructed so that it can distribute it to all the markets, butcher shops and cold storage houses, where it is delivered for shipment to steamers. The system is not altogether

new, and was in operation on a smaller scale and with more limited facilities on the old horse-car lines. As long ago as 1885 the J. G. Brill Company, of Philadelphia, built special meat cars for the street railway companies of Buenos Ayres, Santiago, Montevideo and other South American cities.

The old style cars were handled by horses, and were of necessity small and carried light loads. The meat was carried to the car and hung up inside and then hauled to the city. At each point where meat was required the car was stopped and the desired number of quarters taken down by hand and carried into the market. The car then continued its journey. This method of handling was slow and very laborious, and involved a certain amount of unnecessary exposure.

With the introduction of electric traction in the place of animal power the system is being greatly improved and the facilities for handling increased, while the exposure of the meat in transit is greatly reduced. By the new order of things the sides of meat are placed in meat boxes, which are set upon a flat-car, and are thus taken to the markets without exposure. Upon arrival a powerful crane at the curb lifts each box from the car and deposits it upon a large three-wheeled hand-car, upon which it is taken directly into the ice box. The flat-car then goes on to other points of distribution.

The accompanying illustration shows a meat box motor car. The boxes are 5 ft. 11 ins. square outside and 7 ft. 3 ins. high. They have double sides and are lined with zinc. There are slat ventilators in the two sides and in the doors. The latter lift upward into a horizontal position when open. To economize space in front that part of the side which is below the door lifts out, instead of being made to swing. Inside the boxes are fitted with pipe racks in the center, along the sides, and stationary racks in the roof, all of which are provided with sliding hooks for meat.

In some cases the boxes are carried on flat trail-cars. In this case each corner of the box is furnished with a heavy iron strap terminating at the top in a strong eye. These eyes are for the hooks of the lifting cranes, and the boxes are in this way as easily handled as a barrel or bag. The boxes have a capacity for 6000 lbs. of meat, and the total weight of each box loaded is 7750 lbs. When taken from the flat-cars they are set upon small, but very strongly built, three-wheel hand-cars. The platforms of these hand-cars are 5 ft. 11 ins. square.

MEAT CAR—BUENOS AYRES

Carbon Brushes and Their Manufacture

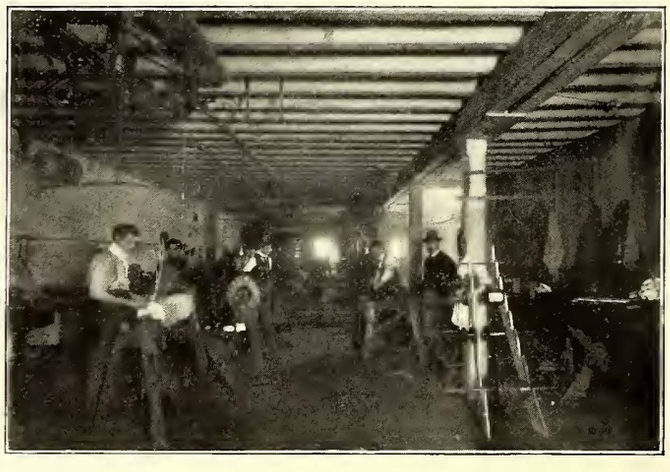
Prof. Elihu Thomson once said "the carbon brush is the most important invention ever made in the electric railway field." He spoke undoubtedly with a full realization of what the statement meant, for none but the actual workers in the field in the early days of electric railroading can understand the utter discouragement that came with the use of wire brushes, particularly for motors, but also to a large extent for railway generators. Often a commutator would be completely rutted and a wire brush "chewed up" in a half day's run of a car, and the operator was fortunate if a burned out armature was not also the result. Electric motors in railway work were at one time actually on the edge of failure through this one imperfect feature. The carbon brush entirely changed the complexion of affairs. Sparking was almost completely done away with, both at generator and motor commutators and the "end on" plan of placing the brushes has made it possible to run the motors either way without difficulty.

The manufacture of carbon brushes has become an important industry. With 75,000 to 100,000 street railway motors in service and with many thousand lighting and railway generators, the total output must be enormous. No one who does not look over such a catalogue, for example, as that of the Partridge Carbon Company, of Sandusky, Ohio, devoted entirely to motor brushes can realize to what an extent specialization in street railroading has been carried out. Here are listed brushes in different sizes for many hundred types of generators and motors and doubtless adapted in composition also to the special requirements of the service. We find carbon brushes for moderate speed generators and motors of 125 volts, 250 volts and 500 volts; for slow speed generators and motors of the same voltage; for many different types of lighting and railway generators based on number of poles; for fan motors, etc. There are fifty-six separate quotations for different sizes of brushes for the motors, and generators manufactured by the General Electric Company, forty-seven for Westinghouse machines, six for the Walker motors, fifty-one for the Western Electric standard dynamos, twenty-eight for the Eddy dynamos, forty-four for the Keystone Electric Company's motors and dynamos, ten for the Jenney motors, sixteen for the Steel motors, ninety-four for miscellaneous stationary motors and no less than 263 additional special sizes and quotations. A single table gives a price list on the Partridge pure plumbago generator brush for 3045 different sizes.

All things being equal, a company which carries on a business of this immense detail and high specialization must be presumed to have made the most careful possible study of the special requirements of its customers and should be in a position to satisfy each, and to turn out a product of the highest quality and at a low price. The Partridge Carbon Company has a splendid reputation for its brushes and the products of its large factory in Sandusky, Ohio, command a wide market.

A Modern Repair Shop

Street railway companies that do not own extensive repair departments of their own must of necessity have much of their electrical repairs made by concerns that make a specialty of this class of work. In fact it is often better and cheaper for a street railway company to have its electrical repairs cared for by a company that has all the facilities for turning out accurate and quick work than to attempt these itself.



SHOP FOR REPAIRING MOTORS AND DYNAMOS

The Chicago Armature Company of Chicago, Ill., while it attends to all classes of dynamos and motors repairs is paying particular attention to the repair of street railway apparatus. The business was established in 1893 as The McLain Armature Company and was reorganized as the Chicago Armature Company in 1895 with U. L. Swingley, secretary and treasurer and E. B. Bronson, manager. Beginning in a small way, the firm's reputation for promptness and fair dealing has constantly increased its list of customers until they are numbered from nearly every State in the union.

The company within the past few weeks, during which time its shops have been running night and day, has shipped repaired dynamos, motors and commutators to Seattle, Portland, Salt Lake, Denver, as far south as Alabama and east to New England. The accompanying illustration shows the interior of the company's works.

Rapid Increase in the Use of Cast Welded Joints

"The number of cast welded joints in use has increased in four years from 744 to more than 200,000."

This quotation from a recently issued brochure of the Falk Manufacturing Company points to a success which perhaps many street railway managers do not realize. The cast welded joint is not to-day an experiment, but is firmly established in the practice of many American and not a few foreign railways. From the day of the Atlanta Convention in 1894 and the first experiment with the joints of Captain McCulloch's road in St. Louis to the present time, this joint has steadily gained favor with managers, and if we are to accept the testimony of such experienced railway men as Robert McCulloch, general manager of the Chicago Syndicate roads in St. Louis, M. K. Bowen, president of the Chicago City Railway Company, and others equally prominent, the joint has proved entirely satisfactory in practice.

In working up this large business, the Falk Company has been obliged to deal with many different rail sections and to undertake some exceedingly knotty problems. About two-thirds of its business has been the curing of old and apparently worn out track, a third being in new track construction. So large a proportion of street railway managers are troubled and perplexed to-day to know how to raise the money for much needed track improvements that any device of this kind which will tend to prolong the life of the old track even for a few years' time is of the greatest possible importance, and there seems to be no question that the Falk process accomplishes the raising of depressed rail ends. The smallest rail so far welded is but three inches high, and is used at Oakland, Cal. The largest rail is the 9-inch girder welded in Brooklyn and other cities. The greater part of the 9-inch and 7-inch rail welded has been on new track, and it is the opinion of many well known railway managers that a 7-inch rail with welded joints and proper tie construction makes as good a track as can be obtained. The most peculiar rail so far welded is an 8-inch slot or Z bar, which is used as a running rail on the Market Street Railway, of San Francisco. This was successfully welded in 1896.

The question is often asked, "Is the Falk cast weld joint really a weld?" What the scientific answer to this question may be is unimportant in view of the fact that the union between the joint metal and the rail is certainly so intimate as to make it many times impossible to separate the two, while the electrical conductivity of the joint is often greater than the rail itself. It is one of the most important features of the cast weld joint, that the binding of the joints with copper appears to be unnecessary, for when the electrical conductivity of a section containing the joint is equal to that of a section of equal length of the rail itself, the best practical result is obtained.

The Falk joint must be made with great care in order to have its greatest value. The question of properly cleaning the rail ends has led to the invention of a sandblast machine by which they are made particularly bright and clean. This sandblast is operated by an electric motor driving an air compressor which at a pressure of about fifteen atmospheres throws a stream of sharp sand at a high velocity against the sides and bottom of the rail, thereby removing all scale and rust.

The Falk Company uses only the best grades of pig iron, believing that scrap iron, as a rule, is not satisfactory.

The problem of repairing badly bonded joints in old rail has led to the devising of various forms of clamps, by which the amount of rise in the end of the rail may be regulated. A flexible shaft grinder and an electrical grinding car are also used.

In addition to its rail joint business, the Falk Company makes built up special work from any type of girder or T rails, making a specialty of barn curves and other complicated layouts, and also through recent arrangements undertakes the building of electric railways, power stations, car houses, overhead construction equipment, etc.

Receivership for the John Stephenson Company, Ltd.

Upon application of a majority of the directors and stockholders of the John Stephenson Company, Limited, Albert A. Wilcox, of Paterson, N. J., and Louis Stern, of New York City, were on Oct. 25 appointed temporary receivers for the company by Judge Cohen, of the Supreme Court. There were no judgment creditors or attachments on the property, and the action was purely a voluntary one on the part of the directors for the purpose of protecting the stockholders' interests. The application for the receivership was signed by Charles H. Davis, the company's president; L. M. Delamater, its secretary and treasurer, and A. L. Phillips and B. P. Flint, directors. The petition sets forth that there are now due in unpaid claims for material and supplies $125,000, and additional obligations coming within the next four months cannot be met. The assets are stated to be $1,175,776, of which the principal items are as follows: Cash in banks, $19,670; cars delivered and finished, $30,738; cars in progress, $148,385; real estate at Larchmont, $49,521; real estate in New York City, $293,000; site of new plant at Bayway, N. J., $80,000; new plant, machinery and tools, etc., $372,779; merchandise, $152,343. The total liabilities amount to $788,782, as follows: Mortgages, $250,000; notes maturing March 13 next and before, $260,000; accounts payable, $45,867; time bills payable, $71,207; goods ordered but not delivered, $17,547; accounts payable, new works at Bayway, $144,161. The company's capital stock is $150,000, of which the directors making application for the receivership represent $132,000. The principal stockholders of the company are understood to be H. C. Valentine, representing $80,000; C. H. Davis, $23,000; J. A. Tackaberry, $14,000; L. M. Delamater, $13,400; N. C. Rogers, $3,200, and D. S. Eggleston, $2,800.

The receivers have been authorized to continue the business, and it is understood that orders will be received and executed and efforts made to secure business as usual. The company's reputation for excellent workmanship and honorable dealing is unexcelled, and it is to be hoped that the present troubles will be but temporary.

Important Patent Decision

The United States Circuit Court of the Eastern District of New York has recently decided the cases of Thomas F. Morrin vs. Thomas J. Lawlor and Thomas F. Morrin and the Clonbrock Steam Boiler Company vs. the Edison Electric Illuminating Company, of Brooklyn, in favor of the complainants, giving as the Court's opinion that the defendants have infringed patent 309,727 which deals with the general construction of the Climax boiler, the first and second claim of patent 463,307 as to the tubes, and patent 463,308 covering improvements in sectional casings.

The principal claims which were in dispute and which are upheld by this decision are:

1. The radial tubes are to be heated by an annular grate surrounding an upright generating cylinder. 2. The tubes are arranged so that the upper branches of one tier overlap and enter the cylinder above the lower branches of the next tier above. 3. The tubes are set obliquely to the axis of the generator cylinder. 4. The tubes extend to an equal extent in the generator cylinder. 5. The tubes are of the ogee form.

Personals

MR. J. W. MAUCH, of Chicago, has been chosen treasurer of the Chicago & Milwaukee Electric Railway.

MR. E. W. DAVIS has been appointed general manager of the Versailles Traction Company, of McKeesport, Pa.

DR. SCHUYLER S. WHEELER, president of the Crocker-Wheeler Electric Company, of Ampere, N. J., was married on Oct. 11 to Miss Amy Sutton.

MR. MARK CUMMINS, general manager of the Janesville (Wis.) Street Railway Company, has resigned that position to accept a position at South Bend, Ind.

MR. G. HENRY WHITCOMB, of Worcester, Mass., has been elected president of the Worcester & Marlborough Street Railway Company, succeeding Mr. J. Russell Marble.

MR. FERD GREEN has been promoted to the office of superintendent of the Janesville (Wis.) Street Railway Company, to take the place of Mr. Mark Cummins, resigned.

MR. F. O. RUSLING, formerly general manager of the Chicago & Milwaukee Railway Company, is engaged in the construction of an electric lighting plant in La Paz, Mexico.

MR. J. G. WHITE sailed for Southampton on the "Paris," Oct. 26, to perfect certain arrangements recently made with the Tramway Syndicate of London and will return in about six weeks.

MR. A. L. GILLETTE has been appointed electrician of the Marinette (Wis.) Light & Power Company. Mr. Gillette was formerly electrician of the Terre Haute Electric Railway Company.

CHAS. A. CHAPMAN, of Chicago, consulting engineer, has removed his office from 1020 Monadnock Block, to 1541 Marquette Building. Mr. Chapman is busy with a number of designs for large power plants.

MR. ALBERT H. JOHNSON, of the Nassau Electric Railroad Company, of Brooklyn, sailed for Europe on the steamer "Cam-

pania" Oct. 15. He will not return until the latter part of December.

MR. W. G. PRICE, until recently mechanical engineer of the Chicago City Railway, has accepted the position of superintendent of the shops of the Peckham Truck Company, at Kingston, N. Y.

MR. W. F. D. CRANE, of New York City, formerly of the H. W. Johns Company, has for the past two months been in Porto Rico in the interests of New York capitalists who are seeking concessions in the island.

MR. L. H. MOUNTNEY has been appointed superintendent of the Portsmouth (Va.) Street Railway. Mr. Mountney comes from Wissahickon, Pa., where he was general manager of the Wissahickon Electric Passenger Railway.

HON. JOHN H. MOFFITT, of Syracuse, N. Y., who for the past eight years has been connected with the street railways of that city, resigned from the position of general manager, his resignation taking effect Oct. 1, 1898.

MR. C. O. SIMPSON, formerly assistant auditor and paymaster of the Metropolitan Street Railway Company, of Kansas City, has been appointed auditor of the Augusta (Ga.) Railway & Electric Company, and will fill the position held by Mr. C. B. Reavis, recently deceased.

MR. GEORGE HENRY DAVIS, of the firm of Ford, Bacon & Davis, of New York city, was married on Sept. 29 to Miss Catherine McGrath, of New Orleans. Mr. Davis has been manager of the New Orleans & Carrollton Railway for some time and has made a large circle of acquaintances while in New Orleans. His many friends extend to him their best wishes.

MR. B. M. BARR, who has been for several years connected with the Walker Company as its agent in Ohio, has recently severed his connection with that company in order to accept the position of manager of the New York agency of the Stirling Boiler Company, of Chicago. In addition to his work in New York and vicinity, Mr. Barr will handle the entire export work of the company.

MR. WILLIAM E. COOKE has been engaged by the Tramway Syndicate of London to supervise the construction of the tramways of Perth, Western Australia. This arrangement was made in the course of Mr. Cooke's recent trip to Europe. Mr. Cooke sailed for Southampton on Oct. 26. He will remain in London about a month, and will go thence to Western Australia and enter upon his new duties.

MR. GEORGE E. PRATT has been obliged to sever his connection with the Jackson & Sharp Company, owing to the fact that the business of the other two concerns which he is representing, Forsyth Brothers Company and The Ajax Metal Company, demand his entire time. The Forsyth Brothers Company's business has greatly increased in the East, and Mr. Pratt is having very good success in handling their goods.

THE HON. SIR A. B. FORWOOD, M. P., died recently at Liverpool, England. Mr. Forwood was a distinguished business man and member of Parliament, having been Secretary of the Admiralty for five years. He was a member of the Liverpool City Council, chairman of the tramway committee, and one of the strongest advocates of the introduction of electric traction in Liverpool.

MR. WILLIAM HENRY HEULINGS, JR., of the J. G. Brill Company, of Philadelphia, was married on Oct. 19, to Miss Grace Lucille Vane, of Philadelphia. Mr. Heulings is widely known throughout the street railway field and his many friends extend to him hearty congratulations on this occasion. He has been with the Brill company for fourteen years and his advancement has been due to the tireless energy and studious application which he has always brought to his work. One of the many wedding presents which Mr. and Mrs. Heulings received was a receipted bill for several pieces of furniture, which Mr. Heulings had ordered. Thirty-five of his friends clubbed together, found out where the furnture was ordered and paid for all of it without Mr. Heuling's knowledge, presenting him the receipted bill as a wedding gift. Mr. Englund, of Mayer & Englund, acted as treasurer for the friends and the success of the little surprise was due mainly to his efforts. Philadelphia's famous "Syndicate," consisting of most of the "good fellows" around town, also raised a large purse for a wedding present to Mr. Heulings.

COL. EUGENE GRIFFEN, of the First Regular Volunteer Engineers, whose illness and return to the United States from Porto Rico several weeks ago has already been noted in these columns, is now nearly well again, and during the last half of October visited his office with the General Electric Company and took a trip to Washington to consult with the War Department and the President concerning the matter of mustering out his regiment. Col. Griffen expects to return to Porto Rico immediately and is now making arrangements to secure, through private channels, a special line of food and other supplies to provide for the more comfortable return passage of his regiment. The regiment has been employed in important and interesting engineering operations in Porto Rico, including the rebuilding of bridges destroyed by the Spaniards in their retreat to San Juan and others damaged by floods.

MR. M. COKELEY, who has many friends in the street railway field, has been made superintendent of the works of the C. W. Hunt Company, on Staten Island, N. Y., assuming the duties of that position on Oct. 14 after several months' work revising the factory systems. Large concerns are beginning to relieve the office management of providing for the details in office routine, the installation of systems, methods, etc. This work properly belongs to a specialist and one who, constantly keeping his eyes open for improvement, studying the best literature on the subject and devoting his energy entirely to this work, becomes an expert. Mr. Cokeley has made this special work his profession for some time, having been for many years with the General Electric Company and later with other prominent firms. His experience as a practical mechanic has been of great benefit in this line of work, enabling him to detect almost instantly the leaks that invariably exist and which are so destructive to profits.

MR. C. LOOMIS ALLEN has been appointed acting general manager of the Syracuse Rapid Transit Company, of Syracuse, N. Y. Mr. Allen has been connected with the Syracuse street railways for the past four years as engineer, during construction and reconstruction, and later as assistant general manager. He is a native of Syracuse, and entered the employ of the Norfolk and Western Railroad Company in the engineering department upon the construction of the Ohio extension of that railroad in February, 1890, and remained in that position until the spring of 1892, when he resigned and returned to Syracuse to enter the partnership of Mather & Allen, having a general engineering practice. During the continuance of this practice, this firm handled all the street railway engineering in the city, as well as other municipal engineering problems. In 1895 this partnership was dissolved, and Mr. Allen became connected with the Syracuse Street Railway Company as its engineer. He occupied the position of engineer of maintenance of way from April, 1895, until March, 1898, when he was appointed assistant general manager. Since that time he has been connected with the management of the road. During 1895-97 the consolidation of the various street railroad systems of the city was accomplished, and the consequent reconstruction of the track and a large portion of the overhead work was done under his direction.

MR. W. J. CLARK, general manager of the railway department of the General Electric Company, was, early in October, appointed by the Secretary of War one of three members of a government commission to select camp sites, report on facilities for transporting troops, etc., in the island of Cuba, during and after the evacuation of the island by the Spanish troops. Mr. Clark's colleagues were Quartermaster-General Col. F. J. Kecker and Capt. Crawford, of the Pennsylvania Railroad. Mr. Clark's special assignment on this commission was expressed in the appointment by the Secretary as "expert on Cuban affairs," and in the course of his trip he gathered an enormous amount of material in addition to that already in his possession upon the present condition of affairs in that devastated and unhappy island. He reports the sanitary conditions as being execrable to a degree almost impossible to believe. In a side street in Havana he saw the festering body of a man which had evidently been lying there for several days, while through open doors in various houses the signs of starvation and misery were terrible to contemplate. It was conceded by the Spanish officials that over one-third of the entire population of the island had died during the past two or three years, chiefly from starvation, and in spite of this the most rigorous custom house blockade of importations is kept up in order to swell the Spanish treasury. There is a general air of despondency and gloom over the city of Havana and the advent of American troops and settlers will be welcomed as the only possible salvation for the island. Mr. Clark returned to the United States Oct. 25, but may possibly have to return to Cuba a little later.

AMONG THE MANUFACTURERS

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, has published a little pamphlet entitled "Helps in Brazing." This treats of the process of brazing by the dipping method, or

liquid brazing, as it is called. The brazing crucible is described, together with instructions and caution in regard to its use.

THE E. T. BURROWES COMPANY, of Portland, Me., has issued a neat little pamphlet giving directions for preserving wire screens.

THE GENERAL ELECTRIC COMPANY has changed the address of its New Orleans office from 423 Baronne Street to Hennen Building.

THE NORTH AMERICAN RAILWAY CONSTRUCTION COMPANY, of Chicago, is just completing the work of converting to electricity about 6 miles of the Broadway Cable Line, in Kansas City.

R. A. BRYNS, formerly of the Walker Company, will hereafter act as representative in the Eastern States for the Ohio Brass Company, of Mansfield, O. He will make his headquarters at 39 Cortlandt Street, New York City.

THE BROOKLYN & NEW YORK RAILWAY SUPPLY COMPANY, of Elizabethport, N. J., is engaged upon a large order for cars to be used in London. The contract was secured by J. A. Trimble, of the company, who is now in England.

THE WESTERN ELECTRIC COMPANY, of Chicago, Ill., has published a circular describing the "Petitc" enclosed long burning arc lamp. These lamps are in very general use on direct current circuits, and are giving excellent satisfaction wherever used.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, is sending out a four-page circular describing the installation of "Chloride Accumulators" in the station of the Barre-Montpelier Traction Company, of Montpelier, Vt. This plant was described in the issue of the STREET RAILWAY JOURNAL for September, 1898.

THE EGAN COMPANY, of Cincinnati, O., has published a large colored poster describing and illustrating the many different kinds of woodworking machinery which it supplies. The poster will be valuable to all users of woodworking machinery, as it will enable them to quickly decide the best machine to buy for any particular class of work.

THE PECKHAM TRUCK COMPANY, of New York and Kingston, has just received an order from the Chicago South Side Elevated Railroad for the truck equipments for thirty-two cars. The trucks will be a modified form of the Peckham No. 14A, changed in some details to especially fit them for the service for which they are intended.

HAROLD P. BROWN, of New York, has received an excellent testimonial to the value of his plastic bond for street railways, it having been specified and ordered for use on the United States Government Railway, now being installed at the Indianhead proving grounds. It therefore receives the indorsement of the United States Government as to its value.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., has shipped six handsome closed cars to the Port Chester Electric Railway Company, of Port Chester, N. Y. The cars are 28 ft. long over all. The interiors are finished in mahogany, the doors and window sashes also being of that wood. The ceilings are all bird's-eye maple, finely striped and decorated.

THE JOHNSON COMPANY, of Lorain, Ohio, through its Chicago representative, A. S. Littlefield, has recently shipped forty-one new trucks to the Metropolitan Street Railway Company, of Kansas City. Thirty-five of these are to be placed under new cars built by the St. Louis and American car companies. Six cars were built by the Metropolitan Company itself.

THE AMERICAN IMPROVED RAIL JOINT COMPANY, of Chicago, has just closed a large contract for cast welded joints on the Toledo Traction Company's lines, Toledo, Ohio, and is also beginning work on an additional contract for the North Chicago Street Railway Company. The company states that it is receiving a large number of inquiries from abroad and is making negotiations with several companies.

THE CONSOLIDATED SAFETY VALVE COMPANY of New York City, is sending out its catalogue describing the Consolidated "Pop" safety valves fitted with Richardson's patent adjustable screw ring for use on stationary, marine, locomotive and portable boilers, "Consolidated" water relief valves and cylinder relief and snifting valves. The catalogue is well illustrated, and will be found of value to any one desiring appliances of this kind.

THE BATES MACHINE COMPANY, of Joliet, Ill., states that the proceedings instituted against it about two years ago by the Excelsior Heater Company for alleged infringement of a heater patent have terminated in a complete victory for the defendant. The decision of the United States Supreme Court of Appeals at Chicago, the court of last resort in this case, was handed down by Judge Woods on Oct. 3, and the complainant's bill was dismissed.

THE CROUSE-HINDS ELECTRIC COMPANY, of Syracuse, N. Y., manufacturers of the Syracuse changeable electric headlight, electrical switches, switchboards, etc., reports that its factory is overflooded with orders and is now running at its full capacity with one shift of men, and the works are run until 10 o'clock at night. This rush of business speaks well for the popularity of the headlights and switchboards manufactured by this company.

THE NEW PROCESS RAWHIDE COMPANY, of Syracuse, N. Y., has received the following letter testifying to the good qualities of the "New Process" rawhide pinions. The letter is from the Oxford Lake Line, of Anniston, Ala., and reads: "We are pleased to say that all of these wheels that we have used have seen, already, very long and hard service and are still giving very excellent satisfaction, so that we have decided to adopt the rawhide pinion and do away with the gear cases."

THE LANE & BODLEY COMPANY, of Cincinnati, O., is sending out a little pamphlet describing the "Bennett-Corliss Compressor" which it manufactures. This apparatus can be used for compressing air for any purpose, and consists of an improved "Columbian" Corliss engine to which, in tandem, is attached a compressing cylinder. The advantages claimed for the Lane & Bodley system are much saving of fuel, dry and coolest air, no liability of derangement, and positive automatic governor control.

THE BALTIMORE CAR WHEEL COMPANY, of Baltimore, Md., is sending out to the trade a very artistic poster in colors describing "The Lord Baltimore" truck. This truck is thoroughly well and carefully built throughout, the construction being such that there are no shearing strains on bolts, all joints being machined and all parts made interchangeable, and the manufacturers claim for it greater strength, fewer parts, easier riding, a minimum cost for maintenance, and comparative noiselessness.

THE ELLIOT FROG & SWITCH CO., of East St. Louis, Ill., has published a new catalogue describing the frogs, curves, switches, turn-outs, crossings and special work for street railways, which it manufactures. The requirements of street railways, especially those using T rails, are to a great extent identical with those of steam railways, and it is by its long experience in the latter branch of work that this company is enabled to furnish track material which very fully meets the demands of street railway practice.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is erecting an extension of the foundry of the Benj. Atha & Illingsworth Company, at Harrison, N. J. This extension is 51 ft. wide and 152 ft. long. The framework is all steel throughout, and the sides are covered with corrugated iron and steel purlins and are arranged for suitable doors and windows. The side columns support a 30-ton electric crane, having a span of 46 ft. The roof construction is of steel trusses and purlins arranged with openings in the roof for skylights.

THE RICE & SARGENT ENGINE COMPANY, of Providence, R. I., has recently installed a Rice & Sargent cross compound condensing engine of 350 i.h.p. in the main machine shop of the Brown & Sharp Manufacturing Company, of Providence. The new engine takes the place of a pair of non-condensing simple engines of the Corliss type, one of which was built in 1872. The change will effect a saving of several tons of coal a week, and the gain in economy illustrates the great advance made in steam engineering during the past twenty years.

THE ASHCROFT MANUFACTURING COMPANY, of New York City, manufacturers of pressure and vacuum gages, revolution counters, pipe stocks and dies, pipe fitters' tools, recorders, indicators and other special steam boiler appliances, has issued an elaborate catalogue bound in cloth describing its different devices. The materials and workmanship entering into the appliances of this company are of the best, and all measuring instruments are carefully tested before shipment, and are guaranteed to correctly fill all the conditions for which they are intended.

THE CENTRAL UNION BRASS COMPANY, of St. Louis, Mo., is sending out its catalogue of appliances which it manufactures for the equipment and maintenance of electric railways. This company claims that its line material cannot be equaled for lightness, strength and beauty, the "Gem" hangers being particularly neat and symmetrical. While these patterns are comparatively new they have been thoroughly tested by use and are fully guaranteed. The catalogue contains descriptions of motor bearings,

journal bearings, hangers of all descriptions, insulators, clamps, trolley ears, wire, trolley wheels, etc., pinions, commutator bars, brackets, and many other supplies.

THE DUPLEX CAR COMPANY, of New York City, has received an order from the Mansfield & Norton Street Railway for Duplex cars similar to the one exhibited at the Boston Convention of the American Street Railway Association. Interest in this new style of car is greatly increasing, and inquiries and several orders are being received from street railway companies in this country and also in foreign countries. The advantages of a car that can be quickly turned from an open one to a closed one when sudden storms or changes of temperature occur are very great, and the Duplex car seems to be doing the work required of it with great satisfaction to all purchasers.

THE KINETIC MANUFACTURING COMPANY, of New York, has just purchased a new manufacturing plant located at Riverside, Del., between Wilmington and Chester, Pa. The Kinetic motor, which employs stored steam, is in use on several roads, and the increasing demand for motors built in accordance with this system has necessitated an increase of the company's facilities. The plant consists of three brick buildings, respectively 241 ft. x 55 ft., 51 ft. x 60 ft., and 33 ft. 6 ins. x 37 ft. In addition to these buildings there are several frame buildings situated on a lot containing about 5 acres. The works are 3 miles north of Wilmington, Del., and 24 miles south of Philadelphia.

THE LOMBARD WATER-WHEEL GOVERNOR COMPANY, of Boston, Mass., has published its catalogue of governors for all makes of turbine and impulse water-wheels and for large steam engines. The pamphlet contains in condensed form much data taken from actual practice, which will be of great value to those interested in the speed regulation of water-wheels and steam engines. This company has made such alterations in its designs as the experience of governing over 75,000 h.p. of water wheels has shown to be desirable, and the governors which it is now building rank among the highest grade machinery made in any country for any purpose.

THE WHITING FOUNDRY EQUIPMENT COMPANY, of Chicago, Ill., has been forced to issue a second edition of its general catalogue to meet the increasing demand for descriptions of various articles needed in the equipment of well-appointed foundries and shops. The company gives its special attention to the furnishing of complete equipments for foundries, but does not limit itself to this field alone, as it also manufactures numerous appliances of utility in several lines of industry, including cranes, derricks, air-hoists, elevators, etc. It also makes a specialty of furnishing apparatus and material for building complete car-wheel foundries.

THE J. G. BRILL COMPANY, of Philadelphia, has issued within the past few weeks a series of beautifully printed catalogues on special subjects. The subjects treated are the following: The Denda gong, the Brill convertible car, profitable feeder lines for trunk railroads, Brill 21E truck, and the Eureka maximum traction truck. These pamphlets have been written and arranged by W. E. Partridge, of the Brill Company, who is responsible for much of the interesting and valuable matter recently published by that concern.

THE BROWN HOISTING AND CONVEYING MACHINE COMPANY, of Cleveland, O., is sending out a little circular describing the Weston patent crabs and winches for hoisting purposes. These appliances were formerly made by the Yale & Towne Manufacturing Company, but are now manufactured by this firm. They are strictly safety crabs and winches, and it is impossible when they are used to drop a suspended load. They are in no sense cheap machines, but on account of this safety feature they are in great demand.

THE HAYDEN & DERBY MANUFACTURING COMPANY, of New York City, has published a pamphlet describing the automatic injectors, ejectors, and jet apparatus which it supplies. Attention is particularly called to the "Metropolitan 1898" injector which this company makes, and which is designed for the severest conditions, embodying safety devices and constructed to be efficient, reliable and durable. Attention is also called to the "H. D. 1898" ejectors, which have been designed with a view to making them as simple as possible, while adhering closely to correct principles.

THE BUREAU OF EXPORT INFORMATION AND FORWARDING AGENCY, of New York, makes a specialty of caring for the details of the export business of manufacturers. This includes the securing of consular invoices, clearances and bills of lading, and the translation of letters from and into all the leading commercial languages. The company also acts as agent for foreign corporations purchasing apparatus in this country, if desired, and its familiarity with foreign languages and customs, as well as with those of the export trade in this country, makes its services of great value to both American companies doing business abroad and foreign companies desiring business with American manufacturers.

THE ELECTRIC RAILWAY EQUIPMENT COMPANY, of Cincinnati, Ohio, has published a unique catalogue illustrating the iron and steel tubular poles, pole trimmings, ornamental and plain pole brackets for electric railway, lighting, telegraph, and telephone service, which it manufactures. The catalogue consists of sixty-one sheets, bound together by wire stitching. Several of the sheets contain large engravings of a number of the different styles of poles which the Electric Railway Equipment Company carries in stock, and the rest of the sheets contain groups of engravings of the various parts of the poles. These include brackets, trimming, etc. Elmer P. Morris, of New York city, is the Eastern agent for these goods.

THE WEIR FROG COMPANY, of Cincinnati, O., has just issued its catalogue No. 5. There are a number of new devices mentioned in this book which were not included in the No. 4 catalogue issued last year. The pamphlet shows about twelve new designs of crossings for electric lines with steam roads, and also several new girder rail tongue switches and mates with hardened steel wearing parts. These are especially designed to meet the requirements of heavy and frequent travel in paved streets where the renewal of special work and paving is an expensive matter. The catalogue also describes a new girder rail frog with hardened wearing parts, and shows several new split switches and stands designed for use on suburban electric railways.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., has published from time to time exceedingly interesting printed matter, but its catalogue issued for the Boston convention surpassed anything that the company has undertaken before. The catalogue fully describes the Christensen air brake system, the scheme being to present on one page some car equipped with the Christensen air brake and on the opposite page a testimonial from one of the officials of that railway regarding the working of the system. The list of the roads using this system includes the interurban roads running out of Cleveland, the elevated roads of Chicago and Brooklyn, the Niagara Falls roads, the Cripple Creek District Railway, the Milwaukee Electric Railway, and many others.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, of New York, has issued its circular No. 10, describing the new Manhattan direct current enclosed arc lamp. While retaining features of the old lamp, the new Manhattan lamp also contains a number of improvements which have been discovered by experience. The principal changes that have been made in the new lamp are as follows: reduction of length from 36 ins. to 29 ins., change in the method of trimming, introduction of mechanism for lowering the inner bulb down through the opening in the bottom of the outer globe, the addition of a gas check plug which materially lengthens the life of the carbon, improvement in the method of adjustment, the elimination of the brush box, and a number of other improvements.

THE J. G. WHITE COMPANY, of New York city, has entered into arrangements with the Tramway Syndicate of London by which it will henceforth purchase all supplies needed by the latter for the various tramway enterprises throughout the world, and particularly for the tramway in Perth, Western Australia, which the syndicate has recently purchased for extension and equipment by electricity. J. G. White & Company has placed contracts in behalf of the British Tramway Syndicate for the equipment of the tramway system in Perth, as follows: Dynamos and motors, General Electric Company; engines, Robb & Company; boilers, Babcock & Wilcox Company; cars and trucks, J. G. Brill Company; overhead material, Macallen; iron poles, R. B. Corey; wire, American Electrical Works. It is expected that the system at Perth will eventually comprise about 30 miles of track and will require thirty cars or more, but the present order is for ten cars only.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., has issued catalogues Nos. 200 and 201, describing respectively generator and rotary transformers for electrolytic work and polyphase inductor generators. Regarding the inductor machines the catalogue states that the generators of this type are designed to give virtually the same performance, efficiency, regulation and temperature as the Westing-

house standard machines, and the choice between the inductor type and the standard rotary armature form is largely a matter of the personal preference of the purchaser, although the placing of the armature on the stationary part of the machine permits increased facilities for insulation and renders it practicable to generate a higher e.m.f. than is possible with revolving armatures.

THE KNOWLES STEAM PUMP WORKS, of New York City, have issued two new catalogues, one their general catalogue for 1898 and one a special catalogue. The general catalogue gives full particulars and illustrations of a large number of standard designs of Knowles improved pumping machinery. This company is constantly bringing out new specialties in the steam pumping line, and is ready to build machinery to fill any conditions. The special catalogue contains descriptions of pumps especially designed for use in paper and kindred manufacturing plants. This company's business intercourse with the paper mills has been of long duration, and it has given so much attention to the requirements of this class of mills that it is ready to guarantee its special pumps to do all that is desired.

THE LOBDELL CAR WHEEL COMPANY, of Wilmington, Del., has issued a new catalogue describing its car wheels. The pamphlet contains a list of the patterns that are in almost constant use which experience has demonstrated will meet nearly all requirements. This company, however, makes any design of pattern desired, and the dimensions can be changed to suit circumstances. The works of the Lobdell Car Wheel Company are equipped with every modern appliance for the making and finishing of car wheels in the best possible manner. The foundry proper has sufficient floor space for moulding 800 wheels per day besides the necessary room for cupolas, blowers, core ovens, etc., storage of equipment, sand and other materials. The Lobdell wheels have been made the standard type on a number of street railway systems in the United States.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, has received the following letter from R. G. Vance, Jr., superintendent of the Stevens Coal Company regarding the Baldwin-Westinghouse electric mine locomotive in operation in the mines of the latter company: "It gives us pleasure to say that this motor is giving the very highest possible satisfaction and is attracting considerable attention in this valley. It has been running since May 1 and has not cost a dollar in the shape of repairs, excepting a new valve for sand box and a headlight base broken in a collision with a car. It is running on a road of 25 lb. steel, 4000 ft. long, over undulating grades varying from 1 to 6 per cent. Its regular load now consists of twenty cars of 1½ tons capacity and the time required for each round trip is from 17 to 19 minutes. It has pulled as high as twenty-five of these cars at one trip, which it did with all ease. When necessity requires we can pull thirty cars, giving 50 per cent more capacity than you guaranteed.'

THE MICA INSULATOR COMPANY, of New York, Chicago and London, manufacturer of "Micanite" materials for high grade insulation, reports a gratifying demand for its commutator rings. This company makes a specialty of manufacturing molded insulation, and is now turning out, for some of the large manufacturers of electrical machinery, molded rings, all in one piece. This pattern of ring is the most difficult insulation to manufacture, but the ring, as it comes from the machinery of this company, is as perfect as a stamped piece of steel ware, and has the same metallic sound when struck. Electrical manufacturers will do well to write the company, sending their blue-prints for estimates. Another form of insulation of which this company has made a specialty is the armature trough or slot, which is now in use by many of the manufacturers of motors for crane work and by those who require a heavy insulation which will stand a very high voltage. While this form of insulation is a trifle more expensive than the common red paper and "Mica," yet those concerns who manufacture machinery which receives such rough usage have found it necessary to get the best possible insulation for their armatures.

THE GOUBERT MANUFACTURING COMPANY, of New York City, manufacturers of the Goubert feed-water heater, state that it is at present exceedingly busy. The magnitude of modern steam plants is well exemplified by the fact that it has just booked the following orders: One 3000 h.p. heater for one of the New York & Pennsylvania Company's pulp mills; one 3000 h.p. heater for the Cleveland Railway Company, Cleveland, O.; one 5000 h.p. auxiliary heater for the Metropolitan Street Railway Company, of New York City, making 35,000 h.p. now building for that company alone. It has also just delivered a 3000 h.p. heater to the People's Electric Light Company, of Newark, N. J. These orders, in addition to regular calls for heaters of smaller sizes, among them 1000 h.p. for the Schenectady Railway Company and 1800 h.p. for the Citizens' Light & Power Company, of Houston, Tex., are indicative of the magnitude of the business done by the Goubert Company.

FITZ HUGH & COMPANY, of Chicago, are offering for sale the engines which were taken off the Lake Street and South Side Elevated railroads in Chicago when those roads adopted electricity. A number of these have been sold to street railway companies who will close down their power houses in winter when the traffic is not sufficient to keep the power house loaded and draw their trains with the steam engines, also to companies handling excursions brought to them by steam roads; where the ordinary electrical equipment is inadequate to carry these large crowds the engines are operated in connection with the motor cars, making it possible to take care of excursions without the necessity of an enlarged power house equipment which must lie idle most of the time. Then, too, some companies are finding these small engines extremely valuable in times of breakdowns or other accidents which tie up the power house.

THE C. W. HUNT COMPANY, of New York City, has just produced three new catalogues on special subjects which will be found of much value to anyone interested in the subjects treated. One of the catalogues is on manila rope, and contains much information of extreme interest to rope users. It contains formulæ tables and data on ropes used for the transmission of power in all kinds of engineering practice. The second of the catalogues is a pamphlet describing and illustrating mast fittings, coal tubs, hoisting blocks and wheel-barrows. All of these appliances are manufactured by the C. W. Hunt Company from the latest designs, and embody all of the recent improvements. The third catalogue is entitled "Industrial Railways for Manufacturing Establishments." The Hunt railways offer conveniences and advantages in all kinds of establishments that can be obtained in no other manner. The track is furnished made in section all ready to be laid, and when in place the gage is correct, switches and frogs right, and further attention is not required.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, report the following recent sales of Cochrane Separators: Philadelphia Engineering Works, Philadelphia, one 8-in., two 6-in. and one 3½-in. horizontal; De La Vergne Refrigerating Machine Co., New York City, one 6-in. oil-ammonia separator; Cheney Brothers, South Manchester, Conn., one 8-in. horizontal; F. R. Dravo & Co., Pittsburgh, Pa., one 4½-in. horizontal; Massachusetts Institute of Technology, Boston, Mass., 8-in. horizontal; Elmwood Mills, Providence, R. I., one 6-in. horizontal; United Gas Improvement company, Philadelphia, three 5-in., one 6-in. and one 8-in. horizontal; Kroeschell Bros., Chicago, Ill., one 8-in. horizontal; George E. Dixon, Chicago, 6-in. horizontal; Arizona Copper Company, Limited, Clifton, Arizona, one 5-in. horizontal; Mills, Horton & Reed, Providence, R. I., one 3-in. horizontal; Spring Garden Institute, Philadelphia, one 7-in. horizontal; Fraser & Chalmers, Chicago, one 6-in. horizontal and one 8-in. vertical; Long Island State Hospital, Kings Park, L. I., one 6-in. horizontal; W. T. Hiscox & Co., New York City, one 4-in. horizontal; Chas. Erith & Co., London, England, one 6-in. horizontal; Lewis Metesser, New Orleans, La., one 8-in. and one 10-in. horizontal, and many others. This company also reports a large number of sales of Cochrane heaters, a few of which are as follows: Shoenberger Steel Company, Pittsburgh, Pa., two 2500-h.p.; Sheffield Electric Company, Sheffield, Ill., one 100-h.p.; Ayer Water Works, Ayer, Mass., one 100-h.p.; G. G. Caldwell, Chicago, Ill., one 100-h.p.; Rosenbaum Brothers, Chicago, one 300-h.p.; The Lane & Bodley Company, Cincinnati, O., one 200-h.p.; Kroeschell Brothers, Chicago, one 300-h.p. special; Clinton Cement Company, Pittsburgh, Pa., one 300-h.p.; Wm. Waterall & Co., Philadelphia, one 100-h.p.; Barrett Manufacturing Company, Philadelphia, one 150-h.p.; Pennsylvania Manufacturing, Light and Power Company, Philadelphia, one 2000 h. p.; Washington Coal and Coke Company, Star Junction, Pa., one 500-h.p.

New Publications

Evolution of the Modern Engine Shaft. By H. F. J. Porter. Published by the Bethlehem Iron Company, of South Bethlehem, Pa.

This is a very comprehensive treatise on the subject of engine shafts and describes the various evolutions through which they have passed and the up-to-date methods now employed for making this important part of the steam engine.

The Motorman and His Duties. By Ludwig Gutman. Published by Windsor & Kenfield Publishing Company, of Chicago, Ill. 145 pages, 84 illustrations. Cloth binding. Price, postpaid, $1.

This is a valuable practical book for electricians, motormen and applicants for such positions and is written by a practical railway engineer. The book tells in plain, simple language how the motorman, by intelligent handling of the controller, can save considerable money for the railway company.

Electric Wire Computer. Published by J. Lester Woodbridge, Boston, Mass. Price $1.50.

This is an ingenious pocket computer for calculating the proper size and weight of feed wire for carrying a given load in amperes, either concentrated at one point or distributed in equal parts at any number of equidistant points. It involves the law of minimum weight of copper for a given drop at the end of the line. The device is based upon Ohm's law, as applied to this problem, and should prove of much value as a time saver to builders and managers of electric railways who have this question to answer.

Cincinnati by Trolley. Published by the Cincinnati Street Railway Publishing Company, of Cincinnati, Ohio. 112 pages. Illustrated.

This is a large pamphlet containing a brief history of the origin, growth and rapid development of the system of the Cincinnati Street Railway Company, together with official maps of the system with directory giving the locations of the leading manufacturing establishments, business houses, public buildings, railroad stations, points of interest, etc., etc., in the city of Cincinnati. The pamphlet is quite elaborately illustrated and contains a number of advertising pages.

American Street Railway Directory and Buyers' Manual. Vol. 1, No. 1. Published quarterly by E. L. Powers, of New York and Chicago. 90 pages. Price, $3 per year.

This is a directory of the street railways in the United States which has heretofore appeared in the Standard Electrical Directory in connection with a list of the central lighting stations. The two lists are now published in separate forms as two distinct publications. The street railway directory just issued aims to give the name, capital stock and funded debt, officials, miles of track, power station equipment and description of rolling stock of every horse, cable, elevated and electric street railway in the United States, corrected to Aug. 31, 1898. The book states that there are 14,674 miles of electric railway in operation in this country and 32,696 motor cars.

Report of the Investigation into the Affairs of the Street Railways of Chicago, made to the Civic Federation, by W. K. Ackerman. 26 pages.

This report gives a financial history of the principal Chicago railway companies and discusses in a general way the powers which they possess under their franchises, which are compared with those of railways in several other cities. Finally, municipal ownership is considered and condemned. The writer's general conclusions are that the Chicago railways have not enjoyed special privileges from the city or State. Some tables giving the license fees and percentages paid by the several railway companies in New York, financial report of the Chicago City Railway from 1886 to 1897, inclusive, of the North Chicago Street Railroad Company for the same period, and of the West Chicago Street Railway Company for the last ten years, are also given. No price is named.

Poor's Manual for 1898. Published by H. V. & H. W. Poor, of New York City. Price $7.50.

This is the thirty-first annual issue of Poor's Manual of Railroads, and contains complete financial statistics of various classes of corporations, including steam railroads, street railways, etc. The 1898 edition has 130 pages more than the edition for 1897, and covers the statements of about 4300 corporations having an approximate capitalization and debt of $16,500,000,000. Of steam railroads there are presented statements of 1951 companies, of which 1782 are in the United States, 152 in the Dominion of Canada and 17 in Mexico. The department of city and suburban railways, comprising electric, cable and horse railroads, is covered by 1187 corporate statements, and contains many items of information respecting these important enterprises.

Commercial Cuba. A Book for Business Men. By William J. Clark, Manager Railway Department, General Electric Company, with an Introduction by E. Sherman Gould. 8 maps, 7 plans of cities, 400 full page illustrations. Published by Charles Scribner's Sons, New York. One volume, large octavo, $4.

This is one of the most important works which has yet appeared relative to the new possessions and "protectorates" of the United States. Mr. Clark's reputation as a statistician and a man who does well everything which he takes hold of, will be increased by this work, for the amount of material which he collected during some of his trips to Cuba and in this country has been simply enormous and proved in the late war of the greatest service to the government, by some of whose officials Mr. Clark was specially thanked and congratulated. Much of this information has been packed into this book and many of the maps and city plans are here published for the first time. The purpose of the work is to be make it possible for those who are planning to help develop the business enterprises in Cuba to enter the field with a full knowledge of the commercial and social conditions there and of the natives. The first two chapters deal with the characteristics and occupations of the people of Cuba, the third of its climate and the preservation of health, the fourth and fifth on its new geographical features and methods of transportation and communication, the sixth on currency, banking and government finance, the seventh on the legal and administrative system of the past and the future, the eighth on animal and vegetable life, the ninth on sugar and tobacco, the tenth on general statistics, and the seven remaining chapters on the different provinces and on the city of Havana. In the appendix is found a commercial directory of the island.

Trade Catalogues

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