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Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1906 *to date,* 57,000 *copies, an average of* 8143 *copies per week.*

The New Haven Electrification

We take pleasure in publishing this week an account of the plans of the New York, New Haven & Hartford Railroad Company for the electrification of its main line between Woodlawn and Stamford. The anticipations of a radical departure from previous heavy traction work, raised through the adoption by the company of the single-phase system, are certainly realized in the plans which are now announced in detail. It certainly seems startling to think of operating a four-track line, now 22 miles long and with a probable future length of 61 miles, without the help of sub-stations or feeders. We are so accustomed to the sub-station with its accompaniment, up to within recently, of an attendant or attendants, and to an elaborate system of high-tension and low-tension feeders, that a railway system hardly seems complete without them. But the plan adopted by the New Haven company is electric railroading reduced to its simplest terms. In its absence of feeders and translating devices between the generator and the car the method constitutes a return to early d. c. practice, and the abolition of the sub-station and the feeder, particularly the former, should mean a large reduction in the number of possible breakdowns. It is true that 11,000 volts have never before been placed upon a trolley wire employed in this country, but 15,000 volts are used on the Seebach-Wettingen line in Switzerland, and even this potential is low compared with that employed to-day on many transmission systems in both the eastern and western parts of this country. With a strong catenary construction there should be no greater difficulties in insulation than in a purely transmission line, carried at the side of the track or over a pole-line private right of way. The use of this voltage on the trolley wire, it is interesting to learn, permits the reduction of the line losses to less than 5 per cent, a figure practically unattainable by any other system.

Closely associated with this question of voltage is that of the supports for the overhead construction. The plan adopted, that of bridges spanning the track every 300 ft., appears somewhat formidable at first sight, but the cost, $26,600 per mile of route, is certainly not excessive. The use of bridges permits a combination in both construction and operation of the trolley lines with the block-signal system, because the bridges not only carry the semaphores, but will also be provided with an auxiliary safeguard against accident in the form of oil switches by which any section can be cut out of circuit. In this way the tower man, who is a trained operator and who would be required in any event, can look out for the condition of the overhead lines, and can have a physical control over the movements of trains as well as the one provided by the signals.

Second only in interest to the subject of power distribution on the New Haven system is that of the electric locomotives to be used. It is not possible yet to secure a complete description of these locomotives, but the information now available is noteworthy. It indicates that the principal departure from recognized standards in their construction is in the motor suspension, and that in other respects the well-known general characteristics of the usual four-motor car equipment are preserved. In other words, while the motors will be gearless, the locomotives, electrically considered, will be simply a double-truck car with quadruple equipment, with the four motors controlled by the auto-transformer tap method on the a. c. section, and by the usual electro-pneumatic two-motor series-parallel method on the d. c. section.

The Problem of First Cost

One of the first things a capitalist desires to know in a preliminary engineering report upon an electric railway is the total investment which will be required. The amount of money to be raised is, of course, a most important factor in the decision to go ahead with or drop a given proposition, but it is a question if undue importance is not in many quarters at the present time attached to the first cost of equipping a modern electric road. The volume of business throughout the country is to-day so great that the demand for equipment in many cases exceeds the available supply, and high prices are the natural result. In times like these there is no doubt that a good many undertakings are indefinitely tabled to await more favorable estimates of first cost. This is particularly true in the building of homes, and in many commercial enterprises a waiting policy is adopted in the anticipation of lower prices at some later period.

In the electric railway field, it is doubtful if it is in the long run wise to neglect opportunities to make money until the cost of labor, material and equipment shall have decreased noticeably. Of course, the prospect of hard times and diminished traffic must always be borne in mind before saddling a proposition with a heavy burden of fixed charges; but if a project figures out a reasonable return upon the investment, upon the basis of a conservative traffic volume, it is certainly a poor plan to hang fire because the total cost of the enterprise represents high prices rather than low ones in their component items. For example, the man who refuses to buy aluminum wire for a transmission line at, say, 35 cents per pound, because he hopes in a year or two to be able to buy it for 25 cents, fails to appreciate broadly the present opportunity if it can be shown that operating economy lies in the 35-cent purchase, high though the price may be.

The cost of a 2000-kw turbo-alternator may seem relatively heavy in itself to one accustomed to purchasing small reciprocating engine-driven units, but if it can be shown that it will pay to install such a machine in a growing street railway system, the first cost ought not to be a stumbling block. To take still another example, we think it is generally considered that the first cost of a large storage battery is a pretty formidable item in the equipment of an electric road, but after all, what difference does the first cost make if substantial economy can be shown by the use of the battery, allowing liberally for fixed charges and operating expenses? It is an American characteristic to replace out-of-date equipment with modern apparatus, even at heavy expense for making the change, and it is well to remember when the cry of high prices goes up that such adjectives as high and low are merely relative terms; that the industry is constantly growing to demand more substantial equipment and more powerful appliances from the coal pile to the car wheel; that the researches upon designs and experimental development of new equipment cost large sums of money; and that the manufacturer has also to meet the higher labor and material cost in turning out his product. If apparatus could remain standard for several years—say a decade—the price might well be beaten down, but in an art undergoing the tremendous development which now characterizes the transportation industry, stationary conditions are not to be expected. With the expiration of patents legal expenses become more and more prominent, for every claim which can be maintained becomes doubly valuable in the fierce competition of the manufacturing industry. The cost of street cars tends constantly upward; the demand for rails is almost insatiable; copper and aluminum can only be had at relatively high prices, and often only upon long deliveries—and yet below all this lies the great fact that we are developing a country of almost boundless possibilities. Let us figure the fixed charges and operating costs rigorously, but let us not balk at the mere sound of prosperity prices.

Lighting Switch Heads

Considerable difference of opinion exists as to the best method of lighting switch heads. With steam trains the only method usually available, of course, is oil, but certain of the important electric railways in the Middle West are employing electric switch lights, and at least one interurban company has received a contract from a parallel steam road to furnish the switch head lamps of the latter company with electric current. Those roads which have adopted electricity for this purpose state that they consider it not only much more economical than oil, but more reliable. The switch lights are arranged in different ways. Sometimes they are connected to the d. c. feeder, and either burn all day or are turned on and off by the proper crews. On other roads they are tapped off of a special feeder, or pilot wire, from the nearest substation, so that all of the switch lights on each section can be thrown in from the sub-station. Two lights are all that are required at each switch or turn-out. This requires the use either of two 300-volt lamps, or two 110-volt lamps can be used in each head and one or two others, to make the group of five or six, in a despatcher's booth if one is located at the switch. The principal objection to the use of electric lamps in switch heads is, of course, the danger of the lamp circuit burning out or being affected by lightning, and the former danger is undoubtedly increased by the vibration to which the lamps in the ordinary switch head are subjected. Nevertheless, practice has shown that the danger of a light going out unobserved is largely theoretical, as the motormen, who know the location of the switches instinctively, report the defect in any circuit, and when electrically-lighted switches are used, an extinguished light means danger. Moreover, when the lamps are supplied from a separate feeder, it is claimed by the advocates of the electrically-lighted switch that the substation attendant can tell pretty accurately from the ammeter on this feeder whether one of the lamp circuits is out. Perhaps the best answer to this objection is that a number of the longest roads which have been using electrically-lighted switches for some time report no trouble of this kind since they have had them in use.

On the other hand, it is claimed by certain experienced interurban railway managers that there is a decided advantage in favor of oil lights, in that they compel the road department to send a man to visit each switch head twice a day. To perform this duty, the roadman has to walk a considerable distance along the track on foot, and this regular inspection is by no means a detriment to the general good. The use of electricity for lighting switch heads is of such recent date that it is difficult to weigh yet the comparative merits of the two plans, and it is an interesting fact that in the case of two adjoining high-speed interurban lines in a Western State, one is very favorably disposed toward electric lighting, while the other, and the later road, has adopted oil lights for its switches.

Results From Gas Engines

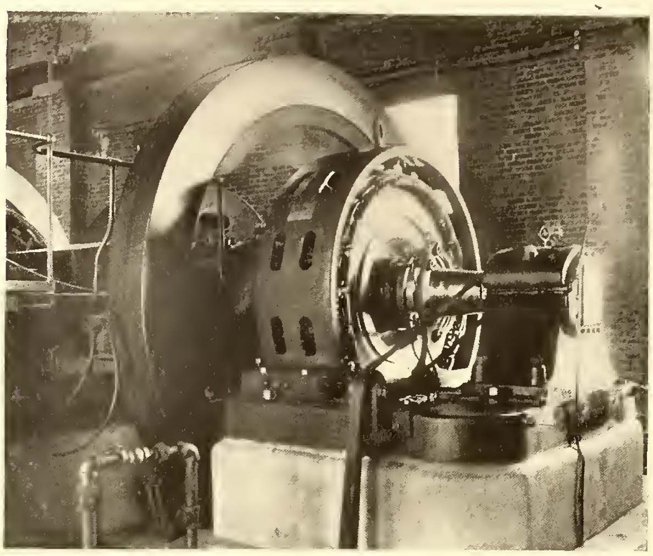
We publish this week a somewhat interesting report of the operation of the Warren & Jamestown Railway, which has the double honor of being one of the small group of single-phase interurbans and of being the only one of the class in which gas engines are used for the station motive power. An interurban road, particularly one like this, operating only three cars, and these at a running speed of nearly 20 miles per hour, is an exceedingly troublesome problem in the way of power supply, and its operation is about the most trying work to which gas engines could be put in a generating station. Hence from an operative standpoint, the success of this plant with its gas engines operating generators in parallel, is very gratifying. In this instance natural gas is the source of power, and is obtained at the low rate of 15 cents per 1000 ft. In many plants in the natural gas belt the gas is used under the boilers, and is found to be a cheaper source of power than coal. Unfortunately, the data given on this Warren & Jamestown road are insufficient to enable one to deduce therefrom the real thermal efficiency of the engines. It is well known, however, that in a well-designed gas engine the thermal efficiency is somewhat more than twice that of a good steam engine, reckoning in each case from the fuel. Hence the use of gas engines is absolutely certain to result in fuel economy, and the question of their use resolves itself into a consideration of their operative properties, reliability, and cost of maintenance. Although the road in question has been in operation now only a few months, the generating plant has been in service about eighteen hours per day and has not developed any serious troubles at all, nor does it show any signs of excessive wear or strain.

The engines in this case are of 500 brake horse-power approximately, each being coupled to a 260-kw generator. The horizontal tandem type chosen gives with the 4-cycle construction two impulses per revolution, so that in this respect the engine acts like a single-cylinder steam engine. The speed, 150 r. p. m., is about what would be expected in a conservatively designed, automatic, single-cylinder steam engine of similar output. It is apparent, therefore, that, so far as the operation of electric generators is concerned, these machines should be very similar to such engines, unless considerable differences should appear in the distribution of internal pressures. As a matter of fact, the indicator cards from the gas engine are quite similar to those from an automatic steam engine, so that from the dynamical standpoint, one is driven to the conclusion that such gas engines should, with good governors, operate as steadily as any other virtually single-cylinder machine. And so in fact they seem to do, the generators being reported as working steadily and well in parallel. The governing device is ingenious. The engines work on a nearly constant mixture, of which the quantity admitted for each stroke is determined by the governor. The work of adjusting the valves for this purpose is not thrown directly on the governor, but is done by an oil relay worked by the governor, so that the work of shifting the supply valves does not make the governor insensitive. This, to our mind, is a very important matter, since gas engines are heavily and strongly built and the valves demand very prompt adjustment to secure good regulation. The Warren station not only handles the interurban service, but seven city cars as well, via a rotary converter. The a. c. cars, as will be noted in the paper, do not run on the d. c. lines, but on their own parallel trolley wires at 550 volts a. c., using on these sections wheel trolleys instead of the pneumatically supported bow trolley employed on the catenary construction of the interurban section. With the whole system working on the gas engine station the cost of fuel per car per hour has been brought down to less than 7½ cents. Unfortunately, no data are at hand for the accurate reduction of this to terms of kilowatt-hours. "On form," however, as our sporting friends would say, the cost reduced to a kilowatt-hour basis should be something under half a cent for fuel.

This implies a very low cost indeed for power under conditions of service that are exceptionally severe. Just how well one would come out in using producer or other cheap gas, it is not easy to figure without more data on the actual performance of the engines under different conditions of load. That one could generally beat out steam very badly on cost of fuel, quite goes without saying, and on the showing made by these engines of the Warren plant the outlook for maintenance and depreciation is promising. Of course, as gas engines are usually rated, their overload capacity is small. As more experience is gained with the manufacture and use of big units, it is exceedingly likely that the moderate load efficiency will be improved and the now rather high costs reduced, so that as commercially rated the engines can make a good showing and still give a considerable overload capacity. There are many small roads now operating very uneconomical steam plants that could save money by using gas engines with producer gas, if they were not deterred by lurking fears of bad regulation and large depreciation. So far as regulation is concerned, the Warren experience seems to be encouraging, and in the matter of repairs and depreciation there is no reason to expect anything very serious if the machinery is well made. The producer itself is generally believed to be the weakest point of the system, and this is the point at which engineers are working. The guarantees of efficiency for producer systems are high—in the vicinity of 1 lb. of coal per ihp-hour even in engines smaller than those here considered. Aside from natural producer and blast-furnace gas, there has been little large work on gas engines. If the gas companies really got out after the business, there is a large field open for them in the matter of auxiliary plants and isolated plants. With a good quality of gas at 50 cents per 1000 ft., or anything under that figure, there is an excellent chance for cheap power production. The economics of the business have not yet been thoroughly worked out, owing to the small number of large units in use. When the big plant of the California Gas & Electric Company gets to running, there will be data of great value available, and we hope they may serve as a guide for important future work. There are plenty of roads suffering for lack of cheaper motive power, which the internal combustion engine ought ere long to be able to furnish.

THE WARREN & JAMESTOWN SINGLE-PHASE RAILWAY

The electric railway, which has recently been opened between Warren, Pa., and Jamestown, N. Y., traverses the valley of the Conewango Creek, through which the waters of Lake Chautauqua empty into the Allegheny River. Warren, the southern terminal of the line and headquarters of the operating company, is located at the junction of the creek and the river, right in the heart of the oil fields and within the natural gas belt, which have contributed so largely to the material development of the western portion of the State. It contains some 15,000 people, while its surrounding territory has a population of 10,000 more within easy reach of the new road. Jamestown, at the other end, is a prosperous manufacturing city of 29,000 inhabitants, and is connected by steam and electric roads with the attractive resorts of the Chautauqua region, whose summer population is estimated at 50,000. The intervening towns, with their surrounding neighborhoods, bring the total permanent population of the territory adjacent to the new railway to upwards of 65,000 inhabitants, or about 3000 per mile of track, exclusive of summer visitors. But the features which make the road particularly interesting are that it is equipped with modern horizontal gas engines as prime sources of driving power, and the single-phase alternating-current system. It is, in fact, the first instance of a single-phase electric railway operated by gas engines. The current is transmitted at a potential of 22,000 volts, fed to the central trolley section at 3300 volts, and to the terminal sections within the city limits at 550 volts, single-phase.



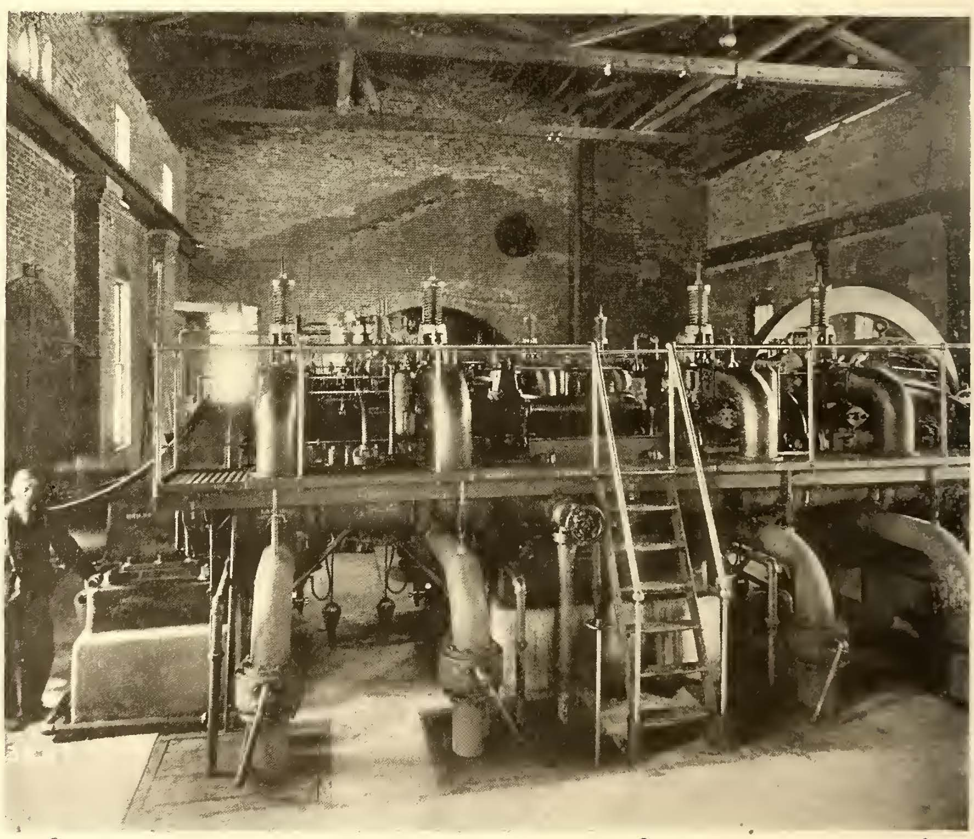
GENERATOR IN WARREN & JAMESTOWN PLANT

TRACK

The track consists of 70-lb. T-rails, laid on ties of oak and chestnut and ballasted with gravel. The rails are connected by the type G, form 2, soldered bonds of the Ohio Brass Company, and are cross-bonded at frequent intervals. As the line follows the winding course of the Conewango it possesses many curves. These, with the grades, one of which is three-quarters of a mile long, with an average of 3½ per cent and a short stretch of 7 per cent, combine to impose upon the power equipment a fluctuating load unusually severe at times. The sharpest curve has a radius of 65 ft. Four turnouts are now in use, but this number will soon be increased to five. The interurban line is 22½ miles in length. In addition, the city lines in Warren consist of about 9 miles of track.

POWER PLANT

The power house is located at Stoneham, 5 miles south of Warren, a site selected by reason of its proximity to the natural gas-pipe lines from which its fuel supply is obtained. The equipment includes two 260-kw, 380-volt, 25-cycle, alternating-current generators of the revolving-field type, which are direct connected to horizontal gas engines operating at a speed of 150 r. p. m. The two units are connected in parallel. The engines were constructed and erected by the Westinghouse Machine Company, and the electrical machinery was furnished and installed by the Westinghouse Electric & Manufacturing Company.



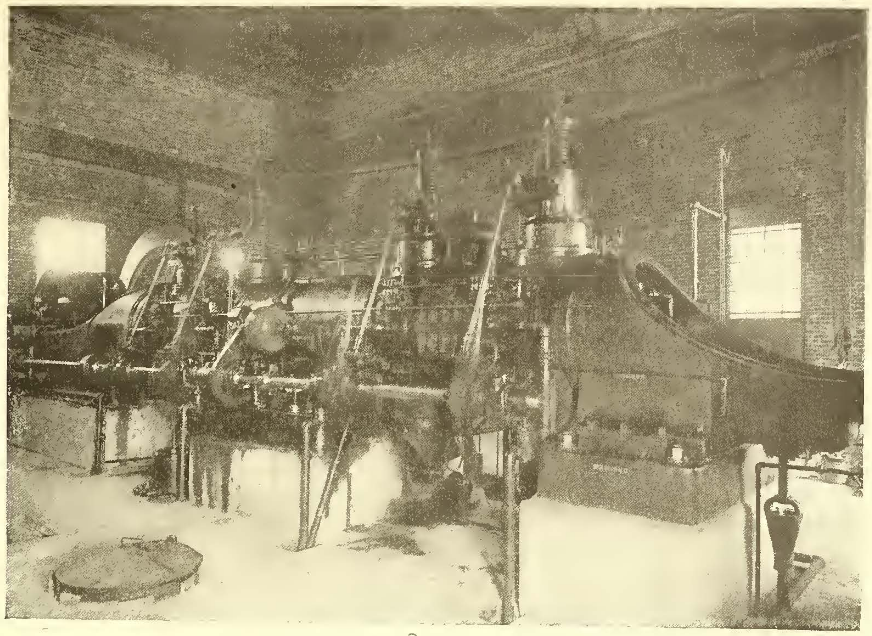
GENERAL VIEW OF PLATFORM SIDE, SHOWING THE EXHAUST ARRANGEMENTS AND DOUBLE-DUCT PIPING TO MAIN VALVES

GAS ENGINE

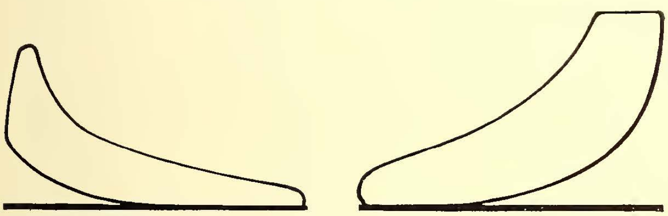
In the new type of horizontal double-acting gas engine, the first representative of which is now operating at Warren, the builders have especially sought to construct a prime mover uncomplicated in design, simple to operate, substantial and permanent in construction, reliable in its working, and possessing the best economy compatible with the more necessary elements of simplicity. The resemblance to approved steam engine practice is strong; in fact, the engine stands not as an example of radical change in structure, but as an adaptation to gas-working of the ample steam experience of the builders in Corliss engines. Symmetrical design has been adopted wherever possible, notably in the cylinder casting with its symmetrical valve chambers and in the pistons.

The absolute necessity of accessible parts has largely influenced the design of the engine and resulted in its elevation to such height that all parts are above the floor level. Inspection and cleaning, especially of cylinders, is possible without dismantling the engine.

Possibility of injury from neglect has been avoided by providing automatic auxiliaries, both oil and cooling water being delivered under the gravity head, cylinder oil by positive pressure and compressed air for starting from storage reservoirs. The starting arrangement has proven particularly efficient, and with only two operations, viz., opening up of gas and air valves, the engine automatically starts and comes up to speed under its own ignition without further attention. On large engines, considerably less than a minute is required to bring the engine up to speed, and, if desirable, a number of engines in a station may be simultaneously started from one point within this period of time. A duplicate system of igniters is employed with four different combinations in each combustion chamber. Any igniters may be replaced while the engine is in service, and in case of necessity any cylinder, or even the entire rear cylinder, may be isolated for repairs during operation.



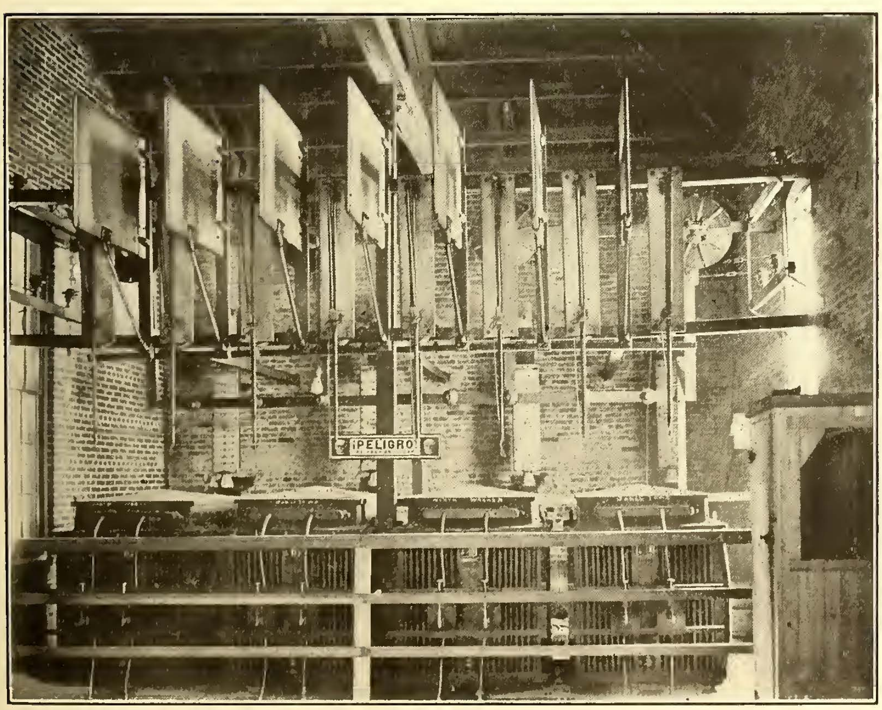
VIEW OF ENGINE FROM VALVE-GEAR SIDE



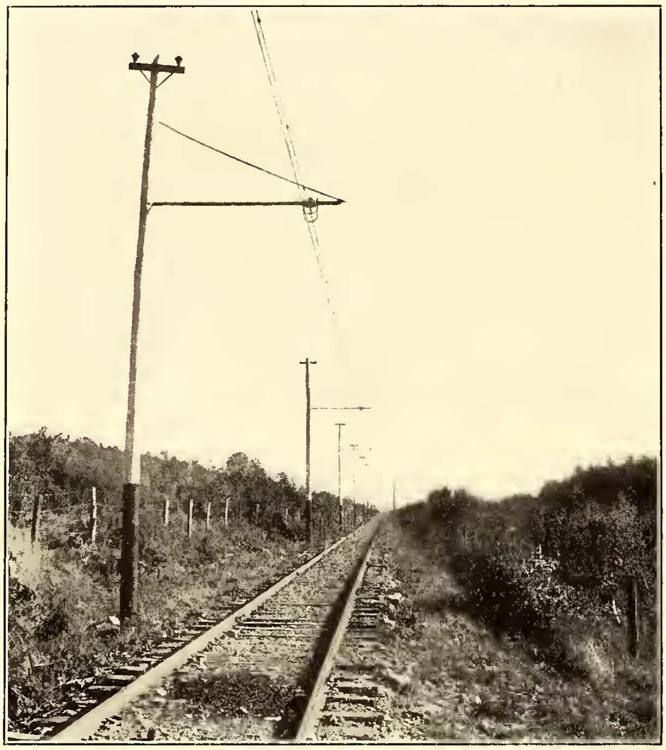
INDICATOR DIAGRAM (REDUCED) TAKEN WITH 160-LB. SPRING, 150 R. P. M., AND THREE-QUARTER LOAD, AND STOP CARD WITH 80-LB. SPRING

There are two main generating units at present installed at Warren, with space for a third of equal size—260-kw, 500-nominal hp. Single-crank tandem units were employed in place of twin-tandem units in order to give greater flexibility of operation, the former representing the standard adopted by the builders. The units have solid couplings between engine and generator, and operate in parallel on the station load in precisely the same manner as an ordinary steam-driven unit. The familiar Beau de Rochas or four-stroke cycle is used, which, with the tandem arrangement, gives a power impulse with each successive stroke of the engine. The cylinders are 21 ins. in diameter by 30-in. stroke. At 150 r. p. m. the engine is rated at 470 bhp., with a maximum of 520 bhp., giving 35 per cent overload capacity to the generator.

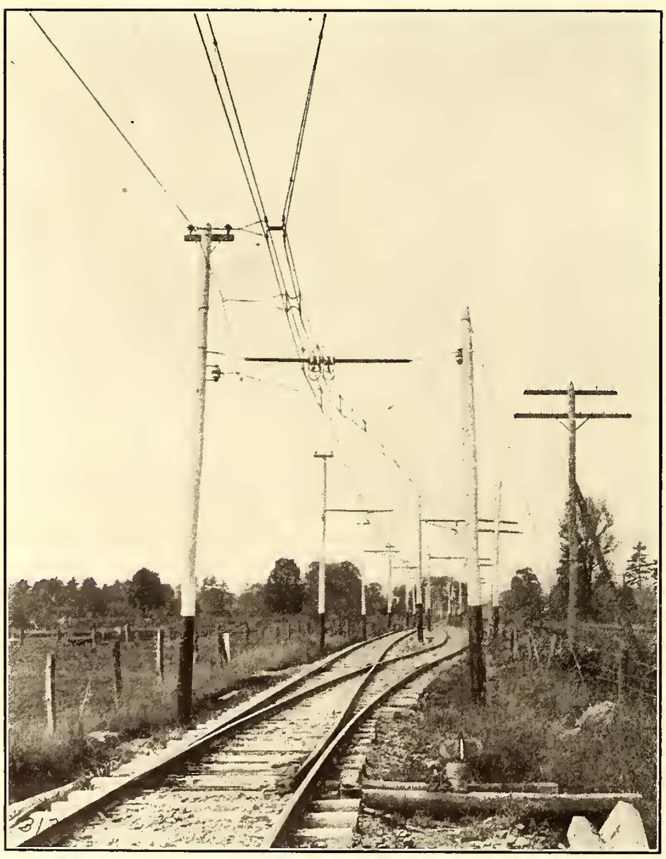
A few months prior to the opening of the interurban system a 300-hp vertical type Westinghouse gas engine was installed to drive a rotary converter, the machine first serving the d. c. city road, and



RAISING TRANSFORMERS, FUSE TYPE CIRCUIT BREAKERS, LIGHTNING PROTECTION, ETC., IN POWER HOUSE later the a. c. interurban road until the main power units could be placed into service. This rotary is now employed to good advantage for supplying the city



TANGENT CONSTRUCTION OF CATENARY

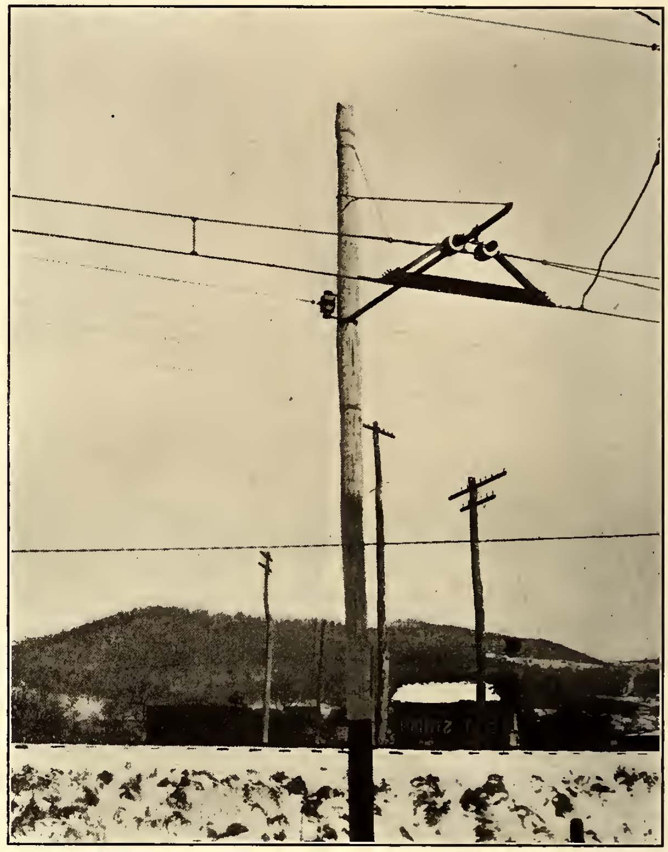


TURN-OUT SHOWING CATENARY OVERHEAD CONSTRUCTION

system from the main alternating-current plant, operating as a simple rotary. In case either side of the a. c. or d. c. plant requires assistance this rotary will be belted to the reserve engine operating either as an a. c. or d. c. generator. A 150 ampere (hour rating) storage battery assists in absorbing the fluctuations of the city load. It floats on the system without a booster, and was first installed for purposes of regulation to assist the old gas-engine plant.

OPERATION

The Warren plant was started on Oct. 19, 1905, and has since been in continuous service, averaging 17½ to 18 hours per day without developing the least trouble of a serious nature. The only prolonged shut-down was made after a two-months' run for the purpose of examining the condition of the interior of the first unit started. Every part was found



SECTION INSULATOR SEPARATING 3300-VOLT AND 550-VOLT SINGLE-PHASE SECTIONS

to be in perfect working order without any evidence of deterioration from wear or excessive strains.

Daily observations of the gas consumption of the plant have been conducted and are presented in the table on page 274. At present the large gas engines operate both interurban and city systems, totaling ten cars. With this combined operation a saving has been realized of approximately 20 per cent in cost of gas over the independent operation of the interurban and urban plants, the former by the new horizontal and the latter by the vertical engines.

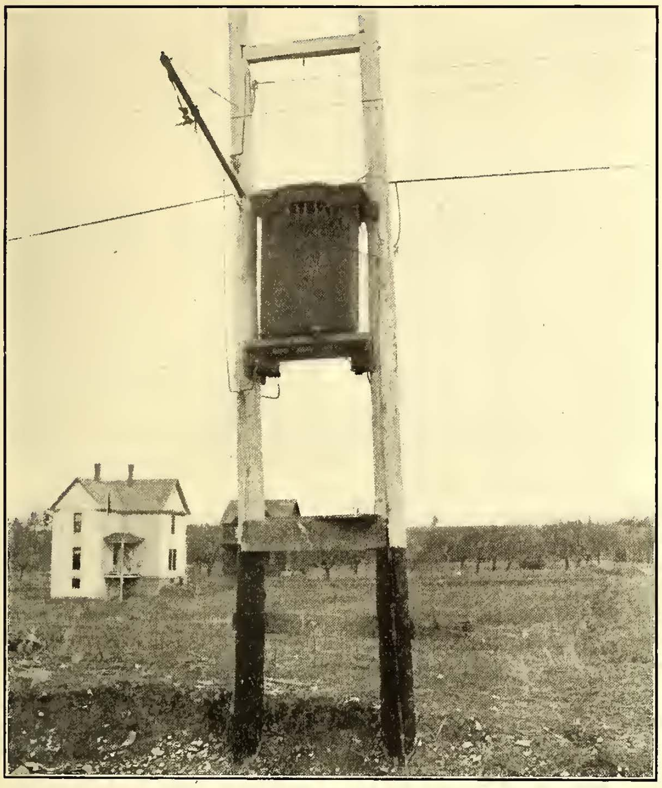
Fuel gas is available from several different points and is clean and uniform in quality, averaging from 1000 to 1100 B. T. U. total per cu. ft. Gas is obtained at a straight rate of 15c. per 1000 cu. ft., which places the cost of power so far below the usual figure that any other source of motive power is out of the question.

TRANSMISSION LINE

The 22,000-volt feeders of No. 6 bare copper wire are carried on Locke No. 406 porcelain insulators, which are supported on chestnut poles. Each feeder connects with a transforming station, one of which is located 1 ¼ miles from the Warren terminal and the other 1 ½ miles from the end of the line in Jamestown.

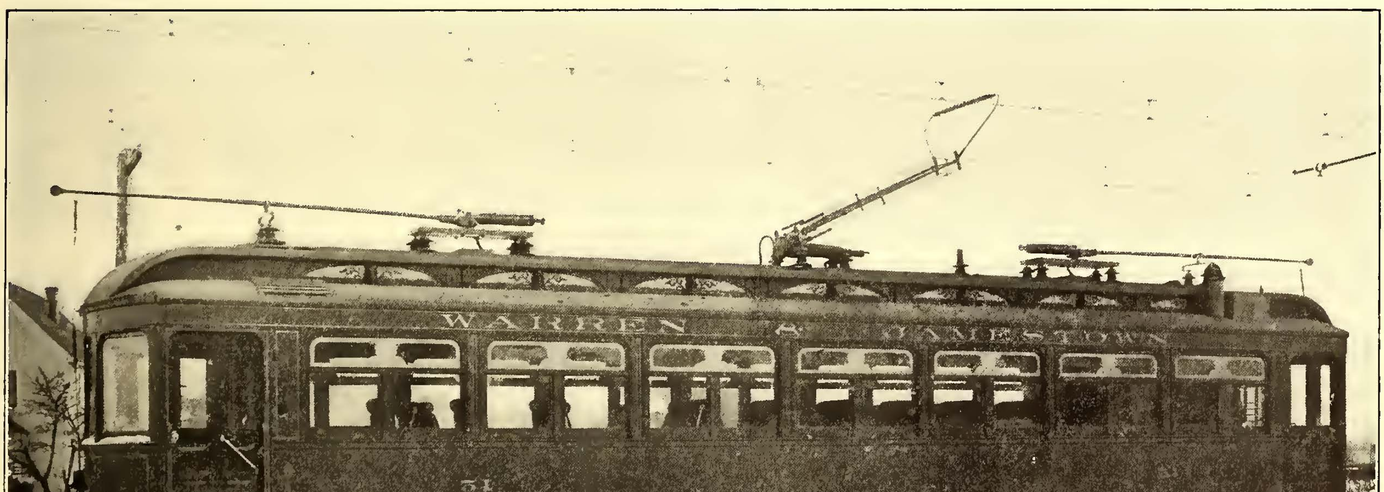
TRANSFORMER STATIONS

The transformer stations are made of concrete blocks, and mersed, self-cooling type, which are controlled and protected by fuse type circuit breakers and disconnecting switches in the high-potential circuits and by oil switches and enclosed fuses in the secondary lines. One secondary taps the 3300-volt trolley section, while the other feeds the city section of the



AUTO-TRANSFORMER SUPPLYING LOW-POTENTIAL TROLLEY ALTERNATING CURRENT IN JAMESTOWN

OPERATING PLATFORM OF INTERURBAN CAR WITH SINGLE-PHASE CONTROLLER



SIDE VIEW OF INTERURBAN PASSENGER CAR, SHOWING WHEEL TROLLEY FOR LOW TENSION AND BOW TROLLEY FOR HIGH TENSION

are of suitable size to permit a wise arrangement of the apparatus. They are similarly equipped, each containing two 150-kw, 22,000-3300-volt, lowering transformers of the oil-im- trolley line through auto-transformers along the track, which reduce the potential from 3300 to 550 volts. Both high and low-potential feeder circuits are protected by choke coils and low-equivalent lightning arresters, which are mounted in the transformer stations. The apparatus is symmetrically arranged, that mounted on one side of the station being exactly duplicated on the other. The two transformers are connected in parallel. Each has sufficient capacity to carry the entire normal load, and either may be readily cut out of service. The transformer stations are operated entirely without attendants and require only occasional inspection. The high-voltage feeder leading to the Jamestown transformer station is carried upon the pole line which supports the overhead construction.

STATISTICS OF OPERATION, WARREN & JAMESTOWN RAILWAY

	Dec., 1905, Interurban Service Only	Jan. 5-12,'06, City and Interurban	Jan. 1-31,'06, City and Interurban
Number of 35-ton cars	3	3	3½
Number of 10-ton cars	0	7	7
Gas consumed, cubic feet	1,701,000	625,000	2,745,000
Gas consumed per day, cu. ft.	54,900	89,285	88 550
Hours operated per day	17.5—18	18	18 +
Gas consumption per hour, cu. ft.	3,090	4,960	4 9[illegible]0
Cost of fuel per day	$8.24	$13.40	$13.27
Cost of fuel per hour run	0.464	0.744	0.735
Cost of fuel per car-hour	0.155	0.0744	0.7

TROLLEY LINE

As has been indicated, the trolley line is divided into a central and two terminal sections. The central section is connected direct to the transformer stations receiving alternating current at 3300 volts. A No. 000 Fig. 8 trolley wire is swung by catenary suspension from a 7-16-in. messenger cable, which is carried on heavy porcelain insulators mounted on angle-iron brackets supported on the chestnut poles. The poles measure 7 ins. at the top and are 35 ft. long. They are painted white and black and present a very attractive appearance. The white upper portions serve as useful guides to the line of track during the darkness of the night. All poles will be numbered to facilitate the location of line faults and other troubles. A nice detail of the overhead construction is the slight raising of one trolley wire at switch turn-outs, as indicated in one of the illustrations, so that the bow trolley easily passes from one wire to the other without impairment of contact. At frequent intervals the messenger cable is anchored and steady-strain brackets are used at curves and turn-outs. A few of the curves are constructed with pull-outs. The central high-voltage trolley line is separated from the terminal sections by section insulators.

Within the limits of the terminal cities the interurban cars are supplied with alternating-current trolley potential of 550 volts. A feeder from each transformer station leads to three 75-kw auto-transformers, which are located along the track and connected to a No. 0000 secondary feeder which supplies the trolley. The auto-transformers reduce the potential from 3300 to 550 volts. They are swung between pairs of poles, as shown in the illustration on page 273.

The low-potential trolley line is supported from span wires by insulating hangers, in accordance with the practice standard for direct-current work. In Warren, the new cars run over the tracks of the Warren Street Railway Company, which at present is equipped with the direct-current system. The two trolley wires—alternating current and direct current—are suspended side by side from the same spans without appreciably complicating the structure or in any way impairing the service of either system.

CARS

The company owns for its interurban service five passenger cars and one baggage car, all of which were furnished by the St. Louis Car Company. The passenger cars measure 52 ft. over all by 9 ft. in width and are equipped with 33-in. wheels and 5½ in. axles. They seat fifty-nine people and are supplied with baggage racks and a smoking compartment at one end. They are finished in mahogany.

Each car is equipped with four Westinghouse No. 108, 50-hp single-phase motors, which are connected permanently in multiple and are operated by the hand-control system by means of taps from an auto-transformer. The controllers are of the drum type and closely resemble those of direct-current practice, though they occupy somewhat less space.

The bow trolley is used on the 3300-volt section, the wheel trolleys on the terminal sections of the line. A change-over switch is arranged to cut out the bow trolley and transfer the connections of the wheel trolleys from the low to the high-voltage service taps of the auto-transformer, so that, in case of accident to the bow trolley, the wheel trolleys, which are mounted on heavy insulators, may be used on the 3300-volt section of the line. The bow trolley is pneumatically operated, the controlling valve being mounted on the platform within easy reach of the motorman. The wheel trolleys are handled in the ordinary way with ropes in which suitable insulators have been inserted to guard against the possibility of ground when used on a high-voltage circuit.

EXPRESS CAR CARRYING BOTH WHEEL AND BOW TROLLEY

The cars are equipped with Westinghouse straight air brakes, operated by means of an air compressor, which is driven by a single-phase, series-wound motor of a construction similar to that employed for the main driving motors. Hand brakes are also supplied.

The car, complete with equipment but without load, weighs approximately 66,000 pounds.

SERVICE

The winter schedule requires two passenger and one baggage car. Commencing at 6 o'clock in the morning cars leave either end of the line every hour and a half; this service continues until 11.30 p. m. The run of 22½ miles is made in an hour and ten minutes, each car laying over about twenty minutes between trips. There are fifty-three stations along the line at which stops may be made; the average run each way includes about fifteen stops. The maximum running speed is 50 miles per hour. The complete run from terminal to terminal without stops has been made in 47 minutes.

The change from the high to the low-voltage trolley is easily accomplished. As the car approaches the terminal section the motorman releases an air valve, thereby lowering the bow trolley, which automatically closes down and locks in place. After passing the section insulator the conductor places the wheel trolley on the line in the ordinary way. The change-over may be made without stopping.

Under present arrangements the car is run two days with a mileage of 246, and is then brought in for inspection. The bow trolley shoes are found to give a life of approximately 10,000 miles. So far there has been no indication of undue wear of the trolley wire, nor has there been any trouble with the overhead structure. The baggage car makes three trips per day on the regular schedule.

The present service of the Warren & Jamestown Street Railway Company requires a total of but eight employees, outside the general offices and car crews. It is made up of four men in the car houses, three power-house attendants and one line-man. An additional line-man is occasionally borrowed from the Warren Street Railway Company.

ORGANIZATION

The officers of the company are: D. H. Siggins, president; H. M. Preston, vice-president; S. Q. Smith, secretary. Mr. Siggins is assisted in the management of the property by his son, H. A. Siggins, a director of the company and general manager of the Warren Street Railway.

INVESTIGATION OF PUBLIC OWNERSHIP

The Public Ownership Commission of the National Civic Federation, which was organized to examine into the relative merits of municipal and private ownership and the operation of quasi public utilities in this country and abroad, has completed all of its plans and begun the actual work of investigation. As announced in the issue of this paper for Oct. 14, 1905, a committee of twenty-one was appointed to investigate the subject of municipal and private ownership of public utilities, and a list of the committee was published in that issue. On Nov. 27, this committee appointed a sub-committee of five, whose names were printed in the issue of this paper for Dec. 2. This sub-committee consists of Frank J. Goodnow, of Columbia University; E. W. Bemis, superintendent of the Cleveland water works; Walton Clark, third vice-president of the United Gas Improvement Company; M. R. Maltbie, of New York, and J. W. Sullivan, editor of the "Cloth-Trades Bulletin."

This sub-committee has drawn up a list of questions, about a thousand in number, relating to the franchises under which public utility corporations are operating, political conditions in the different cities, the efficiency of the service rendered and the financial results secured. The sub-committee has also selected some twenty or thirty representative cities at home and abroad, whose public utilities will be studied along the lines decided upon. It is proposed to send experts to each of these plants and gather facts pertaining to the investigation. In most cases two experts will be sent to each plant, one representing the so-called municipal ownership view and the other the so-called private ownership view. When these reports are received, they will be examined by the committee of twenty-one, and, if they are incomplete in any particular or if any question arises as to any point in connection with the investigation, the entire committee of twenty-one, or as many as can attend, will visit the place from which the report has been received, examine the facts and settle any disputed questions upon the spot. This plan will be followed in the case of all of the foreign and American cities under investigation.

For convenience in carrying on the investigation, the sub-committee of five has selected Walton Clark and Prof. Bemis to direct the expert investigation which is to be conducted in the cities in this country. It also selected Milo R. Maltbie and William J. Clark, of the General Electric Company's foreign department, to conduct the expert examinations for the foreign cities. Mr. Maltbie sailed for London last week. Owing to pressure of other duties, Mr. Clark was not able to accept this appointment, so that J. W. Sullivan, who is a member of the sub-committee of five, was appointed to take his place and sailed for Europe Feb. 15. The following is a list of the experts who have already been appointed to carry on this investigation. They will be supplemented by two or three British experts, who will be engaged in England by the members of the commission which have the European reports in hand:

Theodore Stebbins, of Columbus, Ohio, and C. E. Phelps, Jr., of Baltimore; engineering of electric lighting plants in the United States;

C. J. R. Humphreys, of New York, and assistant; similar work for gas plants in the United States;

Albert E. Forestall, of New York, and L. L. Merrifield, of Toronto; gas plants in the United States;

Marwick Mitchell & Co., of New York; accounting work in both the United States and Europe;

Robert C. James, of Wallingford, Pa., accounting work abroad;

Alton D. Adams, of Worcester, Mass.; Massachusetts system of regulating electric light plants;

Albert E. Winchester, of South Norwalk, Conn.; engineering of British electric light plants;

Prof. John R. Commons, University of Wisconsin, and J. W. Sullivan, of New York; labor conditions in the public utility plants of the United States;

Prof. Lee S. Roe, University of Pennsylvania, Philadelphia; history of the municipal gas plant in Philadelphia;

Walter L. Fisher, of Chicago; history of the municipal electric lighting plant in Chicago;

Dabney H. Maury, of Peoria, Ill.; engineering features of the water-works plants in the United States;

Prof. John H. Gray, of the Northwestern University, Evanston, Ill.; public documents bearing on the question of municipal ownership of public utilities;

J. B. Klumpt, of Philadelphia; engineering features of the electric lighting and gas plants of Great Britain.

It is also probable that N. McD. Crawford, of Hartford, will report on the subject of the street railways and tramways in Great Britain. The expert to report on the street railways in this country has not yet been appointed.

It is planned, after the experts finish their work and the general committee has visited the plants under investigation, to issue an elaborate report giving the findings of the commission. In view of the extent of the work, this report will probably not be ready until late in the present year. The work has been and is being conducted with a sincere desire to secure the facts in all cases, and it is interesting to note that all decisions made by the sub-committee so far have been by unanimous vote.

ELECTRIFICATION OF THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD

Plans are now completed for the equipment of the main line of the New York, New Haven & Hartford Railroad Company between Woodlawn and Stamford, a distance of 21.45 miles, and tests under service conditions of the first of the single-phase electric locomotives to be used on this line will be conducted at Pittsburg about March 1. A few particulars of the proposed electric equipment of the New Haven system have been published in previous issues of this paper, but the following general summary, it is thought, will be of interest:

POWER STATION

Between Woodlawn and New York the trains of the company will run over the tracks of the New York Central and Hudson River Railroad, and power for train operation will be purchased from the New York Central Company by the New Haven Company. After reaching Woodlawn the trains pass on to the New Haven tracks and will then take current from a new power station which is to be erected by the New Haven Company on the west bank of the Miamus River at Cos Cob. The site selected is just south of the main line of the company and on tide water, which will permit the use of sea water for condensing, and a dock will be built for the reception of tide-water coal. A spur will also be run from the main tracks so that fuel may also be received by rail. The station will be of concrete construction and will be built by Westinghouse, Church, Kerr & Co.

The steam generating equipment will consist of water-tube boilers of 9000 nominal horse-power capacity. The generating equipment will be four Parsons steam turbines, each rated at 3000-kw capacity. The generators will supply single-phase current at 11,000 volts and 25 cycles, but they will be wound so as to deliver three-phase current if desired. The equipment of the station will also include two 125-kw steam-driven exciters and the 12-panel switchboard on the engine-room floor. No step-transformers will be used, as power will be distributed at 11,000 volts. The design of the station is such that it can easily be extended as the requirements for power of the company demand.

The power station will also supply three-phase current for the operation of air compressors for the signal system and for a small amount of power for other purposes along the line.

OVERHEAD CONSTRUCTION

As already announced, the company is planning to operate trains on its own line by overhead wires. These wires will be carried on steel structural bridges which will span four, and in some cases six, tracks. They will be spaced 300 ft. apart, and will be mounted on concrete foundations. The trolley wires will be central over the tracks. Each trolley wire will be suspended from two steel ⅝-in. catenary cables, which will be supported on insulators mounted on the top of the cross trusses, while the trolley wire will run under the cross trusses. Each trolley wire will be supported every 10 ft. from its two steel cables by triangles and will be carried at a uniform height of 22 ft. above the rails. This height will give a clearance of 3½-ft. to a 6-ft. man standing on top of a 12½-ft. freight car. This height, it is thought, will also be sufficient to prevent any deleterious effect from the gases of combustion of the steam locomotives which will haul freight trains or passenger trains until the entire work of electrification is completed. No. 0000 trolley wire will be used.

A block-signal system with sections approximately 2 miles in length, which is considerably less than the length of the present block, will be used, and there will be a tower with a signal man at the end of each section. This tower man will have under his control oil-circuit breakers, which will be placed in each trolley wire between the two adjacent block sections. At these points the catenary cables will be broken and suitably fastened on strain insulators to bridges of heavier construction than those used elsewhere. These bridges at the ends of sections are also designed to serve as signal bridges, and will carry the block signal semaphores as well as the oil-circuit breakers. All the trolley wires will normally be connected in parallel, but any two-mile section of any track may be disconnected by the tower man, if desired, by means of the circuit breakers already mentioned. A relay feeder on each side of the tower bridge, suitably looped in at the section terminals, will provide against interruption to service on more than one section at a time, due to any trouble on that section.

It has been found that with all the No. 0000 trolley wires connected in parallel, no additional feeder will be required for purposes of increasing the conductivity, and that the average losses on the distribution system will be less than 5 per cent. As the current will be collected by the locomotive at 11,000 volts, no step-down transformers will be required except those on the locomotives. For this reason no transformer sub-stations will be required, but suitable lightning protection will be provided at the end of each two-mile section.

ELECTRIC LOCOMOTIVES

At present the company is planning to haul all of its trains by electric locomotives. It is possible that later multiple-unit trains will be used, but it was considered desirable not to complicate the situation by the introduction in the first equipment of multiple-unit trains. Among the other reasons which led to this decision were the use of both a. c. and d. c. between Stamford and New York, the desirability of utilizing the existing rolling stock, and the fact that no stops are made between Mt. Vernon and New York.

The locomotives will weigh approximately 72 tons each and all of the axles will be driving axles. The locomotives consist essentially of a steel frame mounted upon two swivel trucks, each of which is equipped with two Westinghouse 250-hp, single-phase gearless motors. These motors are carried on an ingenious form of suspension by which not only the weight of the field but also that of the armature is supported on springs. The motors are capable of operating either on the single-phase current used on the company's own lines, or on 300-volt direct-current. When the locomotives are on d. c. service between Woodlawn and Forty-Second Street, each pair of motors will be coupled in series and will be operated as a unit.

The locomotive control is electro-pneumatic and includes the transformer for reducing the line e. m. f., an air compressor for supplying air to the brake, controlling apparatus and whistle, suitable blowers for ventilating the motors, a flash boiler for train heating, bow trolley, etc.

Each locomotive unit, as described above, is capable of handling a 250-ton train between New Haven and New York under the most severe local schedule practicable over the road. For heavier trains, two or more locomotives may be connected together, if desired, and operated as a single unit by means of the multiple unit. This division of the locomotives into comparatively small units not only reduces their first cost but keeps down the maintenance cost of both locomotives and of the track, besides affording all necessary flexibility for the handling of heavy trains. Under normal voltage and with the average weight of trains as it now obtains on the New Haven system, the locomotives will be capable of maintaining a maximum speed of 80 miles per hour on a tangent level track.

The step-down transformer used in the locomotive will be provided with a high-voltage loop by which increased speed can be secured when desired for emergencies.

MISCELLANEOUS

All contracts have been let with the plan of completing the electric system from Woodlawn to Stamford so that operation can be commenced by Sept. 1, 1906, and up to the present all work has been carried out ahead of the schedule. No definite decision has been made for extending the electric system on the main line from Stamford to New Haven, but it seems to be the general belief that this will be done not long after the completion of the line to Stamford, as New Haven is the logical terminus of the suburban traffic out of New York. The location of the power house is well adapted to such an extension, which would make the total distance to be electrified, if counting from Woodlawn to New Haven, 61.2 miles; or, if counting from Forty-Second Street, of 73.23 miles. No plans have yet been made for the electrical equipment of the New Rochelle-Port Morris branch, partly because this line is now being reconstructed as a six-track line and partly because it is used mainly for freight.

The Westinghouse Electric & Manufacturing Company will supply the locomotives and overhead construction; the Westinghouse Machine Company, the turbines, and Westinghouse, Church, Kerr & Company have the contract for the power station.

The main items in the cost of electrification from Woodlawn to Stamford will be approximately as follows:

Power house, including real estate (12,000 kw)..	$1,130,000
Overhead construction (21.45 miles)............	570,000
Locomotives (thirty-five)......................	1,050,000
Total	$2,750,000

GOVERNMENT REPORT ON BENEFIT ASSOCIATIONS

The Bureau of Labor of the United States, Department of Commerce and Labor, at Washington, is preparing a report covering the various systems of workingmen's insurance and employers' liability, both in this country and abroad. The report will cover insurance against sickness, accident, disability, old age, death and unemployment.

In this connection it is endeavoring to secure information concerning all street railway associations, and especially to obtain, wherever possible, copies of constitutions, rules and by-laws, blank certificate forms, and any other matter relating to funds of this character.

Charles P. Neill, Commissioner of the Bureau, states that all information of this character would be much appreciated by him, and may be addressed to the department at Washington.

The Hudson Companies, which is to operate an underground electric railway between Jersey City and Thirty-Third Street and Sixth Avenue, New York, has awarded a contract for forty steel cars to the American Car & Foundry Company, and one for ten cars to the Pressed Steel Car Company.

COMPARISON BETWEEN SINGLE-PHASE AND THREE-PHASE EQUIPMENT FOR THE SARNIA TUNNEL

BY C. L. DE MURALT

The question whether continuous currents or alternating currents should be used for electrifying our trunk lines has been quite thoroughly discussed of late. In the issue of the Street Railway Journal for Jan. 20, there is a very interesting article descriptive of the single-phase alternating-current equipment now building for the Sarnia tunnel of the Grand Trunk Railway. It is probably safe to assume that the calculations made for this work must have showed quite a decided advantage for the alternating-current system over the continuous-current system, else the responsibility would hardly have been taken of employing a new system in a case where the well tried and standardized continuous-current system was otherwise well adapted. In general it may be said that the advantages of high pressure alternating currents for all heavy traction problems seems to-day to be well realized, but the difference which exists between single-phase and polyphase alternating currents does not seem to be so well understood, and I fear that some of the best points of the polyphase system are not fully appreciated. It is my purpose in the following lines to show what three-phase alternating currents could have done in the case of the Sarnia tunnel, in order that everybody interested in this question may be able to compare the advantages of the two alternating-current systems and draw his own conclusions.

In order to avoid all possible misunderstandsings, I desire to clearly state at the beginning that it is not my intention to criticise in any way the choice made for the Sarnia tunnel equipment. As a matter of fact, I feel convinced that the equipment ordered will be well able to take care of the situation, and I certainly expect to see it render a good account of itself, so that it may furnish a further proof of the general advantages presented by electricity over steam as motive power for heavy railroading.

What I shall attempt to show is, that the use of a three-phase alternating-current system would have effected a certain, not inconsiderable, saving in first cost of installation, as well as in cost of operation, and that in addition to this the three-phase system would have presented certain unique features which would have increased the security against interruption of service, so important for equipment of this character.

The article describing the Sarnia tunnel equipment is the first one containing sufficient data to form the basis of a comparison between the performance of the single-phase and the three-phase alternating-current system with reference to a concrete case. I have long been waiting for such data, and I shall now make use of this opportunity for comparing the two systems, even though I am free to say that the conditions in this instance are about as unfavorable as they possibly can be for the three-phase system. It is well recognized that the latter is at its best where long runs are made at constant speed, and where the traffic is so distributed that the energy recuperated by trains running down grades can always be usefully employed. Neither of these conditions is fulfilled in the case of the Sarnia tunnel. If I can show, therefore, that even under these unfavorable conditions the three-phase system is superior to the single-phase system, the conclusions ought to carry all the more weight, and I trust that my labor will not have been in vain, but will induce all who have to figure on similar propositions to look carefully into the merits presented by polyphase alternating currents in work of this character.

I shall compare the two systems with reference to the following points: weight and power of locomotives, fulfillment of prescribed speed schedule, energy consumption, maximum power consumption, cost of installation and cost of operation.

BASIS FOR COMPARISON

The conditions prevailing in the Sarnia tunnel are given by the following abstract of the specifications:

A profile of the line to be electrified is shown in Fig. 1. The tunnel proper is 6032 ft. long, 1718 ft. of which extend under the river bed and have a grade of 0.1 per cent eastward for drainage, while the rest of the tunnel is built to a 2 per cent grade, of which 2399 ft. are on the Port Huron side and 1915 ft. on the Sarnia side. Beginning at the Sarnia portal the 2 per cent grade is continued for 3269 ft. to the summit, and from this point the tracks are practically level, extending through the yards to a point 3949 ft. from the summit. From the Port Huron portal the 2 per cent grade continues for a distance of 2515 ft. to the summit, and from this point to the end of the yards, 3583 ft. distant, the track is practically level. While the track through the tunnel proper is single, the approaches to the tunnel are double tracked up to a point about 300 ft. distant from each portal. The total distance from terminal to terminal to be electrically equipped is 19,348 ft.

Both passenger and freight trains arriving from either direction are to be hauled through the tunnel electrically. Owing to the great importance of avoiding all possible chances for a wreck, it was thought best to keep the strain on the draw-bars within 50,000 lbs., which will just enable the locomotive to haul a 1000-ton train up the 2 per cent grade.

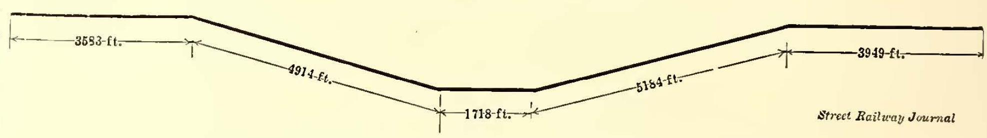


FIG. 1.—PROFILE OF THE SARNIA TUNNEL RAILWAY

Each locomotive must be capable of taking a 1000-ton train through the tunnel block from summit to summit (see profile) in fifteen minutes and continue this service throughout the day of 24 hours, operating under the following conditions: It will be coupled to its train on the level track at a point 1200 ft. from the summit and accelerate this train up to a speed of 12 miles per hour in 2 minutes, when it will have reached the summit of the grade. It will then coast down the 2 per cent grade, and on to the level portion of the track in the tunnel at a speed not exceeding 25 miles per hour. As soon as the train is all on the level track, the locomotive will begin taking current, so that by the time it has reached the foot of the ascending grade it will have taken the slack out of all the draw-bars. From this point to the top of the grade it will haul the train at the rate of 10 miles per hour until the entire train is over the grade and on the level track. It will then gradually accelerate until it has reached a speed not exceeding 18 miles per hour, and at this speed it will run into the terminal. After coming to a stop in the terminal yard it will uncouple and immediately run back to a point 1200 ft. from the summit on this side, where it will couple on to another train and be ready to start through the tunnel in the opposite direction as soon as the next train clears the tunnel block. It will thus make a run of the above character through the tunnel every 30 minutes. The locomotive must also be capable of starting a 1000-ton train from rest upon the 2 per cent grade.

Each locomotive may be built either as one single unit capable of hauling a 1000-ton train as specified above, or it may be composed of two smaller units coupled together, each capable of hauling a 500-ton train under the same conditions. In the latter case each part must be complete and the two parts must be arranged for multiple-unit control from the cab of either part. Each complete locomotive capable of hauling a 1000-ton train under the conditions above mentioned shall weigh not less than 100 tons nor more than 140 tons of 2000 lbs., all of which shall be carried on the driving wheels. Preference will be given to the locomotive which produces the tractive effort called for with the least weight.

COMPARISON OF WEIGHT AND POWER LOCOMOTIVE

The single-phase locomotives now building are described as being composed of two identical smaller locomotives, each one having the following characteristics:

Total weight 62 tons.
Three driving axles with all the weight on drivers.
Diameter of driving wheels 62 ins.
Three driving motors, one geared to each axle.
Weight of three motors 43,500 lbs.
Each motor wound for 240 volts and 25 cycles per second, and to be operated with auto-transformers having 50-volt taps.
Forced ventilation.
Total weight of electric equipment estimated at about 30 tons.

For three-phase operation, single unit locomotives would be the best solution, but in order to make the comparison strictly fair in every respect I have calculated on three-phase locomotives also composed of two identical smaller locomotives, each one built according to the following data:

Total weight 50 tons.
Three driving axles with all the weight on drivers.
Diameter of driving wheels 62 ins., although smaller wheels could readily be used if desirable.
Three driving motors, one geared to each axle.
Weight of three motors 33,000 lbs.
Motor stators wound directly for 3000 volts, rotors for 250 volts.
Natural ventilation.
Total weight of electric equipment about 22 tons.

From these figures it will be seen that it is easily possible to design a three-phase locomotive which will have the required capacity for hauling a 1000-ton train under the above mentioned conditions, within the specified maximum weight of 140 tons. As a matter of fact, it would be possible to design such a locomotive within the minimum weight of 100 tons, but this latter weight has to be used in order to provide for the necessary adhesion between locomotive and track when going up the 2 per cent grade.

In any event, it is worth noting that the three-phase locomotive can easily be designed with 20 per cent less weight that the single-phase locomotive. Furthermore, it may be pointed out that the three-phase locomotive will develop its rated output continuously with natural ventilation, while the single-phase locomotive will use forced ventilation for this purpose. Forced ventilation is not, in itself, seriously objectionable, although it naturally makes the equipment slighly more complicated. But, if forced ventilation were employed for the three-phase locomotive, its power could readily be further increased. In other words, the three-phase locomotive is without question not only very much lighter, but also very much more powerful than the single-phase locomotive.

COMPARISON WITH REFERENCE TO SCHEDULE SPEED

Unfortunately, the curve diagram published in the article of Jan. 20 does not contain any speed-time curves. Nevertheless, careful analysis shows that the single-phase locomotive will make the run about as follows:

It will accelerate on the level from zero to a speed of about 12 miles per hour during 2 minutes. It will then coast down grade on the brakes at about 14 miles per hour. On the level track it will slow down to a speed of about 11 miles per hour and it will run up the grade at that speed. After reaching the summit on the far side it will accelerate during about 85 seconds up to a speed of about 13.5 miles per hour and it will run at that speed to the terminal. This performance is indicated in Fig. 2.

There are several schedules which would be better suitable for a three-phase locomotive, but it is possible to make absolutely the same run by using three motors of four, eight and ten poles respectively. The three-phase locomotive would then accelerate during 2 minutes from zero up to the same speed of about 12 miles per hour. In passing over the summit it would still further increase this speed up to about 14 miles per hour, and it would then start to coast down the grade at about 14.6 miles per hour, at which speed it would return energy to the line. When reaching the level stretch it would stop returning energy and would coast down to about 11 miles per hour, at which speed it would ascend the grade. After passing the summit on the far side, and when the entire train is on the level, it would during 45 seconds accelerate up to about 13.5 miles per hour, at which speed it would run into the terminal. This run is also indicated in Fig. 2.

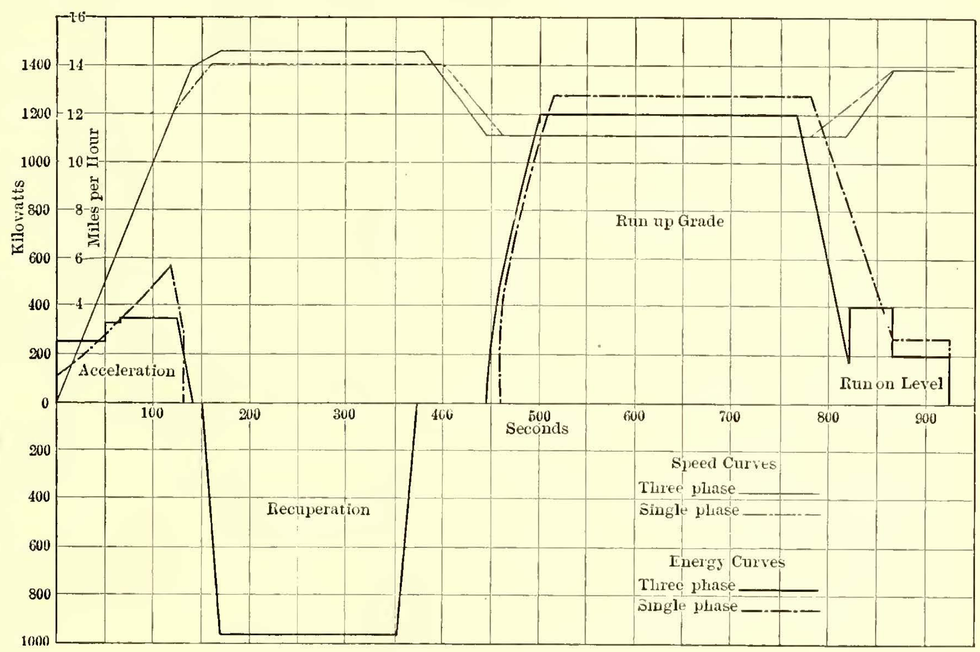


FIG. 2.—SPEED-TIME AND ENERGY CURVES

Speed regulation was quite clearly stated to be of "overwhelming importance" in the case of the Sarnia tunnel equipment, but it is readily seen that this condition can easily be fulfilled by the three-phase locomotive, and the following remarks will show that it can adhere to the schedule proposed at a considerably better efficiency than the single-phase locomotive.

COMPARISON OF ENERGY CONSUMPTION

It may appear startling, or at least unexpected, to hear me say that the three-phase locomotive will use less energy to perform this service than the single-phase locomotive. Nevertheless, this seems to be actually the case and it appears to be so, even if we leave out of consideration entirely the question of recuperation of energy on the run down grades.

Fig. 2 shows the energy required by the single-phase locomotive for one complete run as taken from the curve diagram contained in the article of Jan. 20. The same figure shows the energy consumed for the same run by the three-phase locomotive.

The scale for the curve contained in the article of Jan. 20 is such that an accurate determination of the energy required by the single-phase locomotive is made difficult. But this energy can nevertheless be said to be not less than 508,000 kilowatt-seconds for the entire run, of which 43,500 kilowatt-seconds are consumed during the start and about 464,500 kilowatt-seconds during the run up grade and into the terminal.

The three-phase locomotive, by the use of concatenated control during the start, would require for the starting about 41,800 kilowatt-seconds, and for the rest of the run, due to the considerably higher efficiency of the three-phase induction motor, about 422,500 kilowatt-seconds. The total for the entire run would therefore be about 464,300 kilowatt-seconds.

While the energy consumption of the single-phase locomotive for one run is thus found to be about 141.3 kilowatt-hours, the three-phase locomotive will require only 129 kilowatt-hours, and the difference of 12.3 kilowatt-hours represents the saving which will be made during each run, by the three-phase locomotive.

In addition to this, the three-phase locomotive, on running down the grade, is capable of returning energy to the line at the rate of 960 kw, or a total of about 197,200 kilowatt-seconds, or 54.8 kilowatt-hours for each run.

MAXIMUM POWER CONSUMPTION

There is also quite a difference in the maximum power required by the two types of locomotives, and consequently in the maximum peak on the two systems.

From the curve published in the article on Jan. 20, the maximum power required by the single-phase locomotive when running up the two per cent grade appears to be about 1280 kw, and the maximum power required during the starting period about 570 kw. The maximum peak represented by a combination of two locomotives, one starting while the other is running up the grade, is therefore about 1850 kw.

The published efficiency of the single-phase motor is 86 per cent when running under full load at normal speed. The induction motor when running under full load at normal speed has an efficiency of at least 92 per cent. The maximum power required by the three-phase locomotive when running up the 2 per cent grade will therefore be only 1200 kw, and the maximum power required during the starting period is found to be about 350 kw. This makes the maximum peak on the three-phase system, due to one locomotive starting, and another one running up the grade, about 1550 kw or about 20 per cent less than the maximum peak in the single-phase system.

COMPARISON OF COST OF INSTALLATION

The first cost of installation will be made up in each case by the cost of the locomotives, the cost of the line equipment and the cost of the power house.

The three-phase locomotives were found to weigh about 20 per cent less than the single-phase locomotives and, inasmuch as three-phase motors are, if anything, less expensive to build than single-phase motors, it is not unfair for the purpose of this comparison, to assume that the cost of the two types of locomotives is more or less proportionate to their weight. There is therefore a saving of about 20 per cent in the cost of locomotives in favor of the three-phase system.

The line equipment will consist, with the single-phase system, of one No. 0000 copper wire for each track throughout the electrified section. The three-phase system will require two No. 0 copper wires for each track. The amount of copper is therefore almost identical in the two cases, but the three-phase system will require more insulating material and, perhaps, somewhat heavier suspension, which will undoubtedly increase the cost of the line equipment of the three-phase system to a certain extent.

This increase will, however, be much more than offset by the decrease in the cost of the power station. The single-phase power house will contain two turbo-generator units of 1250 kw each. The maximum load on these generators is represented by the above mentioned maximum peak of about 1850 kw plus about 760 kw of lighting and pumping load, or a total of about 2610 kw. Of this load only the last 760 kw will be equally distributed over the three-phases of the generators, while the 1850 kw will be placed on two phases only, as an interconnected single-phase load. The maximum load on one-phase is therefore one-third of 760 kw plus one-half of 1850 kw, or about 1175 kw, which corresponds to an overload of about 41 per cent over the normal rated load of two 1250 kw three-phase generators. The three-phase system will have a maximum load of about 2310 kw, consisting of the maximum peak plus the same 760 kw for lighting and pumping. All of this load is equally distributed over the three phases of the generators. If we calculate with the same overload capacity of 41 per cent as we did in the case of the single-phase system, we find that the three-phase load can be readily carried by two three-phase generating units of 800 kw each. Instead of a power house of 2500 kw capacity we therefore have one of 1600 kw capacity.

It is not very easy to calculate the exact amount thus saved in the first cost of installation by the use of the three-phase system, but the above considerations show that this saving will amount, at the very least, to say $100,000 out of a total first cost which will be somewhere in the neighborhood of $500,000.

COMPARISON OF COST OF OPERATION

We have seen above that one three-phase locomotive will save in one run with a 1000-ton train, 12.3 kw-hours. The traffic to be handled at present consists of about 12,000 such runs per year. The direct saving in energy effected by the three-phase system is therefore 12,000 x 12.3 kw-hours, equal to 147,500 kw-hours per year. With a variable load of the character under consideration the value of kw-hour will not be less than 1c., and the annual saving can therefore be expressed by the figure $1,475.

As shown above, the three-phase locomotive is capable of returning during one run 54.8 kw-hours. For 12,000 runs there would be 12,000 x 54.8 = 658,000 kw-hours per year, which can be returned to the power station. Unfortunately, not all of this energy can be usefully employed, inasmuch as it is returned at the rate of 960 kw, while there is never a simultaneous demand for such an output. It is possible, however, to utilize part of this energy for trains starting in the opposite direction, which would require, say, an average of 300 kw. Furthermore, there is a steady load on the power station in the shape of the lights in the tunnel and the drainage pumps. This lighting and pumping load will at some time during the day amount to 760 kw, and it is pretty safe to assume that the average of this load will be in the neighborhood of 400 kw. Finally, there are a few motors in the locomotive repair shops which also consume about 70 kw, and it would seem more than likely that a diligent search would show that further similar motors can be found and made useful. All in all, of the 960 kw at least one-half can certainly be utilized and the energy thus recuperated corresponds to 329,000 kw-hours per year. At 1c. per kw-hour this amounts to a further saving of $3,290.

The total energy consumed each year by the single-phase system is 12,000 x 141.3 = 1,695,600 kw-hours. At 1c. per kw-hour, this energy would cost $16,956. The total saving made by the three-phase system is $1,475 plus $3,290, or $4,765, which is 28 per cent of the total cost of energy.

In the cost of maintenance and repairs there will probably also be a certain difference, but this difference is not easily expressed in figures. Whatever additional amount may be due to the maintenance of 4 miles of second overhead wire will certainly be more than counterbalanced by the additional cost of repairs to the commutators of the single-phase motors. Actual data on this subject is lacking, however, and it may be well for the present to take the cost of maintenance and repairs as being the same for the two systems.

The amount to be set aside for interest on the investment will be smaller in the three-phase system by the interest on whatever amount will actually be saved in first cost of installation. If we take this amount, as above, at $100,000, and interest at the rate of 5 per cent, there will be a further saving of $5,000 per year to be credited to the three-phase system.

ADDITIONAL ADVANTAGES OF THREE-PHASE SYSTEM

The question of saving in operating expenses might not in itself be decisive, if there were any special disadvantages connected with the three-phase system. Such is, however, not the case. On the contrary, there are several advantages connected with this system which may prove to be of considerable importance.

The less weight of the locomotives, pointed out above. was clearly stated in the specification to be advantageous. It will readily be seen that with about 50,000-locomotive miles per year a difference of weight of 24 tons per locomotive will represent an appreciable saving in ton miles.

The specification also contained the condition that the locomotive must be capable of starting a 1000-ton train on the 2 per cent grade, and this condition is without question better fulfilled by the three-phase than by the single-phase locomotive. The single-phase motor has an inherent defect in that it cannot while standing still, develop anything like its full torque for any length of time, because the brushes are in this case short-circuiting one of the rotor windings and the current induced in this winding would in a few seconds destroy it. The three-phase motor, on the other hand, can develop its full torque standing still for a practically unlimited time. The advantage presented by this fact will be duly appreciated if it is taken into consideration that the locomotive, when starting on a grade, must exert its full drawbar pull for a certain time before the brakes on the train can be opened.

Among the minor advantages of the three-phase system may be mentioned its absolute and automatic maintenance of schedule speed, and the better balancing of the entire system. This better balancing will certainly improve the lighting as well as the operations of the motors, both of which cannot help but be affected by the throwing on and off of unbalanced loads of 1300 kw, as is done in the single-phase system.

All in all, I believe that the figures and facts brought out during this investigation in the Sarnia tunnel case, which case as such is not at all favorable to three-phase operation, will conclusively show that the three-phase alternating-current system has decided merits of its own, and that it will pay everybody engaged in this line of work to carefully look into these merits. This is what I set out to demonstrate.

[Mr. de Muralt's article was submitted before publication to B. J. Arnold, consulting engineer of the Grand Trunk Railway for this installation, and he replies to the points mentioned by Mr. de Muralt in the following letter.—Eds.]

New York, Feb. 15, 1906.

Editors Street Railway Journal:

I have read with a great deal of interest Mr. de Muralt's article on the St. Clair or Sarnia tunnel installation, which you have been kind enough to allow me to read before its publication.

Inasmuch as the article reached me just as you are about to go to press, I have not time to enter into an analysis of Mr. de Muralt's figures, and shall assume that they are correct, for the entire tone of the article is such as to command respect. It shows that the author is trying to bring out engineering facts instead of endeavoring to get into a controversy. I am glad to have any fair-minded comment and criticism upon this installation, and I consider this such a criticism. But I cannot concur in all of Mr. de Muralt's conclusions, for I believe that some of them are based upon wrong premises. I feel that if he had had before him all of the conditions which governed the choice of apparatus, especially as regards cost, his conclusions in regard to the economies he shows would have been different. I cannot in the short time at my disposal enter into an extended discussion of the relative merits of single-phase and three-phase equipment. I fully recognize that there are conditions under which the three-phase system can show advantages so far as economy of operation is concerned, but in deciding upon the type of apparatus to adopt for a given installation there are many things to be taken into consideration aside from operating efficiency. Not the least of these are: first cost of installation, the commercial availability of the apparatus and convenient access to the manufacturer furnishing it. These three points will generally govern where the difference in efficiency of operation between systems is small.

Mr. de Muralt's economy in operation practically disappears in the St. Clair installation when it is stated that the pumping load, assumed by him to be an average of 400 kw throughout the year, is only in operation for a few hours during a heavy rainstorm or while snow is melting and running into the tunnel. This condition exists only on a few days in the year, and for the rest of the time the pumping load averages about six horse-power. This load, when combined with the lighting load of the tunnel and small shop-motor load, is by no means large enough to absorb the recuperated energy of a train when descending a grade. Hence energy gained by recuperation would have to be dissipated most of the time through water rheostats or metallic resistances, because it is not possible in this installation to have a train ascending and another descending at the same time.

The only practical way of utilizing this energy is by means of a battery auxiliary which will store the kinetic energy of a descending train so that it may be given out at the time another train may be ascending. If there is any advantage to be gained by such a plan, it is not improbable that the single-phase motor may be able to supply it, although this subject is as yet in an experimental state and we must admit that the three-phase motor has this advantage at present. Provision has been made in the St. Clair installation to install a battery and an inverted rotary for recuperating energy and equalizing the load on the power house should conditions ultimately seem to warrant it. Such an installation cannot be justified from the standpoint of economy in operation at present prices, and the provision for its future installation was mainly for the purpose of adding to the reliability of the system in case it should be found necessary. For the present time it was considered better to assume this risk than to incur an investment which can be made at any time with equal facility.

Regarding the first cost of single-phase and three-phase installations, I can only say that while I have been led to believe that three-phase railroad equipment could be purchased for about the same cost as direct-current equipment, and therefore for less than single-phase equipment, when bids were asked for an installation of considerable magnitude upon a road with which I am connected, the tenders for the three-phase installation taken as a whole were much higher than those of either the direct-current or single-phase installations. All were based upon the same specifications as to requirements, and were for delivery in a country where the duty was somewhat in favor of the manufacturers of three-phase apparatus. I presume that if three-phase apparatus was manufactured in this country, this condition would not hold, but this was the situation that confronted those who had to make the decision for the St. Clair tunnel installation. I do not wish to be understood as opposed to the three-phase system where conditions are favorable for its adoption and where the additional overhead work required by it can be allowed, but taking the physical conditions of the St. Clair tunnel and the business conditions as I found them in this country, I feel that my clients' interests are safely preserved as the matter stands.

Bion J. Arnold

The improvements made a few months ago by the Cleveland & Southwestern Traction Company, which included reballasting some of its lines and the installation of fifteen new cars with high-speed limited service to Wooster and Norwalk, has resulted in a tremendous increase in business, the showing for the month of January being $12,000 gross greater than the corresponding month last year.

THE SNOW PROBLEM IN MARQUETTE

BY HAMILTON BALUSS,
General Manager Marquette City & Presque Island Railway Co.

Thinking that the methods pursued by one street railway in combatting the snow problem might be of interest to others, an endeavor will be made to outline the way in which this is being done by the Marquette City & Presque Isle Railway. In this part of the country the snowfall is very heavy. It generally begins some time in November, and falls varying

TYPICAL STREET SCENE IN MARQUETTE DURING WINTER

from a few inches to 2 ft. or more on the level may be expected every few days until the first part of April. The snow also drifts readily, and drifts several feet deep are common. Whatever snow falls during the winter does not usually melt until spring.

To prevent the drifting of snow upon our tracks, we use a considerable amount of snow fence, so constructed that it

SIDE PLOW BEFORE BEING ATTACHED TO SWEEPER

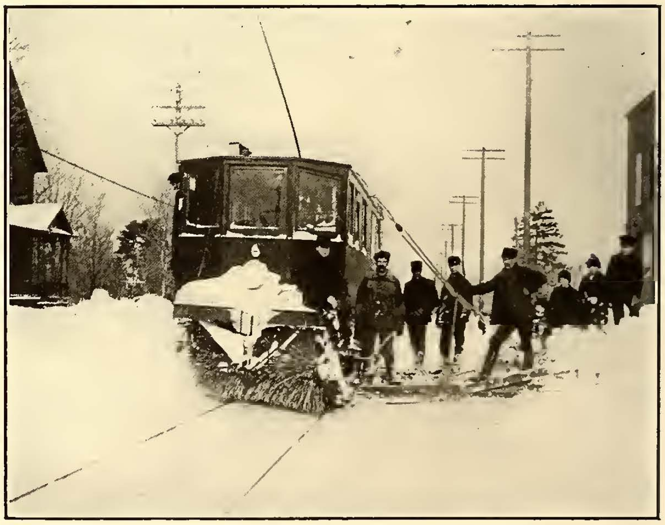
can be folded up and stored when not needed. It is placed at as many points as possible where the snow drifts, and is securely anchored. It is built in sections about 14 ft. long and 5 ft. high, and 4-in. spaces are left between the boards. These spaces render the fence much more effective than if it was boarded up solid. The fence is placed to the windward about 75 ft. from the track. Experience has shown that it should not be placed nearer to the track, as in that case it will not have the desired effect. A fence of this kind properly made will prevent drifting. All bushes within 20 ft. of the track should be kept cut down, as they are drift producing.

The only equipment for fighting snow which required the outlay of any considerable amount of money on our road was a snow sweeper, which was purchased without motors, controllers or wiring. An old discarded motor is used to run the brooms, and the necessary wiring was cleated on the inside of the car so as to be away from the snow and wet. In the fall, when the summer cars are laid up, the motors from

HOME-MADE SNOW PLOW, MARQUETTE

one of them are placed under the sweeper. The sides of this sweeper carry the ordinary adjustable wings. This sweeper is used to keep the city streets open during a storm. It is in charge of an experienced man, and carries sand, salt and all tools necessary for removing snow and replacing cars.

Perhaps it would be well at this point to explain that the removal of snow and the duty of keeping switches open fall



SIDE PLOW ATTACHED TO SWEEPER, REAR VIEW

upon the section crew. All of these men are taught to handle a car, to perform the duties of a wrecking crew and the proper way to handle snow removal apparatus. In case of a storm, there is no delay, but a start is made as soon as it is apparent that trouble may result. The snow is removed from the track before it has time to accumulate. In this way the cars seldom fail to keep up to the schedule, even during a storm.

The first effort is merely to keep the track open. Outside the city a snow plow is used; in the city, the sweeper. The snow is thrown as far back as possible with the sweeper wings. Care is always taken to sweep the snow in the same direction as the wind is blowing. As soon as the track is swept clean, the brooms are raised and the sweeper is run over the track in each direction and the snow is crowded as much further back with the wings as is possible.

After this, the side plow, shown in one of the accompanying illustrations, is attached to the side of the sweeper at right angles by special braces provided for this purpose. The side plow is triangular in shape. The side next to the sweeper is 13 ft. long, the outside is 20 ft. in length and its extremity is 10 ft. 4 ins. from the side of the sweeper. The width of the outer board for the first 12 ft. is 1 ft.; the balance is 2 ft. in width. The side plow is built of oak, tied with iron rods, and the cutting edge is faced with iron. It is very strong. One man built it in about six hours. The nose is attached to the plow by a chain. The outer end of the plow is maintained at any desired height, or can be raised to pass any obstruction, by means of a double pulley block connected to the side of the car. The side plow will move 10 ins. or 12 ins. of snow back from the side of the car for 10½ ft. at a speed of 6 m.p.h. to 8 m.p.h. It will crowd back a bank of snow 6 ft. wide at the base and 4 ft. or 5 ft. high, which would seem at first thought well-nigh impossible of removal by this means.

It leaves a clean driveway over 10 ft. wide on either side of the car, and as smooth as a floor. As about 4 ins. of hard snow is left on this strip, the sleighing is better than on the uncleaned streets. Of course, it is often necessary to haul away a certain amount of snow which has piled in front of

SCRAPER USED FOR CUTTING DOWN RIDGE BETWEEN RAILS

stores and at crossings. When pushing back the first few falls of snow with this plow, a block 12 ins. x 12 ins. and about 2 ft. long is placed endwise between the rear end of the side plow and the braces on the car; this throws the first snow 12 ft. from the car. Later on the block is turned the other way, which throws the snow back 11 ft. Afterward the block is removed altogether. These changes are made according to circumstances.

In a place where there is much snow, this side plow is about as useful a piece of apparatus as is made. After a street is cleaned in this manner it is as though no snow had fallen, in so far as respects the removal of snow from subsequent storms.

It often happens from various causes that snow and ice pack between the rails to form a ridge, on which the motor castings drag. The ordinary plow or sweeper is unable to cut this ridge out. The operation of a sweeper is seriously affected by this ridge, as the wheels run in a sort of groove, from which the sweeper cannot properly remove the snow without soon destroying the brooms, if at all. It therefore becomes highly desirable to cut this ridge down. To do this a heavy road scraper with wheels the same gage as the track was taken and a heavy flange was bolted on each wheel, so that it would run on the track like a car. A piece was then fastened on the end of the tongue so that the wagon could be drawn by a car. After this it was weighted down with iron. This scraper, which is illustrated, removes the hard ridge between the rails and about a foot on each side, and can be made to cut down as low as desired. Once over the road is usually sufficient; more than two trips are never required. The scraper is drawn at a speed of about 5 m.p.h.

When the snow is too deep to use a sweeper successfully, and for work outside the city, a home-made plow is employed. The illustration shows its general construction. The plow is faced with No. 12 sheet iron, underneath which is a backing of 2-in. planks, well braced. The trucks and motors are taken from a summer car. The plow is weighted with as much rail and iron as it will safely carry. It can open a road through drifts 5 ft. deep. All gongs on the plow and sweeper are on the roof, where they will not get clogged with snow.

Salt and sand are used as sparingly as possible. There is one very heavy grade on the road, and if salt is used on this grade it is impossible for a long time to get the rails in good condition so that the wheels will cling to them as well as they did before. The best results on this grade are obtained by using no salt and using sand only when absolutely necessary. A very little salt is used on switch points and special work when they cannot be kept open otherwise. Our experience leads us to consider salt as injurious to both track and equipment, especially to motors and wiring.

In addition to the apparatus previously described, all cars are provided with good scrapers.

TROLLEY BASEBALL LEAGUES

Interurban roads in Ohio are finding that the interest in baseball in small towns is growing, and that one of the best possible means of inducing summer traffic is the formation of, or lending assistance to, semi-professional or professional clubs in the villages along their lines. In a few instances roads have attempted to manage clubs and conduct the parks, but usually it has been found just as satisfactory to allow others to manage affairs and to confine themselves to assisting in advertising and providing transportation for the public, or perhaps donating a cup or cash prize for the championship. Where there are close contests, a local pride is developed, and if distances are not too great or rates too high, there is apt to be a great deal of traveling between towns, and in such cases the roads can well afford to transport the players free. Trolley leagues are now being formed by the Pennsylvania & Mahoning Valley, the Cleveland & Southwestern, the Pennsylvania & Ohio and Lake Shore Electric roads.

MUTUAL BENEFIT ASSOCIATION IN MONTREAL

The development of provident and benefit associations among electric railway employees may now be regarded as a well-defined phase of electric railway management. When properly directed and handled, associations of this kind exert a powerful influence toward bringing public service corporations into that close, harmonious and co-operative relation with their employees which is so essential to the successful administration of quasi-public services.

Name ....

Occupation ....

Dep't ....

Age........Date of Entry in Company's Service....................

Admitted a Member....................

Why not a Member?....................

Remarks ....

Date..........190 ....

FIG. 1.—CARD INDEX OF ALL EMPLOYEES, KEPT IN OFFICE OF MUTUAL BENEFIT ASSOCIATION

Claim No.

Montreal Street Railway Mutual Benefit Association

Notice of Disablement and Application for Sickness or Bodily Injury Benefit.

Montreal, ... 190

To the Head of Department:

I .... Badge ..... residing at .... and employed as .... in .... Department and holding certificate No. ..... hereby certify that I was compelled to quit work at ..... o'clock on the .... 19 , on account of (state nature of sickness or injury) ....

which rendered me totally unable to continue my usual duties.

Disabled Member.

Referred to Secretary-Treasurer.

Head of Department.

Remarks:

This blank is to be filled out by any member who is unable to perform his usual duties on account of sickness or bodily injury. No claim for benefits will be considered unless this notice properly filled and approved by Head of Department, has been received promptly by the Secretary-Treasurer. Full address and correct time of disability must be given.

FIG. 2.—BLANK ON WHICH MEMBER APPLIES FOR BENEFITS IN CASE OF SICKNESS OR INJURY

MONTREAL STREET RAILWAY MUTUAL BENEFIT ASSOCIATION

OFFICE OF THE MEDICAL OFFICER

Hochelaga Division, ... 190

To the Secretary-Treasurer of the Montreal Street Railway Mutual Benefit Association

I hereby certify that on the .... day of .... 190 .... attended Mr. .... of .... for illness or accident and at various times between the said .... day of .... 19 , and the .... day of .... 19 , and that the nature of symptoms which were present during his disability where as follows:

and that he was in consequence thereof confined to the house for .... days, and is at present .... recovered and .... able to resume his usual occupation.

Medical Officer.

I hereby certify that the above party was not at work during the time mentioned hereon.

Head of Department

FIG. 3.—MEDICAL OFFICER'S REPORT ON APPLICATION FOR BENEFITS

The Mutual Benefit Association as maintained by the officers and employees of the Montreal Street Railway Company is an excellent illustration of the good results that can be accomplished by an organization of this nature properly handled.

In 1903 the employees of the Montreal Street Railway Company, in conjunction with the management, took in hand the organization of the Montreal Street Railway Mutual Benefit Association, which for actual benefits accruing to its members at a minimum of cost, and the establishment of mutual co-operative relations between company and men, probably eclipses anything of its kind here or elsewhere. The association was inaugurated in August, 1903, at a conference between delegates appointed by the employees, who met the officials of the company, and as a general plan had already been suggested, it was not long before a complete organization was reached. Rules and regulations were drawn up, and these were submitted at a general meeting and approved, after which a board of directors was elected and medical officers appointed.

Every possible means was taken to place the idea clearly before the employees, and within three months of the time that the association was formed there were 600 members on the roll, while now there are upward of 1700 members in good standing, or practically all the employees eligible for membership. The president of the association is D. McDonald, who is general manager of the Montreal Street Railway Company, and the secretary-treasurer of the association is Patrick Dubee, who is also secretary-treasurer of the company. The affairs of the association are directly in charge of a "committee of management," composed of fifteen members, who are drawn from the various departments, so that each grade of employees is properly represented.

Montreal Street Railway Mutual Benefit Association

Office of the SECRETARY-TREASURER

MONTREAL, ... 190

Mr. ....

Please note that the following members in your Department have reported themselves as sick. You will oblige by calling on them and advising us hereunder as to their condition together with any suggestion you might recommend.

Claim No.	NAME	Badge No.	ADDRESS	REMARKS

PATRICK DUBEE,
SECRETARY-TREASURER

FIG. 4.—REPORT OF HEAD OF DEPARTMENT ON CONDITION OF EMPLOYEES MAKING APPLICATION FOR BENEFITS

Cert. No.	Name	Dept.	No.
Date	Age	Period in Co's Service ...... years ...... months.	

	PAYMENTS													Expenses	Surplus
	Jan.	Feb.	Mch	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total		
1903															
1904															
1905															
1906															
1907															
1908															
1909															
1910															
1911															
1912															

Remarks

FIG. 6.—FACE OF CARD LEDGER FOR KEEPING ACCOUNT WITH EACH MEMBER

Membership in the association is open to every official and employee of the company, including office force and all of the mechanical and operating departments who can pass a satisfactory medical examination.

The object of the association, as declared in the rules and by-laws, is to afford relief to the employees of the company, as follows:

(a) By providing means of subsistence for the members who become unable to serve the company through illness or bodily injury, including the paying of medical and other expenses;

(b) By providing an allowance to the widow or children or representatives of the deceased member;

(c) By providing a pension for old and disabled members.

The sick benefits are as follows:

In case of sickness or disablement, after the first six days the member receives 60 cents per day for ninety days, and 30 cents per day for the next ninety days, also free medical attendance and free medicine. Membership also secures 20 per cent discount on all medicines or druggist supplies required by members of the family.

The insurance feature includes a life insurance policy for $500 and an additional $50 toward the cost of funeral expenses.

The pension benefit insures to every member who leaves the service of the company after the age of sixty-five years, and who has been in the service for a period of twenty-five years, a pension of 50 cents per day during the remainder of his life, and any member permanently disabled from earning his livelihood in any position from injury received while actually at work in the service of the company is entitled to a pension at the rate of 50 cents per day after the first six months of disablement.

Montreal Street Railway Mutual Benefit Association

OFFICE OF THE SECRETARY-TREASURER

MONTREAL, ... 190

Summary of Medical Officers' Reports of the 190

DIVISION	VISITS	CONSULTATIONS	PRESCRIPTIONS	MEMBERS DISABLED	REMARKS
Central					
Hochelaga					
St. Denis					
St. Henri					
Total					

No. of Applicants examined by Chief Medical Officer ....

CORRECT .... CLERK.

.... SECRETARY-TREASURER.

FIG. 5.—SUMMARIZED REPORT OF VISITS AND CONSULTATIONS MADE BY MEDICAL OFFICER

PAYMENT OF BENEFITS											
Mo.	Vr. No.	Amount	Month	Vr. No.	Amount	Month	Vr. No.	Amount	Month	Vr. No.	Amount

FIG. 7.—REVERSE OF CARD LEDGER SHOWN IN FIG. 6

All of these benefits are secured for the sum of $1 initiation fee and 50 cents per month for each member.

The funds of the association are derived from two sources, namely, the dues of members and contributions from the Montreal Street Railway Company, the company agreeing to contribute annually a sum not less than 50 per cent nor exceeding 100 per cent of the annual contributions made by members in the form of dues. The company has been very liberal in this regard, and by generous contributions enables the association not only to pay all its liabilities, but to lay by a substantial surplus for future requirements. From the last annual report of the association for the year ending April 30, 1905, the receipts from members amounted to $8,800; donations and fees from the company, $12,000; receipts from picnic, $1,300; receipts from interest, etc., $215, making total receipts of approximately $22,400. The expenses for sickness and injury, medicine, death and burial, medical attendance and management were $18,850, leaving a surplus of approximately $3,550. A report of the various calls made upon the association for relief work was published in the STREET RAILWAY JOURNAL for Sept. 23, 1905, page 451. The number of members disabled through sickness or injury was 611; number of prescriptions issued, 2864; visits made by association physicians, 692; consultations given by physicians, 4026.

A special feature is made of the annual picnic, which is always considered a "red letter day" in the affairs of the company. Athletic games are held and special prizes are given. At the picnic last year the association cleared over $1,000, which went to the benefit of the treasury. It is stated by the officers of the Montreal Street Railway Company that the association has been of the greatest value in bringing the employees together socially, in increasing the fraternal feeling between officials and employees, and in making the men and their families happy and contented and loyal to the service.

Montreal Street Railway Mutual Benefit Association.

Claims for Benefits submitted this .... day, the 190

CLAIM No.	NAME	OCCUPATION	Certificate No.	NATURE OF DISABLEMENT	No. of days Disabled	No. of days entitled to Benefit	AMOUNT OF BENEFIT	REMARKS

FIG. 8.—HEADING OF DAILY DISBURSEMENT SHEET, SHOWING PAYMENTS MADE BY THE ASSOCIATION

Montreal Street Railway Mutual Benefit Association

OFFICE OF THE
MEDICAL OFFICER

Montreal, ... 190

To the Secretary-Treasurer of
MONTREAL STREET RAILWAY MUTUAL BENEFIT ASSOCIATION

I beg to advise you that the following members of the Association have been seen by me to-day, and now report on their respective cases as under:

NAME	BADGE No.	DISABLED	PRESCRIPTIONS	REMARKS
Called upon the following Members at their Homes				
Applicants examined				
Consultations at the Office				
No. of Disabled Members:				

MEDICAL OFFICER

FIG. 9.—DAILY REPORT MADE BY EACH MEDICAL OFFICER EMPLOYED BY THE ASSOCIATION

Montreal Street Railway Mutual Benefit Association

Employees Discharged, Resigned, Etc. .... Department.

Men Discharged or Resigned for Month ending 190

NAME	OCCUPATION	REASON

New Men taken on for month ending 190

NAME	AGE	ADDRESS	OCCUPATION	SHOP

Men Changing Position for Month ending 190

NAME	FROM PRESENT OCCUPATION	TO	REMARKS

FIG. 10.—BLANK USED FOR NOTIFYING THE BENEFIT ASSOCIATION OF CHANGES IN PERSONNEL OF EMPLOYEES MADE BY OPERATING DEPARTMENT

The system of blanks used in carrying on the work of the benefit association is exceedingly complete. As a basis of all the records, a card index is kept (see Fig. 1) which gives the name and occupation of every employee in the company's service, together with a notation as to whether the employee is a member of the benefit association or not, and if he is not a member, the reason why he has not joined.

In order to become a member of the association, the applicant must fill out an application blank, by signing which he promises to conform to and abide by all the rules and by-laws of the association. In this blank he also gives the name of the beneficiary who is to receive the benefits of the insurance in case of the decease of the member. After signing the application blank in the presence of witnesses, the applicant must pass an examination by the chief medical officer of the association, from whom he must obtain a medical certificate testifying that the applicant is in good state of health and not afflicted with any disease, disorder, habit or bodily health tending to shorten life or to incapacitate him from the performance of the duties required in the service of the company. If the application and the medical examination are approved by the proper committee, his certificate of membership is issued. If a man is taken sick or disabled, he makes application for sickness or bodily injury benefit on form Fig. 2. When a claim is received at the office of the association it is immediately assigned to one of the association physicians, who takes charge of the case, making as many professional calls as may be necessary and prescribing the proper remedies. The physician reports his record of the case on the form Fig. 3.

As an additional check and safeguard, when a claim for relief is received the head of the department in which the employee is engaged is notified and takes immediate steps to find out the exact condition of the applicant. For handling this phase of the work the form Fig. 4 is used.

The medical officers make summarized reports of visits and consultations on form Fig. 5.

By an ingenious card ledger system a separate account is kept between the association and each individual member. The individual accounts are kept on single cards, the face and reverse of which are shown in Figs. 6 and 7. The face of this card gives the name and other information concerning the member, and contains columns in which are entered a record of all payments for dues. In connection with the columns for recording payments of dues, there is a column headed "Expenses," in which is entered any sum that may be paid to the member in the way of sick or injury benefits, so that the face of the card always shows the balance of dues over benefits, or vice versa, for each member. On the reverse side of the card is kept a detail record of payments made to the member in the form of benefits, the columns being ruled to show month, voucher number and amount. The one card therefore serves for all the accounting between each member and the association.

On a blank, the headings of which are reproduced in Fig. 8, are entered each day the sums paid as claims for benefits, and this forms the daily disbursement sheet of the association. Fig. 9 is a blank upon which each medical officer makes report of his work for each day, giving the history of the respective cases. Fig. 10 is a form used by the operating department for notifying the benefit association regarding men discharged or resigned, new men taken on or transferences from one department to another. By means of this information the association is enabled to keep its card index of employees previously mentioned always correct and up to date.

UNIQUE ADVERTISING AT CLINTON, IOWA

Few roads give as much thought to the real promotion of passenger traffic as does the Iowa & Illinois Railway, of Clinton, Iowa. P. P. Crafts, general manager of the company, has inaugurated a thorough system of advertising which has proven most beneficial.

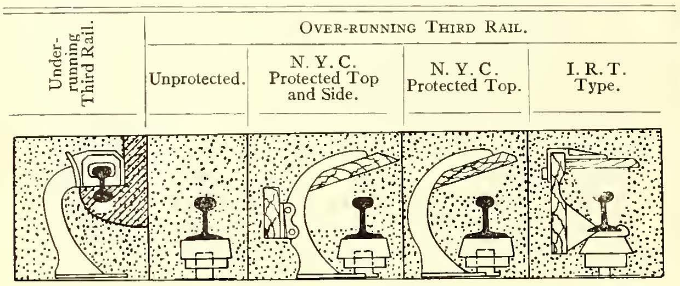
Special attention has been given to methods for attracting

SOME TYPICAL ADVERTISING CARDS OF THE IOWA & ILLINOIS RAILWAY

the patronage of commercial travelers, who constitute a large, if not a major, portion of travel on our steam railroads. Large square or round advertising cards, some 6 ins. in diameter, can be seen in almost every hotel, railway station and public place in Iowa and Eastern Illinois, calling attention of the commercial traveler to the fact that the road is in existence, that baggage is carried free, and the many ways in which the electric service would be to his benefit. In Davenport, Rock Island and at other points on the line, these cards, with various literature, may be seen in shop windows, stores, restaurants, billboards and, in fact, at every point of view encouraging the riding of the hunter, fisherman, pleasure seeker, excursionist, business man and all other classes of possible passenger traffic.

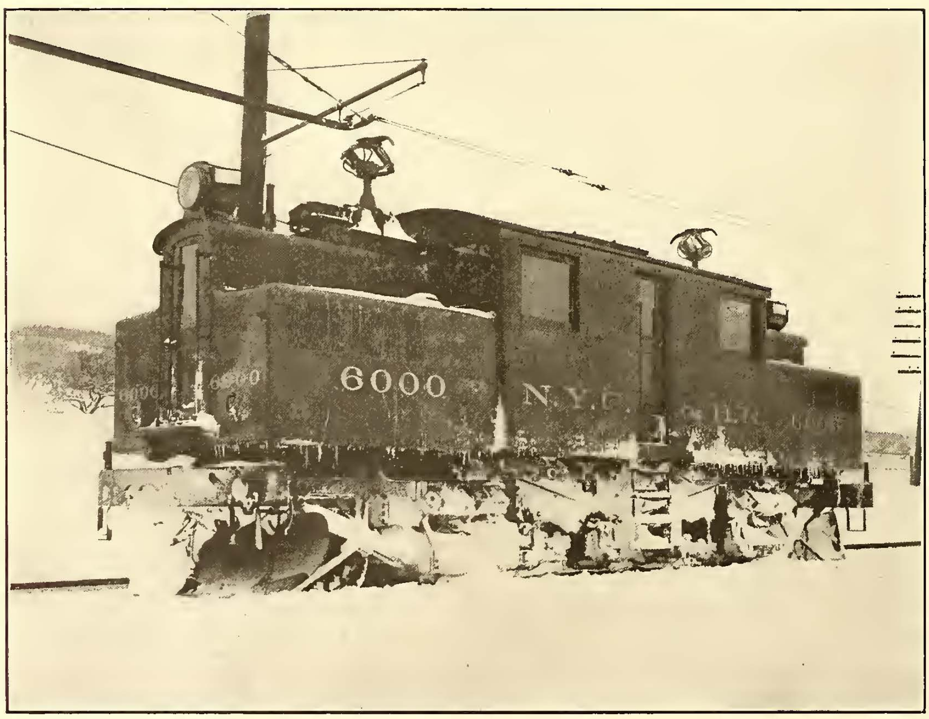
TESTS OF THE EFFECT OF SNOW ON THIRD-RAIL

The heavy snow storm of last week allowed the electrical engineering department of the New York Central & Hudson River Railroad to conduct some interesting tests on the effect of snow on different forms of third rail. As is generally known, the New York Central & Hudson River Railroad Company has equipped a section of its line some 6 miles in length, between Schenectady and Amsterdam, with three different types of third rail, and it is upon this section that electric locomotive No. 6000 is being put through its 50,000-mile run. This section is equipped with three different forms of third rail; viz., (1) the ordinary over-running unpro-



TYPES OF THIRD RAILS USED ON EXPERIMENTAL TRACK, AND EFFECT OF SNOW ON THEM

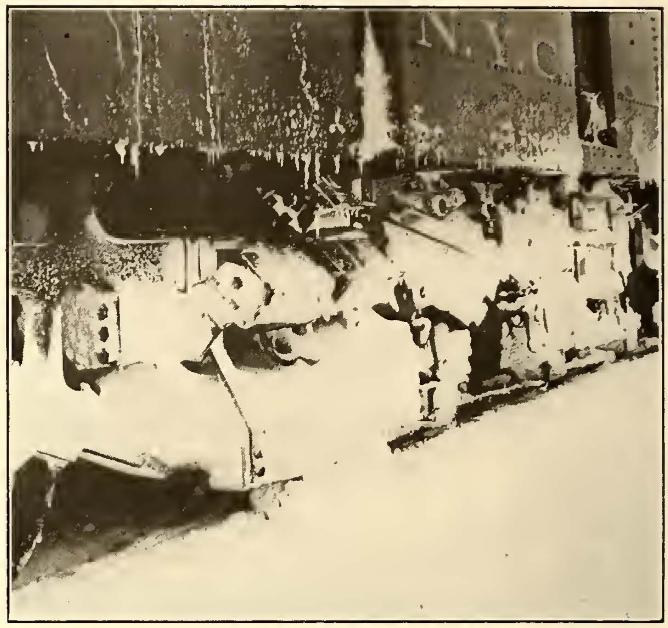
tected third rail; (2) the protected type of over-running third rail, similar to that used on the New York Subway, and described in the Street Railway Journal for Oct. 8, 1904, page 632; (3) the under-running type of third rail in which the rail is inverted. This rail was described in the Street Railway Journal for Sept. 2, 1905, page 336. It was de-



LOCOMOTIVE EQUIPPED WITH PLOW

signed and patented by W. J. Wilgus and F. J. Sprague, and has been developed by E. B. Katte, electrical engineer of the New York Central Railroad Company.

The test was conducted Feb. 9. The locomotive left the car house at 10:30 a. m., and ran all the morning on the section of track east of the sections laid with the protected third rail. At the time the locomotive went on the track, there was 13 ins. of snow between the rails. Both protected and unprotected over-running rails were completely covered, and in some cases there were from 4 to 6 ins. of snow on top of the



CONDITION OF SHOE

protection boards. The electric locomotive carried on its pilot the usual steam railroad type of plow illustrated in the accompanying engraving. It was found, however, that while this style of plow cleans out snow from between the track rails it does not throw it clear of the third rail, so that from the standpoint of third-rail operation much better service on the over-running rail would have been obtained without the plow.

The first third-rail test was made on the over-running unprotected third rail. Very little flashing or trouble was experienced on the first trip of the locomotive. On the following trips conditions grew worse, due to the fact that ice had formed and the snow had become ironed by the shoes. This interfered with collection and contact. It finally became so bad that it was found almost impossible to run the locomotive over the rails.

The next test was made with type 2, or the over-running protected type of third rail. The service of this rail was found to be not much better than that of the bare rail; in fact, in some cases it was worse. The wings of the snow plows would throw up enough snow to keep the top of the rail covered.

At 2 p. m. the locomotive began operation on the long stretch of under-running rail, or type 3. With one exception, there was practically no trouble. This case happened at the west end of the line, where there are two short lengths of this rail installed. The long stretch of open track, equipped with the under-running third rail and which lies between the Fonda, Johnstown & Gloversville station and the West Crossing, gives the shoe a chance to fill up with snow and ice, and it was found that when the top-contact surface of the under-running shoe strikes the rail there is a chance of the circuit being broken. Nevertheless, the test showed that after the locomotive had made one trip over the under-running rail the snow became scooped from under the contact surface for 2½ or 3 ins., and unlike the over-running rail, each passage of the locomotive would tend to clean off the surface of contact. The theory for this action is that the tendency of the shoe is to flatten down the snow which rests on a horizontal surface, as on the over-running type, and to scrape off that which clings to the lower surface of the inverted rail. Moreover, the falling snow will form a pocket under the inverted rail, but will tend to heap up on the old form of rail.

The conclusions reached from this test were: (1) The conditions under which the locomotive was operating were more severe than in regular service, as no flanges were run over line; (2) the snow plow at present on the locomotive can be improved; (3) that the operation of the shoes on the under-contact rail is much more satisfactory than on the other types, and that it is much easier to keep clean.

19,000-KW POWER HOUSE IN WASHINGTON, D. C.

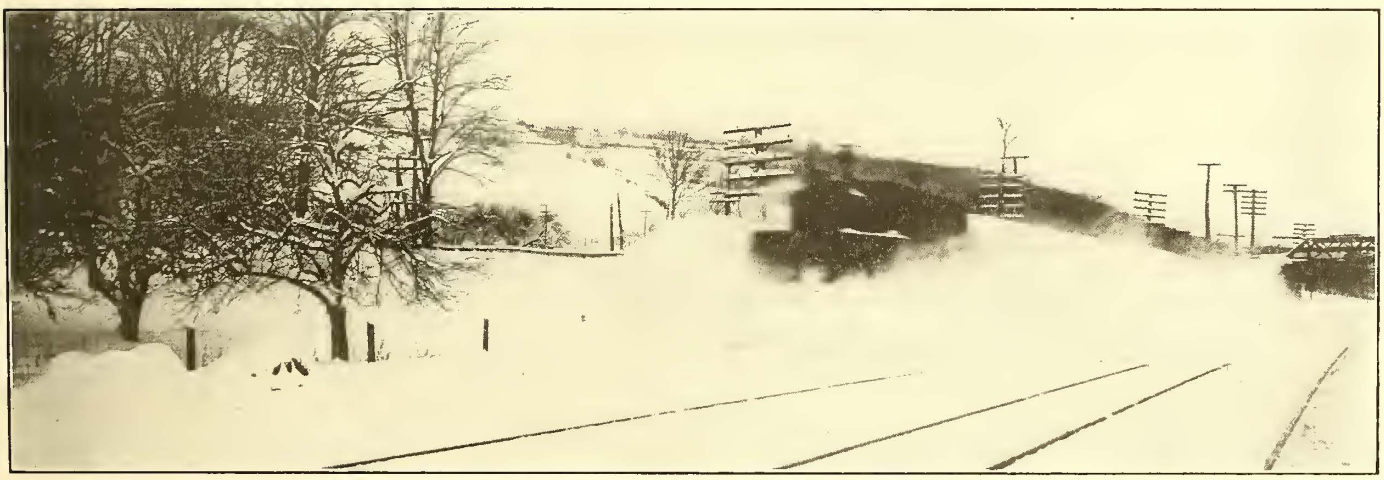
The Potomac Electric Power Company, of Washington, has contracted with J. G. White & Co., of New York, for the erection and equipment of a new power house for both lighting and power purposes in the city of Washington. This company is one of the sub-companies of the Washington Railway & Electric Company, which divides with the Capital Traction Company the electric traction business of the Capital.

The power house in question constitutes an important feature of the general plan for expansion and development adopted by the company sometime ago, and will cost ultimately in the neighborhood of $1,500,000. The building is to be approximately 166 ft. x 183 ft. x 67 ft., and will have a steel frame with curtain walls, which will probably be constructed of moulded concrete blocks. The boiler room will contain four rows of boilers with three chimneys, located between the second and third rows. Thus, there will be two divisions of the firing floor, each serving two rows of boilers. The turbine room will be at right angles to the firing room and will have no basement, its floor lying in approximately the same level as the boiler-room basement.

The first installation will consist of two 2000-kw and one 5000-kw Curtis turbines with boilers and superheaters, and the building is designed for a future installation of two additional 5000-kw Curtis turbines with their steam generators, making a power house of 19,000-kw ultimate capacity. There will be galleries around all the units, connected by short bridges, to permit of easy communication, making, in effect, a secondary operating floor in the turbine room. All of the turbines will generate 25-cycle, three-phase current at 6600 volts for distribution directly to the sub-stations. Two of the 2000-kw units are already installed, one of them being equipped with an ordinary type of surface condenser. All of the remaining units, however, will have the latest type condensers, self-contained in the base of the turbine.

The intake and overflow conduits for the condensing water will run underneath the turbine room, approximately along the center line. There will be a small coal bunker over the firing floor of each boiler, but the main storage room for coal will be outside of the power house back of the boiler room. There will be installed the necessary means for distributing the coal, which will be delivered from railroad cars, in the storage room and of reclaiming it and delivering it to the system of conveyors which will distribute among the bunkers. These ashes will be collected in ash cars running underneath the boilers, and the same apparatus which distributes the coal over the storage area will be used for ashes.

The boilers will be fed by mechanical stokers, supplied directly from the overhead bunkers, and will carry 175 lbs. steam pressure. The superheat will be 150 degs. at that pressure. All of the auxiliary machinery, with the possible exception of the coal-handling apparatus, will be steam driven, and will exhaust into feed-water heaters.



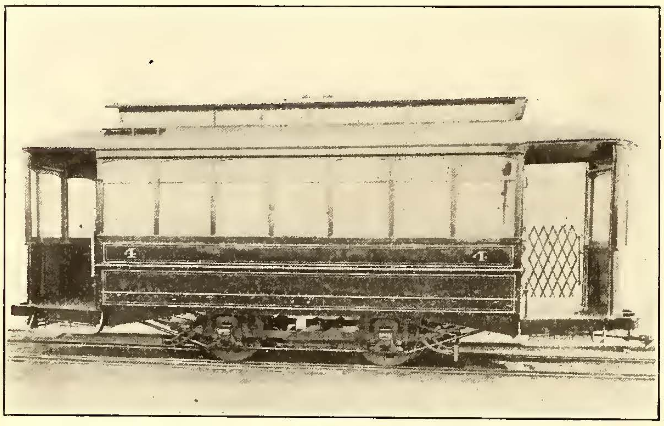
CUTTING THROUGH A DRIFT NEAR SCHENECTADY

The controlling apparatus will be entirely contained in a switch house adjoining the main generating room, and will be distributed among three galleries. The ground floor will contain only the outgoing feeders and main generator leads. The second floor will contain all the bus-bar compartments, disconnecting switches and static apparatus, together with instrument transformers. The third floor will contain both alternating and direct-current switchboards.

A storage battery will be installed, having sufficient capacity to furnish excitation current for the entire station for one hour, so that failure of the exciter units will not cripple the station. The engineering is being done by the contractors.

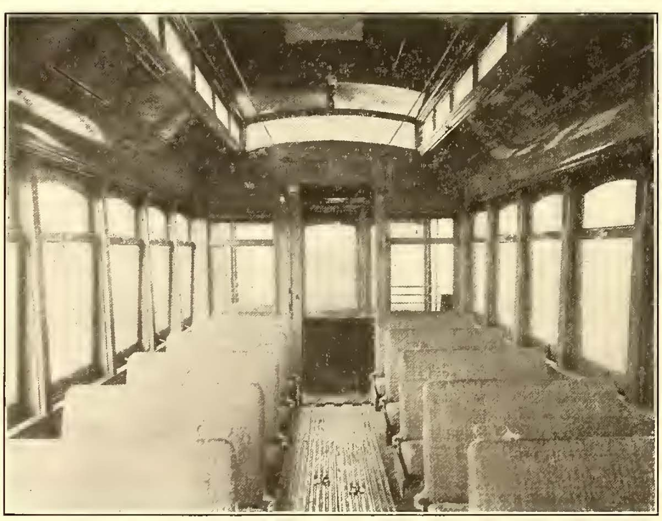
CARS FOR THE RAILWAY SYSTEM AT ALEXANDRIA, LA.

The Alexandria Electric Railways Company, which is completing its 4½-mile system, including a power house, has recently received four cars from the American Car Company of the type illustrated. Five steam railroads enter the city, and two more are now building, which will be in operation within a year. Red River, on which Alexandria is located, is navigable and flows into the Mississippi, 75 miles to the east. The business portion of the city is paved with asphalt and



DOUBLE-VESTIBULE SINGLE-TRUCK CAR FOR ALEXANDRIA

electrically lighted. The railway stations are some distance from the business center, and the necessity for street lines has been urgently felt. Five large saw mills, three foundries, two cotton oil mills, one sugar mill, several cotton compresses and various smaller industries furnish a livelihood for the population, and there are also four banks. The city occupies a considerable area, and the environs are well populated. A rich, alluvial soil renders agriculture easy and profitable, and the neighborhood is surrounded by vast tracts of valuable



INTERIOR OF ALEXANDRIA CAR

timber land. The lines traverse the principal streets and reach an amusement park which is being laid out by the company and is located in the best suburban district. The railway company is backed by Mobile, New Orleans and local capital.

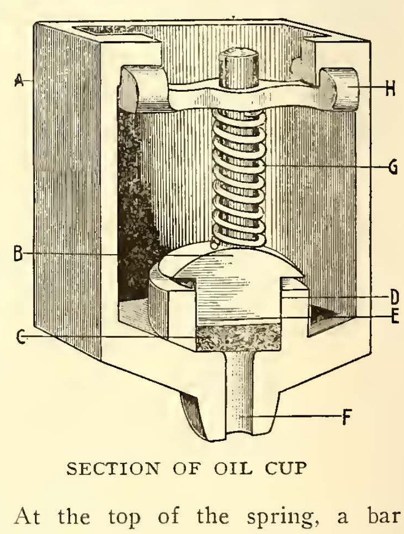
The first rolling stock, which will soon be placed on the lines, consists of four closed cars with 18-ft. bodies and measuring 27 ft. over the dashers. Although somewhat shorter than is usual, these cars have ample width for comfortable transverse seats and a wide aisle. The upper window sashes are stationary, and the lower arranged to drop into pockets in the side walls. Instead of using movable partitions to divide the car into compartments for white and colored people, as is customary in a number of Southern cities, a signboard sliding on rods in the monitor deck, indicates the seats which are for the use of colored people. Brill seats are used, which are upholstered in spring cane, and have corner grab handles. The cushions tilt and are 15 ins. x 34 ins. The interiors are finished in ash, with ceilings of decorated birch. Portable vestibules of the Brill type are used, and the folding gates, brake handles, angle-iron bumpers, "Dedenda" platform gongs, retriever signal bells and other specialties are of the same make.

The general dimensions are as follows: Length over the end panels, 18 ft., and over the dashers, 27 ft.; width over the sills, including the plates, 8 ft. 1 in., and over the posts at the belt, 8 ft. 3½ ins.; sweep of the posts, 1¾ ins.; distance between the centers of the posts, 2 ft. 6¼ ins.; height from the floor to the ceiling, 8 ft. 5⅝ ins.; from the under side of the sills over the trolley board, 9 ft. 5⅞ ins.; from the track to the platform step, 15 ins.; from the step to the platform, 12½ ins., and from the platform to the car floor, 6⅜ ins. The thickness of the side sills and the end sills is 4 ins. x 7 ins. The corner posts are 3¾ ins. thick, and the side posts, 2¾ ins. The wheel base of the trucks, which are of the No. 21-E type, is 7 ft.; diameter of the wheels, 33 ins., and the diameter of the axles, 4 ins. Two 25-hp motors are used per car. The weight of a car and truck without the motors is 12,300 lbs., and with the motors, 17,700 lbs.

A PRACTICAL OIL CUP FOR RAILWAY WORK

After an extended experience in electric railway work with various forms of grease and oil lubricating devices for axle and armature bearings, F. P. Maize, of Rochester, N. Y., devised a new form of oil cup which he has recently placed on the market. The construction details of this cup, which is known as the "F-M", are shown in the accompanying illustration.

The cup is a rectangular casting and so designed as to be easily fitted into the regular grease cup without requiring any alteration in the latter. It consists of the shell "A" which holds the oil. In the center of this shell is a piston "B" which rests upon a felt washer "C"; this washer catches the oil which runs down to it through the almost imperceptible spaces "D" and "E"; from the washer "C" it is fed through the outlet "F" directly upon the bearing. Encircling the piston rod, a tight coil spring "G" is placed. At the top of the spring, a bar "H" serves to keep the pressure on the spring against the piston, the motion of the car causing the piston to move up and down slightly, thus squeezing the oil out of the felt washer and allowing it to run onto the bearing.



SECTION OF OIL CUP

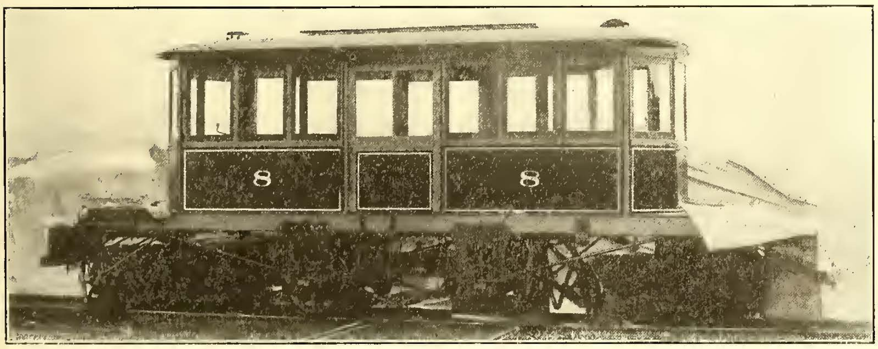
There is no dripping and the inconvenience of adjusting and attaching, so necessary in most oiling devices, is entirely overcome. The entire mechanism of the cup is so simple that there are no parts to get out of order and the feed adjusts itself. The only attention which the oil cup requires is to see that it is filled at regular intervals. The cups are made to fit any size of standard motor.

There has never been a satisfactory oil cup for the older style motors, and but for that reason more companies would now be using oil. The "F-M" Oil Cup has been in daily use on the cars of the Rochester Railway Company for more than eighteen months, and it is now using some 1400 of these cups, and is said to be entirely satisfied with their work. The statement is made that they have cost not a cent for repairs in all this time.

There are no parts to clog up or stick, nor is there any way in which the oil can leak out. There are no loose parts to wear out by rattling and banging themselves to pieces; the greatest space between working parts being not more than 1-100 in. Attention is particularly directed to the fact that all dirt settles in the lowest part of the oil cup, below the point where the oil feeds felt washer, hence the feed never becomes clogged.

SNOW SWEEPERS FOR LEHIGH VALLEY TRACTION COMPANY

The snow sweeper shown in the accompanying cut is one of four delivered a few weeks ago to the Lehigh Valley Traction Company by the J. G. Brill Company. The STREET RAILWAY JOURNAL of Jan. 20 contained a description of twenty cars built by the G. C. Kuhlman Car Company for the Lehigh Valley Traction Company, and included information about the company's 150-mile system in Allentown and vicinity. The valley traversed by the principal division of the system is subject in winter to snow storms of considerable severity, and the last two seasons made a heavy demand upon the resources of the company for keeping the lines clear. The additional snow-fighting equipment, therefore, has been secured, but up to the present there has been little use for it. This type of sweeper has been frequently described in these pages, and therefore the features of the apparatus need not be repeated.

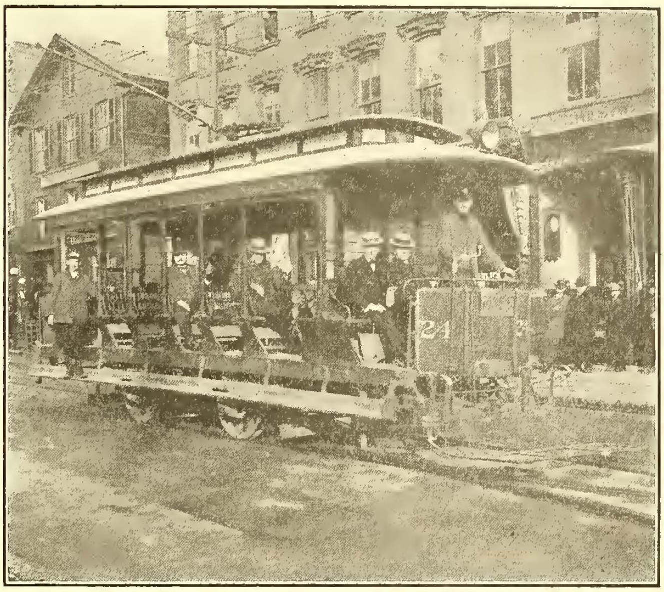


ONE OF THE NEW SWEEPERS FOR FIGHTING SNOW IN THE LEHIGH VALLEY

The cars are larger than usual to permit long brooms to be used. The length over the end sills is 26 ft. 2¼ ins., and over the bumpers, 32 ft. 8¼ ins.; width over the sills, 6 ft. 10¼ ins.; height from the track to the sills, 3 ft. 6 ins.; height from the track to the trolley board, 11 ft. 6 ins.; thickness of the side sills, 4¼ ins. x 8¾ ins., with 8-in. x ½-in. sill plates on the outside. The brooms are arranged to be raised or lowered at each end to suit the curvature of the roadbed. The cars are mounted on gear trucks, having a 7-ft. wheel base and 33-in. wheels; diameter of the axles, 4 ins., and diameter of the broom shafts, 3¾ ins. Two motors are used for propulsion and one for driving the brooms. The weight of a car and truck without the motors is 16,000 lbs.

OPEN CARS FOR WINTER SERVICE IN VERMONT

The very unseasonable weather which was experienced in January proved very satisfactory to street railway operation, and was especially noticeable as it followed the two most severe seasons, as far as snow and low temperature are concerned, which have occurred in the Eastern States since the establishment of the Weather Bureau. The accompanying illustration of an open car in January was not received, as some of our readers might suppose, from Florida, but represents an actual occurrence in the streets of Burlington, Vt., last month. The photograph was taken on Jan. 23, and the car shown was in regular service from 1 p. m. to 5 p. m. on Jan. 22. On those days the temperature was above 60 degs. F. On the same day last year the ice companies in Burlington were cutting ice on Lake Champlain.

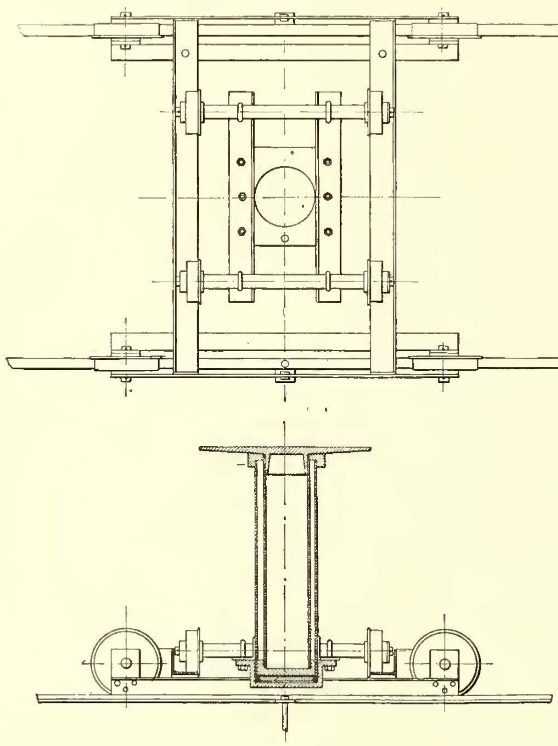


SCENE IN BURLINGTON, VT., DURING JANUARY

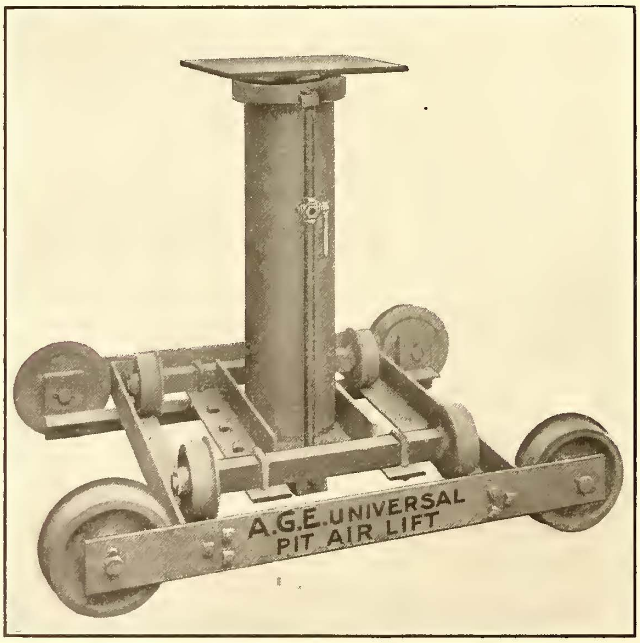
The Allis-Chalmers Club, of Milwaukee, Wis., has issued an attractive little brochure containing its constitution and by-laws, which are very complete and concise. This club was established by the Allis-Chalmers Company for its office men, superintendents and foremen, as a well-appointed club, occupying quarters in a former mansion house near the works, where, for a nominal yearly fee, members are given all the benefits usual to such organizations. During the noon hour a course dinner is served at approximately what the service costs, and supper may also be had by those who are obliged to stay late at the office. The club building stands in a residence district and is easily accessible from all parts of the city.

AIR JACK FOR PIT WORK

The American General Engineering Company, of New York, has recently added to its list of improved railway shop devices a pneumatically operated pit jack. Although of light construction, it is especially adapted for lifting heavy parts under cars, saving time and labor in transferring them, besides insuring safety in operation. The jack is built for standard gage and, as will be noted from the illustration, has a transverse track to reach all parts on either side of the car without moving the jack. It is equipped with a three-way valve, making it simple to operate with a ¾-in. rubber hose so that the different positions of the jack do not affect the air supply. This device is capable of lifting 4000 lbs. under 90 lbs. air pressure.



PLAN AND SECTION OF PNEUMATICALLY OPERATED JACK FOR CAR PITS



AIR LIFT FOR PIT WORK

The standard dimensions of this jack are: from the track to the top of the table, 40 ins.; stroke, 28 ins.; table, 18 ins. square, and travel on the transverse track, 10 ins. The company is prepared, however, to make jacks to suit special conditions and in accordance with the specifications presented by the customer. In one instance the company is building a jack for a large city system in the Central West, requiring a different height and stroke.

Among the railway companies using this device may be mentioned the Public Service Corporation of New Jersey, which has installed over fifty of these air jacks in its new shops.

SINGLE-PHASE RAILWAY MOTORS DISCUSSED BY PACIFIC COAST ENGINEERS

At the February meeting of the Pacific Northwest Society of Engineers, a paper was read by C. Edward Magnusson, assistant professor of electrical engineering in the University of Washington, entitled "Recent Development in Electrical Engineering." The paper dwelt very largely with the advantages afforded by alternating single-phase currents for heavy traffic on surburban lines, and was discussed by Elbert G. Allen, electrical engineer for Seattle Electric Company; H. Day Hanford, formerly superintendent of construction, Indianapolis Interurban Railway Company; Cyrus A. Whipple, electrical engineer at the Puget Sound Navy Yard, Bremerton, Wash., and W. S. Wheeler, inspector of franchises for the city of Seattle.

ELECTRIC COMPETITION CAUSES OHIO STEAM RAILROADS TO REDUCE FARES

The Lake Erie & Western Railway and the Cincinnati, Hamilton & Dayton Railroad (steam) have been stirred into a reduction of rates by the new agreement between Western Ohio traction lines known as the "Lima Route" which, as has been stated in these columns, provides for through limited service between Dayton, Fort Wayne, Toledo and intermediate points, directly paralleling the steam roads mentioned. The two roads have adopted the "twin ticket" scheme, by which round-trip tickets are sold between any competitive points for the single fare plus 10 cents. Tickets are good for a round trip, for two trips in one direction or for two passengers on one trip, amounting practically to a straight cut in rates.

WESTERN OHIO RAILWAY COMPANY'S PUBLICITY METHODS

The Western Ohio Railway Company has installed folder racks in all stations between Dayton and Findlay. In these racks will be found the time cards of all the electric lines in Ohio and Indiana, together with maps and information showing routes and rates. The company has started an intelligent campaign of information showing the possibilities of fast travel by electric lines. The company designates its system and connecting lines as the "Lima Route," and all literature bears a trade-mark showing the through route between Dayton, Fort Wayne and Toledo, with Lima as the central point. The through business being developed by this system is becoming a very important item in its receipts.

FINANCIAL INTELLIGENCE

WALL STREET, Feb. 14, 1906.

The Money Market

Contrary to general expectations the money market developed a decidedly harder tendency during the past week, rates for both call and time loan accommodations ruling materially higher than those prevailing at the close of last week. The firmer conditions are due largely to the preparations for financing a number of prospective bond issues by railroads and other corporations, the most important of those contemplated being by the Southern Railway, the American Telegraph & Telephone Company, the Louisville & Nashville, the Pennsylvania and the Atchison, and also a $20,000,000 issue to be sold this week by the City of New York. Other important factors working in favor of a firmer market were the heavy losses in cash sustained by the local banks in their operations with the sub-treasury, and the comparatively light receipts of money from the interior. Shipments of gold to Argentina continue, the amount to be exported to that point this week being $1,750,000. The demand for funds throughout the week has been fairly active, but in view of the demands above noted, the banks and other lenders are not disposed to offer with any degree of freedom except at the higher quotations, the opinion being quite general in banking circles that the market will rule firm until the usual spring demand for money at the interior has been satisfied. Foreign exchange has ruled decidedly easier, thus eliminating the possibility of gold exports to Paris, at least for the present. A feature of the week has been the disposition of foreign bankers to take advantage of the higher rates prevailing for time loans. Not only have a number of maturing loans been renewed which otherwise could have been called, but fair amounts of fresh money has been made available for market purposes. Government finances continued to improve, and indications point to the restoration of the surplus in the near future. The European markets have ruled easier, especially at Paris, where money has been plentiful and cheap. The statement of the clearing house banks, published last Saturday, was very disappointing. Loans increased $4,632,100, and deposits decreased $452,200. The loss in cash was $5,297,100, and was considerably larger than expected. The reserve required was $113,050 less than in the previous week, which, deducted from the loss in cash, shows a decrease in the surplus reserve of $5,184,050. The surplus is now $5,943,575, as against $11,036,925 in the corresponding week of 1905, $20,379,225 in 1904, $15,529,675 in 1903, $13,560,850 in 1902, $12,852,450 in 1901, and $35,511,825 in 1900.

Money on call has been in good supply at rates ranging from 3¾ to 5 per cent, the average rate for the week being about 4¼ per cent. Time money was fairly active at 5 per cent for all maturities up to six months, being an advance of ½ per cent. Mercantile paper is quoted at 4¾ and 5 per cent for the best names, and 5 and 5½ per cent for other good names.

The Stock Market

The past week in the stock market has been one of comparative inactivity, with price changes as a rule over a rather narrow range, and with very few developments of account and important nature. One of the reasons for this condition of affairs was the occurrence of the Lincoln's birthday holiday, but there were several other more potent factors which operated toward bringing about the conditions noted. Among these may be specifically mentioned the continued active agitation of railway rate legislation in Congress, the uncertainties felt regarding the possibility of a coal strike, though toward the end of the week the general sentiment was that there would be no strike; a firmer tendency to the market for time money and the manifestation of some fears about the future working of the call loan market, more particularly in view of the several impending large bond issues, and a weaker tone in the iron, steel and copper metal markets. With this array of unsettling elements was a rather pessimistic feeling on the part of professional stock market operators, who were more inclined to sell on the strong spots than to buy on the declines. Moreover, there was a very natural disposition on the part of recent purchasers of stocks to turn profits into cash, and in consequence prices at intervals were inclined to sag. However, no such slump in values as that which has lately been predicted so generally occurred, but on the contrary frequent and substantial rallies took place, and at the close of the week prices in not a few instances were somewhat higher than at the end of the previous one, while in a few cases new high record figures were touched. The most notable features of strength were the so-called Hill stocks, which were benefited by the reports current relative to the proposed Great Northern ore land deal, although the street was convinced that there was something more in the wind to account for the bouyancy of these shares, and clung steadfastly to the belief that there is to be some sort of a "melon cutting." The shares of the copper producing companies were likewise decidedly strong, explanation for which was afforded by the confirmation of the reports previously current of a final and amicable settlement of the long-existing difficulties between the Heinze and Amalgamated copper interests. The coal stocks reflected the belief that there will be no strike of the miners next April, and this in turn had a good influence upon the market in general. While sentiment was undoubtedly more optimistic in the closing day of the week, indications pointed to a continued comparatively narrow market with uncertain movements in prices, at least until such time as the monetary outlook becomes clearer.

In common with all other stocks, those of the local traction companies developed considerable irregularity during the greater portion of the week, but towards the close they all moved up, though there was not very much in the way of activity. The late improvement was partly in sympathy with the recovery in the general list, but a favorable decision from Albany, upholding the lease of the Metropolitan Street Railway to the Interurban Street Railway Company, and the publication of an excellent statement of earnings by the Interborough Company for the quarter and the half year ended Dec. 31, contributed not a little to the stronger tone of this entire group.

Philadelphia

Trading in the local traction issues has been considerably less animated during the past week, but values generally displayed decided firmness. Philadelphia Company common was firmly held at 53⅛ and 53, about 4000 shares changing hands at those prices, while small amounts of the preferred brought 50¾ and 51. Philadelphia Rapid Transit was well supported, upward of 1000 shares changing hands at 33 and 32⅝. Consolidated Traction of New Jersey was in better demand, 500 shares selling at 81⅞ and 82. Philadelphia Traction was quiet but strong, with transactions at 101 and 101¼. Union Traction ruled unchanged at 63½. Other transactions included Railways General at 7 1-16 and 7, American Railways at 53 and 52¾, United Companies of New Jersey at 269¼, and Union Traction of Pittsburg preferred at 51.

Baltimore

Increased activity and pronounced strength has characterized the market for traction issues at Baltimore. United Railway shares furnished the overshadowing features, prices for both stocks and bonds reaching the highest points attained for a long while. Interest centered in the incomes, which were heavily bought, on reports that the much-talked-of deal was about to be consummated. The free incomes rose from 72½ to 74⅝, and closed at 74½, while the pooled bonds advanced from 71 to 73, and closed at the highest. About $725,000 of both issues were dealt in. The stock also developed considerable activity, about 8000 shares of the free stock changing hands at from 17⅛ to 18½, while nearly 10,000 shares of the deposited stock brought prices ranging from 18½ to 19¼. The 4 per cents were comparatively quiet, $60,000 selling at 94 and 94¼. Charleston Consolidated Electric 5s rose from 97¼ to 98½, on the purchase of $19,000, and Norfolk Railway & Light 5s brought 100⅛ and 100½ for $17,000 bonds. Other sales included $5,000 Knoxville Traction 5s at 108½, $3,000 Macon Railway & Light 5s at 100, and Baltimore City Passenger 5s at 105½.

Other Traction Securities

Generally lower prices accompanied the dealings in street railway stocks at Chicago. Chicago City Railway sold to the extent of 200 shares at 195 and 194½, and 100 Chicago Union Traction brought 11¾. South Side Elevated ran off to 94½, on the exchange of odd lots. Chicago & Oak Park common sold at 6¾, and the preferred sold at 26½. Metropolitan Elevated common brought 27, and the preferred 69¾. The Boston market has been active and irregular. Boston & Suburban common, after selling at 27, broke to 25, and subsequently rallied to 26½, while the preferred stock declined from 72 to 68½, with a late rally to 70. Boston & Worcester common sold from 30½ to 32, and then rose to 35, and ended the week at 34, while the preferred declined from 84½ to 80, and then advanced to 85¾. Toward the close the price ran off to 82⅝. Massachusetts Electrics were strong, the common advancing to 19 and the preferred to 68 on comparatively light transactions. Other transactions included Boston Elevated at from 155 to 156, and back to 155, West End common at 99½ and 99, and the preferred at 114½ and 114. In the New York curb market trading has been fairly brisk, at slightly lower prices. From 234 at the beginning of the week, Interborough Rapid Transit declined to 232⅞, on the exchange of 2400 shares. Interborough Metropolitan common dropped from 56 to 54, on the exchange of about 7500 shares, while 700 shares of the preferred changed hands at from 96 to 95. The new 4½ per cent bonds sold to the extent of about $400,000, at 93¼ and 93½. New Orleans Railway common sold at 37½, and the preferred at 84. New York, West Chester & Boston certificates advanced from 91¾ to 92⅛, on the purchase of $133,000.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compard with last week:

	Feb. 7	Feb. 14
American Railways	53	53¼
Boston Elevated	*156	155
Brooklyn Rapid Transit	86	85
Chicago City	199	190
Chicago Union Traction (common)	11¾	11½
Chicago Union Traction (preferred)	—	42
Cleveland Electric	82	82
Consolidated Traction of New Jersey	81	81
Detroit United	101	101
Interborough Rapid Transit	233	232
Interborough-Metropolitan Co. (common), W. I	55⅛	53¾
Interborough-Metropolitan Co. (preferred), W. I	95½	94½
Interborough-Metropolitan Co. 4½s, W. I	93	93⅜
International Traction (common)	36½	38
International Traction (preferred), 4s	—	75
Manhattan Railway	160½	160½
Massachusetts Electric Cos. (common)	18½	19
Massachusetts Electric Cos. (preferred)	68	68½
Metropolitan Elevated, Chicago (common)	27½	26
Metropolitan Elevated, Chicago (preferred)	69¾	69½
Metropolitan Street	121¾	120¾
Metropolitan Securities	71½	71
New Orleans Railways (common)	37	38
New Orleans Railways (preferred)	83	83
New Orleans Railways, 4½s	91¼	—
North American	101¾	102¾
North Jersey Street Railway	25	—
Philadelphia Company (common)	54	52¾
Philadelphia Rapid Transit	32¾	32⅝
Philadelphia Traction	101	101
Public Service Corporation 5 per cent notes	95	—
Public Service Corporation certificates	69	—
South Side Elevated (Chicago)	96	94
Third Avenue	136	135
Twin City, Minneapolis (common)	116⅛	118
Union Traction (Philadelphia)	63¼	63
West End (common)	99	99
West End (preferred)	113½	113½

* Ex-dividend. W. I., when issued.

Iron and Steel

According to the "Iron Age," the production of pig iron during January exceeded all previous records, amounting to 2,068,893 gross tons, exclusive of charcoal pig iron. This is an increase of 23,175 tons over the previous high record established in October, 1905. The situation in plates, sheets, wire products and pipe is unusual.

ANNUAL REPORT OF THE DETROIT UNITED RAILWAY

The annual report of the Detroit United Railway Company for the fiscal year ended Dec. 31, 1905, was presented in detail at a meeting of the stockholders of the company, held on Feb. 6, at Detroit. President Hutchins presented figures showing an expenditure to the property for improvements of more than $1,000,000, and detailed the several betterments. The most important items of this account were $236,809 for permanent foundations under the tracks at Woodward and Monroe Avenues, standardizing 3850 ft. of double track in Fairview, and 10,918 ft. on River Road, and building 1.6 miles of additional side and yard tracks; $111,259 for additional feed wire, poles, cable, etc.; $241,600 for fifty double truck and twelve single truck closed cars, including equipments; $21,428 for a locomotive, automobile truck, twelve flat construction cars and a new line wagon; $46,407 for the completion of the air brake equipment; $204,260 for additions to the power house, in which were installed one Reynolds gearless engine, one engine-type 1500-kw generator, four 350-hp boilers, one booster set and the installation of a complete storage battery at Cortland and Woodward Avenues; $63,753 for real estate; $33,234 for the completion of the St. Jean car house; $20,408 for building 2 miles of main and side track and special work in connection with the State Agricultural Grounds. In addition to the above there has been expended on the Rapid Railway System and on the Sandwich, Windsor & Amherstburg Railway $82,123 for addition to the power house at New Baltimore, the building of a few miles of main track and the installation of additional feeder trolley wire, new paving, etc.

The following is a summary of the business of the Detroit United Railway, the Rapid Railway System and the Sandwich, Windsor & Amherstburg Railway for the years ending Dec. 31, 1904 and 1905:

	1904	1905
Gross earnings	$4,541,805	$5,125,563
Operating expenses, including taxes	2,763,092	3,041,522
Net earnings from operation	$1,778,712	$2,084,040
Income from other sources	42,777	44,076
Gross income less operating expenses	$1,821,490	$2,128,116
Deductions:		
Interest on funded and floating debt:		
Detroit United Railway	$927,371	$960,372
Rapid Railway system	135,050	135,050
Sandwich, Windsor & Amherstburg Railway	13,365	17,871
	$1,075,786	$1,113,293
Dividend, Detroit United Railway	$500,000	$562,500
Total deductions	1,575,786	1,675,793
Surplus income	$245,703	$452 322

Passenger Statistics:	D. U. Ry.	R. R. Sys.	S. W. & A.	Total
Revenue passengers	92,838,540	4,382,142	1,916,876	99,137,558
Transfer passengers	27,593,325	278,694	148,926	28,020 945
Employee passengers	4,193,445	229,099	26,361	4,448,905
Total passengers	124,625,310	4,889,935	2,092,163	131,607,408
Receipts per revenue passr	.0465	.1043	.0547	.0492
Receipts per passenger	0347	.0935	.0501	.0371
Mileage Statistics:	**D. U. Ry.**	**R. R. Sys.**	**S. W. & A.**	**Total**
Car mileage	20,697,935	2,260,572	529,778	23,488,285
Earnings per car-mile	.2161	.2408	.2030	.2182
Expenses per car-mile	.1268	.1579	.1107	.1295
Net earnings per car-mile	.0893	.0829	.0923	.0887

The following is a balance sheet of the Detroit United Railway of date Dec. 31, 1905:

LIABILITIES		
Capital stock	......	$12,500,000
Mortgage bonds	......	20,387,000
Current liabilities	......	1,231,812
Unredeemed tickets	......	29,777
Insurance fund	......	25,661
Surplus	......	1,397,636
ASSETS		
Investment	$32,815,879	......
Current assets	2,342,436	......
Prepaid taxes, etc	80,043	......
Accident fund	19,456	......
Stores	217,793	......
Cash	96,278	......
	$35,571,887	$35,571,887

B. R. T. IMPROVEMENTS OUTLINED

President Edwin W. Winter, of the Brooklyn Rapid Transit Company, says the company has expended almost $20,000,000 for betterments since he took office on July 1, 1902, about three and a half years ago. Mr. Winter has also shown that work now under way will cost over $12,000,000 more. The record covers the period between July 1, 1902, and Jan. 26, 1906. There was expended, during this time, for additions and improvements alone, slightly more than $19,835,000. Of the sum thus expended, $8,653,000 has gone for car equipment alone. There are now under way, authorized and uncompleted, additions and improvements aggregating approximately $12,025,000. A few of the more important items making up this last amount are distributed as follows:

New elevated shops and station at Thirty-Sixth Street.	$250,000
Elevating and depressing tracks, Brighton Beach line..	600,000
Automatic signals on elevated roads..................	55,000
Elevated shops and storage yards at East New York...	175,000
Car storage depot and shops at Ninth Avenue and Twentieth Street	385,000
Storage yard, shops and changes at Ridgewood "L" terminal	185,000
Canarsie Railroad—reconstruction	670,000
Track reconstruction—elevated and surface lines.......	1,400,000
Williamsburg power station (which, when completed, will have normal capacity of 116,000 hp)..........	5,000,000
Completion of fifteen sub-stations.....................	765,000
Completion of subways and feeder system............	600,000
Elevated and surface car equipment, contracted for and under way	1,470,000

The following sub-stations have been constructed and placed in operation at a total expense of $1,000,000: Parkville, Halsey Street, Essex Street, Tompkins Avenue, Southern Bridge, Coney Island and Mrytle Avenue. The following sub-stations are now under construction, at an additional cost of $566,000: New Utrecht, Hudson Avenue, Richmond Hill, Prospect Park, Corona, Canarsie and Lexington Avenue.

In addition the company has made a statement to the Brooklyn League, covering the improvements from July 1, 1902, to June 30, 1905. This contains among its items detailed reference to the extension of surface tracks, track improvements, storage yards and terminal facilities. Then under miscellaneous there are detailed these items:

Pavement, approximately 27,500 yds., or 35 miles, double track; electrically welded joints, approximately 20,000 joints; tunnel arch over South Brooklyn railway tracks, from Fourth Avenue to near Seventh Avenue, 1200 ft.; club house, East New York; Thirty-Ninth Street car repair shops, constructed from old terminal buildings; office building, ten-story, completed; dock facilities, improved by extension at Fifty-Second Street, Sixty-Fifth Street, Newtown Creek and coal storage; also handling facilities at Newtown dock; Brighton Beach grade crossing work, completed at Park Place and Prospect Place, commenced work on Section No. 2; High Street emergency station; school room for employees at Fifty-Eighth Street depot.

New car equipment, surface lines—201 convertible cars, 3700 series; 100 combination cars, 100 open cars for summer.

New car equipment, elevated lines—120 open cars for summer, with side panels for winter operation; 100 closed motor cars, 100 convertible motor cars (above including electrical apparatus, brakes, trucks, etc., to complete equipment of cars).

Elevated cars rebuilt and converted to modern electrical standard—123 steam coaches rebuilt for motor cars, including addition of necessary motors, trucks, brakes and electrical apparatus; 182 motor cars rebuilt; 230 trail cars rebuilt; 73 motor cars, rebuilding now in progress; 40 trail cars.

Miscellaneous equipment—70 gondola cars for construction and maintenance; new central power station constructed; Eastern power stations; new Williamsburg power station; sub-stations completed, Halsey Street and Broadway, Fulton and Essex Streets, Tompkins Avenue and Fulton Street, Myrtle Avenue and Broadway, Sands Street and High Street, Brighton Beach line at Long Island Railroad, Coney Island at Culver terminal; under construction, Fifty-Second Street and First Avenue, New Utrecht Avenue, Hudson Avenue, Richmond Hills, Canarsie.

New shops—East New York, Thirty-Ninth Street.

Interlocking signal plants at fourteen points; painting structure, 50,000 ft., practically completed; platforms, lengthened for six-car trains on Fulton Street, Lexington Avenue, Fifth Avenue, Broadway.

FIRE AT POUGHKEEPSIE

Shortly before 1 a. m. on Sunday, Feb. 11, fire was discovered in the power house of the Poughkeepsie & Wappingers Falls Railway Company, on Main Street, Poughkeepsie, N. Y., and before the flames were extinguished the plant was almost entirely destroyed, thus cutting off street railway service and necessitating the suspension of the lighting service temporarily.

The origin of the fire is unknown. Everything was destroyed except the boilers and one car, which had not reached the car house. The boiler room, however, was untouched, as there was a brick fire-wall between the engine room and the boiler room. The engines and generators are wrecks, as the roof fell in on them. Twenty-three cars and a new snow-plow also were destroyed. They fell into the cellar and the roof fell on them. The iron parts are, of course, all warped by the heat. The plant consisted of a car house at street level, with room for twenty-four small cars, an office and a waiting room in front. As the ground falls off in the rear, below the car house was a repair shop quite well equipped for a small road. Here also was the power station, which contained a pair of the early General Electric multipolar, direct-connected generators, driven by Ball cross-compound high-speed engines, of about 300 hp each, which were run condensing. A high-speed Watertown simple engine was direct connected to a 100-kw, 110-125-volt d. c. Walker generator, for commercial lighting in the city. The three 300-hp Stirling boilers are unharmed. The loss is unofficially placed at $200,000, covered in part by insurance.

INTERURBANS OUT OF JOLIET

Included in the plans of the Joliet & Southern Traction Company for building a system of electric railways, to radiate from Joliet as a center, is an interurban terminal station, to be located at Joliet. The company is now before the Joliet City Council, asking for a franchise granting independent entrance to the center of the city from all directions, which embraces about 6 miles of tracks on prominent unoccupied streets. The new interurban station will be patterned after the one at Indianapolis, with about eight parallel tracks and a six or eight-story office building, occupying half a block. There will be no grade crossing with steam railroads within the limits of the city, and the construction throughout will be strictly first class in every respect. The line between Joliet and Dwight will be practically the last or connecting link in an electric line between Chicago and St. Louis. Active work all along the line will be commenced as soon as the weather will permit in the spring, and pushed to completion as rapidly as possible. The Joliet, Plainfield & Aurora Railroad, which has been in operation nearly two years, is owned by those promoting the new companies, and may become a part of the combined system. In any event, it will be operated in harmony with the Joliet & Southern. The overhead trolley system will be used, with the possible exception of the line between Joliet and Blue Island. This division will be built to shorten the time, in connection with the Illinois Central, between Joliet and Chicago, and will probably be equipped with third-rail and high-speed equipment, with the expectation of making the run from Joliet to Chicago in 1 hour or less.

THE EAST ST. LOUIS CONSOLIDATION

Announcement is expected in a few days of the consolidation of the East St. Louis & Suburban Railway with the Alton, Granite & St. Louis Traction Company. Plans for the merger have been under consideration for some time, and the preliminary meeting will probably be held in a day or two. The companies in the proposed deal own 117 miles of track in and between East Side cities and the electric light plants and gas works in East St. Louis and Alton. D. R. Francis & Bro. represent the stockholders in the Alton & Granite City Company, and E. W. Clark & Company, of Philadelphia, control the East St. Louis & Suburban. C. M. Clark is president of the latter company, and has taken active part in the negotiations. It is expected that the basis of consolidation will give Alton & Granite stockholders share for share in the holding company, and East St. Louis & Suburban stockholders two shares in the holding company for one of the original stock. This is based on the present market values of the stocks, which are about $75 and $150 respectively.

FEBRUARY MEETING OF THE AMERICAN STREET RAILWAY MANUFACTURERS' ASSOCIATION

A meeting of the American Street Railway Manufacturers' Association was held on Feb. 9, 1906, at 26 Broadway, New York City. There were present Messrs. Baker, Ellicott, Garland, Huelings, Knickerbocker, Martin, McGraw, Nute, Pierce, Randall, Wharton and Williams. B. V. Swenson, secretary of the American Street & Interurban Railway Association, was also present by invitation. Owing to the fact that Mr. Baker, the chairman of the meeting, is also chairman of the finance committee, and had to present his annual report, James H. McGraw was made acting chairman. Mr. Baker then read the finance committee's report, covering the receipts and expenses for the 1905 convention. He gave the total receipts, including a slight balance from 1904, as $12,616.71; total expenditures, $12,266.45; leaving a balance of $350.26. On motion of Mr. Peirce, seconded by Mr. Williams, Mr. Baker's report was unanimously approved and accepted. Mr. McGraw stated that he and Mr. Baker, by invitation, attended a meeting of the executive committee of the American Street & Interurban Railway Association, in New York, on Feb. 6, at which it was suggested that a committee of three of the American Street Railway Manufacturers' Association's committee be appointed to act with another committee of three appointed by the American Street & Interurban Railway Association, to decide on a meeting place for the next annual convention. On motion of Mr. Nute, seconded by Mr. Huelings, and carried, Messrs. Knickerbocker, McGraw and Peirce were appointed a committee with power to act. Upon the motion of Mr. Peirce, seconded by Mr. Wharton, a committee of five, with three constituting a quorum, was appointed to draft a new constitution and by-laws, to be laid before the executive committee for approval. Messrs. Baker, Ellicott, Martin, McGraw and Peirce were appointed as members of this committee. An executive committee meeting is to be called for April 26, to consider the proposed new organization, and a members' meeting for April 27. A motion, made by Mr. Ellicott and seconded by Mr. Williams, was approved by those present to the effect that the secretary forward at once to each member of the executive committee a copy of the present constitution and by-laws, and also to forward a copy of the new draft to each member of the present committee as soon as practicable.

IMPROVEMENTS ON THE CLEVELAND & SOUTHWESTERN

The Cleveland & Southwestern Traction Company is spending a large amount of money in improvements this year. Contracts were closed last week for fifteen new cars, all of which will be built by the Niles Car & Manufacturing Company, the deal being effected through Charles F. Johnson, who will take some of the old cars of the company. Eight of these cars will be delivered within six weeks. They will be practically duplicates of the cars delivered to this company a short time ago, which were illustrated in this paper. They will be 51 ft. long, will have baggage, smoker and passenger compartments, with high roll seats in the passenger compartment and green leather in the smoking compartments; four of them will have carpeted floors and chair seats in the smoker, and will be used for limited service. The other seven cars on order will be delivered May 15. They will be 46 ft. long, duplicates of the other cars, except that they will not have the baggage compartments. This will give the company 30 new cars this year. Seventeen old cars will be disposed of, giving the company fifty-five cars, none of them more than three years old.

The track between Cleveland and Elyria is being rebuilt, and part of it will be put on private right of way. The running time between Cleveland and Elyria, heretofore the slow part of the road, will be greatly reduced. An additional 750-hp boiler will be contracted for in the near future for the Elyria power station, and a dam will be built in the river near the station to provide additional water supply and a cooling pond for condensing water.

C. N. Wilcoxson, general superintendent of the company, is preparing plans for a new repair shop and car house, which will be of the most approved character for handling all the rolling stock, and it is probable that this will be built this year. Since the installation of limited trains and new rolling stock the business on this system has shown remarkable gains, averaging about $12,000 per month growth for the past three months.

INTERBOROUGH EARNINGS

Interesting results are shown in the reports of the Interborough Rapid Transit Company, operating the elevated and the subway lines in New York, for the three months and the twelve months. The increase in surplus for the three months, for instance, shows as $523,711. For the year the surplus was $2,504,140. The reports follow in detail:

	Oct. 1 to Dec. 31, 1905	Oct. 1 to Dec. 31, 1904	Year Ended Dec. 31, 1905
Gross receipts	$5,181,602	$4,472,855	$18,218,264
Operating expenses	2,137,354	1,888,086	8,245,005
Net earnings	$3,044,248	$2,584,769	$9,973,259
Other income	225,792	96,013	701,661
Total income	$3,270,040	$2,680,782	$10,674,920
Fixed charges	2,306,759	2,241,212	8,170,780
Surplus	$963,281	$439,570	$2,504,140

The income account of the subway division of Interborough for the quarter ended Dec. 31, 1905, compares with the two months and four days (Oct. 27 to Dec. 31) in 1904 as follows:

	*1905	†1904
Gross receipts	$1,887,317	$812,090
Operating expenses	744,977	459,254
Net earnings	$1,142,340	$352,836
Other income	111,075	14,513
Total income	$1,253,415	$367,349
Fixed charges	449,736	175,155
Surplus	$803,679	$192,194

* Oct. 1 to Dec. 31. † Oct. 27 to Dec. 31.

For the calendar year ended Dec. 31, 1905 (Jan. 1 to Dec. 31, 1905) the subway's earnings and expenses were:

Gross receipts	$5,815,924
Operating expenses	2,788,773
Net earnings	$3,027,151
Other income	366,591
Total income	$3,393,742
Fixed charges	1,224,170
Surplus	$2,169,572

Manhattan's income account for the quarter and six months ended Dec. 31, 1905, compares as follows:

Three months (Oct. 1 to Dec. 31):	1905	1904
Gross receipts	$3,294,284	$3,660,764
Operating expenses	1,392,377	1,428,833
Net earnings	$1,901,907	$2,231,931
Other income	114,717	81,500
Total income	$2,016,624	$2,313,431
Charges, etc.	1,857,022	2,066,057
Surplus	$159,602	$247,374
Six months (July 1 to Dec. 31):		
Gross receipts	$6,097,760	$6,893,713
Operating expenses	2,707,222	2,797,927
Net earnings	$3,390,538	$4,095,786
Other income	186,017	160,500
Total income	$3,576,555	$4,256,286
Fixed charges	3,543,694	3,597,601
Surplus	$41,861	$658,685

INDIANAPOLIS HEADQUARTERS FOR CENTRAL ELECTRIC RAILWAY ASSOCIATION

The permanent headquarters of the Central Electric Railway Association will be established in the Traction Terminal Building, Indianapolis, March 1. John H. Merrill, secretary of the association, will remove from Lima, Ohio, to Indianapolis to take charge, and will establish a bureau of interchangeable mileage in connection with his other duties. Among those present at the meeting held in Indianapolis last week, which resulted in the selection of Indianapolis for the headquarters, were: E. C. Spring president; C. L. Henry and F. D. Carpenter, vice-presidents; E. C. Nichols, Will Irwin, C. C. Reynolds, Gardner Wells, H. P. Clegg, C. N. Wilcoxson, F. J. Sloat and J. H. Brown, of the executive committee. The first meeting of the new amalgamated association will be held in Indianapolis March 22.

GRAND RAPIDS ELECTRIC RAILWAY SECURES CENTRAL MICHIGAN COMPANY

The Central Michigan Railroad Company, it is reported, has been merged by sale into the Grand Rapids Electric Railway Company, which owns right of way for a line of railway from Grand Haven to Grand Rapids, thence northeasterly through Belding, Greenville, Langston, Edmore, Winn, Mt. Pleasant, Rosebush, Clare, Gladwin, West Branch and other towns to Alpena.

The purchase from the Central Michigan Railroad Company also includes a line of railroad right of way southeasterly from this city to Battle Creek, thence to Coldwater and Camden in Michigan, and to Pioneer, West Unity, Archibald, Napoleon, McClure, Weston and Fostoria, in Ohio. All surveys and location of the railroad have been made and right of way secured for 300 miles, 175 miles of which are graded and substantially ready for cross-ties and rails.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED FEB. 6, 1906

811,535. Means for Muting Vibrations in Railway Rails; John Anderson, Boston, Mass. Non-metallic blocks clamped to the web of the rail or opposite side thereof and spaced apart.

811,746. Roadbed; George Ross and Stephen F. Deal, Kansas City, Mo. App. filed June 9, 1905. Consists of a mixture of earth and crude petroleum, asphaltum and crude carbolic acid.

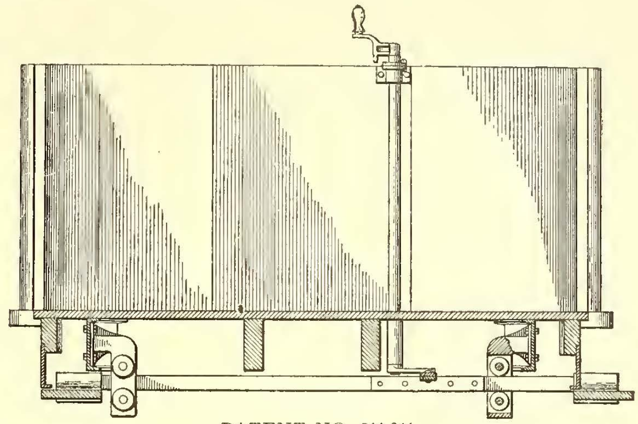
811,765. Air-Brake System and Automatic Valve; Fred. B. Corey, Schenectady, N. Y. App. filed Sept. 16, 1904. Provides an independent source of compressed air on each car, a control pipe extending through the train, and a automatic valve on each car, responsive to variations in the pressures both in the control pipe and in the brake cylinder, and adapted to connect the brake cylinder to the source of pressure or to atmosphere.

811,766. System of Motor Control; Fred. B. Corey, Schenectady, N. Y. App. filed Oct. 1, 1904. Utilizes for each car a single controller of the type which when rotated in one direction controls the motor connections for forward movement, and when rotated in the opposite direction controls the connections for running in the reverse direction, and associating therewith duplicate operating devices, either of which will place the controller in full series position, where it remains until the actuation of the other device, which will then continue the rotation of the controller to its parallel position.

811,822. Automatic Circuit Breaking Safety Appliance for Use in Trolley Wire systems for Electric Traction; James Carter, Stalybridge; George Hall, Manchester, and Arthur Parsons, Leeds, England. The engaging ears of the trolley hanger are hinged so that in case the wire is broken the hinge becomes effective to break the circuit.

811,855. Railroad; George A. Le Fevre, Orangeburg, N. Y. App. filed March 11, 1905. A rail having the usual or any preferred form of tread and having a deep web without a flange, which seats itself in a suitable seat in the sleeper. The seat of the sleeper and a portion of the web of the rail are embedded in the roadbed in such a way that it is impossible for the rails to spread.

811,863. Air Brake; Ernest H. Miller and Charles V. Rote, Lancaster, Pa. App. filed July 21, 1904. A rail brake-shoe and wheel brake-shoes, and a lever adapted to apply the wheel brake-shoes and simultaneously depress the rail brake-shoe, in combination with means acting on said lever to compensate for wear by imparting an accelerated movement to the rail brake-shoe in proportion to the increased distance it has to travel as it wears away.



PATENT NO. 811,911

811,911. Car Step; Delbert A. Faut, Chicago, Ill. App. filed Feb. 11, 1905. The two opposite steps in a closed car are mounted on a common frame which may readily be shifted transversely of the car, so that one operation serves simultaneously to project one step and sheathe or retract the other.

811,919. Trolley Replacer; Robert B. Higgins, St. Louis, Mo. App. filed Aug. 14, 1905. An inverted triangular-shaped trough mounted adjacent the guy wires, whereby the wheel may be guided back to the wire in case it leaves the same.

811,967. Electric Car; Lewis B. Stillwell, Lakewood, N. J. App. filed July 29, 1904. In order to cool the motors, resistances, etc., of a train, and at the same time warm the cars in winter; an air circulatory system is provided through the various resistances and motor casings and leading through the train.

812,018. Method of and Means for Railway Track Construction; Edward E. Clement, Washington, D. C. A method of laying surface-contact railway track, consisting in first arranging supporting means to carry rails during construction approximately at their final level, supporting the rails and contacts with the latter and securing devices supported upon the rails, and building final supporting means under and about the rails and contacts.

812,022. Car Fender and Brake; Lee A. Devin, San Francisco, Cal., and Frank S. Atkins, Oakland, Can. App. filed Nov. 6, 1905. A combined car fender and emergency brake, comprising a frame having a fender-supporting extensions and rearwardly extending track-shoes and a lever to raise and lower the frame.

812,077. Switch-Locking Device; Henry H. Nichols, Philadelphia, Pa. App. filed Nov. 11, 1905. Details of a lock for street railway switches.

812,097. Tramcar and Other Like Vehicle; Ethelbert A. Stanley and John E. Anger, Preston, England. App. filed Feb. 6, 1905. Details of construction of a tramcar.

812,164. Contact Box for Electric Railway Systems; George L. Campbell, Williamsport, Pa. App. filed Dec. 30, 1904. The contact box has a pair of soft iron rods projecting therein which complete a magnetic circuit from an electro-magnet on the car. The circuit is effective to raise a hemispherical iron shell which energizes a contact plate.

REPORT OF CHANGE IN CONTROL OF P. S. C.

It is unofficially stated that an agreement has been entered into by which the Pennsylvania Railroad and J. P. Morgan & Company, acting for clients, will be admitted equally to control with the United Gas Improvement Company, of Philadelphia, the Public Service Corporation of New Jersey, controlling all the electric railway lines in Northern New Jersey and lighting plants throughout the entire State. This will bring together interests somewhat at variance, and will probably result in important changes in the plans for the development of New Jersey as now matured by the separate interests. An official statement is expected to be issued in a few days.

PERSONAL MENTION

MR. ARTHUR W. WARNOCK has been appointed to the position of general passenger agent of the Twin City Rapid Transit Company, a newly-created office.

MR. J. A. BRETT, of Chicago, has been appointed district manager for the Westinghouse Electric & Manufacturing Company, with headquarters in the Traction Building, Cincinnati, Ohio.

MR. THEODORE McCONNELL, for sometime past manager for the Texarkana Traction Company, of Texarkana, Tex., has tendered his resignation, and leaves shortly for Canyon City, Col., where he has accepted a position as manager for the Cripple Creek district, of the Colorado Light & Power Company.

MR. F. J. BOEHM, who has been in the employ of the Milwaukee Electric Railway & Light Company upwards of twenty years, has been appointed to the position of auditor of the company, to succeed Mr. H. C. Mackay, who, as announced last week, has accepted the position of comptroller and auditor of the Virginia & Carolina Coast Line Railroad.

MR. B. B. PIERCE, who for the past two years has been chief engineer of the Mansfield Railway, Light & Power Company, of Mansfield, Ohio, has been appointed superintendent of the company. He will still retain his former duties and enter upon his new ones on Feb. 15. Since the property has been under the control of the H. M. Byllesby Company it has been thoroughly overhauled in all its departments.

MR. W. A. GIBBS, general manager of the Zanesville Railway, Light & Power Company, of Zanesville, Ohio, has been appointed general manager also of the Columbus, Newark & Zanesville and the Columbus, Buckeye Lake & Newark roads, succeeding Mr. J. R. Harrigan, who has become general manager of the Canton-Akron system. A few evenings ago the employees of the Zanesville Company presented Mr. Gibbs with a fine gold watch.

MR. JAMES McCREDIE, treasurer of the United Traction Company, of Albany, has been appointed secretary-treasurer of the company by the board of directors. The office of secretary has been vacant since the formal transfer of the property to the Delaware & Hudson Railroad. Mr. McCredie has been treasurer of the company for a number of years, and his reappointment, with the added responsibility of the secretaryship, is a recognition of his efficiency.

MR. C. K. JEFFERIES, superintendent of the Indianapolis & Northwestern Traction Company, has been transferred to the superintendency of the Indianapolis & Eastern Railway, to succeed Mr. W. R. McKown, and Mr. Raymond Reynolds has become superintendent of the Indianapolis & Northwestern Company. Mr. C. E. Morgan, purchasing agent of the Indianapolis & Eastern Company, has been made superintendent of the Indianapolis & Martinsville Company, and also of the Indianapolis & Plainfield Company.

MR. JOHN M. WALKER, for a number of years chief engineer of the Pennsylvania & Mahoning Valley system, of Youngstown, Ohio, has resigned to become chief engineer of the Lima & Toledo Traction Company, with headquarters at Lima. This is one of the companies of the so-called Widener-Elkins syndicate, and it is building a line from Lima to Toledo. Last week the engineering force of the Mahoning Valley system tendered Mr. Walker a surprise at his home at Girard, Pa., and presented him with two leather chairs.

MR. WALDO H. MARSHALL has resigned as general manager of the Lake Shore & Michigan Southern Railway and accepted the presidency of the American Locomotive Company, the duties of which position he entered upon Feb. 15. Mr. Marshall was at one time associate editor of the "Railway and Engineering Review." Subsequently he became editor of the "Railway Master Mechanic." He left the latter journal to become editor of the "American Engineer," which position he resigned to enter railway service, for which his habits and opportunities of observation and study, together with his native ability, had eminently fitted him. From assistant superintendent of motive power of the Chicago & Northwestern, he became superintendent of motive power of the Lake Shore & Michigan Southern in June, 1899. In February, 1902, he became general superintendent, and in July, 1903, general manager. He will be 42 years of age at his next birthday.

MR. L. B. STILLWELL has been appointed electrical director in charge of the electrical engineering of the various Belmont properties in and near New York City. These include the Interborough Rapid Transit Railway, Section No. 1, which is the subway down to City Hall; the Interborough Rapid Transit Railway, Section No. 2, which is the section from City Hall to Brooklyn; the Manhattan Elevated Railway; the New York & Queens County Railway, of Long Island City; the New York City-Interborough Railway, of the Bronx; the New York & Long Island Railroad, which is popularly known as the "Steinway Tunnel"; the Long Island Electric Railway Company, which owns an electric railway between Brooklyn, Jamaica and Far Rockaway; the New York & Long Island Traction Company, which owns an electric railway between Mineola, Hempstead and Freeport, and the City Island Railway, which is at present operated by horses.

MR. V. W. BERRY, master mechanic of the Houston Electric Company, was born in Brownville, Me., in 1878, and was educated in the public and high schools of that town. Shortly after his graduation from the high school, in 1897, he entered the construction and repair department of the Lynn & Boston Street Railway, and the following year was promoted to the position of master mechanic. Here he remained until 1901, when he became assistant electrical engineer of the Boston & Northern Railway Company, with general offices in Lynn, Mass. Mr. Berry resigned from that company in April, 1903, to become electrical engineer of the Berkshire Street Railway Company, of Pittsfield, Mass., for which he superintended the installation of the substations and general electrical equipment. In November, 1904, Mr. Berry accepted the position of master mechanic of the Houston Electric Company, of Houston, Tex., owned and controlled by Stone & Webster, of Boston, Mass., in which capacity he is at present employed.

MR. H. M. BRINCKERHOFF has become associated with the firm of William Barclay Parsons, consulting engineers, 60 Wall Street, New York. Mr. Brinckerhoff is best known in the electric railway field through his long connection with the Metropolitan West Side Elevated Railway Company in Chicago, of which he was general manager from 1899 to 1905. Mr. Brinckerhoff was born in 1868, and graduated as a mechanical engineer from Stevens Institute of Technology in 1890. He gained practical experience with the West End Street Railway Company, in Boston, for over a year after graduation, doing all classes of electrical work from the line up. In 1891 he became assistant power house engineer of the Utica Belt Line Street Railway, where he remained for about six months, after which he became a construction man for the Thomson-Houston Electric Company. On July 1, 1892, he was made assistant electrical engineer of the Intramural Railway of the World's Columbian Exposition at Chicago, under Mr. Chas. H. Macloskie. He assisted in designing, planning and installing all the details of this first third-rail electric railway in America. He was a joint patentee with Mr. Macloskie of the various new devices developed in this system, and since used on the numerous third-rail systems in this country. He had charge of the maintenance of cars and power houses during the operation of this road until the close of the exposition. About this time the decision was made to equip electrically the Metropolitan Elevated, then being built in Chicago, and he became electrical engineer of this, the first commercial elevated road to be electrically equipped. In 1896 he had added to his duties those of superintendent of motive power, and in 1897 those of superintendent of way. In 1898 he was made assistant general manager and in 1899 general manager of the company. He has just returned from a three months' trip abroad, during which he inspected the various electric railway and power installations in England and on the Continent. His new work with the firm will be in the line of his past experience. He will have in charge their electrical and mechanical engineering, and especially the examination of new projects or existing properties.


H. M. BRINCKERHOFF