December 1899, Vol. 9, No. 12 Canadian Electrical News And Steam Engineering Journal (Toronto) Page 258

THE METROPOLITAN ELECTRIC RAILWAY.

For some years previous to 1890 the Metropolitan Railway Company operated a horse car line on Yonge street from the C.P.R. tracks at the northern city limits of Toronto to Glen Grove, a distance of two and three-quarter miles. In that year electricity was substituted for animal power for the propulsion of the cars, the power house being situated about midway between the two terminals of the road, and current being furnished by a Thomson-Houston dynamo. Gradually extensions were made northwards, and in 1897 the line had reached Richmond Hill, a distance of fourteen miles. Encouraged, perhaps, by the success of this extension, the company concluded to undertake further extensions which had been under consideration, and during the past summer the line was completed and put in operation as far as Newmarket, a distance of about thirty miles. The route tor almost the entire distance follows the public highway of Yonge street, and passes through a chain of suburban villages and country residence districts, as well as the town of Aurora. In order to obviate possible objections by any municipality, the company secured the passing of an act whereby the whole of Yonge street north of the C.P.R. tracks was placed in the control of the county of York. It is understood to be the intention of the company to eventually reach Lake Simcoe.

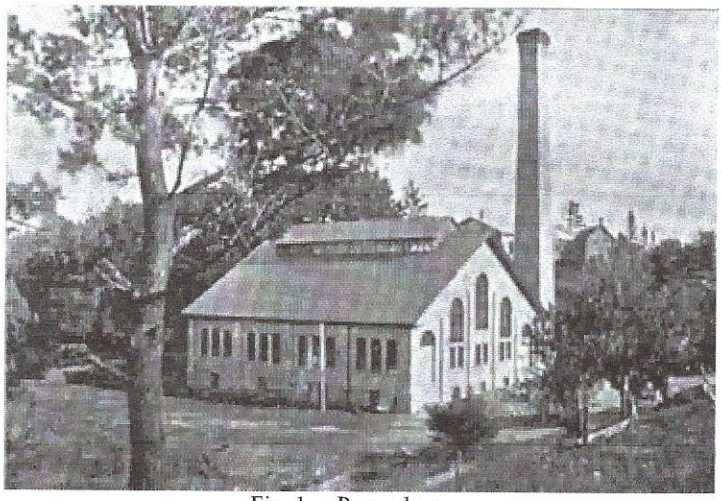

Fig. 1.—Power house.

The system of the Metropolitan Railway Company presents many interesting features. One of these is the unusually heavy grades encountered; another the method of generating and distributing the current, which we believe represents an entirely new practice in street railway operation in Canada.

THE POWER HOUSE

The extensions to the road necessitated the erection of a new power house, for which Nature had provided an ideal site. About twenty miles from the southern terminus of the road, Yonge street converges slightly to the west for the purpose of rendering unnecessary the crossing of a valley. In this valley, and occupying almost the total area, is situated Bond's Lake, which covers an area of forty-eight acres and has a depth at some points of over 100 feet, and around which the land rises to a considerable height, making a very picturesque view. It is in this valley, and bordering on the lake, that the new power house is located, the top of the building being but a few feet above the level of the land. The advantage of this location is that an unlimited supply of water is always obtainable for condensing purposes without the necessity of pumping.

The power house, shown in Fig. 1, was designed by Messrs. Gordon & Helliwell, architects, of Toronto, Mr. John Aldrich being the contractor for labor and the Metropolitan Company supplying all material. It is an imposing white brick structure, with stone foundation and iron and slate roof. The

floor is of concrete supported by steel girders, and the window frames and sashes are of cast iron, the object of the company being to erect an entirely fireproof building. Owing to the advantageous location, very little excavating was necessary. The building has a white brick chimney, with 23 feet base, towering to a height of 125 feet. The boiler room, 50×47 feet, is situated directly to the south of the engine room, from which it is separated by a brick partition wall. The engine room is 74×90 feet, and affords an abundance of room. It is unusually well lighted, having 15,000 feet of window surface.

The boiler room contains a battery of four steel return tubular boilers, 73 inches in diameter and 16 feet in length, with ninety 3 1/2 inch tubes. The boilers, which are of the Goldie & McCulloch Company's well-known make, are fitted with Jubilee shaking bars, manufactured by the Jubilee Grate Bar Company, of Toronto, and are connected to a steam main, from which there is a branch to each engine. The total boiler capacity of 700 h.p. will, it is expected, be sufficient to meet the demands for some time to come. Water is fed to the boilers by two duplex boiler feed pumps, 6×4×7, manufactured by the Northey Manufacturing Company, of Toronto, and there are two Northey jet condensers, 10×1 5×15. When connection is made with the C.P.R., as intended, railway freight cars will run close to the power house, from whence the coal will pass by means of a chute direct into the boiler room.

The engine equipment consists of two cross compound Wheelock condensing engines, furnished by the Goldie & McCulloch Company. They have a capacity of 350 h.p. each, running at 86 revolutions per minute. The high pressure cylinders are 17 1/2 inches in diameter, the low pressure cylinders 32 inches in diameter, with a stroke of 42 inches. The massive pulley fly-wheels are 18 feet in diameter and 42 inches in face. A view of the engines is shown in Fig. 2, the second engine appearing in the background. These engines, with their accompanying generators, take up little more than half the space in the engine room, the balance being reserved for additional equipment whenever the traffic of the road shall demand it. The floor is not yet completed, as will be seen by the illustration.

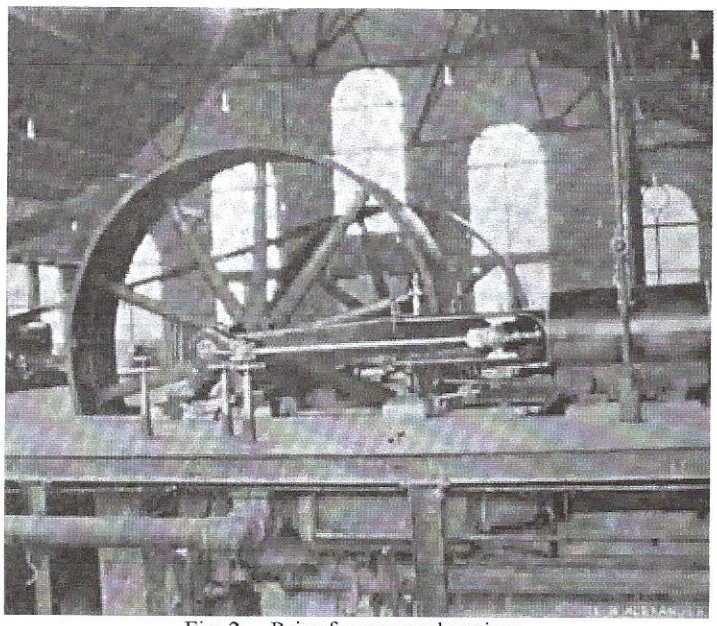

Fig. 2.—Pair of compound engines.

Each engine drives one 275 k.w. A.C.D.C. 60-cycle three-phase multipolar generator, connected by means of a 40-inch belt supplied by the Beardmore Belting Company, of Toronto. These generators, operating at 600 r.p.m., give 550 volts direct current on one side and 350 volts alternating current on the other. The direct current is fed direct to the line and used to operate the section of the road from the power house north to Newmarket, a distance of about 10 miles. The alternating current is delivered to 500 k.w. static transformers, of which there are four, wound for 400 volts primary, situated in the power house, where it is stepped up to a pressure of 16,500 volts. It is then conveyed by the three-wire system a distance of 16 miles to the substation at York Mills, where it is passed through step-down transformers and rotary converters and reduced to 550 volts direct current, at which it is delivered to the line for operating the southern portion of the road.

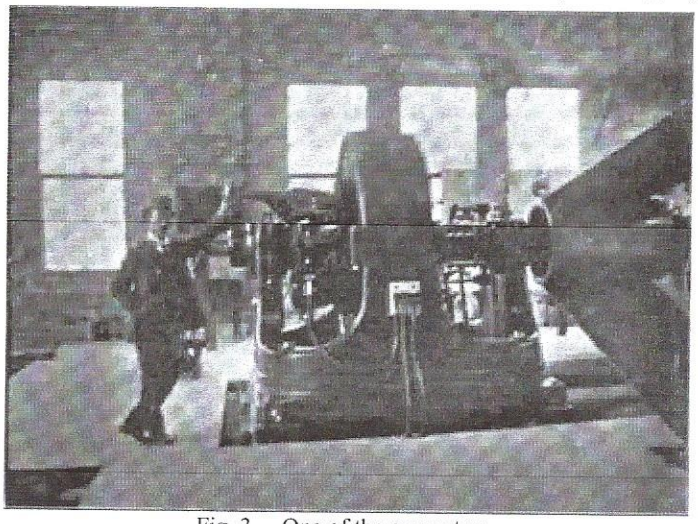

Fig. 3.—One of the generators.

The generators above referred to are of the Westinghouse make, and are separately excited by means of exciters belted from the shaft of the generator. The step-up transformers were also manufactured by the Westinghouse Manufacturing Company and are of the self-cooling oil type. Paraffine oil is used, and has been found very satisfactory. The switch-board in the power house is of marble, mounted on an iron base, and stands six feet from the wall, giving access to all connections back and front. It is 16 feet wide and 8 feet high, and contains eight panels, of which two are alternating current, four direct current, and two double feeder panels. There are in all 13 meters, including 10 ammeters, one direct current volt meter and two alternating current volt meters, the volt meters being hung on swinging brackets so that they can be moved to be visible from all parts of the room. On each panel there are the necessary high tension fuse switches and circuit breakers, and on the back a No. 3 type R 15,000 volt lightning arrestor and one railway tank lightning arrester connecting between the line and the switchboard.

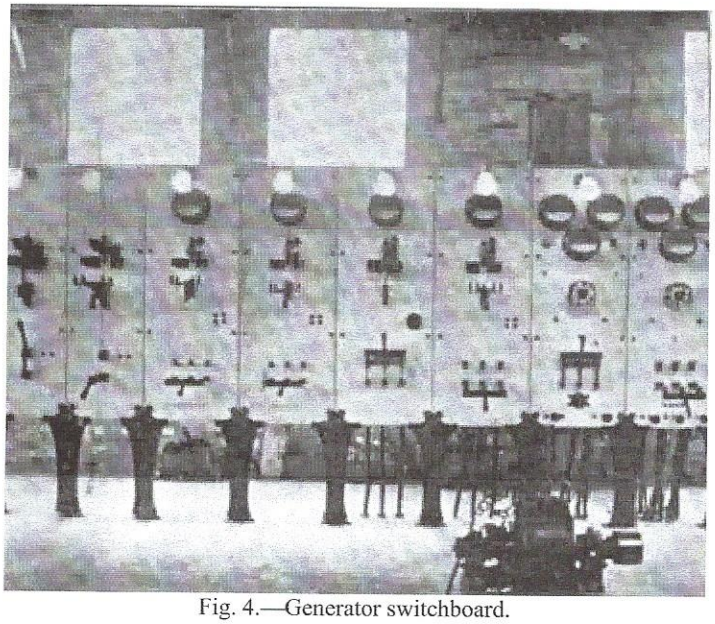

Fig. 4.—Generator switchboard.

A general view of the switchboard is show in Fig. 4.

The old power house has been closed, and it is the intention to remove the direct current machine therein to the new station at Bond Lake.

THE SUB-STATION.

The sub-station is located at York Mills, about four and one-half miles from the southern terminus of the road. It is 30 feet wide and 45 feet long, of red brick, but in other respects its construction is very largely a duplicate of the power house.

Its equipment includes four 100 k.w. static transformers wound for 16,500 volts primary and 400 volts secondary. The current is received into these transformers from the power house at 16,500 volts alternating and reduced to 350 volts. At this pressure it is delivered to two 200 k. w. three-phase rotary converters, where it is changed to 550 volts direct current. These converters are operated at 710 r. p.m. and each are excited on one side by an induction motor of 25 h.p., a synchronizing motor for operating the plant being on the other side. The current thus produced is utilized to operate the southern portion of the road, that is, from the C. P. R. tracks to the power house, a distance of about 20 miles.

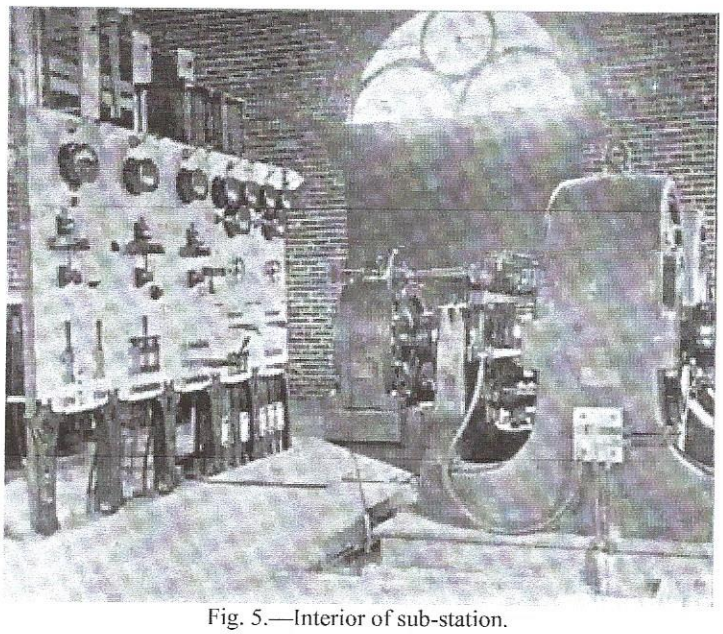

Fig. 5.—Interior of sub-station.

The switchboard in the sub-station is of marble, containing five panels, two for alternating current for operating the machines, two containing equipment for direct current, and the fifth containing two automatic circuit breakers connected into the line. The first two panels contain three A. C. ammeters, rheostat for controlling the current and switches for controlling the starting motor and the synchronizing motor, all of Westinghouse make. The next two panels contain one D.C. ammeter, one D.C. circuit breaker of latest type, and a three knife switch. The fifth panel contains two circuit breakers, two single knife switches and Weston volt meter. The switches are of the latest type of automatic quick breaking. The equipment of the sub-station includes also a 15,000 volt lightning arrester and a Westinghouse tank lightning arrester. The apparatus enumerated occupies but one-half the space in the station, the balance being reserved for additional equipment, if found necessary.

THE POLE LINE.

The poles are of cedar and are set 100 feet apart. They are 38 feet in length, 6 inches at small end, with suspension trolley arms. The insulators are of the ordinary porcelain pattern, and were manufactured by the Imperial Porcelain Works, of Trenton, N.J., and tested to a pressure of 40,000 volts. They are placed 15 inches apart. The high tension line is of No. 4 covered copper wire made by the Montréal Rolling Mills Company. Since the plant was put in operation no trouble has been experienced excepting on one occasion, when, during a heavy east wind, the branches of a poplar tree were blown over the line, causing the two wires to touch and blowing out the circuit breakers in the station. The trolley wire is No. 2 0 and the feed wire No. 4 0 bare copper, with a feeder into the trolley wire every tenth pole. Switches are so arranged that should necessity demand, the road may he entirely operated from either the power house or sub-station.

THE ROAD-BED.

As previously stated, the line follows the Yonge street thoroughfare. The construction of the road represents the best engineering practice. There is a ballast of about six inches under the ties, which are of cedar and tamarac and placed about two feet apart. The track is covered in with gravel and ordinary earth. The rails are of the ordinary T pattern, 56 pounds to the yard, bonded to each other with No. 4 0 copper bond and cross-bonded every one thousand feet. It is a single track, with 13 spring switches,

which are always open to a car running towards them. The track is placed on the side of the road, so that the ties will just clear the ditch. From the city limits to York Mills it is on the west side, and for the balance of the distance on the east side, it being found that this plan would give the least interference by snow. The track practically follows the grade of the road, the southern portion near the city being fully three inches below the level of the crown of the road, and further north on the level with the crown. Box drains are provided for carrying away the water.

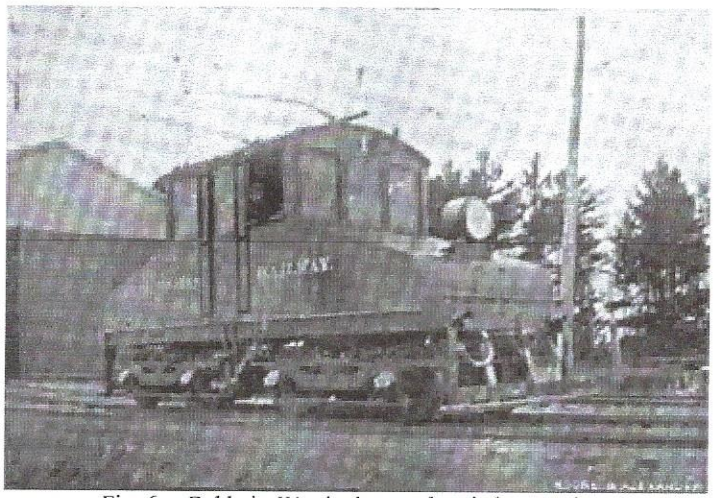

Fig. 6.—Baldwin-Westinghouse electric locomotive.

The road leaves Yonge street at two points. At Aurora it makes a detour to the west[1] in order to cross the G.T.R. by an overhead steel trestle bridge 125 feet in length, built by the company. The second time is at the side-road at Hon. Wm. Mulock's residence beyond Aurora, where it cuts diagonally across private property for one and one-half miles, and thus reaches the town of Newmarket, where it passes up the centre of the main street. Besides the bridge mentioned, there are two steel girder bridges over the Holland river north of Aurora and a steel bridge 100 feet in length over the Don river at York Mills, all calculated to carry a load of the heaviest steam railway coal cars covering the entire bridge. These bridges were also built by the company.

During the summer the gauge of the road-bed was changed from 4 feet 10 3/4 inches to the standard gauge of 4 feet 8 1/2 inches. This was done done to permit connection with the C.P.R., it being the intention to connect with that road at North Toronto.

THE GRADES.

The grades on this road are, it is believed, more severe than on any other suburban electric railway in Canada. Starting at the southern terminus the first grade is encountered at Gallow's Hill, it being a northbound grade of seven per cent. for a distance of 260 feet. At the old power house, about one mile further, there is a south-bound grade of five per cent. for a distance of 132 feet and a north-bound grade of 6.2 per cent. At York Mills, four miles from the southern terminus of the road, there are south-bound grades of 6.4 per cent. for 400 feet and 6.8 per cent. for 700 feet, and one-half mile further on, at the North York Mills hill, 200 feet of 6.2 per cent., 200 feet of 6.4 per cent., 300 feet of 5.8 per cent. and 400 feet of 6.35 per cent., all north-bound grades. At Willowdale there are 1,300 feet of 2.6 per cent. north-bound grade, and at Morgan's Hill, three miles further on, 400 feet of 5.7 and 400 feet of 6.1 per cent. southbound grades. The steepest grades are found at Thornhill, where there are 100 feet of 5, 100 feet of 6.3, 100 feet of 8, 100 feet of 7.3 and 100 feet of 4.7 per cent. southbound, and 100 feet of 4.8, 100 feet of 7.8, 200 feet of 8, 300 feet of 7.35 and 100 feet of 5.1 per cent. north-bound grades. At Richmond Hill there is a north-bound grade of 4.25 for a distance of 1,800 feet. Although the main ridges are crossed above Richmond Hill, none of the grades exceed those above given. There are six north-bound grades, varying from 4 1/2 to 5 1/2 per cent. and from 400 to 1,000 feet in length.

ROLLING STOCK.

The company is well provided with rolling stock, having 19 passenger cars built by the Pullman Company and recently overhauled by the company's own mechanics. These cars are double vestibule,

heated by coal stoves, and with one exception are mounted on single trucks. Each single truck car has two 30 h.p. motor equipment, the double truck car having four 30 h.p. motors. Five of these equipments are Canadian General [Electric] and the remainder Westinghouse. They have also four flat cars for hauling local freight. These will be drawn by a Baldwin-Westinghouse electric locomotive of 200 h.p., of which an illustration appears herewith. This locomotive has 33 inch driving wheels, wheel base 16 feet, length over platform 22 feet, and its total weight is 54,700 pounds. It is fitted with four standard 38B 50 h.p. motors, together with special controllers.[2]

NOTES.

The entire electrical equipment of the system, including the electric locomotive, was furnished by the Westinghouse Manufacturing Company, of Pittsburg, Pa., and installed by the United Electric Company, Limited, of Toronto. The plant is modern in every respect, and notwithstanding the great fluctuations of load caused by steep grades, its operation has been found satisfactory.

Mr. James McDougall, C. E., was engineer in the interest of the. county of York and prescribed grades and alignment and looked after the details of construction in that behalf. Mr. W. T. Jennings, C.E., also acted as consulting engineer in a semi-private capacity.

The president of the road is Mr. C. D. Warren, and the superintendent and manager Mr. J. W. Moyes. Mr. Moyes has held this position for about eight years, he having had charge of the road when it was a horse car line. The chief engineer is Mr. John W. Marr, who has been with the company for two years. Previous to accepting this position he was employed by the T. Eaton Company and the Toronto Incandescent Light Company. Messrs. Joseph Lappin and John Mitchell are electricians at the substation.

At Bond Lake the company have built a stone, brick and iron car barn, 90×36 feet, capable of housing nine cars. The balance will be stored in the old car barn at Deer Park.

The company have purchased 400 acres of land and an hotel at Bond Lake, and it is the intention to establish picnic and camp grounds.

The company have been given the contract for carrying two mails per day each way between Toronto and Newmarket.

Notwithstanding the heavy grades the cars average a speed of about 20 miles per hour without difficulty. A 15 minute service is provided between Toronto and Glen Grove, and between Toronto and Newmarket there are on an average eight cars daily each way.

Railways: Met.Ry.

End Notes

1. The crossing of the G.T.Ry. south of Aurora is actually to the east of Yonge St. [back]
2. Baldwin construction number 16996, weight 27 tons, 260 h.p., all steel construction, built September 23, 1899 [[**Strapac, Joseph A.**: Interurban Electric Locomotives From Baldwin-Westinghouse (Shadetree Books, Bellfower CA: 2005), ISBN 0-930742-22-2, pg. 11]]. The Westinghouse No. 38B, single reduction railway motor is was rated at 50 h.p. so don't understand rating of 260 h.p.[[Westinghouse Catalog No. 188-A/Circular No. 49-A, March, 1898]]. [back]