temperature in the coldest winter weather reaches 35 deg. below zero; while in the hottest summer weather it will go as high as 110 in the sun. In the early spring severe sleet storms sometimes occur.

The poles are of eastern white cedar. The specifications for these poles, and also for the creosote oil used as a preservative, were based upon those of the National Electric Light Association. Steel poles are used in the terminal yard in the city, on account of their more sightly appearance. The wood poles are set 7 ft. in the ground and are all back-guyed. They are long enough to carry 2 cross arms for feeders, signal circuit and a 3-phase transmission line for supplying the shops in the Cartierville yard with electric power. On top of the poles there is a no. 000 copper ground wire, which serves both as a protection against lightning for the circuits on the poles, and also as a preventive against any trouble that might be caused by breakage of the rail bonds, which latter are of the welded V-type. The poles throughout the single track construction are spaced 150 ft. on tangents and 120 ft. on the 2-deg. curve. On the double-track portion, where the overhead clearance is limited, the spacing is reduced to 105 ft. on tangents.

The messenger for the electrification outside the tunnel consists of a ½ in., 7-strand Siemens-Martin steel cable, with an ultimate strength of 11,000 lb. and an elastic limit of 6,600 lb. Two no. 0000 copper feeders are installed, one the full length of the electrification outside the tunnel, and the other for about a mile west of the substation. The messenger is anchored every half mile by running the end of one half mile length past the end of the next for a distance of one span. It is then made fast to an anchor eye on the bracket, through an insulator and turn-buckle, and the same point of the bracket is guyed back to the next pole, which in turn is guyed against this strain. The two messengers, where they pass each other, are kept from 8 to 10 in. apart. By anchoring the trolley wire on the same bracket, the anchorage becomes a section insulation, the air space between the messenger and trolley wires forming the insulation. Where a section insulator is not required, a copper jumper is placed between the messenger and trolley wires. For the double track portion of the line, cross-span construction is used, the cross-span being a ⅜ in., 7-strand Siemens-Martin steel cable. The messenger is fastened to this by a small malleable clamp. This cross-span is made up with a turnbuckle, strain insulator, and wedge grip in each end, and fastened to the poles by means of eyebolts.

In yard work spanning more than 2 tracks, the construction is similar, but with the addition of a cross messenger of ½ in. cable above the ⅜ in. cable. This cross messenger is made fast to the poles directly, without insulators or turnbuckles, and carries the weight of the spans below through lengths of ¼ in. steel cable. These fasten to eyes in the tops of the messenger hangers, and to to the cross messenger, by Crosby clips. There is a strain-insulator in each of these lengths.

Pull-offs are used on curves, for holding the contact wire and messenger in the correct position over the track, and at intervals on long tangents, for steadying the contact wire. The pull-offs are made of sherardized steel tubing, bent to avoid fouling the pantograph. Each pull-off is fitted with a clamp ear at one end and an eye at the other. Adjustable links are sometimes required with the pull-offs, to keep the trolley wires the right distance apart at certain points, such as where the trolley wire for a turn-out approaches the main trolley wire at an angle. Each link is composed of 2 malleable iron brackets, with clamp ears, connected by a ½ in. pipe, the length of which is adjusted between the brackets and held by set screws.

Egg type insulators are used in two sizes. The larger, used with a ½ in. and ⅜ in. steel cable, withstands a wet flash-over test of 14,000 volts, and has a breaking strength of 22,000 lb. The smaller, used with ⅜ in. and ¼ in. steel cable, withstands the same voltage test, and has a breaking strength of 12,000 lb. The insulator used on the bracket construction is of the ordinary glazed porcelain, double petticoat, pin type, 4¼ in. in diameter. It has a wet flash-over test of 20,000 volts. The messenger rests in the groove in the top of this insulator, and is not tied, except on curves.

The contact wire is of special bronze composition, size 0000, with a breaking strength of 65,000 lb. a sq. in. and an elastic limit of 39,000 lb. a sq. in. Its section is American Electric Railway Association's standard 0000 grooved trolley wire. The use of this wire, instead of hard drawn copper, was thought advisable, both because of its longer life, when subjected to the wear caused by sliding pantographs, and also because it could be pulled up tighter than copper, on account of its greater streigth. This latter reason was considered of special importance, because of the wide variation in temperature in Montreal, with the consequent great variation in the sag of ordinary copper trolley wire between winter and summer.

The trolley wire is hung straight over the center of the track, as the natural side sway of the pantograph is sufficient to prevent wearing grooves in the contact strips. The height of the trolley wire above top of rail is ordinarily 23 ft., except along the double track construction and in the tunnel, where it is 16 ft. In this section 2 wires are used over each track. They hang side by side, supported from the same messenger, the hangers of one wire being staggered with those of the other. These double wires do not raise the hanger loops as high as would a single wire, when a pantograph passes along. which is an obvious advantage where the head room is limited. Sparking and consequent wear, both of the contact shoes and contact wires, is reduced to a minimum, as there is always good contact between the slider strips and one of the contact wires. The hangers are all of the long-loop type, having a malleable iron, single bolt, clamp ear, and a strap varying in length to suit its position in the span. All parts are sherardized. In spans of all lengths from 150 ft. to 90 ft. the hangers are spaced 15 ft. apart.

Lightning arresters of the magnetic blow-out type are installed at half mile intervals. The arrester is placed near the top of the pole, and the ground wire run down the pole to a ¾ in. iron pipe driven about 10 ft. into the ground. Before driving this pipe, a 2 in. pipe was driven down about 5 ft., then withdrawn and the hole filled with rock salt. The ¾ in. pipe was driven down through the salt. In addition to these arresters on the poles, aluminum cell arresters are installed in the substation on the positive busbars and on each feeder.

In order to string the messenger cable with the proper tension, a dynamometer was used. It was therefore necessary for the foreman of the line gang to know what the tension should be at different atmospheric temperatures. The right sag at any given temperature was also of importance, as a check on the tension. This information was supplied in tables to which the line gang worked, the sags and tensions being given at 5 deg. intervals. In the tunnel the overhead clearance was so limited that the catenary had to be very flat. This meant pulling the messenger up very tight for spans of reasonable length. A cable of phosphor bronze was decided upon, composed of 19 wires, and having an overall diameter of 0.888 in. This cable has an ultimate breaking strength of 22,000 lb., and an elastic limit of 18,600 lb. This messenger is supported every 90 ft. from the roof of the tunnel by a combination of iron yokes held in the concrete by four 1-in. bolts. The cross yoke carries the messenger insulator, and is supported on two insulators carried on the 2 end yokes, so that there are 2 insulators between the messenger and the ground. The insulators are of glazed porcelain, and have a wet flash-over test of 20,000 volts. All clamps and small parts of the messenger supports are of malleable iron sherardized. The yokes are of 2 x ⅝ in. and 1½ x ⅞ in., mild steel, painted with an asphaltum compound as a protection against rust.

Two no. 0000 phosphor-bronze contact wires hang side by side from the messenger. The hangers for each contact wire are spaced 15 ft., or 7½ ft. between adjacent hangers. The hanger lengths very from 6 in. to 13¾ in., with 90 ft. span. The 2 hangers nearest the messenger support, viz., those 11¼ and 13¾ in. long, are made with 2 loops, one sliding inside the other, where the clearance to the roof is small. The remaining hangers are similar to those used outside the tunnel, except that the loop is wider, in order to take the larger messenger. It was found that the 2 messenger cables and the 4 contact wires over the 2 tracks in the tunnel would give ample conductivity, so that no feeders through the tunnel were required. Both the messenger and contact wires are anchored every half mile. Two bridles of ½ in. steel cable are fastened to the messenger by six ⅞ in. Crosby clips, and the ends of the bridles are fastened each way, through 2 cemented-type strain insulator in series, a turnbuckle and wedge grip, to roof plates. The contact wire is anchored by lapping the ends for one span and then carrying each end up and slightly to one side of the center, making fast to a roof plate through 2 insulators, a turnbuckle and a wedge grip.

At the only curve in the tunnel, one of 2-deg., 2 pull-offs are placed in each span, over each track, one for each of the contact wires. The pull-offs are fastened to the tunnel arch through 2 strain insulators in series by an expansion bolt. The 2 pull-offs are placed 7½ ft. apart, and this arrangement prevents hard spots and at the same time keeps the 2 contact wires close enough together for satisfactory operation.

The United States Court, sitting at Grand Rapids, Mich., on Dec. 27, refused to grant the Grand Rapids, Grand Haven & Muskegon Interurban Ry.'s application to prevent the state from enforcing the 2c a mile railway rate. This is a matter in which the G.T.R. is interested.

Vancouver, B.C., merchants are asking the railways running into the city to abandon the 5c arbitrary rate, and a report states that the Board of Railway Commissioners may be appealed to upon the matter by the Vancouver Board of Trade.