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PRECISE SURVEYS FOR MOUNT ROYAL TUNNEL

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The Canadian Northern Railway have under construction a double-track tunnel about 3½ miles long through Mount Royal, on the west side of the city of Montreal. This tunnel is being built in order to bring the lines of railway from the east and west of Montreal right into the heart of the city, where a large terminal station is to be built.

The construction of a long tunnel usually means that very precise surveys and measurements have to be made as a preliminary step to the actual work of boring, and the Mount Royal tunnel is no exception to the general rule.

In driving a tunnel it is customary to work from both ends towards the centre, and in this case a shaft was sunk down to the level of the tunnel at an intermediate point and the tunnel is being driven both ways from this shaft, as well as from the ends. In order to insure that all these workings will correctly meet, it is essential that their locations with regard to each other should be very carefully established, both with regard to alignment and also for elevation and distance apart. To obtain the correct alignment, a line is, when possible, run on the surface in the same vertical plane as the tunnel, and precise transverses or triangulation must be resorted to for the distances. The necessity for accuracy will readily be understood on account of the fact that once the lines and levels are transferred into the tunnel no further check is obtained until the different workings meet.

Fig. 1.
Letting up Spider.

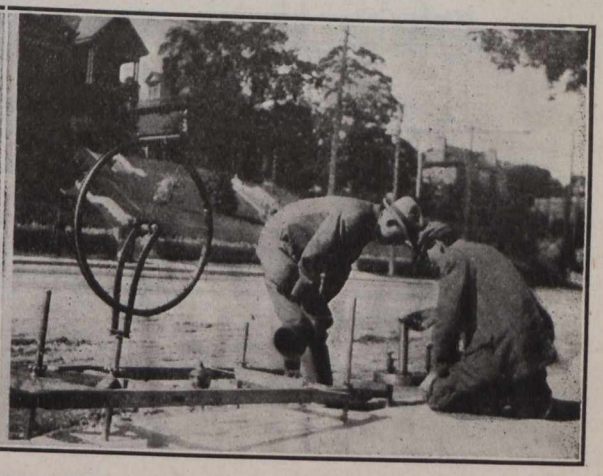

Fig. 2.
Chainman Reading Tape; Tension Wheel at Left.

On account of the steep and inaccessible slopes of the mountain it was deemed advisable to make transverse surveys around the side in order to obtain the exact distance from the east to the west portal, and also to the intermediate shaft at Maplewood Avenue. Suitable routes were selected and at all the angle points (called stations and given consecutive numbers for reference) small copper plugs were set into the sidewalks, or, in the few cases where there were no sidewalks, into the solid rock.

In order to make the transverse sufficiently accurate, the length of the route being about 4½ miles, it was necessary to adopt some form of base line measurement. The form decided upon as being eminently suitable for use on sidewalks and roads was that of portable measuring points called "spiders," used in conjunction with a steel tape supported at twenty-foot intervals, with a tension of twelve pounds applied by means of a weight attached to a cord passed over a bicycle wheel on an adjustable frame. These spiders are illustrated in Figs. 1 and 2, and weighed about sixty pounds each. The tension wheel is shown in Fig. 2.

Previous to making the precise measurements "spider" points were marked on the sidewalks by means of a chiselled cross roughly every ninety-nine feet on the lines of the transverse, being put in line between the angle points either by eye or with a transit. The necessity for exact alignment not being very great as an offset of 0.43 feet on either side of the line would only introduce an error of one thousandth of a foot in the length of the line. Where the lines were not on sidewalks, stakes or ship spikes were driven to mark the spider points. While these were being laid out by one party, a leveller would follow and take the elevations of all the spider points and enter them up in a book provided for that purpose.

In making the base line measurements 100-foot steel tapes were used of ¼-inch steel, divided into feet, tenths and hundredths, the thousandths being estimated by the observer. One steel tape was sent to the Bureau of Standards to be standardized under the same condition as the tapes were to be used under in the field, i.e., supported at 20-foot intervals with a tension of 12 lbs. It was compared with the government standard at a temperature of 62 degrees so all temperature corrections made later were to this figure.

All the tapes to be used in the base line measurements were compared with this standard tape. The standard tape and the one to be compared were fastened at the zero end to