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ELECTRIFICATION OF THE ST. CLAIR TUNNEL.

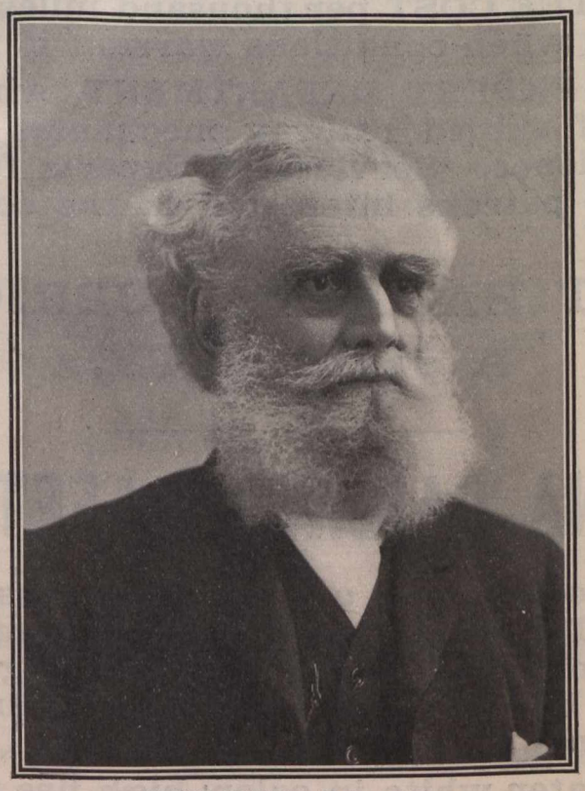
The St. Clair tunnel was opened for traffic in 1890, by the St. Clair Tunnel Co., organized as a subsidiary company to the G.T.R. Co. The tunnel, located under the St. Clair River, is the connecting link between the terminal of the Eastern Division at Sarnia, Ont., and the Western Division at Port Huron, Mich. The length of the tunnel from portal to portal is 6,032 ft. The open tunnel approaches are of considerable magnitude, that on the Port Huron side being slightly over 2,500 ft. long, while that on the Sarnia side is nearly 3,300 ft. long, the total distance between the Canadian and U.S. summits being 12,000 ft., or about 2¼ miles. The grade on the tunnel approaches and the inclined sections of the tunnel is 2%, while the flat middle section of the tunnel, about 1,700 ft. long, has a grade of 0.1% downward toward the east, just enough to provide for the proper drainage of any seepage water.

A single track extends through the tunnel, while a double track is laid in both of the approaches. The necessary tracks for handling the freight and passenger traffic are provided in the yards at Sarnia and Port Huron. The map and profile of the zone operated by the St. Clair Tunnel Co. is shown in an accompanying illustration. The tracks in the yards and on the tunnel approaches are shown on a larger scale in the same drawing.

The tunnel shell consists of cast iron rings built up in sections, the inside diameter being about 19 ft. The hydraulic shield was used in advancing the bore from each of the tunnel portals, by which means the entire work of construction was carried on with reasonable expedition. A vertical shaft was sunk near the bank of the river on both the Canadian and U.S. sides.

The disposal of the rainfall on the tunnel approaches required particular attention. The areas of the Port Huron and Sarnia approaches are approximately 11 and 13 acres respectively. Water precipitated on these areas during a rainfall is discharged into waste ditches on the bank above by means of pumps of large capacity. Retaining levees have been constructed, so arranged as to impound a large proportion of the water falling on the approaches. By this method the pumps have to handle only the water falling on the central portion of the approach during the rainstorm. Later the impounded water is discharged into the pump sump by valves provided for the purpose. As is evident, this pumping service is of great importance in the operation of the tunnel, as, should the tunnel become flooded with water, entire interruption of the traffic would ensue. For the operation of the steam drainage pumps, boiler plants were provided at each portal, and attendants were constantly on duty, it being necessary to keep up steam during a large part of the year in order to take care at a moment's notice of any rainfall that might occur.

Four steam locomotives of special design had been in commission for handling the freight and passenger traffic since the construction of the tunnel. They were designed to provide the necessary high tractive effort required to operate the trains over the grades in the tunnel and on the approaches, and arranged to burn anthracite coal, in order to minimize the inconvenience due to excessive smoke in the tunnel. These locomotives have given good account of themselves, and have handled the traffic in a satisfactory way throughout their service. Their maximum tractive effort limited the weight of the trains handled to about 760 tons, and even with this load the speed up the 2% grade was often very slow. With the constantly increasing traffic, at times the capacity of the tunnel with its steam equipment was taxed in handling the tonnage delivered to the tunnel company by the adjacent divisions of the G.T.R., and it was thought desirable to make such changes in the operation of the tunnel as would increase its possible capacity for handling traffic, and at the same time obviate the danger and inconvenience due to the presence of the locomotive gases in the tunnel.



JOSEPH HOBSON, M. Inst. C.E.

Consulting Engineer G.T.R. and Chief Engineer St. Clair Tunnel Co. from its organization to the completion of the work.

The advantage of the use of electric locomotives, on account of the freedom from smoke and the attendant discomfort, together with the possible greater economy in operation, led finally to the decision to provide an electrical equipment to handle the tunnel service, this equipment to provide for the operation of the trains through the tunnel by means of electric locomotives; the handling of the drainage and seepage water by means of electric pumps; the lighting of the passenger stations, the tunnel and the roundhouses by electricity, as well as furnishing a certain amount of power to the roundhouses; also, provision was made for a limited amount of outside lighting in the form of arc lamps. The different electrical systems available for such service were considered, and estimates as to the relative cost and efficiency of the various systems were prepared and submitted to the tunnel company. These estimates covered the direct current system both with and without battery, as well as estimates on the alternating current systems. Complete specifications were prepared, covering both the direct and alternating current systems, and propositions on these received and considered. The specifications stipulated, in addition to various guarantees regarding efficiencies of different parts of the system, and of the system as a whole, that the installation when completed should be capable of hauling a 1,000-ton train through the tunnel, from terminal to terminal, in 15 minutes, and that in so doing, the maximum speed should not exceed 25 miles per hour, and the minimum speed, when ascending a 2% grade, should not be less than 10 miles per hour. Tenders were submitted by the companies that were prepared to undertake the work as specified, and after careful analysis the decision was made to adopt the alternating current system, using a 3-phase system for distribution of power required for pumping and for shop motors, with single-phase distribution for locomotives and lighting, using an overhead working conductor, this being the first decision providing for the application of the single-phase system to heavy steam road service. The contract was awarded to the Westinghouse Electric and Manufacturing Co., and provided that it be responsible for the installation and successful operation of the entire equipment. The equipment has been in continuous operation since May 17, 1908, handling the entire train service of the tunnel company, this service being the heaviest railway service handled by electricity in the world.

The tunnel is operated as an independent division of the railway, the trains being de-