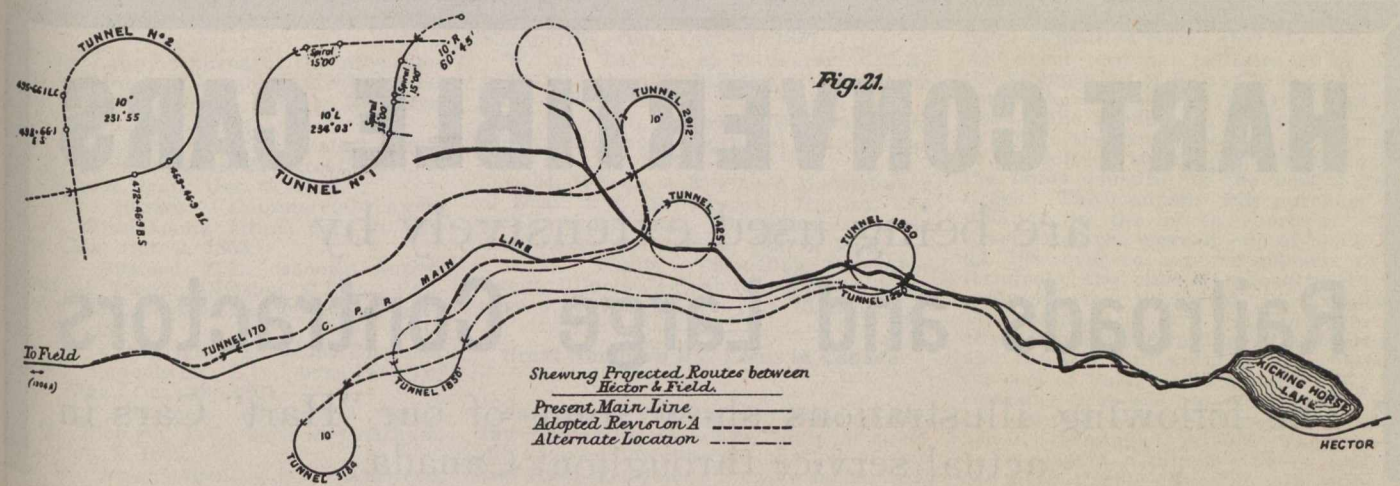


Fig. 21.

control at the upper ends with two small steam-pumps. The two headings in the tunnels met on May 22, the levels checking in tunnel 1 within two-hundredths of a foot, and tunnel 2 within one-hundredth of a foot.

The question of ventilation was investigated, but it was not considered that any would be required in either of these tunnels until the traffic increases to such a degree that it will be necessary to double track outside the present tunnels. On account of the tunnels being on a spiral, and the portals being in such close proximity to each other, there will practically be the same atmospheric conditions at the portals of each of the tunnels, and the tunnel should have a complete change of air in about 2½ minutes.

On account of the nature of the rock, which appears to slack after being exposed to the air for some little time, the greater part of the tunnels were taken out, so that they might be lined with concrete when that may be necessary. This will give a maximum grade of 2.2% through the mountains, of which there will be 12.7 miles east bound and 5.1 miles west bound.

As a comparison between other tunnels it may be stated that the present tunnels have an area of 376.9 sq. ft. of section through the longest tunnel, the actual grade being 1.6%.

Elkhorn tunnel, on Norfolk and Western Rd., is 3,000 ft. long, with an area of 235 sq. ft., and a grade of 2 and 1.4%. It was found necessary to instal a ventilating plant in this tunnel, as the train movements were about 100 per 24 hours.

Cascade tunnel, on Great Northern Ry.—Length, 13,280 ft.; grade, 1.74%. There has been no ventilating plant used at this point, and it is proposed to operate this by electricity, the installation for which was to be completed about the end of June of the present year.

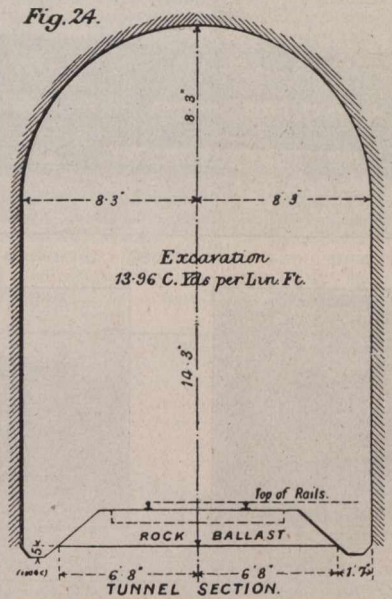
Stampede tunnel, on Northern Pacific Rd.—9,844 ft. long.; area, 333.7 sq. ft.; grade, 0.74% for 5,000 ft., then 0.2% to east portal. Completed 1888. No ventilation.

Boulder tunnel, on Montana Central Ry.—6,139 ft. long; area, 239 sq. ft.; grade, 0.6% ascending from east portal, thence 0.02% descending to west portal.

Busk tunnel, on Colorado Mildanl Ry.—9,400 ft. long; area, 275 sq. ft.; grade, 1.41%. Built 1893. No ventilation.

Hoosac tunnel, on Boston and Maine Rd.—Double track, 4.7 miles long; area, 572 sq. ft.; grade 0.5% from each end to centre, at which point there is a shaft. This was operated without mechanical ventilation till 1899, though in 1890 it was considered to have reached its limit with 65 trains a day without mechanical ventilation.

Fig. 24.



Big Bend tunnel, Chesapeake and Ohio Rd.—6,500 ft. long; area, 250 sq. ft.; grade ascending, 0.4% for 4,300 ft., thence, descending, 0.08% for balance. It was divided in three sections of about 2,000 ft. by two shafts. These were found to be insufficient for proper ventilation when traffic reached 45 trains a day.

St. Clair tunnel, Grand Trunk Ry.—Built 1901; 6,000 ft. long; grades 2%, descending, each way to centre of section of 2,000 ft., which is on 1% grade. Area, 300 sq. ft.. No ventilating plant installed till at least 1904, when train movement became so heavy that it was necessary to install electric locomotives. [These were placed in operation in 1908.—EDITOR.]

Arlberg tunnel, on Arlberg Ry.—Completed 1883; 6.4 miles long; area, 442.6 sq. ft.; double track; grade, 0.2% for 2.6 miles, ascending from east end, thence 1.5% descending to west end. Owing to increased traffic it began to give trouble in 1885, when the company began to use coke. In 1888 the traffic increased to 31 two-engine trains per 24 hours, but no abnormal effects were noticed till Sept., 1890, when some workmen were overcome by gases, but recovered on removal to air. In 1894 started to use petroleum for fuel, and in 1896 all locomotives were equipped to burn petroleum, which has been satisfactory ever since.

St. Gothard tunnel, St. Gothard Ry.—9⅓ miles long; construction completed 1882; grade practically level, being only sufficient to provide drainage. The ventilation was natural till about 1899, when Saccardo system was installed. At this time the traffic was 61 trains per day. The approaches to the St. Gothard has seven spiral tunnels of the following lengths:—5,000 ft., 3,670 ft., 3,605 ft., 5,100 ft., 5,019 ft., 4,000 ft., and 5,010 ft. with grades of 2.5%, with natural ventilation only; besides a straight tunnel of 5,150 ft.

Tangevard tunnel, on Bergen and Christiania Ry.—Length about 5 miles; no ventilation; grade, about 1.5%.

Khojak tunnel, India.—Double track, 3 miles long. Was originally divided into three sections by two shafts, but on account of these shafts it was found that there was a dead section between the two shafts. These were then closed up, and till 1900 it was not found necessary to ventilate same.

[The half-tone illustration on page 713 gives what is really a bird's eye view of the Kicking Horse Valley and the old and new C.P.R. lines. The old line is shown by the barred white line, and that which has taken its place by the single and longer line. EDITOR.]

Fig. 22.

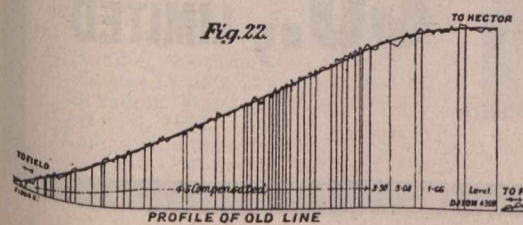


Fig. 23.