overcome in running along a straight and level track is found b. the formula:

$$R=3.5\times0.0055V^2\frac{16}{(V-1)^2}$$

This is shown as the bottom curve fig. 12.

If the train has to be hauled up a grade, the additional resistance due to the grade is found from formula R=20 × rate of grade. These two formulae give the resistance in pounds per ton.

The ruling grade on the profile fig. 1 is 0.75%. Assuming that it is desired to load our locomotive for this ruling grade at a minimum rate of 10 m.p.h. the resistance which will have to be overcome will be Rt for 10 m.p.h., plus Rg for a 0.75% grade, i.e. 4.2+15=19.2 lbs. per ton. 19.2 divided into 26,200 (the tractive effort for 10 m.p.h.) gives 1,360 gross tons as the weight of the train that can be hauled over this district.

This locomotive being loaded for a speed of 10 m.p.h. on a 0.75% grade, would be able to operate with this load on a level track, or a less rate of grade than the ruling one, at a greater rate of speed than 10 m.p.h. If it is operating on a level track, there being no grade resistance, the 15 lbs. per ton of this resistance is no longer in evidence, therefore, there is 15 lbs. per ton of this tractive effort left available for acceleration.

0.75% grade, but that above this speed the rate decreases. It will be sufficiently accurate for our purpose if we use increases of speed of 5 m.p.h. The speed of 15 m.p.h. is equivalent to a velocity head of 8 ft., and by again referring to the curve in fig. 12, we find that at a speed of 15 m.p.h. this train can operate up a 0.85% grade. Using this new value, we continue our line to a point where it is 8 ft. above the engineering profile, here we can change the rate to that given on the curve for 20 m.p.h. This new rate could be used until the lines of the profiles had diverged 14 ft., but that at the foot of the grade we find that we have only risen 9.5 ft. above the engineering profile and that beyond this point the two lines are converging. When they have approached each other to 8 ft. we again change our rate to that given for 15 m.p.h., the two lines continue to converge however and when the distance between them is 3.5 ft. our train is capable of operating up a 0.75% grade. This also being the rate of the engineering grade the two profiles will parallel each other to the top of the grade. Continuing in this manner we secure a continuous operating profile of the line, which takes into consideration the tractive effort of the locomotive, the effect of the ruling grade, and the effect of the average grades, thus producing what is to all intents and purposes an indicator card of the train operation. Such a velocity profile gives a simple means of locating signals, showing the spacing of signals on the engineering alignment in feet, measured in the time of running.

The Alaskan Railway Surveys.

The commission of engineers appointed by the United States President to survey and report on possible routes for Alaskan railways has returned to Washington and will in a short time submit its plans and estimates. Four coast points, Cordova, Valdez, Seward and Portage Bay, have been considered as possible termini. Cordova, on the east shore of Prince William Sound, has a population of about 1,100. It is the terminus of the Copper River & Northwestern Rd., which could be extended from Chitina, 132 miles distant from Cordova, up the Copper River Valley and through the Alaskan Range to the Tanana and Fairbanks, a total distance of about 445 miles.

Valdez, from which now runs the government wagon road to Fairbanks, is situated on the north shore of Prince William Sound and has a population of about 1,500. The total distance from Valdez to Fairbanks over this route is about 380 miles.

Seward, on Resurrection Bay, has a population of about 600. It is the terminus of the Alaska Northern Rd., which extends northerly across the Kenai Mountains for 72 miles to the eastern end of Turnagain Arm, and which could be extended around Turnagain and Knik Arms to the Susitna Valley and thence up to Broad Pass in the Alaskan Range and down the Nenana to the Tanana and Fairbanks, a total distance of about 460 miles.

Portage Bay is situated on the west coast of Prince William Sound, where no settlement now exists. It can be connected by a 15-mile line, in which there are about 3 miles of tunnel, with Turnagain Arm, and thence northerly through the Susitna and Nenana Valleys to the Tanana and Fairbanks, a total distance of about 410 miles.

In addition to the main trunk lines, branch lines to the Matanuska and Bering River coal fields are being considered. During the past summer the commission, with a large force of engineers, has been engaged on the survey and examination of these routes.

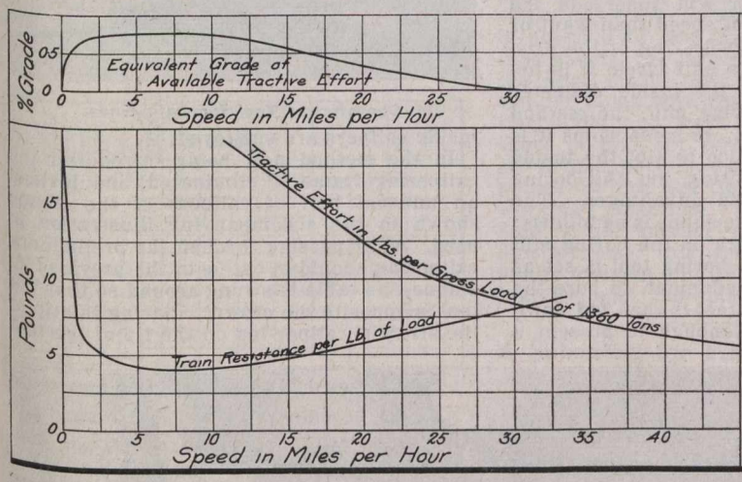

Fig. 12.—Equivalent Grade of Available Tractive Effort, Train Resistance and Tractive Effort Curves.

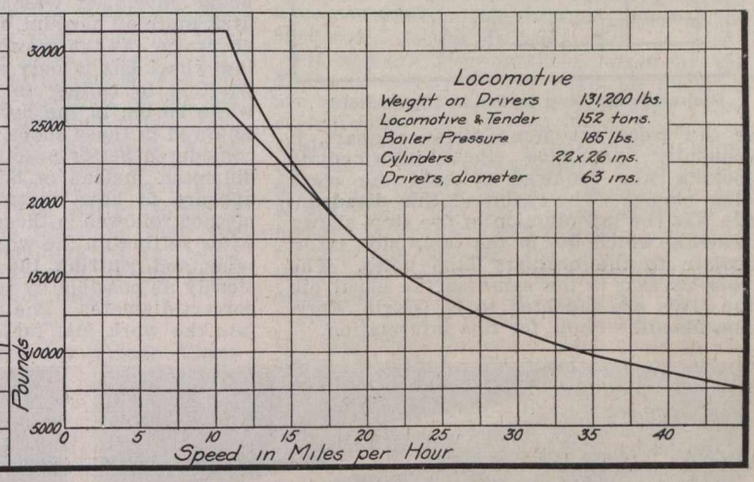

Fig. 13.—Tractive Effort Curve of Locomotive under Discussion.

In fig. 13, the tractive effort is shown in pounds per ton for the locomotive with the gross load of 1,360 tons. Below this curve is the train resistance curve; then the intercepts cut off between the tractive effort curve and the resistance curve, is the amount of tractive effort unused if the train is on a level track, or if we divide the value of these intercepts by 20 (the resistance of a 1% grade) we have the rate of grade up which this locomotive can haul 1,360 tons and the speed in miles per hour which it can make on these grades. The upper curve gives these rates of grade for the different speeds.

With this combination curve in fig. 12, we can proceed to construct a velocity profile on the engineering profile, producing the operating profile shown in fig. 1. The method of constructing this operating profile is as follows:—Assuming that we are starting our full tonnage train from St. Anne. The locomotive is capable of operating up a 0.75% grade, and this was the basis of loading; then if we draw a line, rising above the engineering profile, fig. 1, at the rate of 0.75% from the starting point, and continuing this line until it is 3 ft. 5 in. above the engineering profile. A velocity head of 3 ft. 5 in. is equivalent to a speed of 10 m.p.h. Referring to fig. 12, we find that at this speed the locomotive is capable of operating up a

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Steel Ties made of rolled channels, with wood blocks under the rails, are being tried on the Northern Pacific Ry. About 100 were laid in 1911, but some of them have been removed on account of difficulties in shimming track. During 1914 about 320 were put in, mainly at water stations where wooden ties were burned by cinders dropping from the locomotives. Ties of this general type, but under various names and with various modifications in the rail fastening, have been used experimentally at different times within the past 30 years.

Steam Railway Fatalities.—During December there were 15 fatal accidents to railway employes in the Dominion. Of these, 5 were due to collisions, 3 to being struck by trains or locomotives, 2 to being run over, 4 to electrocution and 1 to being shot.

Revised passenger and station regulations for the Intercolonial Ry. and the Prince Edward Island Ry. were approved by order in Council, Jan. 12.

Heavy rails have developed some new physical weaknesses, one of the most notable being failure through crescent shaped pieces breaking out of the rail flanges, followed by at least one, and in many cases several, ruptures across the whole section of the rail.

The C.P.R. and the G.T.R. shops are reported to be adding the necessary extra plant to enable them to turn out steel shell jackets for the British Government.