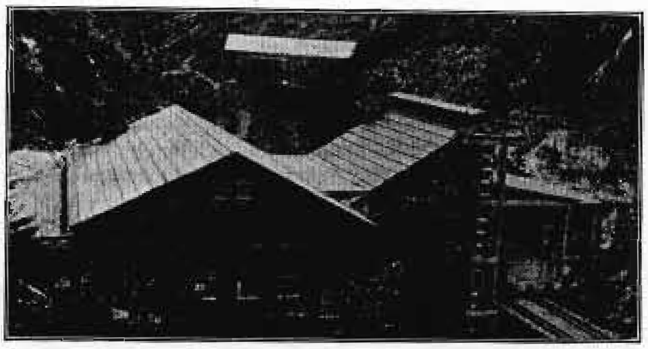
VENTILATING THE STAMPEDE TUNNEL OF THE NORTHERN PACIFIC

Late in March the Northern Pacific placed in operation a ventilating system at the Stampede tunnel, which required the solution of a number of unusual and interesting problems. This tunnel is located on the main line to the Pacific Coast, at the summit of the crossing of the Cascade Mountains, about 75 miles east of Seattle. The approach grade on the west is 2.2 per cent. for several miles, reducing to 0.7 per cent. at the west portal. On the east slope there is a 2.2 per cent. grade for five miles,



General View of the Ventilating Plant with the Power House in the Foreground and the Fan House in the Rear

changing to 0.2 per cent. at the east end. The summit of the grade is a short distance east of the center of the tunnel, which is 1.95 miles long.

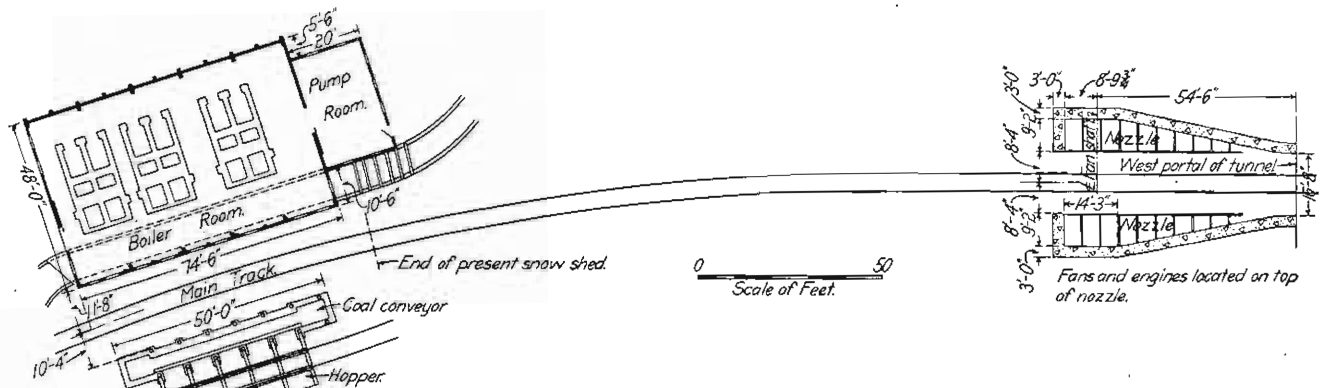
An average of 10 passenger and 10 freight trains pass through this tunnel daily. Most of the passenger and all of the freight trains require helper engines. The rating of freight trains is 2,850 tons westbound, and 2,400 tons eastbound. Such trains are hauled by large Mallet road engines, assisted by two smaller Mallet pusher engines, one of which cuts off at the portal of the tunnel and the other passes entirely through it. The helper engines in freight service drop back to the foot of the grade at each side after assisting trains over the summit, while the passenger helper engines go through from Easton, at the foot of the slope on the east, to Lester, at the bottom of the heavy grade on the west, and vice versa.

This frequent train and helper movement created smoke conditions which made relief necessary. The portal at each end is located in a ravine. This fact, combined with the presence of the summit of the grade midway in the tunnel, caused the smoke to remain in the tunnel for considerable periods of time, especially when the wind was in certain directions. Even more serious was the heat problem, the temperature frequently rising to 150 deg. The substitution of oil-burning locomotives on freight trains two years ago relieved the smoke conditions somewhat, but did not lower the maximum temperature appreciably.

To relieve traffic conditions on these heavy grades over this monntain a second track has been constructed between Lester and Easton during the last two years, the only break in this being through the tunnel, which is still single track.

In considering the design of a ventilating system at this point, the most serious problem presented was the length of the tunnel. Previous installations have been made in tunnels varying from one-half mile to one mile in length. The Stampede tunnel is almost two miles long. This at onee raised the question whether a sufficient nozzle velocity could be obtained to drive the air through the entire length of the tunnel with a train in it with a reasonable expenditure of power. After careful consideration it was decided that such a method required one of two alternatives, either operating the trains slowly to keep the smoke ahead of them by the expenditure of a reasonable amount of power, or if trains were run at their normal speed, the expenditure of a greatly increased amount of power. It was finally decided that the plant should be designed to clear the tunnel of smoke in approximately six minutes after a train had passed through. This insured that every train would enter a elear tunnel, and, also, if for any reason it was stalled in the tunnel the fans would have sufficient capacity to keep the smoke moving through the tunnel, supplying the crew with fresh air.

The presence of the summit of the grade, a short distance east of the center of the tunnel presented another problem. Theoretically, a set of fans would be reqnired at each end, so that the smoke could be driven ahead of a train running up grade in either direction. As it was finally decided to clear the tunnel of smoke after the train passed through, the usual procedure was not followed and only one plant was constructed. As the prevailing natural direction of the wind was eastward it was located at the west portal. It was designed to furnish 540,000 cu. ft. of free air per min. at a velocity of 1,700 ft. per min. in the tunnel. The required impact pressure at the nozzle discharge was figured at 4.2 in. water gage. The general type of the nozzle adopted is that devised a number of years ago by Charles S. Churchill and C. C. Wentworth, of the Norfolk & Western.

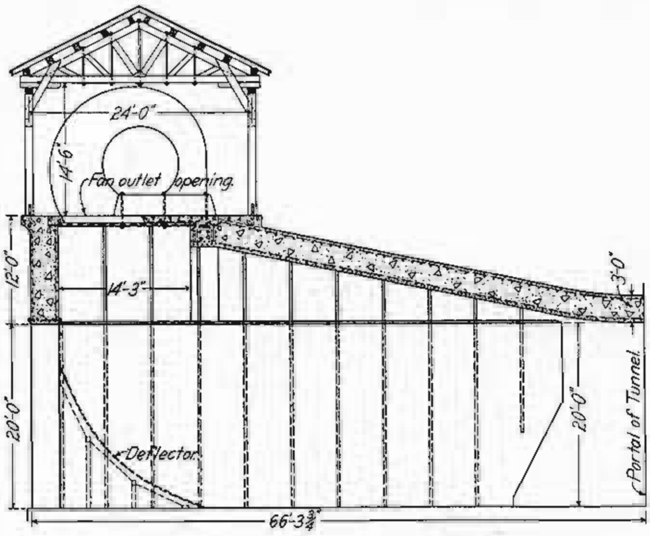


Plan of the Power and Fan Houses

As stated above, the west portal of the tunnel lies in a narrow ravine. For this reason, while the fan house is located directly over the portal it was necessary to locate the power house 250 ft. back along the traek. On the side of the main track opposite the power house, is a short side track leading to a trestle and coal hopper. Coal for the power house is received here and unloaded into pockets. From the pockets it is carried up and over the tracks by a link-belt bucket conveyor and deposited in storage bins directly over the main tracks with a capacity of 450 tons.

The power house is located across the main track from the coal hopper. It contains five Babcock & Wilcox 150-h.p. boilers equipped with Jones underfeed automatic stokers feeding directly from the storage bins. Auxiliary apparatus includes a No. 12 Sturtevant "Multivane" indueed draft fan, driven by a 7-in. by 7-in. vertical engine, a Hoppes feed water heater, and three 12-in. by 8-in. by 12-in. Dean pumps, one of which is for the feed water heater, one for the boiler feed, and one as an auxiliary so connected that it can replace either of the other two.

Steam is conducted from the boiler room to the fan house through a 10-in. steam line. The ventilating equipment consists

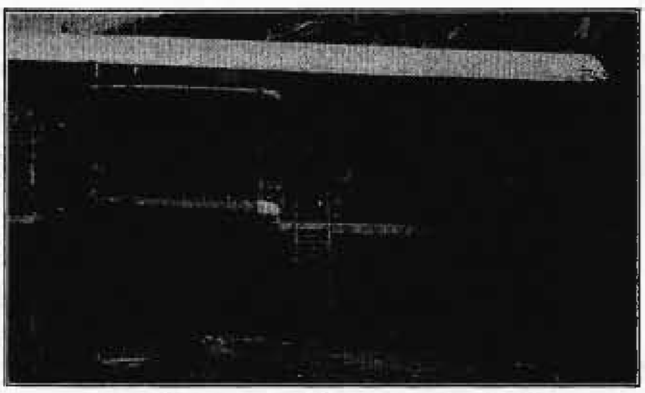


Section Through Fan House and Nozzle

of two No. 22 Sturtevant "Multivane" fans, each fan being driven by two 16-in. by 16-in. Sturtevant horizontal center crank engines, direct connected. The fans are 16 ft. long by 14 ft. high and 7 ft. wide, and operate at 220 revolutions per minute. The fans and engines are mounted on a concrete platform carried on a concrete arch over the tunnel.

The fans force the air vertically down onto a deflector, from which it passes into the nozzle. The nozzle is 50 ft. long and 19½ ft. high inside at the rear, reducing to an 8-in. opening at the top and 14-in. on the bottom at the outlet, which gives a total outlet area of 52 sq. ft.

The outer wall of the nozzle is of concrete 3 ft. thick, while



View of the Fan House Over the Tunnel Portal

the inner wall is of 5-in. tongue and grooved timber anchored to the concrete by ½-in. by 3-in. flat steel bars spaced 6 ft. horizontally and 4 ft. vertically. A damper is placed below each fan so that it can be shut off completely when out of service.

This plant was built by force account during the winter of 1913-14. Over 1,000 cu. yds. of concrete were required in the construction of the nozzle and the engine base. Because of the very limited amount of room available and the necessity of preventing all interference with main line trains, since a westbound train would have to stop in the tunnel and an eastbound train on the ruling grade, the concrete was mixed at the site of the coal dock. It was then hoisted by an Ensley system of spouts and dumped into small cars running on the top of the snow shed extending over the track between the boiler and fan houses. All of this concrete was pnt in in two weeks, as much as 130 yds. being placed in a single day. During this same time all concrete material had to be unloaded directly from the main line.

The fans were installed during last year. Recent tests showed that they are delivering 540,000 cu. ft. of air per min., with an impact pressure at the nozzle outlet of 4 in. Tests made with a freight train moving at a speed of seven miles per hour showed that the smoke was driven ahead of the train and the temperature did not exceed 100 degrees.

This installation was designed and built under the general direction of W. L. Darling, chief engineer, by S. J. Bratager, principal assistant engineer, in conjunction with F. Herlan, district manager, B. F. Sturtevant Company, Boston, which company furnished the equipment. T. Z. Krum was assistant engineed, and B. C. Rowell, resident engineer on the ground for the railroad company.

THE FARMER AND THE RAILROAD

By Philip Meinen

Farmer, Stites, Idaho

One reads much nowadays in almost every newspaper in the country about farmers urging legislation to lower freight and passenger rates. Before going any farther I wish to say that I am not a railroad man, but am a farmer and believe in justice between man and man or man and company, regardless of wealth on either side.

Now, to begin with, the first thing a farmer will say is that the railroads are making too much money, basing his argument on something he has read somewhere or that someone has told him who doesn't know any more about fair rates and profits than he does, but who is urging lower rates only to be a good fellow and get subscriptions for his paper.

To be frank, we need both the farmer and the railroad company. I say company because many would say let the government handle the railroads. I don't think the government shonld go into the railroad bnsiness and you don't either if you have ever given it any observation and thought.

Let's not overlook the consumer, as he is the prime factor to both the farmer and railroad. Without him the farmer couldn't sell his products or the railroad do any transporting, and his sympathy is not altogether with us farmers, as he accuses us of getting too much for our hogs, cattle and grain and is employed by railroad companies or other city industries for his livelihood.

I have heard farmers remark that the cost of living is too high for the poor people in cities and should be reduced by cutting freight rates and cutting out the middleman's profit. Well, there might be something in that, but we don't do it when we have a chance. For example, at present I am living in the state of Idaho. In the village where I live the farmers have a co-operative creamery running the third year now. They were going to fnrnish cheaper butter by cutting out freight rates and also middlemen's profits. Before this creamery was there they used to ship their cream to Spokane, Wash., a distance of 195 miles, and ship the butter back. Now they have saved dray charges at both ends of the line, saved middlemen's commissions at both ends and also saved railroad charges both ways, and the result is that we pay the same price as usual, and at times a little more, so there is not much sincerity to the cheaper butter question.

A short time ago I noticed in some paper where a spokesman for the farmer came before a hearing on freight rates, stating that the railroads were getting from six to nine per cent on their investment. He claimed that this was too much