

the portals open cuts were carried into the solid rock, and at one end, where the depth of the open cut became inconvenient, a tunnel was driven for a short distance temporarily timbered, and the ground above the roof of the tunnel sloped down through chutes in the roof directly into the car. Before the machine drills and air compressors arrived hand drills were used, and the average progress was 2 ft. per day in each heading, but since the advent of the drilling machinery, this has been increased to 10 ft. per day. A system of electric haulage has been installed to facilitate the rapid and economical removal of the muck. The plant at each end includes a 100 h.p. boiler, 60 k.w. 500 volt generator, and a 4-drill two-stage air compressor, 3 $\frac{1}{2}$ air drills, and an electric locomotive. Ventilation is provided for by a 12-inch galvanised iron pipe, through which the air is exhausted by means of an air jet under 100 lbs. pressure, acting as an injector. This is only put in operation for a few minutes after each blast to remove the smoke, the exhaust from the air drills furnishing all the fresh air necessary at other times.

A concrete dam 350 ft. long on the crest and 50 ft. high is now in course of construction across the outlet from Trout lake, and arrangements have been made for bringing out ten 54-inch pipe lines from the dam, but only three lines will be completed at present. Each steel pipe line will be 1,600 ft. in length, 48 ins. in diameter at the upper end, 44 ins. in the middle section, and 42 ins. at the power station. Close to the power station site on the shore of the North Arm a wharf has been erected, at which steamers and barges from Vancouver may discharge their freight on to the cars of an incline tramway built from the wharf to the tunnel portal at Trout lake. By this means all material for the camp at the tunnel portal and for the dam and pipe lines is delivered rapidly and with the least possible handling. To deliver material to the tunnel camp at the Coquitlam portal is quite a different undertaking, since it can only be reached by waggon road from a station on the C.P.R., 10 miles distant. For the greater part of this distance the road penetrates the dense forests, and in winter can be kept in a passable condition only by constant attention.

The power station will be constructed of granite masonry, and much of the material excavated to obtain a building flat will be used in the walls. The water-wheel equipment will consist of three sets of impulse wheels, each set capable of developing a maximum of 3,000 horse-power at 200 revolutions a minute, under the effective head of 390 ft., and one set consisting of 200 horse-power wheels for driving the exciters at 580 r.p.m. Each of the main units will consist of two overhung wheels, one mounted on each end of the shaft of a 1,500 k.w. engine type rotating field generator. The wheel centres are of the steel disc type, and fitted with cast steel buckets, secured to the wheel rims by turned steel bolts driven in reamed holes. The hubs of the wheel centres are bored out for a press fit on a shaft 12 inches in diameter, and will be pressed on in place at the lower station. Each wheel will be enclosed in a cast-iron housing, and provided with centrifugal discs and pockets, and suitable drain pipes for preventing leakage of water along the shaft.

Probably the most interesting feature of the equipment is the single combination, deflecting and needle regulating nozzle provided for each water wheel, and fitted with a high pressure ball joint, which is leather packed, and rocks on forged steel trunion bolts. The joint permits of effecting regulation by deflecting the nozzle by governor or hand, independent of the control of the needle, thus permitting of load and speed variations, independent of any change of velocity in the pipe lines. The deflecting portion of the nozzle is counterbalanced by hydraulic pressure, so that quick operation can be secured from the

governor on account of the absence of inertia of heavy counterbalanced weights. The taper pipe of the nozzle is provided with the necessary geared connections for hand control of the needle, and will have a tell-tale indicator showing the size of the stream for all positions of the needle.

The shaft of each unit is 13 in. in diameter in the journals, and will be carried in two ring oiling ball and socket bearings. The enclosing shells of the oil compartments are provided with cooling pipes, connected through the pedestal with the main wheel compartments and controlling valves, so that cooling water, after being discharged from the wheels may flow continuously through them to keep the oil cool. For each wheel is provided a 24-in. high pressure gate valve, with roller bearing thrusts. The gates are all furnished with the usual hand wheel, and in addition there is provided a worm gear device which can be connected at will to facilitate the working of the gate when nearly closed. The governing of the water wheel units will be effected by means of three type "E" Lombard governors. This type operates under water pressure, and the water used by them will be first passed through a filter tank located some 200 ft. above the power house.

The two 80 k.w. exciters, with their respective wheels will be mounted on a common bed-plate, with a 120 horse-power induction motor between the two exciters. Each exciter will be provided with a pair of jaw-clutch couplings and shifter rigging, so that either water wheel will drive its exciter and the induction motor at the same time. The motor leads are connected to the main bus bars, and the motor is normally run at synchronous speed, neither giving nor taking electric power. Should the exciter water wheel nozzle become clogged and the speed fall, the motor immediately takes power from the bus bars and drives the exciter until the nozzle is cleared by the attendant, or the other exciter unit started up. The deflecting nozzles of the exciters are arranged for hand regulation for the exterior of the wheel case through worm gearing.

The contract for the entire electrical equipment has been awarded, and includes the apparatus for the generating station and the sub-stations at Vancouver and Burnaby. The three 1,500 k.w. 60 cycle, 2,200 volt alternators for the power station are of the rotating field type, and are arranged for a movement of the external frame in a direction parallel to the shaft, to allow access to the windings. For the control of the apparatus at the power station the switchboard will contain nine panels, one for the induction motor and one for each exciter, three panels for control of the main units, and three for the control of the three sets of 550 kilowatt air-cooled transformers, with their motor blower sets, consisting of 20 horse-power motors and 110 in. Sturtevant fans. The step-up transformers, static interrupters, high potential switches, and lightning arresters will be installed in a separate building located on the hill above and just back of the power house. As the static interrupters contain oil they will be separated from the main room and each other by brick partitions. The machinery for the sub-stations includes the usual transformers, rotary converters, switchboards, etc., for the reception and distribution of transmitted power.

The route of the transmission lines to Vancouver is 16 miles in length, and involves the crossing of a navigable arm of Burrard inlet, with a span of 2,800 ft. On one side two steel towers 140 ft. in height will be erected to support twelve 9-16 inch galvanised plow steel cables with wire centres, but on the opposite side there is high ground, and the cables will be supported on poles. Two independent transmission lines, each consisting of two 3-wire circuits of no. 2 copper, will be

constructed on the same right of way, to a point near Barnett. From here one line will be continued to Vancouver and the other to Burnaby. A transmission line already exists between Burnaby and Vancouver, which will be reconstructed to carry 20,000 volts, the pressure to be used on the new lines, and a new line will be built from Burnaby to New Westminster, thus providing what is in effect a double transmission line over the entire distance between the power station and each of the sub-stations. W. Meredith, of San Francisco, is directing the entire work, assisted by Hermon and Burwell, civil engineers, of Vancouver. R. H. Sperling, Chief Engineer of the B.C. Electric Ry. Co., is supervising the work on behalf of that company, whose shareholders hold the controlling interest in the Vancouver Power Co.

TRANSPORTATION APPOINTMENTS.

Brockville, Westport, and Sault Ste. Marie Ry.—S. Rothwell has been appointed mechanical superintendent, succeeding H. Wilkinson, resigned.

Canadian Northern Ry.—A. Wilcox has been appointed Chief Train Dispatcher at Port Arthur, Ont., vice W. A. Stewart.

Canadian Pacific Ry.—F. W. Forster, hitherto traffic agent of the Elder-Dempster line of steamships, at Bristol, Eng., has been appointed Bristol Traffic Agent, C.P.R. Atlantic Steamship Lines, with office at Canada House, Baldwin st., Bristol. He will report to the European Traffic Manager at London.

L. G. Roblin has been appointed locomotive foreman at London, Ont., succeeding J. Wilkinson, resigned.

Cape Breton Ry.—G. E. Johnson, of New York, is reported to have been appointed General Manager.

Grand Trunk Ry.—H. A. White, heretofore mechanical accountant at Point St. Charles, has been appointed chief clerk to Superintendent Car Department, vice W. H. Rosevar, jr.

E. J. Hilliard has been appointed Traveling Freight Agent for the maritime provinces, with headquarters at Moncton, N.B.

J. W. Higgins, heretofore Assistant Superintendent Eastern Division, is appointed Assistant, 1st, 2nd and 3rd Districts, vice C. S. Cunningham, transferred. Office at Island Pond, Vt.

W. Holmes is appointed Trainmaster 1st and 2nd Districts. He will report to and receive instructions from the Assistant Superintendent. Office at Island Pond, Vt.

H. F. Coyle is appointed Trainmaster, 6th and 7th Districts, vice W. Holmes, transferred. He will report to and receive instructions from the Assistant Superintendent. Office at Belleville, Ont.

L. G. Coleman is appointed Trainmaster, 4th District, vice J. H. Dull, transferred. Office at Montreal.

U. E. Gillen, heretofore Trainmaster at Belleville, Ont., has been appointed Assistant Superintendent, in charge of transportation and station service 5th, 6th, and 7th districts. Office, Belleville, Ont. The position of Trainmaster at Belleville has been abolished.

J. Irwin has been appointed Trainmaster 8th, 9th, and 10th districts, in charge of transportation station and yard service. Office at Lindsay, Ont.

Charles Moore has been appointed chief clerk to G. C. Jones, Superintendent Middle Division, at Toronto, succeeding W. White, promoted.

Yardmaster Farrell, at the Toronto terminals, has been transferred to other duties, and has been succeeded by J. Tobin, heretofore assistant yardmaster.

C. S. Cunningham, heretofore Assistant Superintendent Eastern division, has been appointed Assistant Superintendent 16th dis-