CANADIAN PACIFIC RAILWAY

VANCOUVER TUNNEL

about 100-ft. intervals. In the duct carrying the signal, telephone and lighting cables there is a light outlet every 100 ft. Trackmen, when doing work in the tunnel, will have a floodlight, and will plug into the most convenient one of the outlets.

The traffic through the tunnel will be controlled by automatic absolute block signals placed 190 ft. from the portals. The tunnel is ventilated by two double width, double inlet, full housed, Silent-vane blowers, equipped with SKF roller bearings, operating at 360 r.p.m., housed on opposite sides of the tunnel at the front yard portal. The fans are driven by two 80 h.p. 2,200-volt, three-phase, 60-cycle horizontal revolving field synchronous motors with direct connected exciters. The blowers and motors are connected by a magnetic clutch. This equipment starts automatically by a train coming within the circuit about a minute before it enters the tunnel, and is adjusted to operate for six minutes, or long enough to clear the full speed they have a capacity sufficient to produce a velocity of air in the empty tunnel of 10 m.p.h. without abnormal wind or barometric conditions at either end.

The tunnel was built with practically no damage to adjacent property and with no really serious accident to any workman. The most serious was a broken leg, which happened outside the tunnel on the trestle off which the spoil was dumped. The spoil was all utilized in building a city street along the bank of False Creek, and filling up railway property adjacent to that street.

The contractors completed their work well within the time specified in the contract. The tunnel was opened on July 17, by authority of the Board of Railway Commissioners and was put in operation immediately.

The foregoing information was furnished by Thomas Martin, who was transferred from the position of Division Engineer, Portage Division, Manitoba District, at Winnipeg, to supervise

Vancouver Tunnel. Combined fan house and west portal, photographed on opening day.

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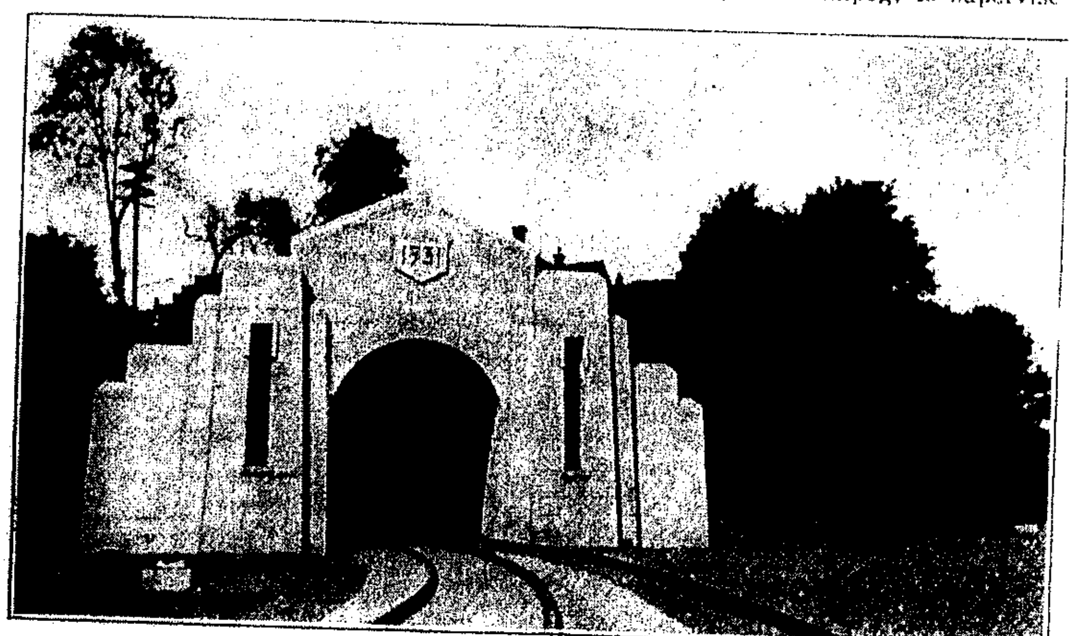
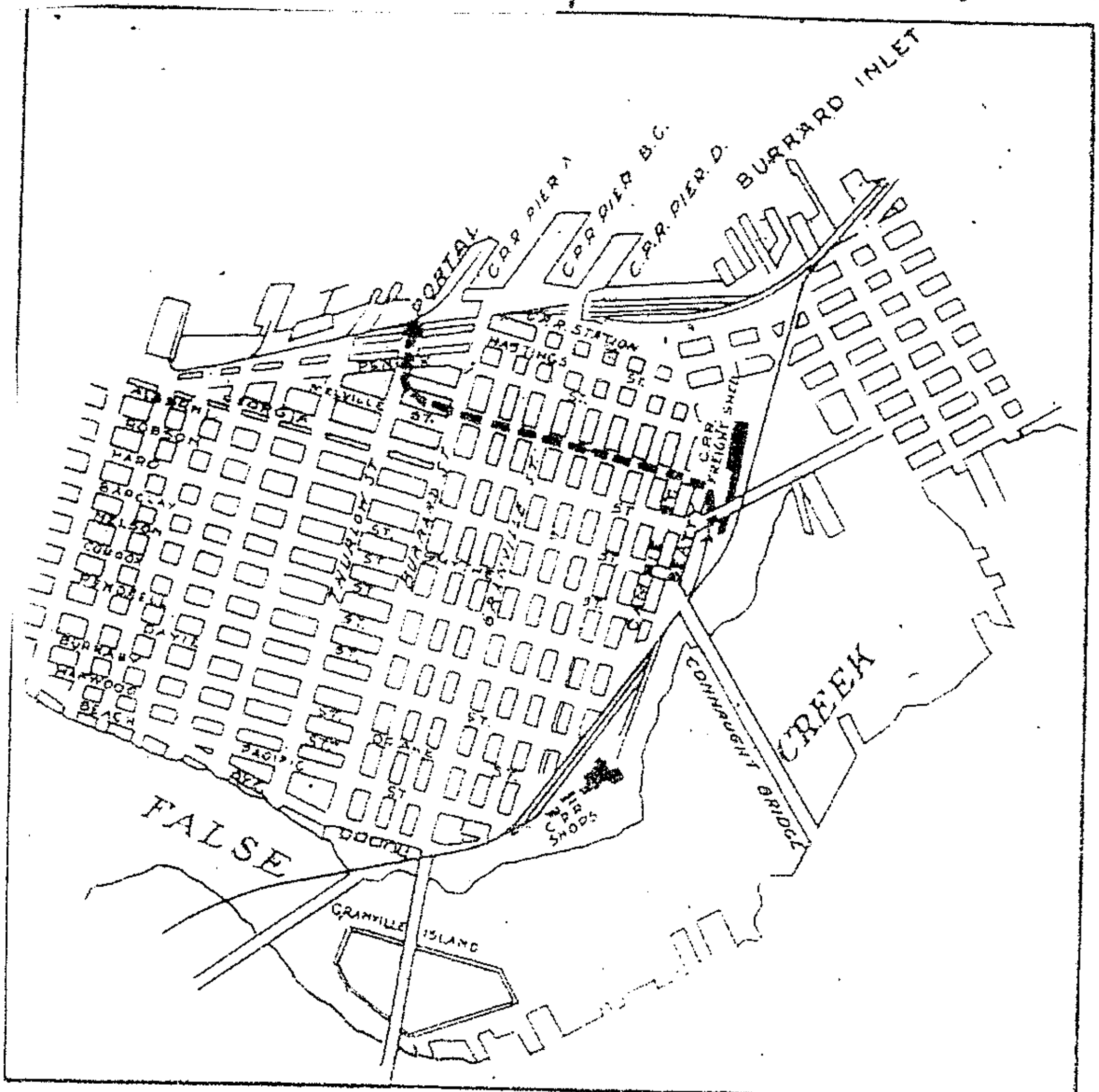


Vancouver Tunnel. Combined fan house and west portal, photographed on opening day.

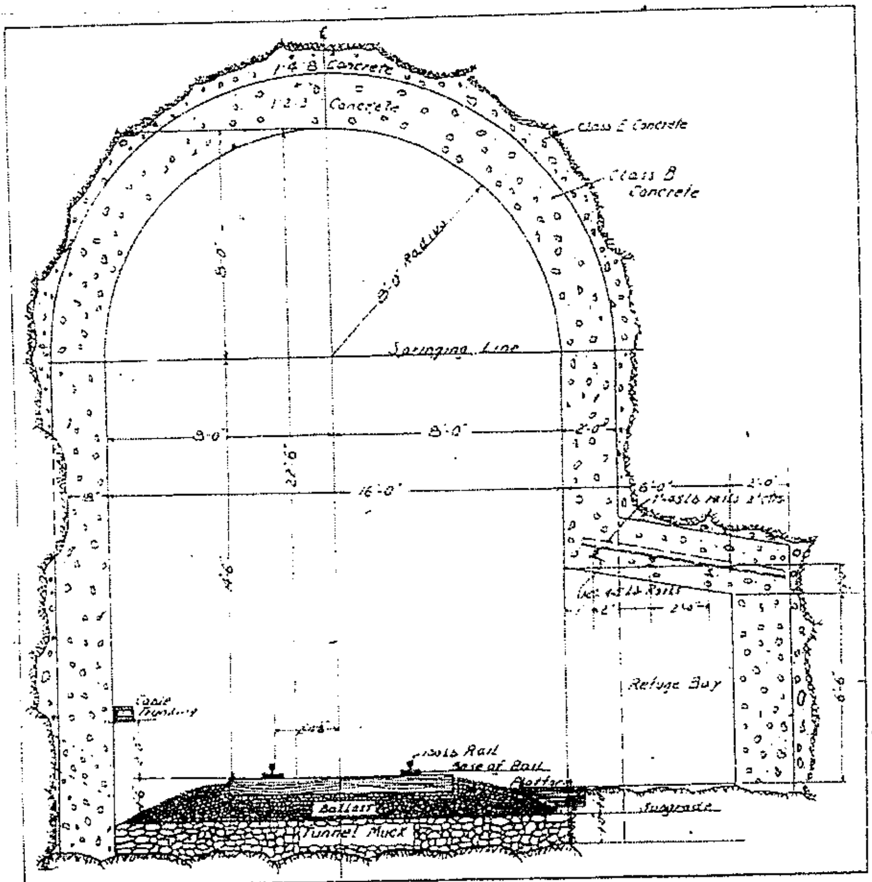
Vancouver Tunnel.—It was reported from Vancouver, Jan. 5, that Northern Construction Co. and J. W. Stewart, Ltd., to which the Canadian Pacific Ry. awarded a contract for boring a tunnel under Vancouver's downtown district to connect Burrard Inlet with the False



Route of Canadian Pacific Ry. Burrard Inlet-False Creek Yards Tunnel, Vancouver.

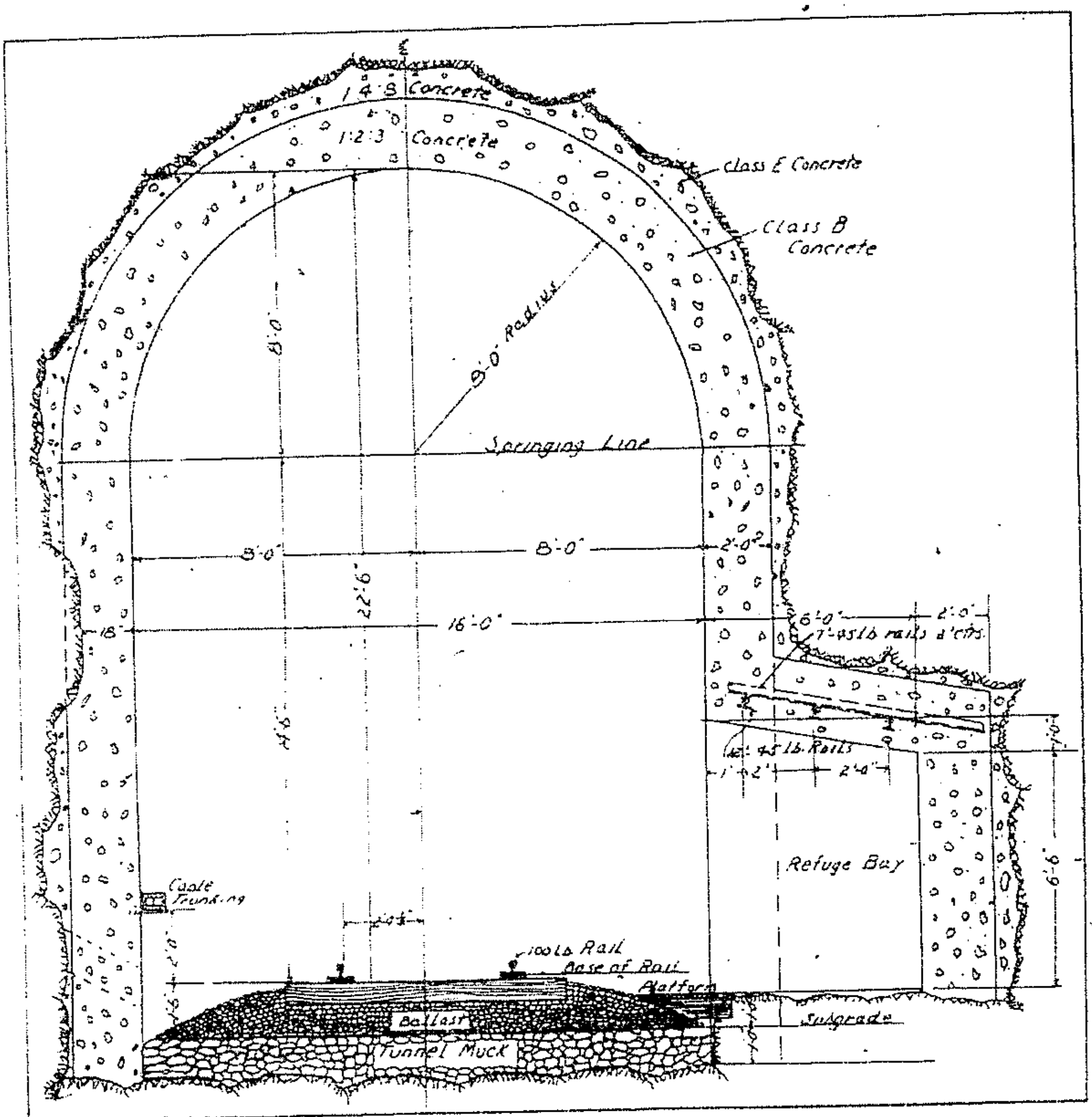
Creek yards, had made a start on preparations for the work and had begun construction of a temporary office building to be used in connection with the job, under the west end of the Georgia St. viaduct. Information about the tunnel, its purpose, estimated cost, length, dimensions, route, lining, etc., was given in Canadian Railway and Marine World for Dec., 1930, pg. 769. Its location is shown by the heavy broken line in the accompanying sketch map. An unconfirmed report states that excavation will total about 86,000 cu. yd.

Vancouver Tunnel.—The accompanying illustration shows a cross section of the tangent portions of the tunnel which the C.P.R. is building to connect Burrard Inlet waterfront with False Creek yards, in Vancouver, a description of which was given in Canadian Railway and Marine World for March, pg. 141, together with the results of test borings made to determine the nature of the strata through which the tunnel will pass. The refuge bay, shown for employes, will not be continuous, but there will be four of them at the northeast side of the bore, at locations to be



Section on tangent, Burrard Inlet-False Creek Tunnel, Vancouver, Canadian Pacific Railway.

April 1931



Section on tangent. Burrard Inlet-False Creek Tunnel, Vancouver, Canadian Pacific Railway.

designated by the company's engineer. The ties to be used in the track will be no. 1, creosoted. On light curves, the clear width ih the tunnel will be 17 ft. 6 in., and the arch radius will be 8 ft. 9½ in.; on sharp curves, the clear width will be 19 ft., and the arch radius 9 ft. 8 in. The cable trunking shown, to be installed by the railway, is for telegraph, telephone, signal and lighting cables and wires. Northern Construction Co. and J. W. Stewart, Ltd., is the general contractor for the construction.

Erection of transformer equipment at the portal of the tunnel in Vancouver where boring operations started this month, has been carried out by the B.C. Electric Ry. Co. light and power department. The contractors for the tunnel are using 250 h.p. of electrical energy for the large compressor which is used in general boring operations.

April 1931

Vancouver Tunnel. Cement gun in left foreground, with pipe in position for filling the form which had not then been bulkheaded, so that the space between the form and the timbering in which the concrete lining was placed can be seen clearly. The concrete lining is 2 ft. thick.

working point, where they were dumped into a hopper holding two cars. From the hopper the concrete was discharged on to an electric driven belt conveyor and discharged into a hopper over a Webb concrete gun of half a cubic yard capacity. The gun discharged the concrete through a 6 in. steel pipe, set at an angle of 45 degrees to the horizontal, anl along a horizontal pipe hung 12 in. below the center segment timber, to within 14 ft. of the inner end of the lining form. In that initial position the gun would continue discharging at the rate of about 45 cubic yards an hour, until the concrete commenced to choke the end of the discharge pipe. Usually about 200 cubic yards could be dis- by a locomotive pulling on a cable through sheave for a distance of 12 ft. That process was repeated until the end of the discharge pipe reached the bulk-head, and then the form was blown full. During the pouring of the concrete, two air hammers were continually at work, hammering the outside of the lagging as the concrete built up within. That pro-

Completed Vancouver tunnel, at a point under Dunsmuir St., on the day it was opened for service.

At 25-ft. intervals along the walls there are weep holes 4 in. wide, 12 in. high, set 12 in. above the level of the footing. From footing to footing across the tunnel there are reinforced concrete struts, 3 ft. by 2 ft. deep in the earth section, and 2 ft. by 1 ft. in the rock section.

The contents of a typical cubic yard of the concrete used was:—fine sand wet, 232 lb.; coarse sand wet, 1,160 lb.; pea gravel wet, 556 lb.; coarse gravel wet, 1,292 lb.; cement, 255 lb.; water, 108 lb.; total, 3,603 lb. per cubic yard. This gave a concrete with an average compressive strength of 1,650 lb. at seven days, and 2,750 lb. at 28 days.

Four refuge bays were built into the north wall, into which the trackmen can place their handcar while engaged in track work. There will be a telephone in each bay, connected with the yard office.

The earth section is drained to the False Creek portal by two perforated corrugated 12 in. steel pipes, laid 2 ft. from the footings and under the struts. The rock section is drained to the front yard portal by two 6 in. vitrified pipes placed similarly. Over these, to the level of the struts, and the whole area between the footings, coarse washed gravel and broken stone is spread ensuring free drainage. Above the level of the struts there is a standard ballast section of broken stone. The track is 100 lb. rail, laid on creosoted ties fully tie-plated.

For all the excavation, concreting and track work the tunnel was electric lighted. For the excavation there were two 1000-watt flood lights bracketed on the wall plates about 50 ft. from the bench. For all the other work 75-watt lights were strung along the tunnel at

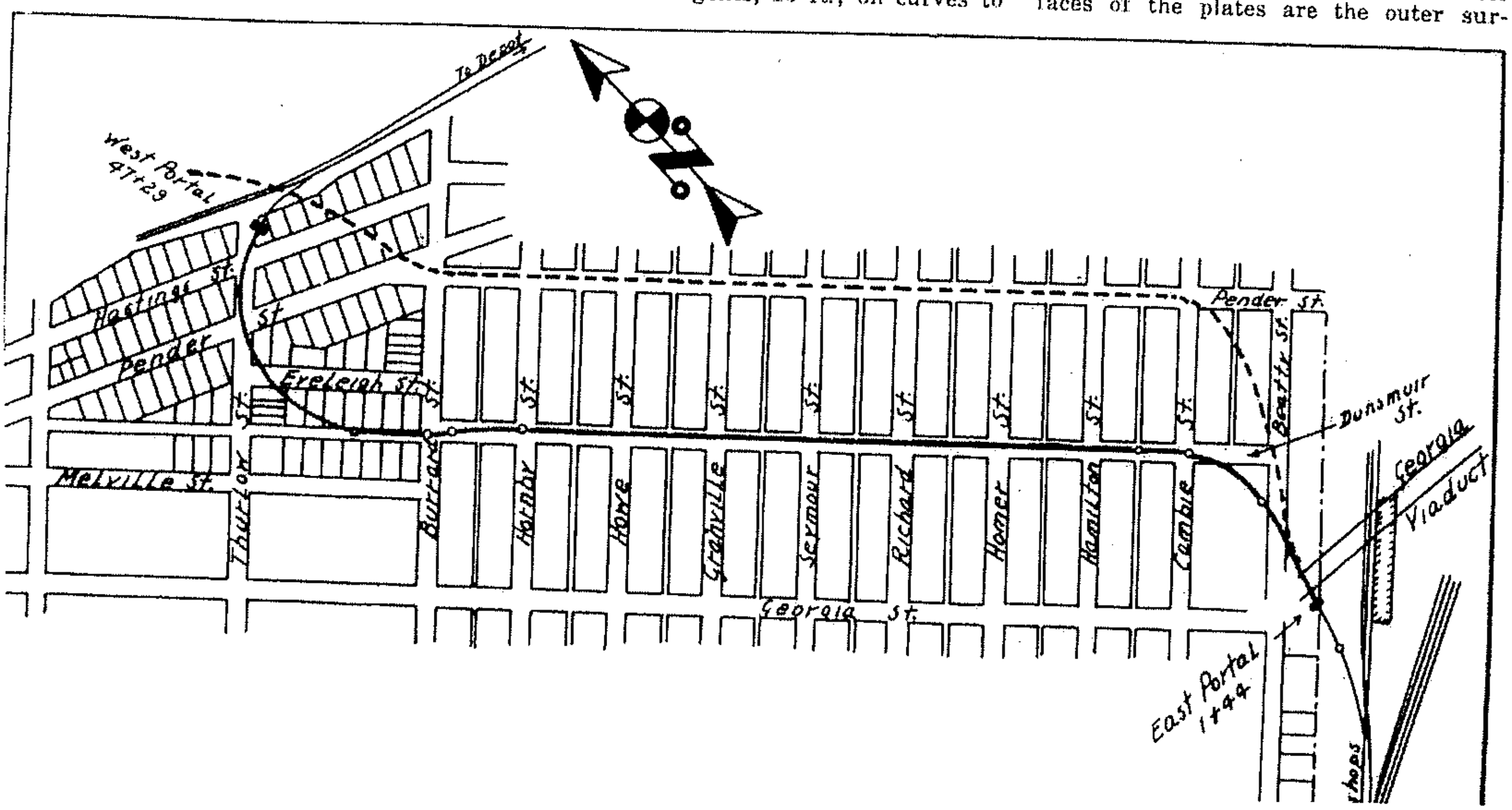
Vancouver Tunnel, Canadian Pacific Railway.

The tunnel completed recently at Vancouver, by Canadian Pacific Ry., was built as a diversion of the English Bay Branch, which connects the front yard along Burrard Inlet with the False Creek yard, the latter containing the freight sheds, shops, locomotive house, stores, and other terminal facilities. The motive for the diversion was the elimination of crossing at grade over seven busy streets, Alexander, Columbia, Powell, Cordova, Carrall, Hastings and Pender.

The first survey for a feasible route, with an estimate of cost of same, was made by the Canadian Pacific in Aug., 1911. The proposed route was for a double track tunnel, starting from the front yard, near the end of Thurlow St., the C.P.R. had 10 diamond drill borings made at intervals along the route, cores being taken out, and seven of the holes cased well down into the tunnel section. The other three holes, being merely to determine the rock surface, were not cased. The cased holes were located accurately with reference to the street lines and, as the work progressed, were used as a check on the alignment within the tunnel by lowering a plumbline to the floor.

On Oct. 23, 1930, contractors were invited to submit tenders for the construction of a single track tunnel, 4,600 ft. long, to be concrete lined throughout. The widths between walls specified were:—on tangents, 16 ft.; on curves to cavation for the portal was complete Jan. 26.

The forming for the portal, a sectio 25 ft. long, was all done in the ope and concrete was poured on Feb. 4 Tunnelling was started Feb. 10. Tw wall plate drifts, 5 x 6 ft., were starte with their floors at the spring line. Th earth was broken loose, with air spade or chisels, wheeled to the entrance o the drifts and dumped over the face When the drifts were excavated to a length of 20 ft. a wall plate 12 in. x 12 in. x 20 ft. was placed. The engineers gave line and grade at the inner end of each wall plate. The wall plates were wedged securely in position. The inner faces of the plates are the outer sur-



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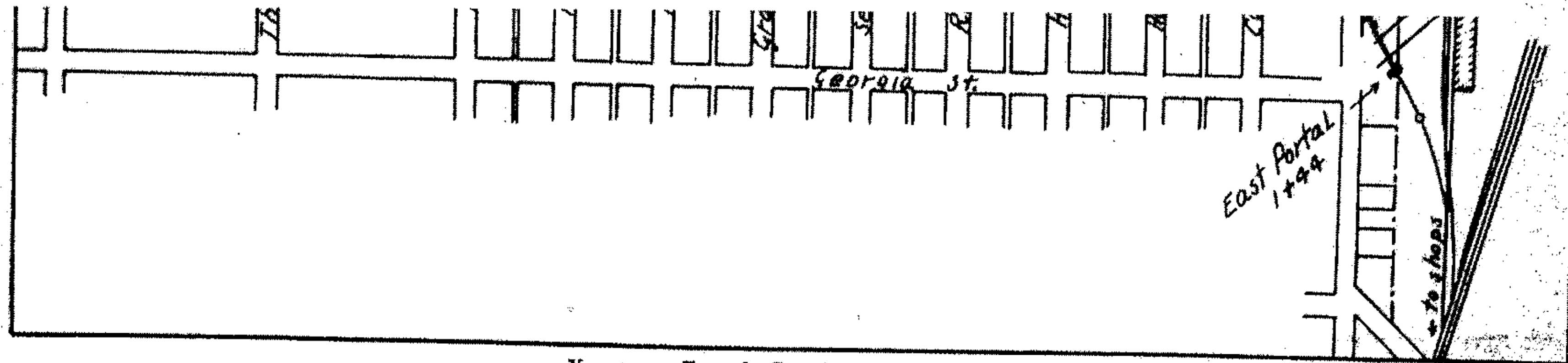
through channels. The studding moved in or out in slots in sill timbers. When extended they were held in position by hardwood wedges driven into the slots. The arch section of the form was 4 x 6 in. lagging on steel ribs; the structure was carried on jacks and could be raised or lowered 6 in. When in position it was also supported on hardwood wedges driven between it and the wall section. The whole form was moved forward on a system of wheels running on rails supported on 12 x 12 in. timbers outset 4 ft. on each side of center line.

The concreting was started when the tunnel excavation had advanced about 300 ft. It was carried forward as the excavation advanced, and at about the above mentioned distance behind the excavation. The concreting was all done on the shift starting at midnight. At that time all the muck from the 16 o'clock shooting was cleaned out, so the locomotives and cars were available for concreting. All the concrete was taken to the tunnel, ready mixed, in 2½ cubic yard dump trucks. It was dumped into a hopper, holding two truck loads, over the portal. From the hopper it was trapped through a chute in the top of the tunnel lining into the truck cars within the tunnel. A storage battery electric locomotive hauled the cars to the working point, where they were dumped into a hopper holding two cars. From the hopper the concrete was discharged on to an electric driven belt conveyor and discharged into a hopper over a Webb concrete gun of half a cubic yard capacity. The gun discharged the concrete through a 6 in. steel pipe, set at an angle of 45 degrees to the horizontal, and along a horizontal pipe hung 12 in. below the ...

charged before that occurred. At that stage the hopper, gun and trestle carrying the discharge pipe, which were built as a unit, on wheels running on a track similar to the form, were moved forward by a locomotive pulling on a cable ...

duced a smooth surface without any pebbles showing. Twenty-four hours were allowed from the completion of a section until starting to loosen up the form preparatory to moving it forward.

Vancouver Tunnel. Cement gun in left foreground, with pipe in position for filling the form which had not then been bulkheaded, so that the space between the form and the timbering in which the concrete lining was placed can be seen clearly. The concrete lining is 2 ft. thick.



Vancouver Tunnel, Canadian Pacific Railway.

Broken line, practically along Pender St., shows location of tunnel as projected originally; solid line, practically along Dunsmuir St., shows location as built.

passing along under the center of Pender St. and emerging in False Creek yard at the west end of the Georgia St. viaduct. The discussion of these plans between the C.P.R. and the City of Vancouver developed a number of difficulties which made it apparent that a further investigation would be necessary. It was finally agreed between the C.P.R. and the city to have an engineer, not connected with either, make a thorough investigation into grade crossing elimination. His recommendation was for a single track tunnel starting from the front yard at the end of Thurlow St., passing along under the center line of Dunsmuir St. and emerging in False Creek yard at the west end of Georgia St. viaduct. This recommendation proved satisfactory to the C.P.R. and the city and was approved by the Board of Railway Commissioners, the order issued by which authorized the C.P.R. to complete the work in 18 months.

In order to determine the nature of the material that would be encountered, 4°30′—17½ ft., on sharper curves, 19 ft., with the standard height of 22½ ft., the concrete lining to be 2 ft. thick in walls and arch, plain through rock sections, and reinforced with 45 lb. rails at 2 ft. centers through earth sections. Ten contractors submitted tenders, the Northern Construction Co. and J. W. Stewart, Limited, of Vancouver, being awarded the contract, and allowed 18 months to complete the work. They chose to drive the entire tunnel from the False Creek yard end, and started erecting their buildings there on Jan. 5, 1931, the buildings consisting of a compressor room and machine shop, a tool shed, a dry shed, a blacksmith shop, contractors' office and C.P.R. Engineer's office. Excavation was started on Jan. 12, with a caterpillar mounted Diesel operated shovel. The face of the hillside was squared up, and an open cut made sufficient for the portal, 25 ft. in length, to be built. The material was all earth and compacted clay, which was dug without the use of explosives. The exface of the concrete lining. As soon as a plate on each side was set, the excavation of the remainder of the heading above the spring line was started. As the excavation advanced a seven segment arch of 8 x 8 in. timber, set close, was erected. All the spaces between the outer surface of the timber segments and the unexcavated surface were driven full of blocks or wedges of wood. When the drifts and heading had advanced 160 ft., the excavation of the bench, i.e., all the tunnel section below the spring line, was commenced. As the bench excavation advanced, 10 x 12 in. posts were set under the wall plates at 4½ ft. centers and supported on mud sills at grade firmly wedged. The spoil was loaded by an electric mine mucking machine into two cubic yard all steel dump cars, hauled to the portal by storage battery locomotives and dumped over the side of a high trestle. The first 585 ft. of the tunnel was all earth, driven without the use of any explosives, and in the general manner described

GTP
PRINCE
RUPERT
TERMINAL

Fuel Oil Installations on the Grand Trunk Pacific Railway.

The G.T.P. Ry. is planning to operate its newly opened line from Prince Rupert, B.C., as far east as Jasper, Alta., about 720 miles, with fuel oil, as soon as the necessary storage facilities are completed. The oil will be taken by vessel from Southern California to Prince Rupert, where large oil storage is being arranged by the oil company, as shown in the accompanying railway plan of Prince Rupert, fig. 1.

Adjoining the drydock property, there has been built an oil wharf, 80 x 150 ft., in line with section A of the drydock. On the other side of the oil wharf there are three tying piles at 75 ft. centres. Joining the wharf to the land, there is a 30 ft. wide pier, along one side of which, a timber ramp carries the five pipes shown in the lower right hand corner of fig. 2, to a bridge that crosses the tracks with a clearance of 22½ ft. above the rails. A cross section of this bridge is shown in the above view of the five pipes. It consists of six 74 ft., and three 83 ft. wooden through spans, 10 ft. deep between chords, and 5 ft. centre to centre of trusses. Between the trusses, there are carried three 8 in. pipes, with a 12 in. pipe on either side. Over top of the piping, there is a 3 in. flooring. Oil is taken over the bridge in these pipes to the several tanks located on the other side of the tracks.

For loading the tank cars for shipping the oil to the several divisional points, there is a delivery bridge, branching off from the pipe line bridge, with a capacity for 6 cars. This is shown in elevation in fig. 2. It consists of a timber bridge of 10 spans, 19½ ft. centres. From the left hand pipe, shown in the section of the oil bridge in the lower right hand corner of fig. 2, a 12 in. pipe leads off along the delivery bridge as shown, with 6 in. swing oil spouts at every 39 ft., each with a control valve, etc., as shown. Alongside the oil main, there is a 1½ in. steam pipe, with a ½ in. connection along each delivery pipe, with a valve at the end. The oil tank cars belonging to the railway company will be spotted under the delivery pipes, and when filled will be forwarded to supply fuel oil stations at Pacific, Smithers, Endako, Prince George, McBride and Jasper.

While oil has been used for locomotive fuel on other western roads for a number of years, it has not been under as extreme climatic conditions, the nearest approach being on the C.P.R., from 300 to 500 miles further south. The installations on the latter line were fully described in Canadian Railway and Marine World, Aug., 1912. Along the G.T.P.R., the temperature remains around zero for weeks at a time, frequently dropping as low as 40 degs. below. California crude oil has the consistency of molasses, and cannot run or be pumped unless it is at a temperature of 60 degs. Fahr. This oil, to be delivered from the service tank to the locomotive, must be heated to at least 100 degs. Fahr., and not more than 110 degs. Fahr., as a higher temperature would cause the evaporation of the volatile constituents, thus reducing the efficiency of the oil as a fuel. From the foregoing, it is evident that the proper heating of the oil is a question of great economic importance.

Fig. 3 shows the fuel oil station design that has been developed to meet these conditions. Each fuel station is located at 400 ft. from the centre of the locomotive house, near the boiler room, from which the necessary supply of steam for heating is obtained. The station consists of two buildings on either side of an unloading tank. Both these buildings are of frame construction, sheathed with corrugated galvanized iron, with an intervening layer of hair insulator. The smaller building is 20 ft. square and 35 ft. high, containing in the basement a receiving tank with a capacity for 8,400 imp. gals. (240 bbls.) On the ground floor level, there is a pair of 10 x 6 x 12 in. duplex pumps, with piping, etc., while elevated above on steel columns, there is a service tank, with a capacity for 21,000 imp. gals. (600 bbls.). The other building is of similar construction, but dodecagonal in form, 56 ft. across and 27 ft. high, containing a 52 ft. diam. storage tank, with a capacity for 350,000 gals. (10,000 bbls.). Both buildings rest on concrete foundations.

The unloading track as mentioned is between the two buildings, and contains three unloading cast iron catch basins, at 39 ft. centres, over which from one to three cars may be spotted. The oil is carried from these catch basins through 8 in. pipes into the receiving tanks. A 1½ in. steam pipe passing through this oil pipe, heats the oil. This steam pipe comes out through a trap on the opposite side of the track, and is used for heating the oil in the cars, by means of a hose connecting the ends of the pipes to the heating systems in the cars. The receiving tank, which replaces the concrete sump generally used, will overcome the difficulty of heating and maintaining a concrete structure, which is almost impossible to maintain water or oil tight, especially when the ground is soft as it is at McBride and Smithers.

The oil in the receiving tank is heated if necessary, by a set of steam coils placed in the centre, the temperature being maintained at a constant heat of 60 degs. Fahr. by an automatic temperature regulating device. From the receiving tank, the oil may be pumped either directly to the service tank, or to the storage tank, in either case through a 6 in. pipe, which ends in an articulated galvanized iron spout, to the extremity of which is attached a float, which keeps the outlet end from 2 to 3 ft. below the surface all the time. To the float is attached an indicator cable, which connects with an indicator in the main floor of the receiving tank building, on the walls of which are indicators for the three tanks. Each pump is capable of filling the service tank in 2 hours. Both pumps may be operated together, or either pump may shut down, allowing the other to work,

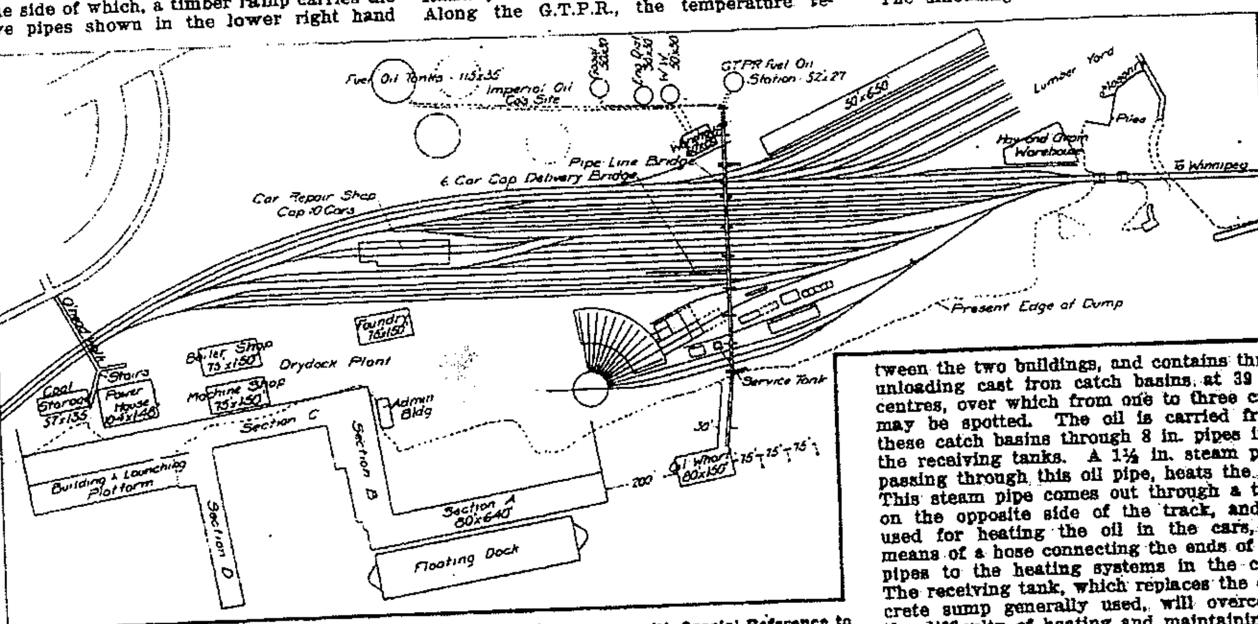


Fig. 1. Grand Trunk Pacific Railway Terminals at Prince Rupert, B. C., with Special Reference to the Oil Handling Facilities.