DETROIT RIVER TUNNEL

C. RIFF

Devoted to Steam and Electric Railway, Marine, Grain Elevator, Express, Telegraph, Telephone and Contractors' interests

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DETROIT RIVER TUNNEL.

The plans for the tunnel under the Detroit River, between Detroit, Mich., and Windsor, Ont., to be constructed by the Michigan Central Rd., which operates the Canada Southern Ry., have been completed.

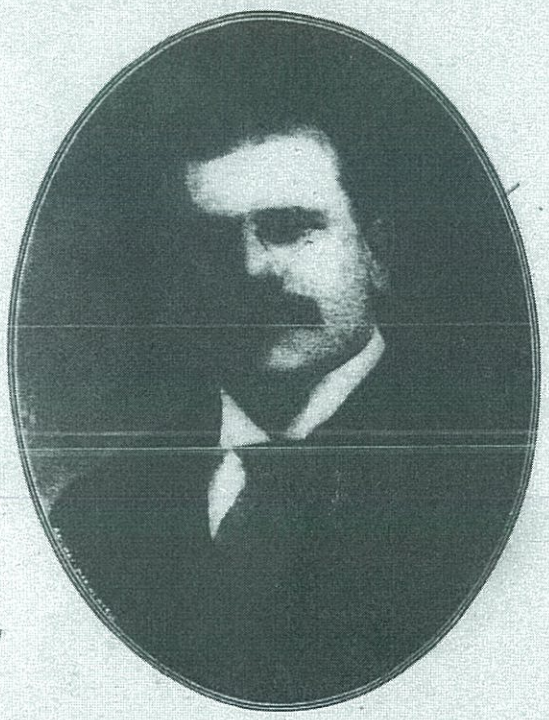
The length of this tunnel, including approuches, will approximate 12,800 ft., or 2.42 miles. The subaqueous portion of the tunnel will be 2,625 ft. long. The other portions are to be as follows:—Easterly open cut, 3,400 ft.; easterly approach tunnel, 3,100 ft.; westerly open cut, 1,540 ft.; westerly approach tunnel, 2,135 ft. The bids for this work were based upon sectional letting, the two open and two tunnel approaches mentioned in the foregoing constituting sections 1, 2, 3 and 4, in the order above named; the subaqueous tunnel constituting section 5, the Windsor shaft section 6, and the Detroit shaft section 7.

The location of the river portion of the tunnel is such as to be substantially tangenital to the curve upon which trains enter the station on the Detroit side and to the curve by which trains now turn toward the ferry slip, on the Canadian side. Such curvature as is necessary is located in the approach tunnels on each side; as shown in the general location plan. The summit on the Canadian side is at the western extremity of the new Windsor yards, as on the Detroit side the approach ends in the Detroit yards. On the Windsor side it is proposed to erect a passenger station a short distance east of the summit, and the plans show a suggested connection with the C.P.R. at this point. A connection with the Wabash-G.T.R. line is suggested at Walkerville Jct., from which point also freight cars of the Pere Marquette are taken to Detroit by the C.P.R. The location appears to be the best possible, taking into consideration the various interests that will or may be served.

The feature of engineering difficulty is, of course, the submerged section of the tunnel. For the construction of this main section five plans are presented, to the bidders. For the purpose of reducing hazard, cost, time of construction, length of tunnel and lift of traffic tonnage, and also to widen the field of bidders, the tunnel company offers three designs which dispense with the necessity of using shields for the construction of the subaqueous portion. Design "A" was evolved by W. J. Wilgus, Vice-President of the New York Central, and at the head of the advisory board of engineers, of which H. A. Carson and W. S. Kinnear are the other members. It may be briefly described as a method by which the previous material underlying the river may be replaced by a watertight material of concrete, placed under water, and through which, without the use of shields, the inner tubes or tunnel proper may be constructed, so as to secure watertightness and continuity of strength, with an absence of high air pressures. This method also dispenses with the use of cofferdams. The progressive stages of this design are:

(a) The dredging of a trench.

(b) The depositing in the bottom of this trench so as to form a barrier between the underlying clay and sand and the superimposed concrete, of "two men" stone to the depth of 18 inches; that is, durable, sound stone, ranging in size from quarry spawls to a maximum size that can be handled by two men.



THE HON. L. P. BRODEUR, M.P.
Minister of Marine and Fisheries

(c) The construction of temporary platforms in accordance with the permits of the United States and Canadian governments, upon which the contractor's machinery, including mixers, etc., may be placed, these platforms to move progressively across the river as the dredging and other work permit.

(d) Depositing of concrete by the Tremie bucket or other process approved by the engineer for a depth of approximately 2 ft.

(e) The placing of saddles, with the aid of blocking and wedges, upon this bed of concrete, upon which forms can be laid. As an alternative method it is suggested that piling can be driven after the trench is excavated, and the piling cut off at a proper height to receive the saddles, so as to dispense with the use of blocking and wedges.

(f) The construction, on shore, of forms consisting of timber and steel in convenient lengths of 50 to 500 ft., to be coupled together in pairs or otherwise, to be floated into position and gradually sunk until they rest on the saddles.

(g) Placing concrete under, around, between and on top of the forms by the bag, Tremie or bucket process, so as entirely to encase the forms. It is optional with the contractor to join adjacent forms under water in such a manner as to secure watertight connections, or to leave an open space between them, to be filled with concrete, to act as a bulkhead, separating the adjacent forms, and to be cut out after the water has been expelled.

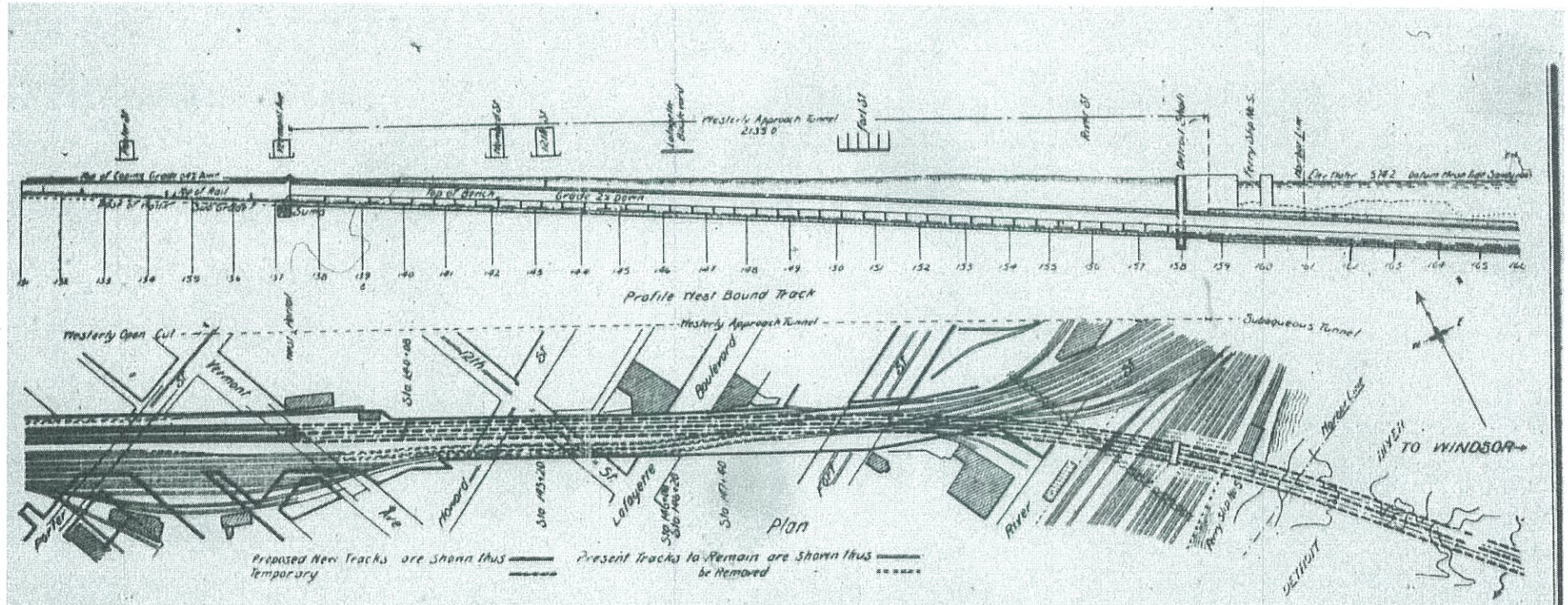
(h) The pumping of the water from the first section after the concrete has had an opportunity thoroughly to set. If the leakage is found to be excessive, the procedure is to use air of sufficient pressure to enable the waterproofing to be perfected and the inner tube or tunnel to be properly constructed.

(i) Should the contractor elect to adopt rolled steel for the forms, they would be constructed with watertight joints in such a manner, that left in the work, they will act as waterproofing to prevent the percolation of water against the exterior of the inner tubes of the tunnel proper. Should the contractor elect to use wooden forms, waterproofing may be placed on the exterior of the forms before they are sunk into position, so that when the forms are removed the waterproofing will remain in place. This method would require the use of air pressure to prevent hydrostatic pressure from distorting the waterproofing.

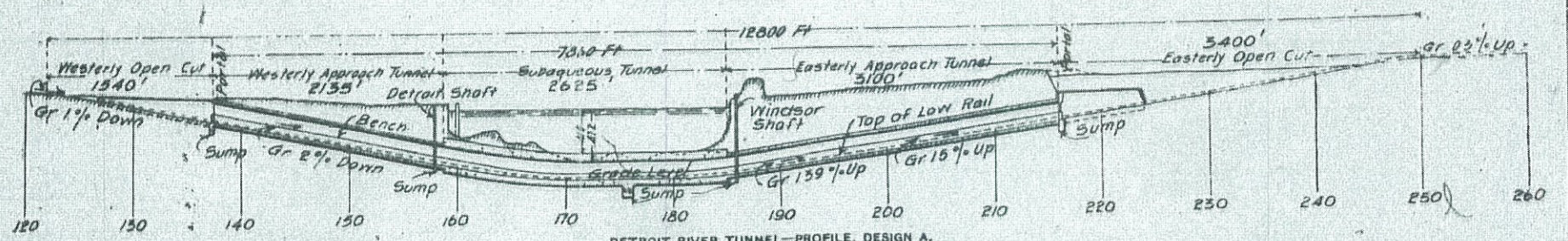
(j) The construction of the inner tubes of the tunnel proper, after measures have been taken to make all sections thoroughly watertight.

DESIGN "B."

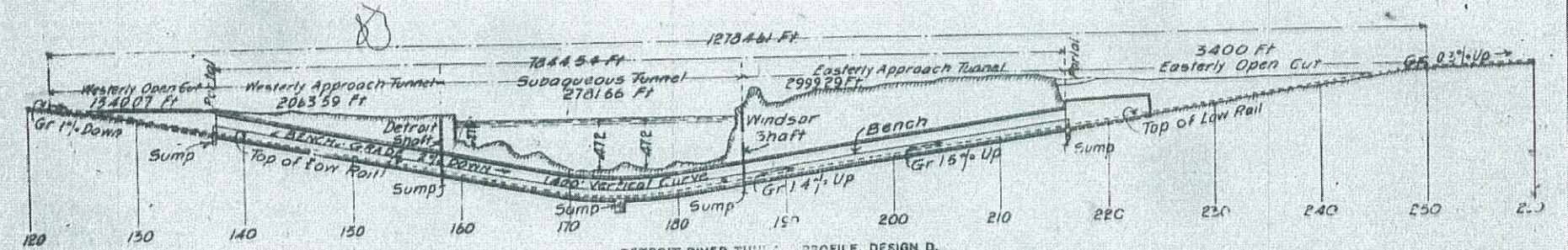
The second design offered by the company, which does not require the use of shields, was proposed by H. A. Carson, of the advisory board of engineers. It is a method by which the inner tubes of the tunnel proper are first built in floats or on dry land, floated and sunk into position on a founciation like that described for the first plan, and joined together by a suitable method, giving continuity of construction and watertightness. In following



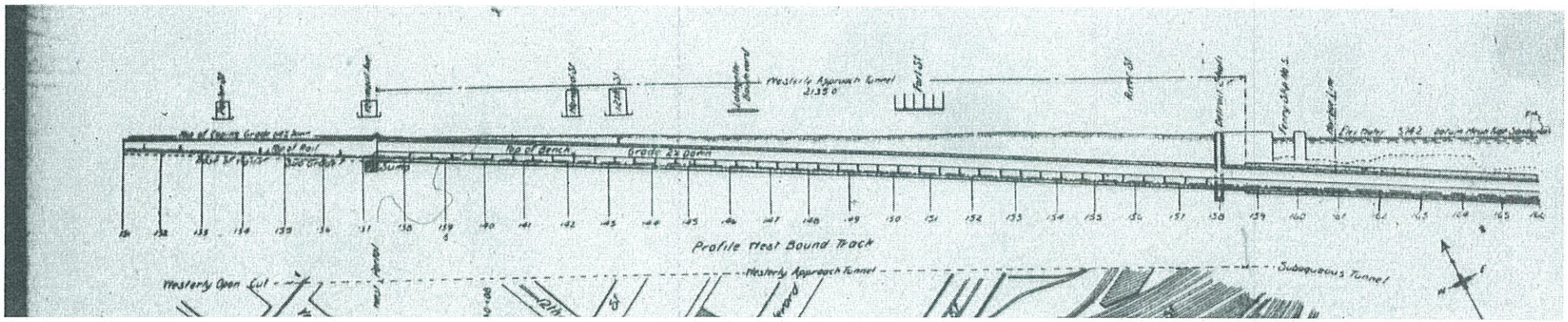
DETROIT RIVER TUNNEL—PROFILE AND PLAN OF WESTERLY APPROACH

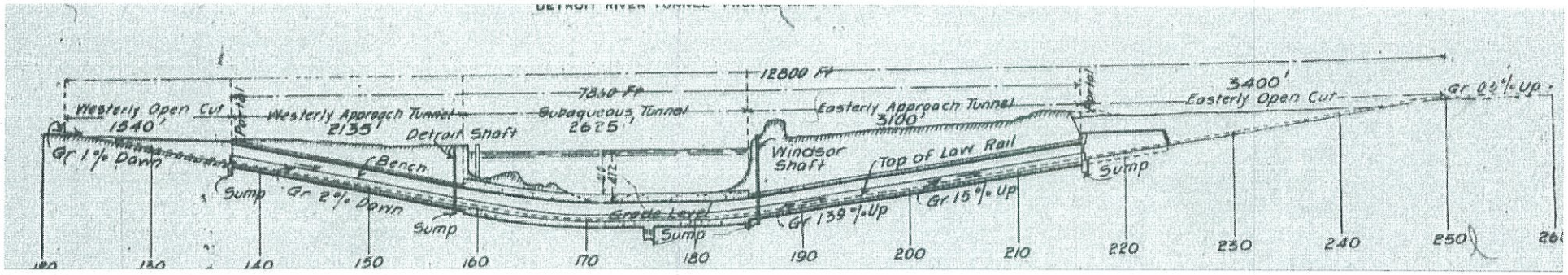


DETROIT RIVER TUNNEL—PROFILE, DESIGN A.



DETROIT RIVER TU[illegible] PROFILE, DESIGN D.


Westerly Approach Tunnel
2135'0
Top of Bench
Grade 2% down
Profile West Bound Track
Westerly Open Cut
Westerly Approach Tunnel
Subaqueous Tunnel


12800 Ft
7860 Ft
Westerly Open Cut
1540'
Westerly Approach Tunnel
2135'
Detroit Shaft
Subaqueous Tunnel
2625'
Easterly Approach Tunnel
3100'
Windsor Shaft
Easterly Open Cut
3400'
Gr 0.3% Up
Gr 1% Down
Bench
Top of Low Rail
Sump
Gr 2% Down
Sump
Grade Level
Sump
Gr 1.39% Up
Gr 1.5% Up
Sump
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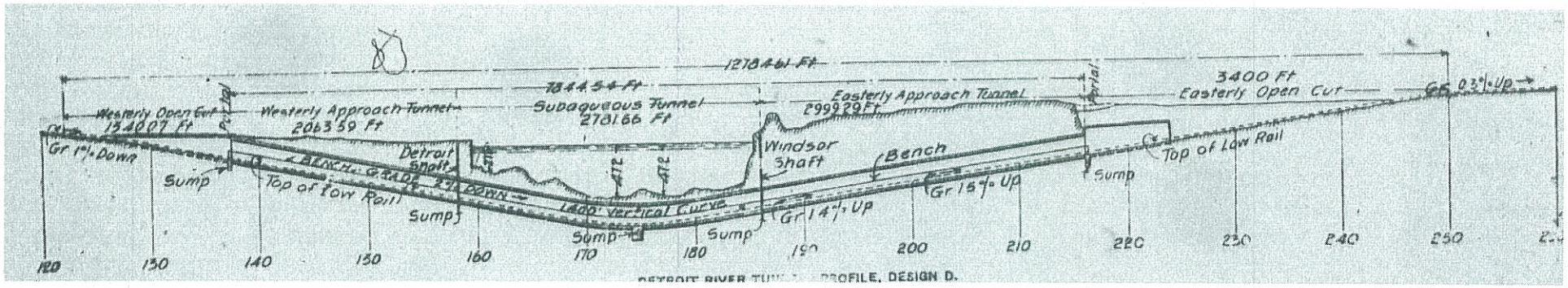
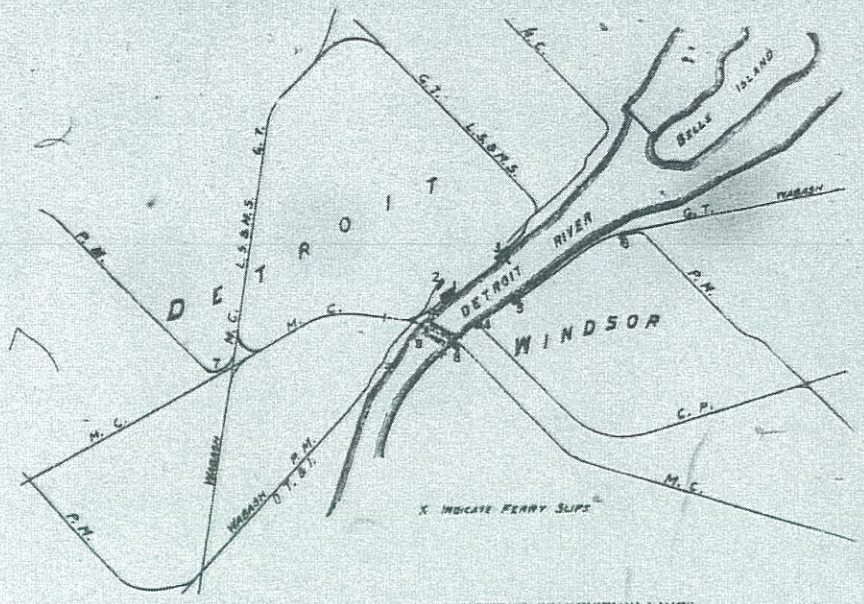


DETROIT RIVER TUN[illegible] PROFILE, DESIGN D.

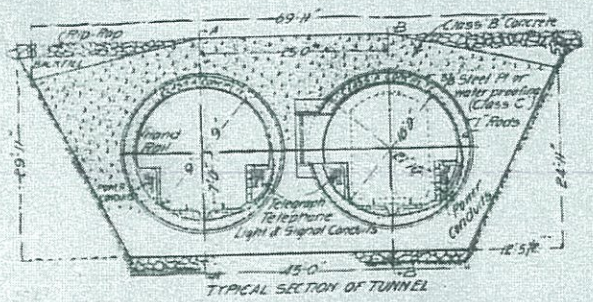


DETROIT RIVER TUNNEL—PLAN SHOWING CONNECTING LINES.

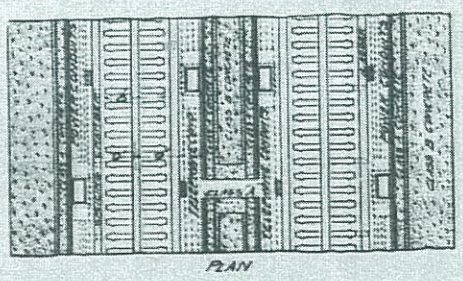
this method great pains would of necessity be taken in joining the sections, so that the joint will not be an element of weakness in the structure, but will be fully as strong as any portion of it. These tubes would then be encased in concrete and protected by backfilling and by riprap.

Design "C" is practically the same as design "A," except that a certain style of steel form and arrangement of reinforcement are prescribed.

Design "D" gives the bidders the option of selecting the well-known shield method of construction. It is pointed out, however, that the necessity of retaining the summits of the tunnel gradients as estimated causes a location of the top of the tunnel for the subaqueous section so close to the river bed as to require artificial filling in order to hold air, the use of which is necessitated by the shield method. Contractors who choose this method must therefore be under the necessity of estimating for the placing of temporary blankets or masses of clay on top of the location of the tunnel, so as to give the necessary thickness between the top of the shield and the water to prevent or reduce the escape of compressed air.

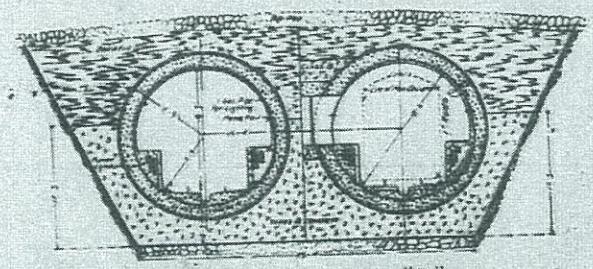


TYPICAL SECTION OF TUNNEL



PLAN

TYPICAL SECTION AND PLAN, DESIGN "A."



TYPICAL SECTION, DESIGN "B."

CONTRACTOR'S ALTERNATIVE METHOD.

Design "C," before mentioned, gives the contractor the option of submitting supplemental specifications and plans illustrating the type of construction upon which he would prefer to bid, provided that the established gradients on the easterly and westerly approaches shall be the same as the company's plans, namely, 2% equated for curvature on the westerly approach, and 1½% equated for curvature on the easterly approach. It is further provided that the depth from the surface of the Detroit River to the outer clearance line of the tunnel construction shall not be less than 41 ft. where the depth of water now equals or exceeds that distance. The tunnel company express a strong preference for the fixing of the summits of the easterly and westerly gradients at the points shown upon the company's plans, because the established points are based upon convenience to the track and yard layouts adjacent.

GENERAL DESCRIPTION.

The maximum depth of the river at the proposed site of the tunnel is about 45 ft., and it is provided in the specifications, as mentioned elsewhere, that the clearance line of the tube structure shall not be less than 41 ft. below the surface where the depth of water now equals or exceeds that amount. The maximum velocity of current at the time measurements were taken (Aug. 28 to Sept. 5, 1905), was 3.40 ft. per second, and at the bed of the river 1.17 ft. per second.

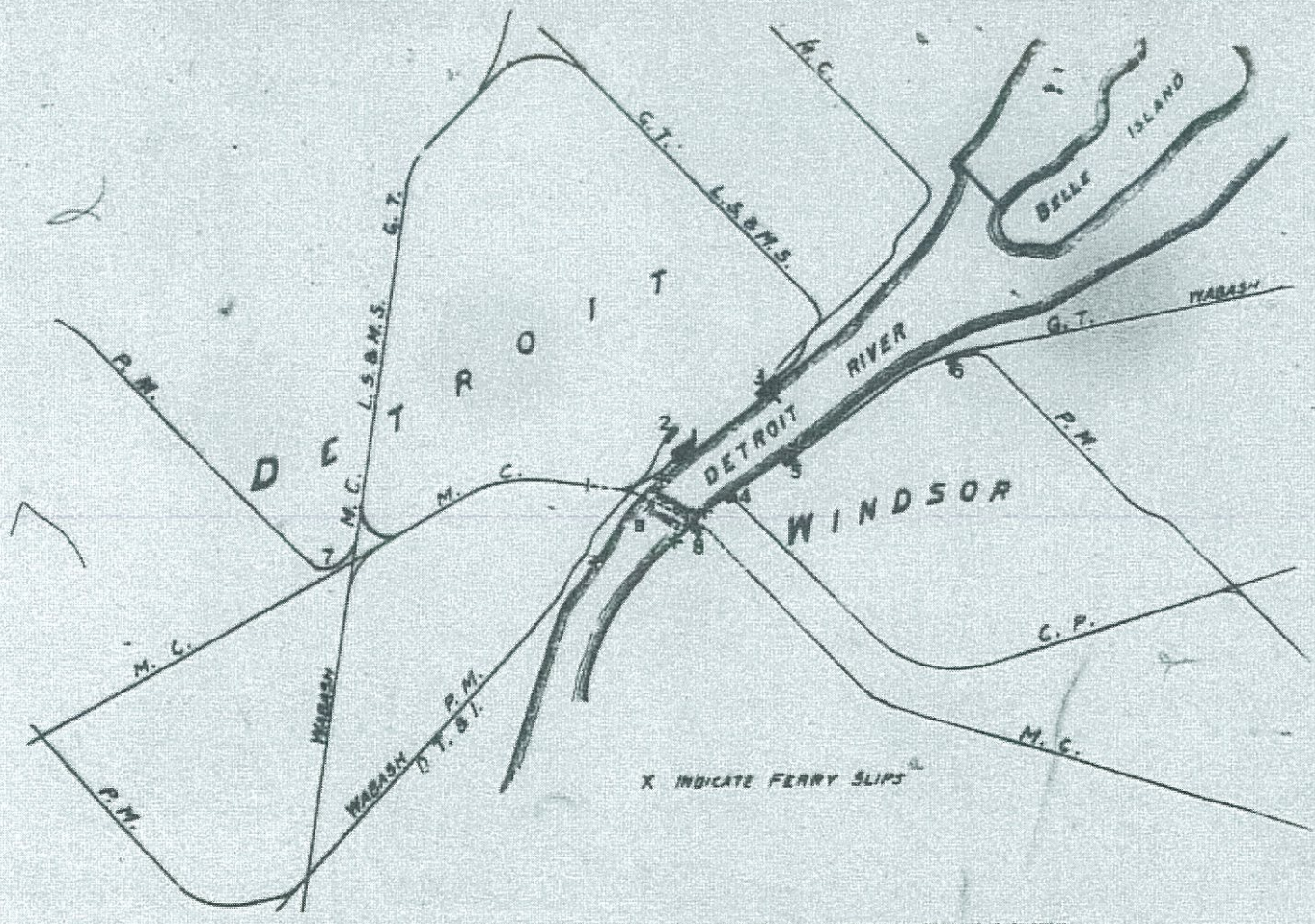
The soil to be excavated consists principally of blue clay, with greater or less admixtures of gravel and sand. In the borings taken on each side of the tunnel site, at intervals of 100 ft. throughout the entire length of subaqueous and approach tunnels, hard pan was struck at about 35 feet below the lowest point in the bed of the river. In case of the use of piling as an additional support for the bottom of the tunnel it is required that piles be driven to refusal.

As shown by the accompanying engravings of typical sections of the tunnel, it is provided that the interior diameter of the tube shall be 18 ft., giving a height above top of rail of 16 ft. Power conduits will be located on the outer side of the tube interior, and telegraph, telephone, light and signal conduits upon the inner side with a clearance of 11 ft. 6 in. between. In all of the various possible designs submitted for the consideration of contractors provision is made for the liberal use of concrete. Design "A" provides for filling the tunnel trench to a depth of 5 feet with Class B concrete above the shell of the tunnel tube, which is itself of Class A concrete, 2 ft. in thickness, reinforced with 1-in. steel longitudinal rods, spaced 14 in. centre to centre, and inner and outer circumferential rods of the same size, spaced 6 in. centre to centre. In the main features of construction the other designs submitted, with the exception of the shield method, do not differ essentially. Design "B" provides for a filling of concrete up to only a short distance above the centre line of the tubes, the balance being backfilling, and a protection of riprap, while Design "C" provides for outer and inner shells of ¾-in. steel, the outer shell being supported by rings of 10-in. I-beams of 30-pound section, spaced 4 ft. centre to centre.

Design "D" provides for a tube, built up of cast iron rings composed of segmental sections 2 ft. 6 in. in width and 6 ft. 3.1414 in. in length on the outer face, with flanges 11 in. in width, and 1½ in. thick on the inner edge, and two intermediate brackets of the same thickness, supporting the longitudinal flanges of each section. Each section is tapped for a 1¼ in. pipe for grouting.

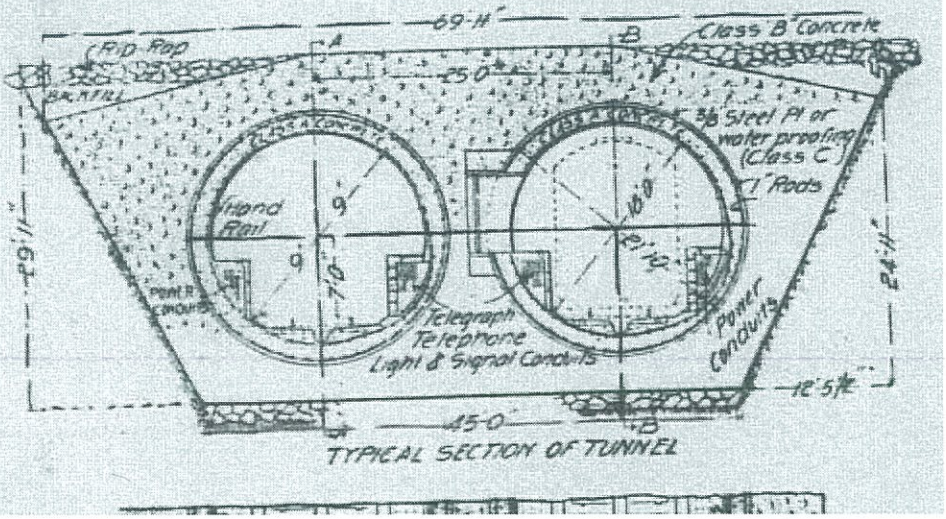
The specifications for the tunnel structure indicate that much attention is to be given to the quality of Portland cement used, to its mixing and the method of application, in order to insure the greatest degree of strength and permanency.

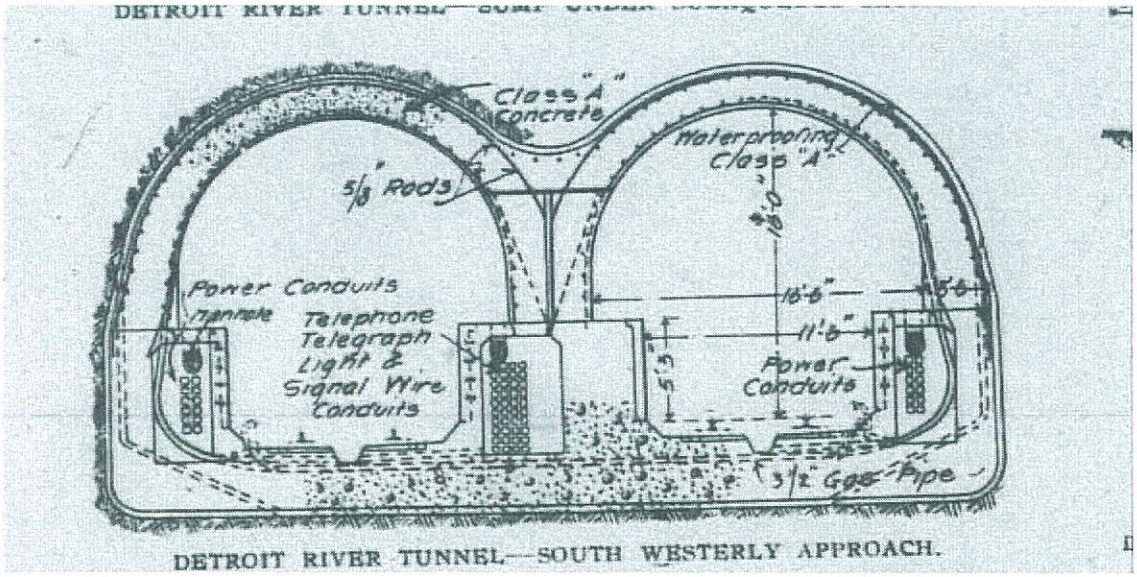
It is the purpose of the tunnel company to secure structures the interiors of which shall be permanently free from moisture or discoloration due to the percolation of water, oils or other liquids from outside sources, by use of a continuous, flexible waterproof sheet, surrounding the exterior of the structure. Coal tar of the grade known as "straight run coal



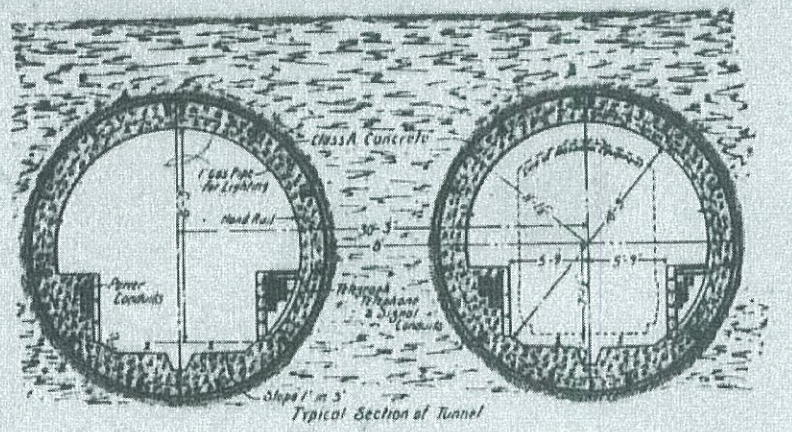
DETROIT RIVER TUNNEL—PLAN SHOWING CONNECTING LINES.

filling and by riprap. construction. It is

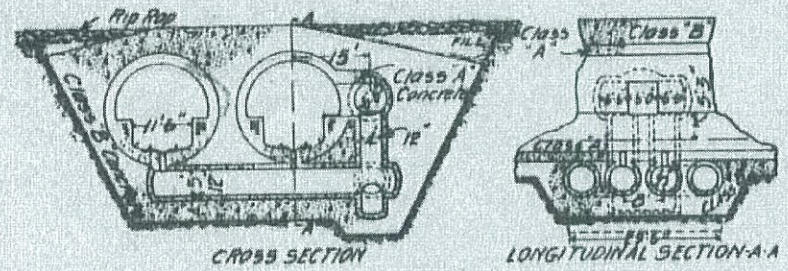




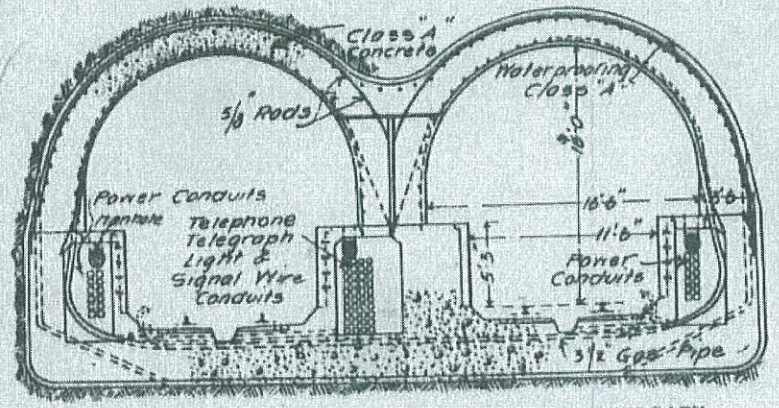
DETROIT RIVER TUNNEL—SOUTH WESTERLY APPROACH.



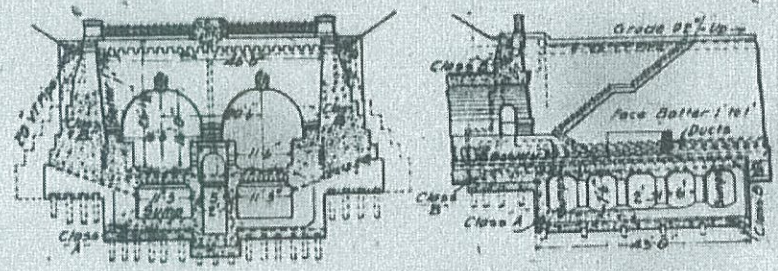
DETROIT RIVER TUNNEL—TYPICAL SECTION, DESIGN "D."



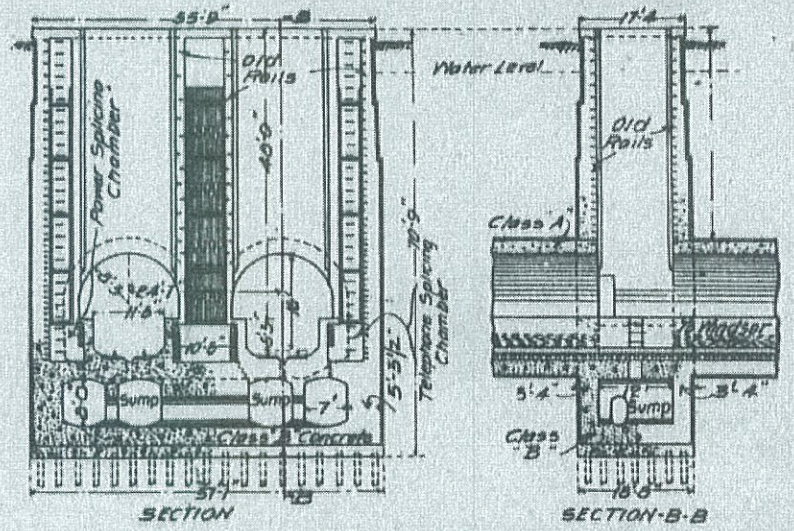
DETROIT RIVER TUNNEL—SUMP UNDER SUBAQUEOUS SECTION.



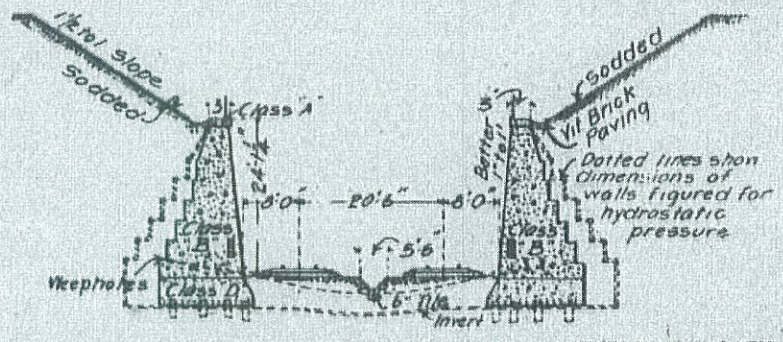
DETROIT RIVER TUNNEL—SOUTH WESTERLY APPROACH.



DETROIT RIVER TUNNEL—WINDSOR PORTAL.



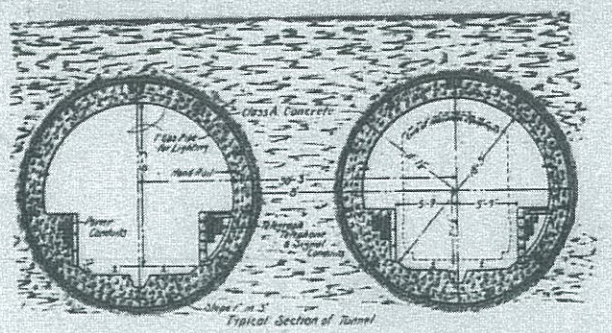
DETROIT RIVER TUNNEL—DETROIT SHAFT.



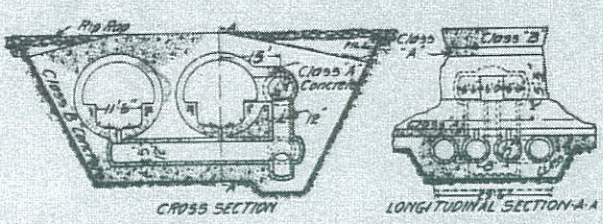
DETROIT RIVER TUNNEL—RETAINING WALL, EASTERLY APPROACH.

will be completed in eight or nine

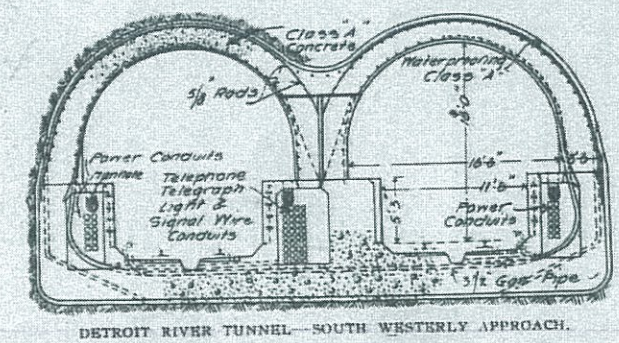
C.P.R. Western Officials' Conference.



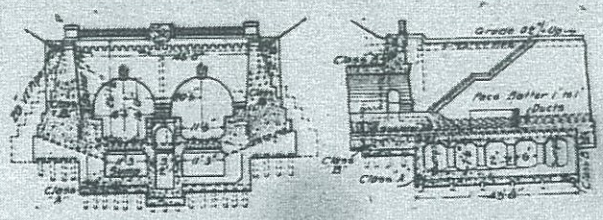
DETROIT RIVER TUNNEL—TYPICAL SECTION, DESIGN "D."



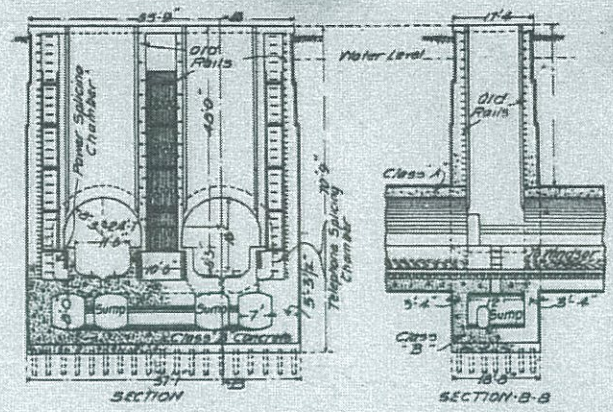
DETROIT RIVER TUNNEL—SUMP UNDER SUBAQUEOUS SECTION.



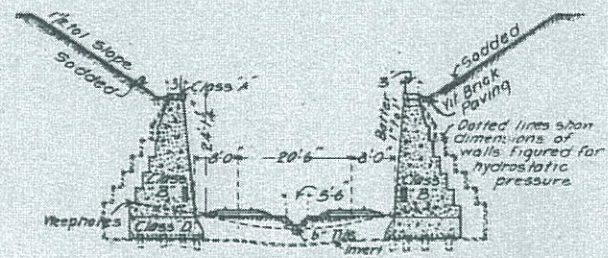
DETROIT RIVER TUNNEL—SOUTH WESTERLY APPROACH.



DETROIT RIVER TUNNEL—WINDSOR PORTAL.



DETROIT RIVER TUNNEL—DETROIT SHAFT.



DETROIT RIVER TUNNEL—RETAINING WALL, EASTERLY APPROACH.

tar pitch" will be used. Felt must be dipped in pitch and weigh not less than 15 lbs. to each 100 square ft. The Class "A" waterproofing will consist of three layers of felt and four layersof coal tar pitch in alternation, each strip or piece of felt to be laid so as to lap well over the previously laid strip.

The Detroit River Tunnel Co. has already completed the excavation of a large portion of the Windsor shaft, and will complete in a similar manner the excavation of the Detroit shaft. This work will be turned over to the contractor, who will complete the excavation and assume maintenance of the temporary work that has been placed.

Answering questions that may arise as to what obstruction to navigation would be occasioned by the trench method of construction proposed, by the plans submitted, it was shown to the satisfaction of the Lake Carriers' Association, at a meeting held in Detroit on Jan. 23, with the Board of United States Engineers appointed by the War Department, that the impairment of the waterway will be immaterial. The total width of the river from harbor line to harbor line is 2,400 ft. It was shown that the tunnel building operations will not obstruct more than 600 ft. of this distance at any one time, leaving the remainder clear to navigation. It was, however, suggested that a patrol boat be maintained to serve as a pilot to passing vessels to indicate to them the particular portion of the channel that at any time was free and unobstructed, and to the maintenance of this boat H. B. Ledyard, Chairman of the Board of Directors, at once assented on behalf of the Michigan Central Rd. It is expected that the actual work in the river will be completed in eight or nine months.

The cost of the tunnel is estimated at from $7,000,000 to $8,000,000, and it is expected to have a capacity for the handling of about 4,000,000 cars per year. The present business of the Michigan Central Rd. amounts to about 400,000 cars annually, and other roads that may be expected to use the tunnel handle about 300,000 cars.

The construction of the tunnel is in the hands of an advisory board of engineers, consisting of W. J. Wilgus, H. A. Carson and W. S. Kinnear, Mr. Kinnear being chief engineer and in direct charge of the work.—Railway Age.

The Executive Council of the Canadian Manufacturers' Association, with a view of building up trade at Canadian ports, has passed a resolution favoring the application of the preferential tariff in favor of British goods only on such as are landed direct at Canadian ports. At present the preferential tariff is applied to goods entering Canada, through U.S. ports as well as to goods coming direct to Canadian ports.

The Shedden Forwarding Co. has been granted a supplemental charter under the Dominion Companies' Act, by which its capital is increased from $700,000 to $1,500,000 and its powers have been extended so that it may engage in the manufacture of vehicles of every description; construct and operate grain elevators and warehouses; develop electric and other power; and acquire stock in similar enterprises.

C.P.R. Western Officials' Conference.

Following are the opening remarks of W. Whyte, Second Vice-President C.P.R., at the conference of officials, Western Lines, held at Field, B.C., Feb. 12 and 13:—

There is nothing novel about such a meeting as this in territory under my jurisdiction, as I understand that officers have frequently called conferences of those acting with them, and this widening out of the idea was adopted by myself to permit of an exchange of ideas and experience of all the principal officers, and in order that by personal contact with those occupying similar offices and with those in other departments, a better understanding and improvement might result, as well that a more profitable administration of the different departments of the railway might result to the company. The calendar year which has just closed has been, in my experience, by far the most successful in the operation of the Western Lines with respect to the volume of business handled, and particularly in the improvement made in most features of its transportation, increased tonnage and reduction in the expense of transport, as well as the improvement in the passenger service and the handling of package freight, and I think, also, from the fact that there has been less disturbance of the car and the power supplied during the movement of the wheat crop in districts not directly affected by that movement. There has also been an improvement in the carrying out of work authorized by the appropriation and in the building of new lines, much of the work having been

The M.C.R. Detroit River Tunnel.

The tunnel being built under the Detroit River for the Michigan Central Rd. passenger and freight service, was illustrated and described in our issue of April, 1906, pg. 181. The following additional information has been received in regard to its electrical equipment. The electric section will be 4.5 miles long and will comprise within the yards some 15 miles of single track. Electric locomotives for operating through the tunnel were decided upon because they would not only permit of greater celerity in handling traffic, but also afford a complete solution of the ventilation problem. Six 100-ton direct-current locomotives of the swivel truck type, with geared motors, will comprise the initial equipment for hauling both freight and passenger trains. Each locomotive will be capable of hauling a 900-ton train up a 2% grade at a speed of 10 miles per hour. Four 280-horsepower motors will be mounted on each locomotive, two motors being placed on each of the two swivel trucks. The electric multiple unit control system will be furnished in enabling the locomotives to be operated singly or in train. Current for operating the motors will be taken from a third rail by means of contact shoes. Automatic, high-speed air brakes will form a necessary part of the equipment.

Current for operating the system will be purchased from the Detroit Edison Co., and will be delivered to a substation at Detroit at a potential of 4,400 volts, and at a frequency of 60 cycles. At the substation two 1,000-kilowatt synchronous motor-generator sets will be installed for supplying direct current to the third rail at 650 volts. A 15-kilowatt, 125-volt exciter for the synchronous motor will be mounted on a shaft extension of each of the motor-generator sets.

A very complete electric lighting and electric pumping equipment forms a part of the project. The yards and approaches to the tunnel will be lighted by arc lamps, while the tunnel itself will be illuminated by incandescent lamps arranged on duplicate circuits. Alternating current from the main power supply, at a frequency of 60 cycles, will be used on the lighting circuits. To insure an uninterrupted lighting service, the lighting circuits in the tunnels are so arranged that half the lamps in both tunnels will burn if, by chance either of the lighting circuits in the tunnels should be broken. A single 3-phase distributing circuit will run through each tunnel and from these circuits suitable connections will be made to step-down transformers. The secondaries of the step-down transformers will be interconnected with duplicate circuits for half the lamps in each of the tunnels.

For keeping the tunnel dry five sumps will be provided, each sump drained by induction motor centrifugal pumps arranged in duplicate. The motors on the pumps will operate

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uity of the whole process of rail making from the blast furnace to the gagging presses. Robert Job has said:

"The toughness and elasticity of the fine granular structure produced by annealing at the proper temperature permit an increase in the hardening contents considerably beyond the point which otherwise would be safe, thus obtaining greater capacity

Canadian Northern Ry. Earnings, etc.

Gross earnings, working expenses, net profits, increases or decreases over 1905-06, from July 1, 1906:

	Earnings.	Expenses.	Net Earnings.	Increase or Decrease.
July	$ 603,800	$ 397,900	$ 205,900	$ 63,400+
Aug.	594,900	402,800	192,100	80,400+
Sept.	624,400	417,800	206,600	96,400+

The M.C.R. Detroit River Tunnel.

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For keeping the tunnel dry five sumps will be provided, each sump drained by induction motor centrifugal pumps arranged in duplicate. The motors on the pumps will operate directly at 4,400 volts and the controlling circuits with compensators will be centralized in the substation. For indicating the amount of water in each sump, a float system will be provided having both visible and audible indicating devices in the substation.

At the substation a regulating storage battery will be provided to carry the fluctuations of the load. If the main power supply from the Detroit Edison mains should be interrupted this storage battery will have sufficient capacity to operate the entire system for half an hour. In such an emergency the lighting and pumping alternating current equipment will be energized by 60 cycle, alternating current from a 50-kilowatt motor-generator set, the driving motor being supplied with current from the storage battery. Flexible switching arrangements will be installed to enable this interchange of power supply to be easily and quickly made.

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