feeders, several bus voltages may be maintained at the station.

The return system of a street railway is strictly analogous to any other D.C. network system of distribution and is subject to the same economical limitations controlling the design.

It may be said, therefore, that such a system should consist of a network of mains formed by the tracks with feeders connected thereto in sufficient numbers and properly located to keep the maximum voltage difference between any two points on the track system and the voltage gradient in the track within prescribed limits, while allowing such voltage drops in the feeders as consideration of power loss and cost of copper may dictate.

The above line of development will, however, be open to the consideration of using an increased number of substations instead of excessively long feeders, and the question itself becomes a further consideration of economic analysis with, however, the complicating condition of the advantages and disadvantages from an operating standpoint of an increased number of substations.

A number of electric railway systems, the growth of which resulted in the occurrence of electrolysis with the original layout, were able to return to satisfactory conditions for a period of several years by increasing the number of substations, but conditions have become again unsatisfactory, to the author's knowledge, due to further growth.

It is surely extraordinary that street railways, of all companies operating D.C. distributing network, should attempt to obtain close voltage regulation of their negative network by combining the function of main and feeder in one conductor, while experience in all other D.C. networks has shown the separate feeder and main system to be the only method capable of giving close regulation at anything but prohibitive cost.

THE MONTREAL AQUEDUCT PROJECT.

After a conference last week with the consulting engineers, Messrs. Vautelet, McRae, and St. Laurent, the Montreal Board of Control resolved to instruct Chief Engineer Mercier to prepare plans showing the modifications in the aqueduct scheme required according to the engineers' projects Nos. 2, 4 and 5. Controller Cote said, after the meeting, that when this information was available the board would be in a position to decide what project should be finally selected.

It was further resolved by the board to instruct the chief engineer to prepare specifications for the supply of electricity for pumping purposes. This is in accordance with project No. 5 of the report of the consulting engineers.

Controller Cote said that the quotations on electric power would be asked for periods of 10, 20 and 40 years. Personally he was in favor of adopting project No. 2, which is the present plan, with modifications.

Controller Cote further stated that during the discussion Mr. Vautelet declared that as regards the manufacture of artificial ice, as outlined in the report, with the surplus power of the city's plant in summer time, ice could be provided for a population of 1,500,000 persons if desired.

The United States supplied $536,354 worth or 80 per cent. of the total railway imports of Peru in 1915. The total value of the supplies imported was $664,103, the largest item of which was rails and accessories, $445,420.

THE DESIGN OF A TOWER FOR A 50,000-GALLON HEMISPHERICAL BOTTOM TANK.

(Continued from page 498.)

times the column stresses obtained from the diagram. This may be easily proved by taking moments about a line perpendicular to the direction of the wind. The maximum column wind stress is not the result of a constant load and occurs but rarely, so only 80 per cent. of it has been used in designing the columns.

With the total stresses in the tower determined we may now select the sections to be used for the various tower members.

Columns.—As the loads on the columns can be accurately determined and are only subject to gradual changes, it is permissible to use higher unit stresses than is customary in structures such as railroad bridges. For 10-inch channels, laced, give a maximum $\frac{L}{R}$, or slenderness ratio of 91, and unit stresses well within the allowable.

Rods.—One-inch diameter rods in each panel give unit stresses varying from 9,000 to 11,000 pounds per square inch.

Struts.—Struts are usually made heavy enough to carry erection equipment, and are much larger than is needed to provide for the wind stresses alone. The struts selected in the accompanying design will carry a load of 2,000 pounds at the centre in addition to the wind. The unit stresses due to wind are quite small.

Anchor Bolts.—When the tank is empty, the maximum wind load is sufficient to tip the structure over on two of its column bases. Anchor bolts are provided to prevent this. The net uplift is 14,300 pounds and it is taken care of by one 1¾-inch anchor bolt. Provision for rusting is made by selecting a large bolt with consequent low unit stress.

Foundations.—The maximum load under each foundation is equal to the sum of the maximum lower panel column loads plus the weight of the foundation. The foundation base should be large enough to distribute this load over the soil with a safe unit bearing pressure. Three thousand six hundred pounds per square foot is a conservative unit pressure to use with average soil conditions. The foundation should also be heavy enough to resist the maximum uplift, but except for small tanks on high towers, the uplift is usually not as great as the weight of the foundation.

When the members have been selected the weight of the structure can be calculated and the metal loads adjusted. This will probably not affect the design if the original metal loads were well chosen. We now have a design in which the stresses are fully known—one that we are sure will do the work for which it was intended.

We should not be too strongly influenced by designs of older structures. Because a tower has stood up in the past is no reason for believing that its design is faultless. Perhaps it is on the verge of failure, or, on the other hand, is far too heavy, and consequently uneconomical. With a good design the most is procured for the money expended.

In England and Wales there are 3,639 miles of canals; in Scotland, 183 miles, and in Ireland, 848 miles—a total for the United Kingdom of 4,670 miles, or 3,822 miles for Great Britain. Of the total mileage, 1,363 miles are owned by various railway companies.