This record obtained in a carefully conducted experiment is confirmation of the possibility of a thaw causing the freezing of water pipes. The rapid lowering of ground temperature by cold water percolating through the ground was strikingly shown several times during the period covered by the records. While percolating waters may lower the temperature, the presence of moisture reduces the likelihood of services freezing, for the following reasons:—

(*a*) The freezing of the water releases latent heat which is transmitted to the ground.

(*b*) The frozen ground is a poor conductor of heat.

(*c*) Water is a poor conductor of heat, and when it is held in the ground by the action of capillarity, it cannot readily conduct heat by convection, as it would if it were free to move.

Prevention of Formation of Ice in Mains and Services.—Where frost penetration has extended to, and possibly beyond, the level at which a water main or service has been installed, the water in the main or service will freeze unless the temperature of the water in such main is kept at or above 32° F. This can only be accomplished by having such quantity of water pass through the main that the rate of abstraction of heat will not be sufficiently rapid to cause the temperaure of the water to fall below 32°

As has been pointed out, in the supply from the Croton River, the temperature of the water, even during a very cold spell, is found to be about 34°. As long as there is sufficient water passing through the mains to prevent this temperature being reduced by more than 2°, *i.e.*, to 32° F., there will be no danger of freezing of water in the mains. By testing the temperature of the water as it is drawn from a hydrant, it can be determined whether there is or is not likelihood of the main freezing. No rule can be formulated which would answer the question as to whether a main will freeze under given conditions. A protecting covering is certainly a great aid in reducing the danger of freezing, and snow on the ground is an almost sure preventive.

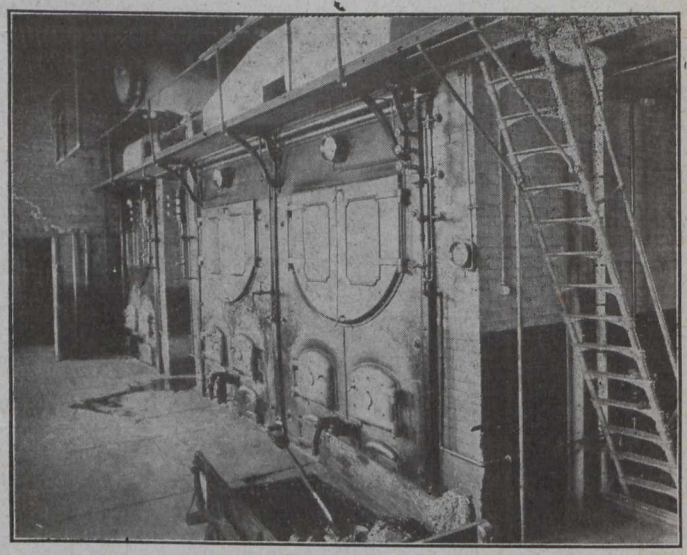
Thawing Ice in Mains and Services.—The problem of thawing out frozen mains and services has been greatly simplified through the utilization of the electric current at low tension. While it was found that this method was not of much value when applied to a main laid in water, where the heat generated through the passage of the electric current would be rapidly dissipated by the flowing current of water, the condition where the pipe is covered with soil is entirely different and much more favorable to the thawing of the main. As the electric current passes through the metal, the heat generated will thaw both the ice which is formed within the main and the ice which is formed in the soil outside of the main. The transmission of this heat to the surrounding earth and thence to the surface is very slow and a comparatively small amount of current is required to make the necessary change from ice to water. It is not necessary to describe the actual application of electricity to the mains as this has been set forth in detail many times.

The writer found in his investigation of this subject that a study of the formation of ice in streams has greatly aided him in obtaining a clearer conception of the conditions under which ice is liable to be formed in mains, and on this subject he has drawn freely from the "Treatise on Ice Formation," by Howard T. Barnes, Associate Professor of Physics, McGill University, Montreal, who has made extensive experiments and observations on ice formation in the St. Lawrence River and elsewhere.

BRANTFORD WATERWORKS.

(*Continued from page 24.*)

The water commissioners for 1916 are: Mr. John Fair, C.E., chairman; Mr. A. G. Montgomery, Mr. J. W. Rowlby, K.C. (Mayor), Mr. Fred. W. Frank, secretary; Mr. Thomas Lamb, superintendent; Mr. David L. Webster, chief engineer.



Boiler Room, Brantford Waterworks.

BRITISH FIRM OUTBIDS UNITED STATES FIRMS.

There was great surprise a few days ago when it was announced by Secretary Daniels of the United States Navy that Hadfields, Limited, of Sheffield, England, was the lowest bidder on contracts for 16-inch and 14-inch armour-piercing naval projectiles. Not only were their bids $146 lower per shell on the 14-inch shells and $237 lower on the larger ones than the lowest American bids, but they offered to deliver the order in eleven months and sixteen months respectively, while the best the American firms could do was 22 and 24 months. Hadfields became a serious competitor for naval contracts in 1912, when they underbid the American firms on 14-inch shells by a considerable margin.

Commenting on the wide disparity between the English bid and the American proffers, Secretary of the Navy Daniels said he thought it singular that American firms with their tremendous facilities were unable to compete either as to price or time of delivery with the English manufacturer.

The report of the German steel syndicate regarding shipments of steel for the fiscal year 1915-1916 states that of the total shipments 87 per cent. were for home consumption, as against 81 per cent. the preceding year. The total steel production of Germany for the same period is given as 14,700,000 tons, as compared with 11,700,000 tons the preceding year.

Dutch shipyards have been informed by the German authorities that they will be put on the German black list if they repair Norwegian vessels, whether the work is carried out with German material or not. For Danish and Swedish vessels special permission has to be obtained. In the case of vessels being built in Holland of German materials, permission for export has to be obtained, and no such permission will be available for vessels built for Norwegian account.