H. T. BARNES

METHOD OF LOOSENING ICE ACCUMULATIONS

Filed March 18, 1925

INVENTOR

H. T. Barnes

ATTY.
To all whom it may concern:

Be it known that I, HOWARD TURNER BARNES, of the city of Montreal, in the county of Hochelaga, Province of Quebec, Canada, have invented certain new and useful Improvements in Methods of Loosening Ice Accumulations, of which the following is a specification.

In cold climates a great deal of trouble is experienced with accumulations of ice in rivers supplying water for hydropuic power development. This is mainly due to accumulations, beneath the surface ice, of ice in a slow moving form such as frazil which forms in suspension, or anchor ice which forms on the bottom and sides of a channel. Where ice particles in water are carried into quiet pools or wide lakes which are covered with surface formed sheets, the small particles float upward and become attached to the underside of the surface sheet, forming after a time great hanging dams which quickly reduce the free passage of water by blocking the channels. So far, it has been found practically impossible to destroy these ice jams when once formed and the shutting down of power plants dependent on the water supply, naturally follows.

As the result of long continued experiments, I have found that ice forms in or under the surface of water only when the temperature of the water is reduced a minute fraction of a degree below the freezing point 0° Cent. or 32° F., and under conditions which frequently obtain in our rivers and in very cold weather this super-cooling takes place. Once the frazil or anchor ice has been formed it tends to persist in agglomerated form until a mild spell occurs and enough heat is thus supplied to it to overcome the effects of the super-cooling. It follows then that by preventing this super-cooling the formation of a jam may be prevented and that, by raising the temperature of a mass of such ice when formed, the bond of the ice particles may be loosened and a jam broken up.

My object, therefore, was to devise a method of and means for quickly raising the temperature of considerable masses of ice so as to loosen the bond of the myriads of ice particles, without necessarily melting them, thus weakening the structure of the jam sufficiently to enable the flow of water to break it up. For any such method to be practicable, the means for carrying it out require to be available for use at a moment's notice and to be readily and easily transported to the scene of action.

I have further found that the necessary heat must be supplied at a very high temperature so that it will diffuse very rapidly over a wide area. The temperature is preferably so high that a large proportion of radiant heat and light is generated and also high enough to disassociate water into its gaseous elements.

I attain my object by using what may be termed "thermal mines," that is devices adapted to contain chemical re-agents which may be ignited and will then combine with a violent exothermic reaction. Satisfactory results have so far been obtained by employing the material known commercially as "Thermit," which is a mixture of iron oxide (FeO) and aluminum in a pulverulent condition. Containers, such as hereinafter described, are filled with a charge of 100 lbs. of thermit, and one or more of such containers are sunk into the ice mass to a greater or less depth as determined by circumstances. Satisfactory results have been attained with the charges located at depths of from 4 feet to 20 feet, depending on the depth of the ice.

When such a charge is ignited, a molten mass is formed of a temperature approximating 4000° F. to 5400° F. and the transfer of heat from this mass to the ice takes place with great rapidity and with explosive violence.

How this heat is transmitted through the ice and dissipated is not at present known but it appears probable that it is partly by radiation and partly by conduction and also that there is actual disassociation of water into its elements, the oxygen and hydrogen subsequently re-uniting more or less explosively.

The immediate effects of the ignition of such a charge are found to be wide spread but the full effects are not immediately felt, and the action of the generated heat in loosening the ice may continue for a period of twenty-four hours after the ignition of the charge. The effectiveness of such thermal mines was demonstrated by experiment in the case of an ice jam which had formed in the channel of the St. Lawrence River at the pulp dock at Waddington, N. Y., between the main shore and Thompson's Is-
land. This jam was approximately 1000 feet in length and 500 feet in width, the depth of ice varying from 6 inches to 45 feet, while the head, foot and sides of the jam were solidly lodged on the bottom. Three charges were ignited in this mass at points hereinafter more particularly set out and illustrated in the accompanying drawings in which—

10 Fig. 1 is a chart of an ice jam between the pulp wood dock at Waddington, N. Y., and Thompson's Island, illustrating the use of my method;

15 Fig. 2 a cross section on the line 2—2 in Fig. 1; and

20 Fig. 3 a longitudinal section of a thermal line suitable for use in removing ice jams according to my method.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

The mine comprises a metal cylinder 1, which, in the case of a mine intended to carry a 100 pound charge of thermit, is 10 inches inside diameter and 22 inches in height. The exact weight of material employed does appear to be important, as satisfactory results have been obtained with cylinders of 2 1/22 gauge sheet steel and containers formed of one-quarter inch plate. The top 2 of the container is provided with a 2 inch nipple 3 having an annular flange 4 formed at its upper end. A cover 5 is secured to this flange by means of the bolts 6 after the container has been filled with the thermit. In the cover 5 are formed openings provided with stuffing box glands 7. Through these openings are led insulated wires 8, the openings being made tight by suitable packing compressed by the glands. These wires terminate towards the centre of the container in an ignition element 9, which may be formed of any material which, on igniting, will raise the temperature of the surrounding thermit sufficiently for ignition.

This ignition element preferably comprises a small amount of ignition powder made into a solid ball and containing a heating wire adapted to be heated by current supplied through wires 8. Such ignition elements, being well known in the art, need no further description.

Each drum is preferably provided with four 2 inch angle iron clips 10 substantially flush with the top facing of the drum. In practice two lengths of 2x4 inch timber are bolted to these clips in order to facilitate sliding the drums to the position in which they are to be used.

In the carrying out of my process in the instance hereinafter referred to, two locations were selected in the ice jam near its head and in the centre of the channel, and in the third point at the foot of the jam also...
7. A method of combating ice which consists in effecting an exo-thermic chemical reaction in the ice below the surface to produce heat therein in large quantity and at a temperature approximating 4,000° F. or more.

8. A method of combating ice which consists in igniting a charge of thermit in the ice below the surface to produce heat therein in large quantity and at a high temperature.

Signed at Toronto, Can., this 6th day of March, 1925.

HOWARD TURNER BARNES.