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ICE BORING MACHINE

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This invention pertains to an ice boring machine, and particularly to a machine of this type which is especially adapted for the drilling of holes through the ice formed upon bodies of water such as lakes or rivers. When so utilized, the machine also operates to raise water through the hole so formed, and to distribute it over the surrounding surface where it quickly freezes, to increase the thickness and the bearing strength of the surrounding ice for uses as winter roads, storage places for timber, ice-harvesting operations and the like.

It is therefore a principal object of the invention to provide an apparatus of the above class which can readily be transported as a unit to the site of the operations, and which in itself provides both for the boring of a suitable hole through even thick layers of ice, for the clearing of this hole of slush and large pieces of ice, and for pumping or lifting underlying water for distribution over the surface of the ice.

Another object of the invention is to provide a machine of the above type which includes a drill or boring assembly whose vertical elevation can readily be controlled for efficient drilling, and which can be left in the optimum position, after completion of the hole, for use in lifting the underlying water most effectively. The same positioning arrangement permits the drilling assembly to be locked in a raised position out of contact with the supporting surface, so that the entire machine can readily be moved from place to place.

A further object of the invention is to provide, in a machine of the type described, an arrangement of impellers or the like rotated by the same shaft which carries the drilling head, but free to rest upon the ice surface regardless of the depth to which the drilling head descends, and operating to discharge pieces of ice, slush and water away from the top of the hole.

Still another object of the invention is to provide a drilling head for a machine of this kind, which head is provided with an arrangement for regulating the rate at which the drill eats its way through the ice, and which also serves to propel the underlying water more rapidly against the drill spiral which lifts it from the hole.

The above and other objects and advantages of the invention will best be understood from the following detailed specification of a preferred embodiment thereof, taken in connection with the appended drawings, in which:

Fig. 1 is a vertical elevation, with parts in section, of the preferred embodiment of the machine, and

Fig. 2 is an enlarged sectional view of the portion of the device which serves to maintain the drill head at the desired elevation.

In the drawings, numeral 1 designates the main axle of the device, which may be tubular for adequate stiffness without excessive weight, and which is provided with a longitudinal keyway and slot 2. At its lower end, 1 is connected as by a pin coupling 3 with the drill head 4 fast to a drill axle 5. A spiral plate or wing 6 is welded to axle 5 and is so formed that the pitch of the spiral decreases in the upward direction. The spiral plate 6 extends a distance slightly greater than or in other words more than one complete turn and terminates at its lower edge in a cutting edge 7 of hard tool steel or the like lying at an angle of from 45 to 70 degrees with the axle 5, and inclined somewhat forward in the direction of rotation. Diagonally opposite the cutting edge 7, and below the spiral plate 6 there is a plate 8 perpendicular to the axle but whose underedge is inclined at the same vertical angle as the cutting edge 7, the major portion of said underedge being located higher than the edge 7 by an amount equal to the desired feed of the drill per revolution. At its outer end, the plate 8 has a rounded protuberance or swelling 9 adapted to slide on the bottom of the hole and prevent the drill from eating too rapidly into the ice. This plate 8 is also desirably made in the form of a rib which extends the same distance from axle 5 as the cutting edge 7, and is successively inclined toward the periphery so as to form a propeller blade cooperate with the plate spiral 6. To this end, the propeller blade is separated from the underside of spiral 6 by an interval of approximately the same width as the blade.

Above the drill head is located the ice and slush ejector, comprising a hub 11 in which is secured a key 10 engaged in the keyway 2 of axle 1, so that the entire rotor with the axle 1 but is free to slide therealong. To this hub are secured two diametrically opposite vertical plate ribs 12 which extend beyond the drill in the horizontal direction, and whose underedges are preferably curved backward (counter to the direction of rotation) at angles of 95 to 100 degrees to act as runners 13 which slide freely on the surface of the ice without cutting therein. These ribs 12, when the axle 1 rotates, eject to the sides the ice, slush and water brought out of the hole by the plate spiral 6. Ribs 12 may desirably be inclined gradually from their outer ends in such a way that, when the device is employed as a water pump, they hurl the ice and water upwards as well as outwardly, and spread it over a large area.

The axle 1 is mounted for rotating and sliding in three bearings 14, 15 and 16 carried by a drill stand comprising two base plates 17 and 18 having on their underedges sharp spikes 19 which can bite into the ice and hold the stand steady during drilling. The edges of the base plates 17, 18 facing inwardly toward the drill head 5 have vertical walls 20, 21 braced against the base plates by brackets 22 or the like, and these walls 20, 21 at their tops have inwardly facing support flanges 23. To these are secured the four vertical bolts 24 having spacing sleeves 25, 26, 27 and 28 which locate and support the pairs of bearing plates 30, 31 and 32 each of which has a central hole in which holes are secured the bearings 14–16.

Between plates 30 and plate 31 is disposed a bevel gear 33 keyed on shaft 1 for rotation therewith, but permitting the shaft 1 to slide vertically, and this gear 33 meshes with another bevel gear 35 secured to a shaft 34 perpendicular with shaft 1. Shaft 34 may be the drive shaft of a motor (not shown) which may conveniently be mounted on a shelf 36 carried by wall 21.

For regulating the vertical position of axle 1, and as best shown in Fig. 2, there is an arrangement for cooperating with a series of spaced annular grooves 37 in the axle; these grooves have upper edges 39 perpendicular to the direction of the axle 1, but lower edges 41 inclined at an angle which may be 45 degrees. The lowermost of these grooves is so located that it lies slightly above the bearing portion 15 when the axle is raised to lift the drill head above the ice surface. For supporting the axle and drill head at the desired position, there is provided an arresting head 40 shaped to conform to a portion of the axle periphery and carrying the protruberance 38 engageable with the grooves 37. The head 40 is fastened to a
plunger 41 slidable in a guide sleeve 42 supported by plate 31. The plunger 41 has a flange 43 against which presses a spring 44 whose other end engages the end wall of sleeve 42, and 41 is normally urged against axle 1. At its outer end, plunger 41 carries a bracket 45 having a hinge pin 46 which passes loosely through an oblong hole in a manipulating or control lever 47 articulated on the stand. The arresting assembly 40—45 is as a whole designated by numeral 39 in Fig. 1. It is clear from the above that, by manipulating lever 47, the drill head can be allowed to descend to any desired position, or held out of contact with the ice for transport, while at the same time the inclined lower edges of grooves 37 enable the axle 1 to be raised as desired by merely lifting upon the manipulating grip 49 when a hole is finished, the protuberance 38 snapping behind successive grooves during such raising.

A plate cap 48 may serve to cover the upper part of the stand as protection against snow and water.

In operation, the drill is transported to the location where a hole is to be drilled, and to this end may be mounted upon any suitable transport, not shown. With the stand lowered so that spines 19 bite into the ice, the motor is started, and the operator takes his place on the base plate 17 for the purpose of increasing the load thereon, and, with manipulating lever 47, pulls the arresting protuberance 38 out of the groove 37 so that the drill head falls into contact with the ice. The pressure against the ice is initially regulated by the hand grip 49 so that the initial feed is small, after which the drill feed is self-regulating. The broken ice from the drilling operation is hurled outwardly by the shush ejector 11, 12 through two openings provided between the support walls 20 and 21 and the support plate 30.

After the drill head has worked its way through the ice, it pumps water up through the hole, and the water entrains all of the slush which is then hurled through the openings so that the slush obtained is completely free from ice. Thereafter, and in order to get the largest delivery of water, the best position of the drill head may be maintained by engagement of the proper groove 37 with the arresting protuberance 38. The machine can then be left to itself until the desired quantity of water has been pumped onto the surface, there to freeze and provide the desired bearing strength.

It will be seen from the above that the machine provided will operate very efficiently for producing ice holes for any desired purpose, for example for fire-fighting, sounding, fishing or the like, as well as permitting the thickness of ice to be increased to any desired value for supporting purposes in building construction, water roads, ice harvesting or for other uses. While the invention has been disclosed in connection with a preferred embodiment which has been described in detail, it is to be understood that the invention is not limited to these precise details, and that the combinations of elements described can be embodied in modified forms without departing from the scope of the invention, which is defined in the appended claims.

What is claimed is:
1. An ice boring machine for quickly opening holes in ice of any thickness, and operable to remove therefrom slush and the like, and for pumping water out of such holes, comprising a vertical axle having a plurality of grooves, a drill head secured to the lower end of said axle, a support adapted to rest upon the surface of a body of ice, means on said support for journaling said axle and drill head for both rotary and vertical sliding movements, means for driving said axe in all positions of vertical adjustment thereof, arresting means for securing said axe and said drill head at a desired elevation, said arresting means comprising a plunger retractably mounted on said support and having a portion engageable with said grooves to support said axe at the desired elevation, and a slush ejector comprising an impeller slidable along said axle but rotatably connected therewith, said ejector having an effective diameter larger than the effective diameter of said drill head, whereby it may slide freely in contact with the surface of said ice.

2. An ice boring machine in accordance with claim 1, in which the lower edges of said annular grooves are inclined to the direction of the main axle, and said plunger portion is correspondingly inclined to permit upward movement of said main axle by snapping said portion out of said grooves.

3. An ice boring machine in accordance with claim 2, and spring means for urging said portion into engagement with said grooves.

4. An ice boring machine in accordance with claim 1, in which said sludge ejector impeller comprises a pair of radially extending vertical blades whose lower edges curve rearwardly of the direction of motion thereof to slide freely upon the surface of the ice.

5. An ice boring machine in accordance with claim 1, in which said support comprises oppositely positioned base plates on either side of the axle and each having spiles protruding from its underside to bite into the ice surface.

6. A cutting head for an ice boring machine, comprising a shaft portion, a helical wing connected to said shaft portion, said wing having an upwardly decreasing pitch and extending through more than one complete turn, a blade forming a downward continuation of said wing and including lower cutting edge lying at an angle between 45 and 70 degrees with said shaft portion, a vertical plate extending to the opposite side of said shaft portion from said blade and connected therewith, said plate including a lower edge and an outer lower corner, the lower edges of both said blade and said plate being of equal length and forming equal oblique angles with respect to said shaft portion, and a rounded bulge on the outer lower corner of said plate to ride upon the ice surface and located above the lowest part of said cutting edge a distance equal to the desired feed per revolution.

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