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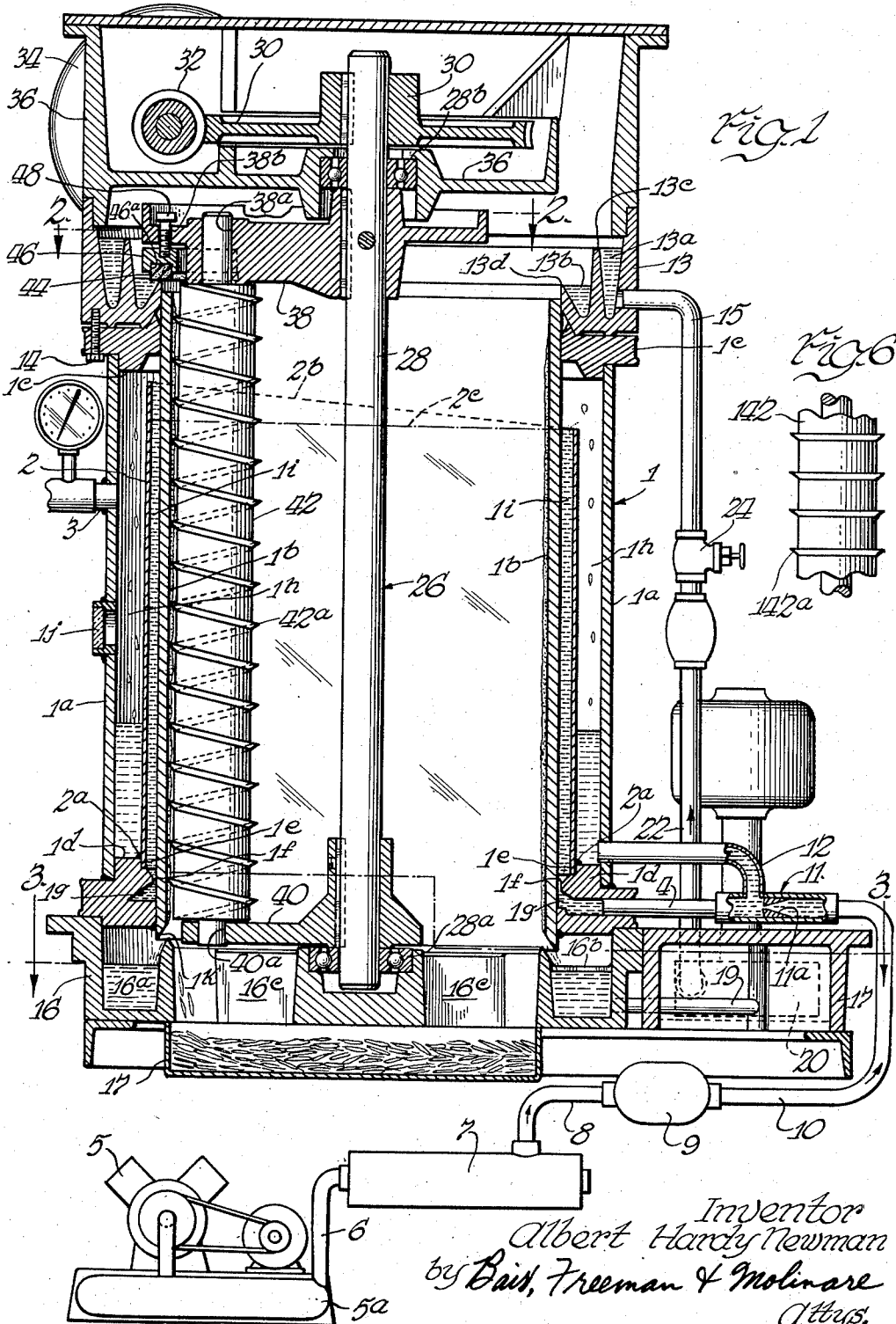
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FLAKE ICE MAKING MACHINE

Filed Jan. 19, 1953

2 Sheets-Sheet 1



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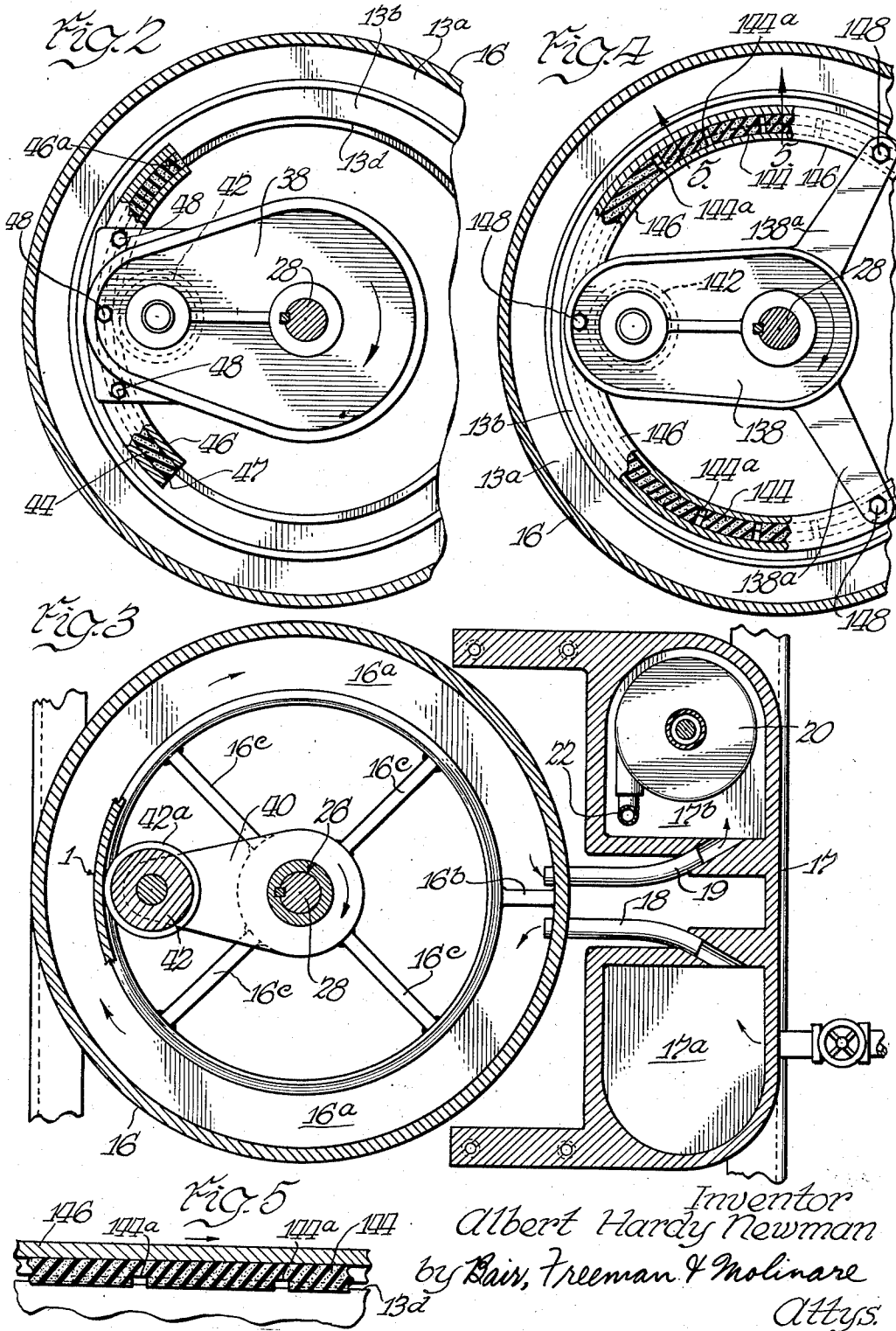
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FLAKE ICE MAKING MACHINE

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7 Claims. (Cl. 62—106)

My invention relates to a flake ice making machine characterized by simple construction, reliable operation, and a high degree of effectiveness in producing dry flakes of ice.

In one form of flake ice making machine a cylindrical evaporator is maintained below the freezing temperature of water and water flowed on the interior face thereof to freeze. A rotor carrying an ice harvesting device is rotated within the cylinder to dislodge the frozen water in flake form. Suitable means is provided to supply water to the top edge of the cylinder to freeze on the inner face thereof and to interrupt the water supply in the region of the harvesting device to assure the production of cold, dry ice and to avoid contamination of the ice by dripping water.

The present invention contemplates an improved machine of the above type wherein the water is distributed on the face of the cylindrical evaporator through a pair of annular gutters. The water flows over the lips of the gutters in a uniform and steady flow which is interrupted only by a shoe which revolves with the rotor to prevent flow in the region of the moving ice harvester. Water dripping from the cylinder is deflected radially outwardly by the conical beveled lower edge of the evaporator so as to fall into a suitable annular water trough. It there mixes with make-up water which is flowing circumferentially about this trough and is recirculated to form ice.

The present invention also contemplates an improved baffle arrangement that maintains a high velocity of liquid refrigerant flow adjacent the freezing face of the drum. This high velocity flow minimizes difficulty due to oil contamination of the refrigerant and improves the heat flow between the refrigerant and the freezing surface. The evaporator is also provided with means to assure that the escaping refrigerant is in the gaseous form uncontaminated by liquid droplets while at the same time any oil-laden foam is returned to the compressor.

It is, therefore, a general object of the present invention to provide an improved flake ice making machine.

Another object of the present invention is to provide an improved water feeding means for a flake ice making machine.

Still another object of the present invention is to provide an improved water distribution device for a flake ice making machine.

Further, it is an object of the present invention to provide an improved evaporator drum for a flake ice making machine.

Another object of the present invention is to provide an improved structure for an evaporator which avoids the return of liquid refrigerant while at the same time acts to return any oil-laden foam.

Yet another object of the present invention is to provide an improved make-up water circulating means in a flake ice machine.

Another object of the present invention is to provide an improved water collecting mechanism for a flake ice making machine.

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It is yet another object of the present invention to provide a flake ice making machine incorporating the above devices.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, together with further objects and advantages thereof, will best be understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

10 Figure 1 is a view in axial cross section of a machine constructed in accordance with the present invention with parts shown in diagrammatic form;

Figure 2 is a fragmentary cross-sectional view through axis 2—2, Figure 1;

15 Figure 3 is a fragmentary view in cross section through axis 3—3, Figure 1;

Figure 4 is a view like Figure 2 but showing an alternative form of the present invention;

Figure 5 is an enlarged fragmentary view through axis 20 5—5, Figure 4; and

Figure 6 is a fragmentary view of an alternative ice harvester for the machine of Figure 1.

In Figure 1, there is shown generally at 1 an evaporator drum. This drum consists of concentric cylindrical outer and inner jackets 1a and 1b defining an annular space closed at the top by the annular top member 1c and at the bottom by the annular bottom member 1d. The bottom member 1d has a stepped or seating portion 1e which forms a socket into which the cylindrical baffle 2 is seated and welded in place as indicated at 2a. Below and inwardly of this socket portion 1e the bottom member 1d extends to proximity with the inner member 1b to form a restricted annular passage 1f. Below passage 1f, the bottom member 1d expands outwardly to form the 35 V-shaped annular passage 1g in conjunction with the inner jacket 1b.

The top edge 2b of the baffle 2 is at all points spaced from the top member 1c to define an edge over which refrigerant can flow in gaseous or liquid form to the outer annular space indicated generally at 1h. Refrigerant escapes from the evaporator drum 1 through the outlet pipe 3 which is located well up on the outer jacket 1a. Refrigerant is supplied to the drum 1 by the pipe 4, which carries the refrigerant in liquid form to the annular 45 header 1g.

Refrigerant travels through suitable pipes (not shown) from the outlet pipe 3 of the evaporator 1 to the intake passage of the motor driven compressor 5 (not shown). In the compressed vapor phase, the refrigerant is discharged from the pump into a condenser 5a where it passes into the fluid state. It then travels through pipe 6 to the heat exchanger 7, where it further cools. Heat exchanger 7 includes pipes (not shown) which receive the vaporized returning refrigerant, together with oil-bearing foam, from the pipe 3. The condensate then travels through pipe 8, dehydrator 9, and pipe 10 to the venturi unit 11. The latter discharges into pipe 4, which in turn feeds the evaporator 1, thus completing the circuit.

60 The venturi unit 11 includes a nozzle 11a which imparts a high velocity to the refrigerant and hence a low static head. Consequently, liquid refrigerant collected at the bottom of annular space 1h is drawn through pipe 12 to mix with the incoming liquid refrigerant to be recirculated. By this means a greater flow of refrigerant travels past the inner jacket 1b than is actually evaporated assuring a flooded condition of refrigerant along the inner face of the jacket 1b and also greater velocity (and hence improved heat transfer and flushing of entrapped 70 gas) is achieved between the inner jacket 1b and the refrigerant.

It will be noted that the refrigerant travelling up the

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inside annular space 1i is travelling through a restricted space defined by the inner jacket 1b and the baffle 2. The refrigerant accordingly travels at a rapid velocity, carrying away gaseous bubbles, giving a good heat transfer and a surface flushing action that minimizes the effects of oil entrained in the refrigerant.

The upper edge 2b of the baffle 2 is sloped with its lowermost point diametrically opposed to the outlet pipe 3. This slope causes the liquid refrigerant level to be approximately as shown at 2c, Figure 1, and assures that the liquid refrigerant escapes over the top of the baffle at points spaced from the outlet pipe 3. This has the advantage of assuring that the refrigerant escaping through the pipe 3 is in gaseous form uncontaminated by splashing or droplets of the liquid refrigerant. In addition, this construction automatically frees the evaporator 1 from any oil logging because any oil in the refrigerant causes foaming over the top of the baffle 1i. The foaming that thus occurs causes the oil-laden foam to escape through the pipe 3 to the pump 5 where it belongs. The relatively heavy liquid refrigerant spills over the low side of the baffle 1i while the very light oil-bearing foam is sucked over the entire peripheral surface of the baffle.

Window 1j is provided for convenient observation of the action of the refrigerant in the annular space 1h.

Water is fed or supplied to the inner face of the drum 1 by the unit shown generally at 13. This unit at its bottom face has a pair of annular ribs or feet which are held against the upper face of the top member 1c by a series of bolts 14 which are threadedly received in the unit 13. This provides a firm anchorage for unit 13 while at the same time minimizing heat transfer therefrom and the consequent risk of freezing of the feed water. If desired, the unit 13 may be in whole or in part unitary with the top member 1c, or may have a considerable area of contact therewith so as to precool water in trough 13b.

At its top face the unit 13 defines a pair of radially spaced annular troughs, indicated at 13a and 13b, respectively. These troughs have a common lip 13c which forms an annular weir over which the feed water travels from trough 13a to trough 13b. The other lip of trough 13b is in registration with the inner face of the freezing drum 1 and is at a lower level than lip 13c. Feed water travels through the pipe 15 into the outer trough 13a as shown.

The annular troughs 13a and 13b with their weir-defining lips 13c and 13d have been found to give a uniform flow of water onto the freezing surface of drum 1. This is highly desirable since the uniformity of the ice formed depends in a large measure on the uniformity of the water supply.

Water dripping from the jacket 1b falls into the annular gutter 16a defined by the bottom member 16. Gutter 16a is radially outward of the jacket 1b so that it does not tend to catch the dropping ice which falls freely into container 17. The jacket 1b is conically bevelled at its lower extremity as shown at 1k to define an annular edge in registry with the gutter 16a and from which water drips into gutter 16a. The water dripping down the jacket 1b adheres to the surface of that jacket by reason of surface tension and hence travels along the face 1k in a downward and radially outward direction to drop into the gutter 16a.

As shown in Figure 3, a web 16b spans the gutter 16a in the region adjacent the intake reservoir 17a and the discharge reservoir 17b defined by the housing 17. The intake make-up water travels from the reservoir 17a through the pipe 18 into the circumferential path defined by the web 16b. The make-up water—progressively augmented by the dripping water to be recirculated—travels circumferentially about the gutter 16a to be discharged through pipe 19 and into the reservoir 17b. Pump 20, located in reservoir 17b, pumps the combined

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make-up water and recirculating water therein through the pipe 22 and the valve 24 into the trough 13a.

The circumferential flow of make-up water through the gutter 16a provides a flushing action that prevents freezing of that gutter, melts any entrapped ice flakes and, in addition, assures a uniform mixture of make-up water and recirculating water.

The ice is harvested by the rotor unit indicated generally at 26, Figure 1. This unit comprises a shaft 28 which is rotated slowly by the motor 34 through the worm gear 32 and bull gear 30. The rotor 26 is supported concentrically with the evaporator drum by the bearings 28a and 28b. The former is in turn supported by the spider arms 16c extending inwardly from the part 16. Bearing 26b is supported by the top frame member 36. The shaft 26 carries a pair of aligned radial arms 38 and 40 which have aligned bearing-defining holes 38a and 40a, respectively. These holes receive the cylindrical bearing end portions of the harvester 42.

The harvester 42 is of generally cylindrical construction with a spiral edged knife part 42a protruding therefrom. The bearing holes 38a and 40a are so spaced with respect to the inner face of the inner jacket 1b that the part 42a has a suitable ice-cutting and dislodging spacing therefrom. As the rotor 26 turns, the knife edge 42a bites into and dislodges the ice to harvest the ice in flakes from the surface upon which it is frozen.

If desired the harvester 42 may have a series of jacketing non-spiraled ice-cutting edges. This is shown in Figure 6 where the harvester is indicated at 142 and the edges indicated at 142a.

Also, if desired, either the form of the harvester shown in Figure 1 or that shown in Figure 6 may be positively driven, either to impart the same relative velocity as the freezing surface of drum 1 or some other velocity. Rotations of the harvester may also be braked if desired.

The flow of water over lip 13d onto the freezing inner face of the drum 1 is interrupted in the region of the harvester 42 by the shoe 44. This shoe rides on the lip 13d and extends both in advance of the harvester 42 and behind the harvester. The top part of the shoe is received in the arcuate support member 46 which defines a socket 46a for this purpose. The support 46 threadedly receives a series of bolts 48 which extend through the holes 38b, Figure 1, in the arm 38 to give a vertically movable lost motion support for the member 46 and for the shoe 44 while confining the same to circumferential movement in unison with the rotor 26.

The shoe 44 may be of felt, rubber, or other suitable substance which will hold back water flow over lip 13d. It is desirable to use a material that wears faster than lip 13d to minimize lip wear. Wear of the shoe is unimportant since it is accommodated by the lost motion connection with the rotor 26.

The shoe 44 not only prevents water flow in the region of harvester 42 but, in addition, it wipes the lip 13d. This prevents the accumulation of ice or foreign matter on this lip and thus maintains a uniform water flow.

Figure 4 shows an alternative embodiment of the present invention wherein the shoe, indicated at 144, is of annular shape and is received in a similar annular support member 146. The latter is carried by an arm 138 which, in addition to the main part supporting the harvester 142, has a pair of spider arms 138a which receive bolts 148 loosely to define a lost motion support for the member 146.

The shoe 144 has a series of radial grooves 144a in the regions spaced from the harvester 142. These grooves define radial water passages with respect to lip 13d, in Figure 5, to permit water flow to the evaporator surface. Since these passages are of limited size, a water pressure can be built up in the trough 13b and the velocity of the water can be increased beyond that asso-

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ciated with the weir action of the device of Figure 1. This increased velocity minimizes surface tension effects and reduces any tendency of this part of the unit to freeze.

If desired the lip 13c may slope from a high point opposite the pipe 15 to a low point diametrically opposed to the high point. By this means water flow at the low point of the lip is favored, thus overcoming any tendency for greater water flow adjacent pipe 15.

While I have shown and described specific embodiments of the present invention, it will, of course, be understood that various modifications and alternative embodiments may be made without departing from the true spirit and scope thereof. I, therefore, intend by the appended claims to cover all such modifications and alternative constructions as fall within the true spirit and scope.

What I claim is:

1. A flake ice making machine comprising in combination: an evaporating drum comprising inner and outer concentric cylindrical walls and upper and lower annular walls to define an annular space, the drum having a refrigerant outlet passage at the upper portion of said space; a cylindrical baffle within said space and in closely spaced relation with one of the cylindrical walls, the baffle having a sloping top with its highest reach in alignment with the refrigerant outlet opening of the drum; means to introduce refrigerant to the lower portion of the space between the baffle and said one cylindrical wall; means to flow water on said one cylindrical wall; and means to remove ice from said one cylindrical wall.

2. In a flake ice making machine; a freezing cylinder; means to cool one face of the cylinder to form ice thereon; an annular water trough located above and in radially spaced relation to said face; a second annular water trough located above said face and having one lip in common with the said first trough to define a weir, the other lip of the second annular water trough being in registry with the said face of the cylinder and below said one lip; and means to supply water to the first trough to flow over the said first lip to the second trough and over the said second lip onto said face of the cylinder.

3. In a flake ice making machine; a freezing cylinder; means to cool one face of the cylinder to form ice thereon; an annular water trough located above and in radially spaced relation to said face; a second annular water trough located above said face and having one lip in common with the said first trough to define a weir, the other lip of the second annular water trough being in registry with said face of the cylinder and below said one lip; a rotor having ice harvesting means operable to remove ice from said face of the cylinder along a moving element thereof; a shoe mounted for movement in unison with the rotor and to ride on said other lip, the shoe being located in registry with said ice harvesting means to cut off water flow to the regions of the cylinder adjacent the ice harvesting means; and means to supply water to the first trough to flow over said first lip to the second trough and over said second lip onto said face of the cylinder in regions spaced from ice harvesting means.

4. In a flake ice making machine; a cylinder; means operable to cool a face of the cylinder below freezing

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temperature; an annular water supply trough located above said face and having a lip over which water can flow onto said face of the cylinder; a rotor; a knife having a spiral blade rotatably mounted on the rotor and in position to ride on said face of the cylinder; and a shoe mounted for rotation in unison with the rotor and to ride on the said lip, the shoe being located to interrupt the flow of water over said lip in the region of the knife.

5. In a flake ice making machine; a cylinder; means operable to cool a face of the cylinder below freezing temperature; an annular water supply trough located above said face and having a lip over which water can flow onto said face of the cylinder; a rotor; a knife having a spiral blade rotatably mounted on the rotor and in position to ride on said face of the cylinder; a shoe mounted for rotation in unison with the rotor and to ride on the said lip, the shoe being attached to the rotor by a vertically movable lost motion connection.

6. In a water collecting trough for a flake ice making machine of the type wherein water is flowed on a vertical cylindrical freezing surface and excess water drips from the surface, the improvement comprising; an annular water trough located below the surface to receive water dripping therefrom, the trough having a web at one point and defining water inlet and water outlet passages adjacent the web; means to introduce water through the water inlet passage to mix with the collected dripping water and travel circumferentially about the trough; and means to discharge water from the outlet passage onto the top edge of the face of the cylinder for freezing.

7. A water distributing and ice harvesting device for a flake ice making machine of the type having a vertical freezing cylinder, the device comprising an annular trough with a lip in registry with the cylinder and over which water can flow onto the cylinder; a rotor; an annular shoe on the rotor and having a series of radial grooves through which water can flow over the lip of the trough and onto the cylinder, the shoe having a portion of substantial length free from the grooves; and an ice harvesting device mounted on the rotor in registration with said portion of the shoe.

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