

Nov. 29, 1955

T. KATTIS
FLAKE ICE MACHINE

2,724,949

Filed March 10, 1951

5 Sheets-Sheet 1

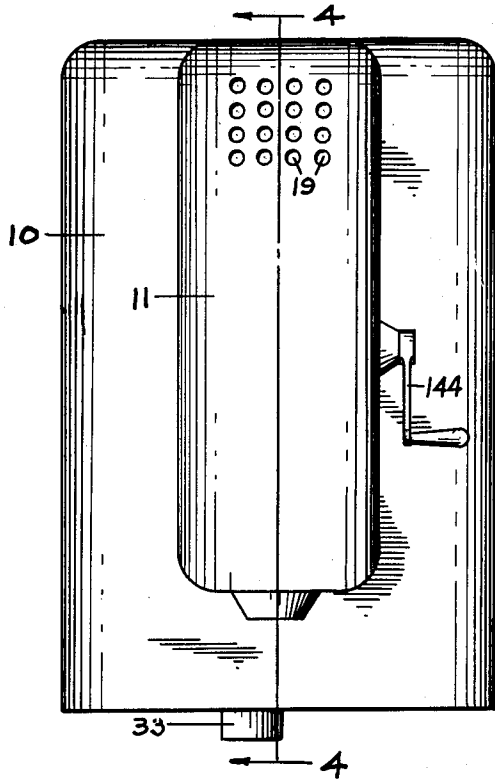


Fig. 1.

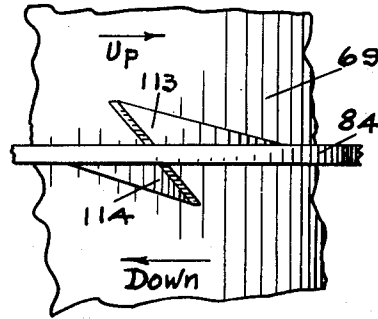


Fig. 3.

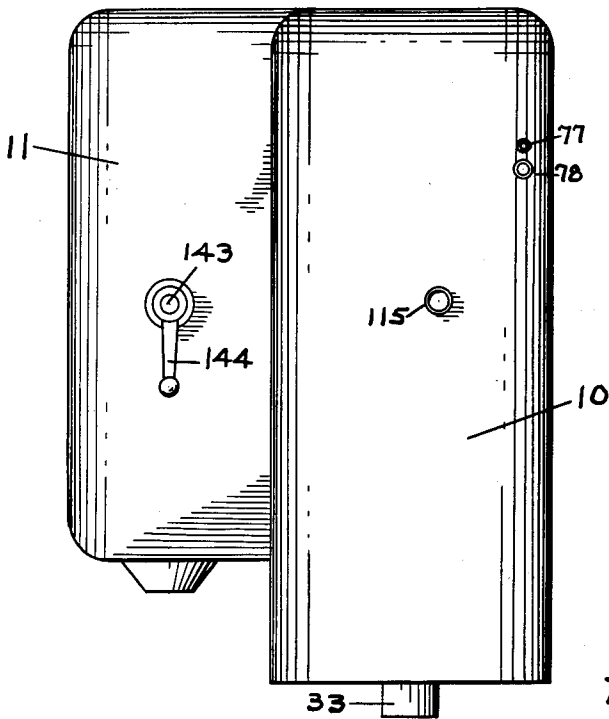


Fig. 2.

INVENTOR,
Theodore Kattis,
By Herbert A. Minturn,
Attorney.

Nov. 29, 1955

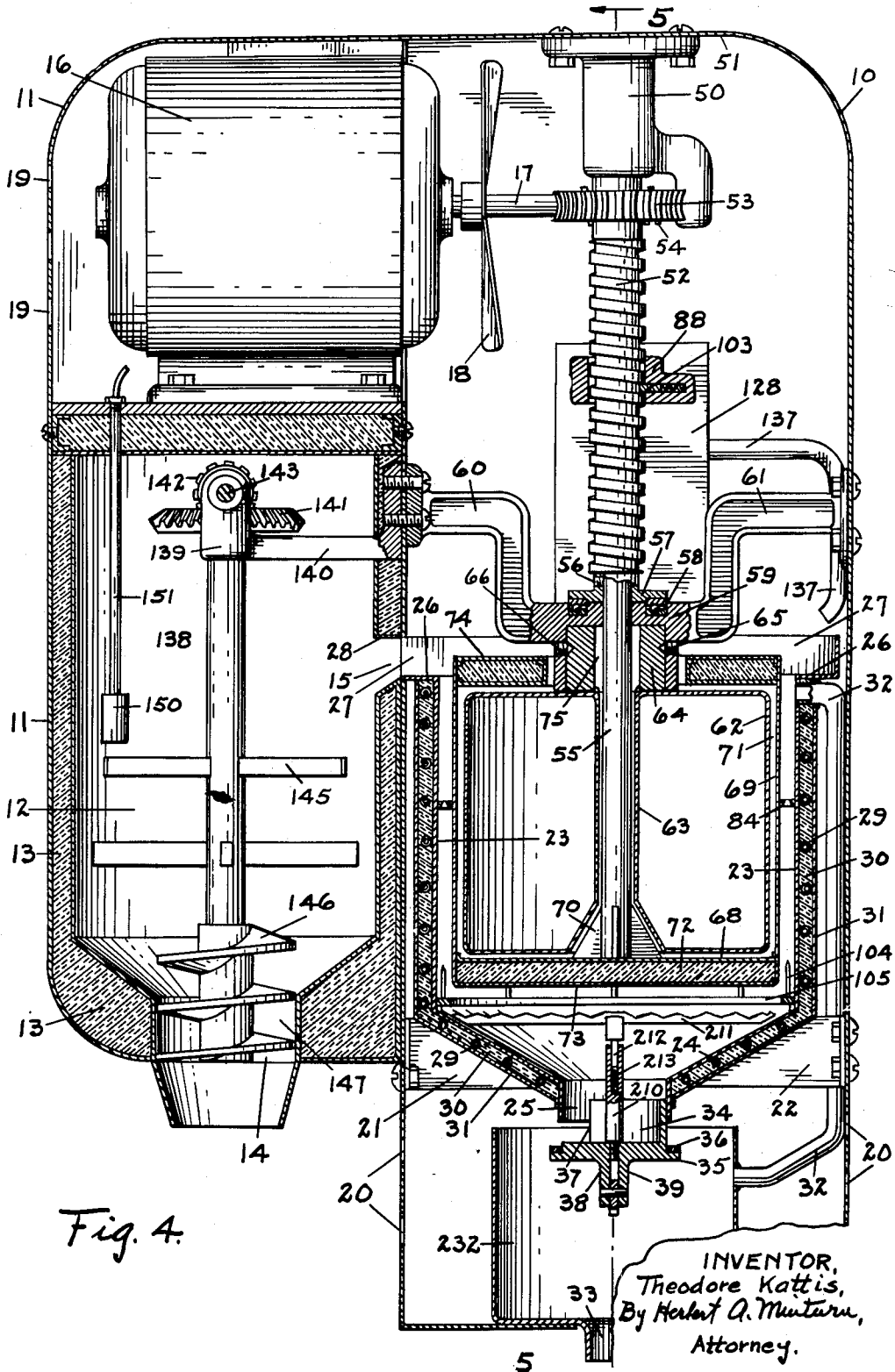
T. KATTIS

2,724,949

FLAKE ICE MACHINE

Filed March 10, 1951

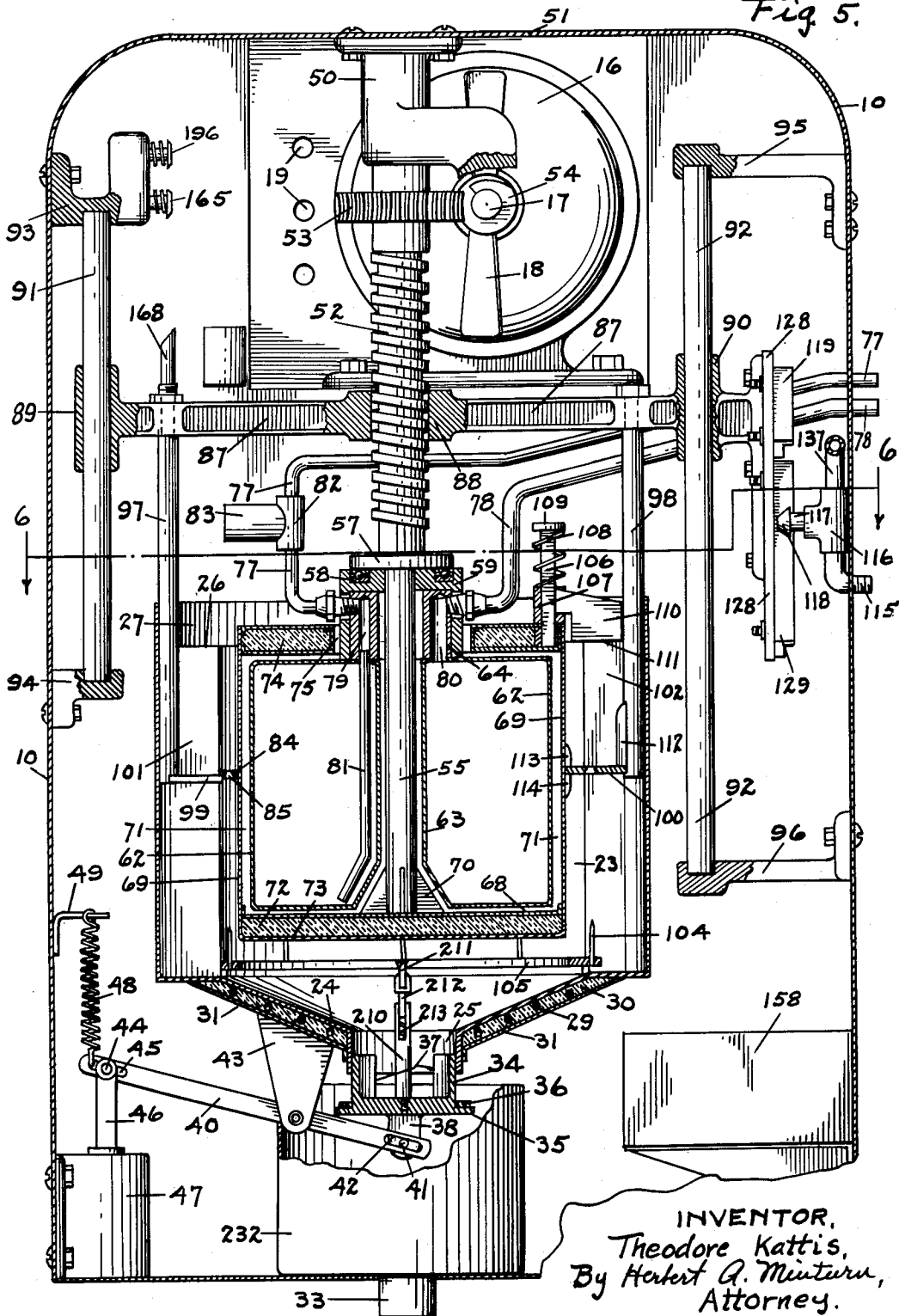
5 Sheets-Sheet 2



T. KATTIS
FLAKE ICE MACHINE

5 Sheets-Sheet 3

Fig 5.



Nov. 29, 1955

T. KATTIS

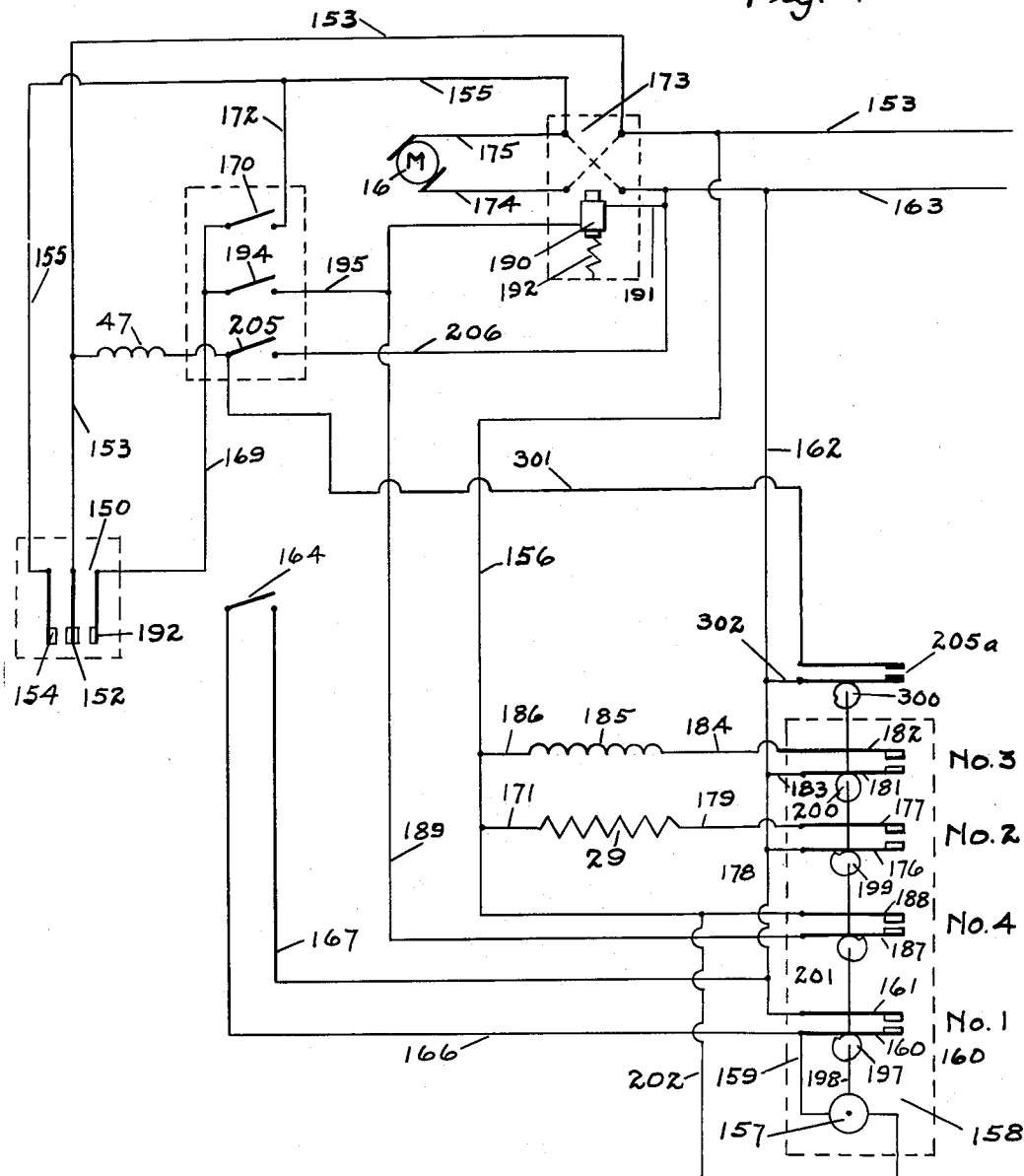
2,724,949

FLAKE ICE MACHINE

Filed March 10, 1951

5 Sheets-Sheet 5

Fig. 9.



INVENTOR,
Theodore Kattis,
By Herbert A. Minturn,
Attorney.

1

2,724,949

FLAKE ICE MACHINE

Theodore Kattis, Bedford, Ind.

Application March 10, 1951, Serial No. 214,874

18 Claims. (Cl. 62-4)

This invention relates to a machine for making flake or chipped ice such as is normally employed in icing glasses of drinks. The machine is intended to be made primarily in units which may be mounted on counters or suitable supports in confectionaries, drug stores, restaurants and the like, where the machine will be conveniently available for dispensing ice directly into glasses into which the drinks may be poured.

The machine includes a revoluble drum which is internally refrigerated so that the drum forms a surface upon which ice may be formed directly from water in contact with the exterior surface of the drum. A primary purpose of the invention is to form on and remove from this drum surface ice that is perfectly clear or transparent rather than the usual clouded or opaque ice which is not very attractive when served in glasses.

In order to produce ice of this nature, in the chipped or flake form, it is necessary that frost be removed from the freezing unit or drum as well as the water container in which the drum is immersed so that this frost will not be mixed with the ice produced and removed from the drum.

To remove the ice from the freezing unit or drum, a ring is provided to completely encircle the drum, and this ring carries a shaving blade which cuts off the ice as the drum revolves therepast. This cut-off ice is removed very ingeniously by a "flipper" blade which kicks the cut-off ice into a storage chamber. The amount of ice in this storage chamber is the controlling factor in effecting and stopping operation of the machine. That is, when the ice compartment is filled to a predetermined level, the ice machine does not operate. When the ice drops below that predetermined upper limit, then the ice machine automatically is set into operation and continues in a cyclic manner to produce ice as long as there is a demand for that ice in the ice storage compartment or chamber.

In order to conserve water consumption, the water container in which the freezer drum is immersed is automatically replenished with water in accordance with the amount of water which is withdrawn in the form of ice during the operating cycles of the freezing unit. Finally when the freezing cycles are completed, and there is no further demand for ice in the ice compartment then all of the water in the water container is dumped in order to prevent freezing up of the unit when the unit is idle between demands for ice.

In further respect to the frost removal before the ice is formed on the surface of the freezing unit drum, there is a preliminary warming cycle softening the ice on the wall of the water container particularly previous to a mechanical scraping of the frost from the wall of the water container. To prevent excessive building up of frost on the various surfaces, the refrigerating cycle is controlled, and refrigeration is effected primarily only during the demand for production of ice.

A further important object of the invention is to provide a relatively simple structure with a simple cyclic

2

control thereof which may be extremely durable and operable over long periods of time without undue servicing of the mechanism. The size of the ice storage chamber is purposely held to a minimum so that fresh ice is frequently formed, and the ice in the storage does not stand so long as to become a solid unit, and moreover does not stand long enough to take up odors which may be present in the room in which the machine is to operate.

These and many other important objects and advantages of the invention will become apparent to those versed in the art in the following description of one particular form of the invention as illustrated in the accompanying drawings, in which:

Fig. 1 is a view in front elevation of a structure embodying the invention;

Fig. 2 is a view in right-hand side elevation;

Fig. 3 is a detail on an enlarged scale in side elevation of the ice and frost cutting instrumentalities;

Fig. 4 is a view in vertical section on the line 4-4 in Fig. 1;

Fig. 5 is a view in vertical transverse section on the line 5-5 in Fig. 4;

Fig. 6 is a view in horizontal transverse section on the line 6-6 in Fig. 5;

Fig. 7 is a view in right-hand elevation of the water control mechanism;

Fig. 8 is a view in transverse section on the line 8-8 in Fig. 7; and

Fig. 9 is a schematic wiring diagram of the control system.

A primary housing 10 is utilized to house the ice making mechanism. A secondary housing 11 is mounted in the present form on the front side of the housing 10, and the major part of this housing 11 contains an ice holding compartment 12. This ice holding compartment 12 is entirely surrounded on its sides and top by suitable heat insulating material 13, the entire chamber 12 being thus enclosed with the exception of an underside opening 14 and an entrance doorway 15 on the side adjacent the housing 10. Above the ice chamber 12 and within the housing 11 there is mounted the main drive motor 16. This motor is of the reversible type. Its armature shaft 17 extends into the housing 10, and in any suitable manner drives an air circulating fan 18, herein shown as being mounted directly on the shaft 17 within the housing 10. It is desirable to circulate air through the housing 10 in order to reduce as much as possible the formation of frost therein which might arise due to moist conditions and to the refrigerating mechanism which will be presently described. This circulation is achieved by means of this fan 18 taking air in through a plurality of holes 19 in the front wall of the housing 11, and discharging air through holes 20 in the lower part of the housing 10, Fig. 4.

Within the housing 10, and within the lower half thereof, there is mounted upon suitable brackets 21 and 22 a water tank, hereinafter termed a water can for the sake of simplicity in following through the description. This can carries the numeral 23 and is cylindrical in shape in respect to its side wall, from which wall the floor 24 is carried downwardly in the nature of an inverted cone, terminating in a discharge neck 25 directed downwardly.

This water can 23 has its upper end flaring outwardly into a horizontally disposed annular floor 26 extending entirely therearound, and bounded by a vertically disposed enclosing wall 27. This floor 26 is carried across to the front wall of the can where it forms the bottom horizontal edge of the window 15, Fig. 4, and the top of the wall 27 comes at least to the top edge 28 of this window 15.

The water can 23 is preferably surrounded by some means for heating the wall thereof. In the present showing, this heating means consists of electrical resistance 29 carried around the outside of the wall of the can 23, within

3

suitable insulating material 30, and completely enclosed by an outer shell 31. The resistance 29 is continued down under the under conical floor 24 as indicated in Fig. 4.

To hold water below or at a predetermined level, there is an overflow pipe 32 leading from the top of the water can 23 immediately under the floor 26, and carried downwardly to discharge into a basin 232. This basin 232 has an outlet 33 which may be connected to any suitable means for disposing of water collecting in the basin.

Fitting within the collar or drain nipple 25 which continues from the floor 24 is a sleeve valve 34 carrying an outwardly turned annular flange 35 on the top of which is mounted a suitable gasket 36 for sealing connection between the flange 35 and the rim of the nipple 25. That is, this sealing is obtained when the valve 34 is pushed upwardly as far as it may be inserted within the nipple 25, which travel is determined by the striking of the gasket 36 against the under edge of the nipple 25.

This sleeve valve 34 has its side wall cut away to leave an open gate 37 on one side. In the present design, this gate 37 is on the forward side of the valve 34. Thus, as soon as the valve 34 starts to lower from the nipple 25, there is an opening provided by the valve through this gate 37. The basin 232 is centered under this valve 34 so that drainage from the water can 23 through the nipple 25 and out past the valve 34 through its gate 37 is directly into the basin 232.

This valve 34 carries a pair of downwardly turned ears 38 and 39 between which slidably passes a rocker arm 40 having a pin 41 engaged through a slot 42 in the arm 40, the pin 41 being fixed between the ears 38 and 39, Fig. 4.

This arm 40 is rockably supported by a bracket 43 which is fixed to the underside of the enclosing shell 31, that is on the part of the shell under the water can floor 24, Fig. 5. The arm 40 is carried on out toward the wall of the housing 10, where a pin 44 entering through a slot 45 is carried on the upper end of an armature link 46 which connects with an armature carried within a solenoid winding 47, the link 46 being if desired the armature itself. The travel of the member 46 in any event is primarily vertical. In order to maintain the valve 34 in a normal open position, that is a water can draining position, a spring 48 is engaged by its lower end to the arm 40 adjacent the pin 44, and by its upper end to any suitable member such as a bracket 49 which in turn is fixed to the side wall of the housing 10. Thus, the spring 48 normally controls the valve 34, and biases it to an opening position. When the solenoid 47 is energized, it overcomes the spring 48 to stretch that spring, and cause the arm 40 to rock the valve 34 to a closed and water holding condition.

Within the housing 10, there is fixed a bracket 50 to the top wall 51 of the housing 10, and this bracket 50 supports a vertically disposed worm or screw shaft 52, holding the shaft in a vertically aligned position, and also holding it in a fixed position against longitudinal travel thereof. On this shaft 52 there is fixed a worm wheel 53 which is in constant mesh with a driving worm 54 in turn fixed on the motor shaft 17.

The shaft 52 has an extension shaft 55 which extends downwardly and axially within the water can 23. This extension shaft 55, in the present design, telescopes within the lower end of the screw shaft 52, and is secured by its upper end in any suitable means to the shaft 52, herein shown as by a set screw 56, Fig. 4. As a further support for the screw shaft 52, there is provided at its lower end an annular collar 57 which rides on a thrust bearing 58 in turn carried by a fixed block 59. This block 59 is supported by a pair of inverted L-shaped arms 60 and 61 which are fixed to the front and back walls of the housing 10 respectively, Fig. 4. The extension shaft 55 extends downwardly and freely through the block 59.

An evaporator chamber 62 is provided with a centrally disposed tube 63 entirely therethrough, and through which tube 63 the shaft 55 extends freely and out of contact

4

with the tube wall. This evaporator chamber 62 is in the nature of a "doughnut" and is supported by means of an annular ring 64 fixed on its top end concentrically with the central tube 63, and is engaged within a bore provided in the lower end of the block 59, and there secured by any suitable means, such as by the set screws 65 and 66, Fig. 4. Thus the evaporator chamber 62 is held stationary, against rotation, and against vertical travel.

The extension shaft 55 extends on through the tube 63 as above indicated and has fixed to its lower end a floor 68 of the ice drum 69, around the cylindrical wall of which is formed the ice as will hereinafter be described. The shaft 55 is further secured to the floor 28 by a means of a plurality of gussets 70, the lower end of the tube 63 flaring out so as to clear these gussets 70. These gussets 70 not only serve as reinforcing means to stabilize the floor 68 in reference to its connection with the shaft 55, but also serve as impellers of a heat transfer fluid which is carried by the ice drum 69, between it and the evaporator 62. The ice drum 69 has a clearance space 71 entirely around the evaporator chamber wall 69 so as to leave space for this fluid.

However this space is held to a minimum as indicated in Figs. 4 and 5 in order to effect a quick transfer of heat between the ice drum 69 and the evaporator 62, this space being such that the fluid contained therein will be tended to be carried circumferentially around the evaporator 62 as the drum 69 is revolved therearound by means of the shaft 55. The fluid may be of different compositions, one particular suitable fluid being the usual brine solution which will not freeze at normal water freezing temperatures.

The floor 68 of the drum 69 is insulated by suitable insulation 72, supported thereagainst by a sub-floor 73. The top of the ice drum 69 is provided with a removable cover 74 of an insulating nature, having an annular opening 75 therethrough clearing the outside of the lower portion of the block 59, Figs. 4 and 5. By reason of the upper cover 74 being of an insulating nature, and by reason of the presence of the insulation 73 across the underside of the floor 68, the primary heat transfer then from the brine carried within the space between the ice drum 69 and evaporator chamber 62 is laterally through the side walls of those two members.

Thus it is to be noted, that the evaporator chamber 62 is held stationary while the ice drum 69 is revolved in spaced relation therearound.

The block 59 is so proportioned that the collar 64 extends up therein a distance so as to permit side connections with a refrigerant conveying tube 77 and a gas outlet tube 78, Fig. 5. These tubes 77 and 78 interconnect respectively with the vertical bores 79 and 80 provided in the collar 64. The bore 79 has a tube 81 fixed in its lower end thereof to extend downwardly to the floor of the evaporator 62, where the refrigerant in the nature of a liquid may discharge and evaporate within the chamber 62. Gas produced by the evaporation escapes through the vertical bore 80 and out through the tube 78. The refrigerant tube 77 carries an intercepting and control valve 82 which is magnetically controlled such as by a solenoid 83.

A ring plate 84 surrounds the ice drum 69 and fits between it and the wall of the water can 23 with a close sliding fit. This ring plate 84 is provided with a plurality of frustoconical passageways 85 therethrough as a means for permitting water to pass through those openings from one side of the plate 84 to the other.

A cross beam 87 carries a tooth block 88 through which the screw shaft 52 slidably passes. The beam 87 is substantially horizontally disposed, and by means of vertically disposed end sleeves 89 and 90 is guided to travel in vertical directions by reason of these sleeves 89 and 90 slidably fitting over vertically disposed posts 91 and 92. These posts 91 and 92 are fixed in positions by means of

the upper and lower brackets 93, 94, and 95, 96 respectively. These brackets in turn are supported by the wall of the housing 10. Fixed to and extending downwardly from the beam 87 is a pair of ring plate supporting rods 97 and 98. These rods 97 and 98 engage through an arm 99 on the one side and an extension tongue 100 on the other side with the ring plate 84. It is necessary as will become apparent later to space apart these rods 97 and 98 a diametrical distance by their opposing sides equal to the diameter of the inside of the flange 27 which extends upwardly from the floor 26. Thus the arm 99 is carried outwardly from the ring plate 84 through a vertically disposed slot 101 on the one side, and through a rectangular ice receiving chamber 102 on the other side. The slot 99 is an extension or bulge outwardly of the wall of the water can 23, and likewise the chamber 102 is an outward extension from this water can 23.

The tooth block 88 carries a spring-urged tooth 103 into engagement with the threads of the screw shaft 52. This engagement is such that upon turning of the shaft 52, the tooth block 88 will be carried upwardly and downwardly longitudinally of the shaft 52 depending upon the direction of rotation of that shaft. This motion in turn is imparted to the ring plate 84. However when the tooth block 88 is carried downwardly toward the lower end of the screw shaft 52, above the collar 57, the tooth 103 will become disengaged from the threads, with the result that the tooth block 88 is no longer driven downwardly, but by means of the spring control of the tooth 103, upon reverse direction of travel of the screw shaft 52, the tooth 103 will become reengaged with the threads of that shaft, so that the tooth block may be carried upwardly along the shaft 52. The tooth 103 does not leave engagement of the threads of the shaft 52 at the upper end thereof, so that the shaft 52 has to be reversed in direction of rotation to effect reversal of travel of the tooth block 88. The purpose of the spring urged tooth 103 is to permit the tooth block 88 to dwell for a desired length of time at the lower end of the threads on the shaft 52, until that shaft 52 may be reversed in direction of rotation.

Within the water can 23, and at the lower end thereof, at approximately the junction of the cylindrical wall with the lower conical floor, there is provided a plurality of upwardly directed pins 104 which are so aligned as to enter the passageways 85 in the ring plate 84. The purpose of these pins 104 is to enter and in effect traverse these passageways as the ring plate may be lowered over the pins 104 so as to keep these passageways open and clear of ice, the openings being cleared at each downward limit of travel of the ring plate. For convenience, these pins 104 are shown herein as being mounted on a ring 105 supported at the lower end of the water can 23.

A post 106 is fixed to the ice drum cover 74 to extend upwardly, vertically therefrom near its outer peripheral margin. This post 106 is securely fixed against rotation, and against lifting from the cover 74. Surrounding the post 106 is a sleeve 107 which may travel longitudinally of the post 106 but not circumferentially therearound. A spring 108 bearing against the head 109 of the post 106 and the top side of the sleeve 107 normally retains the sleeve 107 in its lower position against the top side of the cover 74.

A "flipper" blade 110 is connected to the sleeve 107, with a fixed attachment thereto, and is shaped to extend by a lower edge 111 to be in contact with the floor 26 as the drum 69 may be revolved to carry the blade 110 therearound. The blade 110 has a radial length outwardly from the drum 69 to bring its outer edge into close proximity with the upturned wall 27. This blade 110 is made out of an elastic material, such as spring steel, so as to have sufficient rigidity to carry along normally any ice particles which may be around on the floor 26, but which may be bent out of its true radial position by meeting an obstruction particularly at its outer end.

The post 98 which extends upwardly along the outside of the ice receiving compartment 102 carries a cam 112 at its lower end to extend within that receiving compartment, for a vertical distance slightly exceeding the height of the blade 110. Thus as the blade 110 is carried around to wipe over the floor 26 within the wall 27, and when the rod 98 is in an elevated position to carry the cam 112 into the path of the outer edge of the blade 110, the blade 110 will be caused to be bent backwardly from the direction of rotation, by reason of its striking this cam 112, with the result that as the blade 110 is carried on therepast, the blade will flip forwardly quite sharply, and return to its true radial position, as indicated in Fig. 6.

The ring plate 84 has fixed thereon an upwardly disposed ice scraping or cutting tooth 113, Fig. 3. With the rods 97 and 98 travelling unwardly, and the ice drum 69 revolving in a counterclockwise direction as viewed in Fig. 6, the tooth 113 will be shaped as indicated in Fig. 3, preferably inclined against or toward the direction of the oncoming surface of the drum 69 so as to give a diagonal, sheer cut of ice which may be on that surface. There is also a frost shaving tooth 114 mounted to extend from the underside of the ring plate 84 to be in substantial sliding contact with the wall of the ice drum 69 as is also the tooth 113. The purpose of this tooth 114 is to scrape off the frost which may have accumulated on the surface of the ice drum 69 when the ring plate 84 has been carried to the top thereof, and allowed to rest between ice making cycles, this tooth 114 being inclined against the oncoming travelling direction of the drum 69 when the ring 84 is being lowered by the rods 97 and 98. Thus the tooth 114 is inclined in the opposite direction from the tooth 113. It is to be noted that due to the relative inter-travel between the drum 69 and the ring plate 84, the tooth 113 as well as the tooth 114, depending upon the direction of rotation of the drum 69, will in effect define a spiral or helical cut around the drum 69 of either the ice or frost which ever may be the cutting operation at the time. In many instances, the frost tooth may not be required, since the frost will be relatively soft as compared to the ice to be removed. The ring plate 84 will be sturdy enough to shave or scrape off the frost as it traverses the drum in the direction opposite to the direction of travel in the ice cutting operation. In either use, with or without the frost tooth 114, the ring plate 84 not only scrapes the drum but serves as an effective barrier across the space between the drum 62 and the water can 23, so that the frost never comes into contact with the ice. The primary frost condition encountered is that after the water has been dumped and before the next ice forming cycle.

Water supply is had through an external connection 115 which leads into the housing 10 to a control valve 116. This valve 116 is of that type of construction which has a control stem 117 normally urged outwardly when the valve 116 is in a closed position. The outer end of this stem 117 carries a cam head 118 herein shown as being of a conical nature.

On the outer right-hand end of the beam 87 there is a plate 128 fixed thereto in substantially vertical alignment. This plate 128 is so positioned on the beam 87 as to travel vertically past the head 118 with sufficient clearance therebetween to permit the head 118 to remain in its outwardly extending, closed-valve condition.

On the outer face of the plate 128 is rockably mounted a short length of a cam block 119. This cam block 119 is L-shaped in cross section, and is interconnected with the plate 128 by means of pins 120 and 121 extending respectively through upper and lower slots 122 and 123. The upper end of the cam block 119 is pulled forwardly by means of a tension spring 124 interconnecting the cam block 119 an an abutment such as a pin 125 fixed to the plate 128. A spring 126 engages the lower

pin 121, herein shown as on the inner side of the plate 128 to pull it rearwardly so that the cam block 119 normally assumes the inclined position as indicated in Fig. 7, to have the flange 127 to be normally in the path of the head 118 as the plate 128 may be vertically reciprocated in reference thereto.

Then the plate 128 also carries a block 129 longer in length than that of the upper cam block 119. This lower cam block 129 has a pin 130 entering through an upper slot 131, and a lower pin 132 entering through a lower slot 133. A tension spring 134 normally retains the upper end of the cam block 129 to the forward end of the slot 131, and likewise a lower spring 135 pulls the lower end of the cam block 129 rearwardly of its lower slot 133. These slots 122, 123, and 131, 133, are so arranged and so proportioned that the cam blocks 119 and 120 may be shifted from their inclined positions to vertically aligned positions from the dash line positions to the dot-dash line positions, Fig. 7. The path of the valve stem head 118 is also in the path of the vertically aligned cam blocks as shown in the dash line positions, Fig. 7. The lower cam block 129 has the same cross-sectional shape as does the cam block 119, with the flange 136 being on the rear side of the block. However it is to be remembered that the cam blocks 119 and 129 are normally in their solid line positions by reason of the biasing of the respective springs as above described. From the water valve 116, a discharge line 137 leads to discharge over the wall 27 onto the floor 26, so that water may be discharged onto that floor, and wash it off and flow down onto the plate 84, and on below through the passages 85 into the water can 23.

In the ice storage compartment 12, Figs. 4 and 6, there is a vertically disposed shaft 138 suspended from a supporting bracket 139 in turn supported from the housing 10 by the arm 140. This shaft 138 has fixed on its upper top end a bevel gear 141 in constant mesh with a smaller bevel gear 142. This bevel gear 142 is fixed on a cross shaft 143 which extends horizontally and outwardly through the wall of the housing 11 to carry on its outer end a crank arm 144 as a means of revolving the shaft 138. The shaft 138 carries a plurality of agitating arms 145, these arms being radially disposed so as to break up ice masses tending to form within the compartment 12 from the chipped or flaked ice deposited therein. On the lower end of the shaft 138 there is provided a feed screw 146 fitting within a cylindrical neck 147 leading to the discharge 14. This feed screw 146 will turn with the shaft 138 so that ice will be fed from the lower portion of the compartment 12 upon turning the external crank 144.

Operation

The entire operation of the device so far described is subject to conditions within the ice storage compartment 12, as reflected by a thermostat 150 which is exposed within the chamber 12 at a position at which it will be covered by ice at the maximum level thereof, the ice terminating at substantially the top or slightly above the top of the thermostat. In the present instance, Fig. 4, the thermostat 150 is supported within the chamber 12 by a pipe or conduit 151 through which the wires interconnecting at the thermostat with the various circuits are conducted.

Referring to the wiring diagram, Fig. 9, when the ice compartment 12 is empty, or the ice level has dropped below the thermostat 150, the thermostat will close a circuit whereby the shiftable element in the thermostat, 152, will interconnect a wire 153 leading from a current source to the wire 155 through the thermostat contact member 154, the wire 155 connecting with the reversing switch 173 from which leads the wire 175 to the main drive motor 16. From the main drive motor 16, a wire 174 leads back to the reversing switch 173, and thence to the wire 163 leading from the current source to com-

plete a circuit through the motor 16, this circuit completing serving to energize the motor 16 to drive the screw shaft 52 in that direction which will carry the tooth block 88 downwardly.

Also, a circuit will be closed from the service wire 153, wire 156 the wire 202, to the synchronous motor 157 which drives a time cycle controller 158. From the synchronous motor 157, a wire 159 leads to connect with the time cycle controller switch element 160. The opposing switch element 161 is connected through the wire 162 to the service wire 163. The switch embodying the two opposing contact elements 160, 161 will be hereinafter referred to as switch Number 1. When the thermostat contact members 152 and 154 come into contact one with the other, and the tooth block 88 is at its extreme upper limit of permissible travel, this switch No. 1 will be open.

From the wire 159, there is a wire 166 leading to a switch 164, from which a wire 167 leads back to the wire 162. The switch 164 is provided to close the circuit to the synchronous motor initially prior to the closing of switch No. 1. This switch 164 is located, Fig. 5, to have a push button 165 or some other similar operating member to be in the path of a cam post 168, whereby the button 165 is pushed to the left as viewed in Fig. 5 to open the switch 164 when contacted and over-ridden by the post 168, as will be the case when the tooth block 88 is in its upper portion of its travel. The switch 164 therefore does not close until the post 168 has been lowered sufficiently to permit the operating member 165 of the switch 164 to return to the right position which is the closed position of the switch 164.

However since the thermostat 150 as above indicated has closed the circuit to set the motor 16 into operation to drive the screw shaft 52 in that direction carrying the tooth block 88 downwardly, the post 168 will thereby be lowered within a short length of travel of the tooth block 88, so that the switch 164 may close and set the synchronous motor 157 into operation to operate its variously driven switches in the cycles hereinafter described. The first operation is the closure of the switch No. 1 so that the synchronous motor 157 will be energized thereafter until the completion of a predetermined cycle regardless of the possible open condition of the switch 164. Any suitable means for opening and closing the switch members 160 and 161 may be employed, such as the cam 197 herein suggested, the cam being turned in accordance with the turning of the main drive shaft 198 operated by the synchronous motor 157.

While the motor 16 remains energized as above indicated, driving the tooth block 88 downwardly, and continuing to drive the shaft 52 even after the cam block 88 reaches the extreme lower end of the possible travel along the shaft 52, the synchronous motor 157 continues to operate since the switch No. 1 is then closed in addition to switch 164. Operation of the synchronous motor 157 next closes the contact members 176 and 177 of switch No. 2, operated by the cam 199.

Switch No. 2 closes a circuit between the service wire 163, wire 162, wire 178, switch contact member 176, switch contact member 177, wire 179, and the heating element 29 which surrounds the water can 23. From the heating element 29, a wire 171 interconnects with the wire 156 thereby setting up the circuit to energize the heating element 29, and supply heat sufficient to melt frost on the inner wall of the water can 23.

The cam 199 has that contour whereby the switch No. 2 will remain closed but a few seconds and then open and remain open during the remainder of the single revolution of the cam shaft 198, so that the heating element 29 is initially energized upon the first closing of the switch No. 1 which is at or shortly after the closing of the switch 164, that event occurring when the tooth block 88 has travelled but a short distance downwardly from its extreme upper position as is dependent

upon the location of the switch operating member 165 in relation to the length of the cam post 168.

Following successive steps of operation by the synchronous motor 157, a cam 200 turns to permit the contact members 181 and 182 of a switch No. 3 to close, to complete a circuit from the service wire 163, the wire 162, wire 183, the switch member 181, switch member 182, wire 184, the winding 185 of the solenoid 83 which controls the refrigerant line valve 82, the wire 186, and wire 156 connecting with the other service wire 153. This energization of the winding 185 opens the valve 82 to allow the refrigerant to flow through the line 77, the valve 82, and into the expansion chamber 62 so as to set up the refrigerating cycle. Switch No. 3 remains closed for that interval of time which is predetermined to effect the desired thickness of ice on the external wall of the ice drum 69. It is to be remembered that the ice drum 69 is filled with brine or a like liquid through which the heat is extracted from the wall 69 to the expansion chamber 62.

As the desired length of time of the refrigerating operation nears its end, a switch No. 4 closes through the turning of the cam 201 to close a circuit from the service wire 153, the wire 156, the switch element 188, the switch element 187, a wire 189, the winding 190 of a solenoid which is part of the reversing switch 173, the wire 191, and the service wire 163.

This causes the winding 190 to be energized so that the solenoid will operate to put the switch 173 in a reverse position from that in which the circuit was originally established above described to put the motor 16 into operation. In other words the switch 173 when operated by the solenoid winding 190 upon being energized reverses the direction of travel of the motor 16, to in turn reverse the direction of rotation of the shaft 52, thereby starting the tooth block 88 in its upwardly directed travel. The refrigerant control switch No. 3 then opens. The synchronous motor 157 continues to revolve its shaft 198 holding the switches No. 1 and No. 4 closed while switches No. 2 and 3 are open.

As the tooth block 88 moves upwardly, the ring plate 84 is pulled upwardly along the drum 69, to cause the tooth 113 to start shaving off the accumulated ice on the surface of that drum, and depositing it primarily outwardly on the plate extension 100. The gradual lifting of the plate ring 84 carries the ice up in the compartment 102 until the flipper blade 110 directs the ice across the floor 26 into the ice compartment 12.

If the one upward lift of the ring plate 84 is not sufficient to fill the compartment 12 up to that point where the thermostat 150 is affected by being in contact with or covered over by the ice, the cycle just described is again repeated.

This repetition of the cycle is produced by reason of the fact that the contact members 152 and 154 of the thermostat 150 remain closed, maintaining the motor 16 in operation. When the post 168 strikes the button 165 to open the switch 164, the switch No. 1 in the controller 158 is still closed, so that the synchronous motor 157 continues to operate until the switch No. 4 opens to de-energize the solenoid 190, whereupon that solenoid 190 is returned to the influence of a spring 192 which restores the reversing switch 173 to its initial position whereby the motor 16 is reversed to drive the screw shaft 52 in that direction to carry downwardly the tooth block 88. Then the post 168 is carried downwardly, while the motor 157 remains in operation (or at least is restored to operation if the switch No. 1 has opened in the meantime), by reason of the fact that the switch 164 then becomes closed and the motor 157 is energized to start the switches 1, 2, 3 and 4, in their cycling closing and opening operations again as has been described.

Thus the tooth block 88 is carried downwardly and upwardly in these repeated cycles until the ice compartment 12 is sufficiently filled to affect the thermostat 150

to separate the contact members 152 and 154. When that separation occurs, then the following operation is set up.

Spaced slightly above the switch push button 165, is a second push button 196, Fig. 5, to be in the path of the cam post 168, so that when the cam post 168 rides past the button 165 a sufficient, predetermined distance, the button 196 will be pushed to the left as viewed in Fig. 5, to operate a pair of switches 170 and 194, these switches being normally closed when the cam post 168 is removed from contact with the push button 196. That is, the push button 196 controls two switches 170 and 194 both normally closed during the cycling operation of the machine. Both switches are opened when the post 168 reaches its upper extreme permissible travel.

When the thermostat 150 reflects the condition of sufficient ice being present in the compartment 12, the shiftable element 152 will move over into contact with the element 192. In so doing, a circuit is established from the service wire 153, through the element 152, the element 192, a wire 169, the switch 170, wire 172, wire 155, to the reversing switch 173 so as to maintain a circuit to the motor 16.

Also a circuit is established from the service wire 153 through the shiftable thermostat member 152 the thermostat contact member 192, the switch 194, a wire 195, the wire 189, the solenoid winding 190, the wire 191, and the other service wire 163, thereby energizing the winding 190, to condition the reversing switch 173 whereby the motor 16 is caused to revolve the shaft 52 to carry the tooth block 88 upwardly. Now those two circuits as controlled by the switches 170 and 194 (as long as the thermostat elements 152 and 192 are in contact one with the other) remain closed until the post 168 comes up and strikes the push button 196 to open those two switches. Then the entire mechanism comes to a stand still by reason of the fact that the motor 16 is no longer energized, and the synchronous motor 157 through its self contained switch No. 1, will operate until that switch opens to restore the controller to its original, starting condition.

The sequence of time cycles is again initiated as above described, when the condition in the ice storage chamber 12 affects the thermostat 150 so as to bring the shiftable member 152 back into contact with its other member 154, to follow through in exactly the same manner as above described.

Thus it is to be seen that when there is a demand for ice as reflected by the thermostat 150 in the compartment 12, the machine will continue to operate between a lower upper limit as determined by the push button 165 being operated by the post 168, and the lower end of travel of the tooth block 88 along the shaft 52, that block remaining stationary at the lower end, until the refrigerating cycle is sufficiently advanced to produce the desired thickness of ice, then the ice is removed from the drum by upward travel of the plate ring, and that up and down travel is continued until the ice builds up to the predetermined height at the thermostat 150 in the compartment 12 to shut down all of the operation until a subsequent demand is had for additional ice.

The foregoing description of the various cycles has been made without any reference to the control of water flow into and out of the water can 23. However this flow control is very important to the successful operation of the device, particularly in regard to the removal of any danger of freezing up of the various elements, and also in regard to the conservation of water.

As above indicated, the solenoid 47, Fig. 5, is not energized when the valve 34 is to be maintained in its lower or open position as indicated in Fig. 5.

A third switch 205 is also combined to be operated by the push button 196, this switch 205 being normally open when the push button 196 is free from contact by the cam post 168. After the cam post 168 is lowered from pres-

11

sure on the button 196, this switch 205 closes to complete a circuit from the service wire 153, the winding of the solenoid 47, the switch 205, and a wire 206 connecting with the other service wire 163. Thus after the tooth block 88 starts in its initial downward travel, the switch 205 closes to energize the solenoid 47, and thereby close the valve 34 to place the water can 23 in condition to hold and retain water. The switch 205 remains closed as long as the tooth block 88 is operating between its lower limit and the upper limit and the upper, lower limits as defined by the cam post 168 operating the push button 165, but not coming high enough to operate the second push button 196. When the cam post 168 does come high enough to operate the push button 196, it causes the switch 205 to open, thereby deenergizing the solenoid 47, and allowing the spring 48 to operate the valve 34 to its open position which is the drain position to dump the water from the water can 23.

Now to feed water into the can 23 initially, and also to maintain the desired water level therein, replenishing the water as it is withdrawn in the form of ice so as to maintain the desired upper level of the water, the following mechanism is employed.

The plate 128 is reciprocated vertically past the water valve 116 control operating head 118. When the plate 128 is in its extreme upper position which is that position whereby the cam post 168 is pressing the button 196 to the left, and the plate ring 84 is elevated to at least the top or slightly above the ice drum 69, the plate 128 will then be positioned in relation to the cam head 118 as indicated by the dash line position of the head in Fig. 7, wherein the cam head 118 is relatively below the plate 128.

Then as the plate 128 is carried downwardly, the lower end of the cam block 129 comes into contact with the cam head 118, to press the cam head 118 relatively to the right as viewed in Fig. 5 so as to open the water valve 116 and cause water to flow into the water can 23 as above described. The shoulder 136 on the block 129 causes the block 129 to shift to the left to the dash line position, thereby maintaining the cam head 118 in its "pushed in" position, that is the open water valve condition.

As the plate 128 continues downwardly, and the upper end of the cam block 129 approaches the cam head 118, then the pressure of the cam head 118 is continued through the next above cam block 119, then in the inclined position, so that the cam head 118 is maintained in its open valve condition while the plate 128 continues on downwardly to cause the cam block 119 to be pulled over to its substantially vertically aligned position as indicated by the dash lines, Fig. 7, this being occasioned by reason of the cam head 118 riding along the shoulder 127.

Finally when the plate 128 has reached its extreme lower position which is that position occurring during the refrigerating period of the cycle, the cam head 118 will then be in that position as indicated by the upper dot-dash line position in Fig. 7, entirely free of the upper cam block 119.

Upon upward travel of the plate 128 which is normally that travel when the ice cutter tooth 113 is removing ice from the drum 69, the cam block 119 will be presented under the cam head 118 so that the cam head 118 will strike the outer side of the block 119 and ride on downwardly, relatively, therepast shifting the cam block 119 to the dash-dot line position indicated in Fig. 7, without operating the valve 116 in any way. Continued upward travel of the plate 128 causes the next below cam block 129 to come into contact along the side of the cam head 118 as indicated in Fig. 7 by the solid line position of the cam head 118, causing the cam block 129 to eventually shift over to its dot-dash line position whereby the cam head 118 is maintained in its inoperative position.

However in respect to the cam head 118 and the cam block 129, the cam block 129 is of that length whereby the cam head 118 will not leave the shoulder side, lower end thereof as long as the cam post 168 does not come up

12

into contact with the switch button 196. Therefore the plate 128 is not lifted high enough for the cam block 129 to shift back relative to the left as viewed in Fig. 7, to permit the lower end of that cam block 129 to come into the path of the cam head 118. Thus while the plate 128 is being reciprocated vertically the cammed head 118 is not being operated in the lower portion of that reciprocation.

However when the plate 128 is approaching its down limit of travel, the cam block 119 will have come over the cam head 118 so as to force the cam head 118 into the open valve position, only so long as it is travelling over the cam block 119 to the right of the shoulder 127. The length of this cam block 119 is purposely made to be that which will cause the water valve 116 to be opened in that lower portion of the down travel of the plate 128 which is sufficient to provide an inflow of water to the can 23 which will replace the water which has been removed in the form of ice. The valve 116 thus shuts off by the time the plate 128 has reached its extreme lower position, and no water is flowing when the plate 128 is travelling upwardly. It only flows in one of the two conditions, namely following the down travel of the plate 128 from its extreme top limit of travel, and thereafter during the cyclic operations water is flowed only during the lower down portion of travel of the plate 128 for water replacement purposes, the water shutting off by the time the plate 128 has reached its extreme lowest position.

A further water valve action is to be noted in that while the plate 128 is travelling down a distance equal to approximately the spacing between the switch operating buttons 196 and 165, the lower cam block 129 will be pressing on the valve head 118 to start water flowing into the can or tank 23. This occurs before the dump valve 34 closes, so that frost or ice accumulating in the can 23 will be flushed out before water is retained in the can 23. This action is made possible by employing a delayed action of the magnetic effect in the solenoid 47, whereby the solenoid does not close the valve 34 until after a slight initial period of its energization.

Thus it is to be seen that the valve 34 remains closed throughout the various cycling operations during the ice making and ice removing cycles, so that the water in the can 23 is never dumped until those cycles are finally completed as is reflected by the extreme upward limit of travel of the cam post 168 over the button 196, whereupon all water is dumped from the can 23. This is done to prevent freezing during that quiet period between demands for making ice and the forming of ice. Thereafter only that amount of water is supplied to the ice can 23 as is needed to replenish the water which has been removed in the form of ice. Thus the water level is maintained in the water can 23 as long as there is need for the water in the various cycles.

Referring to the valve 34, there is centrally disposed thereon a post 210 to rise vertically therefrom and to carry on its upper end a frost cutting blade 211. This blade is yieldingly urged against the underside of the ice drum 69 when the valve 34 is lifted to its closed position. The cutter blade 211 is yieldingly maintained against the ice drum 69 by reason of a mounting post 212 being urged by a spring 213 upwardly.

There will be a definite relation between the temperature of the surface of the drum 62; the clearance space between the drum 62 and the wall of the tank 23; the speed revolution of the drum 62; and the temperature of the water in the tank 23.

As an example for one size of a small unit machine only, the temperature of the surface of the drum will be maintained around ten degrees Fahrenheit below zero; the clearance between the drum surface and the wall of the tank, three-eighths of an inch; the speed of the drum turning approximately thirty-five revolutions per minute; and the temperature of the tank water being

that of city water supply tap water, ranging around fifty-five to sixty-five degrees Fahrenheit. The diameter of the drum surface would be approximately six inches.

In these relations, ice forms quickly in a thin film around an eighth of an inch in thickness. This relatively thin ice film not only forms quickly, but is easy to remove as compared to thicker films. Refrigeration cost is reduced, a smaller unit may be employed, and still a large volume of ice for the refrigerated surface presented, may be produced in a given time, because heat transfer from the interface of the water-ice is extremely short, as compared to ice thickness heretofore produced.

By keeping the frost always separated or removed ahead of the ice forming on the drum surface, and keeping the frost removed from the separated ice, the ice remains perfectly clear and transparent, even though the water used is not previously treated nor entrained air or gases removed from it.

The apparatus described is capable of being operated in different sequences. In addition to the operation previously described where the water is retained in the can 23 throughout a number of reciprocations of the plate ring 84 across the drum 62; water is replenished to make up for the water removed in ice-form; and the water then dumped from the can at the end of demand for ice in the storage chamber 12, there is the following operation possible and desirable where conditions require it.

Assuming the plate ring 84 to be stationary at the upper end of the drum 62, with no water in the can 23, and then there is a demand for ice in the chamber 12, the plate ring 84 starts downwardly.

In this action, the ring 84 will serve either by itself or the frost tooth 114, or both the ring 84 and the tooth 114 to scrape or cut off frost and/or ice which in the normal course of events will have generally formed on the drum 62 during the idle condition of the apparatus.

Now this scraped off matter—frost and ice—may be handled in one of two ways. As it is being scraped off by downward travel of the ring 84, the frost (the term being used to include ice as well) drops to the floor 24 of the can 23. The valve 34 may be shifted at the start of the frost removal to a closed position as previously described. In this case, water may be flowed into the can 23, and the accumulating frost will serve to reduce the temperature of the incoming water so as to reduce the following time required to form the ice film on the drum 62. Then the water may be dumped from the can 23, as the ring 84 ascends.

The other way of handling the scraped off frost is to allow the valve 34 to remain open initially while water is flowed into the can on the down stroke or travel of the ring 84, the water continuing to flow to flush the frost out of the can 23 until toward the end of the ring travel downwardly, whereupon the valve 34 closes, and the water fills the can 23. This operation will serve to prevent frost from accumulating in the bottom of the tank during a number of repeated ice forming periods when the water is not dumped until the full demand for ice in the chamber 12 is supplied.

In any event, in any operation procedure, the frost must not be allowed to build up on the floor 24 to that level or degree which will bring the frost into contact with the floor 73 of the drum 62.

To accomplish this operation of frost disposal when the water is dumped on each reciprocation of the ring 84, the length of the cam block 192 may be increased or shifted vertically in reference to the plate 128 and held stationary in the dash line position, Fig. 7.

Also the solenoid 47, will be controlled by placing its control switch 205a in the controller 158 as a fifth switch to set up the operation above indicated, and as indicated in Fig. 9, where the cam 300 operates the switch 205a to open and close the circuit from the winding 47 through the wires 301, 302, 162 and 163.

Thus it is to be seen from the foregoing description of the one particular form of the mechanism, that there is provided a relatively simple mechanism which is entirely automatic, subject to the demand for ice in a storage compartment. While I have herein shown and described the mechanism in that one particular form, in precise detail, it is obvious that many structural variations may be employed without departing from the spirit of the invention, and I therefore do not desire to be limited to that precise form beyond the limitations which may be imposed by the following claims.

I claim:

1. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; means for carrying said member across said drum surface in a direction transversely of the direction of rotation thereof to remove ice from said surface and lifting it from the water; an ice storage chamber receiving ice from said member; means responsive to a predetermined high ice level in said chamber for rendering said refrigerating means inoperative when the ice reaches said level; said ice level responsive means also controlling travel of said ice removing member to return that member to an initial position across said drum for a subsequent ice removing travel thereacross.

2. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; an ice storage chamber receiving ice from said member; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; said abutment comprising a spring-like blade free at one end; and a member fixed in respect to revolution of said drum to be in the path of said blade free end whereby contact of that end with said fixed member initially retards travel of the end followed by a forward flipping action upon travelling past the fixed member so as to flip the removed ice to said chamber.

3. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; an ice storage chamber receiving ice from said member; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; said abutment comprising a spring-like blade free at one end; and a member fixed in respect to revolution of said drum to be in the path of said blade free end whereby contact of that end with said fixed member initially retards travel of the end followed by a forward flipping action upon travelling past the fixed member so as to flip the removed ice to said chamber; means for carrying said removed ice toward one end of said drum to accumulate it at said end; said blade being mounted at said drum end to intercept said accumulated ice.

4. In an automatic ice making machine; a water tank; a revoluble drum carried into said tank; means for revolving the drum; means for refrigerating the surface of said drum to ice forming temperatures; a control for said refrigerator means; an ice cutter carried in close proximity to said drum surface; means for admitting water to said tank responsive to travel of said cutter; cyclic controller means including a plurality of electric circuits opening and closing in a predetermined sequence; an ice

chamber receiving ice as separated from said drum by said ice cutter; a control member in said chamber at a predetermined ice level height therein; said control member initiating starting and stopping of said cyclic controller means in response to ice falling below said level; said circuits including respectively said refrigerating means control and said cutter means to move the cutter across said drum; a cutter extreme travel limit switch operable to open condition by said cutter travelling to at least one end of said drum; a circuit including said limit switch, said chamber control member, and said drum revolving means, whereby said drum is stopped revolving at that drum end position of the cutter when ice in said chamber reaches said level; said cyclic controller means continuing to an initial starting condition for ice formation.

5. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; means for carrying said member across said drum surface in a direction transversely of the direction of rotation thereof to remove ice from said surface; an ice storage chamber receiving ice from said member; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; the axis of revolution of said drum being substantially vertical; a ring surrounding said drum to be in approximately sliding contact with said drum surface and with the surface of said tank; both of said drum and tank surfaces being cylindrical; said ice removing member being mounted on said ring to extend upwardly therefrom; means holding said ring against circumferential travel about said drum; said ice accumulation being lifted up by said ring through water in said tank to an upper level above water in the tank; said abutment being in the path of the rising ring; said abutment being held to extend normally radially from the drum; and means yieldingly maintaining the abutment in a lower position of vertical travel as may be set up by said ring rising thereagainst.

6. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; means for carrying said member across said drum surface in a direction transversely of the direction of rotation thereof to remove ice from said surface; an ice storage chamber receiving ice from said member; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; the axis of revolution of said drum being substantially vertical; a ring surrounding said drum to be in approximately sliding contact with said drum surface and with the surface of said tank; both of said drum and tank surfaces being cylindrical; said ice removing member being mounted on said ring to extend upwardly therefrom; means holding said ring against circumferential travel about said drum; said ice accumulation being lifted up by said ring through water in said tank to an upper level above water in the tank; said abutment being in the path of the rising ring; an ice receiving compartment opening through the wall of said water tank and extending vertically a distance approximately equal to ice cutting travel of said ice removing member; a tongue extending from said ring to form a shiftable floor in said compartment; said abutment comprising a spring-like blade having a radial length to extend approximately to the outer end of said tongue; a floor extending around said tank at said upper level and toward said ice chamber; a wall surrounding the outer portion

of the floor; and a flexible blade striker carried into the path of the outer end of said blade upon rising of said tongue to the level of said floor, whereby the blade is bent to pass the striker and thereafter spring back into its radial alignment to flip ice off said tongue over said floor to said chamber.

7. An automatic ice making machine wherein the ice produced is in the form of flakes or chips, comprising in combination, a water tank; means to maintain a predetermined water level in the tank; a freezing drum mounted to carry an external surface thereof in said tank; means for effecting a water below-freezing temperature on said surface; means for revolving said surface in said tank in the presence of water therein to permit ice to form thereon from said water; means for removing said ice from said surface; an ice storage chamber receiving said removed ice; means for dumping water from said tank; said drum being revoluble upon a vertical axis; an ice receiving compartment vertically disposed along one side of said tank opening toward the path of said ice removing means to receive removed ice therein; a floor in said compartment shiftable with said ice removing member, whereby ice received in the compartment is lifted therein by said floor through water in said tank; and an ice transfer blade revolving with said drum at a relatively fixed level to travel across said floor when it reaches a predetermined upper level, whereby the blade carries the ice off said floor in a direction toward said chamber.

8. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; means for carrying said member across said drum surface in a direction transversely of the direction of rotation thereof to remove ice from said surface; an ice storage chamber receiving ice from said member; means responsive to a predetermined high ice level in said chamber for rendering said refrigerating means inoperative when the ice reaches said level; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; said ice removing member comprising a ring surrounding said drum to fit slidably around said drum surface and around the inner surface of said tank, and a tooth extending from one side of the ring; and a frost cutter tooth extending from the other side of the ring; both teeth being in close proximity with the drum surface, the first tooth cutting ice off the drum surface as the ring is shifted therealong in one direction, and the frost tooth cutting frost off in the other direction.

9. In an automatic flake ice making machine, a water tank; a revoluble drum carried into said tank; means for refrigerating the drum surface to temperatures below water freezing; means for revolving the drum in the water of said tank to build up a predetermined ice thickness on the surface of the drum; an ice removing member; means for carrying said member across said drum surface in a direction transversely of the direction of rotation thereof to remove ice from said surface; an ice storage chamber receiving ice from said member; means responsive to a predetermined high ice level in said chamber for rendering said refrigerating means inoperative when the ice reaches said level; an abutment carried by said drum circumferentially therearound to intercept and carry toward said chamber ice removed by said member; said ice removing member comprising a ring surrounding said drum to fit slidably around said drum surface and around the inner surface of said tank, and a tooth extending from one side of the ring; and a frost cutter tooth extending from the other side of the ring; both teeth being in close proximity with the drum surface, the first tooth cutting ice off the drum surface as the ring is

17

shifted therealong in one direction, and the frost tooth cutting frost off in the other direction; means for heating said tank; time cycle controlling means controlled by said ice level responsive means; said time cycle controlling means controlling said heating means heating operation only in an initial travel of said ring in a frost cutting direction.

10. In an ice making machine having a refrigerated drum revoluble in a water tank and means to shave off and remove ice from the drum, mechanism for maintaining a predetermined water level in the tank to replenish water removed in form of ice, comprising an ice shaving member; means for reciprocating the member along the drum; a water line from a source to the water tank; a shut-off valve in the line; a valve operating member reciprocating to open and shut positions of the valve; a cam block base member reciprocating with said ice shaving member; a pair of cam blocks each shiftable laterally of said base member; spring means biasing each of said blocks to positions inclined from the directions of reciprocation of said base member and to have a respective end each in the path of said valve member when the base member is advanced in one direction toward the valve member, whereby in that travel direction, one of said blocks will ride by its said end over said valve member to press it to open valve condition; said one block having a flange along one edge to be contacted by said valve member and cause the block to shift from its inclined position and slide along over said one block and allow the second block to enter by its said end over said valve member and permit said one block to return to its inclined position; said second block being a flange along one edge to cam the block from its inclined position; said second block maintaining said valve member in open valve condition until the second block traverses the valve member to allow the second block to return to its inclined position; said base member in its reverse direction of travel bringing the second block flange side along the side of said valve member without shifting that valve member, and presenting the said ends of the blocks in the path of the valve member in order upon said first travel of the base being again effected.

11. In an ice making machine, a water level control comprising a water supply line; a valve in the line; a reciprocable valve operating member; a base; a pair of cam blocks individually mounted on said base to shift laterally thereof and be fixed longitudinally thereof; spring means normally biasing both blocks to inclined positions toward the same side of said base; and a flange along a common side of each of said blocks; the ends of said blocks removed from said base side being normally in the path of said valve member when carried theretoward in one travel direction, and the outer sides of said flanges being in the path of said valve member when carried theretoward in the opposite travel direction.

12. An ice making apparatus comprising a water tank; a water freezing drum mounted to enter said tank; means for revolving the drum in the water tank for a period to freeze water on the surface of said drum; means for removing the ice from the drum below the water level in the tank; and ejecting means removing ice from the water tank; said ejecting means including ice gathering means to withhold the removed ice from dispersion in the water tank and to lift the ice in a mass of discrete particles from the water; said ejecting means further including a blade; means to carry the blade transversely across the ice as lifted from the water; and means yieldingly retarding and releasing travel of the blade across said ice to impart a snapping action thereagainst.

13. An ice making apparatus comprising a water tank; a water freezing drum mounted to enter said tank; means for revolving the drum in the water tank for a period to freeze water on the surface of said drum; means for removing the ice from the drum below the water level in the tank; and ejecting means removing ice from the

18

water tank; said ejecting means including ice gathering means to withhold the removed ice from dispersion in the water tank and to lift the ice in a mass of discrete particles from the water; said ice gathering means being immediately adjacent said ice removing means; said ice gathering means including a ring encircling said drum, a compartment opening laterally from a side of and extending along the water tank, a tongue extending into said compartment forming a movable barrier thereacross, said compartment opening from the position of said ice removing means, and said tongue serving to lift the ice along said compartment.

14. An ice making machine automatically responding to a demand and a no-demand for ice, comprising a freezer drum; a water tank receiving the drum therein; means for revolving the drum in the tank to freeze water on the drum surface; means removing ice from said surface following a predetermined build-up of ice thereon; means refrigerating said drum surface to icing condition therearound; means for holding an accumulation of ice in storage; and means subject to the extent of said accumulation for initiating operation of said refrigerating means to cause formation of said ice and cutting off said refrigerating means upon said predetermined ice build-up; and means for heating said machine for a predetermined period prior to said initiating operation; and means removing frost from said drum surface and said water tank intermediate operations of said ice removing means and of said heating means.

15. An ice making apparatus comprising an open top, cylindrical water tank having a discharge opening in its under side; a valve for closing said opening, normally open; means for closing the valve; a water supply line discharging into said tank; a valve in said line; a cylindrical drum supported with its axis vertically disposed to have its major portion within said tank, said drum and said tank being coaxially aligned, the diameter of the drum outer surface being less than that of the tank wall inner surface to leave a space therebetween to provide an annular water column space between the two surfaces; an annular plate ring slidably surrounding said drum to be traversable through said water column space; means for revolving said drum; means for raising and lowering said ring; a refrigerant flow line connected with said drum; a valve in the refrigerant line; means for operating said refrigerant line valve; an ice tooth carried by said ring to extend from its upper side in approximate contact with said drum surface; means retaining said ring in a predetermined lower position during an ice forming period on the drum surface thereabove; an ice storage chamber adjacent said tank and having an opening thereto near the top of said tank; an ice shifter blade carried by said drum on its upper portion circumferentially traversing said space with turning of said drum; said water valve being opened and closed by reciprocation of said ring; a plurality of electric circuits interconnecting with said refrigerant valve opening means, said tank opening means and said ring raising and lowering means; a thermostat in said storage compartment positioned at a predetermined top level for ice therein; said thermostat interconnecting a part at least of said circuits whereby cyclic operation of said ring travel, said refrigerant valve, and said tank valve is set up and maintained in accordance with operation of the thermostat; a refrigerant evaporator chamber inside said drum; means for holding said evaporator chamber stationary to have said drum revolve therearound; and a heat conductor fluid within said drum and externally of said evaporator chamber.

16. An ice making apparatus comprising an open top, cylindrical water tank having a discharge opening in its under side; a valve for closing said opening, normally open; means for closing the valve; a water supply line discharging into said tank; a valve in said line; a cylindrical drum supported with its axis vertically disposed to have its major portion within said tank, said drum and said tank

19

being coaxially aligned, the diameter of the drum outer surface being less than that of the tank wall inner surface to leave a space therebetween to provide an annular water column space between the two surfaces; an annular plate ring slidably surrounding said drum to be traversable through said water column space; means for revolving said drum; means for raising and lowering said ring; a refrigerant flow line connected with said drum; a valve in the refrigerant line; means for operating said refrigerant line valve; an ice tooth carried by said ring to extend from its upper side in approximate contact with said drum surface; means retaining said ring in a predetermined lower position during an ice forming period on the drum surface thereabove; an ice storage chamber adjacent said tank and having an opening thereto near the top of said tank; an ice shifter blade carried by said drum on its upper portion circumferentially traversing said space with turning of said drum; said water valve being opened and closed by reciprocation of said ring; a plurality of electric circuits interconnecting with said refrigerant valve opening means, said tank opening means and said ring raising and lowering means; a thermostat in said storage compartment positioned at a predetermined top level for ice therein; said thermostat interconnecting a part at least of said circuits whereby cyclic operation of said ring travel, said refrigerant valve, and said tank valve is set up and maintained in accordance with operation of the thermostat; a refrigerant evaporator chamber inside said drum; means for holding said evaporator chamber stationary to have said drum revolve therearound; and a heat conductor fluid within said drum and externally of said evaporator chamber; and water circulating means between said drum and said tank.

17. In a flake ice making machine, a cylindrical water freezing unit; a wall spaced from and surrounding said

20

unit; means for covering a surface of the unit with water to form a film of ice thereover; means for removing frost from said surface; means for removing ice from said surface; and means for maintaining at all times separation of said frost from said ice; said separation means comprising a ring surrounding said surface and substantially filling the space between that surface and said wall; and means causing said ring to traverse said surface in directions parallel to the axis thereof.

18. In a flake ice making machine, a water tank; a refrigerating drum revoluble in the tank to form ice thereon in the presence of water; means for scraping frost off the drum into the tank prior to said ice formation; means for scraping ice off the drum; means collecting said frost apart from said ice; means for applying water to the drum; and means for draining the water from the tank following said ice formation.

References Cited in the file of this patent

UNITED STATES PATENTS

530,527	Holden	Dec. 11, 1894
865,040	Holden	Sept. 5, 1907
2,077,820	Arp	Apr. 20, 1937
2,299,414	Spiegl	Oct. 20, 1942
2,368,675	Muffly	Feb. 6, 1945
2,396,308	Williams	Mar. 12, 1946
2,405,272	Smith	Aug. 6, 1946
2,431,278	Raver	Nov. 18, 1947
2,487,408	Askin	Nov. 8, 1949
2,526,262	Munshower	Oct. 17, 1950
2,538,097	Henderson	Jan. 16, 1951
2,563,093	Bayston	Aug. 7, 1951
2,575,892	Roberts	Nov. 20, 1951
2,590,499	Braswell	Mar. 25, 1952
2,648,203	Heuser	Aug. 11, 1953