Jan. 5, 1960 G. M. LEES 2,919,557

ICE MAKING MACHINES

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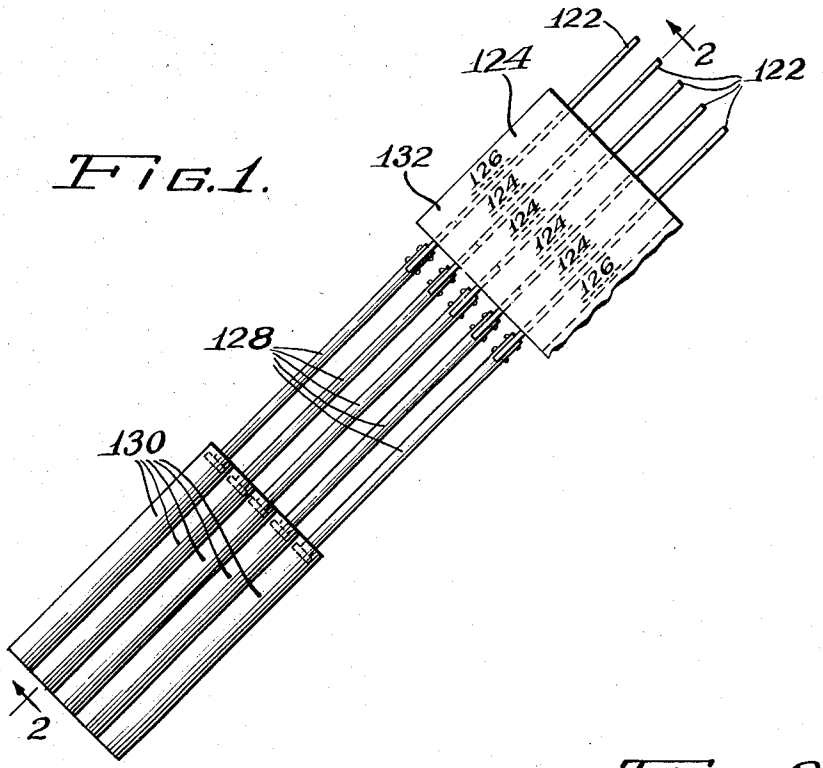


FIG. 1.

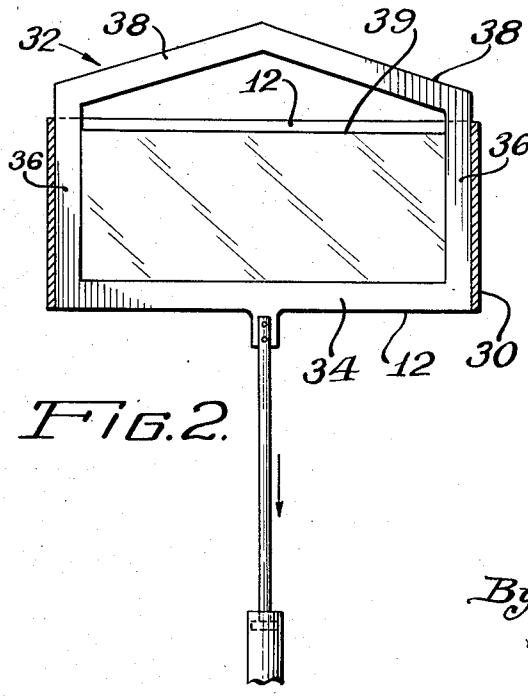
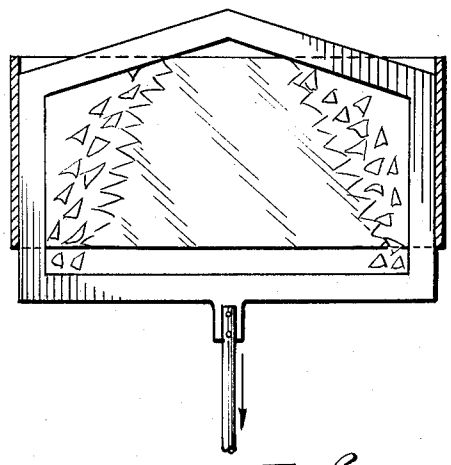


FIG. 2.

FIG. 3.



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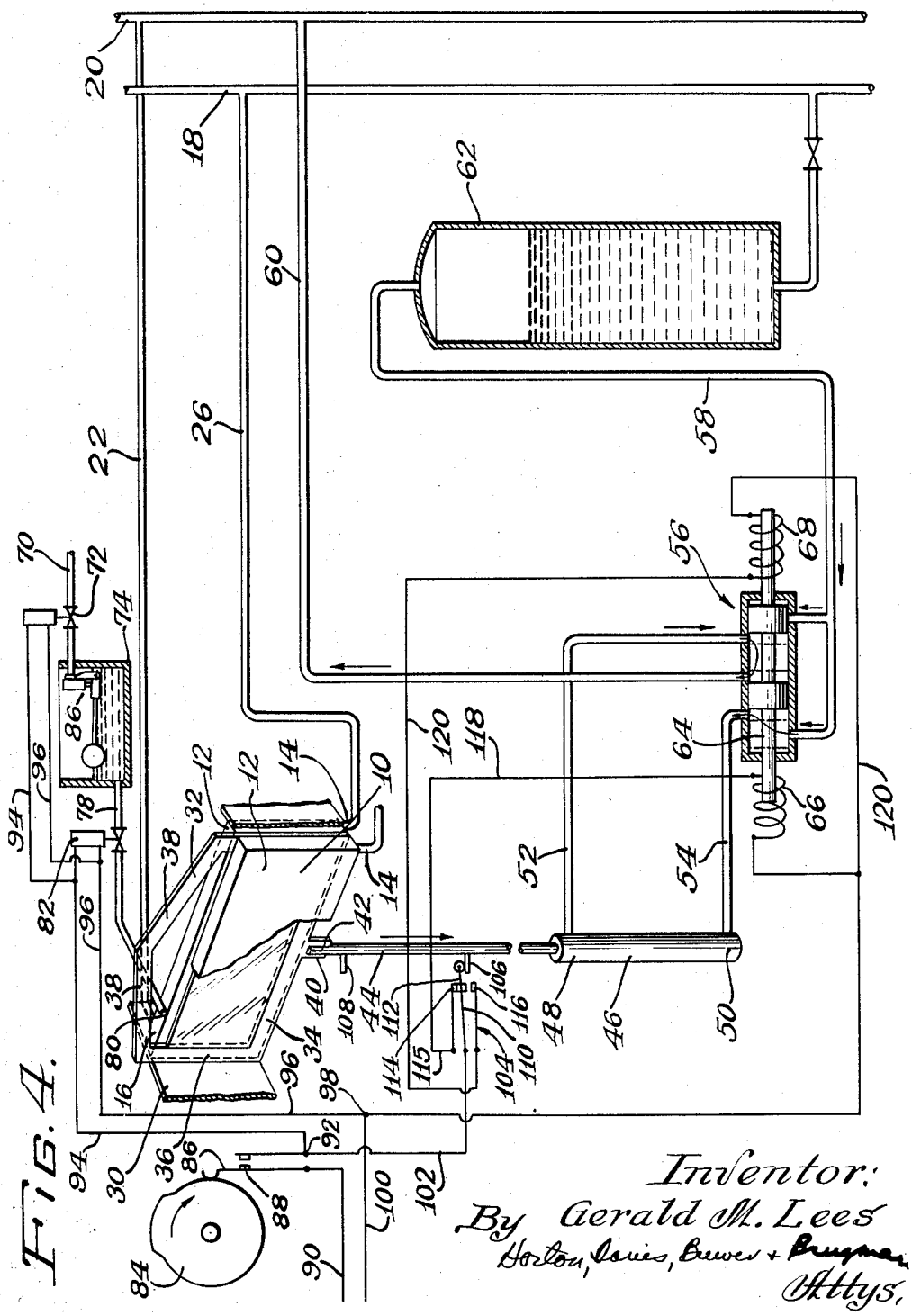


FIG. 4.

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ICE MAKING MACHINES

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12 Claims. (Cl. 62—71)

My invention relates to an ice making machine. While ice making machines for large consumers of ice such as packing plants and the like have been rather thoroughly refined, the problem of providing a machine for the small user of ice, such as soda fountains, drugstores, grocery stores, etc., has not been given the attention devoted to the larger machines. My invention is directed to an ice making machine for the relatively small ice user which is simply and inexpensively constructed, automatic in operation, and as near foolproof as possible by virtue of the simplicity and sturdiness of the construction thereof. Another major advantage of my invention is that it will accommodate, without manufacturing complication, varying demands for ice, since it involves basically a simple, small, freezing unit which may be multiplied as desired to deliver varying amounts of ice while at the same time not expanding significantly the space required by such machine.

Other objects and advantages of my invention will be apparent from the following description and drawings, of which:

Fig. 1 is a side elevation of a bank of the freezing unit forming a part of my invention, assembled together for ice production;

Fig. 2 is a section through one of the freezing units illustrated in Fig. 1, taken along the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a view similar to Fig. 2, showing, however, the method of separating ice from the freezing surface and discharging it from the machine; and

Fig. 4 is a schematic view of a machine incorporating my invention with some parts shown in section, some in perspective, and some diagrammatically.

Considering first Fig. 4 the unit freezer 10 of my invention is composed of a pair of narrowly spaced, parallel, thin, rectangular evaporator shells 12. The shells are adapted to have refrigerant circulate through the interior thereof and have refrigerant inlet ports 14 adjacent the bottom edges thereof and refrigerant outlet ports 16 at the top. The inlet and outlet ports are connected respectively to a refrigerant supply line 18 and a refrigerant return line 20 by ducts 22. The mechanism for abstracting heat from the refrigerant is entirely conventional and has not been illustrated except for the supply and exhaust lines 18 and 20 and the liquid refrigerant receiver 62.

As stated, each freezing unit is comprised of two of the evaporator shells 10 parallel to each other and spaced narrowly apart. The evaporator shells are supported and fixed in the spaced parallel relation by end plates 30 which lie against the ends of the shells and are secured thereto. The shells and the end plates define a narrow, deep and wide slot extending between the shells.

The slots are converted into a water-holding receptacle by a pentagonal frame 32. The bottom 34 of the frame and the two sides 36 thereof are rectangular with respect to each other and constitute the bottom and end walls of the receptacle. The upper side is comprised of

two equal segments 38 at an obtuse angle to each other and to the side members 36. It will be noted that the side members 36 are long enough to space the top members above the expected water or ice level 39 a distance equal to or slightly greater than the width of the bottom member 34. The bottom edge of the bottom frame member 34 has a bracket 40 formed centrally thereon, to which is secured the outer end 42 of the shaft 44 of a double acting pneumatic cylinder 46.

In the illustrated embodiment, I employ gas pressure differentials inherent in a refrigerating system to operate the cylinder. The pressure of the gas over the liquified refrigerant in the reservoir 62 is substantially greater than that in the spent refrigerant return line 20. The upper 48 and lower 50 ends of the pneumatic cylinder are respectively connected by ducts 52 and 54 to the four-way flow reversing valve 56. The reversing valve is likewise connected by duct 58 to the refrigerant receiver 62 so as to draw gaseous refrigerant therefrom under pressure and by duct 60 to the exhaust line 20. Since such valves are well known in the art, detailed description is believed unnecessary. The valve rod 64 is operated in each direction by solenoids 66 and 68. Operation of the solenoid 66 serves to apply the refrigerant pressure in the receiver 62 to the lower end of the pneumatic cylinder 46 to extend the shaft 44 thereof, the valve 56 simultaneously permitting a return of the gaseous refrigerant in the upper end of the cylinder 46 to the refrigerant return line. Operation of the solenoid 68 reverses the situation, applying refrigerant pressure to the upper end of the cylinder 46 to retract the rod 44 and exhausting the lower end of the cylinder to the refrigerant return line.

Water is delivered into the freezing chamber defined by the frame 32 and the shells 12 from a duct 70 connected to a source of water supply. The duct 70 has a solenoid-operated normally closed valve 72 therein or open when energized. The duct 70 leads into a tank 74 and has a float operated shut-off valve 76 thereon within the tank 74. A duct 78 leads from a lower portion of the tank 74 and has an open end 80 situated to deliver water into the freezing chamber. The duct 78 has a normally open solenoid-operated valve 82 therein which is closed when energized. The float valve 76 is adjusted to shut off the flow of water through duct 70 into the tank 74 when the discharge from the tank to duct 78 will be just sufficient to fill the freezing chamber.

My ice machine is electrically controlled and operates through a timed cycle. I provide a program timer here illustrated as a cam 84 driven at constant speed together with a cam follower 86 which operates to open and close a switch 88. The circuit runs from a source of power 90 through switch 88 to a terminal 92. A conductor 94 extends from terminal 92 to energize the solenoids of the valves 72 and 82 in parallel. A conductor 96 is connected to the other side of the solenoids of these valves and returns to a terminal 98 which in turn is connected to the other side 100 of the power line. Another conductor 102 is connected to terminal 92 and leads to a single pole double throw switch 104. The shaft 44 of the pneumatic cylinder 46 has a pair of spaced switch operating studs 106 and 108 thereon, and the switch element 110 of the switch 104 has an extension 112 interposed in the path of the operating studs 106 and 108. The switch element 110 is moved into contact with contact 114 when the shaft 44 reaches its maximum extension and is moved into contact with contact 116 when the shaft 44 is fully retracted. The switch element 116 should be equipped with a permanent magnet hold or some similar device to keep it in contact with either of the contacts 114 or 116 during the travel of the shaft 44,

Contact 114 is connected by conductor 118 to one terminal of solenoid 66. Contact 116 is connected by conductor 120 to one terminal of solenoid 68. The other terminals of the two solenoids are connected to conductor 120 which leads to terminal 98 connected to ground 100.

As illustrated, the machine is in that stage of the cycle where ice is being formed. Since the cam follower 86 is on the low surface on the program timer 84, switch 88 is open and no circuits are energized. The normally open switch 72 governing the flow of water into the tank 74 is closed. Normally closed switch 82 is open, and water has drained from tank 74 to fill the chamber. The position of the frame 32 relative to the evaporator shells 12 is shown in Fig. 2. Illustratively, I contemplate a programming of the cycle such that the freezing operation may take, for instance, one minute and the separation of the formed ice from the freezing chamber take on the order of fifteen seconds. The program timer cam 84, therefore, will make a complete revolution in one minute fifteen seconds, during one minute of which the cam follower is on the low part of the cam and switch 88 is open.

When the program timer progresses to the point where the higher part of the cam moves the cam follower to close switch 88, current flows through switch 88 to terminal 92, through conductor 102 and to the switching element 110 making contact with contact 114. Solenoid 66 is thus energized through conductor 118 and operates to move the valve rod 64 to the left, thereupon directing gaseous refrigerant under pressure into the upper end of the pneumatic cylinder 48 and opening the lower end of the cylinder to exhaust line 60 leading to the refrigerant return line 20. The cylinder rod 44 is thus retracted and draws the frame downwardly relative to the evaporator shells 12.

The position of the parts in the freezing chamber during freezing and just before the start of the ice removing cycle is shown in Fig. 2. Initially, the frame must be drawn downwardly to withdraw the bottom frame member from between the freezing surfaces since the broken ice discharges downwardly from the freezing surfaces. It is to permit this initial clearance of the bottom edge 34 of the frame that the top edge 38 is spaced above ice level 34. At first the ice sheet will remain firmly between the facing surfaces of the evaporator shells. As retraction of the frame continues, however, the upper inclined sides 38 thereof bear first on the outside edges of the ice sheet and commence a progressive breaking away of the sheet working from the outside edges toward the center as the point of contact between the upper frame members 38 and the ice sheet moves toward the center as seen in Fig. 3. The inclined frame members 38 thus avoid a loading of the frame and cylinder with the force required to separate the ice sheet as an entity from the surfaces on which it is frozen and likewise achieve a desirable fragmentation of the ice sheet.

When the shaft 44 of the cylinder 46 moves downward to the point where switch actuating stud 108 operated switch element 112 to remove it from contact with contact 14 and place it in contact with contact 116, solenoid 66 is de-energized and solenoid 68 is energized, so moving the valve shaft 64 to the right or to its illustrated position. In such position the lower end of the pneumatic cylinder 46 is opened to refrigerant under pressure and the upper end is opened to the refrigerant return line. The rod 44 is thus powered to move outwardly and restore the frame to its illustrated water-retaining position between the evaporator shells 12. The rate of travel of the piston rod should be such as to complete a cycle of movement in fifteen seconds or slightly more. The upper edge of the bottom frame member should at least arrive in water-retaining position with respect to the evaporators before the timer breaks the circuit. Thereafter, pneumatic pressure will continue its travel to terminal position. It must not, however, reach terminal position before the circuits are broken and start downward again, lest there be a progressively downward positioning of the frame with each cycle. Of course, other circuit devices may be used to hold the frame in freezing position should the rate of cycling be difficult to adjust.

The closure of switch elements 88 by the cam follower 86 likewise results in an energization of the solenoid-operated valves 72 and 82. The energization of valve 82 results in a closing thereof and the energization of valve 72 results in its opening. Water is thus admitted through line 70 into tank 74 until the flow of water is shut off by the float valve 76 when the tank contains enough water to charge fully the container defined by the frame 32 within the evaporator shells 12. The timing of this filling, must, of course, be fifteen seconds or less.

As the program timer 84 continues to revolve so that the raised portion thereof passes beyond cam follower 86, the switch 88 is opened, de-energizing both circuits. The pneumatic cylinder 46 and its shaft and piston will remain in their illustrated position. Valve 82 will thereupon open and permit a draining of the tank 74 into the container defined by the frame 32 between the evaporator shells 12. Simultaneously valve 72 will close to prevent any refilling of the tank with more water until the fifteen-second portion of the cycle occurs again. The evaporator shells will of course be continuously cold.

Fig. 1 illustrates the fashion in which a plurality of the units described may be assembled together to increase the capacity of the ice machine. A unit is shown having four freezing chambers. Illustrated are the four frames 122 which define the freezing chambers. There will be five evaporator shells 124, 126, only one surface of the outside evaporator shells 126 being employed for freezing purposes. The frames are connected by means of shafts 128 to a bank of pneumatic cylinders 130. The evaporator shells 124, 126 are held in position and tied together by means of the end plates 132. It will be noted that the bank of freezing chambers is inclined at an angle to the vertical. The ice is separated from the freezing surfaces and drawn downwardly through the bottom thereof. The inclination of the freezing chambers, shafts 128 and pneumatic cylinders 130 permits the ice to fall freely without lodging on the bank of cylinders 130.

In a banked structure such as illustrated in Fig. 1, each of the freezing chambers may have an individual source of water supply like the tank 74 or a single tank may be used. There are well known methods for distributing equal amounts of liquid from a single reservoir into vessels of various elevation.

It will be appreciated that I have described here merely an embodiment of my invention and that many alternatives both as to structure and operation are readily conceivable. For instance, cranking means, sprocket chains or hydraulic means may be used to move the frame relative to the evaporator shells to dislodge the formed ice therewithin and to restore the frame to its container defining position.

Likewise, although I have illustrated the pneumatic cylinders as being connected to the bottom of the frames, it will be evident that they may as well be connected to the top apices of the frames defined by the point of juncture between the two members 38. The cylinder will of course be situated above the frame and there will be nothing to impede the free fall of ice from the frames. In such case, the angular disposition of a banked set of frames as illustrated in Fig. 1 will not be necessary. It will be noted that the frames will be amply guided for proper movement by the side plates 30.

Other alternatives will readily suggest themselves and I, therefore, desire that my invention be regarded as being limited only as set forth in the following claims.

I claim:

1. A method of making ice which comprises delivering a predetermined amount of water between two spaced freezing surfaces and within retaining means between said

surfaces, retaining said water between said surfaces until said water is frozen to form an ice sheet, withdrawing the retaining means from water-retaining association with said surfaces and moving a surface inclined with respect to an edge of said ice sheet against said edge of said ice sheet to dislodge said ice sheet progressively from said surfaces in fragments.

2. A method of making ice which comprises delivering a predetermined amount of water between two spaced freezing surfaces and within retaining means between said surfaces, retaining said water between said surfaces until said water is frozen to form an ice sheet on said freezing surfaces, withdrawing the retaining means from water-retaining association with said surfaces and applying pressure progressively on one edge of said ice sheet formed between said surfaces from the ends of said edge uniformly toward the center of said edge to dislodge said ice sheet progressively from said surfaces in fragments.

3. A method of making ice which comprises delivering a predetermined amount of water between two spaced freezing surfaces and within retaining means between said surfaces, retaining said water between said surfaces until said water is frozen to form an ice sheet on said freezing surfaces, withdrawing the retaining means from water-retaining association with said surfaces and applying pressure progressively on the top edge of said ice sheet formed between said surfaces from the ends of said edge uniformly toward the center of said edge to dislodge said ice sheet progressively from said surfaces in fragments.

4. A method of making ice which comprises delivering a predetermined amount of water between two spaced freezing surfaces and within retaining means between said surfaces, retaining said water between said surfaces until said water is frozen to form an ice sheet, withdrawing the retaining means from water-retaining association with said surfaces and applying pressure against a progressively longitudinally migrating point on one edge of said ice sheet progressively to dislodge said ice sheet from said surfaces in fragments.

5. An ice making machine comprising a pair of spaced freezing surfaces, means for delivering water between said surfaces, means for retaining said water between said surfaces, means for removing said retaining means from water-retaining relation with said surfaces when said water is frozen, and means comprising an angularly disposed top member on said retaining means for applying longitudinally progressive pressure against one edge of the ice sheet formed between said surfaces to dislodge said ice in fragments from said surfaces.

6. An ice machine comprising a pair of parallel spaced freezing surfaces, a pentagonal frame situated between said surfaces to define with said surfaces a water-holding chamber defined on the sides by said surfaces and on the ends and bottom by said frame, said frame having a symmetrical angled upper side above said water chamber, means for moving said frame to draw said upper side wholly into the area of said water chamber and said bottom out of water-holding relation with said surfaces, and means for delivering a measured amount of water into said water chamber.

7. An ice making machine comprising a pair of spaced freezing surfaces, means for delivering water between said surfaces, an open frame movable within and between said surfaces to hold water between said surfaces in one position and to dislodge and discharge ice formed between and frozen to said surfaces in movement to another position, the top member of said frame being so disposed angularly relative to a side member of said frame as to apply longitudinally progressive pressure against one edge of said ice to fragmentize said ice during the ice dislodging movement of said frame, and means to move said frame between said positions.

8. An ice making machine compriisng a pair of evaporator shells each having a freezing surface parallel to and spaced from each other, refrigerating mechanism for circulating liquid refrigerant to said evaporator shells and withdrawing spent refrigerant therefrom, an open frame contained between said surfaces for vertical movement between a position of containing water between said surfaces and a position wherein ice is dislodged from between said surfaces, a pneumatic cylinder having a rod connected to said frame to move said frame between said positions, a four-way solenoid-operated valve connecting, in one position, one end of said cylinder to the refrigerant supply and the other end of said cylinder to the spent refrigerant return and alternatively said one end to said spent refrigerant return and said other end to said refrigerant supply, a water suply line, a normally closed valve in said line, a tank receiving water from said supply line, means associated with said supply line in said tank to limit the filling of said tank to a predetermined level, a duct extending from said tank to discharge between said surfaces of said evaporator shells, a normally open valve in said duct, a source of electric power, circuit means connected to said source of power to energize said normally open valve and said normally closed valve and said four-way valve, timer means in said circuit including a switch for periodically energizing said circuits and periodically breaking said circuits, and switch means actuated in response to the movement of said frame to reverse said four-way valve to move said frame from its water receptacle defining position to its ice removing position and again to reverse said valve to restore said frame to said water receptacle defining position.

9. An ice machine comprising a plurality of thin rectangular evaporator shells, guide plates secured to opposite ends of said shells to support said shells in spaced parallel relation, means for delivering liquid refrigerant to said shells and returning spent refrigerant therefrom, an open frame contained between each pair of facing surfaces of said shells, said frame being movable relative to said shells between a position defining with said surfaces a water-containing chamber and a position in movement to which ice is removed from said chambers, said frames being guided by said guide plates in said movement, means for causing said relative movement between said shells and said frames and means for delivering a measured amount of water into each of said water-containing chambers.

10. An ice making machine comprising a pair of spaced evaporator shells having facing freezing surfaces, a refrigerating system including a zone of refrigerant at relatively high pressure and a zone of refrigerant at relatively low pressure, means connecting said evaporator shells to said refrigerating system, means for delivering water between said surfaces, a frame movable within and between said surfaces to retain water between said surfaces in a first position, and to dislodge ice formed between said surfaces in movement to a second position, a double acting, pneumatic cylinder having a rod connected to said frame, and means alternatively connecting one end of said cylinder to said zone of relatively high pressure and the other end to said zone of relatively low pressure to move said frame from said first position to said second position, and connecting said one end of said cylinder to said zone of relatively low pressure and said other end to said zone of relatively high pressure to move said frame back to said first position.

11. An ice machine comprising a pair of spaced freezing surfaces, means for delivering water between said surfaces, an open frame movable within and between said surfaces to retain water between said surfaces in one position, the top side of said frame being above said surfaces in said position and to dislodge ice formed between said surfaces in movement to another position, the bottom side of said frame being below said surfaces in said other position and means for moving said frame between said positions.

12. An ice making machine comprising a pair of spaced freezing surfaces, means for delivering water between said surfaces, an open frame movable within and between said surfaces to retain water between said surfaces in one position and to dislodge and discharge ice formed between and frozen to said surfaces in movement to another position and means to move said frame cyclically between said positions, said frame having a top portion so disposed relative to the sides of said frame as to fragmentize said ice in the dislodging movement.

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