Sept. 25, 1956 J. R. BAYSTON 2,763,993

ICE CUBE MANUFACTURING APPARATUS

Filed Nov 16, 1954

3 Sheets-Sheet 1

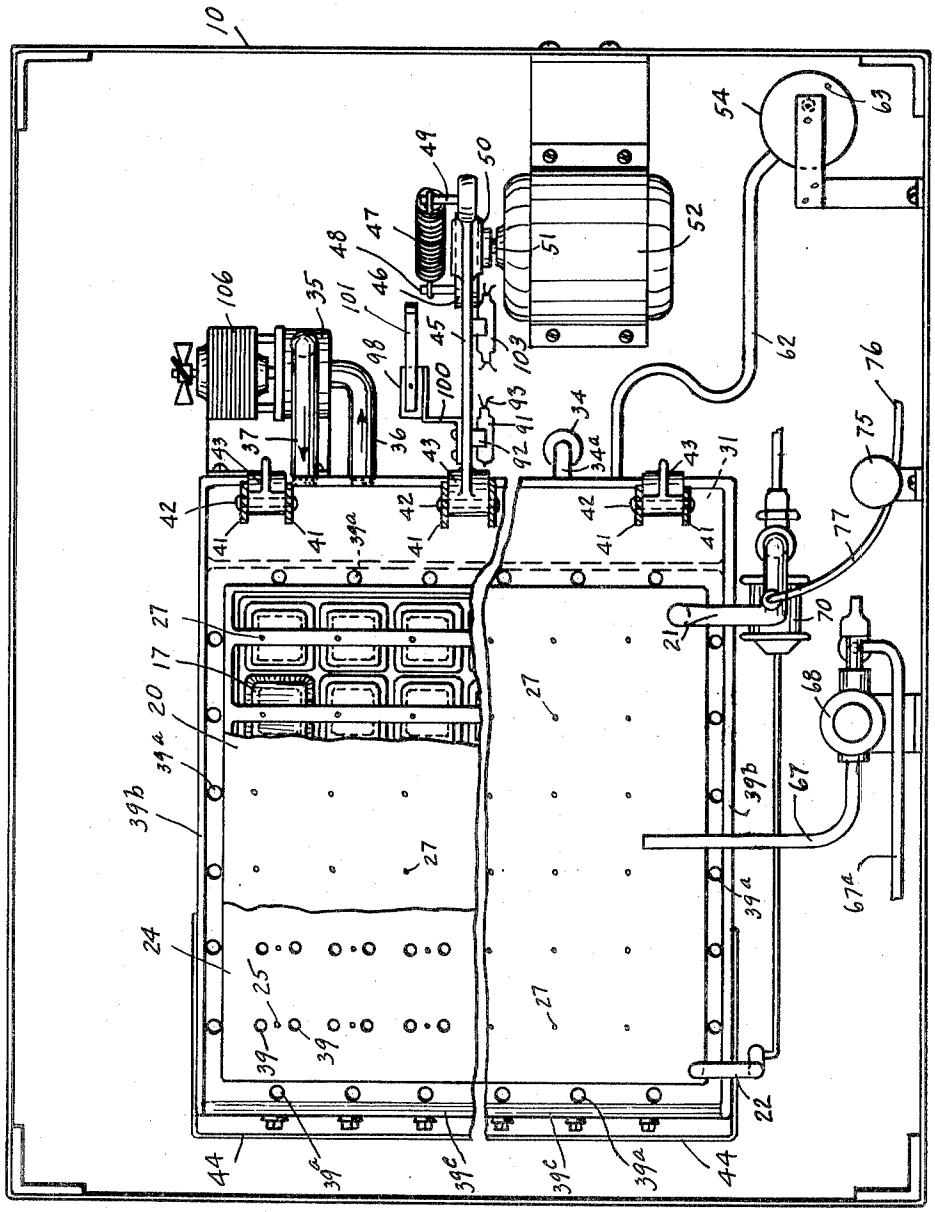

FIG. 1

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ICE CUBE MANUFACTURING APPARATUS

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FIG. 2

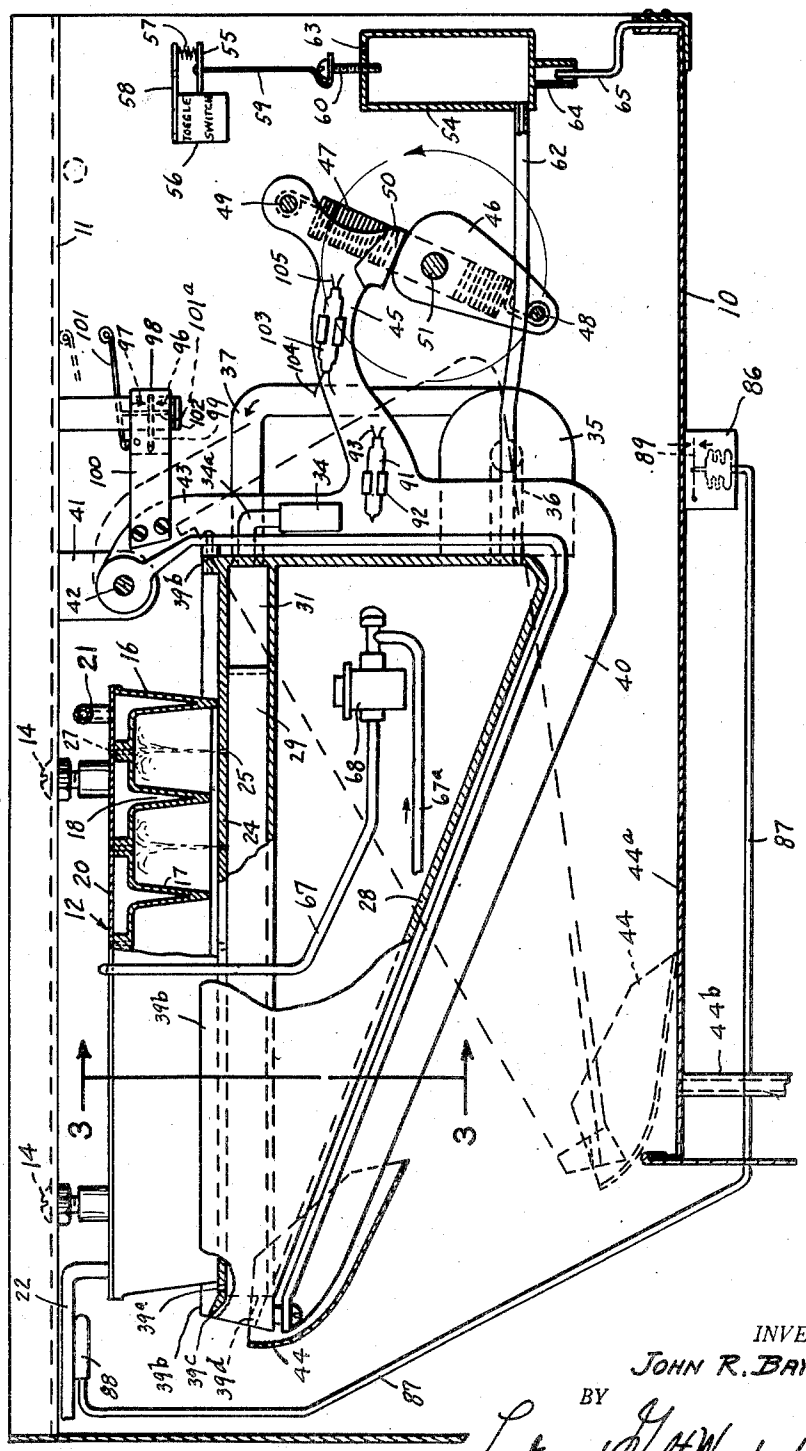

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FIG. 4

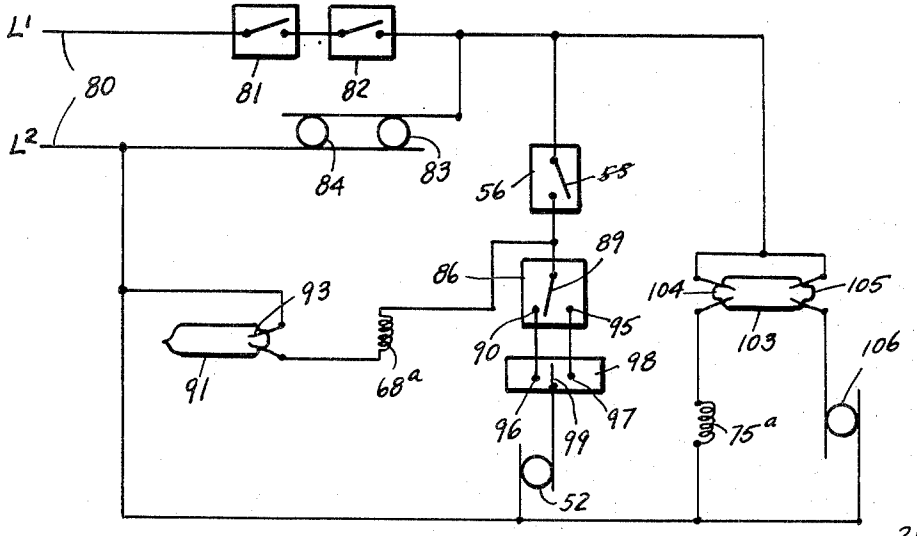
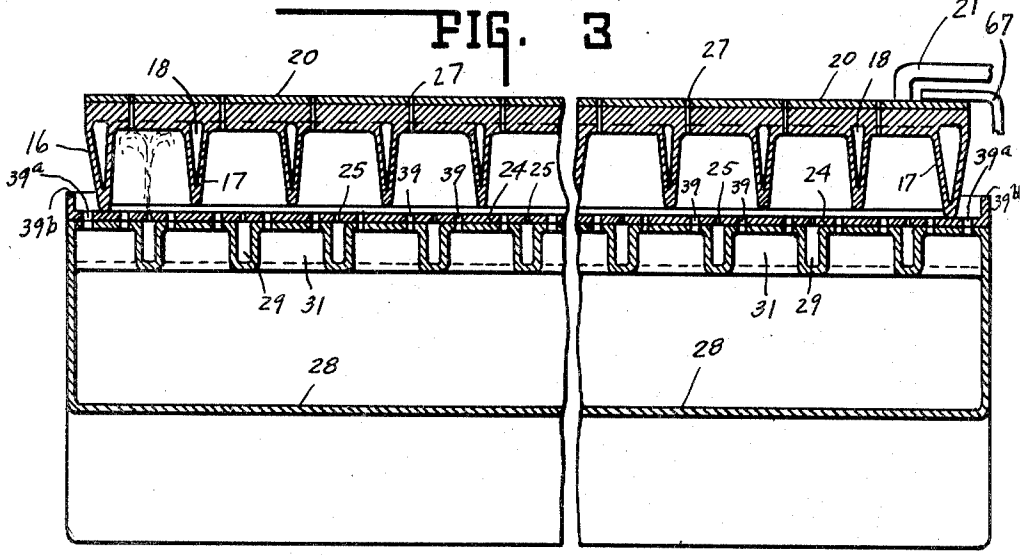


FIG. 3



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ICE CUBE MANUFACTURING APPARATUS

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Application November 16, 1954, Serial No. 469,106

15 Claims. (Cl. 62—7)

This invention relates generally to ice manufacturing machines, and more particularly to ice cube manufacturing apparatus.

Prior ice cube manufacturing machines include an evaporator and a means for supplying water thereto for forming ice cubes. After the cubes are frozen, they are released and dumped by means of thermostatic controls which determine the end of the freezing cycle by sensing the temperature of the evaporator. Thermostatic controls are not sufficiently accurate because they are affected by changes of ambient temperature. For example, a thermostat may be set to operate at zero degrees Fahrenheit at an ambient temperature of seventy degrees. So long as the ambient temperature remains stable within a degree or two, the thermostat will operate at zero degrees Fahrenheit. When the ambient temperature changes to eighty degrees, for example, the thermostat will operate at one or two degrees above zero. As a result, it may be found that the ice cubes have a water core in the center portions thereof and, thus, are not solid ice cubes.

In prior ice cube manufacturing machines, ice cubes are formed by directing a small stream of water into each freezing cell of the evaporator through a small aperture in the water plate. If one of the apertures in the water plate becomes plugged and no stream of water flows into a freezing cell, no ice will be formed therein during a freezing cycle. If a number of apertures are plugged, there may be a number of cells in which ice is not formed whereby the temperature of the evaporator falls abnormally fast. As a result, the conventional thermostatic control apparatus, which determines the end of a freezing cycle and operates the apparatus to release the ice cubes, may operate prematurely to dump the ice cubes before they are frozen completely, with water cones.

Prior ice cube manufacturing machines have been found to be subject to breakage of various parts by reason of failure of ice cubes to drop from the water plate or platen when the mechanism operates at the end of a freezing cycle. The ice cubes are released to fall onto the water plate which swings downwardly away from the evaporator, and this water plate is controlled by positive motion device such as a cam. If one or more of the ice cubes fail to slide off the water plate, these ice cubes may jam between the water plate and the evaporator and stop the driving motor. This can cause the motor to overheat or it can cause breakage of some of the parts of the machine.

Certain prior ice cube freezing machines comprise a closed water system wherein control apparatus may be actuated after a predetermined quantity of water has been removed from the water system by the freezing of ice cubes, thereby to cause discharge of frozen ice cubes. In systems of this type it is necessary to provide a water seal between the water plate or platen and the evaporator for preventing escape of water from the water system during a freezing cycle. In the first place it is difficult to attach a rubber or other kind of seal to aluminum or other metals used on the water plate. The temperatures

are so low that it is necessary to vulcanize rubber, or other material, to the metal. Furthermore, such seals are often torn from the water plate when it is moved out of engagement with the evaporator due to the freezing of ice between the seal and the evaporator. Seals of this type also cause serious troubles in commercial operation because high pressure resulting from freezing of water forces the seal out of engagement with the evaporator. Such failures of the seal in turn may cause complete failure of the machine to produce ice cubes by reason of excessive loss of water during a freezing cycle.

The principal object of this invention is to provide ice cube freezing apparatus which will function to form solid ice cubes as distinguished from cubes having a small water core therein.

Another object of this invention is to provide, in an ice cube freezing apparatus wherein water is fed to a plurality of freezing cells, some of which may be inoperative, a control apparatus effective to terminate a freezing cycle only after solid ice cubes are formed in each operative freezing cell.

Another object of this invention is to provide control apparatus for ice cube manufacturing machines which responds to predetermined maximum and minimum weights of water in a water tank for initiating and terminating a freezing cycle.

Still another object of this invention is to provide in an ice cube manufacturing machine a means adapted to initiate and terminate a freezing cycle only after solid ice cubes are formed, even though some of the freezing cells in the machine may be empty.

Another object of this invention is to provide mechanism in an ice cube freezing apparatus which will cause all ice cubes to be discharged at the end of a freezing cycle, thereby to prevent overheating of the drive motor or breakage of parts.

A further object of this invention is to provide, in an ice cube freezing machine having an evaporator and a water plate for supplying water thereto, water drainage means whereby no seal is required between said evaporator and said water plate.

A still further object of this invention is to provide, in an ice cube freezing machine having an evaporator and a water plate for supplying water thereto, means for feeding water over said evaporator and water plate for the purpose of pre-cooling feed water.

A still further object of this invention is to provide in an ice cube freezing machine a means for charging a tank with a predetermined weight of water, freezing a predetermined portion thereof, thereby to provide drainage water which may be utilized for flushing the tank after the freezing cycle.

In accordance with this invention there is provided an ice cube freezing apparatus comprising an evaporator, a water plate for closing the evaporator during a freezing cycle, a water tank for supplying water to said evaporator, and means responsive to a predetermined weight of water within said tank for initiating and terminating a freezing cycle of said evaporator.

In accordance with a further feature of this invention there is provided an ice cube manufacturing apparatus comprising an evaporator, a water plate and tank for supplying water to said evaporator, said plate including small apertures for feeding a stream of water into each freezing cell of the evaporator, means responsive to a predetermined amount of water within said tank for initiating and terminating a freezing cycle of said evaporator, and means responsive to predetermined pressure within said water plate for exhausting water from said tank when any of said water plate apertures become clogged, whereby said initiating and terminating

means may still respond to said predetermined amount of water.

In accordance with another feature of this invention there is provided an ice cube manufacturing apparatus comprising an evaporator, a water plate for closing said evaporator during a freezing cycle, and apparatus adapted to close said water plate with respect to said evaporator only after all ice cubes have been discharged from said evaporator and water plate following an ice cube freezing cycle.

In accordance with still another feature of this invention there is provided an ice cube manufacturing machine comprising an evaporator, a water plate for closing said evaporator during a freezing cycle, a water system for circulating water through said evaporator and said water plate during a freezing cycle, said water system including means for collecting water which may escape from said evaporator during a freezing cycle and returning it to said water system, whereby it is not necessary to provide a seal between said evaporator and said water plate, and there is no loss of water during the freezing cycle and the freezing cycle may be controlled in accordance with the amount of water present in the water system at the beginning and the end of the freezing cycle.

In accordance with a still further feature of this invention there is provided an ice cube manufacturing apparatus comprising an evaporator having a plurality of open-bottom cells, a water plate for feeding water into said cells and means for feeding water over said evaporator and water plate, thereby to pre-cool feed water.

In accordance with a still further feature of this invention there is provided an ice cube manufacturing apparatus having a water tank, means for charging said tank with a predetermined weight of water, means for freezing a predetermined portion thereof, and means for draining said water tank after a freezing cycle, thereby to flush said tank after each freezing cycle.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

Fig. 1 is a top plan view of an ice cube freezing apparatus provided in accordance with this invention with parts broken away to show a portion of the top of the evaporator and a portion of the top of the water plate.

Fig. 2 is a side elevation view of the apparatus illustrated in Fig. 1 with certain parts omitted for the sake of clarity and certain parts shown in partial cross section.

Fig. 3 is a cross section taken on line 3—3 of Fig. 2.

Fig. 4 is a diagram illustrating the control circuit incorporated in the apparatus of Figs. 1 and 2.

Referring to the drawings, the ice cube freezing apparatus comprises a frame **10** which may be the frame of a cabinet (not shown). Frame **10** may include a transverse plate **11** from which may be supported an evaporator **12** by means of bolts **14**. The evaporator **12** comprises a casting **16** formed to provide a plurality of ice cube freezing cells **17**. Evaporator **12** may be insulated by conventional insulation **15**. Each of the cells **17** comprises vertically divergent walls, whereby space is provided between the adjacent walls of the cells as at **18** for the circulation of a refrigerant and ice cubes may drop freely from the cells after the evaporator is heated. The top of the casting **16** may be closed by means of a cover plate **20**, whereby a refrigerant may be circulated around the walls of the cells by means of an inlet tube **21** and an outlet tube **22**.

The evaporator **12** may be fed with water by means of a water plate **24** having a plurality of apertures **25** opening centrally of each of the cells **17** whereby a stream of water may be forced upwardly against the top and flow downward over the walls of each cell **17**. Plate **24** is spaced from evaporator **12** as shown in Fig. 3, whereby a solid web of ice is formed under the cells to initially connect the cubes for discharge. For insuring that vacuum will not prevent ice cubes from dropping out of the cells, each of the cells **17** is provided with a vent **27**, all of which are displaced laterally with respect to the apertures **25**, thereby to prevent escape of water through the vents when the stream initially spurts upwardly through the apertures **25**.

The water plate **24** is an integral part of a water tank **28**, the plate serving as a water distribution system for supplying water to the cells **17** through apertures **25**. Plate **24** includes rectangular feed lines **29** in alignment with each row of cells **17** to form pressure chambers beneath each row of freezing cells **17** connected thereto by means of the apertures **25**. The rectangular feed lines have the particular advantage that failure of the controls and resulting freezing of water within the lateral feed lines will cause only slight bulging of the rectangular walls thereof. If these feed lines were tubular, such freezing would cause breakage and serious damage.

Plate **24** also includes a high pressure water feed header **31** opening into each of the lateral feed lines. For supplying water to the high pressure feed header **31** there is provided a water pump **35** having a suction line **36** connected to tank **28**, and a pressure line **37** connected between the pump and the high pressure feed header **31**.

In order to drain water from the upper surface of water plate **24** there are provided one or more drain holes **39** for each cell **17**, which holes may be disposed to either side of apertures **25**, whereby any water which may not be frozen may be returned to the tank **28**. Preferably these drain holes are located closely adjacent to apertures **25** to insure that ice may be frozen down to and over said apertures. Wherein the freezing cycle is terminated after a predetermined weight of water has been frozen, any unfrozen water draining from the evaporator does not change the total weight of water and ice within the system.

For eliminating the need for a seal between the upper surface of water plate **24** and the lower periphery of evaporator **12**, there are provided a plurality of drain holes **39***a* located between the outer edge of evaporator **12** and the outer edge of the water plate **24** and opening into tank **28**. For preventing water from running off the outer edges of the water plate **24**, the hinged end of the water plate and the sides thereof are provided with upwardly extending wall members **39***b*. The free end of water plate **24** is provided with a sloping lip member **39***c*, the outer edge of which is raised above the level of water plate **24** to prevent escape of water over the outer end thereof. The lip **39***c* is sloped to permit ice cubes to slide from the water plate when it is lowered to its lowermost position. Thus, no seal is required between evaporator **12** and plate **24**, and the gross weight of water and ice remains constant throughout a freezing cycle and until such cycle is completed.

For preventing accumulation of sediment such as minerals and salts in tank **28** from one freezing cycle to another, there are provided a plurality of drain holes **39***d* in the left hand end (Fig. 2) of tank **28**. Thus, salt water or various mineral waters may be utilized for making ice cubes because during each ice cube discharging cycle of the machine, a certain quantity of surplus water may flow from the deep end of the tank **28** to the shallow end and out through holes **39***d* carrying any residual sediment or solids out of the tank.

The tank **28** is provided with a trough **44** disposed under the outer edge of lip **39***c* to catch drainage water as it emerges from the drain holes **39***d*. Trough **44** extends backwardly beneath the lower surface of tank **28** far enough to direct drainage water into the drainage pan **44***a*, thereby to prevent drainage water from being discharged into the ice collecting bin. Water collecting in the drainage pan **44***a* may be discharged to the sewer by means of a drainage pipe **44***b*.

During a freezing cycle, the apertures **25** freeze closed as soon as complete ice cubes are formed. It can happen

that some of the apertures 25 may become plugged by dirt or other foreign matter. For the purpose of permitting water to escape from the system, there is provided a check valve 34 connected to the high pressure feed header 31 by a tube 34a. As will be described subsequently, the freezing cycle is terminated when a predetermined weight of water is removed from the water tank and frozen in the cells 17. Clogging of apertures 25 would prevent decrease in weight of water in the tank 28 and prevent termination of the freezing cycle. Check valve 34 may be set to drain water from the high pressure feed header 31 when the pressure therein attains a value of three pounds per square inch, for example, which pressure indicates that all of the apertures 25 have been closed either by freezing or clogging. Valve 34 then opens to exhaust water from tank 28, thereby to cause functioning of the control apparatus to terminate the freezing cycle.

The tank 28 may be supported by means of a bracket 40 connected to the supporting plate 11 by means of a plurality of depending hangers 41 which in turn support the hinge pins 42 on which are pivotally supported the upwardly extending arms 43 of bracket 40.

Bracket 40 includes an outwardly extending arm 45 which is adapted to cooperate with a rotating cam 46 connected with the arm 45 by means of a spring 47 stretched between crank pin 48 in cam 46 and a pin 49 fixed in the extreme end of arm 45. The arm 45 includes a cam follower 50 adapted to engage with the outer surface of cam 46. Cam 46 may be mounted on shaft 51 of drive motor 52, whereby when the motor 52 is energized, cam 46 operates to exert upward pressure on the cam follower 50 pivoting bracket 40 and tank 28 about the hinge pins 42 in a counter-clockwise direction (Fig. 2). The cam 46 and spring 47 cooperate to provide lost motion between the motor shaft 51 and the bracket 40 so that failure of an ice cube to slide from the water plate 24 will not cause jamming of the water plate with respect to the evaporator. If an ice cube is not discharged during a discharge portion of the cycle of operation, the spring 47 merely exerts downward tension on the arm 45 without exerting positive force which might cause breakage of parts.

For measuring the weight of the water within tank 28 to determine the end of a water charging cycle and to determine the end of a freezing cycle, there is provided a water level control tank 54 which may be supported from the operating arm 55 of a water level control toggle switch 56. The operating arm 55 may be controlled by a spring member 57 fixed between the outer end of arm 55 and the outer end of a stationary arm 58 mounted to the casing of switch 56. The tank 54 may be suspended from arm 55 by means of a hanger rod 59 engaging the head of an adjustment screw 60, whereby the height of tank 54 with respect to tank 28 is adjustable. Tank 54 may be connected with tank 28 by means of a flexible hose 62, whereby water may rise within tank 54 as tank 28 is filled. An air vent 63 is provided in top of tank 54 to permit rise and fall of water within tank 54. For guiding the upward and downward motion of tank 54 there is provided a depending tubular member 64 in sliding engagement with a guide rod 65 connected to a portion of the frame 10 as illustrated in Fig. 2.

As the water rises and falls within water tank 28, the weight of water within tank 54 correspondingly varies and causes upward and downward movement of tank 54 as controlled by spring 57. Thus, it is arranged that switch 56 may be operated to open when the water reaches a predetermined maximum weight or level in tanks 28 and 54. Conversely, switch 56 is arranged to close when the weight of the water in tank 54 has decreased to a predetermined value. It will be readily apparent that the predetermined weight of water will be established by determining the capacity of the cells 17. Switch 56 is incorporated in a control circuit to control the water level within the tank 28, and it also operates at the end of a freezing cycle to carry out control functions which will be described in more detail.

For charging the tank 28 with water there is provided a feed line 67 which may be connected to a conventional pressure water supply 67a and mounted on top of plate 20 to flow water over the plate and downwardly through vents 27, holes 25, 39 and 39a into the tank 28. This provides pre-cooling of the water. For controlling flow of water in line 67 there is provided a solenoid operated water valve 68 which may be operated at the proper time to fill the tank.

For supplying refrigerant to the evaporator 12, a conventional refrigeration system (not shown) may be connected to evaporator 12 through any conventional restrictive or calibrating means such as an expansion valve 70 and tube 21, outlet tube 22 being provided to conduct the refrigerant back to the compressor (not shown). For feeding hot gas to the evaporator 12 after the termination of a freezing cycle there is provided a solenoid operated valve 75 connected to the compressor by means of a feeder tube 76 and an evaporator tube 77.

For controlling the operating cycle of the apparatus described herein, there is provided the control circuit of Fig. 3 which may be connected across the power line 80. An off/on switch 81, a bin control thermostatic switch 82, the condenser motor 83 and the condenser fan motor 84 may be series connected directly across line 80, whereby switches 81 and 82 energize motors 83 and 84 at all times during operation of the apparatus. The bin control thermostat 82 is provided at a predetermined height in the ice cube receiving bin (not shown) to open the entire control circuit when a predetermined quantity of ice cubes may have accumulated in the cube receiving bin.

The control circuit also includes the water level control switch 56 which may be a conventional toggle switch having an operating arm 55 connected directly to the toggle arm (not shown) of the switch. Switch 56 and arm 55 may be so arranged that arm 55 will snap the toggle to close the switch 56 as arm 55 reaches a lowermost position when a predetermined weight of water has been frozen. Similarly, switch 56 may be opened by arm 55 when the water reaches a predetermined level in tank 28 during a tank charging cycle.

Switch 56 is connected in series with the solenoid 68a of water valve 68, and a mercury, water valve control switch 91 connected to the other side of power line 80. The switch 91 may be mounted by means of a clip 92 on the bracket 40, as illustrated in Figs. 1 and 2, so that the mercury closes contacts 93 when the tank is in its uppermost position, as shown in Fig. 2.

Switch 56 is also connected in series with the single pole, double throw thermostatically operated, switch 86 which may be mounted at a suitable point on the frame 10 and connected by tube 87 with a temperature responsive bulb 88 mounted on the refrigerant outlet tube 22. Bulb 88 may respond to a predetermined degree of heat in tube 22, 40° F. for example, to actuate switch 86 to close its arm 89 with a hot contact 90.

The switch 86 also includes the contact 95 which may be closed near the end of a freezing cycle when the refrigerant outlet pipe 73 is at a temperature below the freezing point of water, for example. Contacts 90 and 95 are connected to contacts 96 and 97, respectively, of a single pole, double throw reset switch 98 mounted on the bracket 40 by means of an arm 100 and including an actuating arm 101 movable into engagement with the supporting plate 11 when the tank is moved into its lowermost dotted-line position (Fig. 2). In this position arm 101 is operable to close movable contact 99 with contact 96, and when the tank is in the upper full-line position illustrated in Fig. 2, the movable contact 99 of switch 98 is operable by finger 101a of arm 101 engaging depending stop member 102, mounted on plate 11, to close with contact 97. Switch contact 99 is connected

in series with the tank elevating and lowering motor 52, which in turn is also connected with the power line 80. The reset switch 98 is of a character that the circuit, as at 96, being once completed is not broken until the reset plunger is operated by finger 101*a*, only after the plate has reached its uppermost position.

A pump and hot valve controlling switch 103 is connected in series with the switches 81, 82 and is a double pole, double throw mercury switch, the contacts 104 of which may be connected with the solenoid 75*a* of the hot valve 75, and the contacts 105 of which may be connected with the water pump motor 106. The switch 103 may be mounted on the arm 45 of bracket 40 to close the water pump controlling contacts 105 when the tank 28 is in its uppermost position shown in Fig. 2, and to open these contacts and close contacts 104 when the water tank 28 is lowered to its cube discharging position, contacts 104 being open when the tank 28 is in its uppermost position.

In operation the apparatus may be energized by closing switch 81 to start the condenser motor 83 and the condenser fan motor 84. Thermostatic switch 82 is normally closed unless the ice cube bin is filled with cubes. These motors run continuously except when the bin associated with the ice cube freezing apparatus becomes full of ice cubes, at which time the thermostatic switch 82 operates automatically to terminate operation of the entire mechanism until a sufficient number of cubes have been removed from the bin to cause re-closure of switch 82.

The water level control switch 56 is in closed position since it may be assumed that the tank 28 and tank 54 are empty. The water valve switch 91 is in closed position when the tank 28 is in its uppermost position. Therefore, water valve solenoid 68*a* will be energized to open valve 68.

Water flows to fill the tank 28, raising the level of the water in the water level control tank 54 until sufficient weight of water accumulates in tank 28. At this point tank 54 will have moved downwardly to open switch 56, thereby to de-energize solenoid 68*a* and close water valve 68. The tank 54 may be adjusted to hold the valve 68 open until approximately twelve pounds of water are accumulated in tank 28. Experimental operation shows that eight pounds of ice may be frozen in an evaporator having ninety-six cells 17, thereby allowing four pounds of drainage water to escape partially through the check valve 34, but principally through the drainage holes 39*d* upon the water tank reaching its lowermost position as shown in dotted lines in Fig. 2. In this manner the freezing cycle is continued until all of the ice cubes are frozen solid, thereby eliminating the possibility of producing ice cubes having hollow cores.

After tank 28 has been filled to the proper level, the freezing operation occurs, the water pump motor 106 being energized through the closed contacts 105 to circulate water from tank 28 through the high pressure header into the lateral feed lines 31, whereby streams of water are directed into the cells 17. Layer after layer of ice accumulates on the walls of the cells, and any unfrozen water drains through the drain holes 39 into tank 28. This circulation continues until the cells 17 have frozen solid cubes of ice sealing the apertures 25 and having a total predetermined weight of, for example, eight pounds.

Sealing of apertures 25 increases the pressure within header 31 to the point where valve 34 opens and water in tank 28 will be discharged through the check valve 34 until enough of the water in the tank 28 is exhausted to effect operation of the water level control tank 54 which will then have sensed the exhaustion of the water from tank 28 and will have moved upwardly sufficiently far to operate the switch arm 55 and close switch 56. Meanwhile, the thermostatically controlled switch 86 will have closed its switch arm 89 with contact 95 due to the fact that the refrigerant outlet line 22 will have cooled, thereby to effect closure of these contacts. This switch is adjusted to shift contact 89 from the contact 90 to contact 95 near the end of the freezing cycle. The re-set switch 98 will be in such a position that switch arm 99 will have closed with contact 97, thereby establishing a circuit through the motor 52 to initiate its operation. It will rotate the cam 46 counterclockwise (Fig. 2) engaging it with the cam follower 50 on arm 45, exerting a positive upward force to break away the water plate 24 and simultaneously lowering tank 28 away from evaporator 12. The motor 52 rotates cam 46 to lower the tank 28 to a degree sufficient that cubes may drop from the evaporator 12 and slide down the water plate 24 into an ice cube bin. At this point, arm 101 contacts plate 11 moving switch arm 99 out of contact with contact 97 and into contact with contact 96, thereby breaking the circuit through 89, 95, 97 and 99 stopping motor 52 and the downward movement of tank 28. In this connection it may be noted that contact 89 is in engagement with contact 95 until the ice drops from the evaporator and thermostat 86 warms up. Thereupon contact 89 will be thrown into engagement with contact 90 to thus close the circuit through 96, 99 to start the motor and the upward travel of the water plate 24.

The ice cubes are freed from the evaporator by circulating hot gases through and around the walls of the cells 17. This is accomplished after the bracket 40 has reached its lowermost position, thereby to close contacts 104 of switch 103 to energize the solenoid 75*a* of hot valve 75. Thus, hot gases from the compressor are circulated until the ice cubes are freed and slide into the ice cube bin. During the time that check valve 34 is discharging water, the pilot tank 54 will rise and actuate switch 56 before water in tank 28 reaches the level of suction tube 36, thereby to prevent circulation of an air-water mixture in the evaporator which would cause production of cloudy ice cubes. Also, this operation of tank 54 serves to prevent circulation of water having minerals, salts or sediment therein which might produce cloudy ice cubes. Hence, it is desirable in order to produce eight pounds of ice to provide twelve pounds of water in tank 28 at the start of a freezing cycle whereby the above mentioned results may be achieved and also whereby a sufficient quantity of water remains in tank 28 after the freezing cycle to drain from tank 28, thereby removing said minerals, salts or sediment.

As the tube 22 warms up, switch 86 shifts arm 89 to contact 90 completing the circuit of motor 52 and starting cam 46. The water plate 24 and tank 28 are returned toward the uppermost position through tension on spring 47. If there are still ice cubes on the water plate or in the way of its upward movement, spring 47 will stretch and the water plate will not actually reach its uppermost position but will be inclined at an angle sufficient that the contact 96 of re-set switch 98 will still be closed. The contacts 104 of switch 103 will remain closed, and contact 90 of switch 86 will still be closed since the tube 73 will still be warm. Therefore, the hot gases continue to circulate around cells 17, and motor 52 operates through another cycle to lower water plate 24 and tank 28 through another cycle. The motor 52 continues to repeat its operating cycle until all of the cubes on the water plate have been melted or have dropped to the bin. Thus the water plate 24 and tank 28 eventually return to their uppermost position, at which time and only at which time, the depending finger 101*a* of arm 101 associated with switch 98 may re-set the arm 99 into contact with contact 97.

Meanwhile, the water level control switch 56 has closed due to exhaust of water from tank 28, thereby to energize solenoid 68*a* to open the water valve 68, thus intitiating charging of tank 28 with a new charge of water. It should be noted that switch 91 will have closed when tank 28 assumed its uppermost position. Also, the contacts 105 of switch 103 will have closed, and contacts 104 will have opened, thus re-initiating operation of the water

pump motor 106 and terminating operation of the hot valve, whereby refrigerant will re-circulate in evaporator 12.

The freezing and thawing cycles continue as described until the bin is filled with ice cubes to open the bin thermostatic switch 82, thereby to terminate operation of the mechanism.

From the foregoing description it will be apparent that it is possible to freeze solid ice cubes regardless of ambient temperatures or the time interval which may be required. This is by reason of the fact that the freezing cycle is controlled by determining the amount of water frozen in the evaporator cells and the pressure of the water in the water plate 24.

This invention also provides clear ice cubes free from cloudy appearance by reason of the fact that circulation of air and water mixtures is prevented and minerals, salts or other forms of sediment can not collect in the water tank and are circulated near the end of a freezing cycle. Thus, clear cubes may be produced from substantially any raw water regardless of its mineral or sediment content.

This invention prevents breakage of parts which might be caused by lodged cubes on the water plate. Even though one or more cubes may not slide off the water plate after a freezing cycle, the mechanism inherently repeats the discharge cycle until the ice cubes are either dislodged or melted. This invention provides solid ice cubes even though some cells may be inoperative by means of a combined weight and pressure controlled electrical circuit. Furthermore, the need for a seal between the evaporator and the water plate is eliminated in this type of system by providing facilities for draining unfrozen water from the evaporator back into the water tank.

The invention claimed is:

1. Ice cube freezing apparatus comprising an evaporator, a swinging water plate supported for movement into engagement with said evaporator for feeding water thereto and to a downwardly inclined ice discharge position, a water supply tank suspended from said water plate and including drainage means operative when said water plate assumes said discharge position, power driven means for swinging said plate and tank into said engagement position or into said ice discharging position, a motor driven pump connected between said tank and said water plate for feeding water to said plate during the freezing cycle, electric circuits for controlling the freezing and defrosting cycles and the recharging of said tank with water, a pilot tank connected to said water tank and operatively associated with said electric circuits to initiate recharging of said tank after a defrosting cycle and responsive to a predetermined maximum weight of water in said tank to terminate said recharging of said tank, and a check valve connected to said water plate and responsive to a predetermined pressure in said water plate to exhaust water from said tank to a predetermined minimum weight of water, whereby said tank may be charged with an amount of water in excess of that required to fill said evaporator with ice and said excessive supply of water may be drained from said tank when it assumes its ice discharge position.

2. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice discharge position, a water supply tank suspended from said water plate and including an outwardly projecting lever, a motor having cam means in the way of said lever for swinging said plate and tank into said engagement or into an ice discharging position, a motor driven pump connected between said tank and said water plate for feeding water to said plate during a freezing cycle, means for draining water from said cells to said tank, electric circuits for controlling the freezing and defrosting cycles and the recharging of said tank, said circuits including an energizing switch having a spring normally holding its contacts in open position, and a pilot tank connected to said water tank and suspended from said switch and spring at such a level with respect to said tank that said pilot tank is operable to operate said switch when said tank is filled with a predetermined weight of water and to reset said switch when a predetermined amount of water is withdrawn from said tank.

3. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice discharge position, a water supply tank suspended from said water plate, motor driven means for swinging said plate and tank into said engagement or into an ice discharging position, water circulating means connected between said tank and said water plate for feeding water to said plate during a freezing cycle, means for draining water from said cells to said tank, electric circuits for controlling the freezing and defrosting cycles and the recharging of said tank, said circuits including an energizing switch, and a pilot tank connected to said water tank and suspended from said switch at such a level with respect to said tank that said pilot tank is operable to operate said switch when said tank is filled with a predetermined weight of water and to reset said switch when a predetermined amount of water is withdrawn from said tank.

4. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice discharge position, a water supply system connected to said water plate, power means for swinging said plate into said engagement or into an ice discharging position, water circulating means connected to said water system for feeding water to said plate during a freezing cycle, electric circuits for controlling the freezing and defrosting cycles and the recharging of said system, said circuits including a switch, and a weight responsive means connected to said water system and operatively associated with said switch for operating said switch when said system is filled with a predetermined weight of water and to reset said switch when said system is exhausted to a predetermined degree.

5. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice discharge position, a closed water supply system connected to said water plate, power means for swinging said plate into said engagement or into an ice discharging position, electric circuits for controlling the freezing and defrosting cycles and the recharging of said tank, said circuits including a switch and a pilot tank connected to said system and suspended from said switch for operating said switch when said system is filled with a predetermined weight of water and to reset said switch when said system is exhausted to predetermined degrees.

6. Ice cube freezing apparatus comprising an evaporator, a water plate for closing the evaporator during a freezing cycle, a water system for supplying water to said evaporator, and means responsive to a predetermined maximum and minimum weight of water within said system for initiating and terminating a freezing cycle of said evaporator.

7. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into water-pervious engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice receiving and discharging position, said water plate including gravity drainage means, a water supply tank suspended from said water plate to collect water escaping from said evaporator, and drainage means connected to said tank

for draining it in said ice discharge position, thereby to purge said tank of sediment after each freezing cycle.

8. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, a swinging water plate supported for movement into water pervious engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice receiving and discharging position, a water supply tank suspended from said water plate, said plate including drain holes disposed outwardly of said evaporator and opening into said tank, drive means for swinging said plate and tank into said engagement or into an ice discharging position, a motor driven pump connected between said tank and said water plate for feeding water to said plate during a freezing cycle, and means for draining water from said tank when said plate is in said discharge position, thereby to purge said tank of sediment after each freezing cycle.

9. Ice cube manufacturing apparatus comprising an evaporator, a water plate and tank for supplying water to said evaporator, pumping means for circulating water from said tank to said evaporator and return to said tank, said plate including relatively small apertures for feeding streams of water into said evaporator, means responsive to predetermined minimum amounts of water within said tank for charging said tank with an amount of water in excess of that to be frozen and for terminating a freezing cycle of said evaporator when a predetermined minimum amount of water is left in said tank, and a check valve connected to said water plate and responsive to predetermined pressure within said water plate for exhausting water from said plate to reduce said amount of water within said tank to said predetermined minimum amount when any of said apertures become clogged, whereby said charging and terminating means may respond to said predetermined minimum amount of water respectively.

10. Ice cube manufacturing apparatus comprising an evaporator, a water plate and tank for supplying water to said evaporator, said plate including means for feeding streams of water into said evaporator, means responsive to predetermined maximum and minimum amounts of water within said tank for initiating and terminating a freezing cycle of said evaporator, and a check valve connected to said water plate and responsive to predetermined pressure within said water plate for exhausting water from said plate to reduce said amount of water within said tank to said predetermined minimum amount when said feeding means becomes clogged, whereby said initiating and terminating means may respond to said predetermined minimum amount of water.

11. Ice cube manufacturing apparatus comprising an evaporator, a water system for supplying water to said evaporator, said system including means for feeding streams of water into said evaporator, means responsive to predetermined maximum and minimum amounts of water within said system for initiating and terminating a freezing cycle of said evaporator, and means connected to said water system and responsive to predetermined pressure within said water system for exhausting water from said system to reduce said amount of water within said system to said predetermined minimum amount when any of said feeding means become clogged, whereby said initiating and terminating means may respond to said predetermined minimum amount of water.

12. Ice cube freezing apparatus comprising an evaporator, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice receiving and discharging position, an outwardly projecting lever connected to said water plate, a motor having cam means in the way of said lever for swinging said plate into said ice discharging position and a spring connection between said cam means and said lever for swinging said water plate toward engagement with said evaporator, and an electrical control circuit for driving said motor and including switch means operative to initiate operation of said motor and to continue said operation for repeatedly swinging said water plate through said downwardly inclined discharge position and toward said evaporator engaging position until said water plate engages said evaporator.

13. Ice cube freezing apparatus comprising an evaporator, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice receiving and discharging position, a motor having a positive drive linkage connected to said plate for swinging said plate into said ice discharging position, and a lost motion connection with said water plate for swinging said water plate toward engagement with said evaporator, and an electrical control circuit for driving said motor and including switch means operative to initiate operation of said motor and to continue said operation for repeatedly swinging said water plate through said downwardly inclined discharge position and toward said evaporator engaging position until said water plate engages said evaporator.

14. Ice cube freezing apparatus comprising an evaporator, a swinging water plate supported for movement into engagement with said evaporator for feeding water into said cells and to a downwardly inclined ice receiving and discharging position, drive means for swinging said plate into said ice discharging position and for swinging said water plate toward engagement with said evaporator, and an electrical control circuit for driving said drive means and including switch means operative to initiate operation of said drive means and to continue said operation for repeatedly swinging said water plate through said downwardly inclined discharge position and toward said evaporator engaging position until said water plate engages said evaporator.

15. Ice cube freezing apparatus comprising an evaporator having a plurality of open-bottom cells, vent holes in the top portions of said cells, a water plate disposed beneath said cells for feeding water into said cells and including drainage holes, a water tank beneath said water plate, and means for charging said tank by feeding water over the top surface of said evaporator for drainage through said vents and said holes into said water tank, whereby water introduced into said tank is pre-cooled.

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