Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

Filed July 22, 1960 7 Sheets-Sheet 1

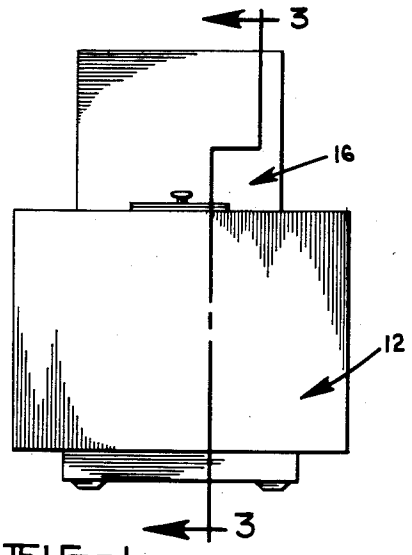


FIG.-1

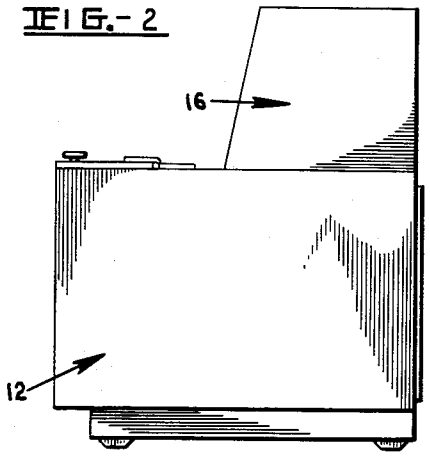


FIG.-2

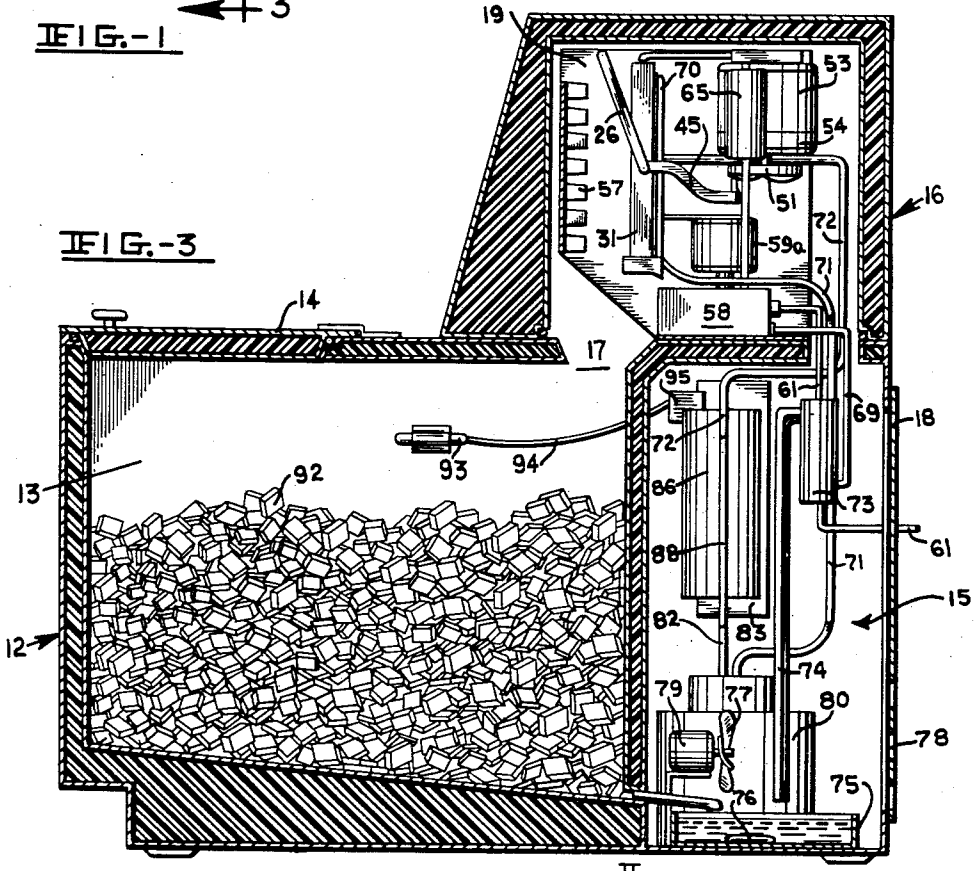


FIG.-3

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Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

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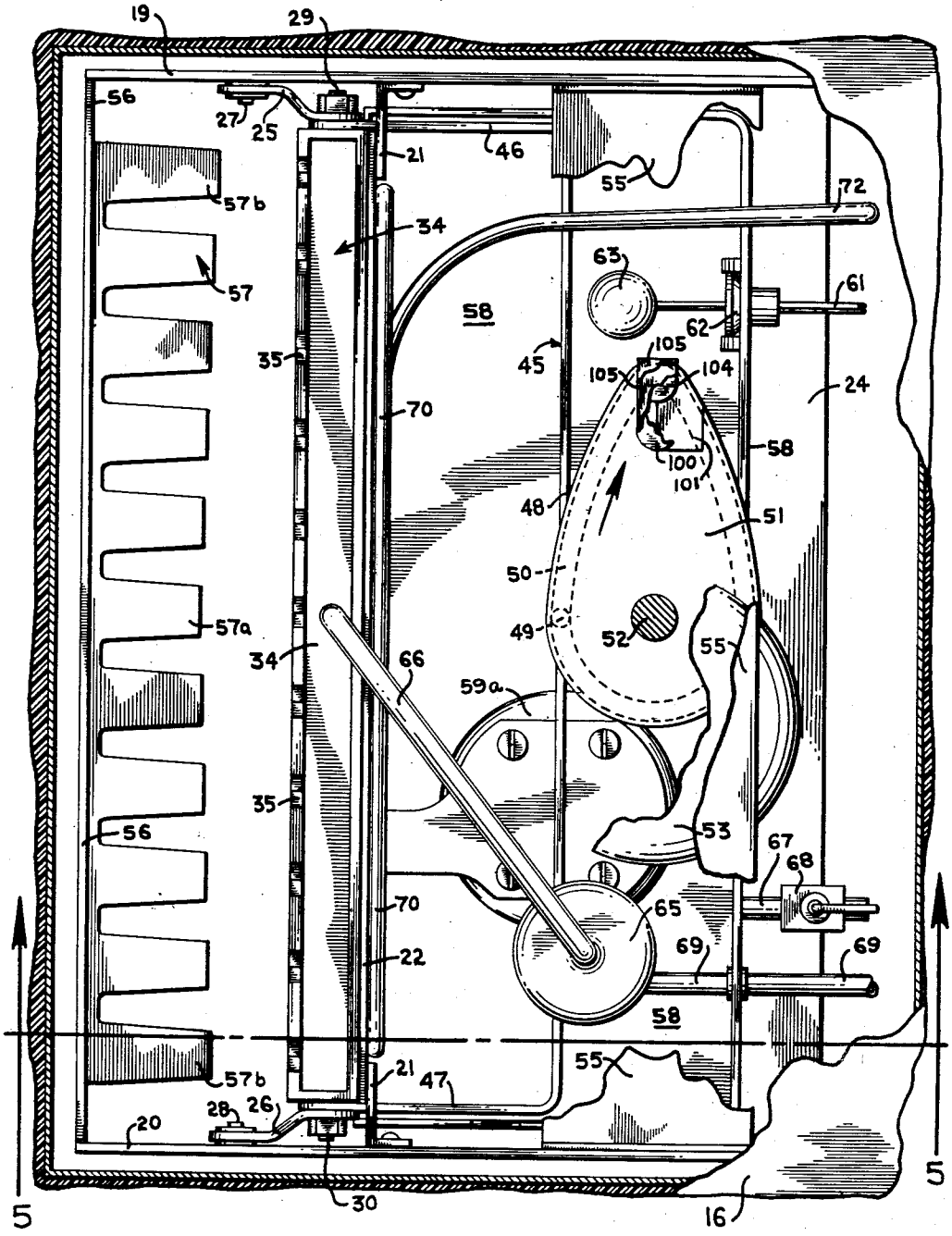


FIG.- 4

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ICE MAKING MACHINE

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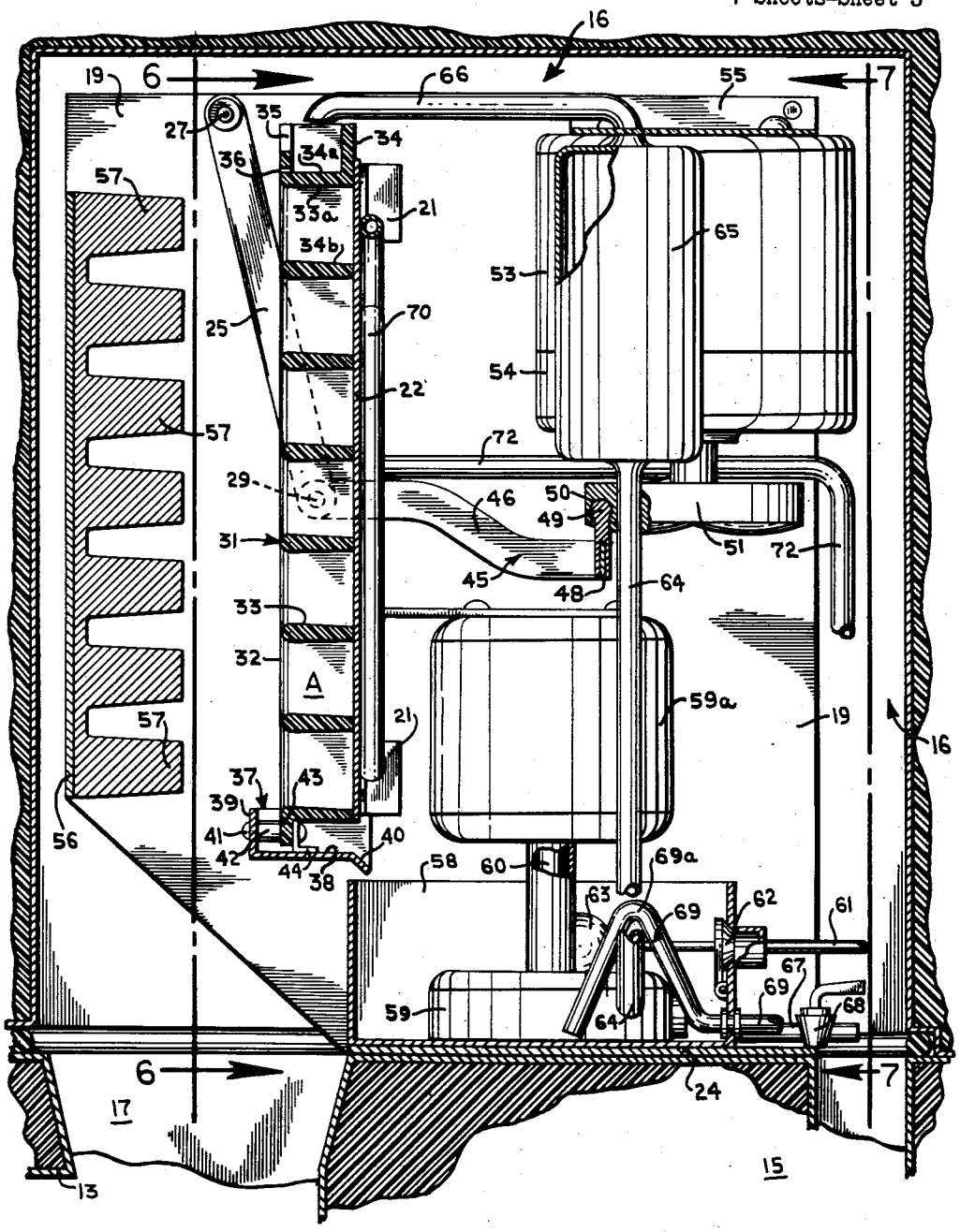


FIG.-5

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Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

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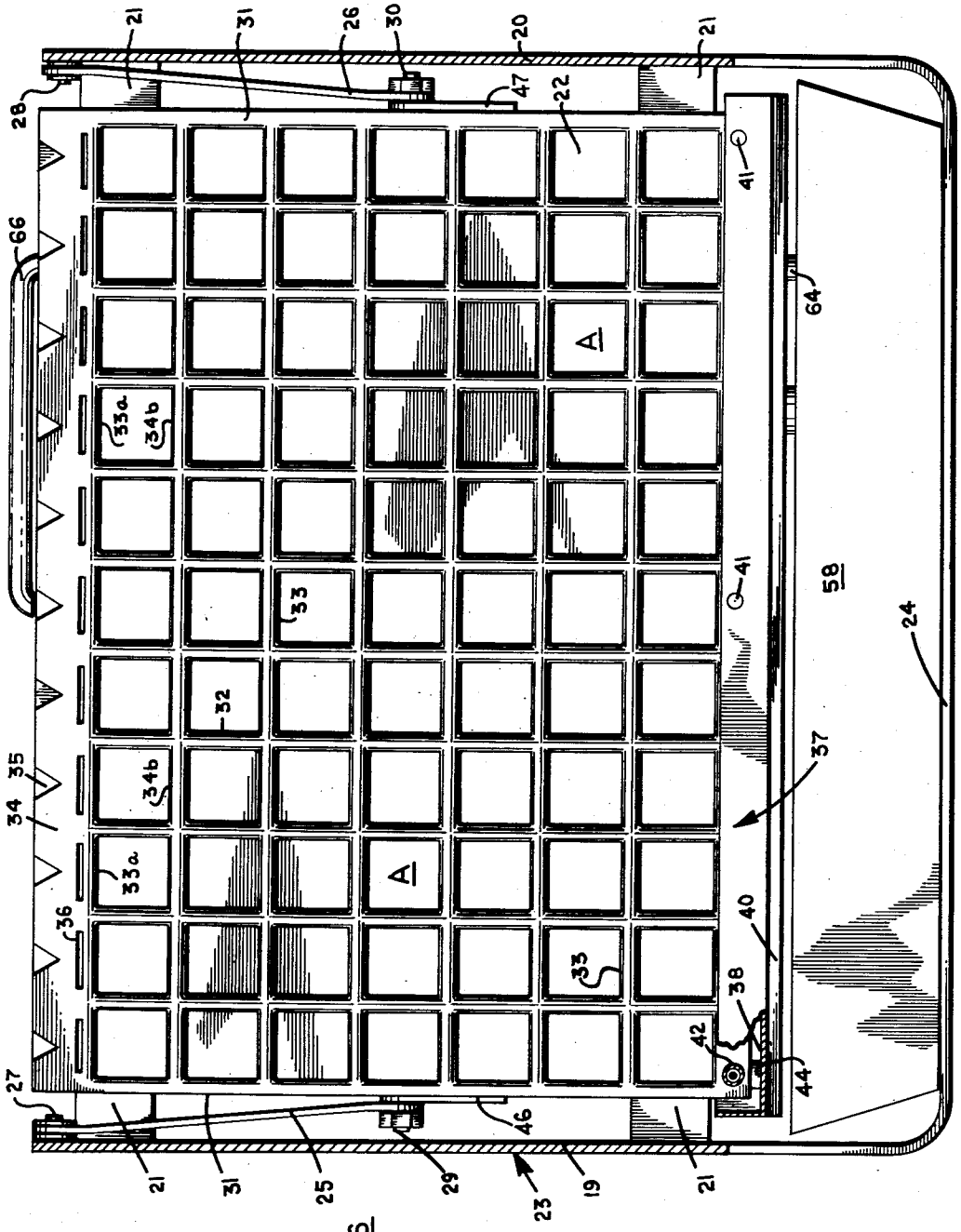


FIG. 6

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Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

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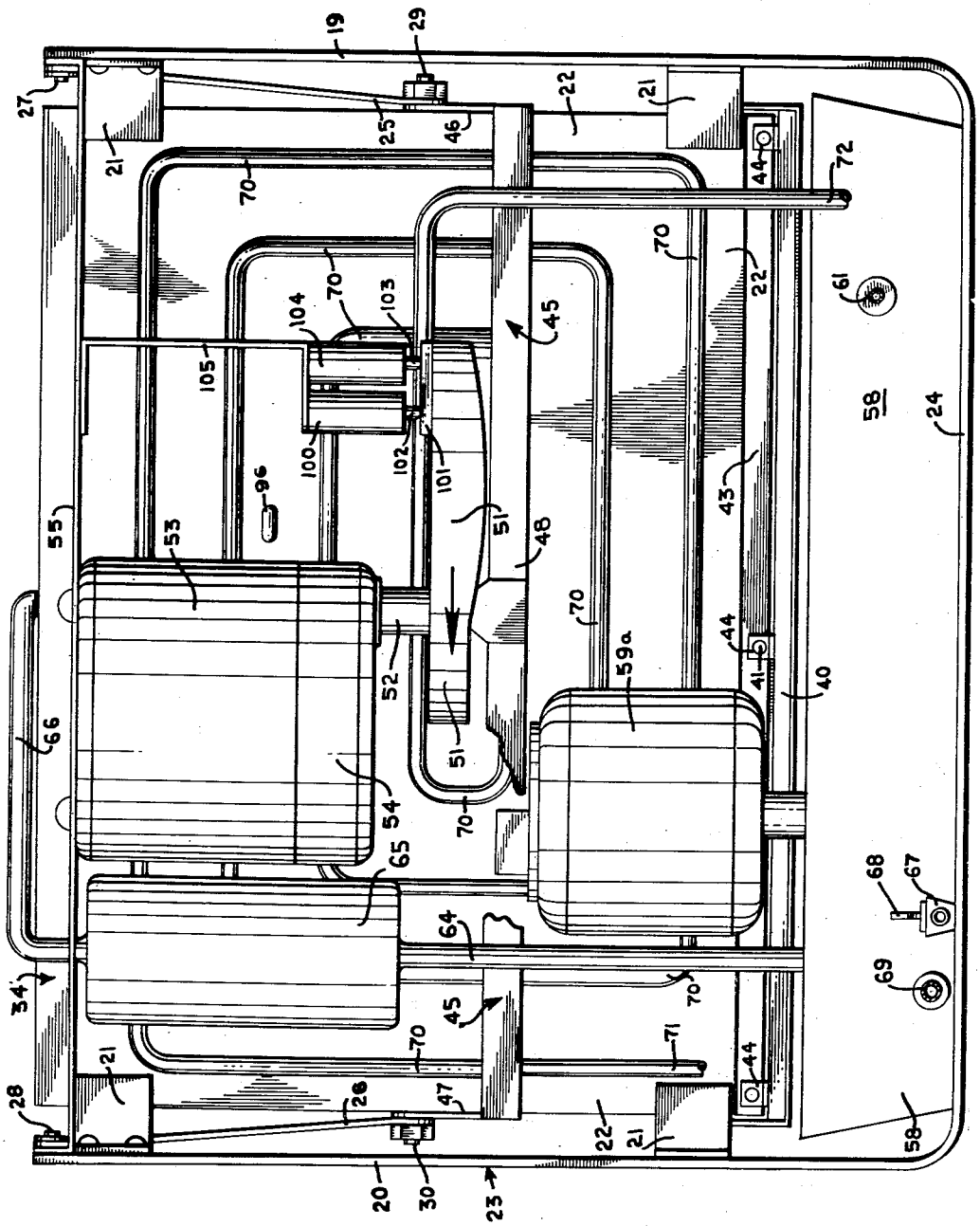


FIG. 7

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Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

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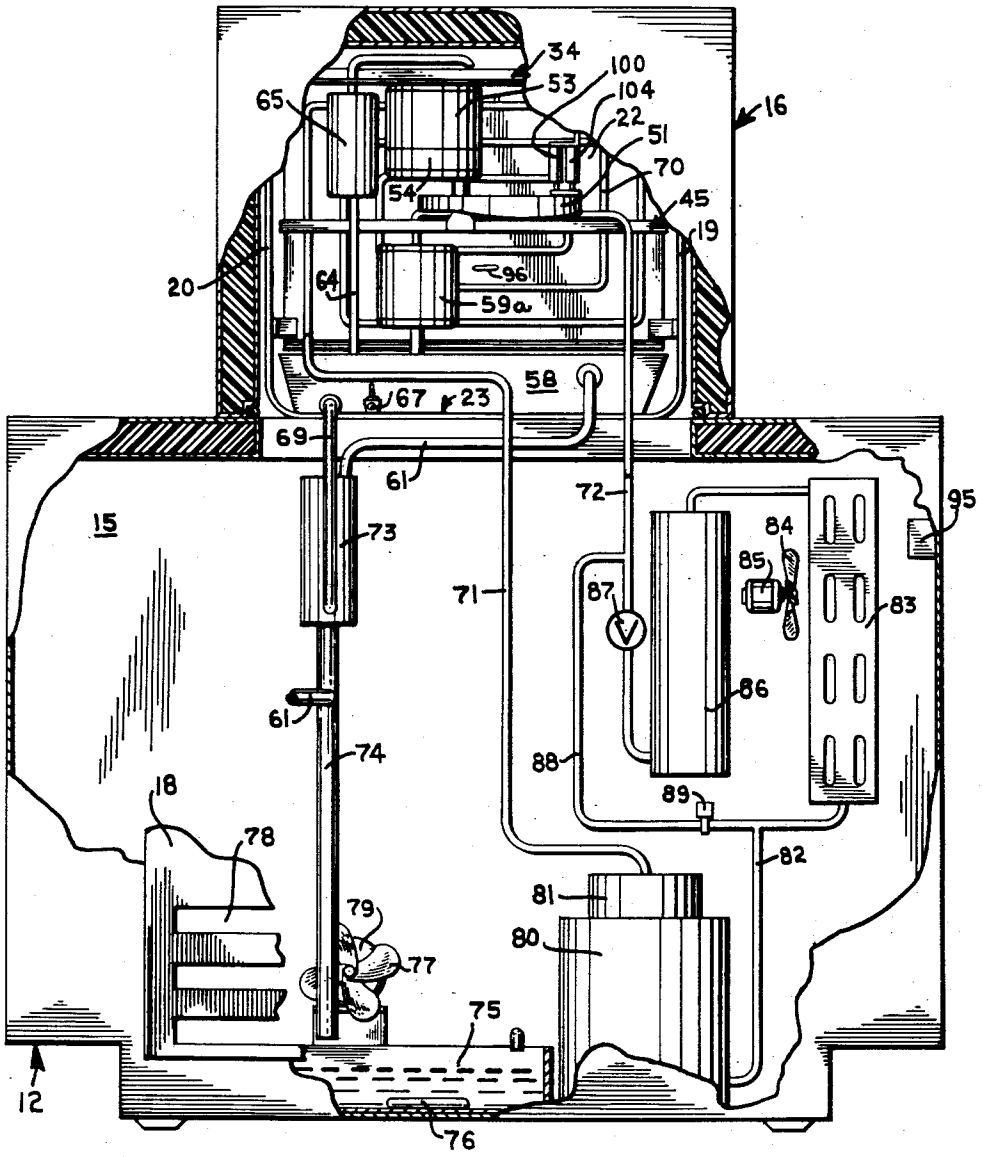


FIG.-8

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Oct. 10, 1961 T. KATTIS 3,003,335

ICE MAKING MACHINE

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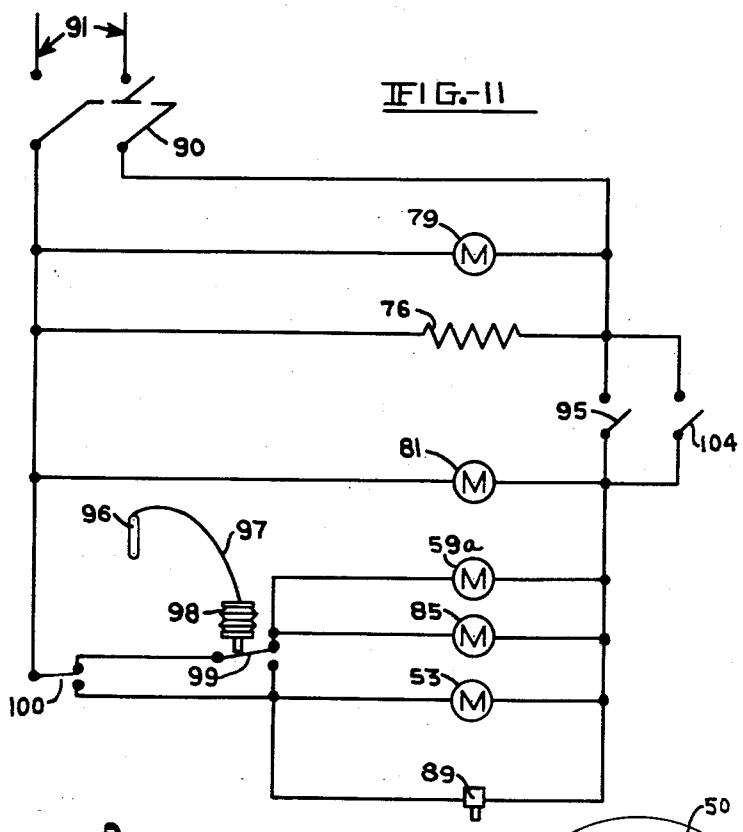


FIG.-11

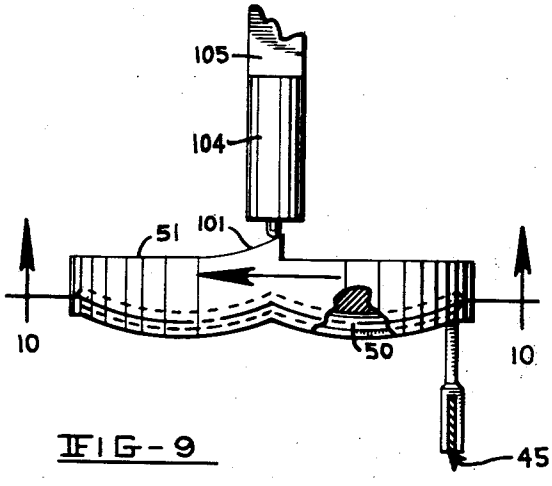


FIG-9

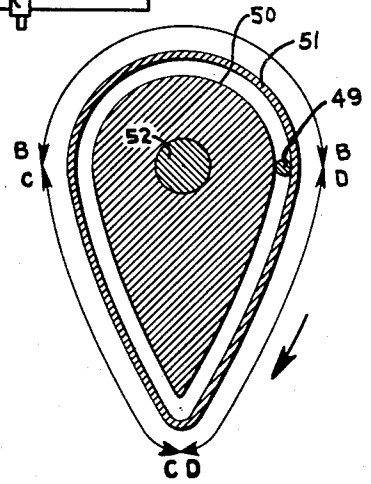


FIG.-10

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United States Patent Office 3,003,335 Patented Oct. 10, 1961

3,003,335

ICE MAKING MACHINE

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Filed July 22, 1960, Ser. No. 44,708
17 Claims. (Cl. 62—348)

This invention relates to a device for making relatively small blocks of ice popularly known as "ice cubes." The cubes may not necessarily be of six equal faces since the block may be thinner in relation to the dimensions normally associated with a cube.

A primary object of the invention is to provide a machine which is relatively inexpensive and is quite simple in operation and construction.

Another primary object of the invention is to provide a machine which will make clear, individual ice cubes from water not requiring to be distilled or purified, but obtained directly from a public water supply or the like.

A still further important object of the invention is to provide a machine which will minimize the effects of the accumulation of lime and mineral deposists on the ice forming surfaces.

A further important object of the invention is to provide a mechanism which will occupy a minimum space and which will rapidly produce ice in uniform blocks transparent in nature.

Briefly the invention involves the use of a fixed, generally vertical refrigerated plate against which a water wettable grid open from opposite sides is abutted in position to receive a spray or flow of water thereover to permit the water to flow in and out of the grid openings and against the refrigerated plate to form individual cubes by freezing the water from the plate outwardly in the openings of the grid; and then through appropriate controls, following a predetermined ice thickness in the grid openings, heating the refrigerating plate to release the ice bond between the ice and the plate; then moving the grid from the plate and telescoping its openings over pins or posts to eject the ice from the grid, following which the ice droys by gravity into a storage compartment.

The invention will be described in detail in reference to the accompanying drawings illustrating more or less diagrammatically the invention wherein

FIG. 1 is a view in front elevation of a device embodying the invention on a small scale;

FIG. 2 is a view in side elevation of the device;

FIG. 3 is a vertical section on the line 3—3 in FIG. 1, on an enlarged scale;

FIG. 4 is a top plan view of the uppermost part of the device shown in FIGS. 1 and 2 and in partial section;

FIG. 5 is a view in vertical section on the line 5—5 in FIG. 4 and through the upper ice making compartment of the device only;

FIG. 6 is a vertical section on the line 6—6 in FIG. 5;

FIG. 7 is a vertical section through the upper cabinet only on the line 7—7 in FIG. 5;

FIG. 8 is a view in rear elevation and partial section of the entire device;

FIG. 9 is a view in vertical elevation and partial section of an operating cam;

FIG. 10 is a transverse section through the cam; and

FIG. 11 is a wiring diagram of the electrical operating and control system.

In the present form of the invention, mechanism is embodied in a lower base unit 12 which contains, FIG. 3, an ice storage compartment 13 having an upper access door 14 thereto, and also having a back compartment 15 in which the refrigerating mechanism is placed. On the top of the base unit 12 is a second unit 16 which houses the ice making mechanism, and is so arranged that

there is an opening 17 from the underside of the unit 16 into the storage compartment 13 at the upper rear end thereof, FIG. 3. The storage compartment 13 is thermally insulated as is also the compartment 16. The refrigerating compartment 15 is subjected to room terperature through the back wall 18 thereof.

In the upper compartment 16 there is mounted transversely between the side walls 19 and 20, by any suitable means such as herein shown as consisting of four brackets 21, a metallic curved or planar plate, shown herein as planar, of high thermal conductivity such as copper, aluminum, or the like. That is, this plate designated by the numeral 22 is fixed in position in the present example. The position as indicated particularly in FIGS. 4 and 5 is substantially vertical, although some angularity from the vertical may be permitted as will later be described. While the walls 19 and 20 have above been referred to as being sides of the cabinet 16, they may be as herein shown wings of a U-shaped frame 23, FIG. 6, wherein the walls 19 and 20 are upwardly directed from a lower interconnecting floor web 24 spaced below the bottom edge of the plate 22. By so using the frame 23, all of the apparatus located in the cabinet 16 may be installed or removed therefrom as a unit carried by the frame 23.

A pair of arms 25, 26 are respectively hinged or pivoted at upper end portions thereof to the walls 19 and 20, FIGS. 5 and 6, the pivot points 27 and 28 being adjacent the top edges of those walls 19 and 20 and toward the front edges thereof. The lower ends of these arms 25 and 26 rockably receive pins 29 and 30 respectively fixed to sides of a grid generally designated by the numeral 31. The relatively back face of the grid 31 has all of its elements falling into a common surface conforming to that of the plate 22. The grid 31 is intended to be swung by the arms 25 and 26 to have this back side come into intimate contact over the relatively forward face of the plate 22. The external dimensions of the grid 31 are such that the grid will have its top, bottom, and side edges coincide with like margins of the plate 22.

The grid 31 is what might be termed an open lattice wherein, in the present form, there are vertically disposed bars 32 intersecting horizontally disposed bars 33, FIG. 6. The grid 31 is entirely open between the rectangular spacings defined by these vertical and horizontal bars, as indicated in FIG. 5. All of these bars are thinner in transverse section at their abutting edges bearing against the plate 22 than they are at their forward edges. In other words there is draft provided from the front to the back sides of these openings or cavities designated by the letter A. When the grid 31 is in abutment with the plate 22, the openings A are closed off from the back side, and thus become cups open from the forward side, the cups being thus arranged to have their opening margins in a common plane vertically disposed. The material of the grid 31 is important since it must be of water wetting nature and also be of low thermal conductivity with the additional requirement of being substantially rigid.

This grid 31 is further characterized by having a water distributing means herein shown as comprising a trough 34 formed across the uppermost part of the grid as indicated in FIGS. 5 and 6, and this trough 34 is provided with a plurality of V weirs 35 spaced apart across the forward side of the grid. The trough is also provided with a plurality of slot-like openings 36 through the forward wall and below the weirs 35, the slots 36 opening from over the floor 34a of the trough 34. These weirs 35 and slots 36 are centered above each of the vertically disposed rows of the openings A, FIG. 6. Across the bottom of the grid 31 is a water collecting and return chute 37 which extends throughout the length of the grid

31 and is spaced below its lower edge. This chute 37 has a floor 38 spaced below the grid 31, and across the front and ends of the floor 38 there is an upwardly extending flange 39. This chute 37 is open entirely along its back side and has a downturned lip 40 coextensive with the length of the floor 38. Any water flowing downwardly from the grid 31 will be caught by the chute 37 and directed over the floor 38 and will discharge therefrom over the lip 40. The chute 37 is secured to the lower edges of the grid 31 by any suitable means, herein shown as consisting of a rivet 41 extending through a spacer 42; through a lower flange 43 of the grid 31; and through a supporting bracket 44 which in turn rests on the floor 38.

A yoke 45 has forward ends of its arms 46 and 47 fixed rigidly to the pins 29 and 30. Intermediate the web 48 between the arms 46 and 47 is a cam follower 49 constituting a ball head. The head 49 is received in a cam track 50 of a cam 51. The cam 51 is an elongated heart shaped member fixed on the end of a drive shaft 52 which extends vertically upwardly to the head of a cam drive motor 53.

This motor 53 has a gear reduction head 54 from which the shaft 52 extends so that the shaft 52 turns at a relatively low speed in comparison to the speed of the motor itself. Thus, as the shaft 52 rotates, the cam 51 likewise rotates and gives the yoke 45 a fore and aft reciprocating movement, whereby the arms 25 and 26 rock on their respective pivots 27 and 28, and in turn carry the grid 31 against the plate 22 and away from that plate in a regular cyclic action. Since the rocking action of the arms 25 and 26 causes the lower ends of the arms to rock in an arc of travel, this means that the pins 29 and 30 likewise travel in that arc and in turn causes a corresponding rise and fall vertically of the pins. In order to maintain the yoke arms 46 and 47 in substantially horizontal lines of travel, the cam track 50 rises and falls around the sides of the cam which is in those side portions of the cam corresponding to the fore and aft travel of the yoke arms. In this manner, the grid 31 will always be in paralell relationship with respect to the plate 22. The motor 53 is secured in any suitable manner, such as by a bracket 55, FIG. 5, in turn fastened to the wall members 19 and 20.

A rigid backing plate 56 preferably made out of metal is fixed by its ends to and between the forward end portions of the side frames 19 and 20. A plurality of ejector posts of a material of low thermal conductivity are mounted on the back side of this plate 56 to extend rearwardly, and are so positioned and shaped that when the grid 31 is pushed forwardly on the arms 25 and 26, the posts will relatively enter the openings A in the grid, and these posts are of sufficient length to extend slightly beyond the back side of the grid 31 at the forwardmost travel of the grid. It is to be noted that these posts designated by the numeral 57 extend a greater distance from the plate 56 at the outer ends, and gradually decrease in length to the centralmost portion of the plate. For example the centralmost pins 57*a* are shorter than are the outer pins 57*b*. The posts step-off in lengths from the greatest length of the posts 57*b* on each side to the shortest length 57*a* in the center, doing so in regular decreasing increments.

In this same upper compartment 16, there is mounted a water tank or trough 58 in any suitable location, such as on the member 24. A water pump 59 is fixed to the floor of the tank 58. A water pump drive motor 59*a* is mounted above the tank 58 and by a shaft 60 is drivingly connected to the pump 59. A water intake pipe 61 leads into the tank 58, and when the tank is empty, there is a float valve 62 in an open condition to allow water flowing in the pipe 61 to enter the tank 58. This valve 62 is controlled by a float 63 rising and falling with the rising and falling level of water in the tank.

The pump 59 when in operation delivers water from the tank 58 upwardly through the discharge pipe 64, through a reservoir chamber 65, and out the top of that chamber 65 through a tube 66 which discharges by an open end into the trough 34 when that trough 34 is in the position indicated in FIG. 5, which position is that when the grid 31 is in snug abutment against the plate 22. As the water level may be lowered in the tank 58, the float 63 drops to admit more water to maintain a predetermined level. When desired, a tank drain pipe 67 is provided with a petcock 68 therein to keep the pipe 67 normally closed. The reservoir 65 is full of water during normal operation of the pump 59. When the pump 59 is stopped, the water from that reservoir 65 will drain back down through the pipe 64 through the pump 59 and into the tank 58. A siphon is provided which consists essentially of an inverted V tube 69 which has an open end adjacent the floor of the tank 58, and the other end of the V tube bends horizontally and passes through the tank wall to any suitable point of water discharge. Normally there is no siphoning action unless the upper bend 69*a* is filled with water such as occurs when the pump stops and the water in the reservoir 65 drains back into the tank 58, whereupon the siphoning action will be initiated and water will flow up and around over the bend 69*a* and down through the horizontal lengths to drain out water from the tank 58 substantially to the floor thereof until the sipon action is broken by the water dropping down to the open end of the tube 69.

The float 63, lowered during this siphoning action, will begin admitting water. However, the rate of flow through the siphon tube 69 is large compared to the water inlet flow, so that the siphoning action is rapidly terminated.

On the back side of the plate 22 there is mounted in intimate contact with the plate a coil 70 of refrigerant carrying tubing. The ends of this coil 70 are merged into leads 71 and 72 which extend downwardly from the upper cabinet 16 into the refrigerating mechanism cabinet 15.

A heat exchanger 73 is located in the compartment 15. Water coming in through the pipe 61 passes through the exchanger 73 in heat exchanging relationship with water discharging from the siphon 69 which is normally cooler than the incoming water. The water from the siphon 69 flowing through the exchanger 73 discharges through the pipe 74 into a sump 75, at the bottom of which is an electrical heater 76 for increasing the temperature of the water. The water collecting in the sump 75 is that of course which is drained from the tank 58 in each ice making cycle, and carries the impurities and minerals normally in the water supply coming through the line 61. By employing this cyclic drainage of the tank 58, no excess of impurities in concentrated quantities may build up, since the water is changed in each ice making cycle. However this changed water accumulating in the sump 75 must be eliminated, or connected to some sewage line. Since the present ice making device may be portable, any connection to a sewage line may be objectionable. Therefore the water in the sump 75 is heated by the heating element 76 to at least a vaporizing temperature, and an electric fan 77 directed across the sump 75 eliminates the vapor from the cabinet 15 by blowing it outwardly through the openings 78 in the back wall 18. This fan 77 is driven by an electric motor 79. The floor of the ice storage space 13 is sloped toward the rear compartment 15, and any water accumulating therein is drained into the sump 75.

A refrigerating unit designated generally by the numeral 80 may be of the usual and well known type. Since this unit 80 is of a commercially obtainable type, the details thereof are not herein illustrated or described. A motor (not shown) but termed a compressor motor 81, in the usual manner, drives a compressor taking in low temperature, low pressure refrigerant vapor through the line 71. The vapor is compressed to a high temperature vapor at high pressure. The vapor leaves the compressor unit 80 through the discharge line 82, FIG. 8, to discharge into a condenser 83 which is tended to be cooled

by means of the fan 84 driven by the motor 85. The vapor through the condenser 83 passes into a high pressure liquid and is directed into the liquid receiver 86. This liquid is metered from the tank 86 through the usual expansion device 87 into the tube 72 leading to the coil 70. This tube 72, as indicated, discharges to the centermost portion of the coil 70 and from there travels around in a more or less helical manner to the suction tube 71 leading back to the compressor.

In communication with the discharge line 82 is a by-pass line 88 in which there is a solenoid operated valve 89. This by-pass line 88 leads around to the tube 72 between the coil 70 and the expansion valve 87. Only when the solenoid 89 is energized will the discharge of relatively high temperature vapor be allowed to flow through the by-pass line 88 directly to the coil 70.

Operation

The operation of the mechanism will be described in connection with the one particular form of the structure above set forth and in conjunction with the wiring diagram, FIG. 11. To set the device into operation, the main switch 90 is closed to the line 91. This action immediately sets into operation the fan motor 79. This motor runs continuously during the operation of the device. Also in continuous operation is the heating element 76 at the sump 75.

If the ice storage bin 13 is well filled with ice cubes 92, FIG. 3, no other part of the mechanism will be in operation. However when the ice cube level drops sufficiently to permit the temperature to rise above the ice, a pressure type thermal bulb 93 will, through a capillary tube 94, operate a switch 95. This switch 95 is the ice level control instrumentality. This switch 95 closes a number of circuits, one of which is the circuit including the compressor motor 81 setting the refrigerant mechanism into operation so that the coil 70 may be cooled and in turn the plate 22 brought down to a temperature below freezing. On the back of the plate 22 is located a thermal bulb 96 which, through a capillary tube 97, operates a bellows mechanism 98 in turn operating a switch 99. This switch 99 controls the ice thickness of the forming cubes. Normally the switch 99 is in the position indicated in FIG. 11 closing a circuit energizing the water pump motor 59*a* and condenser fan motor 85. In this circuit a limit switch 100 is closed to complete the circuit through the motor 59*a* and fan motor 85.

In describing the operation, it is assumed that the grid 31 is in firm abutment against the forward face of the refrigerating plate 22. Water coming from the pump 59 discharges from the pipe 66 into the trough 34, and the pump has that capacity which will maintain a water head in the trough 34 to permit the water to flow uniformly out the slots 36. Any additional water from the pump 59 will overflow out the weirs and down and over their corresponding slots 36. In this flow of water the regulation thereof is such that the water will flow down, and due to the water wetting properties of the grid material, the water will flow back under the bar 33A in each top opening A, down the face of the plate 22 exposed in that opening, and approximately horizontally outwardly along the top side of the bar 34*b* and thence around over its rounded edge and back under the bar 34*b* to against the plate 22 and thence downwardly and so on down through the entire tier of openings A under each of the sets of weirs and slots of the trough 34. As the water passes over the exposed portions of the face of the plate 22, it freezes thereon and continues to build up as the water flows on down. There is sufficient water flowing at all times during the freezing operation to have an excess pouring out into the lower chute 37 to flow back into the tank 58. There is a continuous scrubbing action of the flowing water on the forming ice. Entrapped air and impurities are removed with the result that the formed ice is crystal clear and of a high degree of purity.

The grid material is such that it is of low heat conductivity as above indicated, so that the water will not have a tendency to freeze on the horizontal and vertical bars since these members will be maintained for their major part at a temperature around thirty-two degrees or slightly thereabove. The flow of water is continued until the plate 22 begins to decrease in temperature due to the build-up of ice thereon. When that temperature has reached a predetermined degree, the bulb 96 shifts the switch 99 deenergizing the pump motor 59*a* and the condenser fan motor 85, closing another circuit including the cam drive motor 53. Also there is closed a circuit through the winding of the solenoid 89 which causes the heated gases in the discharge line 82 from the compressor 80 to flow through the by-pass line 88 and into the coil 70 to apply heat to the plate 22, and thereby melt the bond between the ice formed in the various openings A and the plate 22. Continued rotation of the cam 51 causes the yoke 45 to shift the grid 31 toward the posts 57, whereby the longest posts 57*b* enter the endmost openings A and as the grid progresses toward the post holding plate 56, the ice cubes are pushed out of the openings A and allowed to drop by gravity down through the opening 17 into the storage compartment 13.

With this method of separating the grid and plate and causing positive ejection of the ice blocks from the grid openings, the effect of any accumulation of lime or mineral deposits on the ice forming surfaces is practically eliminated. Also, as the ice blocks are pushed out of their respective cavities, there is a wiping or self-cleaning action between the two. This self-cleaning action prevents the accumulation of scale and the like on the cavity walls.

In the meantime as above indicated, water is flowing back from the reservoir 65 into the tank 58 and causing the siphon 69 to operate and unload the tank 58 for a fresh supply of water for the next freezing cycle.

Further attention is directed to the operation of the cam 51 which returns the grid 31 back to its position against the plate 22 as indicated in FIG. 5 for the next ice forming cycle. In conjunction with the cam 51, there is a secondary cam 101 on its topside to be in the path of a pair of actuating plungers 102 and 103 of the switches 100 and 104 respectively. These switches are mounted in fixed positions in any suitable manner, herein shown by means of a bracket 105 suspended from the motor mounting bracket 55. These two switches 100 and 104 serve as limit switches.

The switch 104 is of a normally closed type but is open when the plunger 103 is actuated by the cam 101. When the plunger 102 of switch 100 is actuated by the cam 101, a circuit is completed through switch 99, as disclosed in FIG. 11, to the pump motor 59*a* and condenser fan motor 85. The switch 100 although momentarily dropping out, will close a circuit to the cam drive motor 53 and solenoid 89 after the switch 99 has been operated by the thermal bulb 96 on the back of the freezing plate 22 to operate the cam drive motor 53 and solenoid 89. These two switches 100 and 104 are actuated by having their plungers lifted and lowered as they pass over the top surface cam 101. When the condenser fan motor 85 is stopped normally rejected heat in the compartment 16 is employed to aid in heating the plate 22.

Reference is now made to the cam 51 and its action as indicated in FIG. 10 in controlling the movement of the grid 31 and the operation of the switches 100 and 104. The cam follower 49 has three different phases of operation, namely a grid-against-plate dwell period, a forward grid travel period, and a return grid travel period. The cam 51 has its track 50 divided into three lengths. There is the length B—B which is of constant radius from the center of rotation of the cam. When the follower 49 is within this arc length B—B, there is no movement of the yoke 45 nor of the grid 31.

It is assumed that the cam 51 is turning in a clockwise direction as viewed in FIG. 4. When the cam 51 in its

continued rotation comes around to have the follower 49 come into the second track length C—C, the head 49 is caused to move to in turn shift the grid 31 away from the plate 22. Then as the cam comes around to have the head 49 within the track length D—D, the grid 31 is reversed in the direction of travel to bring it back against the plate 22.

In these three different lengths of track, when the follower 49 is within the arc B—B, the grid remains against the plate for the predetermined period of time which is fixed by the speed of rotation of the cam. The dwell of the follower within the arc B—B gives a period of time sufficient after ice formation to insure heat input into the plate to break the bond of the ice at its juncture with the plate 22. Continued rotation of the cam with the follower in the track length C—C, carries the grid 31 toward the ejecting posts with the ice cubes still within the grid. It is during this period of travel of the cam that the cubes are pushed out of the grid. It takes relatively little force to eject the cubes from the grid 31 since any bond between the cubes and the walls of the grid openings A is very slight due to the higher temperature of the major areas of the walls of each of those holes at thirty-two degrees or above, or even the friction of the ice cubes on the walls in case there is no bond due to freezing with the grid itself. Then following the complete travel of the posts at least to the back side of the grid, the cam 51 in its continued rotation comes around to have the follower 49 within the length D—D, and it is during this third phase of travel that the grid is brought back snugly against the plate 22 for the next cycle of ice forming operation. It is to be noted that by reason of the "draft" of the walls of each grid opening A, the opening progresses in greater cross-sectional area as the ice cube travels from front to back of the grid in the ejecting operation. It is also to be noted that in respect to the grid material, the grid walls about each opening A serve as ice partitioning or ice separating means for ice that is formed on the plate, instead of being ice freezing surfaces themselves and this results in the forming of cubes that have no undesirable concave surfaces on the side of the cube most remote from the freezing plate. Furthermore it is to be pointed out that in the upper compartment 16, normal heat gains in the compartment 16 will be sufficient to retain the ambient temperature surrounding the ice making unit continually above thirty-two degrees and it is this fact that the leading edges and side portions of the grid are continually exposed to this above-water-freezing ambient temperature which retains the grid itself at a temperature never less than thirty-two degrees, and as above indicated normally above thirty-two degrees F.

When the cam 51 has travelled to that point where the follower 49 is at the junction of the track lengths B—B and D—D, the switch cam 101 will engage the switch plungers of the limit switches 100 and 104. The ice thickness control switch 99 will have previously returned to the ice freezing cycle position, and the limit switch 100 will open the circuit which includes the solenoid 89 as well as the cam drive motor 53, and while the switch 100 momentarily opens, it closes after the cam 101 actuates it so as to reestablish the circuit through the ice thickness control switch 99 to the condenser, fan motor and the water pump. The other switch 104 is in parallel with the switch 99 and is opened by the switch cam 101.

Then a new ice freezing cycle is initiated if the storage cabinet switch 95 remains closed and therefore is calling for more ice. The switch 95 will open the electric circuits to stop the ice freezing cycle at any point when no ice is demanded. However the limit switch 104, in a parallel circuit with the storage compartment switch 99, will therefore be closed during an ice harvesting cycle. An initiated ice harvesting cycle will be completed regardless of whether the ice storage compartment switch 95 is open or closed. Under these conditions, during normal operation, the grid 31 will always be bearing against the plate 22 when the ice making mechanism is inoperative. Should the storage compartment switch 95 open during the ice freezing cycle, the direction of the draft of the grid openings will retain the partially formed cubes in their respective enclosures. Then upon resumption of an ice freezing cycle, with the partially formed cubes in the grid openings, there will be no affect on the performance of the cycle. In this manner, operating difficulties with respect to interrupted ice making cycles are eliminated. Also it is to be noted that the distance between the plate 22 and the ejector pins 57 is sufficient for the ejected cubes to fall freely therebetween. This fact, plus the progressive ejection of the ice cubes, normally prevents any entrapment of cubes between the grid and the plate as the grid is moved back toward the plate. However if due to any possibility that cubes would be entrapped between the grid and the plate, the grid will be steadily forced toward the plate, where a combination of this force and the heated plate will rapidly melt the trapped cubes. The gear head motor is suitably protected against stalling under such resistance.

While I have above indicated that the plate 22 would normally be vertically positioned, which is preferably, it may be varied from the vertical position to such as an angle of fifteen degrees forwardly of the vertical, that is toward the pins 57 and approximately thirty degrees back of the vertical. If the plate is inclined more than fifteen degrees forwardly, the capillary attraction between the downwardly flowing water and the grid bar surfaces may be overcome by inertia and gravitational effects of the flowing water and excessive water will be directed away from the grid rather than back therein. On the other hand, with the plate inclined more than thirty degrees to the back, the water tends to become stagnant in the back of the grid openings at the juncture of the grid and the plate and this results in the formation of opaque or "marbled" ice at those locations unless excessive amounts of water are circulated, which is not necessary when the plate is vertically positioned.

This "marble" ice is due primarily to the entrapment of minerals and impurities in the water rather than the inclusion of water bearing gases. With proper backward inclination of the plate and controlled amount of water flow, the minerals in the inlet water supply will be deposited and frozen in the ice blocks at these locations. The formed ice block therefore, due to the scrubbing action of the flowing water, will be clear except for a small opaque portion. Since the impurities in the inlet water are concentrated and frozen in a small portion of the ice blocks, it is not necessary to flush away a portion of the surplus water at the end of each ice making cycle to dispose of the concentrated minerals. Since the device is intended to be portable, this method of forming the ice blocks eliminates the water bleed off disposal problem. Although the ice blocks are not as desirable as completely clear ice blocks as the disclosed invention will make with plate in the vertical position, they are still of acceptable nature.

In respect to the above indicated provision, that the grid walls be wettable, if such material is employed that does not have a readily water wettable surface, then water will trickle over that surface rather than uniformly diffuse thereover.

While I have herein shown and described my invention in the one particular form, it is quite obvious that numerous structure 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. An ice making apparatus comprising a generally vertically disposed plate; means refrigerating said plate; a member having a plurality of cavities therein opening

from opposite faces and generally disposed vertically along the member; means shiftably moving said member into contact with said plate closing off openings of said cavities in the member face toward the plate and moving the member away from said plate; means flowing water over the face of said member opposite said plate contacting face, the water flowing into and out of said cavities and freezing therein against said plate; means separating the ice from said plate; and means ejecting the ice from said cavities upon the movement of said member from said plate.

2. The structure of claim 1 in which said member and said plate are respectively of relatively low and high thermal conductivity.

3. The structure of claim 1 in which there is a water holding vessel, said water flowing means circulating the water from said vessel in cascade-like manner downwardly over said member in surplus quantity above that which is frozen and returning the surplus water to said vessel.

4. The structure of claim 3 in which there are means withdrawing at least a part of the water in said vessel and means replacing it with fresh water following ice forming cycles.

5. The structure of claim 1 in which there is means responsive to a predetermined temperature change in said plate initiating said member movement away from said plate.

6. The structure of claim 1 in which there is means for raising the temperature of said plate to approximately melting.

7. The structure of claim 5 in which there is means for heating said plate to release the ice freezing thereon.

8. The structure of claim 1 in which said ice ejecting means comprises a plurality of posts fixed relative to said member and spaced from said plate, one post aligned with each of said cavities, movement of said member fitting the cavities about said posts and stripping the ice in each cavity from the member to drop therefrom.

9. The structure of claim 8 in which said posts vary in length, initiating ejection of ice from said member in steps in accordance with said lengths and continued movement of the member.

10. The structure of claim 8 in which said cavities have side walls sloping divergently from the member face opposite the plate side to the plate side and said walls are water wettable.

11. The structure of claim 1 in which there is a housing enclosing said plate and said member, and the temperature in said housing is maintained above freezing, the sides and edge portions of said member removed from said plate contact being exposed to said housing temperature.

12. In an ice making machine, a plate; means refrigerating said plate; an ice mold member including a plurality of cavities opening from opposite faces of the member; both said plate and said member being generally vertically disposed; means shifting said member against and away from said plate, closing and opening cavity openings toward said plate; means for delivering water to and distributing it across the top of said member to flow thereover; a water collector across the underside of the member; said member having a low intra-facial surface tension with water flowing thereover; each of said cavities being divided one from the other by upper and lower partition walls and spaced apart vertical walls; the passage of said water from said openings to said collector when the said member is in abutment with said plate being downwardly across each of said cavities one after another by travel inwardly along and under the upper wall, down over the cavity exposed area of the plate, and outwardly over the lower wall in each instance and finally by a remainder portion into the collector.

13. The structure of claim 12 in which said water freezes over said plate areas, said water delivery means maintaining a flow of water through the cavities in excess of the amounts freezing.

14. The structure of claim 13 in which there is a vessel receiving water from a source and there is means maintaining a predetermined water level in said vessel; said collector draining into said vessel; and said water delivery means delivers water from said vessel to said distribution means.

15. The structure of claim 13 in which there are means stopping said water delivery preceding shifting of said member from said plate; and means draining at least part of the water from said vessel.

16. An ice making apparatus comprising a plate; means refrigerating said plate; a member having a plurality of cavities therein opening from opposite faces generally disposed vertically of the member; means relatively shifting together said plate and said member for contact of said member with said plate closing off openings of said cavities in the member face toward the plate; means flowing water into and out of said cavities to freeze therein against said plate; means separating the ice from said plate; and means ejecting the ice from said cavities.

17. The structure of claim 16 in which said flowing means includes means for collecting the unfrozen water, means for recirculating the unfrozen water; and means for discarding at least a portion of said unfrozen water collected.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,003,335 October 10, 1961

Theodore Kattis

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 40, for "droys" read -- drops --; column 2, lines 5 and 6, for "terperature" read -- temperature --; column 8, line 67, for "structure" read -- structural --.

Signed and sealed this 1st day of May 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents