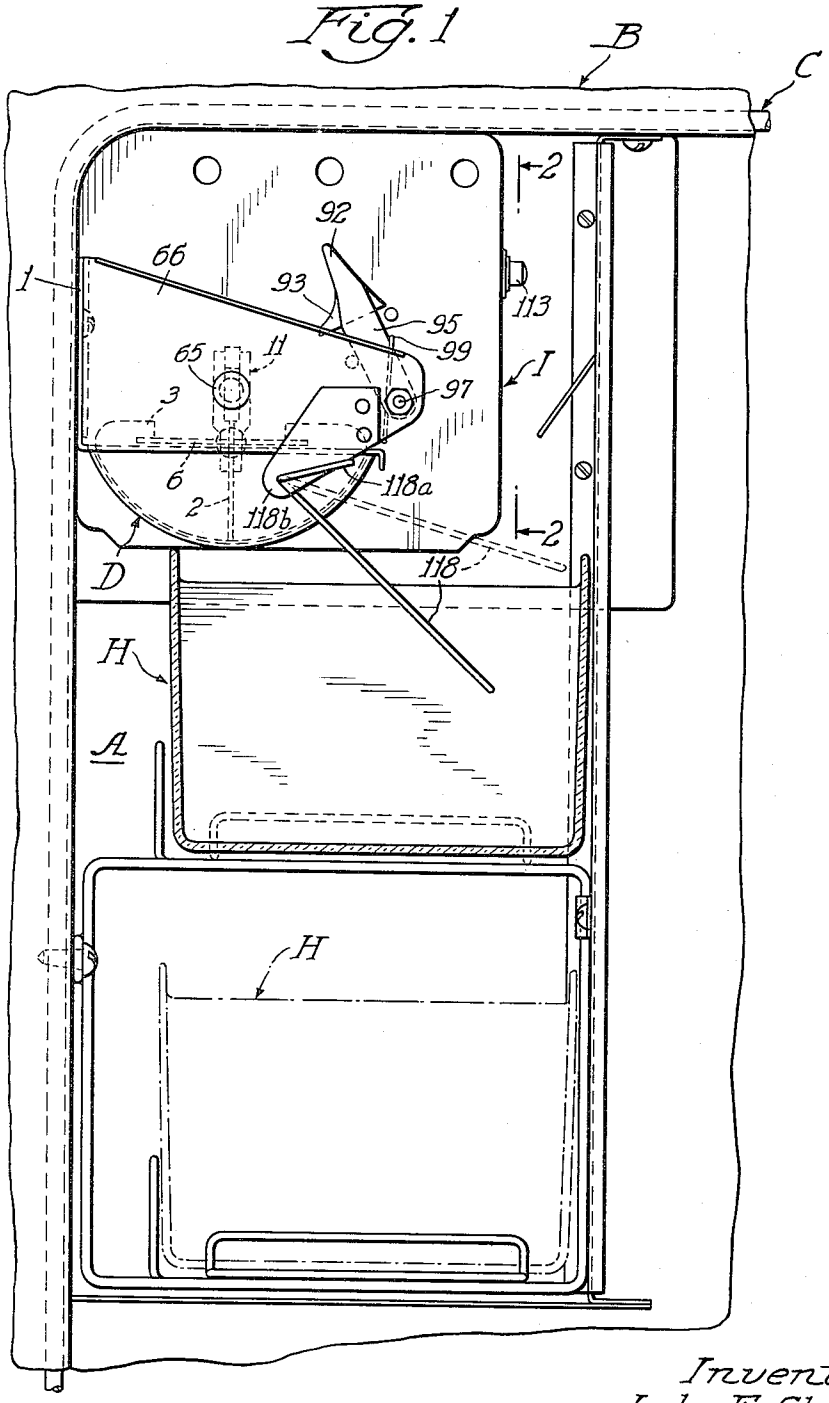
Aug. 1, 1961 L. F. SHAW ET AL 2,994,206

AUTOMATIC ICE CUBE MAKER

Filed Feb. 24, 1960

6 Sheets-Sheet 1

Fig. 1



Inventors:
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6 Sheets-Sheet 2

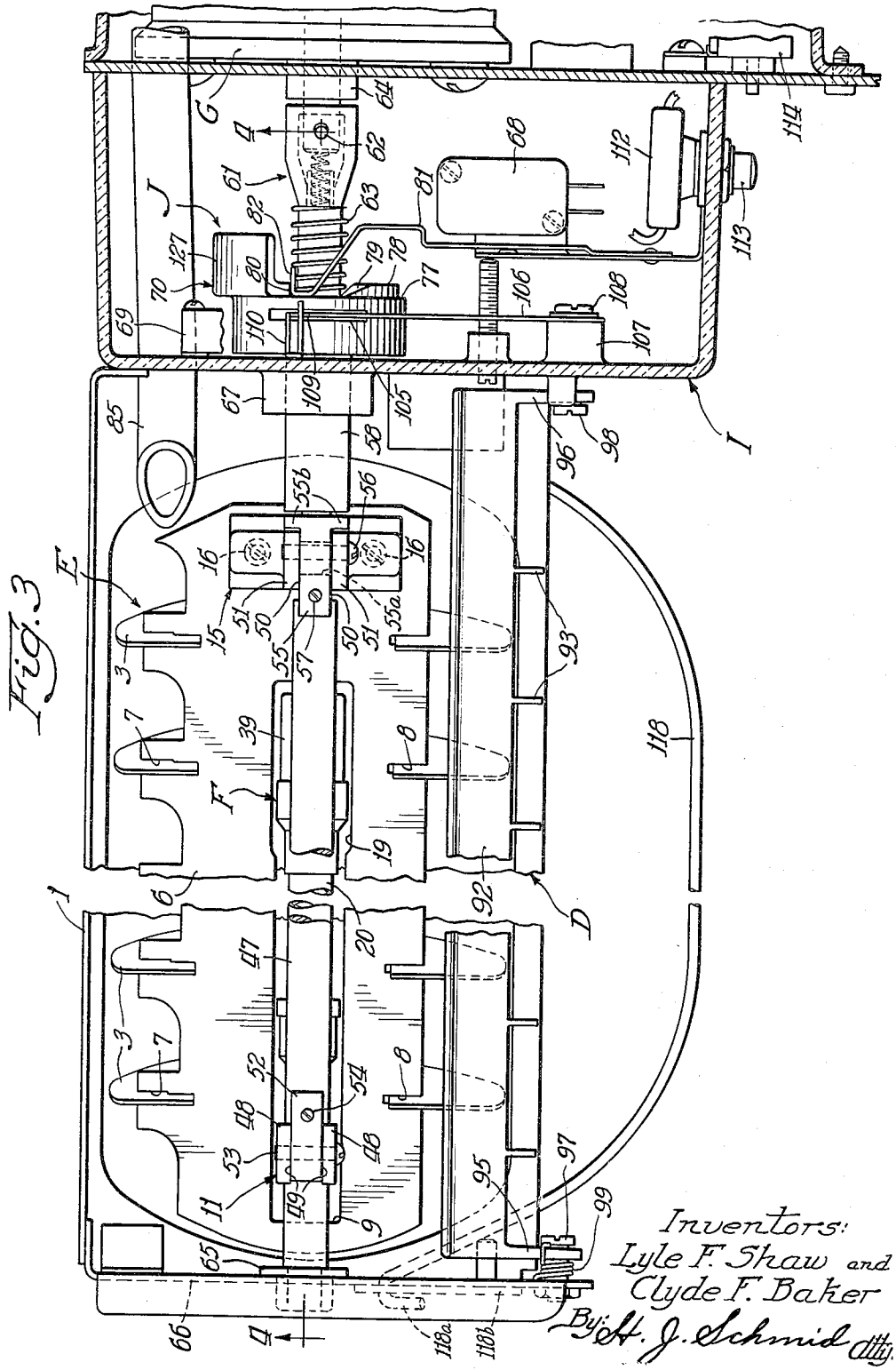


Fig. 3

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6 Sheets-Sheet 3

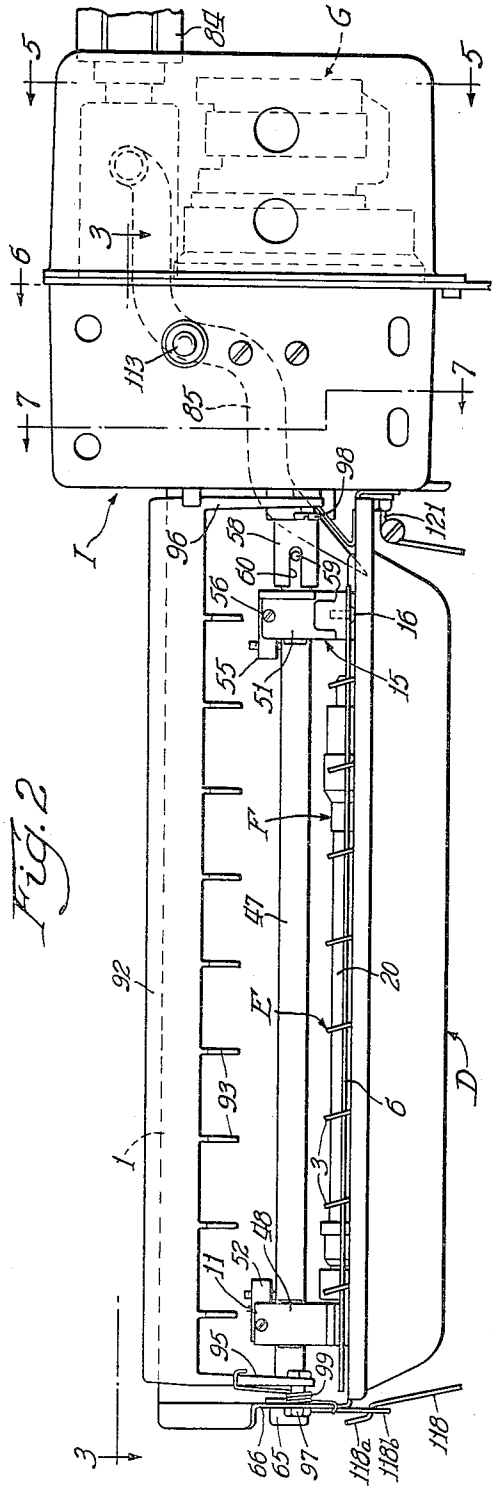


Fig. 2

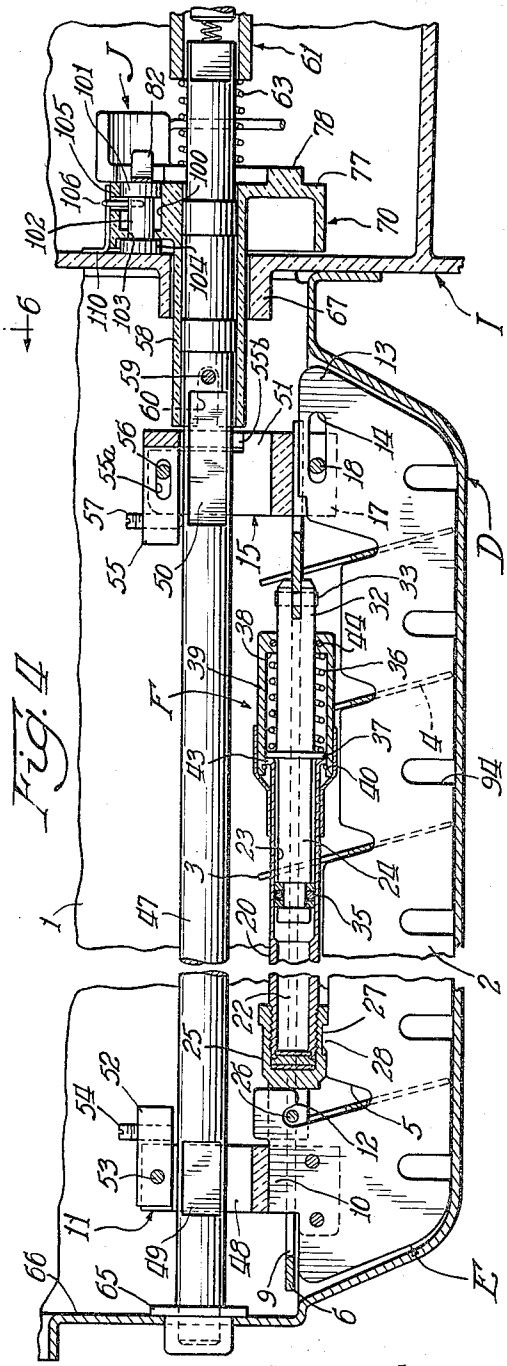


Fig. 4

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AUTOMATIC ICE CUBE MAKER

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6 Sheets-Sheet 4

Fig. 5

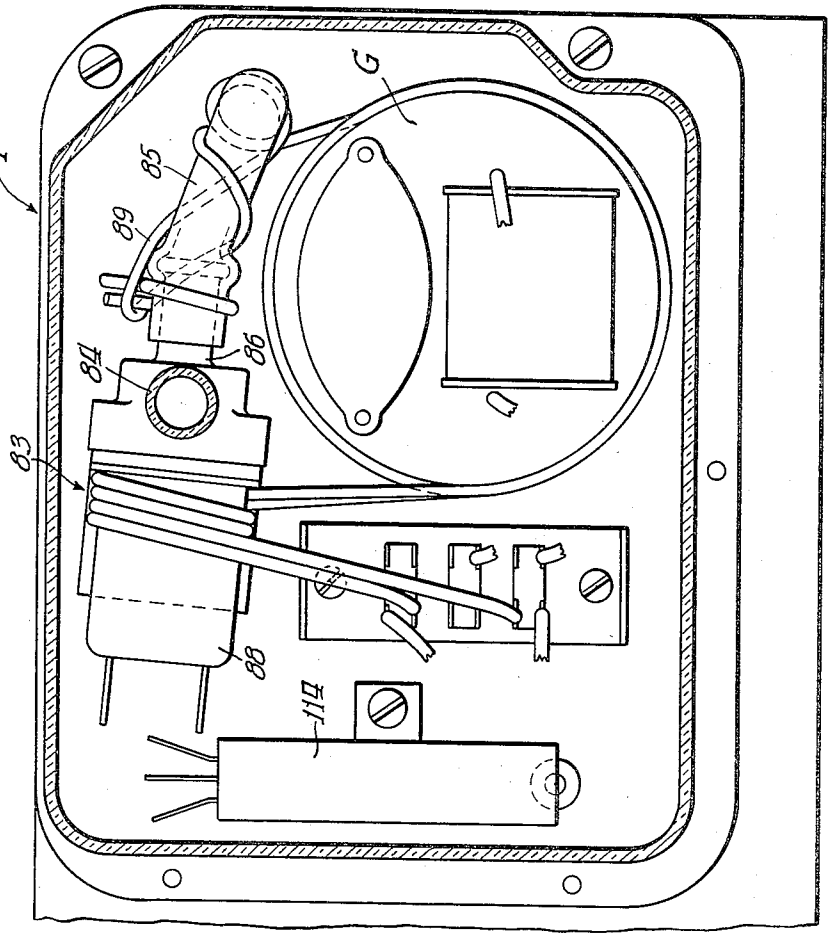
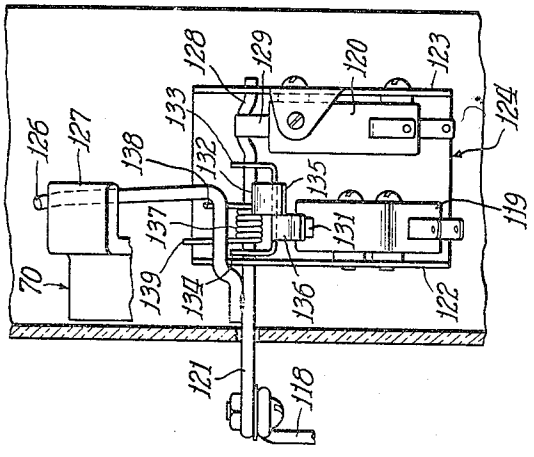


Fig. 8



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6 Sheets-Sheet 5

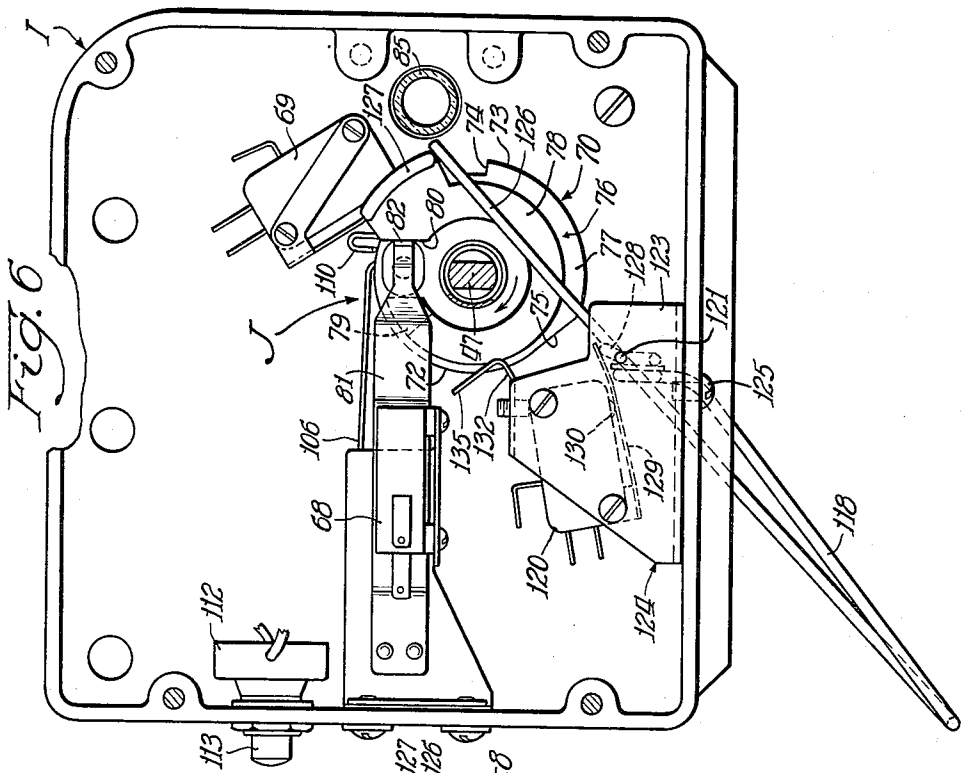


Fig. 6

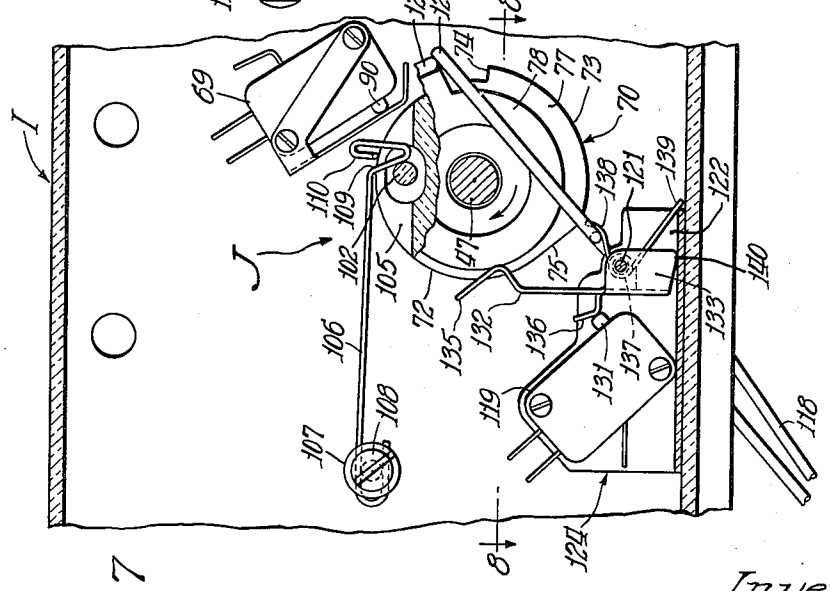


Fig. 7

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AUTOMATIC ICE CUBE MAKER

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6 Sheets-Sheet 6

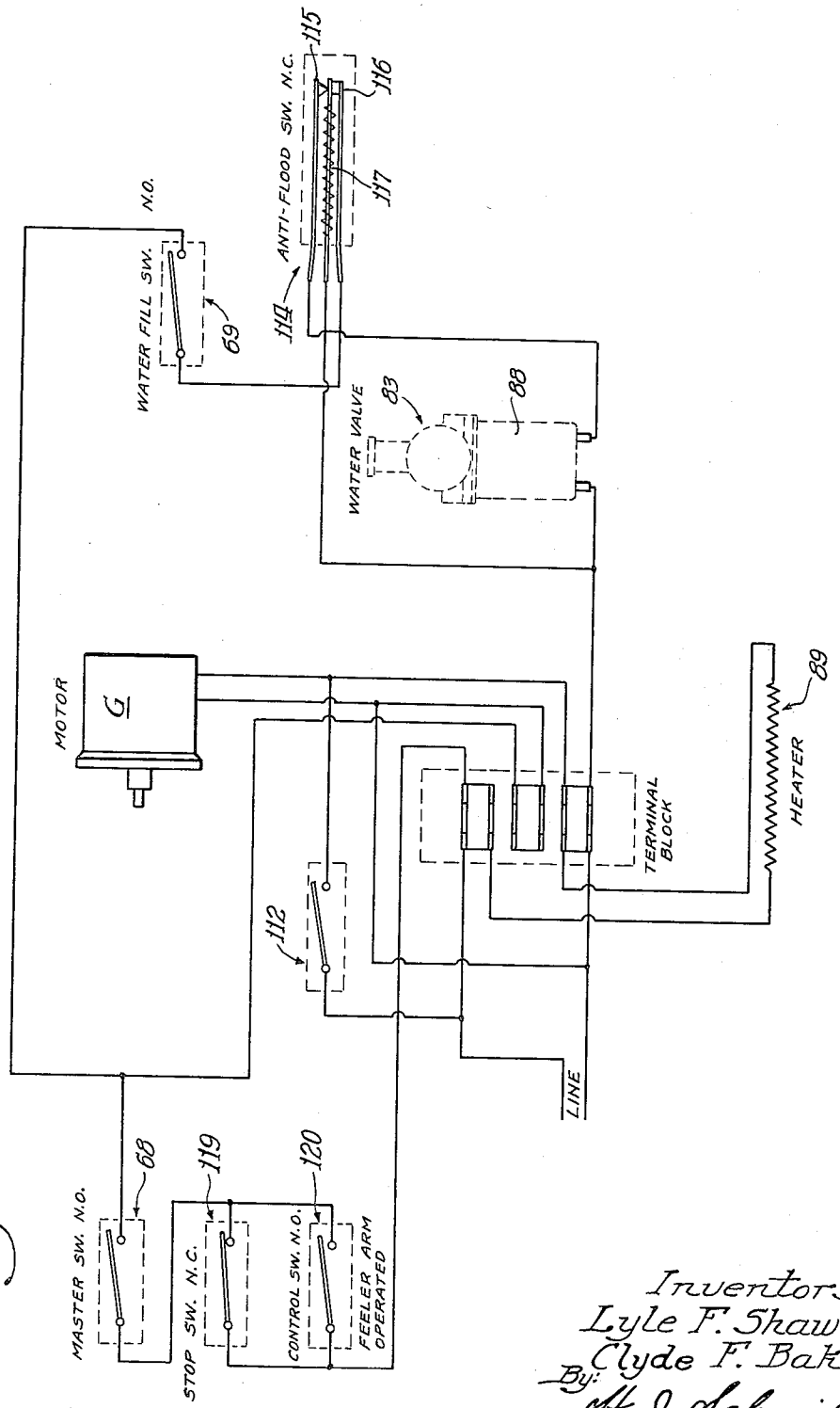


Fig. 9

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AUTOMATIC ICE CUBE MAKER

Lyle F. Shaw, Muskegon, and Clyde F. Baker, Muskegon Heights, Mich., assignors to Borg-Warner Corporation, Chicago, Ill., a corporation of Illinois

Filed Feb. 24, 1960, Ser. No. 10,676

11 Claims. (Cl. 62—137)

This invention relates to ice cube making machines and more particularly relates to an automatic ice cube making machine which is adapted to be disposed in the freezing compartment of a domestic refrigerator for continuously producing ice cubes.

The present ice cube making machine is an improvement of the ice cube making machine disclosed in U.S. Patent No. 2,833,123 issued May 6, 1958, of common ownership.

The above-identified patent discloses an automatic ice cube making machine adapted to be installed in the freezing compartment of a domestic refrigerator and comprises, in general, a tray for receiving water, means for automatically supplying the desired quantity of water to the tray, a grid structure in the tray and composed of a plurality of relatively movable plates which divide the tray into a plurality of compartments for making a plurality of ice cubes, an ice-motor for moving the plates relative to one another and effective to loosen the ice cubes from the grid and the tray, an electric motor connected to the grid structure and effective when the ice-motor moves the plates to loosen the cubes to rotate the grid structure and evacuate the cubes from the tray into a receptacle. The machine further comprises an electrical control system including a switch disposed in operative relationship with the receptacle and opened to render the electrical control system ineffective when a predetermined quantity of ice cubes have been received by the receptacle.

The present invention is an improvement in the above-mentioned machine and it is an object of the present invention to provide a new and improved control arrangement including an electrical control system and mechanism operative on switch means thereof to stop operation of the automatic ice cube making machine when the receptacle is filled with a quantity of ice cubes from the tray.

The invention consists of the novel constructions, arrangements and devices to be hereinafter described and claimed for carrying out the above stated objects and such other objects as will appear from the following description of the preferred embodiments of the invention illustrated with reference to the accompanying drawings wherein:

FIG. 1 is an end view of the ice cube making machine;

FIG. 2 is a side view of the machine taken on line 2—2 of FIG. 1;

FIG. 3 is a top view looking in the direction of the arrows 3—3 of FIG. 2;

FIG. 4 is a longitudinal sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is an enlarged cross sectional view taken along the arrows 5—5 of FIG. 2;

FIG. 6 is an enlarged cross sectional view taken along the arrows 6—6 of FIG. 2;

FIG. 7 is an enlarged cross sectional view taken on line 7—7 of FIG. 2;

FIG. 8 is a cross sectional view taken on line 8—8 of FIG. 7;

FIG. 9 is a diagrammatic view of the electric circuit of the machine.

Referring to FIGS. 1, 2, and 3 of the drawings, the present ice cube making machine may be installed in the freezing compartment A of a domestic refrigerator B, the compartment A being surrounded by a continuous evaporator C. The machine, in general comprises an ice cube tray D having a grid structure E disposed therein, the grid structure being actuated by an ice-motor F to loosen the ice cubes from the grid structure and the tray. An electric motor G is operatively connected to the grid structure E to rotate the same to evacuate the loosened ice cubes from the tray D. A receptacle H is disposed within the freezing compartment A and beneath the tray D so that when the motor G rotates the grid structure, the ice cubes will fall from the tray into the receptacle H for storage. A housing I is bolted or otherwise secured to a wall of the freezing compartment A and this housing acts both as a support for the tray structure D and as an enclosure for an actuating cam mechanism J (see FIGS. 3, 4, and 6).

Referring now to the drawings, the tray D, made of aluminum or any other suitable metal, has an upwardly extending side bracket 1 secured to a sidewall of the freezing compartment A. The tray D receives the grid structure E which divides the tray into a plurality of individual compartments for making a plurality of ice cubes. The grid structure E comprises a longitudinal vertically disposed plate 2 and a plurality of transverse or divider plates 3. Each of the transverse plates 3 is provided with a slot 4 and the longitudinal plate 2 is provided with a plurality of V-shaped slots 5. Each transverse plate 3, with its slot 4, is adapted to rest in the V-shaped slots 5 of the longitudinal plate 2, the V-shaped slots permitting pivotal movement of the transverse plate 3 on the longitudinal plate 2. As will be noted from FIG. 1, the tray D and the transverse plates 3 are of substantially semi-circular shape.

A longitudinal horizontal plate 6 is provided for pivotally moving the transverse plates 3 relative to the longitudinal plate 2 to loosen the ice cubes from the grid structure and the tray. Plate 6 has a plurality of slots 7 and 8 at its edges for receiving the upper portions of the transverse plates 3. A slot 9 is provided in the plate 6 for receiving an extension or ear 10 of the vertical longitudinal plate 2. The extension or ear 10 is provided with a cutout portion 12. The other end of the plate 2 has an extension or ear 13 provided with a longitudinal slot 14.

A plastic yoke element 15 is attached to the horizontal plate 6 by means of screws 16 or other suitable fastening means (FIG. 1) extending upwardly through the plate 6 and threaded into the yoke element. The yoke element 15 has a pair of depending arms 17 formed thereof (FIG. 4) and the arms 17 straddle the vertical plate 2. The arms 17 carry a pin 18 slidably disposed in the longitudinal slot 14 of the plate 2. As seen, the slot 14 provides a lost motion connection between the vertical plate 2 and the horizontal plate 6. This lost motion connection permits relative movement between the plate 2 and the horizontal plate 6 so that the horizontal plate 6 can move the transverse plates 3 from a first position shown in full lines in FIG. 4, in which the ice cubes are frozen, to a second position in which the ice cubes are loosened from the plates 3, plate 2 and the tray D.

The ice-motor F is provided for moving the horizontal plate 6 and thereby plates 3 relative to the vertical plate 2. The ice-motor is in the form of a cylinder member connected to the longitudinal plate 2 and having a portion thereof filled with a liquid which expands upon freezing, and another portion which slidably receives a piston, one end of which is connected to the horizontal plate 6 so that as the liquid within the cylinder freezes and expands, the piston will move the plate 6 and the transverse plates 3 relative to the plate 2 to loosen the frozen ice cubes

from the grid structure and tray. The ice-motor F is disposed in a longitudinal slot or cutout portion 19 in the horizontal plate 6 and comprises an elongated cylinder or tube 20 having a liquid-filled portion 22 and a portion 23 for slidably receiving a piston 24. The portion 22 of the cylinder 20 is completely filled with water or any other suitable fluid or liquid which expands on freezing. It may be desirable to use a liquid which has a freezing point lower than water so that there will be no danger of the ice-motor freezing and expanding prior to the freezing of the ice in the tray. We have found, for example, that either a solution of water and sodium nitrate, or a solution of water and sodium-metasilicate, is suitable as the freezing liquid.

The tube 20 is threadedly or otherwise connected to a bifurcated member 25. The bifurcated member 25 has a pin 26 extending therethrough and the extension or ear 10 of the plate 2 receives the bifurcated member 25 with the pin 26 of the member 25 resting in the cutout portion 12 of the extension 10.

A groove 27 is provided in the bifurcated member 25 and a projection 28 is provided in the vertical plate 2. The projection 28 rests in the groove 27 to provide a reaction point for the ice-motor as will be hereinafter described. A bifurcated extension 32 is provided at one end of the piston 24 and this bifurcation receives the portion of the horizontal plate 6 at the right end of the slot 19. A pin 33 extends through the bifurcated extension 32 and the plate 6 for securing these members together. An O-ring 35 is disposed in a groove provided in the piston 24 for providing a fluid-tight seal for the liquid compartment 22 of the cylinder 20.

A metal compression spring 36 is provided for returning the piston member 24 to its original position when the liquid in the cylinder 22 melts. The spring 36 surrounds the piston 24 and is disposed between an outwardly extending annular flange 37 on the piston and an inturned annular flange 38 of a housing 39. The housing 39 is actually an extension of the cylinder 20 and is connected thereto by a snap ring 40. The snap ring 40 rests within a groove in the housing 39 and constantly abuts against a flange 43 on the end of the cylinder 20 due to the pressure of the spring 36 urging the housing 39 to the right as seen in FIG. 4.

To prevent any possibility of water coming into contact with the piston and spring, an O-ring 44 is disposed around the piston 24 and within a groove in the inturned flange 38 of the housing 39 to provide a fluid-tight seal at this end of the housing.

When the freezing liquid contained within the portion 22 of the cylinder 20 freezes, there is sufficient expansion of the frozen liquid to force the piston 24 axially of the cylinder 20. Since the piston 24 is attached to the plate 6 at one end thereof by the pin 33 and since the cylinder 20 is attached to the longitudinal plate 2 by the pin 26 and groove 27, the expansion of the frozen liquid in the ice-motor moves the piston toward the right (FIG. 4) in the cylinder, and the plate 6 will be moved relative to the plate 2 carrying the transverse plates 3 so that the grid structure and ice-motor will be raised upwardly and the plates 3 will move to vertical positions. This movement of the grid structure loosens the ice cubes from the tray and from the grid structure so that they are now ready to be removed from the tray.

The ice cubes are removed from the tray by rotating the grid structure E relative to the tray. The means for rotating the grid structure comprises a shaft 47 driven by the electric motor G. The grid structure E is drivingly connected to the shaft 47 by attaching the extension 10 of the plate 2 and the yoke element 11 to the shaft 47. The extension 10 of the plate 2 includes two parallel vertically extending fingers 48, 48 receiving therebetween flat sides 49, 49 of the shaft 47 to provide a driving connection between the shaft and plate 2. The fingers 48, 48 permits the plate 2 to move vertically while preventing the grid structure from becoming separated from the shaft when it is rotated. The shaft 47 also has reduced flat sides 50, 50 thereon and the yoke member 15 has two upstanding fingers 51, 51 slidably engaging the flat sides 50, 50 to provide a driving connection between the yoke 15 and the shaft 47. A block 52 is disposed between the upper portions of the fingers 48, 48 and is secured thereto by a screw 53 to prevent the yoke 11 from becoming separated from the shaft 47 when it is rotated, but permitting movement of the yoke 11 relative to the shaft 47 during operation of the ice-motor. The block 52 is also provided with an adjusting screw 54 engaging the shaft 47. In similar manner, a block 55 is positioned between the fingers 51, 51 and a screw 56 extends through the block 55 and elongate a notch 55*a* in the block 55, the block having an adjusting screw 57, and also being provided with a rear wall having legs 55*b* extending downwardly thereof to straddle the shaft 47 for engagement with one end of a nylon shaft 58.

The cam mechanism J is integral with the hollow shaft 58 slidably and rotatably disposed on the shaft 47. The shaft 58 is rotatably connected to the shaft 47 by a pin 59 extending through the shaft 47 and into a slot 60 in the shaft 58. The shaft 47 is connected to the electric motor G by means of a flexible coupling 61. The coupling 61 surrounds and is connected to the shaft 47 by a spline. A pin 62 connects the coupling to the motor shaft. A compression spring 63 is disposed between the cam mechanism J and the coupling 61, the spring tending to move the cam mechanism J and the hollow shaft 58 to the position shown in FIG. 4. A bearing 64 which forms a part of the motor G, extends through an opening in the wall of the freezing compartment A. A bearing 65 is provided in an upstanding end portion 66 of the tray D for receiving the other end of the shaft 47. A bearing 67 is formed as an integral portion of the housing I and receives the hollow shaft 58. A flange is provided at the right end on the tray (FIG. 4) and this flange is fixedly secured to the housing I.

A microswitch 68 is provided in the housing I for energizing the electric motor G to rotate the shaft 47 and the grid structure E which is attached thereto, and a microswitch 69 is provided for automatically controlling the water supply to the tray D. Both microswitches are closed and opened by operation of the cam mechanism J.

Referring now to FIGS. 3, 4, 6, and 7, it is apparent that the hollow shaft 58 extends into the housing I and carries the actuating cam 70 of the cam mechanism J, which is integral with and formed as a continuation of the hollow shaft 58.

The cam 70 has a peripheral face provided with radially and circumferentially spaced, substantially concentric, arcuate surfaces 72 and 73, terminating at adjacent ends thereof by a abrupt shoulder 74 and having a flat cam surface 75 between and connecting the other ends of the surfaces 72 and 73. The cam 70 also has a lateral face 76 defined by a flat surface 77 and a raised cam surface 78, said surface lying in parallel planes, opposite ends of the cam surface 78 at the juncture of said flat surface 77 being defined by a sloping, leading shoulder 79 and a trailing shoulder 80. The cam J is rotatable in a clockwise direction as shown by the arrow in FIGS. 6 and 7, the abrupt shoulder 74 on the peripheral face of the cam lying ahead of and adjacent to the shoulder 80 of the peripheral face of the cam, in the direction of rotation of the cam. The flat cam surface 75 and cam surface 73 are provided for closing the microswitch 69 and the abrupt shoulder 74 is provided for opening the microswitch 69.

The microswitch 68 is operatively connected to the cam mechanism J by means of a metal spring strip 81 (FIGS. 3 and 6) which has its bent hoop-shaped end 82 urged against the lateral face 76 of the cam 70.

The water supplying means for the present machine

comprises a solenoid-operated metering valve 83 (FIG. 5) having an inlet connected to the ordinary house water supply by suitable pipe or tubing 84. A flexible tube 85 of plastic is connected to the outlet 86 of the valve 83 with the tube 85 extending through aligned openings in walls of the housing I and extending over and above the tray D as shown in FIGS. 2 and 3 for directing water into the tray D. The valve 83 is of the type which meters a desired quantity of water to the tube 85 and is actuated by a solenoid 88, such solenoid-operated valve being shown in U.S. Patent No. 2,717,497, issued September 13, 1955. To prevent any possibility of freezing of water in the tube 85, an electrical coil heater 89 (FIGS. 5 and 9) is wrapped around the tube.

The microswitch 69 is operatively connected to the cam mechanism J by means of a button 90 which is engaged by a metal spring strip secured to the switch 69 and adapted to be engaged with the peripheral face of the cam 70.

The operation of the ice cube making machine will now be described. Assuming the tray D to be filled with water and thereafter frozen to form ice cubes, the liquid in the cylinder 20 of the ice-motor F will subsequently freeze and expand to move the piston 24 away from the cylinder 20, as hereinbefore pointed out, causing the plate 6 to move to the right as seen in FIGS. 3 and 4 and loosen the ice cubes. Since the yoke element 15 is fixedly attached to the plate 6, the yoke is also moved to the right which moves the shaft 58 and cam 70 to the right on the shaft 47 to move the end 82 of the spring stop 81, engaging the flat surface 77, to its position wherein the microswitch 68 closes the electrical circuit to start the motor G. The motor G rotates the shaft 47, the grid structure E, and the cam mechanism J in the direction as shown by the arrows in FIGS. 6 and 7. As the grid structure is rotated, the loosened ice cubes will be evacuated from the tray D and will fall into the receptacle H. Means are provided to dislodge any of the loosened cubes from the grid structure E and which do not fall away from the grid structure as it is rotated. As seen in FIGS. 1, 2, and 3, this dislodging means comprises a rod or bar 92 having a plurality of fingers 93 fixedly secured thereto. It is to be noted in FIGS. 1, 2, and 3 that each of the fingers 93 is disposed in the path of an ice cube compartment of the grid structure E and that notches 94 (FIG. 4) are provided in the bottom of the plate 2 so that the plate will clear the fingers 93. The bar 92 has an arm 95 fixedly secured to one end thereof and an arm 96 secured to its other end. The arms 95 and 96 are pivotally secured respectively to the end wall 66 of the tray D and to the housing I by screws 97 and 98. A torsion spring 99 surrounds the shaft of the screw 97 and has its opposite ends respectively engaging the arm 95 and end wall 66 to urge the bar 92 to the position shown in FIGS. 1, 2 and 3.

As the motor G continues to rotate the shaft 47, the grid structure E, and the cam mechanism J, the metal strip 91 will be actuated by the cam surface 75 to depress the button 90 of the switch 69 to actuate the solenoid 88 of the water valve 83 to permit water to enter the tube 85 from whence it flows into the tray D. The tube 85 is disposed to eject relatively warm water directly into the tray D and the heat of the water will rise to melt the frozen liquid in the cylinder 20 of the ice motor F to permit operation of the compressed spring 36 to return the grid structure E to its original position. Since the water valve 83 is actuated by the cam surface 75 at about 180° rotation of the grid structure and since the spring 63 moves the cam mechanism J back to its original position on the shaft 47 when the ice-motor returns to its original position, the microswitch 68 would be opened at this time to break the electric circuit and stop the motor G. However, as the water valve is actuated to permit water to enter the tube 85, the end 82 of the spring strip 81 of the motor microswitch 68 rides upon the lateral cam surface 78 so that the microswitch 68 will remain energized after

the cam has moved back to its original position and until the shaft 47, the grid structure E, and the cam 70 have been rotated by the motor G approximately 360° at which time the end 82 of the spring strip 81 will drop off the cam surface 78 to cause the microswitch 68 to be deenergized and stop the motor. It is to be noted that the abrupt shoulder 74 of the peripheral face of the cam 70 is immediately ahead of the shoulder 80 of the motor microswitch cam surface 78 so that the spring strip 91 and button 90 will move away from the microswitch 69 to open the switch 69 and thereby deenergize the water valve solenoid 88 and shut off the water supply just before the end 82 of the spring strip 81 drops off the shoulder 80.

As will be understood from the foregoing description, the sliding of the cam 70 and its shaft 58 on the driven shaft 47 controls the energization of the motor for the present machine. It will be further understood that the frozen liquid in the ice-motor F must melt, due to the heat emanating from the relatively warm water which is admitted to the tray D, so that the cam mechanism can slide to a motor deenergizing position. If, for any reason, the supply of water to the machine were to fail during its automatic operation, the fluid in the ice-motor F would not melt and the motor G would continue to rotate the grid structure. Therefore, means are provided for shutting off the electric motor G when the water supply fails. Referring to FIGS. 4 and 8–11 inclusive, the cam 70 is provided with a cylinder or bore 100 in the flat lateral surface 77 thereof and a dumbbell-shaped piston-like member 101 is slidable therein, the depth of the cylinder 100 being about double the length of the piston 101. The piston 101 has a shaft 102 extending through a reduced bore 103 in the cam 70 and a flange 104 is provided on the end of the shaft. A slot 105 is provided in the arcuate surface 72 of the cam 70, said slot being in communication with the cylinder 100 as seen in FIGS. 4 and 7. A spring wire 106 is attached to the housing I by means of a boss 107 and a screw 108 and a depending portion 109 of the wire is adapted at times to ride on the surface 72 and at other times to rest in the slot 105 and in the cylinder 100 over the shaft 102. A bend 110 is provided in the wire 106 and engages the adjacent wall of the housing I to position the depending portion 109 of the wire on the surface 72 in alignment with the slot 105 in the cam 70.

The spring operates in the following manner to shut off the ice cube machine when the supply of water fails:

As seen in FIGS. 3, 4, and 7, the depending portion 109 of the spring 106 rests in the slot 105 and in the cylinder 100 to prevent any movement of the piston 101 to the left as seen in FIGS. 3 and 4. As the liquid in the ice-motor F freezes to move the plate 6, the yoke 15, the shaft 58, and the cam mechanism J to a position wherein the spring actuator 81 closes the microswitch 68 and the electric motor G is started to rotate the shaft 47 and the cam mechanism J. As the cam member 70 is rotated in the clockwise direction indicated by the arrow in FIGS. 6 and 7, the depending portion 109 of the spring 106 will move out of the slot 105 and will move along the peripheral surface 70 of the cam 70. As the cam mechanism J completes its 360° cycle and after the freezing liquid in the ice-motor has melted, the spring 63 will move the cam mechanism J to its original position and the depending portion 109 of the spring 106 will again move into the slot 105 so that the cam mechanism is in condition to again actuate the microswitch 68. It is to be noted that the face of the piston 101, when the depending portion 109 of the spring 106 is in the slot 105, is flush with the lateral surface 77 of the cam mechanism J so that the spring strip 81 in the normal operation of the machine will be moved to actuate the microswitch 68 whenever the ice-motor moves the cam mechanism J. However, in the event water is not permitted to enter the tube 85 and melt the freezing liquid in the ice-motor cylinder 20, the depending portion 109 of the wire 106

will not move into the slot 105 as the cam mechanism J completes its full revolution but will rest upon the arcuate surface 72 of the cam 70. As a result, the spring strip 81, when it drops its end 82 off the lateral cam surface 78 at the shoulder 80 will drop against the piston 101, and since the portion 109 is not in the slot and against the piston to prevent its movement to the left as seen in FIG. 4, the spring strip 81 will move its end 82 and thereby the piston 101 to the left to permit the end 82 of the strip 81 to move into the cylinder 100 and away from the microswitch 68 to open the microswitch to stop the electric motor G. The ice cube machine is thus inoperative even though the ice-motor F is in its expanded position. Referring to FIGS. 3 and 9, the machine will remain inoperative until the normally open contacts of switch 112 are manually closed by the push button 113 thereof to complete a circuit energizing the motor G. Rotation of the motor drive shaft will rotate the cam 70 to disengage the end 82 of the spring strip 81 from the piston 101 and cause it to ride along the sloping shoulder 79 and force the cam toward the right, as viewed in FIG. 3, to return the cam mechanism J to its original position so that the depending portion 109 of the wire 106 will enter the slot 105. It will be apparent that movement of the cam 70 will cause its cam surface 78 to operate the strip 81 to close the switch 68 for a machine ice-making cycle. The switch 112 is mounted on the housing I with the push button 113 positioned for manual operation and being capable of closing the contacts of the switch only while manual pressure is applied to the button, which is only for a few seconds required to energize the motor.

Means are also provided for insuring stoppage of the flow of water to the tray D in the event the water supplying control means, such as the switch 69 controlling the solenoid-operated water valve 83 should fail to close with consequent flooding of the ice cube making machine with water. For this purpose and referring to FIGS. 5 and 9, a thermostatic bimetallic switch 114 of generally linear form is mounted on the housing I and is in series with the switch 69 in the electrical control circuit, the switch 114 having normally closed contacts 115 and 116 and a heater element 117 in the circuit being energized when the contacts of the switch 68 are closed and producing sufficient heat to open the contacts of the switch 114. More particularly, in normal operation, the cam 70 is rotated at a speed by the motor G to close the switch 69 to energize the solenoid 88 of the water valve 83 for 17 seconds to permit a sufficient amount of water to flow into the tray D to subsequently freeze to provide a batch of ice cubes. As the contacts of the switch 113 are normally closed to provide a circuit for energizing the heater element 117 when the contacts of the switch 69 are closed by the cam 70, the heater element produces sufficient heat to actuate the heater element to move one of the contacts of the switch 113 relative to the other contact of the switch 113 to open the switch 113 in 18 or 19 seconds, or 1 or 2 seconds, after opening of switch 89 by the cam 70 and deenergization of the solenoid of the valve 83. Thus, if for some reason, the contacts of the switch 89 remain closed, the opening of the contacts of the switch 113 will break the circuit to the solenoid 88 of the water valve 83 to prevent the flow of water to the tray D. If the main cam 70 should accidentally rotate continuously, the heater element 117 of the switch 113, after three complete rotations of the cam 70, will store sufficient heat to maintain the contacts of the switch 113 in open position. It will be apparent that this safety feature provided by the switch 113 affords definite and positive insurance for preventing flooding of the ice cube making machine with water.

Means are also provided for stopping operation of the automatic ice cube making machine when a desired adequate quantity of ice cubes have been made by the machine. As previously described, the ice cube-receiving basket H is supported beneath the ice cube maker and in a position to capture the ice cubes ejected from the tray D by the grid E upon rotation thereof by the motor G, as shown in FIG. 1. The control arrangement for stopping operation of the ice cube making machine when the basket H is filled with an adequate supply of ice cubes comprises a pivotal bail 118 normally extending down into the basket, and operative in conjunction with two microswitches 119, 120 and cam 70, to automatically shut off the machine when the bail is maintained in a raised position by the accumulation of ice cubes in the basket.

More particularly, the bail 118 is formed of wire and extends parallel and in spaced relation to the edge of the tray D as shown in FIG. 3 and has one end formed to provide a reversely bent hook 118*a* extending through a plate 118*b* secured to the end wall portion 66 of the tray D, the bail also having a shaft portion 121 extending through a wall of the housing and journaled in aligned openings in the side walls 122, 123 of a V-shaped frame 124 secured by screws 125 to the bottom wall of the housing I (FIGS. 5, 6), to pivotally support the bail for movement to and from the tray D. The shaft portion 121 of the bail has secured thereto (FIG. 8) an upwardly extending wire actuator 126 adapted to underlie and engage a laterally extending projection 127 on the cam 70, as shown in FIGS. 6, 7 and 8, for pivoting the bail 118 from the position shown in full lines in FIG. 1 to the dotted line position of FIG. 1, during rotation of the cam 70.

The bail has its shaft portion 121 provided with a laterally offset cam portion 128 to provide an actuator engaging the spring strip 129 contacting and actuating a button 130 of the microswitch 120 to close the normally open contacts of the switch 120 when the bail is in its down position shown in FIG. 1. The switch 120 is mounted on the side wall 123 of the frame 124. During pivotal movement of the bail, the bail actuates the microswitch 120 by the cam portion 128 of the shaft portion 121 of the bail, adjacent the wall 123 of the frame, to cause the spring strip 129 to release the button 130 of the microswitch 120 to permit the contacts of the switch 120 to open.

The microswitch 119 is mounted on the side wall 122 of the frame 124 with the button 131 thereof being movable by an actuating lever 132, formed of strip metal, having parallel lateral arms 133, 134 through which the shaft portion 121 of the bail extends to provide for free pivotal movement of the lever relative to the bail, the top end 135 of the lever being adapted to be engaged by the projection 127 of the cam during rotation of the cam to effect pivotal movement of the lever to engage its laterally extending arm 136 with the button 131 of the microswitch 119 to open the normally closed contacts of the switch.

The bail 118 is normally maintained in the position shown in the drawings by a torsion spring 137 having its coiled portion surrounding the shaft portion 121 of the bail and with its opposite ends 138 and 139 repectively engaging the actuator portion 126 of the bail and the frame 124, as clearly shown in FIGS. 7 and 8. It may also be observed that the lever 132 is normally maintained in its shown position by the spring contacts and button of the microswitch 119 constantly urging the lever toward the cam 70 and to engage the bottom edges of its arms 133, 134 with the bottom wall of the frame 124 as at 140 to limit movement of the lever toward the cam.

In the operation of the ice cube making machine when the ice cubes are being formed in the tray D and the motor G is deenergized, the various parts of the machine are in the positions shown in the several views of the drawings. At this time, the contacts of the motor control switch 68, the water fill switch 69, are open and the bimetallic switch 114 and switches 119 and 120 are closed. Upon operation of the ice motor F and movement of the cam 70, the contacts of the switch 68 close

to establish a circuit energizing the motor G to rotate the cam 70 and to eject the ice cubes from the tray into the basket. It will be noted that the upper end of the actuator 126 of the bail engages the projection 127 of the cam 70 so that the cam will immediately apply force to the bail to cause pivotal movement thereof from the full line position thereof shown in FIG. 1 to the dotted line position to permit the subsequently ejected ice cubes from the tray to fall between the tray and the bail without contacting the bail. During this upward movement of the bail by the cam, the bail portion 128 is effective to open the contacts of the microswitch 120 and maintain these contacts open until about at 120° rotation of the cam, the bail disengages from the cam and returns to its normal down position and closes the contacts of the switch 120, the ice cubes having been ejected from the tray prior to disengagement of the bail from the cam. Upon the bail being disengaged from the cam, the cam projection 127 engages the end of the lever to pivot the lever 132 to effect opening of the contacts of the switch 119. It will be noted that the microswitches 119 and 120 are placed in parallel with the switch 68 and motor G so that either the contacts of the switches 119 and 120 are closed during this operation to insure continuous energization of the motor.

Assuming now that the basket H contains a quantity of ice cubes and the parts of the ice cube making machine are in the positions shown in the drawings, upon operation of the ice motor and energization of the motor, the grid E is rotated to eject the ice cubes from the tray D and the cam 70 also rotates. The cam projection 127 will actuate the bail from its position within the basket and raise the bail, and maintain the bail raised, to open the contacts of the switch 120 until the cam is rotated 120° when the bail will be released and be moved downwardly by the spring 137 to close the contacts of the switch 120. In the event the basket H is filled with ice cubes, the contacts of the switch 120 and their actuating portion 128 are so related that downward movement of the bail will be arrested by the ice cubes with the result the open contacts of the switch 120 will be unable to be closed by the bail. Upon further rotation of the cam, the normally closed contacts of the switch 119 will open to break the circuit to the motor to deenergize the motor. As the switches 119 and 120 remain open, the ice cube making machine can no longer function until sufficient ice cubes have been removed from the basket to allow the bail to move downwardly in the basket to again establish a circuit for the motor G and thereby automatic operation of the ice cube making machine.

While we have described our invention in connection with one specific embodiment thereof, it is to be understood that this is by way of illustration and not by way of limitation and the scope of our invention is defined solely by the appended claims which should be construed as broadly as the prior art will permit.

What is claimed is:

1. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; a receptacle for receiving the removed ice; electrically-operated power means for actuating said ice-removing means; means for controlling energization of said power means including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member associated with said container and closing said first switch and extending downwardly into said receptacle, control mechanism operative during operation of said power means to move said member from the receptacle to a raised position and thereby open said first switch while said second switch remains closed and thereafter said control mechanism being operative to open said second switch while controlling movement of said member into said receptacle to close said first switch, said member being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said first switch whereby opening of said second switch by said control mechanism during operation thereof is effective to break said circuit to thereby deenergize said power means.

2. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; a receptacle for receiving the removed ice; an electric motor having a shaft connected to said ice-removing means for rotating said ice-removing means; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member associated with said container and closing said first switch and extending downwardly into said receptacle, control mechanism operative during rotation of said motor shaft to move said member from the receptacle to a raised position and thereby open said first switch while said second switch remains closed and thereafter said control mechanism being operative to open said second switch while controlling movement of said member into said receptacle to close said first switch, said member being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said first switch whereby opening of said second switch by said control mechanism during operation thereof is effective to break said circuit to thereby deenergize said motor.

3. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; a receptacle for receiving the removed ice; an electric motor having a shaft for rotating said ice-removing means; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a member pivotally mounted on said container and closing said first switch and extending downwardly into said receptacle; controlling cam mechanism rotatable with said motor shaft to pivotally move said member from the receptacle to a raised position and thereby open said first switch while said second switch remains closed and thereafter said cam mechanism being operative to open said second switch while controlling pivotal movement of said member into said receptacle to close said first switch, said member being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said first switch whereby opening of said second switch by said cam mechanism during rotation thereof is effective to break said circuit to thereby deenergize said motor.

4. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; a grid structure within said container and composed of relatively movable plates for dividing the ice into blocks; means for moving the plates relative to each other and effective to loosen the blocks from the grid structure while said grid structure is disposed within said container; power means operative to rotate said grid structure to remove the blocks from the container; a receptacle for receiving the removed blocks; means for controlling operation of said power means including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member associated with said container and closing said first switch and extending downwardly into said receptacle; control mechanism rotatable by said power means during rotation of said grid structure to move said member from the receptacle to a raised position and thereby open said first switch while said second switch re-

mains closed and thereafter said control mechanism being operative to open said second switch while permitting movement of said member into said receptacle to close said first switch, said member being held in a raised position in said receptacle by an accumulation of the blocks in said receptacle to prevent closing of said first switch whereby opening of said second switch by said control mechanism during rotation thereof is effective to break said circuit to thereby deenergize said power means.

5. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; a grid structure within said container and composed of relatively movable plates for dividing the ice into blocks; means for moving the plates relative to each other and effective to loosen the blocks from the grid structure while said grid structure is disposed within the container; an electric motor having a shaft for rotating said grid structure to remove the blocks from the container; a receptacle for receiving the removed ice blocks; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member associated with said container and closing said first switch and extending downwardly into said receptacle, control mechanism including cam means rotatable with said shaft of said motor to move said member from the receptacle to a raised position and thereby open said first switch while said second switch remains closed and thereafter said cam means being operative to open said second switch while controlling movement of said member into said receptacle to close said first switch, said member being held in a raised position in said receptacle by an accumulation of blocks in said receptacle to prevent closing of said first switch whereby opening of said second switch by said cam means during rotation thereof is effective to break said circuit to thereby deenergize said motor.

6. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; a receptacle for receiving the removed ice; an electric motor having a shaft for rotating said ice-removing means; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member movably associated with said container and biased to close the contacts of said first switch and to extend downwardly into said receptacle, control mechanism including a cam rotatable by said motor shaft and having a peripheral cam surface and an actuating portion extending laterally thereof, said actuating portion being operative to move said movable member from the receptacle to a raised position and thereby open the contacts of said first switch and thereafter to disengage said movable member to cause biasing movement thereof into said receptacle and to close said first switch, and said cam surface being subsequently operative to open the contacts of said second switch whereby said switches are sequentially operated to maintain said motor energized, said movable member being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of the contacts of said first switch by said movable member whereby opening of said second switch contacts by said cam surface during rotation of said cam is effective to break said circuit to deenergize said motor.

7. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; a grid structure within said container and composed of relatively movable plates for dividing the ice into blocks; means for moving the plates relative to each other and effective to loosen the blocks from the grid structure while said grid structure is disposed within the container; an electric motor having a shaft for rotating said grid structure to remove the blocks from the container; a receptacle for receiving the removed ice blocks; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable member pivotally connected to said container and biased to close said first switch and to extend downwardly into said receptacle, control mechanism including a cam rotatable by said motor shaft and having circumferentially spaced cam portions, one of said cam portions being operative to pivot said movable member for removal from the receptacle to a raised position and thereby open the contacts of said first switch and thereafter to disengage said movable member to cause movement thereof into said receptacle and to close said first switch contacts, and the other of said cam portions being subsequently operative to open the contacts of said second switch whereby said switches are sequentially operated to maintain said motor energized, said movable member being held in a raised position in said receptacle by an accumulation of ice blocks in said receptacle to prevent closing of said first switch contacts by said movable member whereby opening of said second switch contacts by said other cam portion during rotation of said cam is effective to interrupt said circuit to deenergize said motor.

8. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; a grid structure within said container and composed of relatively movable plates for dividing the ice into blocks; means for moving the plates relative to each other and effective to loosen the blocks from the grid structure while said grid structure is disposed within the container; an electric motor having a shaft for rotating said grid structure to remove the blocks from the container; a receptacle for receiving the removed ice blocks; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable arcuate bail having opposite ends pivotally connected to said machine and having an actuating portion projecting upwardly from one end thereof and a cam portion adjacent said actuating portion, spring means biasing said bail to extend downwardly into said receptacle, and to position said cam portion of said bail to close said first switch, control mechanism including a cam rotatable by said motor shaft and having circumferentially spaced cam portions, one of said cam portions of said cam being operative to engage said actuating portion of said bail to pivot said bail for removal from the receptacle to a raised position and thereby open the contacts of said first switch and thereafter to disengage said actuating portion of said bail to cause movement of said bail by said spring means into said receptacle and to close said first switch contact, and the other of said cam portions of said cam being subsequently operative to open the contacts of said second switch whereby said switches are sequentially operated to maintain said motor energized, said bail being held in a raised position in said receptacle by an accumulation of ice blocks in said receptacle to prevent closing of said first switch contacts by said cam portion of said ball whereby opening of said second switch contacts by said other cam portion of said cam during rotation of said cam is effective to interrupt said circuit to deenergize said motor.

9. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from said container; an electric motor having a shaft for rotating said ice-removing means; a receptacle for receiving the removed ice; means for controlling energization of said motor including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relation

ship in said circuit, a movable arcuate bail having opposite ends pivotally connected to said machine and having an actuating portion projecting upwardly from one end thereof and a cam portion adjacent said actuating portion, spring means biasing said bail to extend downwardly into said receptacle and to position said cam portion of said bail to close said first switch, control mechanism including a cam rotatable by said motor shaft and having circumferentially spaced cam portions, one of said cam portions of said cam being operative to engage said actuating portion of said bail to pivot said bail for removal from the receptacle to a raised position and thereby open the contacts of said first switch and thereafter to disengage said actuating portion of said bail to cause movement of said bail by said spring means into said receptacle and to close said first switch contact, and the other of said cam portions of said cam being subsequently operative to open the contacts of said second switch whereby said switches are sequentially operated to maintain said motor energized, said bail being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said first switch contacts by said cam portion of said bail whereby opening of said second switch contacts by said other cam portion of said cam during rotation of said cam is effective to interrupt said circuit to deenergize said motor.

10. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; electrically-operated power means for actuating said ice-removing means; a receptacle for receiving the removed ice; means for controlling energization of said power means including an electric circuit having a first normally open switch and a second normally closed switch, said first and second switches being arranged in parallel relationship in said circuit, a movable arcuate bail having opposite ends pivotally connected to said machine and having an actuating portion projecting upwardly from one end thereof and a cam portion adjacent said actuating portion, spring means biasing said bail to position said cam portion of said bail to close said first switch and to position said bail to extend downwardly in said receptacle, control mechanism including a cam rotatable by said power means and having circumferentially spaced cam portions, one of said cam portions of said cam being operative to engage said actuating portion of said bail to pivot said bail for removal from the receptacle to a raised position and thereby open the contacts of said first switch and thereafter to disengage said actuating portion of said bail to cause movement of said bail by said spring means into said receptacle and to close said

first switch contact, and the other of said cam portions of said cam being subsequently operative to open the contacts of said second switch whereby said switches are sequentially operated to maintain said power means operative, said bail being held in a raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said first switch contacts by said cam portion of said bail whereby opening of said second switch contacts by said other cam portion of said cam during rotation of said cam is effective to interrupt said circuit to deenergize said power means.

11. In an ice making machine, a container for receiving water; refrigerating means for freezing the water into ice; means for removing the ice from the container; a receptacle for receiving the removed ice; an electric motor having a shaft for rotating said ice-removing means; means for controlling energization of said motor including an electric circuit having a first normally open switch, a second normally open switch, and a third normally closed switch, said second and third switches being arranged in parallel relationship in said circuit and in series relationship with said first switch and said motor, a movable member pivotally connected to said container, spring means biasing said movable member to extend downwardly to position the movable member in said receptacle and for closing said second switch, temperature responsive means operable to close said first switch and thereby establish the electric circuit through said first and third switches to energize said motor to rotate said ice-removing means, and control mechanism operative during rotation of said motor to move said movable member from the receptacle to a raised position and to open said second switch while said third switch remains closed and thereafter said control mechanism opening said third switch while controlling movement of said movable member into said receptacle to close said second switch to maintain the circuit for continuous energization of said motor, said mechanism being operative upon one revolution of said motor shaft to open said first switch to deenergize said motor, said movable member being maintained in raised position in said receptacle by an accumulation of ice in said receptacle to prevent closing of said second switch whereby opening of said third switch by said control mechanism during rotation thereof is effective to interrupt said circuit to deenergize said motor.

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