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AUTOMATIC ICE MAKER

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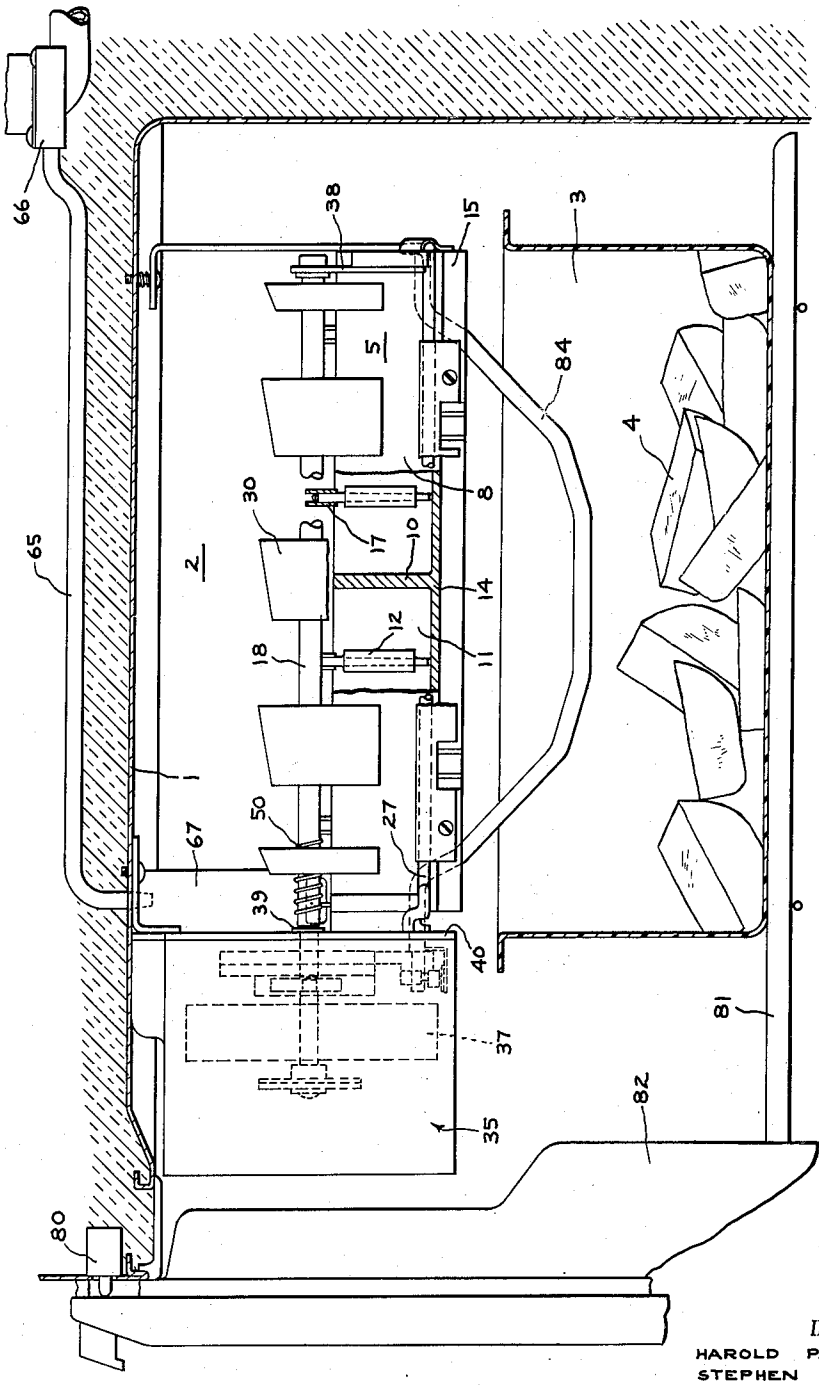


FIG. 1

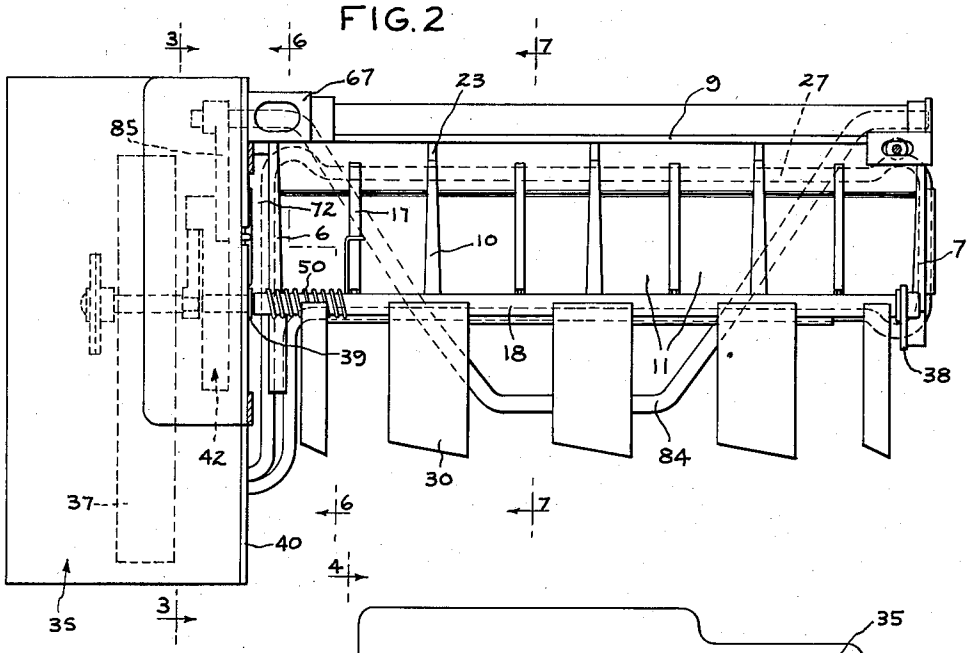
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FIG. 2



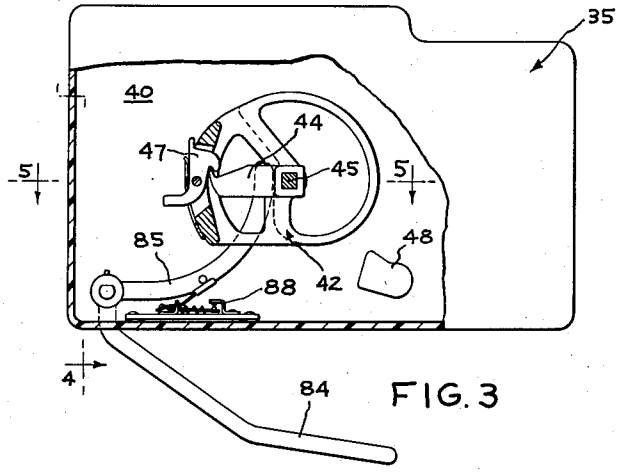


FIG. 3

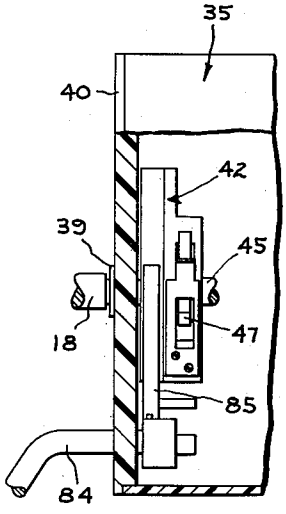


FIG. 4

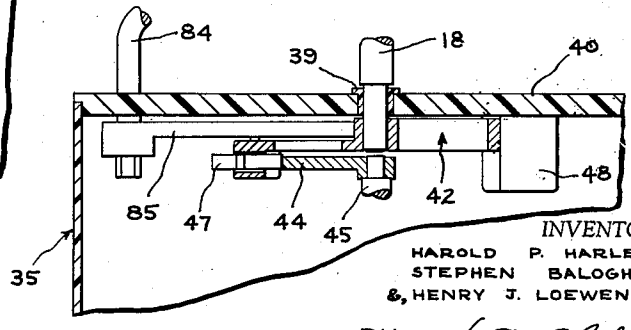


FIG. 5

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FIG. 6

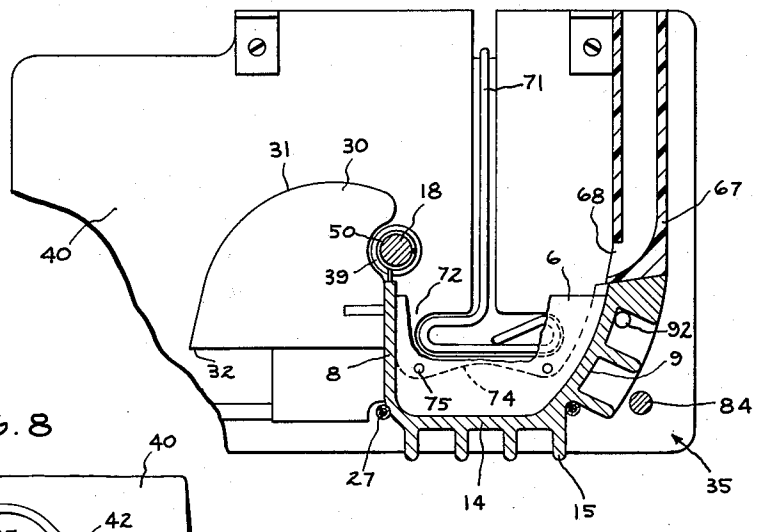
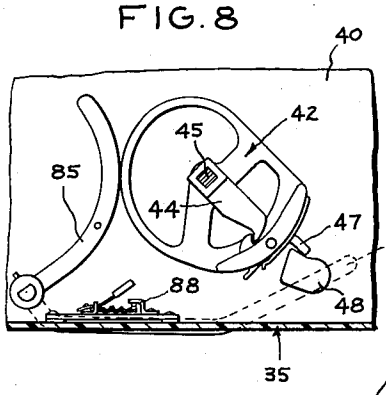


FIG. 8



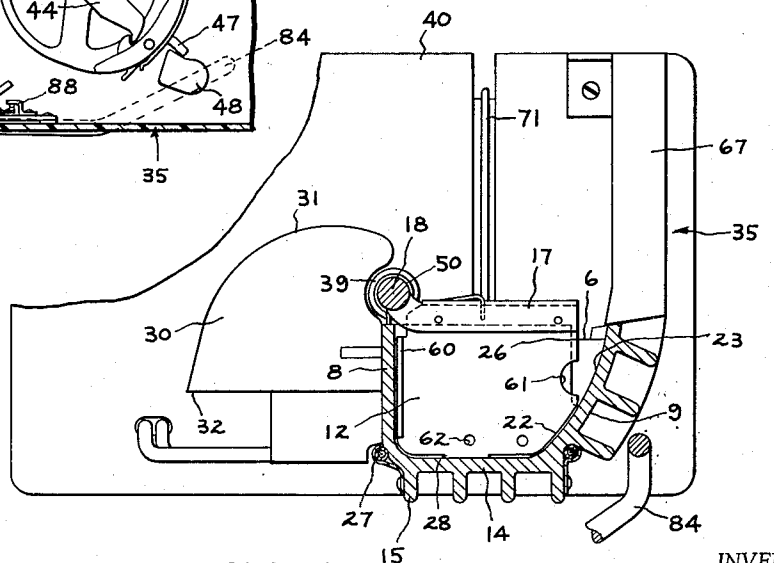


FIG. 7

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FIG. 12

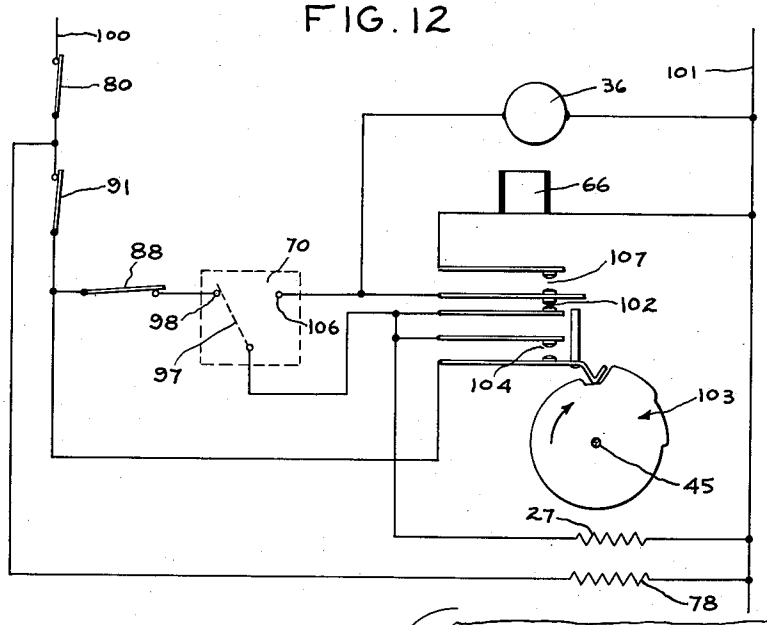
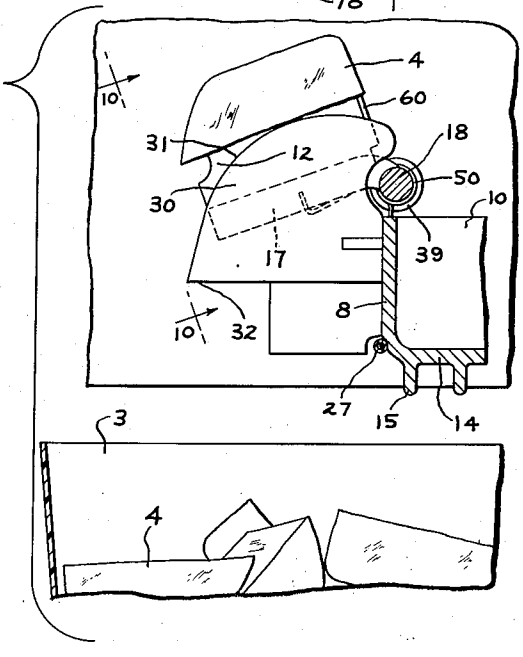


FIG. 9



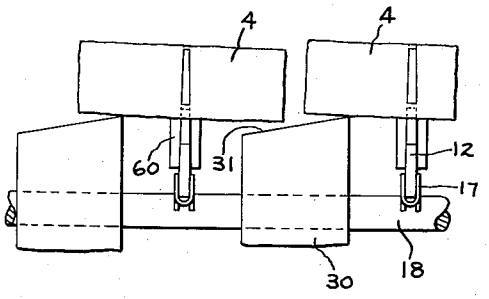


FIG. 10

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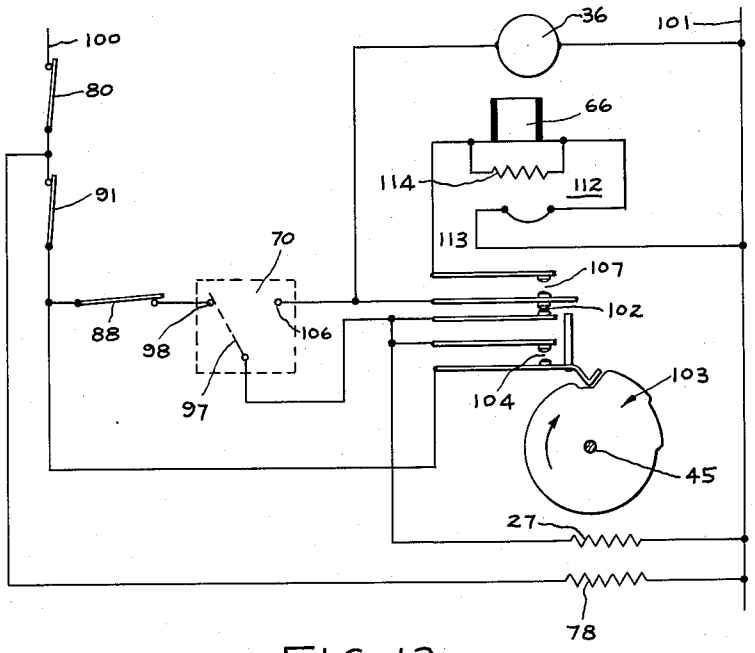


FIG. 13

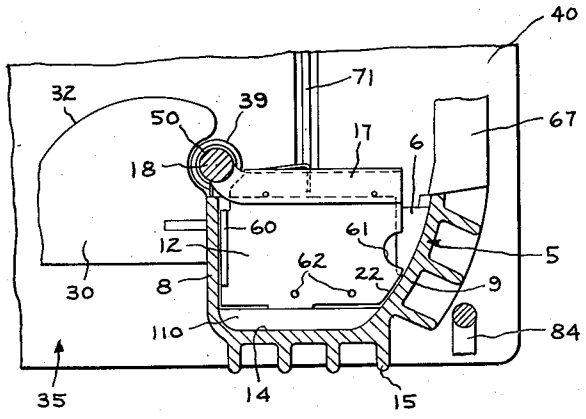


FIG. 11

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United States Patent Office 2,970,453 Patented Feb. 7, 1961

2,970,453

AUTOMATIC ICE MAKER

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Filed May 18, 1959, Ser. No. 813,790
15 Claims. (Cl. 62—135)

The present invention relates to an automatic ice maker and is more particularly concerned with an improved ice maker adapted to be incorporated in a domestic or household refrigerator.

The invention is specifically concerned with a domestic or household ice maker in which ice pieces are released from the mold by the application of heat and are thereafter automatically transferred out of the mold and discharged into a receptacle, the mold and receptacle being designed for operation within the freezer or low freezing compartment of a household refrigerator.

One object of the present invention is to provide an ice maker of this type in which a portion of the divider mechanism dividing the mold into a plurality of compartments serves as means for transferring the released ice pieces from the mold to a storage receptacle.

Another object of the present invention is to provide an ice mold which is divided into a plurality of ice making compartments by means of alternate fixed and movable dividers, the movable dividers being so constructed and arranged that they serve as means for harvesting ice pieces from the mold.

A further object of the invention is to provide an ice maker including a mold having movable dividers to which the ice pieces will continue to adhere after melting of the bond between the ice pieces and the remaining portions of the mold structure.

Another object of the invention is to provide an automatic ice maker including movable dividers for transferring the ice from an ice mold to a storage receptacle and control means for interrupting the ice making cycle in the event that the dividers do not thereafter return to their normal or operative position in the mold.

Further objects and advantages of the invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

In accordance with the present invention there is provided an ice maker comprising an ice mold having a partitioning or divider means including one or more movable elements or dividers dividing the mold into adjacent compartments in which water is frozen into ice pieces. The movable dividers or elements are, for example, composed of a material of relatively low heat conductivity as compared with the remaining portions of the mold, so that when heat is applied to the mold to break the bond between the ice pieces and the remaining portions of the mold, the ice pieces will continue to adhere to the movable dividers. By this arrangement, the movable dividers are employed for transferring the ice pieces from the mold and to this end these dividers are mounted for pivotal movement out of the mold and over one side thereof to a position in which engagement of the ice pieces with suitable bumpers mechanically breaks the bond between the pieces and the movable dividers.

These and additional features of the present invention will now be more fully described with reference to the accompanying drawings in which:

Fig. 1 is an elevational view partly in section of one embodiment of the present invention;

Fig. 2 is a top view of the embodiment of the ice maker shown in Fig. 1;

Fig. 3 is a vertical section of a portion of the ice maker taken along line 3—3 of Fig. 2;

Fig. 4 is a vertical section along line 4—4 of Fig. 3;

Fig. 5 is a horizontal sectional view of the mechanism shown in Figs. 3 and 4 taken along the line 5—5 of Fig. 3;

Fig. 6 is a vertical view of the ice mold component taken along line 6—6 of Fig. 2;

Fig. 7 is another sectional view of the ice mold taken along line 7—7 of Fig. 2;

Fig. 8 is an operational view of the mechanism particularly shown in Figs. 3–5;

Fig. 9 is a sectional view similar to Fig. 7 showing one stage in the process of harvesting the ice pieces;

Fig. 10 is a view taken generally along line 10—10 of Fig. 8;

Fig. 11 is a sectional view illustrating one modification of the present invention;

Fig. 12 is a wiring diagram for the electrical control system employed for the automatic operation of the ice maker of the present invention; and

Fig. 13 is a modification of the control system of Fig. 12.

As shown in Fig. 1 of the accompanying drawing, the illustrated embodiment of the ice maker of the present invention is designed to be suspended from the top wall 1 of the low temperature or freezing compartment 2 of a household refrigerator. The contents of the compartment 2 including the ice maker are maintained at below freezing temperatures by air blown over a low temperature evaporator (not shown) so that the ice maker can be mounted in the compartment independently of any evaporator unit. Also positioned within the compartment and below the ice maker is a receptacle or bin 3 so that the ice pieces 4 contained in the bin are maintained at below freezing temperatures.

Referring now to Figs. 1, 2 and 5–8 inclusive, the ice mold 5 in a form of an elongated or generally rectangular mold includes end walls 6 and 7 and side walls 8 and 9 forming a substantially rectangular mold divided into a plurality of sections by fixed dividers or partitions 10 extending transversely of the mold cavity, each of these sections in turn being divided into compartments 11 by movable dividers 12 arranged between each of the fixed dividers or partitions 10. The mold proper including the end walls 6 and 7, the side walls 8 and 9 and the bottom wall 14 as well as the fixed dividers or partitions 10 comprise a unitary structure in the form of a metal die casting, such as an aluminum die casting; the casting also including a plurality of fins 15 for better heat transfer between the cooled air within the compartment 2 and the mold body.

As illustrated in Fig. 7 of the drawing, the movable dividers 12 which are composed of a low heat conducting flexible material such as a plastic material, thin stainless steel or the like, are suitably secured to a frame member 17 which in turn is fixed to a shaft 18 rotatably supported above the vertical mold side wall 8. Teflon has been found to be a particularly suitable plastic material for the movable dividers 12. In order that the movable dividers 12 can pivot about the axis of the shaft 18 from a position within the mold as illustrated in Fig. 7 to a discharge position along one side of the mold as illustrated in Fig. 9, the mold side wall 9 opposite the shaft 18 slopes outwardly and is of a generally concave configuration while the cooperating side edge 22 of the movable dividers is similarly shaped. To provide for the flow of water from one compartment to another during filling of the mold cavity, each of the fixed dividers 10 includes a slot 23 adjacent the side wall 9 while the movable dividers 12 have their upper edge portions 26

terminating short of the side wall 9 to provide a channel or spacing similar to that provided by the slots 23.

In order to release ice pieces formed in the compartments 11 from the mold walls, there is provided an electric heating element 27 extending along each side of the bottom thereof below the side walls 8 and 9. When this heating element is energized, the mold, that is the bottom wall 14, the end walls 6 and 7 and the side walls 8 and 9 as well as the fixed partitions 10 becomes sufficiently warm to melt the bond between the mold surfaces and the ice pieces. However, since the movable dividers 12 are composed of a material of lower heat conductivity than the mold, there is insufficient warming of these members to melt the ice bond so that upon rotation of the movable dividers 12 out of the mold, the ice pieces are carried along with the movable dividers. In the illustrated embodiment of the invention, additional means for preventing warming of the movable dividers to a temperature which will cause meltage of the ice bond between the ice pieces and these dividers is provided one or more projections maintaining most of this movable divider structure in spaced relationship with the walls of the mold. For example, a projection indicated by the numeral 28 in Fig. 7 spaces the bottom edge of the divider 12 from the bottom of the mold 14. This spacing of most of the bottom edge of the movable dividers away from the mold bottom also prevents water from the melting of the ice in contact with the mold bottom 14 from being drawn up between the ice piece and the movable dividers by capillary action thereby loosening the ice piece from the dividers.

In order to positively assure transportation of the ice pieces from the mold and over the mold side wall 8 during pivotal movement of the movable dividers, these dividers are preferably also provided with additional means for anchoring the ice pieces to the dividers in addition to the natural tendency for the pieces to remain frozen to the low heat conductivity material for a longer period of time than to the directly heated mold. In the illustrated embodiment of the invention, the movable dividers 12 have fins 60 provided along both of the rear edges thereof, that is along the edge adjacent the shaft 18 and a notch 61 in the opposite edge. In addition one or more small holes 62 are provided in the bottom edge of the divider. As water freezes into ice in the compartments 11, the ice pieces are anchored positively to the movable dividers 12 by the portions of the ice extending through the notch 61 and the holes 62 while the fins 60 provide additional surface for bonding between the ice pieces and the movable divider 12.

Once the bond between the ice mold proper and the ice pieces has been broken or thawed, the movable dividers 12 can be pivoted upwardly and outwardly from the mold by rotation of the shaft 18 to a point in which the ice pieces come into contact with a plurality of spaced bumpers 30 suitably supported along the side wall 8 of the mold. As will be seen in Fig. 1 of the drawing these bumpers which are opposite the fixed dividers 10 are wide enough to overlap the compartments 11 on each side of the fixed dividers so that their surfaces are in the path of the ice pieces as they are removed from the mold by pivotal movement of the movable dividers 12. When the ice pieces contact the bumpers 30, movement of the ice pieces is stopped and the continued movement of the dividers causes the ice pieces to peel away from the dividers and drop into the bin or receptacle provided below the mold.

Preferably, the ice contacting surfaces 31 of the bumpers 30 are sloped from one side to the other, or in other words, in a longitudinal direction relative to the mold, so that an ice piece on one side of a movable divider will contact the higher edge of the bumper before the ice pieces on the other side contacts the lower edge of the adjacent bumpers. This action is illustrated in Fig. 9 of the drawing. By this action, the forces required to separate the ice pieces from the movable dividers is cut in two since the ice piece first to hit one of the bumpers will be removed from the divider before the other piece carried by the same divider contacts its bumper. It also causes flexing of the dividers as shown in Fig. 10 so that the pieces are in effect peeled rather than sheared from the dividers. It will be obvious, of course, that a stepped or other equivalent bumper surface could be used to accomplish the same purposes.

A further feature of the bumpers 30 is the curved configuration of their surfaces 31 which contact the ice pieces. As illustrated, for example, in Fig. 9, this surface is in the form of an arc of gradually increasing radius from the point adjacent the shaft 18 to the tip 32 of the bumper. By this gradually increasing radius removal of ice pieces of any thickness is assured. Furthermore, the curved shape of the surface 31 is such that contact of that surface by the ice piece will take place at a point intermediate the center line of the ice piece and the edge thereof adjacent the shaft 18 as shown in Fig. 9 so that the releasing pressure is applied rearwardly of the center of gravity of the ice piece thereby causing the ice piece to be discharged forwardly and over the forward edge of the bumpers 30 rather than back into the tray. Fins 60 aid in this discharge action as they provide a back stop so that when the ice cubes are broken free from the dividers, they cannot slip back into the mold.

Control and drive mechanism for controlling the operation of the ice maker and rotating the shaft 18 is housed in a housing 35 secured to one end of the mold 5. The power mechanism includes a motor 36 diagrammatically illustrated in Fig. 12 of the drawing, the motor and a suitable speed reducing gear train forming a drive mechanism being generally indicated in broken lines by the numeral 37 in Fig. 2 of the drawing. The shaft 18 is rotatably mounted in bearings 38 adjacent the mold end wall 7 and in bearings 39 in the front wall 40 of the housing 35. A pawl and cam assembly 42 illustrated in Figs. 3, 4, 5 and 8 of the drawing connected to an end of the shaft 18 extending into the housing 35 and an arm 44 connected to the drive shaft 45 forming part of the drive mechanism 37 provides means for rotating the shaft 18 upon operation of the motor 36. The pawl 47 forming part of the pawl and cam assembly 42 is pivotally supported on that assembly as illustrated in Figs. 3 and 8 of the drawing in such a position that upon rotation of the cam assembly 42 through a predetermined number of degrees, a projection 48 on the wall 40 causes disengagement of the pawl from the arm and allows the motor to continue rotating in the same direction while a return spring 50 which is arranged to bias the movable dividers 12 into the mold causes the shaft to rotate in the opposite direction and return the dividers to the mold.

Additional elements required for a completely automatic operation of the ice maker through successive freezing and ice harvesting cycles include means for introducing a charge of water into the mold, means for energizing the motor in order to initiate an ice harvesting cycle and means for stopping the ice making operation whenever the receptacle 3 is full or out of position.

The water supply means includes a filler tube 65 connected through a solenoid valve 66 to a suitable source of water supply. When the solenoid valve 66 is energized to open the valve, water supplied to the mold from the outlet end of the supply tube 65 discharges into a filler spout 67 having its lower or discharge end 68 disposed adjacent the end wall 6 of the mold. The water thus introduced into the mold flows from compartment to compartment through the slots or grooves 23 and around the ends 26 of the movable dividers.

In order to initiate an ice harvesting cycle when the water charge in the mold has frozen into ice, there is employed a control circuit including a bellows-operated switch 70 which is shown in the wiring diagram of Fig.

12 and which is mounted within the housing 35. The sensing bulb component of this switch which is in the form of a capillary tube 71 extends outwardly through the wall 40 and downwardly along that wall into a control compartment 72 provided at one end of the ice mold. As is shown more particularly in Figs. 2 and 6 of the drawing, this control compartment is defined by walls including the housing wall 40 and the mold end wall 6 and is of a relatively small volume as compared with the ice making compartments 11. In addition, the bottom wall 74 of the control compartment 72 is elevated above the bottom wall 14 of the mold and one or more holes 75 are provided in the end wall 6 for the flow of water between the control compartment 72 and the adjacent ice making compartment 11. A small slab or piece of ice is formed in a control compartment 72 during each ice making operation and the control is regulated to respond to the temperature of the ice in the control compartment in order to initiate the start of the ejection cycle by energizing the motor 36. In order to prevent the accumulation of stagnate water in the control compartment 72, the outlet end 68 of the filler spout partially overlaps this control compartment so that each time water is introduced into the mold a portion of that water will flow into and flush the control compartment while each timeheat is applied to the mold the small ice piece formed in the control compartment will melt and the resultant water flow from the control compartment through the holes 75 into the mold proper.

In order to assure complete freezing of all of the water in the mold before energization of the motor 36, the sensing bulb 71 is preferably warmed slightly by means of the heater 73 which is illustrated in the control circuit of Fig. 12 and which is arranged in heating contact with the sensing bulb 71 as well as the bellows component of the switch 70. The purpose of this heater is two fold. First, it biases the sensing bulb at a temperature a few degrees above mold temperature to assure that the water adjacent the movable dividers 12 which is the last to freeze will be frozen before energization of the motor. In addition, this heater maintains the control bulb and bellows component at temperatures above the freezing temperatures existing in the freezer compartment 2.

In order to stop the ice maker and prevent discharge of ice from the mold whenever the receptacle 3 is removed from beneath the mold, there is provided a switch 80 which breaks the ice maker control circuit to completely de-energize all of the components thereof. In the embodiment of the invention shown in the drawing, the ice maker receptacle is supported on a shelf 81 forming part of a drawer structure 82 slidably supported within the compartment 2. The switch 80 is arranged along the front of the cabinet adjacent the access opening to the compartment 2 so that when the drawer is in its closed position the switch 80 is closed but when the drawer is moved to an open position thereby carrying with it the receptacle 3, the switch 80 is opened.

To stop the ice making operation when the receptacle 3 is filled with ice, there is provided a switch 88 actuated by a feeler arm 84 which as illustrated in Figs. 1 and 7 of the drawing is of a generally open U-shaped construction and is pivotally mounted at each end along the side 9 of the ice mold. Normally, this arm 84 hangs downwardly into the receptacle 3 in a position in which it will contact the ice which has accumulated when the receptacle 3 is approximately full of ice. In order that the ice level sensing arm will measure the total amount of stored ice after each additional charge of ice is delivered to the receptacle, means are provided for raising the feeler arm 84 out of the receptable during each ice making cycle so that when it returns to its normal position within the receptacle, it will rest on top of the added amount of ice if that ice has substantially filled the receptacle 3. For this raising action, the feeler arm includes within the housing 35 an extension or actuating arm 85 which rides on the cam surface of the cam assembly 42. This cam surface is arranged so that when the shaft 18 is in such a position that the movable dividers are within the mold, the feeler arm 84 depends into the receptacle 3. Upon rotation of the shaft, contact of the cam surface with the actuating arm 85 causes this arm to move outwardly from the vicinity of the shaft 18 and to raise the feeler arm 84. At the same time the normally closed switch 88 shown in Fig. 3 as being positioned within the housing 35 below arm 85 is opened. As will be more fully described hereinafter, this switch 88 is connected in the control circuit in such a manner that if the feeler arm is prevented from returning to its normal position, the ice making cycle is interrupted. Continued rotation of the shaft 18 completely raises the feeler arm 84 to a position shown in Figure 8 immediately beneath the mold 5 and out of the receptacle 3. When the pawl 47 disengages the drive arm 44, the action of the spring 50 causes the dividers 12 to return to the mold, and at the same time reverses the direction of rotation of the cam element so that the feeler arm 84 can again return to its normal position in the receptacle and the actuating arm 85 can engage and close the switch 88. If for any reason the dividers 12 are prevented from returning to their normal position in the mold in which they are frozen into engagement with the ice pieces, the cam element 42 will also prevent movement of the arm 85 to a position in which the switch 88 is closed thereby preventing continued operation of the ice maker under conditions in which the movable dividers are not positioned to remove ice pieces from the mold.

The open U-shape of the feeler arm 84 is provided so that this arm can ride over the sides of container 3 during opening or closing of the drawer 82. Since the two sides of the feeler arm both converge at a substantial angle as shown in Fig. 1 and contact with a side of the receptacle will cause the feeler arm to rise and slide over the receptacle side.

If desired an overheat protection thermostat may also be incorporated in the control circuit in order to completely shut off the motor, the solenoid valve and the heater should the temperature of the mold go above a safe point. This thermostat includes a switch 91 in series with the drawer switch 80 and a sensing bulb or element 92 which may be positioned as shown in Fig. 6 along one edge of the mold adjacent the housing 35.

Additional switch means and control circuitry required for the automatic operation of the ice maker will be described during the following consideration of the ice maker operation. During freezing of a batch of ice in the mold 5, the temperature sensed by the sensing bulb 71 gradually decreases to the point where a slab of ice is formed in the control compartment 72. At the same time most of the water in the ice piece compartment 11 has also frozen, the water last to freeze being that adjacent the movable dividers 12 which because of their lower heat conductivity rates provide a slower heat removal from that portion of the water. Since the control heater 73 is designed to maintain the control bulb 71 at a temperature which lags the actual temperature within the control compartment 72 by a few degrees, the switch 70 will not operate until the biased control bulb senses a temperature of for example 15 degrees which is sufficiently low to assure complete freezing of all of the water in the mold. At this point the switch arm 97 forming part of the switch 70 controlled by the thermostate including the sensing bulb 71 moves into contact with the contact 98. With the drawer switch 80 and the overheat switch 91 closed and the feeler arm in its normal position so that switch 88 is closed, a circuit is completed between the supply conductors 100 and 101 to energize the motor 36 through the normally closed switch 102 constituting one of the switches operated by cam 103 and also to energize heater 27. A few degrees of motor rotation is permitted before the arm 44 carried on

the drive shaft 45 engages the pawl 47 which is connected to the shaft 18. During this initial rotation, the switch cam 103 which is also driven by the shaft 45 closes a holding switch 104 to establish a first holding circuit through the heater and a motor holding circuit which includes cam operated switch 102. Both of these circuits bypass the feeler arm switch 88 and contact 98 of the control switch 70. The switch 104 remains closed regardless of the operation of the feeler arm or the control switch until the end of the cycle or in other words through one complete revolution of the shaft 45.

Since the movable dividers 12 are frozen solidly into the ice in the mold, the drive motor stalls until sufficient heat is applied by the hetater 27 to the mold to melt the bond between the ice pieces and the mold end, side and bottom walls and the surfaces of the fixed dividers 10. At this point, the motor again rotates, lifting the movable dividers 12 upwardly and outwardly over the side 8 of the mold to a point where the ice pieces engage the bumpers 30. Continued rotation of the shaft 18 causes the ice pieces to break free from the dividers and drop into the storage container 3.

After the movable dividers have moved to a point between the bumpers 30 which assures complete release of the ice pieces carried thereby regardless of size or thickness, the pawl 47 carried by the pawl and cam assembly is positioned to strike the projection 48 and disengage the pawl from the motor drive arm 44. This allows the motor to continue rotation in the same direction while the return spring 50, biasing the dividers to their normal position within the mold, returns the dividers to that position thus conditioning the dividers for the subsequent manufacture of another batch of ice pieces. By thus disconnecting the divider shaft from the motor, jamming or other mechanical failure of the divider structure cannot interfere with the subsequent water timing cycle.

During the harvesting operation, the ice in the control compartment increases in temperature and begins to melt causing the temperature of the sensing bulb 71 to increase due to the heat from the mold added to that from the control heater 78. Water formed by melting ice flows out through the holes 75 into the mold. At a temperature of, for example, 25 degrees, and even though ice remains in the control compartment, the switch arm 97 forming part of the control switch 70 moves into contact with a warm contact 106. When this occurs, a second holding circuit for energizing only the motor is completed through the closed holding switch 104, and the warm contact 106 of switch 70. Unless this motor circuit through the contact 106 is established by switch 70 before further rotation of the switch cam 103 opens switch 102 to break the first circuit to the motor, further rotation of the motor is prevented until the switch arm 97 does make contact with contact 106.

Further rotation of the switch cam 103 then closes the switch contacts 107 to energize the solenoid valve 66 so that a measured charge of water will be introduced into the mold through the filler spout 67. Thereafter, during the final few degrees of rotation of the switch cam 103, the switches 102, 104 and 107 are returned to their normal or starting positions and reset for a subsequent ice harvesting cycle, the opening of switch 104 de-energizing the mold heater 27 and breaking the circuit including switch contact 106 to de-energize the motor 36.

Unless the receptacle 3 is filled with ice, the feeler arm 84 will also return to its normal position within the receptacle thereby closing the feeler arm switch 88 so that when switch arm 97 subsequently moves into engagement with contact 98 another harvesting cycle is initiated. If on the other hand the ice receptacle is full of ice, the feeler arm will be held in a raised position by the ice pieces so that the switch 88 is maintained in an open position and the motor 36 and heater 27 cannot be energized.

Referring now to Fig. 11 of the drawing there is shown a modification of the present invention which operates on the same principle as that shown in the remaining figures. In this modification, the movable dividers 12 extend only part way into the mold 5 so that their entire bottom edges are spaced a distance from the bottom wall 14 of the mold. This space is occupied by a short fixed divider 110 forming part of the mold 5. By this arrangement with the added fixed dividers 110 forming part of the mold and having good heat conductivity properties, faster freezing of the water within the compartments 11 is obtained while proper adhesion of the ice pieces to the movable dividers 12 and their removal from the mold is assured by the notch 61, the holes 62 and the fins 60. An additional advantage of this arrangement, is that there is less surface engagement between the ice pieces and the dividers so that the pieces can be more easily separated from the dividers during the harvesting cycle.

Fig. 13 discloses a modification of the control circuit which may be employed to prevent control failure from energizing the water valve 66 for a period of time longer than that needed to introduce the required amount of water into the mold, thereby causing flooding of the refrigerator cabinet. The safety feature shown in Fig. 13 includes a manual reset time delay switch 112 in series with the solenoid valve 66, the switch including a bimetal operating element 113 and a heater 114 in parallel with the solenoid valve for heating the bimetal element whenever the valve 66 is energized. The switch 112 is designed so that if the solenoid valve is energized for a period of time substantially exceeding its normal operating period, switch 112 will break the solenoid valve circuit to close the valve.

While there has been shown and described particular embodiments of the present invention it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is intended by the appended claims to cover all such changes and modifications which fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An ice maker comprising an ice mold, partition means including a movable divider dividing said mold into adjacent compartments in which water is to be frozen into ice pieces, said movable divider being composed of a material of lower heat conductivity than the material forming the remaining surfaces of said compartments whereby upon the application of heat to said mold the ice pieces will continue to adhere to said movable divider after melting of the bond between the ice pieces and the remaining surfaces of said compartments, means for heating said mold to break the bond between the surfaces of the mold and ice pieces formed therein, means for mounting said movable divider for pivotal movement of said divider and the ice pieces adhering to the opposed faces thereof out of said mold and over one side of said mold about an axis adjacent one side of said mold and bumpers positioned along said side of said mold and on each side of said divider for engaging said ice pieces and separating said pieces therefrom.

2. An ice maker as set forth in claim 1 in which said movable divider includes fins along the edge thereof adjacent said mold side to prevent separated ice pieces from dropping back into said mold.

3. An ice maker as set forth in claim 1 in which bumpers on opposite sides of said divider are arranged so that one ice piece adhering to said divider is engaged by a bumper and released from said divider before the other ice piece contacts a bumper.

4. An ice maker comprising an elongated mold including a plurality of transverse dividers integral with said mold, movable transverse dividers between said integral dividers and cooperating therewith to divide said mold

into a plurality of compartments in which water is frozen into ice pieces, said mold and integral dividers being composed of material of relatively high heat conductivity, said movable dividers being composed of a material of lower heat conductivity than said mold and integral dividers whereby upon the application of heat to said mold ice pieces will continue to adhere to said movable divider after melting of the bond between the ice pieces and the surfaces of said mold and integral dividers, heating means for warming said mold and said integral dividers to free the ice pieces therefrom, means supporting said movable dividers for pivotal movement thereof along with the ice pieces adhering thereto about an axis adjacent one side edge of said movable dividers upwardly and outwardly over one side of said mold to an inverted position along said side of said mold, bumpers having generally curved surfaces arranged along said side of said mold to engage said ice pieces during movement thereof to said inverted position and to free said pieces from said movable dividers, each of said curved surfaces being shaped to contact an ice piece at a point between the center thereof and the side of the cube adjacent said axis regardless of the thickness of said piece.

5. An ice maker comprising an ice mold including alternate transverse fixed and movable dividers dividing said mold into a plurality of compartments in which water is frozen into ice pieces, means for heating said mold and said fixed dividers to loosen the ice pieces therefrom, said movable dividers being adapted to provide adhesion of said ice pieces to said movable dividers after loosening of said pieces from said mold and fixed dividers by said heating means, means pivotally supporting said movable dividers for movement from their normal position in said mold to a discharge position out of said mold and over one side thereof and power mechanism for effecting said movement and for returning said movable dividers to their normal position within the mold.

6. An ice maker as set forth in claim 5 in which said power mechanism includes drive means for moving said movable dividers to said discharge position, means for disconnecting said drive means when said movable dividers are in the discharge position and spring means for returning said movable dividers to their normal position in said mold upon operation of said disconnecting means.

7. An ice maker as set forth in claim 5 in which said movable dividers include openings therein to increase the bond between said movable dividers and said ice pieces.

8. An ice maker as set forth in claim 5 in which said movable dividers include projections on the bottom edges thereof spacing said movable dividers from the surface of said mold to prevent loosening of said ice pieces from said movable dividers during heating of said mold.

9. An ice maker comprising an elongated ice mold, means including alternate fixed and movable transverse dividers dividing said mold into a plurality of compartments in which water is frozen into ice, said movable dividers being composed of a material of lower heat conductivity than said mold and fixed dividers, means for heating said mold and fixed dividers to loosen ice pieces therefrom, means for pivoting said movable dividers about an axis adjacent one vertical edge thereof for movement out of said mold, each of said movable dividers including a notch in the opposite vertical edge thereof in which water is frozen to form a connecting bridge between adjacent ice pieces for anchoring said pieces to said movable dividers during movement thereof out of said mold, said movable dividers including projections on the bottom edges thereof spacing said movable dividers from the surface of said mold to prevent loosening of said ice pieces from said movable dividers during heating of said mold.

10. An ice maker comprising an elongated ice mold, means including alternate fixed and movable transverse dividers dividing said mold into a plurality of compartments in which water is frozen into ice, said movable dividers being composed of a material of lower heat conductivity than said mold and fixed dividers, means for heating said mold and fixed dividers to loosen ice pieces therefrom, means for pivoting said movable dividers about an axis adjacent one vertical edge thereof for movement out of said mold, said movable dividers including fins on said vertical edges and openings extending through said movable dividers for anchoring said pieces to said movable dividers during movement thereof out of said mold.

11. An ice maker comprising an elongated ice mold, means including alternate fixed and movable transverse dividers dividing said mold into a plurality of compartments in which water is frozen into ice, said movable dividers being composed of a flexible material of lower heat conductivity than said mold and fixed dividers, means for heating said mold and fixed dividers to loosen ice pieces therefrom, means for pivoting said movable dividers and ice pieces adhering thereto about an axis adjacent one vertical edge thereof for movement out of said mold, and bumpers for contacting said ice pieces and releasing said pieces from said movable dividers, said movable dividers including fins on said vertical edge thereof to prevent the released ice pieces from returning to said mold.

12. An ice maker comprising an ice mold including end walls, a bottom wall, a generally flat side wall substantially perpendicular to said bottom wall and an outwardly sloping concave side wall forming a mold cavity of a generally trapezoidal cross-section, spaced fixed transverse dividers integral with said mold, the upper portions of said dividers terminating short of said concave side wall to form slots for the flow of water past said dividers, said mold and dividers being composed of a material of relatively high heat conductivity, transverse movable dividers composed of a material of lower heat conductivity than said mold disposed between said fixed dividers and cooperating therewith to form a plurality of compartments in which water is frozen into ice pieces, said movable dividers having approximately the same shape as said fixed dividers whereby the sides thereof adjacent said concave mold side wall form with said concave wall slots for the flow of water between said compartments, means for introducing water to be frozen into said mold adjacent one end thereof, means for applying heat to said mold for freeing ice pieces from the mold surfaces, a shaft extending along the upper edge of said flat side wall, means connecting said movable dividers with said shaft whereby rotation of said shaft causes said movable dividers to pivot from a normal position within said mold to an inverted position along said flat side wall of said mold, said movable dividers having means including at least one aperture therein for causing the ice pieces formed in adjacent compartments to adhere thereto during pivotal movement of said movable dividers to said inverted position, fixed bumpers spaced along said flat side wall and arranged to be engaged by said ice pieces during movement of said movable dividers to their inverted positions between said bumpers and to separate said ice pieces therefrom for discharge into a receptacle beneath said bumpers, spring means biasing said movable dividers to said normal position, power mechanism including an electric motor for rotating said shaft for movement of said movable dividers to said inverted position, and disconnect means for disconnecting said power mechanism when said movable dividers reach said inverted position whereby said spring means returns said movable dividers to said normal position, a feeler arm pivotally mounted on said ice maker for movement between a normal position in said receptacle and an elevated position, means including a cam surface connected to said shaft and engaging said arm for moving said feeler arm to the elevated position and maintaining said arm in said elevated position until said movable dividers are returned to their normal position in said mold, a housing connected to one end of

said mold for enclosing said power mechanism, said housing including a wall spaced from an end wall of said mold and forming therewith a control cavity of a volume substantially less than each of said compartments, means for introducing a charge of water into said mold and said cavity, said mold end wall having an aperture therein to permit drainage of water from said cavity into said mold, electrical control means for controlling the operation of said ice maker for successive freezing and ice pieces delivery cycles comprising a temperature actuated normally open switch having a temperature sensing control positioned in said control cavity for closing said switch and initiating an ice delivery cycle by energizing said motor and said heater when the water in said mold is frozen, and a second normally closed switch actuated by said feeler arm and arranged to prevent energization of said motor and heater upon closing of said temperature actuated switch if said movable dividers do not return to their normal position following the ice delivery cycle.

13. An ice maker comprising a metal ice mold, spaced fixed transverse metal dividers integral with said mold, transverse movable dividers composed of a material of lower heat conductivity than said mold disposed between said transverse dividers and cooperating therewith to divide said mold into a plurality of compartments in which water is frozen into ice pieces, means for introducing a charge of water into said mold, means for applying heat to said mold for freeing the ice pieces from the mold surfaces, a shaft extending along the upper edge of one side wall of said mold, means connecting said movable dividers with said shaft whereby rotation of said shaft causes said movable dividers and adhering ice pieces to pivot from a normal position within said mold to an inverted position along one side of said mold, a plurality of spaced fixed bumpers arranged along said side wall of said mold to be engaged by said ice pieces during movement of said movable dividers to their inverted positions between said bumpers and to separate said ice pieces therefrom for discharge into a receptacle beneath said bumpers, means biasing said movable dividers to said normal position, power mechanism including an electric motor for rotating said shaft and said movable dividers to said inverted position and disconnect means for disconnecting said power mechanism when said movable dividers reach said inverted position whereby said biasing means returns said movable dividers to said normal position, a feeler arm pivotally mounted on said ice maker for movement between a normal position in said receptacle and an elevated position and means including a cam surface engaging said arm and rotatable with said shaft for moving said feeler arm to the elevated position and maintaining said arm in said elevated position until said movable dividers are returned to their normal position in said mold and a switch actuated by said feeler arm and arranged to prevent energization of said motor and heater if said movable dividers fail to return to their normal position following an ice delivery cycle.

14. An ice maker comprising a metal ice mold having walls including a generally flat side wall and a concave side wall forming a mold cavity of a generally trapezoidal cross-section, spaced transverse metal dividers integral with said mold, transverse movable dividers composed of a material of lower heat conductivity than said mold disposed between said transverse dividers and cooperating therewith to divide said mold into a plurality of compartments in which water is frozen into ice pieces, means for applying heat to said mold for freeing the ice pieces from the mold surfaces, a shaft extending along the upper edge of said flat side wall, means connecting said movable dividers with said shaft whereby rotation of said shaft causes said movable dividers to pivot from a normal position within said mold to an inverted position downwardly along said flat side wall of said mold, fixed bumpers arranged alongside of said mold ajacent said flat side wall to be engaged by said ice pieces during movement of said movable dividers to their inverted positions between said bumpers and to separate said ice pieces therefrom for discharge into a receptacle beneath said bumpers, spring means biasing said dividers to said normal position, power mechanism including an electric motor for rotating said shaft and said movable dividers to said inverted position and disconnect means for disconnecting said power mechanism when said movable dividers reach said inverted position whereby said spring means returns said movable dividers to said normal position, means including an end wall of said mold forming a control cavity of a volume substantially less than each of said compartments, means for introducing a charge of water into said mold and said cavity, electrical control means for controlling the operation of said ice maker for successive freezing and ice piece delivery cycles comprising a temperature actuated normally open switch having a temperature sensing control element positioned in said control cavity for closing said switch and initiating an ice delivery cycle by energizing said motor and said heater when the temperature sensed by said control element is below freezing, said mold end wall having a hole therein to permit water to flow from said cavity into said mold.

15. An ice maker comprising a metal ice mold, means including transverse movable dividers composed of a material of lower heat conductivity than said mold dividing said mold into a plurality of compartments in which water is frozen into ice pieces, means for applying heat to said mold for freeing the ice pieces from the mold surfaces, a shaft extending along the upper edge of one side wall of said mold, means connecting said movable dividers with said shaft whereby rotation of said shaft causes said movable dividers to pivot from a normal position within said mold to an inverted position along one side of the mold, a plurality of spaced fixed bumpers arranged along said side wall of said mold to be engaged by said ice pieces during movement of said movable dividers to their inverted positions between said bumpers and to separate said ice pieces therefrom for discharge into a receptacle beneath said bumpers, power mechanism including an electric motor for rotating said shaft and said movable dividers to said inverted position, a V-shaped feeler arm pivotally mounted at both ends on said ice maker for movement between a normal position extending into said receptacle and an elevated position above said receptacle, said arm being adapted by means of its shape to ride upwardly over a side of receptacle upon sliding movement of said receptacle to and from its position beneath said ice maker.

References Cited in the file of this patent

UNITED STATES PATENTS

1,510,147	Keith	Sept. 30, 1924
1,931,053	Berkeley	Oct. 17, 1933
2,036,784	Warneke	Apr. 7, 1936
2,048,412	Sissman	July 21, 1936
2,049,902	Fischer	Aug. 4, 1936
2,067,074	Chilton	Jan. 5, 1937
2,161,321	Smith	June 6, 1939
2,340,693	Roberts	Feb. 1, 1944
2,418,572	Brennan	Apr. 8, 1947
2,454,960	Berkeley	Nov. 30, 1948
2,490,044	Garbarini	Dec. 6, 1949
2,514,175	Beckman	July 4, 1950
2,559,414	Erickson	July 3, 1951
2,757,520	Sampson	Aug. 7, 1956
2,770,102	Roedter	Nov. 13, 1956
2,799,144	Barton	July 16, 1957
2,833,123	Kennedy	May 6, 1958

FOREIGN PATENTS

506,508	Italy	Dec. 23, 1954
1,047,312	France	Dec. 14, 1953