June 13, 1961 H. J. LOEWENTHAL 2,987,895

AUTOMATIC ICE MAKER

Filed May 18, 1959 2 Sheets-Sheet 1

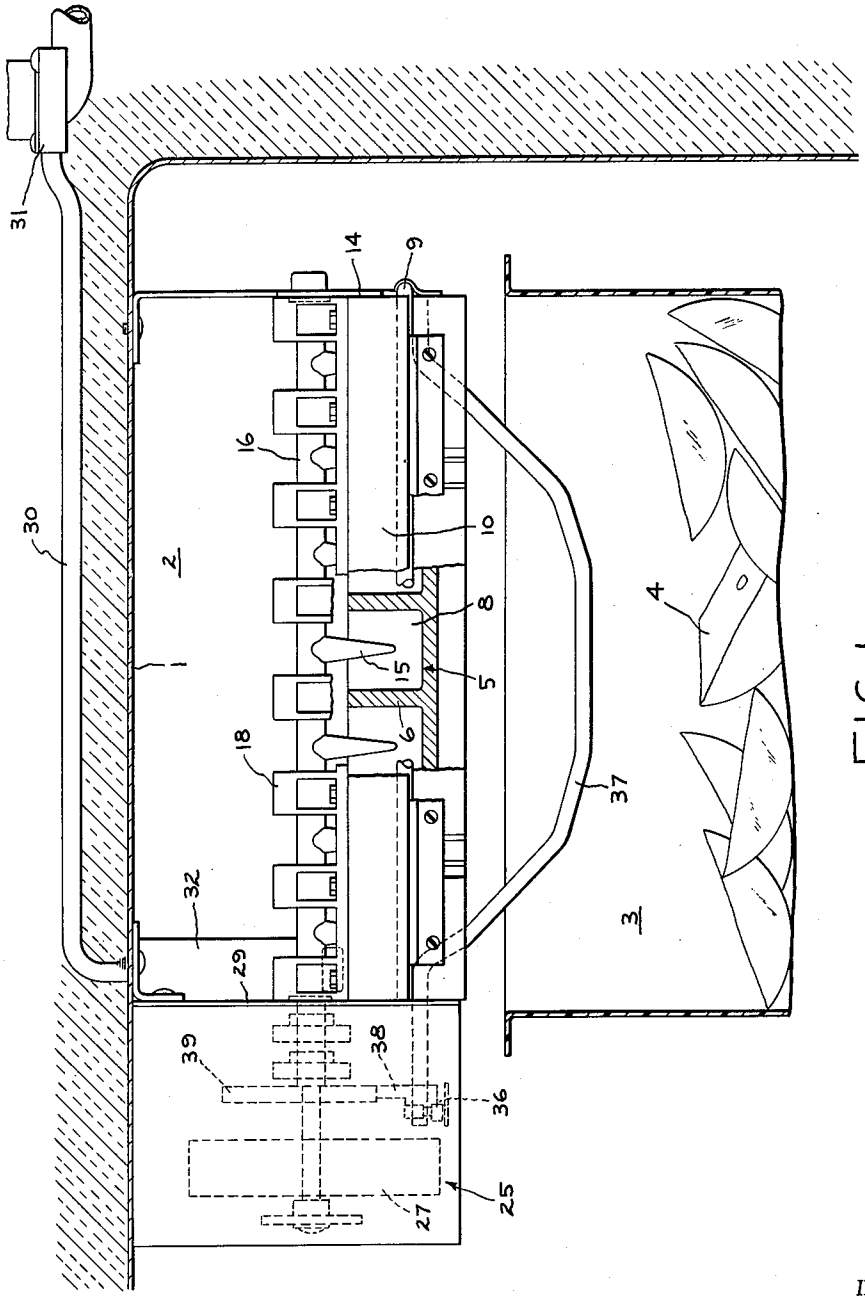

FIG. 1

INVENTOR
HENRY J. LOEWENTHAL

BY Walter E. Rule

HIS ATTORNEY

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FIG. 2

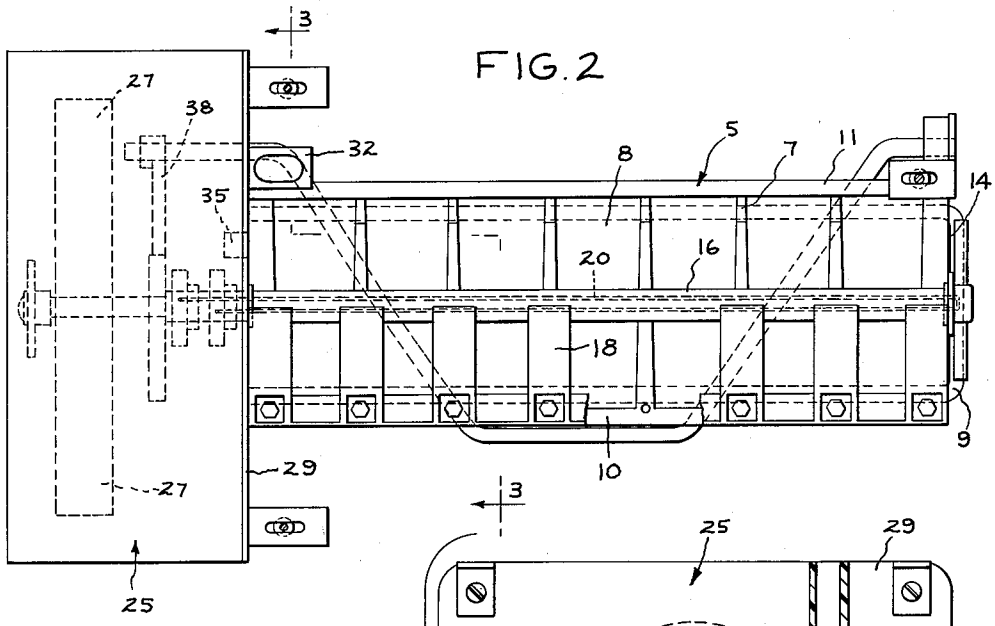
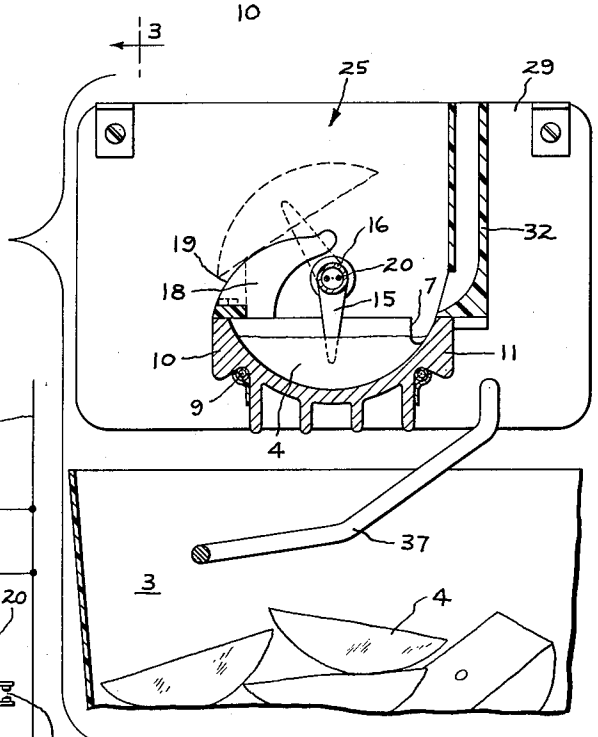


FIG. 3



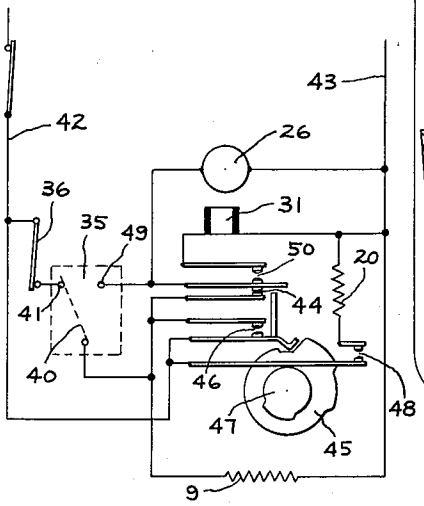


FIG. 4

INVENTOR

HENRY J. LOEWENTHAL

BY Walter E. Rule

HIS ATTORNEY

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2,987,895

AUTOMATIC ICE MAKER

Henry J. Loewenthal, Louisville, Ky., assignor to General Electric Company, a corporation of New York

Filed May 18, 1959, Ser. No. 813,787
3 Claims. (Cl. 62—351)

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

A primary object of the invention is to provide a new and improved domestic or household refrigerator ice maker in which ice pieces released by the application of heat from a mold having an arcuate contour are thereafter automatically transferred out of the mold for discharge into a storage receptacle by means of rotatable fingers mounted above the mold and having end portions normally extending into the mold where they are frozen into the ice pieces.

Additional 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 fixed transverse partitions dividing the mold into a plurality of adjacent compartments in which water is frozen into ice pieces and heating means for warming the mold to loosen the ice pieces from the walls defining the compartments. The mold is of arcuate contour so that each of the compartments formed by the partitions are of the same semi-circular cross-section transversely of the mold. In order to remove the ice pieces from the mold, there is provided a transfer mechanism comprising a shaft extending longitudinally above the mold on which are mounted a plurality of fingers having their ends extending into the compartments short of the arcuate walls defining the compartments so that ice pieces formed in the individual compartments are frozen into engagement with the fingers. The shaft is positioned at or below the center of curvature of the mold walls so that upon rotation of the shaft and the radially extending fingers mounted thereon, the individual ice pieces are rotated by the fingers out of the mold and into engagement with bumpers positioned above the mold and in the path of the transferred ice pieces, engagement of the ice pieces by these bumpers serving to remove the ice pieces from the fingers for discharge into a suitable receptacle. To aid in this removal, means are provided for warming the fingers during rotation thereof and prior to engagement of the ice pieces with the bumpers.

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 a side elevational view, partly in section, of the ice maker of the present invention;

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

FIG. 3 is a vertical sectional view of a portion of the ice maker taken along line 3—3 of FIG. 2; and

FIG. 4 is a wiring diagram for an electrical control system which can be employed for the automatic operation of the ice maker of the present invention.

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 temperatures below freezing by air circulated over a low

temperature evaporator (not shown) and through the compartment 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 in which ice pieces 4 discharged from the ice maker are stored in an ambient temperature below freezing.

The ice maker includes an ice mold 5 in the form of an elongated or generally rectangular structure composed of a material of high heat conductivity such as aluminum. The interior of the mold has a generally arcuate contour in transverse cross-section as illustrated in FIG. 3 of the drawing and is divided into a plurality of compartments 8 by transverse dividers or partitions 6 which are formed integrally with the mold. In order that water may flow from one compartment to the other during filling of the mold, each of the transverse dividers 6 is provided with a slot 7 adjacent one end thereof extending below the normal water level in the mold.

For the purpose of warming the mold to release ice pieces formed in the compartments 8 from the mold and partition surfaces, there is provided an electric heating element 9 in the form of a loop extending along the sides 10 and 11 of the mold and along the one end wall 14. Upon energization of this heating element, the mold, including its dividers 6, becomes sufficiently warm to melt the bond between the mold surfaces and the ice pieces so that the ice pieces can be removed from the compartments.

In accordance with the present invention, means for removing the released ice pieces are provided in the form of fingers 15 secured to a hollow or tubular shaft 16 extending longitudinally along the mold at or below the center of curvature of the arcuate surface forming the interior of the mold. One finger 15 is provided for each of the compartments 8 and as illustrated in FIG. 3 of the drawing, each extends radially into its compartment so that the end thereof is below the normal water level in the mold or in other words in a position to be frozen into the ice pieces 4 formed in the mold. With the ice pieces 4 frozen into engagement with the fingers 15, it will be seen that rotation of the shaft and fingers will sweep the ice pieces 4 in a circular path upwardly and out of the mold.

After the fingers have rotated the ice pieces to a substantially inverted position above the mold or in other words to a position in which they cannot slide off the fingers upon loosening of the bond between the two, a heater 20 extending through the hollow shaft 16 is energized. Heat conducted through the fingers then serves to melt the bond between the fingers and the ice pieces so that they can be readily slid off the fingers.

For the purpose of removing the individual ice pieces 4 from the fingers 15 after the ice pieces have been rotated past their inverted position about the mold and during their downward travel, there are provided a series of bumpers 18 overlying the partitions 6 and of a sufficient width so that the bumpers 18 will contact the edges of adjacent ice pieces after they are removed from the mold by the rotating fingers. As is shown more clearly in FIG. 3 of the drawing, each of these bumpers 18 which are supported on the side walls of the mold 5, has a curved ice contacting surface 19 extending over the adjacent mold compartment and terminating above the shaft 16 so that an ice piece engages the bumper only after a finger has rotated the ice piece somewhat over 180° to a point where the ice piece is travelling downwardly at the time it engages the bumper for removal and discharge into the bin 3 provided below the mold. The bumper contacting point on the ice piece is ahead of the finger 15 so that as the bumper applies a

force having a radial component relative to the finger which causes the piece to slide off the finger, the finger continues to urge the ice piece downwardly over the bumper surface so long as the finger is in engagement with the ice piece.

The invention claimed in this application relates broadly to an ice maker comprising the above described ice harvesting arrangement wherein rotatable fingers extending into a mold of arcuate contour are employed to transfer the heat released ice pieces from the mold into engagement with bumper means for separating the pieces from the fingers after the latter have been warmed to facilitate the separation. In addition to means for rotating the shaft **16** and energizing the heaters **9** and **20** at the proper points in the harvesting cycle, the automatic operation of the ice maker requires additional components and controls such as those which will now be described. These additional components and controls, apart from the combination thereof with the ice harvesting arrangement claimed herein, are not part of the present invention but are more completely disclosed and are claimed in the copending application of Harold P. Harle, Stephen Balogh and Henry J. Loewenthal, Serial No. 813,790, filed concurrently herewith and assigned to the same assignee as the present invention.

The illustrated control and power mechanism for the operation of the ice maker is generally housed within a housing **25** secured to one end of the mold **5**. The power mechanism includes a motor **26** diagrammatically illustrated in FIG. 4 of the drawing, the motor and a suitable speed reducing gear train forming a drive mechanism **27** that is generally shown in broken lines in FIGS. 1 and 2 of the drawing. The shaft **16** is rotatably mounted in bearings adjacent the mold end wall **14** and in the front wall **29** of the housing **25**.

Water supply means for the mold includes a supply line **30** connected through a solenoid valve **31** to a suitable source of water supply. When the solenoid valve **31** is opened, water from the supply line **30** flows into a filler tube **32** having its lower or discharge end disposed adjacent one end wall of the mold. The charge of water thus introduced into the mold flows from compartment to compartment through the slots or grooves **7**.

In order to initiate the ice harvesting cycle when the water charge in the mold has frozen into ice, there is employed a control circuit including a temperature responsive switch **35** arranged within the mold wall as indicated in FIG. 2 to sense freezing temperatures within one of the compartments **7**. Preferably this temperature sensing switch **35** is located near the filler spout **32** so that it will be warmed by each new charge of water for reset purposes.

For the purpose of stopping operation of the ice maker when the receptacle **3** is full of ice, there is provided a switch **36** actuated by a feeler arm **37** pivotally mounted along the side **11** of the mold. Normally, this feeler arm hangs downwardly into the receptacle **3** in a position in which it will contact the ice when the receptacle **3** is approximately full of ice. In order that the arm will measure the stored ice after each additional charge of ice is delivered to the receptacle, means are provided for raising the feeler arm out of the receptacle during each ice harvesting cycle so that when it turns to its normal position within the receptacle, it will rest on top of the added amount of ice if the receptacle is full of ice. In order to raise the feeler arm **37** during each harvesting cycle, the arm is provided with an actuating arm **38** within the housing **25** which rides on a cam member **39** carried by the shaft **16**. During each rotation of the shaft **16**, the cam is arranged to raise the feeler arm **37** out of the receptacle during the first part of the cycle and return it to the receptacle after a new batch of ice pieces has been discharged into the receptacle. The actuating arm **38** is also arranged to open the normally closed switch **36** when the feeler arm is in the elevated position and to close this switch when the arm returns to its normal position within the receptacle. Switch **36** is connected into a control circuit in such a manner that if the feeler arm is prevented from returning to its normal position by the accumulation of ice in the receptacle, the ice making cycle is interrupted.

Additional switch means and control circuitry for the automatic operation of the ice maker will be described in the following description of the ice maker operation and with particular reference to FIG. 4 of the drawing.

During freezing of a charge of water in the mold **5**, the temperature sensed by the thermal switch **35** gradually decreases. After all of the water in the mold has become frozen, the switch **35** is designed so that its switch arm **40** moves into contact with a cold contact **41**, as illustrated in FIG. 4 of the drawing. Closing of the switch contact **41** completes a circuit between supply conductors **42** and **43** to energize the motor **26** and the mold heater **9**. This circuit includes the normally closed feeler arm switch **36** and the normally closed switch **44** constituting one of three switches operated by the motor driven cam **45**. After a few degrees of motor rotation, the cam **45** closes a cam operated holding switch **46** to establish a first heater holding circuit for energizing the heater and a first motor holding circuit which includes cam operated switch **44**. Both of these circuits bypass the feeler arm switch **36** and the control switch **35**. The switch **46** 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 approximately one complete revolution of the shaft **16** and cam **45**.

Since the fingers **15** are frozen solidly into the ice pieces formed in the mold compartments, the drive motor stalls until sufficient heat has been applied by the heater **9** to melt the bond between the ice pieces and the mold walls. At this point, the motor again rotates so that the ice pieces carried by the fingers move in a counterclockwise direction as viewed in FIG. 3. After the fingers have rotated at least 90°, that is, past the horizontal position, the second motor driven cam **47** closes switch **48** to energize heater **20** in the shaft **16**. The resultant warming of the fingers **15** loosens the bond between the fingers and the ice pieces so that when the ice pieces engage the bumpers **18** only a minimum force is required to slip the ice pieces off the fingers for discharge into container **3**.

After removal of the ice pieces **4** from the mold, continued energization of the heater **9** causes the temperature of the mold to increase thereby increasing the temperature sensed by the switch **35**. The switch arm **40** moves to its warmer position to engage the warm contact **49**. When this occurs, a second holding circuit for energizing only the motor is completed through the closed holding switch **46** and the warm contact **49** of switch **35**. Unless this motor circuit through the contact **49** is established before further rotation of the switch cam **45** opens the switch **44** to break the first circuit to the motor, further rotation of the motor will be prevented until such action does take place.

Following opening of switch **44**, further rotation of the switch cam **45** closes the switch contacts **50** to energize the solenoid valve **31** for a predetermined time so that a measured charge of water will be introduced into the mold through the spout **32**. Thereafter and during the final few degrees of rotation of the motor and switch cam **45**, the switches **44**, **46** and **50** are returned to their normal or starting positions and reset for a subsequent ice harvesting cycle, the opening of the switch **46** de-energizing the mold heater **9** and also breaking the circuit including the switch contact **49** to de-energize the motor **26**. At this point the fingers **15** return to a vertical position in the mold, in which position their ends are immersed in the newly added charge of water.

Unless the receptacle **3** is filled with ice, the feeler arm **37** will also return to its normal position within the recep-

tacle thereby closing the operated switch **36** operated by the feeler arm so that when the switch arm **40** again moves into engagement with the cold contact **41** of switch **35** another ice harvesting cycle is initiated. If, on the other hand, the ice receptable is full of ice, the feeler arm will be held in a raised position by the accumulated ice pieces and switch **36** will remain open. With switch **36** held open the motor and heater cannot again be energized to start a subsequent harvesting operation regardless of the position of switch **35**.

While there has been shown and described a particular embodiment 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 therefore intended by the appended claims to cover all such changes and modifications as fall within the true spirit and scope of this invention.

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

1. An ice maker comprising an ice mold having an interior wall of an arcuate contour and in which water is frozen into an ice piece, means for removing said ice piece from the mold comprising a finger having one end extending vertically into said mold below the water level therein whereby an ice piece formed in said mold adheres thereto, the other end of said finger being rotatably mounted above said mold for rotation of said one end of said finger and said ice piece about the center of curvature of said wall, bumper means positioned above said mold in the path of said ice piece for removing said ice piece from said finger, and means for heating said finger to loosen said ice piece before engagement of said ice piece with said bumper.

2. An ice maker comprising an elongated metal mold having an internal wall of transverse arcuate contour, said mold including a plurality of transverse dividers integral with said mold and dividing said mold into a plurality of compartments in which water is frozen into ice pieces, means for heating said mold to loosen the ice pieces formed therein, and means for harvesting said ice pieces comprising a shaft positioned longitudinally of said mold at the center of curvature of said internal wall, fingers extending radially from said shaft into said compartments and below the water level therein whereby ice pieces formed in said compartments adhere to said fingers and are transferred out of said compartments on said fingers upon rotation of said shaft, and means for heating said fingers operable when said fingers rotate said ice pieces to an inverted position above said mold and means engaged by said ice pieces upon further rotation of said shaft for removing said pieces from said fingers.

3. An ice maker comprising an elongated metal mold having an internal wall of transverse arcuate contour, said mold including a plurality of transverse dividers integral with said mold and dividing said mold into a plurality of compartments in which water is frozen into ice pieces, means for heating said mold to loosen the ice pieces formed therein, and means for harvesting said ice pieces comprising a shaft extending longitudinally of said mold at the center of curvature of said internal wall, fingers extending radially from said shaft into said compartments and terminating below the water level therein whereby ice pieces formed in said compartments adhere to said fingers and are transferred out of said compartments on said fingers upon rotation of said shaft, and means for heating said fingers oerable when said fingers rotate past a horizontal position to loosen said ice pieces while in an inverted position above said mold and means engaged by said ice pieces after said fingers have rotated past said inverted position for removing said pieces from said fingers.

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