

[54] TRAY ICE MAKER WITH ICE LEVEL
SENSING CONTROL

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[52] U.S. Cl. 62/137, 62/344

[51] Int. Cl. F25c 5/18

[58] Field of Search 62/137, 344

[56] References Cited

UNITED STATES PATENTS

3,540,227	11/1970	Eyman, Jr. et al.	62/137
3,601,145	8/1971	Eyman, Jr.	62/137
3,643,456	2/1972	Nichols	62/137

3,648,476 3/1972 Linstromberg 62/137

Primary Examiner—William F. O'Dea

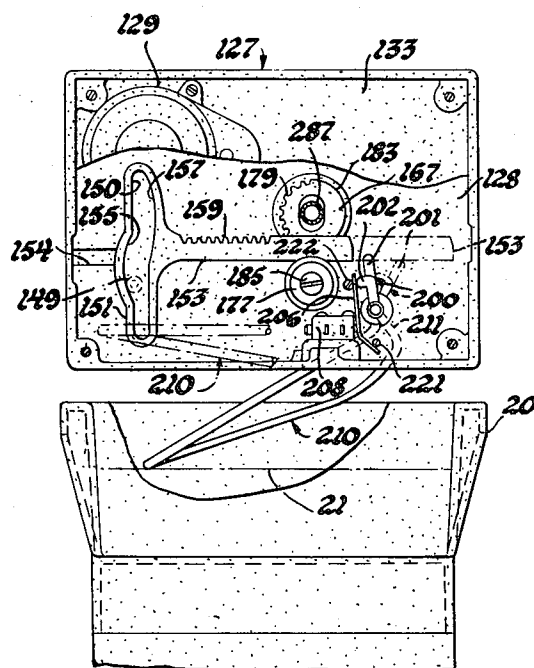
Assistant Examiner—Peter D. Ferguson

Attorney, Agent, or Firm—Edward P. Barthel

[57] ABSTRACT

An automatic ice maker having an ice level sensing arm and control permitting the horizontally driven rack bar of a Scotch yoke tray driving mechanism for inverting the ice piece tray to also engage a cam finger portion of a pivotal holder member causing rotation of the sensing arm out of an ice collecting bin and the opening of a normally closed reset and ice level switch to interrupt the operation of the ice maker when the mechanism is harvesting and/or when the collecting bin reaches a predetermined level.

3 Claims, 8 Drawing Figures



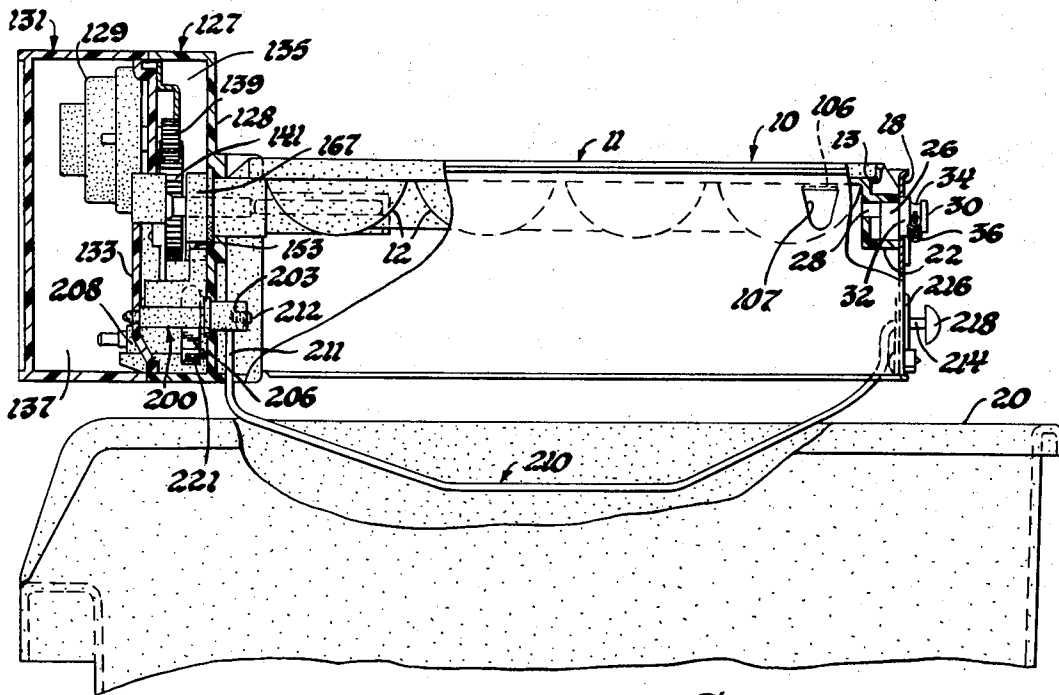


Fig. 1

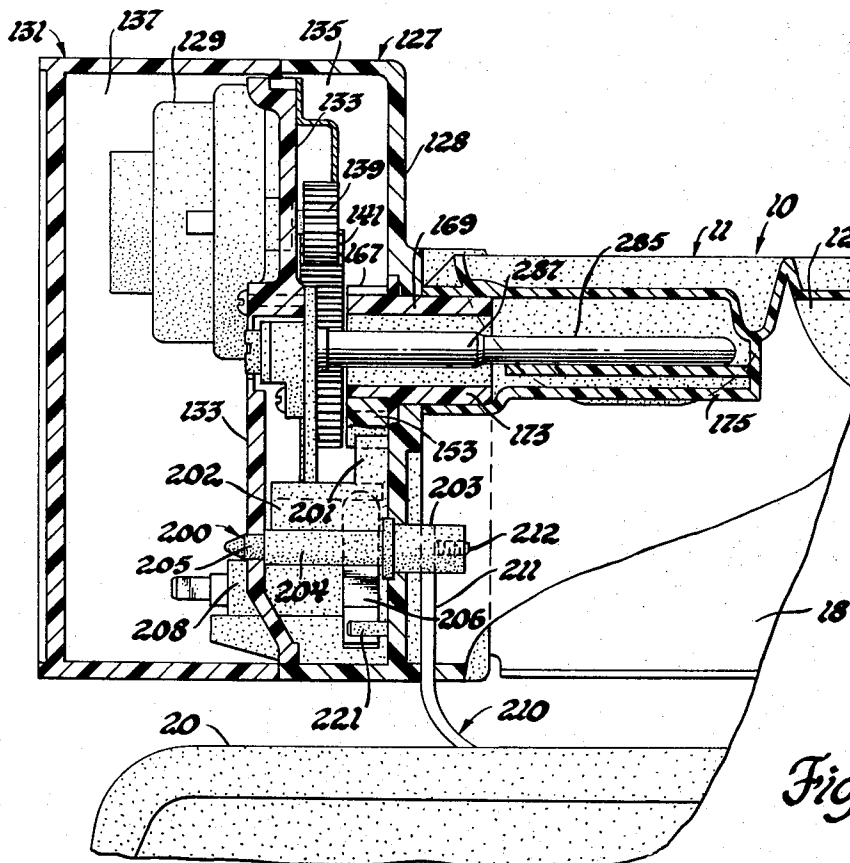
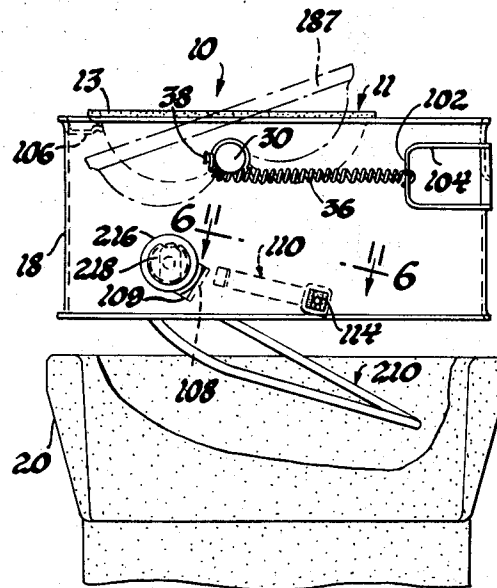
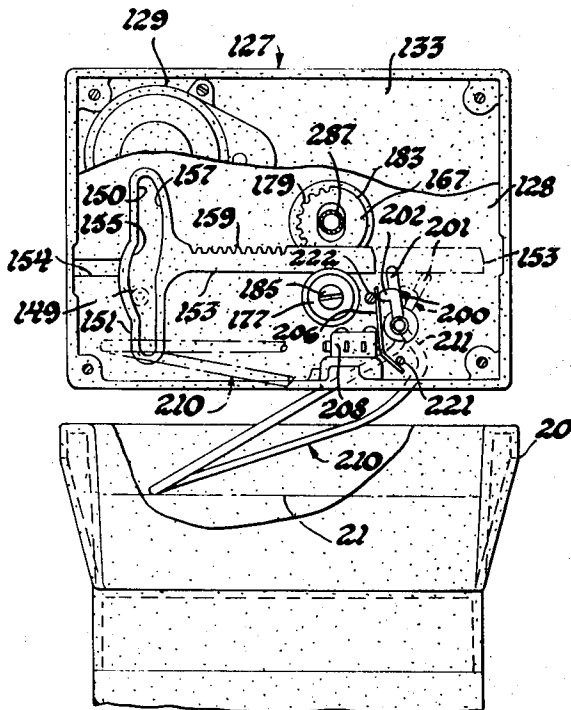
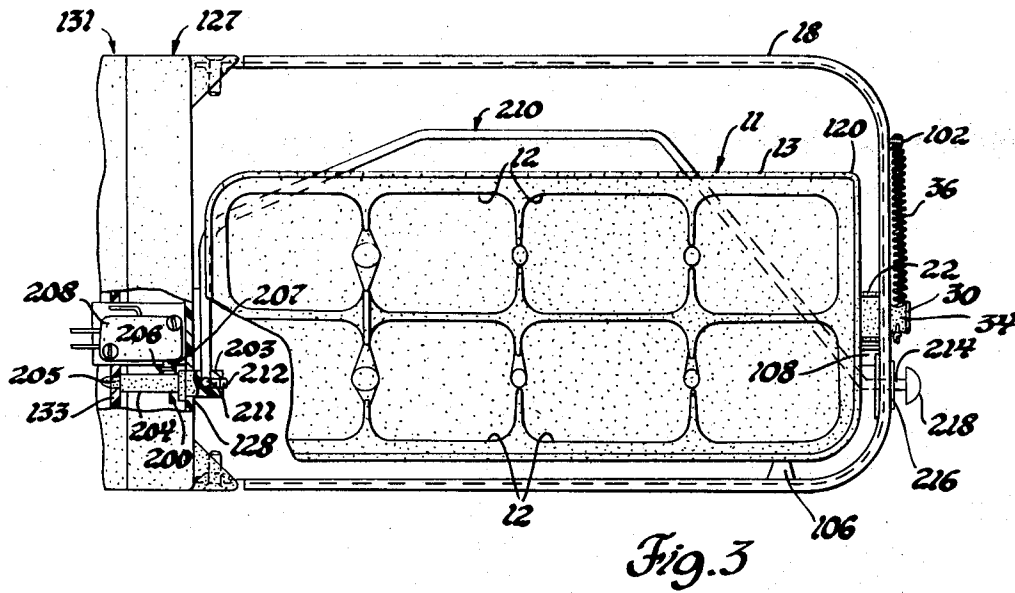


Fig. 2



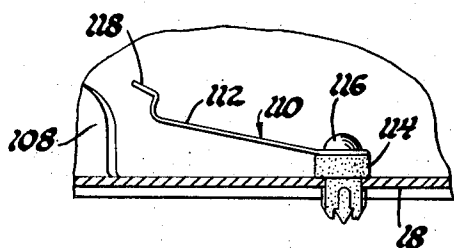


Fig. 6

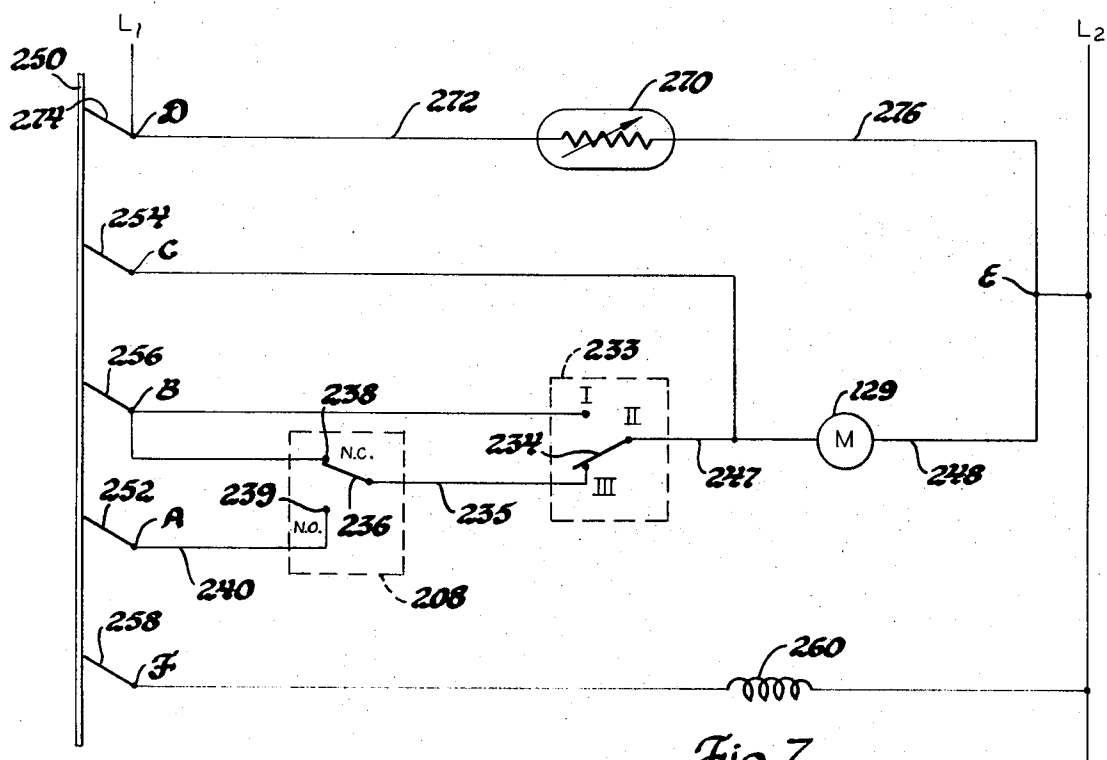


Fig. 7

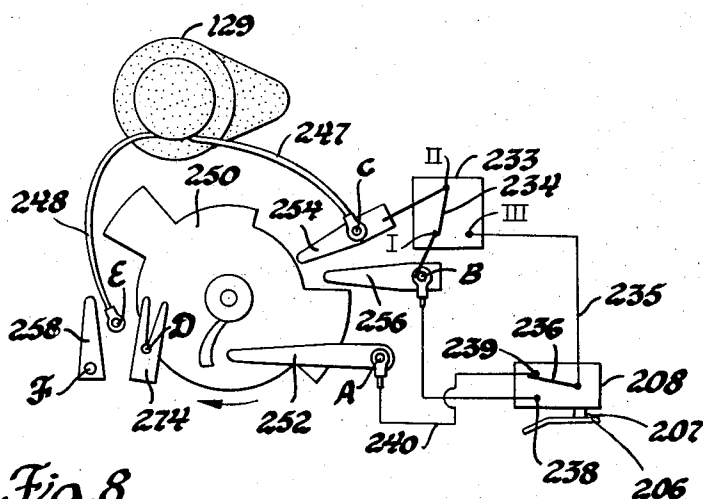


Fig. 8

TRAY ICE MAKER WITH ICE LEVEL SENSING CONTROL

This invention relates to automatic ice makers and in particular to an ice level sensing arm mechanism and control therefor.

It is an object of this invention to provide a reliable, low cost improved ice level sensing arm mechanism and control for an automatic ice maker actuated by a horizontally reciprocating rack bar portion of a Scotch yoke tray driving mechanism such that upon moving in its tray inverting direction the rack bar cams the sensing arm pivotal hub member to raise the sensing arm out of an ice piece collecting bin and open a reset and ice level switch momentarily during the ice harvesting cycle or permanently when the quantity of ice pieces in the bin is at a preselected level.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of the present invention is clearly shown.

In the Drawings:

FIG. 1 is a vertical side elevational view, partly in section, of the automatic ice maker;

FIG. 2 is an enlarged fragmentary vertical sectional view of the ice maker of FIG. 1 showing the drive and control mechanism;

FIG. 3 is a top plan view, partly in section, of the automatic ice maker;

FIG. 4 is a front elevation thereof with portions thereof removed to show the operating mechanism;

FIG. 5 is a rear view of the automatic ice maker;

FIG. 6 is a view taken on line 6—6 of FIG. 5;

FIG. 7 is a schematic diagram of the electrical control circuit; and

FIG. 8 is a wiring diagram of the commutator plate.

In the preferred embodiment of the invention as disclosed in the drawings, an ice maker generally designated 10 is shown which is adapted to be housed in the freezer section of a household refrigerator and comprises a mold or tray 11 defining a plurality of pockets, such as the two rows of pockets 12 shown containing four blocks in each row, and has an upwardly flanged rim 13 extending around the short and long sides with the tray adapted to receive water to be frozen into a plurality of ice pieces as shown in U.S. Pat. No. 3,540,227 to Eyman et al. the disclosure of which is incorporated by reference herein. The ice maker is provided with a wide U-shaped frame 18 which surrounds the tray while disposed directly below the frame is a rectangular bin 20 for receiving the frozen cubes ejected from the tray 11.

At the rear the tray 11 has an integrally molded boss 22 provided with a recess tightly receiving the flattened cylindrical portion 26 and a coaxial projecting pin 28 of the pivot pin 30 having a bearing portion 32 of reduced size fitting a bearing aperture within the rear wall of the frame 18. This pivot pin 30 portion located outside the frame is provided with an annular groove 34 around which is wrapped a portion of a tension coil spring 36 and has one end hooked to a hook 38 projecting from the groove 34 with its opposite end hooked to a punched out tab 102 on the rear wall of the frame 18 adjacent horizontally disposed slot 104. The frame also has a stop 106 which is punched out of its side wall at aperture 107 for extending into the path of movement of the adjacent portion of the tray rim 13 to stop the

tray rotation in a horizontal position in the direction of the turning force applied by the tension spring 36. The frame 18 also has a stop 108 which is punched out of its side wall and extends into the path of movement of the tray rim 13 in the direction opposite to the pull of the spring 36 to limit the inverting movement of the rear of the tray to about 122 1/2 degrees of rotation as explained in the above-mentioned Eyman, et al patent.

To further insure the complete ejection of all the frozen liquid from the tray 11 during the "second twist" a spring detent 110 is provided which comprises a leaf spring 112 secured on the inside of the frame 18 by a plastic spacer insert 114 and expanding screw 116. The leaf spring main portion extends at an angle of about 30 degrees toward the tray and terminates in a Z-shaped end portion 118. The tray 11 has a sharp rear corner 120 which is adapted to engage the Z-shaped end portion and to be held there about 15° in advance of the stop 108 until the rear corner 120 suddenly rides out of the Z 118 and under the resilient force provided by a 17° twist of the plastic tray accelerates into contact with the stop 118 to insure ejection of the ice pieces from the tray 11.

For accessibility, all the mechanism and controls for the ice maker are located at the front of the refrigerator freezer compartment with the tray rotating and twisting mechanism and control system being located in the rear housing 127 while the electric driving motor 129 and wiring are located in the front housing 131. Both of these housings are formed of suitable plastic material. Substantially the entire operating and control mechanism is mounted upon an irregular plastic upright dividing wall 133 which divides the interior of the housings 127 and 131 into a rear compartment 135 and a front compartment 137. The front compartment 137 contains the drive motor 129 having its final drive shaft extending through the dividing wall 133 and provided with a drive pinion gear 139 (not shown) on the opposite side which continuously meshes with a large driven gear 141 as shown in detail in the above-mentioned Eyman, et al patent.

As best seen in FIG. 4, the large gear 141 is provided with an eccentrically located crank pin, shown in phantom at 149, which extends into the elongated irregular loop 150 of the upright yoke 151 molded integrally with the horizontal rack bar 153. The yoke loop 150 forms cams which cooperate with the crank pin 149 to reciprocate the rack bar 153 in a manner similar to a Scotch yoke mechanism. As explained in the Eyman patent, the difference from a true Scotch yoke mechanism is that the surfaces of the yoke contacted by the crank pin 149 are not all perpendicular to the rack bar 153 and in particular the yoke includes a curved cam surface 155 in the side opposite the bar 153 and a curved and inclined surface 157 on the side adjacent the bar 153. The rack bar includes nine full teeth 159 adjacent to the yoke 151. Between the nine full teeth 159 and the yoke there is a single half tooth which is cut off substantially at the pitch line.

The rack bar 153 is slidably mounted in a horizontal groove 154 provided in the adjacent wall 128 of the rear housing 127. The rack bar 153 and its teeth 159 cooperate with an interrupted pinion 167, provided on the front end of a coaxial sleeve 169, which sleeve is rotatably mounted in a bearing provided in the rear housing 127. This sleeve 169 has a coaxial rearward hollow projection 173 provided with a flattened upper surface

which fits within a boss 175 located between the front pockets of the mold 11 and containing a recess receiving the projection 173. The rack bar 153 is held in engagement with the pinion 167 by an adjustable eccentric 177 contacting its bottom surface which may be rotated to maintain the teeth 159 in the proper meshing and contacting relationship with the teeth 179 and interrupted surface 183 on the pinion 167. The eccentric 177 is mounted upon and fastened in place by the screw 185 threading into the rear housing 127.

The crank pin 149, as explained in the Eyman patent, cooperates with the cam surface 155 to apply at the left end of its stroke through the rack bar 153 and the rack teeth a maximum torque for applying an initial reverse twist of about $17\frac{1}{2}^\circ$ to the front end of the tray 11, indicated in phantom at 187 in FIG. 5, and a subsequent inverting of the tray 11 until after 140° the rear of the ray 11 engages the stop 108 and rotation continues to finally twist the mold until it completes a $17\frac{1}{2}^\circ$ twist opposite to the initial twist.

A sensing arm holder member 200 includes a radially extending cam finger 201 and integral switch probe 202 positioned normal to the cam finger 201. The holder 200 has a hub 203 pivotally received in a circular opening in the base 128 of housing 127 and a forward shank 204 with a spindle 205 pivotally received in wall 133. A transverse bore extends through the hub 203 for receiving the outer radial end 211 of a sensing arm 210 and retained by an adjusting set screw 212. The rearward axial end 214 of the arm 210 is pivotally mounted in the rear side of the frame 18 by means of a clip 216 inserted in the aperture 109 such that the end 214 is in axial alignment with the hub 203. A removable retaining button 218 is inserted on the sensing arm free end 214 for permitting the removal thereof.

As seen in FIG. 4, as the rack bar 153 moves to the right it engages extended cam finger 201 portion of holder 200 and rotates the arm 210 and holder about 30° from its gravity biased solid-line position to its broken-line upper position. A flexible angled blade 206, retained on the base 128 by post 221, flexes to the right from its stop post 222 to its biased vertical free position away from spring biased switch operator means or detent button 207 of a reset and ice level micro switch 208. At the same time the ice tray 11 is rotated counterclockwise to its ice cube release position allowing the ice cubes to fall from the tray into the collecting bin 20.

As the rack bar 153 is moved to the left by means of the crank pin 149 and the yoke 151 arrangement, returning the tray to its horizontal position the sensing arm 210 is allowed to rotate by gravity in a downward arc into its solid line position in the bin 20. If the ice piece level in the bin has reached the maximum level the sensing arm 210 is stopped by the ice pieces, therefore preventing the sensing arm holder switch probe 202 from contacting and moving flexing blade 206 and depressing switch button 207 to its inner position and actuating the reset and ice level micro switch 208. Thus, the ice maker cannot now initiate a harvest cycle until the sensing arm 210 is allowed to lower or fall and actuate the switch 208. The ice maker can be manually reset when there is no water in the tray 11 or the tray thermostat is not sufficiently warmed up by raising the sensing arm 210 for about 15 seconds.

The circuit for the ice maker, partially shown in the FIG. 7 schematic, is carried on the mounting plate 133.

After the tray 11 has been filled hydraulic thermostatic switch 233, described in the Eyman patent, has its movable contact 234 close to its contact "I" on a rising predetermined water temperature, sensed by the end portion 285 of tube 287 of the thermostat at a temperature of about $19^\circ\text{F.} \pm 1^\circ\text{F.}$, which means that there is no continuity via line 235 from thermostat terminal contact "III" to movable contact 236 of reset and ice level switch 208, fixed switch contact 239, line 240 to post A of delay switch arm 252 rendering the motor circuit incomplete. When the ice pieces are frozen and the thermostat sensing tube drops to a predetermined temperature, which in the disclosed for is about $16^\circ\text{F.} \pm 10^\circ\text{F.}$, the thermostat movable contact 234 closes to fixed terminal contact III (cold position) initiating the ice harvest cycle.

The operation of a harvest cycle will now be described with the collecting bin 20 having a quantity of ice pieces less than its design maximum ice level indicated by dashed line 21 in FIG. 4. Thus, with the sensing arm 210 in its down position of FIG. 4, with room for more ice pieces in the bin, the button 207 of the ice level switch 208 in its depressed position with movable contact 236 contacting normally open contact 239 and normally closed contact 238 in its open position.

The commutator plate, shown at 250 in the wiring diagram of FIG. 7 and the cycle diagram of FIG. 8, is carried on the large gear 141 and driven directly off the motor pinion gear 139 as disclosed in detail by the Eyman patent. Thus, whenever the unidirectional electric motor 129 runs the commutator 250 must also rotate in a clockwise direction as viewed by the arrow in FIG. 8. With the commutator plate 250 in its harvest start position current from L_1 flows through the plate 250 to terminal post A via delay arm 252 and line 240 to the micro switch closed contact 239, movable contact 236 and line 235 to thermostat post "III", movable contact 234, line 247, motor 129, line 248 to post E and then to the line L_2 to start the motor 129. Shortly after the motor 129 starts the hold switch arm 254 contacts plate 250 to short out the thermostat switch 233 and the reset and ice level switch 208 so that the motor will continue to run irrespective of the condition of either switch 208 or 233.

At the same time the large gear crank pin 149 starts to move the rack bar 153 slightly to the left to reverse twist the tray 11 and then to the right as viewed in FIG. 4 engaging the cam finger 201 to pivot the sensing arm 210 to its raised dashed line position causing the micro switch button 207 to move out to place the micro switch 208 in its free state with movable contact 236 in its normally closed position contacting contact 238. As the cycle continues the ice is harvested into bin 20 and the tray 11 is returned to its upright position the fill switch arm 258 on post F contacts plate 250 to energize water fill solenoid 260 and fill tray 11 causing the thermostat movable contact 234 to close to its contact "I" or warm position. With the holding switch arm 252 having dropped off the plate 250 the circuit is now complete through the stop switch arm 256 and the motor runs about 5 seconds until arm 256 drops off plate 250 to complete the cycle.

The manual reset feature of the invention is provided when there is no water in the tray 11 or the thermostat 233 has not warmed up to the proper temperature. This is accomplished by manually raising the sensing arm for about 15 seconds placing the single pole-double throw

micro switch 208 in its free state with button 307 outwardly biased, i.e., with the movable contact 236 contacting normally closed micro switch contact 238 the motor 129 is energized which allows the stop switch arm 256 to drop off the commutator plate 250 and the delay switch arm 252 to remake contact with plate 250 so that the unit is ready for the next cycle with the thermostat still in its cold position.

As disclosed in U.S. Pat. No. 3,751,939., issued to J. A. Bright and assigned to the same assignee as the present application, the thermostat 233 could be of the gas operated type in which case a positive temperature coefficient thermistor heater 270 is positioned adjacent the bellows portion of the thermostat and provides a small amount of heat to insure the operating temperatures of the thermostat are controlled by the temperature of the thermostat sensing tube bulb rather than being controlled by the temperatures of the bellows casing. The heater 270 is connected by line 272 and arm 274 to line post D continuously closed to the commutator plate 250 and line 276 to line post E.

While the embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

I claim:

1. An automatic icemaker comprising a frame, means for rotatably mounting a mold on said frame including a rotatable support connected to one end of said mold, means for filling said mold with water for freezing the water in said mold, a pinion gear connected to said rotatable support, a horizontally disposed rack bar having driving means on one end thereof, said rack having a tooth portion adapted to engage said pinion gear, a drive motor for said rack bar driving means for rotating said pinion gear and inverting said mold whereby the frozen ice pieces are harvested from said mold and discharged into a receptacle, and a thermostatic switch in the control circuit of said drive motor, wherein the improvement comprises an ice level sensing arm, including a holder pivotally received on said frame, for movement between a gravity biased lower position in said receptacle and an elevated position above said receptacle; said holder including a cam means and an integral switch actuator, said switch actuator operative for tripping an operator of an ice level switch, in said control circuit, to a first normally open contact when said sensing arm is in its gravity biased lower position, said cam means positioned in the path of said rack bar when said mold is in its upright position, whereby upon said thermostatic switch closing to its ice harvesting contact, in response to the formation of ice in said mold, and said ice level switch in its tripped position being series connected with said thermostatic switch to energize said drive motor, the energizing of said drive motor causing said rack bar to be moved to its mold inverting position whereby it engages said cam means causing said holder and sensing arm to be pivoted through a predetermined angle to its elevated position.

2. An automatic icemaker comprising a frame, means for rotatably mounting a mold on said frame including a rotatable support connected to one end of said mold, means for filling said mold with water, means for freezing the water in said mold, a pinion gear connected to said rotatable support, a horizontally disposed rack bar having driving means on one end thereof, said rack having a tooth portion adapted to engage said pinion gear, a drive motor for said rack bar driving means for

rotating said pinion gear and inverting said mold whereby the frozen ice pieces are harvested from said mold and discharged into a receptacle, beneath said mold, a commutator driven by said drive motor, and a control circuit including a thermostatic switch and first and second commutator contact means, each said commutator contact means being connectable in series with said drive motor for the energization thereof, wherein the improvement comprises an ice level sensing arm, including a holder pivotally received on said frame, for movement between a gravity biased lower position in said receptacle and an elevated position above said receptacle; said holder including a cam means and an integral switch actuator, said switch actuator operative for tripping an operator of an ice level switch, in said control circuit, to a first normally open contact when said sensing arm is in its gravity biased lower position, said cam means positioned in the path of said rack bar when said mold is in its upright position, whereby upon said thermostatic switch closing to an ice harvesting contact, in response to the formation of ice in said mold, and said ice level switch in its tripped position being series connected with said thermostatic switch to complete a first circuit to said commutator first contact means to energize said drive motor, the energizing said drive motor causing said rack bar to be moved to its mold inverting position whereby it engages said cam means causing said holder and sensing arm to be pivoted through a predetermined angle to its elevated position, such that said switch actuator is disengaged from said ice level switch operator placing said ice level switch in its normally closed position completing a second circuit to said commutator second contact means to energize said motor and reset said commutator in the event said thermostatic switch remains closed to its ice harvesting contact position.

3. An automatic icemaker comprising a frame, means for rotatably mounting a mold on said frame including a rotatable support connected to one end of said mold, means for filling said mold with water, means for freezing the water in said mold, a pinion gear connected to said rotatable support, a horizontally disposed rack bar having driving means on one end thereof, said rack having a tooth portion adapted to engage said pinion gear, a drive motor for said rack bar driving means for rotating said pinion gear and inverting said mold whereby the frozen ice pieces are harvested from said mold and discharged into a receptacle beneath said mold, a commutator driven by said drive motor, and a control circuit including a thermostatic switch and first delay and second stop commutator contacts, each said commutator contact being connectable in series with said drive motor for the energization thereof, wherein the improvement comprises an ice level sensing arm, including a holder pivotally received on said frame, for movement between a gravity biased lower position in said receptacle and an elevated position above said receptacle; said holder including a radially extending cam finger and an integral switch actuator probe, said switch probe operative for depressing the button of an ice level and reset micro switch, in said control circuit, to a first normally open contact when said sensing arm is in its gravity biased lower position, said cam finger positioned in the path of said rack bar when said mold is in its upright position, whereby upon said thermostatic switch closing to an ice harvesting contact, in response to the formation of ice in said mold, and said

micro switch in its tripped position being series connected with said thermostatic switch to complete a first circuit to said commutator first delay contact to energize said drive motor, the energizing said drive motor causing said rack bar to be moved to its mold inverting position whereby it engages said cam finger causing said holder and sensing arm to be pivoted through a predetermined angle to its elevated position, such that said probe is disengaged from said ice level micro switch button placing said ice level switch in its nor-

mally closed position completing a second circuit to said commutator second stop contact to energize said motor and reset said commutator in the event said thermostatic switch remains closed to its ice harvesting contact, and whereby said icemaker can be manually reset by the operator raising the sensing arm to energize said motor and advance said commutator to its normal completed cycle position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,863,461
DATED : February 4, 1975
INVENTOR(S) : James A. Bright

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 58, "fram" should read -- frame --.

Column 4, line 13, after "disclosed" change "for" to -- form --;
line 27, "diamgram" should read -- diagram --.

Column 5, line 1, "307" should read -- 207 --;
line 29, after "water" insert -- , means --.

Signed and sealed this 27th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks