

Sept. 13, 1955

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2,717,501

ICE MAKER

Filed Dec. 10, 1952

4 Sheets-Sheet 1

Fig. 1.

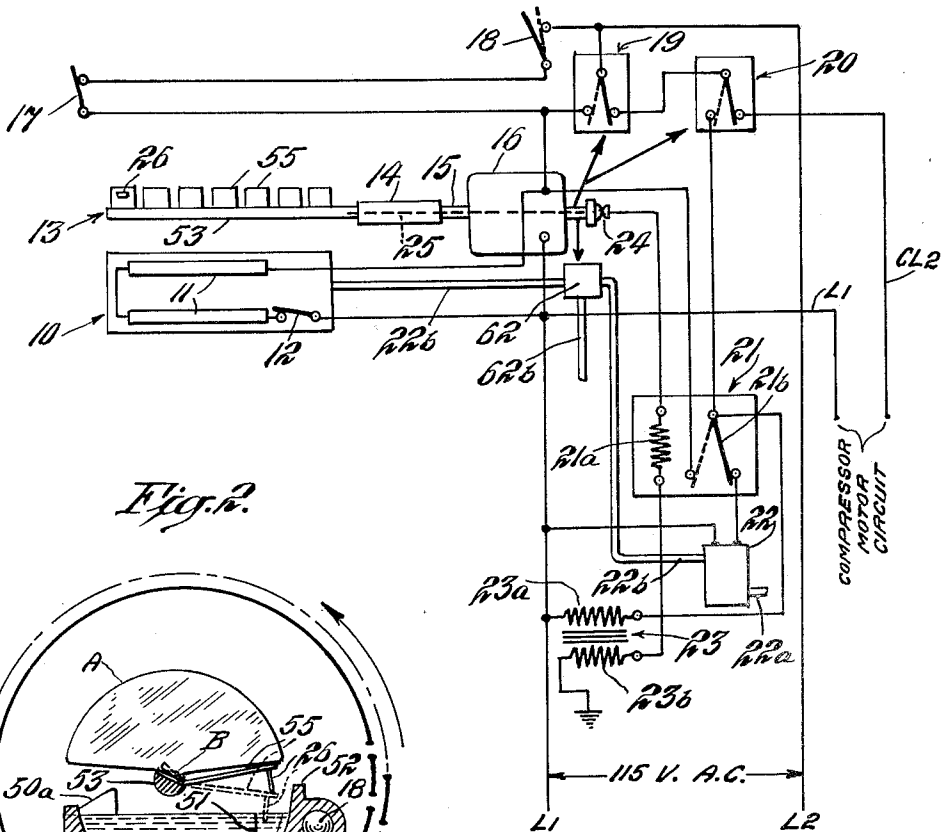


Fig. 2.

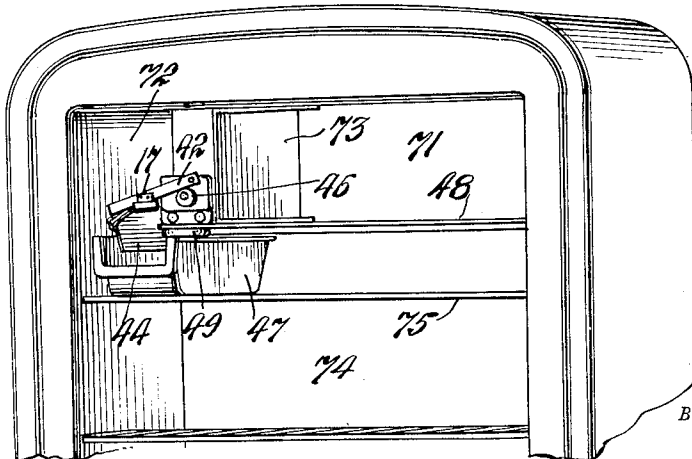
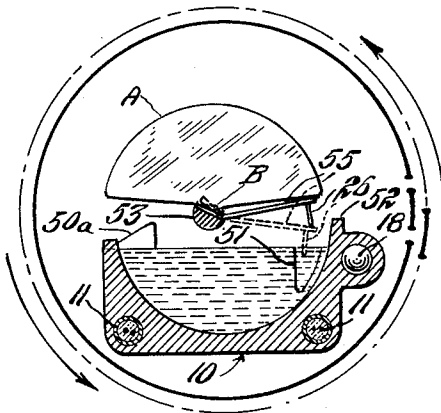


Fig. 3.

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Fig. 4.

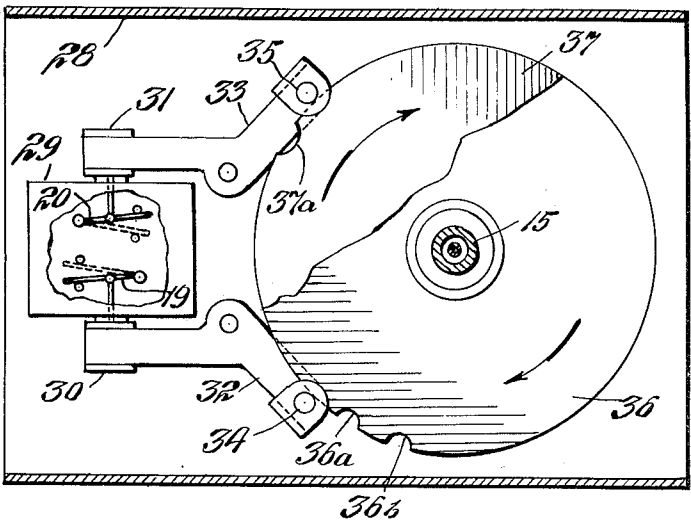
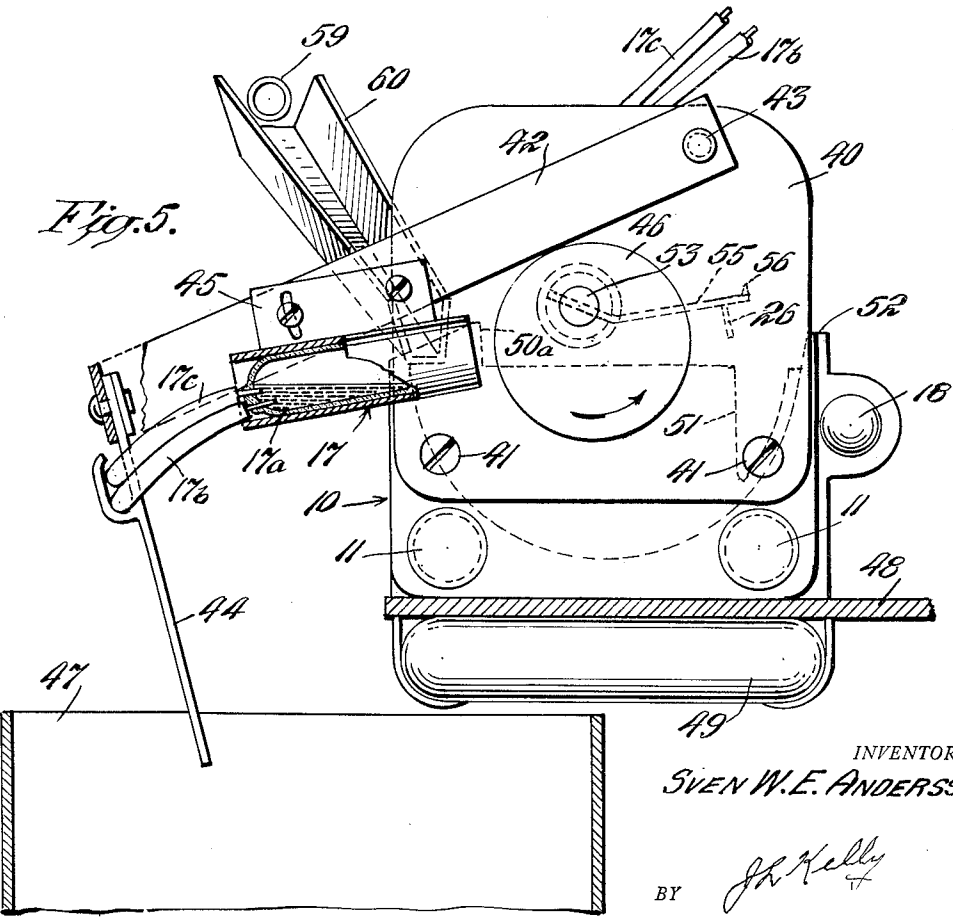


Fig. 5.



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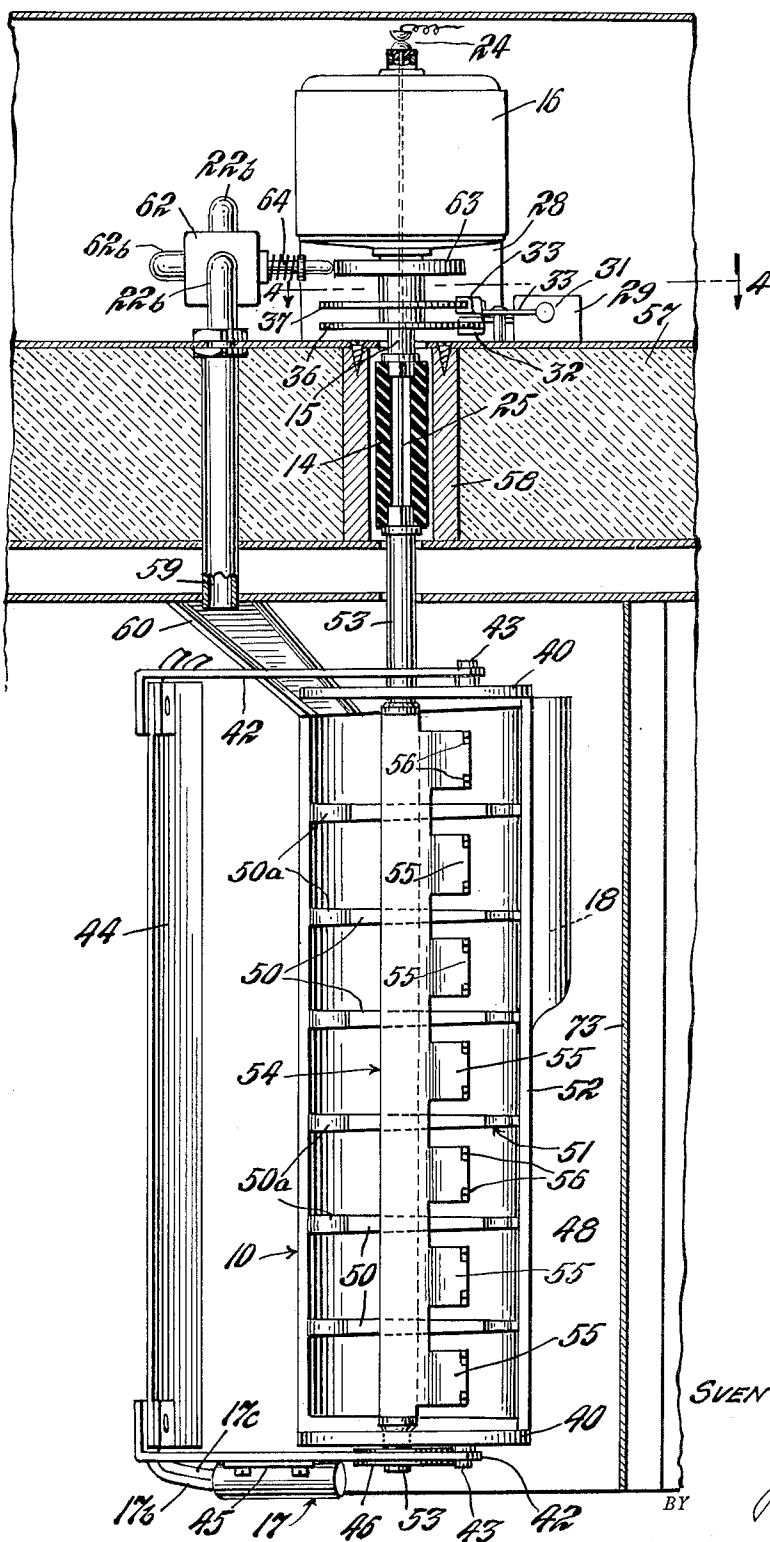


Fig. 6.

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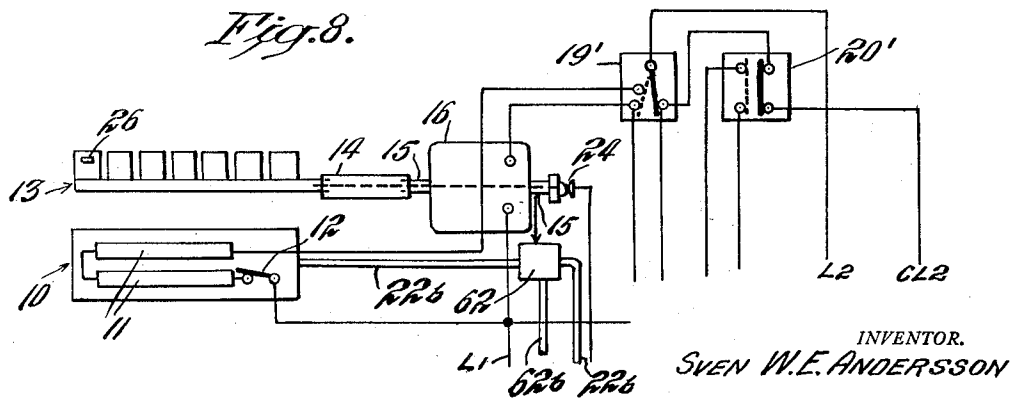
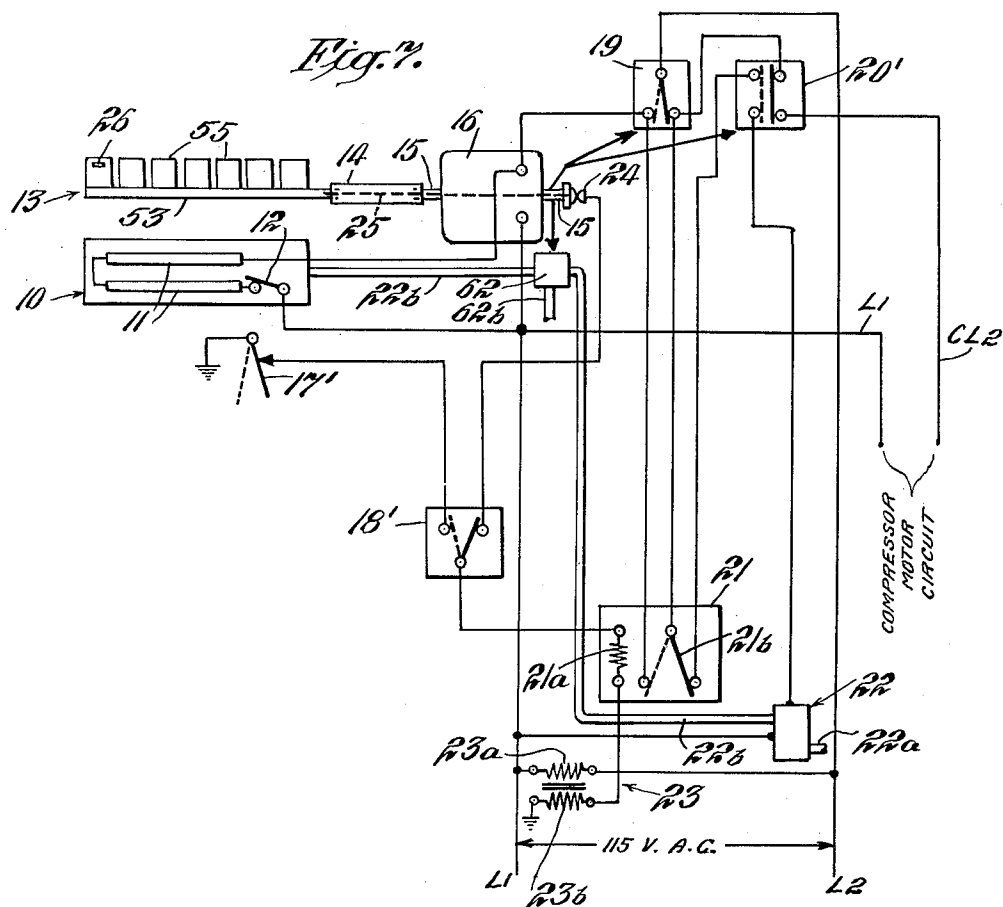
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2,717,501

ICE MAKER

Filed Dec. 10, 1952

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2,717,501

ICE MAKER

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Application December 10, 1952, Serial No. 325,145

27 Claims. (Cl. 62-7)

This invention relates to automatic making, harvesting, drying, and storing of ice pieces, generally called ice cubes.

This invention may be considered an addition and improvement to the ice maker disclosed and claimed in my copending patent application Serial No. 205,519, filed January 11, 1951.

Briefly my above copending application discloses an ice maker wherein an ice forming mold has a generally arcuate contour so that a piece of ice may be readily turned or swept from the mold by relative turning movement between the mold and the ice piece. The ice removing action is automatic, as is the filling of the mold, freezing, and loosening of the ice piece. The ice piece is detained for thorough drying before discharge to storage. The automatic operation is stopped short of discharge of ice to storage, and remains suspended during the time that a desired quantity of ice pieces is held in storage. In the specific structure disclosed in my above copending application, power for operating the ice release and the control mechanisms is provided by a hydraulic motor which also measures and delivers a quantity of water to the ice mold for freezing. The disclosure of my above copending application may be considered a part of this instant application and may be referred to for a detailed description of parts thereof that are common to the two patent applications.

In accordance with the present invention, a geared electric motor is used for operating the mechanism that automatically removes the ice pieces from the mold. This motor is of a type that stalls while energized when a given torque is applied to the output shaft thereof without burning out or otherwise harming the motor. As contrasted with a conventional motor, this motor is geared down from 3400 R. P. M. to approximately 2 R. P. M.

The particular stall motor used with this invention is known as a shaded pole motor; that is, the main winding is several thousand turns of fine wire and the starting winding is one or two shorted turns of $\frac{1}{8}$ " wire at 45° in the pole piece. This latter winding is commonly spoken of as the shading coil and gives the necessary phase displacement for the motor to start and run. Motors of this type are, in general, only about 10% efficient and they take almost exactly the same amount of current stalled as they do running. For that reason, it is possible to design a motor having enough iron and copper to dissipate the I²R losses. It doesn't follow however this is always done. It all depends on how much torque is needed. Motors of this type sometimes are protected with overload devices and sometimes not. The design of the stall motor makes it necessary to use a thermostat and not an overload operating on change in current. As a precaution in my particular installation, there may be incorporated a thermostat on the windings set at approximately 190° F. and which protects the winding itself.

The mold and ejector or conveyor mechanism used with my present invention is generally similar to that illustrated and described in my above copending application. Further, in accordance with this invention, I provide con-

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trol means whereby upon the freezing of the water in the mold a circuit is closed to the stall motor by a mold thermostat whereupon the motor turns the ejector mechanism through approximately 180 degrees of rotation until the ejector mechanism contacts the ice frozen in the mold which stalls the motor. The motor remains stalled though energized until such time as the ice has been thawed free of the mold surfaces by electric heating elements contained in the mold. Shortly after the stall motor begins its initial movement, a holding circuit is closed by a motor activated switch which maintains the motor and heating elements energized even though the original circuit be opened by the warming of the mold thermostat or the opening of a stop switch, to be referred to hereinafter.

After the ice has been thawed free of the mold, the motor and attached ejector mechanism resumes its turning until such time as the motor is stopped by the motor actuated switch mechanism just short of completing 360 degrees of rotation, which movement sweeps the ice from the mold. The switch mechanism that stops the motor near the end of an ejecting cycle also closes a circuit to a solenoid operated water valve whereby the valve is opened and water flows from a suitable source of supply to the ice mold. An electrode is located on the ejector mechanism in a manner that when the water reaches the desired level in the mold and contacts the electrode, a low voltage circuit to a sensitive relay is closed, which relay opens the circuit to the solenoid valve, thereby closing such valve and stopping the flow of water to the mold. With the closing of the relay circuit, the motor circuit is again closed whereupon the motor and attached ejector mechanism continues to turn to complete the 360 degrees of rotation. The motor and ejector mechanism is then stopped in this latter position with the ice coming to rest on the ejector mechanism and a new freezing cycle is started. The ice that is held on the ejector mechanism is dried during the next freezing cycle and is discharged into an ice receptacle at the beginning of the next release cycle.

The invention, together with its objects and advantages, is set forth in more technical detail in the following description and accompanying drawings, wherein:

Fig. 1 is a wiring diagram for the controls for my ice maker;

Fig. 2 is a vertical section of the ice mold and ejector mechanism and showing the action of certain switches relative to the ejector mechanism.

Fig. 3 is a perspective of a portion of a refrigerator showing one installation of my improved ice maker.

Fig. 4 is an enlarged section taken substantially on line 4-4 of Fig. 6, looking in the direction of the arrows, and showing a portion of the switch mechanism;

Fig. 5 is a front elevation of the ice maker partly in section;

Fig. 6 is a top plan, partly in section, of the ice maker;

Fig. 7 is a wiring diagram, similar to Fig. 1, but showing modified controls for the ice maker; and

Fig. 8 is a part of the wiring diagram of Fig. 7, showing another modification of the controls.

In Fig. 1 there is shown a wiring diagram wherein 10 represents an ice mold with built-in heaters 11 and a high temperature limit switch 12. 13 indicates an ejector mechanism which is connected by an insulating coupling 14 to the shaft 15 of a geared stall motor 16. A line voltage stop switch and a mold thermostat are shown as 17 and 18, respectively. The mold thermostat 18 may be provided with an ambient temperature compensator, not shown. Two switches 19 and 20 are operated by the motor shaft 15, as indicated by the arrows and may be built into the motor 16. The motor 16 is equipped with an automatic brake for instant stopping,

when deenergized, and the output shaft 15 is accessible from both ends to facilitate the mounting of the switch operating mechanism. 21 is a sensitive relay and 22 is a normally closed two-way solenoid water valve, having an inlet conduit 22a leading thereto from a source of supply and an outlet conduit 22b leading therefrom to the ice mold 10. The coil 21a of relay 21 is connected as shown to the grounded secondary 23b of a small step-down transformer 23. The transformer provides a reduced voltage for an electrode circuit to satisfy code requirements, and it also isolates this grounded circuit so that the polarity of the supply wires L1 and L2 becomes immaterial. The electrode circuit comprises the grounded secondary 23b of the transformer, the coil 21a of the relay, a rotary contact 24 on the rear end of the motor shaft 15, and an insulated wire 25 that extends from this contact through the hollow shaft of the motor and coupling 14 to the shaft of the ejector 13. As an alternative, the relay coil could obviously be connected by a separate wire to a contact riding on the ejector shaft. The electrode proper may be an ear or tab 26 attached to the ejector 13 as indicated in Fig. 2, which shows the ejector mechanism and ice mold in cross section. The electrode 26 becomes grounded through the water when the mold 10 is being filled, as described hereinafter.

Any suitable refrigerating system may be used for freezing the water in the mold. When the ice maker is applied to a compressor operated refrigerator, it may be desirable and advisable to prevent compressor operation during periods when ice is being released from the mold so that the mold heaters do not have to buck the refrigerating effect of such system. A circuit is therefore provided for the compressor motor which is energized at all times except during the release periods. As shown in Fig. 1, the compressor motor circuit is connected between the wires L1 and CL2. From the wiring diagram, it will be seen that the wire CL2 is not energized or connected to L2 except when both switches 19 and 20 are in their full drawn positions. This occurs only after the ice has been released from the mold but never during the release process. Should the ice maker be applied to a heat operated refrigerating system, and should it be desired that operation of such system be interrupted during the release periods, the heat source to the system may be controlled by the circuit that includes the wires L1 and CL2. For example, the fuel supply to a burner or the electric supply to a heating element may be controlled by the circuit which includes the wires L1 and CL2.

Fig. 4 illustrates a manner of operating the switches 19 and 20 from the motor shaft 15. The switch operating mechanism is suitably mounted within a housing 28 and includes a switch box 29 having a pair of spring pressed plungers 30 and 31 projecting therefrom and connected at one end to the switches 19 and 20, respectively. The opposite ends of the plungers are connected to pivotally mounted bellcranks 32 and 33. The free ends of the bellcranks are provided with rollers 34 and 35, which rollers ride upon the circumference of a pair of circular cams 36 and 37, respectively. The cam 36 is provided with two arcuate notches 36a and 36b, and the cam 37 is provided with a single but longer arcuate notch 37a. The arrangement is such that, upon rotation of the cams 36 and 37 by the motor shaft 15, the rollers 34 and 35 when riding upon the circumference of the cams hold the switches 19 and 20 in the dotted position of Figs. 1 and 4, and when the rollers are in the notches 36a and 36b of cam 36 and 37a of cam 37 the switches 19 and 20 are in the full drawn position of Figs. 1 and 4. The full line position of the switches 19 and 20 shown in Figs. 1 and 4 is their normal position during freezing cycles of operation. However, for clarity of illustration, the bellcranks 32 and 33, the rollers 34 and 35 and the cams 36 and 37

are shown in the respective positions they occupy near the end of an ice ejecting cycle.

Referring now to Fig. 5, the ice mold 10 is shown in elevation with the stop switch 17 movably mounted thereon. Mounting plates 40, made of plastic or other suitable insulating material, are attached to each end of the ice mold, as by screws 41. A pair of arms 42 (Figs. 5 and 6) are pivotally mounted at one end upon the mounting plates 40 by pivot pins 43, and at their opposite ends, the arms support a stop vane 44. The stop vane extends throughout the length of the ice mold at the left side thereof. The stop switch 17 comprises a conventional mercury switch 17a attached to the front arm 42 by an adjustable bracket 45. A circular cam 46 is eccentrically mounted upon the front end of the ejector shaft 53, and upon rotation of such shaft the arms 42 and the attached switch 17 and stop vane 44 are raised and lowered. An ice receptacle 47 is located below the ice maker to receive ice therefrom. The arrangement is such that the stop vane 44 is moved out and up at the beginning of a release cycle so that a previously frozen and dried batch of ice resting on the ejector blade may slide therefrom into the ice receptacle below the stop vane, and when the receptacle becomes filled with ice, the stop vane 44 is blocked by the ice and cannot return to the position shown in Fig. 5, whereupon the mercury switch 17a is held open and the ejector motor is stopped at the end of an ejecting cycle and until such time as ice is removed from the receptacle and the stop vane resumes the position shown in Fig. 4. The ice mold 10 is mounted in good thermal contact upon a freezing plate or shelf 48, which plate is cooled by a suitable freezing coil 49.

The ice mold 10 and ejector mechanism 13 are shown in detail in Fig. 6. The ice mold comprises an aluminum die casting that is adapted to rest upon the freezing shelf 48. The interior of the mold is arcuate or semi-circular in cross-section and is divided into a plurality of compartments by tapered transverse partitions 50. As shown, the partitions are tapered from the left to the right side of the mold and are each provided with a slot or weir 51, as best shown in Figs. 2 and 5. The slots 51, which provide for flow of water from one compartment to another when filling the mold, are particularly shaped and located at the right side of the partitions so as to allow the ice to be easily swept from the compartments. Also, these slots provide bridge members of ice for connecting the individual ice pieces into a unit. The inside of the end walls of the mold slant outward from left to right. The ice mold is provided with an upstanding edge 52 on its right side, and the partitions 50 are each provided with an upstanding projection 50a at their left side. As shown in Fig. 6, the ice mold compartments are larger on the right side of the mold than on the left side thereof. With this arrangement the ice pieces, once they have been thawed free of the partitions and mold surfaces, are readily turned in the mold and swept therefrom by the ejector mechanism. The electric heating elements 11 are located in holes in the bottom longitudinal edges of the mold and the thermostat 18 is located in an opening in the upper right corner of the mold, as best shown in Figs. 2 and 5. During a freezing cycle the temperature of the mold in the vicinity of the thermostat 18 remains around 32° F., but this temperature drops quickly when the freezing is completed. When the temperature of the thermostat falls to a desired low its electric contacts close which in turn closes the circuit to the motor 16 and starts an ice ejecting cycle.

The ejector mechanism 13 includes a shaft 53 that is milled flat on its upper side throughout a portion of its length, as shown in Fig. 2. The shaft 53 is mounted for counterclockwise rotation in bearings in the insulated mounting plates 40 at each end of the mold. A blade 54 provided with a plurality of tabs or fingers 55, one for each ice mold compartment, is welded or otherwise

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secured to the flat portion of the shaft 53. In order that the ice may be turned out of the mold and come to rest on top of the blade 54, the ejector shaft 53 is located off center relative to the longitudinal axis of the mold, and in order to provide for the upwardly projecting tips B that form on the top center portion of the ice pieces in freezing, the blade 54 is bent in the manner shown in Figs. 2 and 5. As an aid in removing the ice from the mold and to provide only point and line contact between the ice and the ejector, the tabs or fingers 55 are each provided with a pair of teeth 56 (Figs. 5 and 6) at their outer edges. As stated above, the cam 46 which operates the stop switch 17 and vane 44 is mounted on the front end of the ejector shaft 53. The rear end of the ejector shaft 53 is connected to the motor shaft 15 by the insulating coupling 14. As shown in Fig. 6, the coupling 14 is located in the rear wall 57 of the refrigerator in which the ice maker is located. The coupling 14 is surrounded by a wooden block 58 which acts as a guide and support and also protects the insulator in the rear wall 57.

The ejector motor 16 and housing 28 which contains the mechanism for operating the switches 19 and 20 are mounted in any suitable manner on the rear wall 57 of the refrigerator. As shown in Fig. 6, the conduit 22b which leads from the water valve 22 to the ice mold is provided with an extension 59 that passes through the rear wall 57 and discharges into a trough 60 which in turn discharges into the rear compartment of the ice mold. So that water will not be trapped in the extension 59 and trough 60, and be frozen therein and block passage therethrough, each of these elements slopes downward toward the ice mold and each is constructed of plastic or other suitable heat insulating material. Also, the extension 59 is of much larger diameter than the water conduit 22b.

Due to the fact that some movement of the motor shaft 15 and connected mechanism takes place after the ice mold is filled with water and just before a freezing cycle begins, as described hereinafter, this movement is used to operate, for example, a small, three-way valve 62 for closing the water line 22b leading from the solenoid valve 22 and for opening at the same time a drain 62b for this water line leading to the ice mold. As indicated by the arrow in Fig. 1 and as shown in Fig. 6, an additional cam 63 is mounted on the motor shaft 15 in a manner to operate a spring-pressed plunger 64 so as to place the three-way valve 62 in position to open the water line 22b between the solenoid valve 22 and the ice mold and to close the drain 62b during the filling of the mold, and to close the line 22b and open the drain line 62b during the freezing period. In this way, there is an electrical and a mechanical valve in series in the water line leading to the mold. Thus, any small leakage past both the valves 22 and 62 during a freezing period will flow through the drain 62b for disposal in any suitable manner and will not flow through the inlet extension 59 to the mold, which would become plugged due to freezing of this water. It is not advisable to eliminate the solenoid valve 22 and depend entirely on a motor operated valve 62, because only the former will close automatically in case of current failure during a filling period or whenever the current is shut off manually for some reason.

Fig. 3 of the drawing shows the ice maker located in a modern household refrigerator 70. The refrigerator includes a freezing compartment 71, an ice making compartment 72, separated from the freezing compartment by a partition 73, and a food storage compartment 74. The freezing plate 48 having the freezing coil 49 attached thereto, separates the compartments 71 and 74 and supports the ice maker in the compartment 72. The ice receptacle 47, which should be kept at a temperature below freezing, is supported on a conventional refrigerator shelf 75 directly below the freezing coil 49, and, if desired, this receptacle may be insulated from the air in the food storage compartment 74. Only so much of the ice maker

as is necessary to show its location in the refrigerator is included in Fig. 3 of the drawings.

In operation, during an ice freezing period all switch contacts remain in the full drawn positions shown in Fig. 1, provided the ice receptacle 47 (Fig. 5) is not yet filled with ice so that the stop switch 17 is closed. When the mold thermostat 18 then closes its contacts upon completion of the freezing, current can flow from L2 through switches 18 and 17 and in parallel through the motor 16 and heaters 11 of the ice mold 10 to L1. The motor 16 then starts turning so that a previous ice batch A, which has been held and dried on top of the ejector blade, is thrown off into the ice receptacle 47 while the heaters 11 start warming up the ice mold. Soon after the start of the motor, the roller 34 on bellcrank 32 leaves the notch 36b and rides upon the circumference of the cam 36 (Fig. 4) and the switch 19 snaps to the dotted position (Fig. 1) to provide a bypass or holding circuit around the stop switch 17 and thermostat 18 to maintain the circuit closed, even though both switches 17 and 18 may open. The ejector therefore continues turning until the fingers 55 encounter the ice frozen in the mold whereupon the ejector motor 16 is stalled. The motor 16 then remains stalled, though energized, until the applied heat from the heating elements 11 has loosened the ice in the mold so that the turning movement can be resumed. The high temperature switch 12 is a thermostatic device which opens the heater circuit at about 100° F., and opens only in the event that the mold heaters are energized too long due to something having gone wrong with the controls.

Shortly before the final position of the ejector shaft has been attained, the roller 34 on bellcrank 32 passes into the notch 36a (Fig. 4) on the cam 36 and the switch 19 snaps to the full-drawn position which deenergizes the motor and the mold heaters so that the ejector blade 55 comes to a temporary stop in the dotted position shown in Fig. 2. The roller 35 on bellcrank 33 has passed into the notch 37a on cam 37 and the switch 20 has snapped to its dotted position (Fig. 1) somewhat earlier so that a circuit is completed from L2 through switches 19 and 20 to the switch 21b of the relay 21 and from there directly to the primary 23a of the transformer and to L1. Another branch circuit is formed through the normally closed contacts of switch 21b of the relay to the water valve 22 and to L1. The water valve consequently opens to admit water to the ice mold. Simultaneous with the opening of the water valve 22, the valve 62 is shifted so that now the conduit 22a is placed in open communication with the mold and the drain 62b is closed. When the water level in the mold reaches the electrode 26 (broken line position Fig. 2) on the ejector blade, the coil 21a of the relay becomes energized so that the switch 21b snaps over to the dotted position (Fig. 1). This shuts off the water valve 22 and transfers the circuit to the motor 16. When the motor starts turning, the roller 34 on bellcrank 32 (Fig. 4) leaves the notch 36a and rides upon the circumference of the cam 36 which causes the switch 19 to snap to its dotted position and the roller 35 on bellcrank 33 leaves the notch 37a on cam 37 and the switch 20 snaps to its full line position. Also, the cam 63 operates the plunger 64 (Fig. 6) to shift the valve 62 back to its position whereby the water line 22b is closed and the drain line 62b is open. The ejector motor continues to run until the roller 34 again passes into the notch 36b and the switch 19 snaps back to its full-drawn position, whereupon the motor 16 is deenergized and the ejector comes to rest in its normal or freezing position with the ice batch resting thereon, as shown in full lines in Fig. 2. Both of the switches 19 and 20 are now in their full drawn positions (Fig. 1), the compressor motor circuit is closed through wire L2, switch 19, switch 20, wire CL2, the compressor motor (not shown) and wire L1, and another freezing period begins. The electrode 26

is then well above the water, as shown in full lines in Fig. 2, which prevents it from being frozen into the ice. The two circles drawn around Fig. 2 indicate more clearly the action of the motor operated switches 19 and 20 in relation to the position of the ejector blade 54. The full drawn portions of the inner circle show during which parts of a full turn of the motor that the switch 19 is in its dotted position, and the full drawn portion of the outer circle shows when the switch 20 is in the dotted position.

During an ice release operation, as the fingers 55 on the ejector blade pass through the mold compartments and sweep the ice therefrom, the teeth 56 on the outer corners of the fingers bite into the surface of the ice and bring the ice to rest in an upside-down position for drying on top of the ejector, as shown in Fig. 2. The edge 52, along the upper right side of the mold, aids in this movement. It is to be noted that the surface of the ice that contacts the ejector blade is dry when the ice is swept from the mold—this being the top surface during the thawing and therefore not wetted by the thawing—and the ice does not stick to the ejector during the drying period of that batch of ice, which is the freezing period of a subsequent batch. However, should there be some adhesion between the ice and the ejector, as by an accumulation of frost due to prolonged standing, the bond between the ice and the ejector is readily broken at the beginning of the next release cycle. That is, since the mold compartments are tapered from left to right, as viewed in Figs. 2 and 5, the left bottom surface of the ice in the upside-down position is of greater extent than the spacing of the partitions 50 and of the projections 50a on the left side of the mold. Therefore, at the beginning of a release cycle the left bottom surface of the ice particles, as viewed in Figs. 2 and 5, will contact the projections 50a which causes the ice to be stripped or peeled from the ejector and be guided into the receptacle 47 located therebelow. The projections 50a may be omitted. In which case, the left bottom surface of the ice will contact the left upper portions of the partitions 50 and be stripped from the ejector, as before.

In the wiring diagram in Fig. 7 the same reference characters are used to designate the same parts, and prime reference characters are used to designate parts similar to those of Fig. 1. As in Fig. 1, 10 represents the ice mold with built-in heaters 11 and a high temperature limit switch 12. 13 indicates the ejector mechanism, which is connected by the insulating coupling 14 to the shaft 15 of the stall gear motor 16. A stop vane arrangement and low voltage stop switch is shown at 17'. A mold thermostat 18' with ambient temperature compensation of the setting operates a single pole, double throw switch, as indicated. The switches 19 and 20' are operated by the motor shaft 15, as indicated by the arrows, and may be built into the motor 16. 21 is the sensitive relay, and 22 is the normally closed two-way solenoid water valve. The coil 21a of the relay 21 is connected, as shown, to the grounded secondary 23b of the small step-down transformer 23. As in Fig. 1, this transformer 23 of Fig. 7 provides a reduced voltage for the coil circuit to satisfy code requirements, and it also insulates this grounded circuit so that the polarity of the supply wires L1 and L2 becomes immaterial. From the grounded secondary of the transformer 23, the relay energizing circuit proceeds through the coil 21a of the relay to the common contact on the mold thermostat 18'. If the thermostat contacts are in the dotted position, the circuit is completed through the stop switch 17' to the grounded stop vane; but if the contacts are in the full-drawn position, the circuit instead proceeds through the rotary contact 24 on the rear end of the motor shaft 15 and the insulated wire 25 from this contact through the hollow motor shaft 15 and coupling 14 to the ejector shaft 53. On one of the fingers 55 of the ejector blade is an electrode surface 26 which becomes

grounded through the water when the ice mold is being filled as described in connection with Fig. 1.

It will thus be seen that the sensitive relay 21 that is used in Fig. 1 near the end of a release period in connection with the operation of the solenoid valve 22 for filling the ice mold, is used also in Fig. 7 for starting the ejector motor at the beginning of a release period. This is accomplished by controlling the relay circuit by the mold thermostat and by a simple low-voltage contact operated by the stop vane 44. In this manner, the need for a completely waterproof line voltage stop switch as used in Fig. 1 is eliminated.

As in Fig. 1, during an ice freezing period all switch contacts remain in the full-drawn position, as shown in Fig. 7, provided the ice receptacle 47 is not yet filled so that the stop switch 17' is closed. When the mold thermostat 18' then snaps to the dotted position upon completion of the freezing, the relay coil 21a becomes energized and its switch 21b moves to the dotted position. Current can now flow from L2 through switches 19 and 21b and in parallel through the motor 16 and the mold heaters 11 to L1. The motor then starts turning so that the previous ice batch on top of the ejector blade is thrown off into the ice receptacle while the heaters 11 start warming up the ice mold. Switch 19 now snaps to the dotted position and provides a by-pass or holding circuit around the relay contacts to maintain the motor and heater circuit closed even though the relay coil 21a may be de-energized and snap the switch 21b to its full-drawn position due to the opening of the stop switch 17' and the warming up of the thermostat 18'. The ejector shaft 53, therefore, continues turning until the fingers on the ejector blade encounter the ice frozen in the mold. The motor then remains stalled, though energized, until the heat has loosened the ice so that the turning can be resumed. Shortly before the final position of the ejector has been attained, the switch 19 snaps to the full-drawn position, which deenergizes the motor and the mold heaters so that the ejector come to a stop. The switch 20' has moved to the dotted position somewhat earlier so that a circuit is completed from L2 through switch 19, relay 21 and switch 20' to the water valve 22 and L1. The valve consequently opens to admit water to the ice mold. When the water level in the mold reaches the electrode 26 on the ejector finger, the relay coil 21a becomes energized because the contacts of the thermostat 18' are now in the full-drawn position due to the higher temperature of the mold. When the relay switch 21b therefore snaps to the dotted position, this shuts off the water valve 22 and transfers the circuit to the motor 16. When the motor start turning, switch 19 snaps to its dotted position and switch 20' snaps to its full position simultaneously or shortly thereafter. The motor keeps running and the mold heaters are on until the switch 19 moves back to its full-drawn position when the ejector has attained its normal position. The electrodes 26 are then well above the water, and another freezing period begins. As in Fig. 1, the compressor motor circuit is closed when both of the switches 19 and 20' are in their full-drawn positions, and this occurs only when the circuit to the mold heating elements 11 is opened.

An alternate circuit is shown in Fig. 8 wherein the switch 19' is provided with an additional contact and with a separate wire leading therefrom to the heating elements 11 of the ice mold 10. When this connection is used the contact of the switch 21b of relay 21 need carry only the motor current, and the mold heaters 11 are not energized until the switch 19' snaps to its dotted position, which happens soon after the motor has started a release cycle. In either case the switch 19 or 19' when in dotted position provides a by-pass or holding circuit around the relay contacts to maintain the motor and heater circuits closed even though the relay 21 may be deenergized due to the opening of the stop switch 17' and to the warming up of the thermostat 18'.

The construction and operation of ice mold, the ejector

mechanism, the switch operating mechanism and the stop switch, shown in detail in Figs. 2 to 6, inclusive, except as pointed out above, are the same when used with the controls of Figs. 7 and 8 as with Fig. 1. Therefore, further description of these elements is deemed unnecessary.

With further description it is thought that the features and advantages of the invention will be readily apparent to those skilled in the art to which this invention appertains, and it will, of course, be understood that changes in form, proportions and minor details of construction may be resorted to without departing from the spirit of the invention and scope of the claims.

What is claimed is:

1. An ice maker comprising an ice mold having a generally arcuate contour, a freezer for congealing water in the mold, means for loosening an ice piece formed in the mold, power mechanism including an electric motor operative when energized to cause relative turning movement between the mold and the ice piece formed therein to remove the ice piece from the mold, said electric motor being so constructed and arranged as to stall while energized pending the loosening of the ice in the mold and to cause the relative turning movement immediately the ice is loosened, and a control device operative responsive to the formation of the ice piece to instigate operation of the power mechanism.

2. An ice maker comprising a mold having a generally arcuate contour, a freezer for congealing water in the mold, means for loosening an ice piece formed in the mold, a conveyor having a rotatable member for engaging and removing the ice piece from the mold, an electric motor for operating the conveyor, means operative responsive to the formation of the ice piece to instigate operation of the loosening means and motor, and said electric motor being so constructed and arranged as to stall while energized upon initial engagement of the conveyor with the ice piece to temporarily discontinue operation of the conveyor pending the loosening of the ice piece in the mold and to move the ice piece from the mold immediately the ice is loosened therein.

3. In an automatic ice maker, an ice mold, means for filling the mold with water to be frozen, means for freezing the water into ice in the mold, and means for removing the ice from the mold, said last-named means including an ejector mechanism movable into and out of the mold, an electric motor for operating said ejector mechanism, and control means for energizing and deenergizing said motor, said control means including means operative responsive to the formation of ice in said mold for energizing said motor, means operative responsive to rotation of said motor for operating a second energizing means for said motor, means for loosening the ice in the mold, said electric motor being so constructed and connected to the ejector mechanism as to stall while energized upon contact of the ejector mechanism with ice frozen to the mold and to move the ice from the mold immediately the ice is loosened therein, and means operative responsive to a predetermined movement of the ejector mechanism for stopping the motor.

4. In an automatic ice maker, an ice mold, means for filling the mold with water to be frozen, means for freezing the water into ice, and means for removing the ice from the mold, said filling means including a member so positioned relative to the mold as to be contacted by water upon filling the mold, and said member being operable responsive to the filling of the mold for discontinuing the filling and for removing said member from contact with the water in the mold.

5. In an automatic ice maker, an ice mold, means for filling the mold with water, means for freezing the water into ice, and an ejector for removing the ice from the mold, said filling means including a member so positioned relative to the mold as to be contacted by water upon filling the mold, and means operable after the mold

is filled for changing the position of said member relative to a surface level of water in the mold.

6. An automatic ice maker as set forth in claim 5 wherein said member is moved from contact with the water in the mold responsive to the filling of the mold.

7. An automatic ice maker as set forth in claim 5 wherein said member includes an electrode mounted on the ejector for movement into and out of the mold, and wherein said electrode is stopped within the mold during the filling thereof and is moved above the water level in the mold responsive to the filling of the mold.

8. In an automatic ice maker, an ice mold, means including a conduit having a first valve therein for filling the mold with water, means for freezing the water in the mold and an ejector for removing the ice from the mold, said ejector having means thereon for opening said valve for flow of water to the mold, a member so positioned relative to the mold as to be contacted by water in the mold to close said valve, and means for moving said member from contact with the water in the mold.

9. An automatic ice maker as set forth in claim 8 wherein said conduit includes a drain and means operable responsive to movement of the ejector for opening the drain after the mold has been filled.

10. An automatic ice maker as set forth in claim 8 wherein said conduit includes a second valve and a drain connected thereto, and means operable responsive to movement of said ejector for opening said first valve and closing said second valve for flow of water to the mold and for closing the first valve and opening the second valve for flow of water to the drain.

11. In an automatic ice maker, an ice mold, a water conduit having means therein for filling the mold, refrigerating means for forming ice in the mold, heating means for thawing the ice free of the mold, ejecting means for removing the ice from the mold, and control means for operating said filling, refrigerating, heating and ejecting means in sequence, said control means including a first electric switch operable responsive to the formation of ice in the mold for starting the ejector and heating means, a second electric switch movable to one position by the ejector mechanism for continuing operation of the ejector and heating means and for discontinuing operation of the refrigerating means regardless of the position of the first switch, means operable responsive to movement of the ejector after removing ice from the mold for opening said filling means, and said second electric switch being movable to a second position by the ejector mechanism for discontinuing the operation of the ejector and for resuming operation of the refrigerating means.

12. In an automatic ice maker, an ice mold, a water conduit having a valve therein for filling the mold, refrigerating means for freezing the water in the mold, heating means for thawing the ice free of the mold, ejecting means including an electric motor for removing the ice from the mold, and control means for operating said filling, heating and ejecting means in sequence, said control means including a first electric switch operable responsive to the freezing of ice in the mold for starting the ejecting and heating means, a second electric switch movable to one position by the ejector for continuing operation of the ejector and heating means regardless of the position of the first switch, a third electric switch operable responsive to movement of the ejector after removing ice from the mold for opening said water valve, and a fourth electric switch operable responsive to the filling of the mold for closing the water valve and for resuming operation of said ejector.

13. In an automatic ice maker, an ice mold, means for filling the mold with water, refrigerating means for freezing the water into ice in the mold, means for loosening the ice in the mold, means for conveying the ice from the mold, and control means for operating said filling, loosening and conveying means in sequence, said control means including a first electric switch operable responsive to the

formation of ice in the mold for starting said conveying and loosening means, a second electric switch operable responsive to movement of said conveyor for continuing the operation of the conveying and loosening means even though the first switch be open, a third electric switch operable by movement of said conveyor for operating the mold filling means upon removal of ice from the mold, a low voltage circuit, and means operable responsive to the filling of the ice mold for closing said low voltage circuit to thereby discontinue the operation of said filling means and resume the operation of the said conveying means, and means for stopping said conveyor in a predetermined position with the ice resting thereon.

14. In an automatic ice maker, a cooling element, an ice mold mounted on said cooling element, means for filling said mold with water to be frozen, an ejector mechanism for conveying the frozen contents from the mold, said ejector mechanism including a rotatable shaft mounted above said mold and having members thereon movable into and out of the mold in one direction of movement, a motor for rotating said shaft, and control means for energizing said motor, said control means including a first electric circuit having a first electric switch operable responsive to the temperature of said mold for closing said first circuit, a second electric circuit for said motor, a second switch in said second circuit operable by said motor for holding said second circuit closed even though the first circuit be open, a third electric circuit, a third electric switch in said third circuit operable by said motor, an electrically operated water valve in said third circuit for controlling the flow of water to the ice mold, a low voltage circuit for opening said third electric circuit and thereby close said water valve, and means operable responsive to the flow of water to the ice mold for energizing said low voltage circuit.

15. In an automatic ice maker, an ice mold, means including a conduit having a valve therein for filling the mold, means for freezing the water in the mold, means for thawing the ice free of the mold, means for removing the ice from the mold, means for storing the ice removed from the mold, and control means for operating the filling, freezing, thawing, removing and storing means, said control means including a first electric circuit closed by the formation of ice in the mold for energizing the thawing and the removing means, a second electric circuit closed by movement of the removing means for continuing the thawing and removing means energized even though the first circuit be open, a third electric circuit closed by movement of the removing means for opening the water valve for flow of water to the mold, a fourth electric circuit closed by the filling of the mold for closing the water valve and for resuming operation of the removing means, and a fifth electric circuit closed by movement of the removing means for energizing the freezing means and for deenergizing the thawing and the removing means.

16. An ice maker as set forth in claim 15 wherein the removing means is operated by an electric motor which tops turning while energized upon contact of the removing means with the ice frozen in the mold and which resumes turning responsive to the thawing of the ice free of the mold.

17. An ice maker as set forth in claim 15 wherein the first electric circuit is opened and closed responsive to the amount of ice in storage in the storage means.

18. An ice maker as set forth in claim 15 wherein the first circuit includes a switch operated by a sensitive relay in a low voltage circuit and wherein the low voltage circuit is closed responsive to the formation of ice in the mold.

19. An ice maker as set forth in claim 15 wherein said second circuit includes a parallel circuit for energizing the

thawing means and wherein said parallel circuit is opened responsive to the operation of the thawing means.

20. An ice maker as set forth in claim 15 wherein said second circuit includes a switch movable to a first position for closing said second circuit and movable to a second position for opening said second circuit and for closing the third circuit.

21. An ice maker as set forth in claim 20 wherein the second circuit includes a second switch operated by a sensitive relay in a low voltage circuit and wherein the low voltage circuit is closed by the formation of ice in the mold.

22. An ice maker as set forth in claim 21 wherein the low voltage circuit is opened by the accumulation of a given amount of ice in the storage means.

23. An ice maker as set forth in claim 15 wherein said third circuit includes a switch movable to a first position for closing said third circuit and movable to a second position for opening said third circuit and for closing the fifth circuit.

24. An ice maker as set forth in claim 15 wherein the fourth circuit includes a switch movable to a first position for opening the water valve and movable into a second position for closing the water valve and for energizing the removing means.

25. An ice maker as set forth in claim 24 wherein the conduit of the mold filling means includes a drain operable when the valve is closed to convey any leakage past the valve to a place of disposal other than the ice mold.

26. An ice maker as set forth in claim 24 wherein the switch in the fourth circuit is operated by a sensitive relay in a low voltage circuit and wherein the low voltage circuit is closed by the filling of the ice mold.

27. An ice maker comprising a mold, means for cooling the mold to freeze liquid therein, ice harvesting mechanism having a member movable into engagement with the ice for applying an ejecting force thereon to remove it from the mold, an electric motor connected to operate the harvesting mechanism, means for releasing the bond between the ice and mold, a control responsive to the forming of ice in the mold for simultaneously operating the ice releasing means and ice harvesting means, and said motor being so constructed and arranged as to stall while energized upon engagement of the member with the ice while producing an ejecting force thereon and to move the ice from the mold immediately it is freed by the releasing means.

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