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Horvay et al.

[11] **3,826,102**

[45] **July 30, 1974**

[54] **REFRIGERATOR INCLUDING AUTOMATIC ICE MAKER AND WATER RESERVOIR**

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[73] Assignee: **General Electric Company,** Louisville, Ky.

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[52] **U.S. Cl.** **62/137,** 62/188, 62/233

[51] **Int. Cl.** **F25c 1/04**

[58] **Field of Search** 62/188, 233, 135

[56] **References Cited**

UNITED STATES PATENTS

2,846,854 8/1958 Galin 62/337

3,208,233 9/1965 Linstromberg 62/137

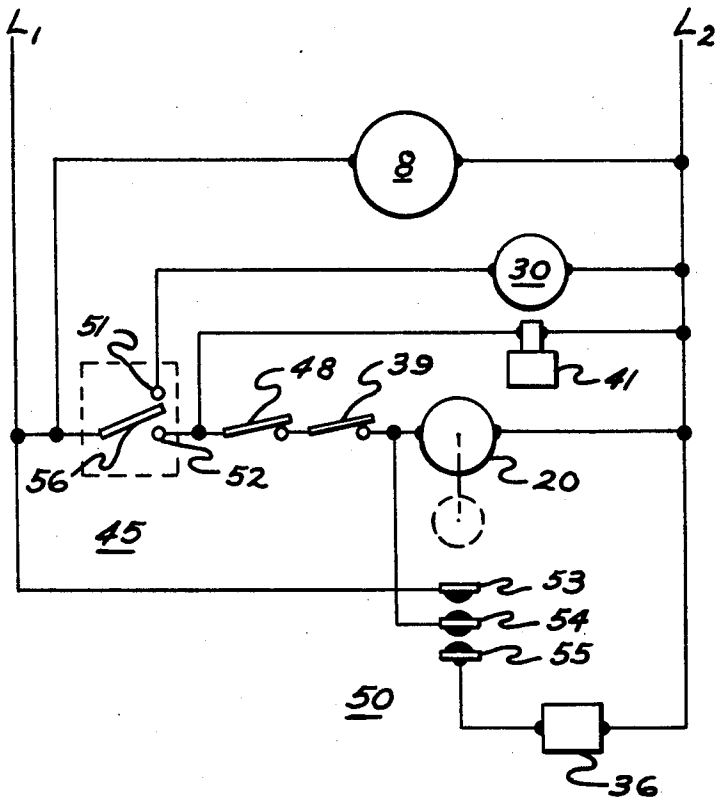
Primary Examiner—William E. Wayner

Attorney, Agent, or Firm—Francis H. Boos

[57] **ABSTRACT**

A refrigerator particularly adapted for the manufacture and storage of ice pieces comprising a below-freezing compartment containing an automatic ice maker and an above-freezing compartment containing a water reservoir. The ice maker control circuitry for controlling the operation of the ice maker through an ice discharging and water fill cycle includes a switch means associated with the reservoir for interrupting the ice maker operation when the water level is low but assuring operation of the ice maker through the water fill step.

2 Claims, 5 Drawing Figures



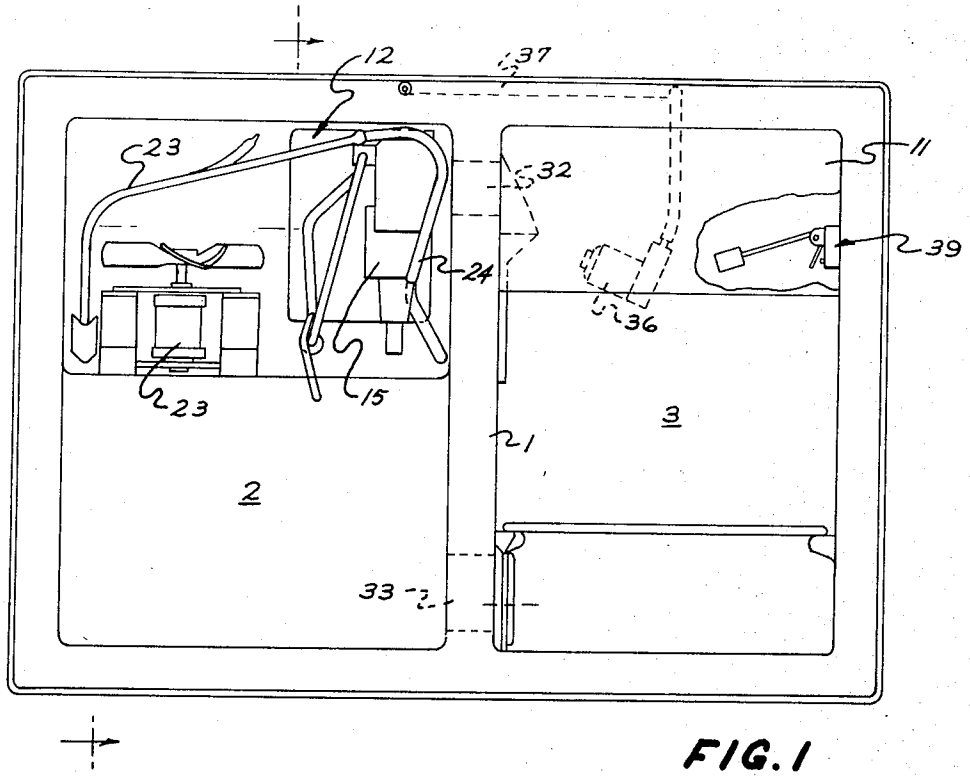


FIG. 1

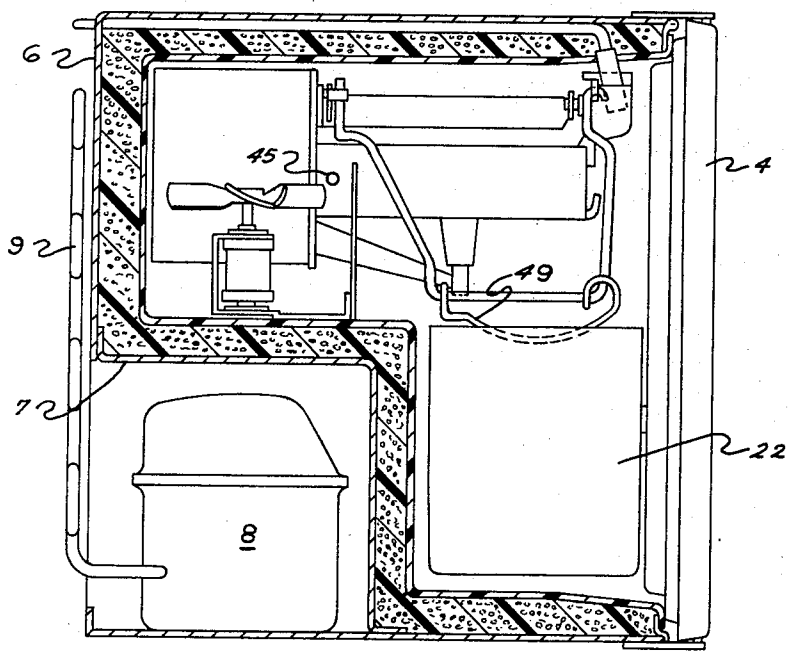


FIG. 2

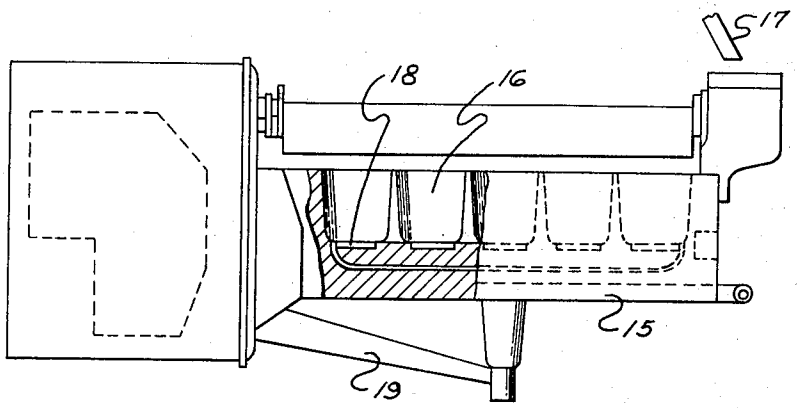


FIG. 3

FIG. 4

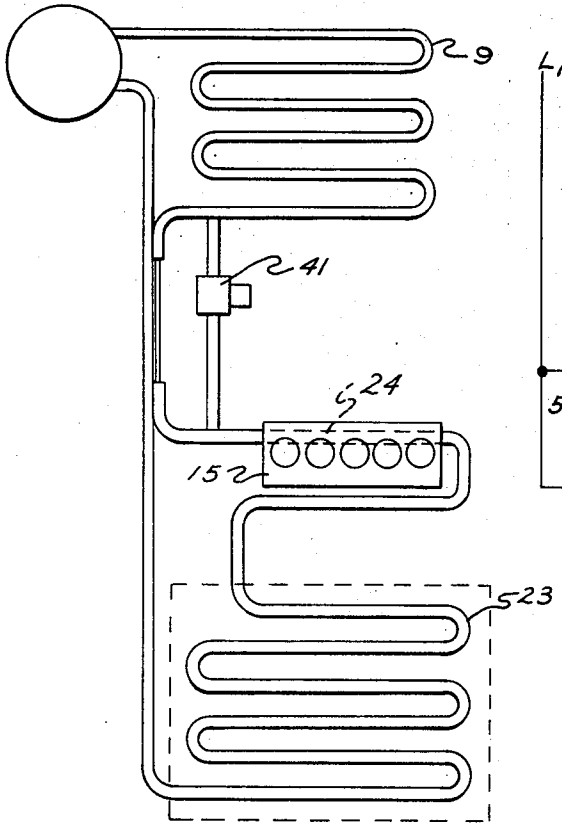
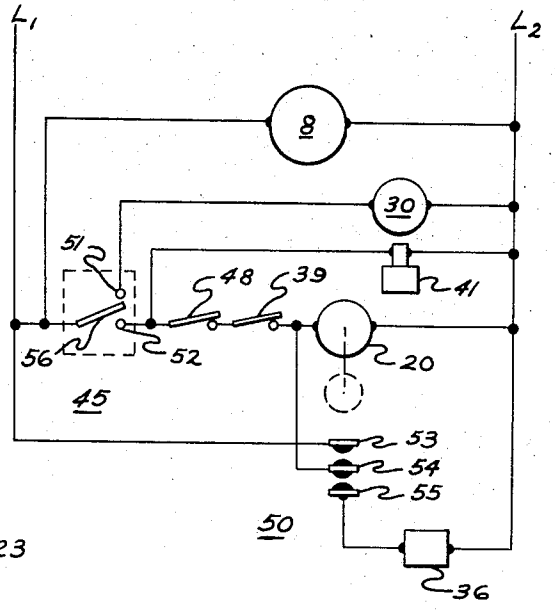


FIG. 5



REFRIGERATOR INCLUDING AUTOMATIC ICE MAKER AND WATER RESERVOIR

BACKGROUND OF THE INVENTION

The present invention relates to a household refrigerator of the type disclosed and claimed in the copending application, Ser. No. 314,695, filed Dec. 13, 1972 in the name of Frank A. Schumacher, entitled "Refrigerator Including Automatic Ice Maker" and assigned to the same assignee as the present invention. The automatic ice maker disclosed therein is of the type described and claimed in U.S. Pat. Nos. 3,163,017-Baker et al. and 3,331,215-Shaw in which the automatic cycle of operation powered by a timer motor and switch means includes ejection of ice pieces from the mold followed by the introduction of a fresh charge of water into the mold. The water supply is in the form of a reservoir in the fresh food compartment of the refrigerator and pump means for pumping a measured charge of water to the ice maker. U.S. Pat. No. 3,570,266-Alvarez et al. is also referred to as disclosing an automatic ice maker refrigerator including a water supply reservoir.

In the operation of an ice maker of the aforementioned type, it is desirable to provide means for stopping the automatic operation of the ice maker when the water supply in the reservoir is low. A control circuit intended to accomplish this result is described in U.S. Pat. No. 2,846,854—Galin issued Aug. 12, 1958. Galin's circuit comprises a timer operated switch for energizing a water pump and a float switch which, when opened at a low water level, deenergizes the timer motor for the ice maker to stop operation thereof. However, if the Galin float switch should happen to be opened in the middle of a water fill step, that is when the timer operated switch is closed to energize the water pump, the water pump will continue to operate even after the remaining supply of water in the reservoir is exhausted. As a result, the excess water may overflow the mold into the usual ice storage receptacle.

SUMMARY OF THE INVENTION

A general object of the present invention is to provide improved control circuitry for an automatic ice maker including a water reservoir as water supply means comprising switch means responsive to a lowering of the level of water in the reservoir so connected into the circuitry that, during a harvesting cycle, the water pump will continue to pump the full required charge of water into the mold following opening of the reservoir switch means and stop the ice maker operation only after completion of the harvesting cycle.

In accordance with the illustrated embodiment of the invention, there is provided an ice service refrigerator including an ice maker in the freezer compartment and a water reservoir in the fresh food compartment for supplying water to the ice maker. The ice maker comprises discharge means for harvesting or discharging ice pieces from the ice mold and a pump means is provided for supplying water to the mold from the reservoir following each ice discharge. A drive motor and timer switch means driven by the motor is provided for periodically operating the ice maker through a harvesting cycle including the successive steps of discharging the ice pieces from the mold and operating the pump to supply a timed volume of water to the mold. The power supply means for supplying electrical power to the motor and control circuitry includes a first circuit containing switch means responsive to a low water level in the reservoir for interrupting the power supply and a second circuit including switch means operated by the motor for supplying power to the ice maker during the water supply step so that if a harvesting cycle is interrupted by the operation of the water level switch means during the water supply step, the second circuit will supply power for continuing the timed water fill step and complete the harvesting cycle.

BRIEF DESCRIPTION OF THE DRAWING

With reference to the accompanying drawings:

FIG. 1 is a front elevational view of the refrigerator incorporating the present invention with the refrigerator doors removed;

FIG. 2 is a sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 illustrates certain components of an ice maker of the type employed in the practice of the present invention;

FIG. 4 is a schematic diagram of the refrigerant circuit employed in the practice of the present invention; and

FIG. 5 is a schematic wiring diagram of the electrical circuitry employed in the practice of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention, while not limited thereto, will be specifically described with reference to the ice service refrigerator of the aforementioned copending Schumacher application.

With particular reference to FIGS. 1 and 2 of the drawing, such a refrigerator comprises a rectangular cabinet including insulated outer walls and a partition 1 dividing the cabinet into a freezer compartment 2 and a fresh food compartment 3 in side-by-side relationship. The access openings to these compartments are respectively closed by suitable doors including a freezer compartment door 4. The rear wall 6 of the freezer compartment has a re-entrant portion 7 adjacent the lower end of the wall forming an area or housing outside the freezer compartment 2 for housing the compressor component 8 of the refrigeration system. A condenser 9 is supported on the rear wall of the cabinet.

The fresh food compartment 3 contains a removable water storage reservoir or tank 11 suitably supported adjacent the top thereof.

The freezer compartment 2 contains an automatic ice maker generally indicated by the numeral 12. This ice maker is of the type described and claimed in the aforementioned Baker et al. and Shaw patents and, as illustrated particularly in FIG. 3 of the drawing, comprises a mold 15 containing a plurality of mold cavities 16 for receiving water from a water supply conduit 17. Ejection pads 18 at the bottom of each of the cavities are provided for mechanically raising and ejecting ice pieces from the cavities, these pads being operated through a lever mechanism 19 driven by a motor 20 which, as is described in the aforementioned Baker et al. and Shaw patents, also drives a timing mechanism for controlling the operation of the ice maker through

a harvesting cycle which comprises ejecting the ice pieces from the mold, returning the pads to their normal position at the bottom of the cavities and introducing a fresh charge of water into the mold. The ice maker **12** is supported above an ice storage receptacle **22** mounted on the freezer door **4**. The freezer compartment **2** also includes an evaporator comprising a section **23** for maintaining the freezer compartment at the desired below-freezing temperature and an ice maker section **24** which, as illustrated in FIG. **3** of the drawing, is in heat exchange contact with the lower portion of the ice maker mold **15**.

A fan **30** may be provided below the evaporator section **23** for improving the air circulation. For refrigerating the fresh food compartment **3** there is provided an air passage **32** in the upper portion of the partition **1** for conveying cooled air from the evaporator and freezer compartment into the fresh food compartment **3**. A second air passage **33** in the bottom portion of the partition provides for return of air from the fresh food compartment to the freezer compartment. The fan **30** aids in the circulation of air through these passages.

The evaporator forms part of a refrigerant circuit shown in FIG. **4** and including the compressor **8**, condenser **9**, suitable flow restricting means **38** and the evaporator sections **23** and **24** connected in closed series flow relationship. The refrigeration system also includes means for conveying warm compressed refrigerant directly from the condenser outlet to the inlet of the evaporator or, more specifically, bypassing the flow restrictor **38**. The hot gas conduit indicated by the numeral **40** includes a normally closed solenoid valve **41**.

Cooling of the mold to freeze the water contained in the mold cavities is primarily accomplished by the refrigerant flowing through the evaporator section **24** while thawing of the bond between the ice pieces and the cavity walls during the harvesting cycle is accomplished by the warming action of the hot compressed refrigerant bypassed through the hot gas conduit **40** and into the evaporator sections when valve **41** is open. The usual ice maker mold thermostat **45**, which initiates an ice harvesting cycle upon sensing a predetermined below-freezing mold temperature, is employed also to control the valve **41** for warming the mold to an ice releasing temperature and for defrosting the evaporator section **23** during each ice making cycle.

The water supply line **17** is connected to the reservoir **11** positioned in the upper part of the fresh food compartment through an electrically operated pump **36** and a supply line **37**. It includes means (not shown) for manually filling the reservoir.

In accordance with the present invention, the reservoir is provided with a float valve operated switch **39** which forms part of the control circuitry for stopping the ice maker operation when the level of water in the reservoir approaches a lower limit or level at which there is still sufficient water available to complete a water fill step.

The electrical control circuitry for controlling the ice maker and compressor operation is shown in FIG. **5** of the drawing. The compressor **8** is connected directly across the supply lines **L1, L2** so that it runs continuously. The ice maker motor **20** is connected across lines **L1, L2** through contact **52** of the thermostat **45**, water level switch **39**, and an ice level sensing switch **48** operated by a feeler arm **49** (FIG. **2**). Arm **49**, as taught in the aforementioned Baker et al and Shaw patents, is raised and lowered during each ice maker harvesting cycle to open and close switch **48**, this switch being held open if the collection of ice in the receptacle **22** prevents the feeler arm **49** from returning to its lower position thereby preventing the initiation of a subsequent harvesting cycle. The water level switch **39** similarly opens the circuit when the reservoir water level is low. Motor operated timer switch means **50** includes contacts **53** and **54** for connecting motor **20** across lines **L1, L2** during a harvesting cycle and contacts **54** and **55** for timed energization of water pump **36** during a harvesting cycle. The hot gas solenoid valve **41** is connected to contact **52** of the thermostat **45** and in parallel with the feeler arm switch **48** and the ice maker motor **20** so that whenever the thermostat **45** senses a predetermined below-freezing temperature in the ice mold, the solenoid valve is opened. In normal ice making operation, opening of contacts **53, 54** at the end of an ice making cycle de-energizes the solenoid valve **41**. Normally, switch **45** opens contact **52** prior to this time. Back contact **51** of the switch **45** energizes fan **30** during normal refrigerating operation.

Considering the operation of the ice maker under the control of the circuitry of FIG. **5**, if the ice bin is not filled with ice and the water level in the reservoir is above that at which switch **39** opens, the switches **48** and **39** are closed. At the time a new charge of water has been added to the mold, switch arm **56** of the thermostat **45** is engaged with contact **51** and fan **30** is energized. The compressor **8** is operating since it is connected directly across lines **L1, L2** while the hot gas solenoid valve **41** is closed. Refrigeration is produced by the operation of the compressor to cause the evaporator sections **23** and **24** to go to below freezing temperatures. The ice mold is cooled, causing the water in the mold to freeze. At the same time, the evaporator section **23** lowers the temperature of the freezer compartment.

When the temperature of the ice mold reduces to a below-freezing temperature, such as about 4° F., assuring that the ice cubes are frozen, the thermostat **45** engages contact **52** thereby opening the fan circuit and energizing the ice maker motor **29** to close contacts **53** and **54** to open solenoid valve **41**. The motor and ice ejection mechanism is then stalled by the bond between the ice pieces and the cavity walls until the hot gas flowing through the hot gas conduit into the mold and evaporator sections warms the mold to an ice releasing temperature. The ice maker motor **20** then runs, driving the timer switch **50**, energization of the motor being assured by the holding circuit through the contacts **53** and **54** of the timer switch so as to continue operation of the ice maker motor **20** regardless of the position of the thermostat switch **45**, the feeler arm switch **48** and the switch **39**. If, during the water fill step, or during the harvesting cycle, the water level reaches a low point at which switch **39** is opened, the holding circuit including contacts **53** and **54** assures continued operation of the ice maker through a complete harvesting cycle. After ejection of the ice pieces, a second circuit is established through contact **55** of the timer switch **50** to energize the water supply pump **36** for a period sufficient to fill the mold with a complete fresh charge of water. During completion of the ice maker harvesting cycle, the hot gas solenoid valve **41** is closed by opening of switch contacts **53** and **54**, and the thermostat switch returns

to its normal position engaging contact **51** in which the fan **30** is energized.

If the ice bin is full, or the reservoir water level low so that switch **48** or switch **39** is held open, periodic defrosting of the evaporator section **23** is accomplished even though the ice maker does not operate. When the thermostat **45** senses the below-freezing temperature completing a circuit through contact **52**, the hot gas valve **41** is energized, but when switch **39** or **48** or both are open the ice maker motor is not energized. Heating of both evaporator sections continues until the thermostat **45** senses the upper operating temperature of the mold thermostat. Breaking of the thermostat contact **52** ends the defrost cycle and places the system back into a refrigeration cycle.

While there has been shown and described what is believed to be a preferred embodiment of the invention, it is to be understood that the invention is not limited thereto and it is intended by the appended claims to cover all such modifications as fall within the true spirit and scope of the invention.

We claim:

1. In a refrigerator having a freezer compartment, a fresh food compartment, an automatic ice maker having an ice mold and being positioned in the freezer compartment, a water reservoir positioned in the fresh food compartment, discharge means for discharging ice pieces from the mold, a receptacle for receiving ice pieces from the mold, pump means for supplying water from the reservoir to said mold, a drive motor for operating said ice maker through a harvesting cycle, and a power supply means for supplying electrical power to said drive motor and said pump means, said harvesting cycle comprising successive steps of actuating the drive motor, discharging ice pieces from said ice mold, actuating the pump means, and supplying water to said mold, the improvement comprising:

a first circuit connecting the power supply means to the drive motor through a thermostatically-actuated switch means for actuating the drive motor, initiating a harvesting cycle, and operating the ice maker through the harvesting cycle in response to the temperature of the mold, said first circuit having first and second serially connected switch means positioned between the thermostatically-actuated switch and the drive motor for controllably breaking the first circuit, said first switch means being opened in response to water level in the reservoir being below a preselected elevation and said second switch means being opened in response to the level of ice pieces in the receptacle being above a preselected elevation; and

a bypass circuit connecting the power supply means to the drive motor and the pump means through a timer switch means, said timer switch means being actuated in response to actuating the drive motor through the first circuit for passing power to the drive motor through the second circuit, thereafter passing power to the pump means through the second circuit for supplying water to the mold, and thereafter breaking the second circuit, thereby assuring completion of the water-filling step of a harvesting cycle after initiation of said harvesting cycle and a subsequent opening of the first circuit during said harvesting cycle.

2. A refrigerator according to claim **1**, in which said first switch means is float operated.

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