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Canter

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[54] **ICE MAKER CONTROL CIRCUIT**

[75] Inventor: **James A. Canter**, Englewood, Ohio

[73] Assignee: **General Motors Corporation**, Detroit, Mich.

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[52] **U.S. Cl.** **62/138**, 62/320

[51] **Int. Cl.** **F25c 1/12**

[58] **Field of Search** 62/320, 138, 348

[56] **References Cited**

UNITED STATES PATENTS

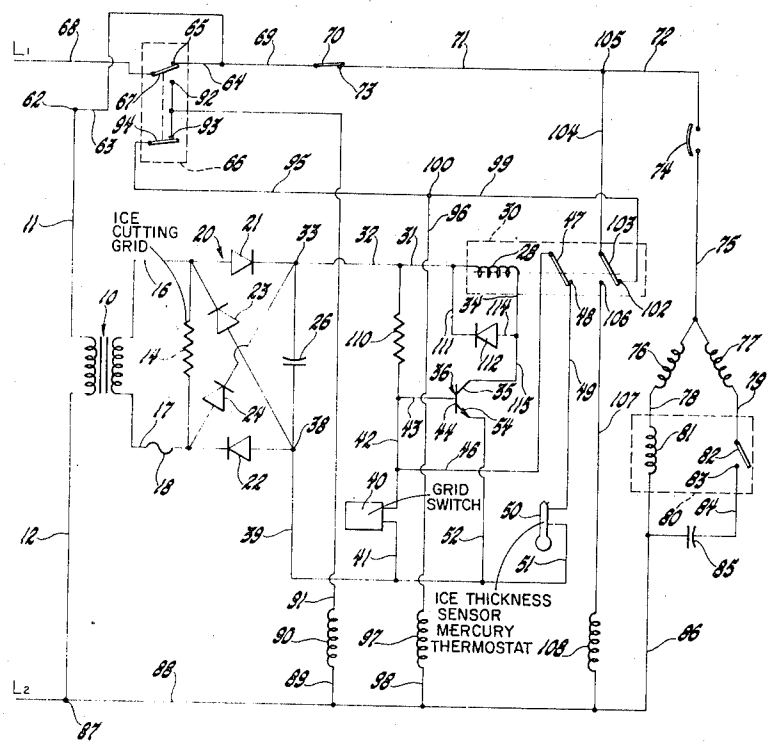
2,784,563	3/1957	Baker	62/138
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3,760,600	9/1973	Matsui et al.	62/348 X

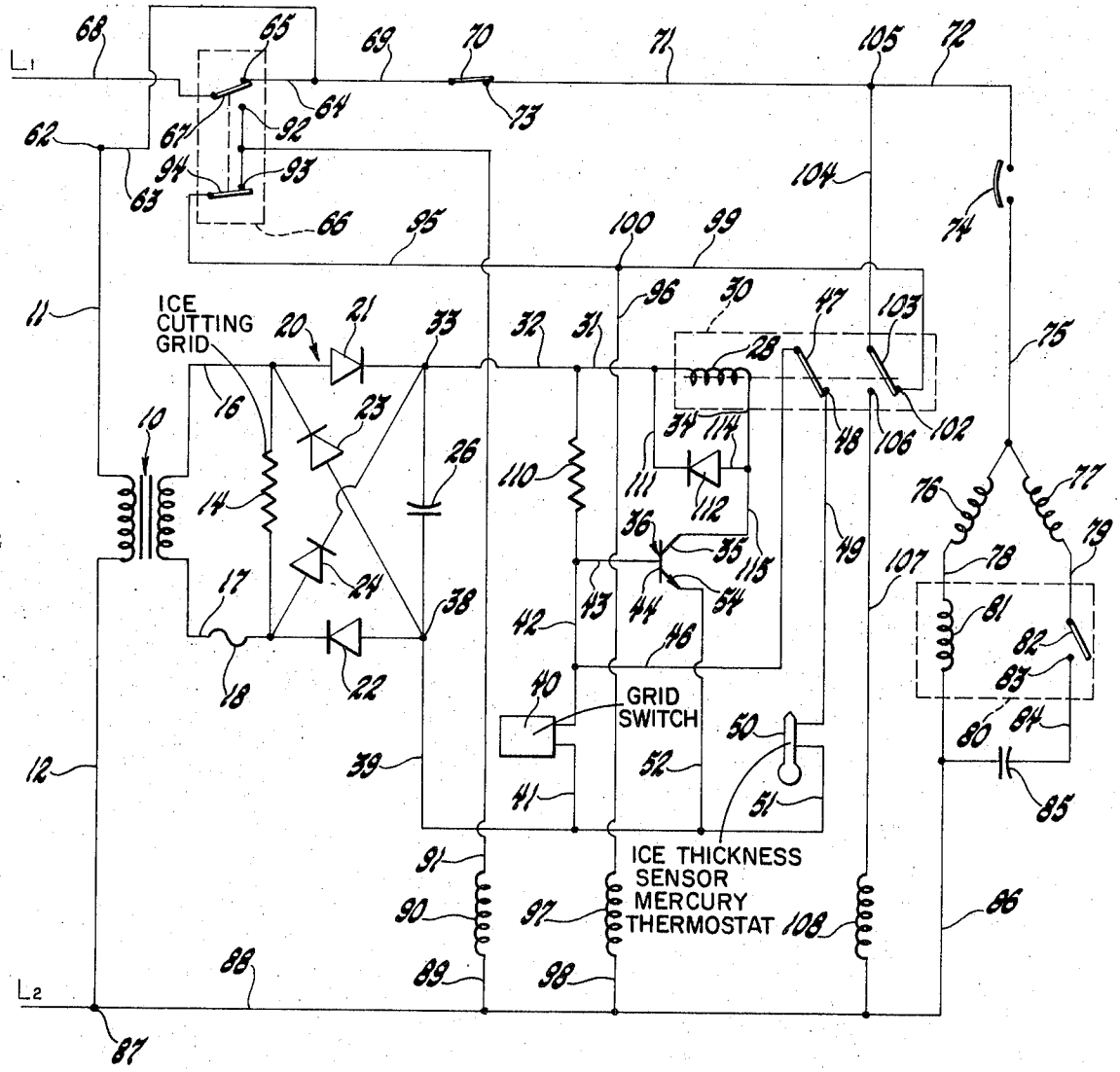
Primary Examiner—William F. O'Dea
Assistant Examiner—W. E. Tapolcai, Jr.
Attorney, Agent, or Firm—Edward P. Barthel

[57] **ABSTRACT**

An improved control circuit for a commercial automatic ice cube maker of the type wherein a slab of ice is formed on a freezing plate by flowing water thereover. The circuit provides a more uniform control means that is independent of atmospheric pressure effects by means of a mercury ice thickness control thermostat switch connected between the base and emitter of a transistor, such that upon sensing a predetermined temperature of the built up ice slab the thermostatic switch opens to cause the transistor to switch ON and operating relay means to stop the water pump and close the solenoid operated defrost valve while opening second relay contacts in the thermostat switch circuit such that the system is locked in its ice slab release mode. During the ice slab release mode the mercury thermostatic switch closes while a defrosting operation of the plate causes the ice slab to release and slide onto an ice cutting grid, tripping a mercury type switch, connected from the emitter to the base of the transistor, turning the transistor OFF and causing a deenergization of the relay means thereby restarting the ice making cycle of the ice maker.

3 Claims, 1 Drawing Figure




ICE CUTTING GRID
GRID SWITCH
ICE THICKNESS SENSOR
MERCURY THERMOSTAT
L1
L2

ICE MAKER CONTROL CIRCUIT

This invention relates to automatic refrigerating apparatus and more particularly to an improved control circuit for an automatic ice maker.

It is an object of this invention to provide an improved control circuit for an automatic ice cube making apparatus to sense the thickness of a finished slab or layer of ice and initiate an ice harvest cycle that does not require adjusting for variations in altitude between the place of manufacture and the altitude of the place of installation. The prior art, as exemplified in U.S. Pat. No. 2,784,563 issued Mar. 12, 1957, to Baker and assigned to the same assignee as the instant invention, uses an interlocking electro-mechanical system for sensing the thickness of a slab of ice incorporating a thermostatic switch, an ice harvesting relay, a heating element to heat the thermostatic switch expansible and contractable gas filled bulb and its sealed tube between the bulb and the thermostat together with miscellaneous other switches. This system has proved satisfactory once adjusted for variations introduced because of differing atmospheric pressures. That is, the ice maker requires readjusting between its point of manufacture and the final location where it is installed depending upon whether it is at a higher or lower altitude. The bulb heating element, which also requires a time consuming operation for servicing, is necessary to provide the bulb within the ice slab feeler receptacle with a small amount of heat to quickly raise the temperature of the gas expanding the bulb and closing the thermostatic switch as explained in U.S. Pat. No. 2,995,905 issued Aug. 15, 1916 to Ayres et al., the disclosure of which is incorporated by reference herein.

It is therefore another object of this invention to provide a transistorized control circuit for an automatic ice maker wherein a slab or layer of ice is formed on an inclined freezing plate by flowing water thereover, the slab being released from the plate when an ice thickness control mercury sensor switch is cooled by the built up ice slab. The cooled sensor switch opens causing the transistor to switch ON and trip open a relay stopping the water pump and closing the defrost solenoid controlled valve; while at the same instant by means of opening the relay in the sensor switch circuit the control system is locked in the slab release mode. During the ice slab release operation the sensor switch recloses. When the ice slab moves onto the cutting grid its presence causes a closing of a switch resulting in the transistor being turned OFF dropping out the relay and restarting the ice making cycle.

In the accompanying drawing, FIG. 1 is a circuit diagram illustrating the electrical components of a preferred embodiment of the present invention.

Referring now to FIG. **1**, a preferred embodiment of the invention is illustrated as indicating a step-down transformer **10** with the 115 volt power mains indicated at L_1 and L_2 connected via wires **11** and **12** to the primary of the transformer **10.** The transformer **10** steps down the line voltage to a low voltage, as for example about 14 volts, suitable for use in heating the cutting wires of an ice dissector, cutter or grid **14** such that the slab of ice slides automatically onto the cutting grid where the grid cuts the ice slab into a plurality of ice cubes which fall through the grid into a storage bin. An example of one such automatic ice making apparatus is shown and described in the above-mentioned U.S. Pat. No. 2,784,563 to Baker and assigned to the assignee of the present invention, the disclosure of which is incorporated by reference herein.

The wires **16** and **17** are connected from the secondary of the transformer to the grid **14** with the line **17** shown fused at **18.** A small amount of current is drawn from the transformer secondary to provide the necessary low voltage suitable for use is heating the cutting wires of the grid with no danger of injury or shock to those operating the ice maker. The secondary of the transformer is shown connected to a full wave bridge rectifier **20,** comprising diodes **21, 22, 23** and **24** and a filter capacitor **26** to provide the necessary D.C. voltage for the circuit. While a full wave D.C. power supply rectifier is shown it will be appreciated that a D.C. power supply using a half wave rectifier could be used without departing from the scope of the invention.

A coil **28** of a double pole-double throw relay **30** has one side connected by wires **31** and **32** to one output terminal **33** of the bridge rectifier **20** while wire **34** connects the other side of the coil **28** to the collector **35** of an NPN transistor **36.** The bridge rectifier **20** is also connected from its other terminal **38** by lines **39** and **41** to switch means **40** which in the preferred form is a pivotal or tilt type mercury switch having tubular-like glass member with liquid mercury and electrical contacts sealed therein as shown in U.S. Pat. No. 2,887,852, issued May 25, 1959 to Thomas for an Ice Maker. As disclosed by the Thomas patent, the ice slab slides onto the ice cutting grid, actuating the switch means **40** and causing the switch means **40** to trip closed. The grid switch **40** is connected by lines **42** and **43** to the base **44** of the transistor **36,** while the lines **43, 42** and **46** connect the transistor base **44** to first switch means in the form of movable contact **47** of the single pole section of double pole-double throw (DP-DT) transfer means or relay **30** whose fixed contact **48** is in turn connected by wire **49** to one lead of a mercury slab thickness temperature sensor switch **50.** The thickness sensor mercury switch **50** is connected by lines **51** and **52** to the emitter **54** of the transistor **36.**

Terminal **62** of the transformer primary is connected by lines **63** and **64** to fixed contact **65** of a double pole-double throw service switch **66** whose movable contact **67** is connected by line **68** to power line L_1. Fixed contact **65** is connected via lines **64** and **69** to an ice collecting bin thermostat electric switch having a movable contact **70,** which may be of any desired conventional construction. The lines **71** and **72** connect the fixed contact **73** of the bin thermostat through an overload thermostat **74.** The line **75** connects the overload thermostat **74** to electric motor windings **76** and **77** of a motor-compressor unit (not shown) while lines **78** and **79** respectively, lead to a conventional start relay **80** including a coil **81** and movable contact **82.** The relay fixed contact **83** is connected via line **84** through motor start capacitor **85** and thence connected by line **86** to terminal **87** energized by the other line side L_2 of the power source.

The power line L_2 is also connected by wires **88** and **89** to water pump motor windings **90** which is in turn connected by wire **91** to fixed terminals **92, 93** and second movable contact **94** of the service switch **66.** The movable contact **94** is shown connected via wires **95** and **96** to the ice maker's condenser fan motor windings **97** which is in turn connected by wire **98** to the L_2 side of the power source. The wire **99** is connected

from terminal **100** to the fixed contact **102** of the relay **30** and thence through relay second switch movable contact **103** and wire **104** to terminal **105** and thence to the line L_1 of the power source. The other fixed contact **106** for movable contact **103** is connected by line **107** to the coil **108** of a solenoid controlling a defrost hot gas valve such as shown, for example, in U.S. Pat. No. 3,049,894 issued Aug. 21, 1962 to J. R. Pichler et al., the disclosure of which is incorporated by reference herein. As described in the Pichler patent, when the hot gas solenoid valve is actuated, hot refrigerant gas flows to an evaporator plate causing the plate to be warmed resulting in the ice slab being released to slide down the inclined plate surface onto a cutter wire grid. The transistor **36** has a biasing resistor **110** which is shown connected by line **43** to the transistor base **44** and by lines **31** and **111** to the cathode of a diode rectifier **112** while line **114** connects the anode of the diode **112** via line **115** to the transistor collector **35.** It will be noted that the diode **112** is not required provided the transistor has a high enough breakdown voltage.

In operation assume the ice maker unit is making ice with the pump motor **90** energized, the mercury ice thickness control thermostat or sensor switch **50** closed and with the mercury grid switch **40** open. When the ice thickness control thermostat switch **50** is cooled to the desired temperature, which in the disclosed form is about 35.5° F. by the build up of the ice slab on the evaporator plate, the switch **50** opens causing the emitter **54** base **44** junction to be forward-biased by the current flow in resistor **110.** The transistor **36** switches On to conduct allowing current to flow in the collector **35** to emitter **54** circuit energizing the relay coil **28,** tripping the DP-DT relay **30** and causing movable contact **103** to move to fixed contact **106** stopping the water pump motor **90** and condenser fan **97** and completing the current path through line **107** energizing the hot gas solenoid coil **108** for the defrost and ice slab release cycle.

At the same time by moving the movable contact **47** of relay **30** away from fixed contact **48** to open line **49** connected with the ice slab sensor thermostatic switch **50** the control circuit is locked in the slab release mode of operation. While the ice slab release cycle is in operation, wherein warming the evaporator plate is occurring, the mercury sensor thermostatic switch **50** warms and recloses. Upon the ice slab being released from the evaporator plate, its presence on the cutting grid **14** causes a pivoting and closing of the mercury grid switch **40** with the result that the transistor **36** is now reverse-biased and will not conduct, i.e., is turned OFF, dropping out the relay coil **30** and returning the first and second switch means **47** and **103** to their ice slab making position shown initiating a new ice making cycle. It will be noted that the closing of the grid switch **40** will normally be only momentarily but the grid switch **40** will remain closed if for any reason the ice slab remains on the top of the cutting grid **14.**

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

I claim:

1. A solid state refrigeration control circuit for an automatic icemaker operative for sensing the presence of a finished slab of ice on a freezer plate and initiating an ice harvest cycle for the icemaker, means for refrigerating said plate to form an ice slab thereon, and means for defrosting the freezer plate and causing the ice slab to slide onto an ice cube cutting grid, said control comprising, in combination; a mercury ice thickness control thermostat switch; a normally open grid switch being operable upon the slab of ice sliding from the freezing plate onto the cutting grid to close; a transistor having a base, an emitter and a collector; a rectifier circuit for producing rectification of an AC power input, said rectifier circuit having one terminal connected to both said grid switch and said mercury thermostat switch, said rectifier circuit other terminal connected to the base of said transistor via biasing means; normally closed first switch means connecting said transistor base to said mercury thermostat switch; second switch means having a normally closed contact energizing the plate refrigerating means and a normally open contact for providing an electrical path when closed for energizing the freezer plate defrosting means; said mercury thermostat switch being positioned a preselected distance above the plate such that when a predetermined thickness of the ice slab is achieved the temperature of the ice slab is sensed by said mercury thermostat switch whereby said mercury thermostat switch opens causing said transistor to be triggered conductive; and transfer means operable, when energized by said conductive transistor, to open said normally closed first switch means and move said second switch means from its plate refrigerating contact to its freezer plate defrosting contact.

2. A solid state refrigeration control circuit for an automatic icemaker operative for sensing the presence of a finished slab of ice on a freezing plate and initiating an ice harvest cycle for the icemaker, means for refrigerating said plate to form an ice slab thereon, means for defrosting the freezing plate and causing the ice slab to slide onto an ice cube cutting grid, said control circuit comprising, in combination; a mercury ice thickness control thermostat switch; a grid switch being actuated upon the slab of ice sliding from the freezing plate onto the cutting grid; an NPN transistor having a base, an emitter and a collector; a bridge circuit for producing rectification of the AC power input; said bridge circuit having one terminal connected to a terminal of both said grid switch and said mercury thermostat switch, and its other terminal connected, at a junction point, to the base of said transistor through a biasing resistor; normally closed first switch contacts connecting said transistor base to the other terminal of said mercury thermostat switch, second switch means having a normally closed contact energizing the plate refrigerating means and a normally open contact for providing an electrical path when closed energizing the freezer plate defrosting means, said biasing resistor being of a value such that when a predetermined temperature of the ice slab is sensed by said thermostat mercury switch said thermostat switch opens directing the current flow through the base-emitter circuit of said transistor whereby said transistor is triggered conductive, and transfer means operable, when energized, to open said normally closed contact of said first switch means and close the normally open contact of said second switch means to energize said defrosting means and initiating the ice slab harvest cycle, said transfer means including a relay exciting coil connected, in series with the collector-emitter circuit of said transistor, between said junction point and said one terminal of said bridge circuit.

3. A solid state refrigeration control circuit for an automatic icemaker operative for sensing the presence of a finished slab of ice on a freezing plate and initiating an ice harvest cycle for the icemaker, means for refrigerating said plate to form an ice slab thereon, a hot gas solenoid controlled valve operative for defrosting the freezing plate and causing the ice slab to slide onto an ice cube cutting grid, and pump means for distributing water on the freezing plate, said control circuit comprising, in combination; a mercury ice thickness control thermostat switch; a grid switch being actuated upon the slab of ice sliding from the freezing plate onto the cutting grid; an NPN transistor having a base, an emitter and a collector; a diode bridge rectifier for producing full wave rectification of the AC power input; said bridge rectifier having one terminal connected to a terminal of both said grid switch and said mercury thermostat switch, and its other terminal connected, at a junction point, to the base of said transistor through a biasing resistor; said other terminal also connected to one side of an exciting coil of a double pole-double throw relay, the other side of said exciting coil connected to said transistor collector, said relay including a first single pole section and a second double pole section, the normally closed contact of said single pole section connecting said transistor base to the other terminal of said mercury thermostat switch, the normally closed contact of said second double pole section operative for energizing the plate refrigerating means and the normally open contact thereof operative for providing an electrical path when closed energizing the freezer plate hot gas solenoid for defrosting the plate, the ohmic value of said biasing resistor being such that when a predetermined temperature of the ice slab is sensed by said thermostat mercury switch said thermostat switch opens directing the current flow through the base-emitter circuit of said transistor, whereby said transistor is triggered conductive to energize said exciting coil and open said normally closed contact of said first single pole section and close the normally open contact of said second double pole section of said relay to energize the hot gas solenoid and initiating the ice slab harvest cycle.

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