

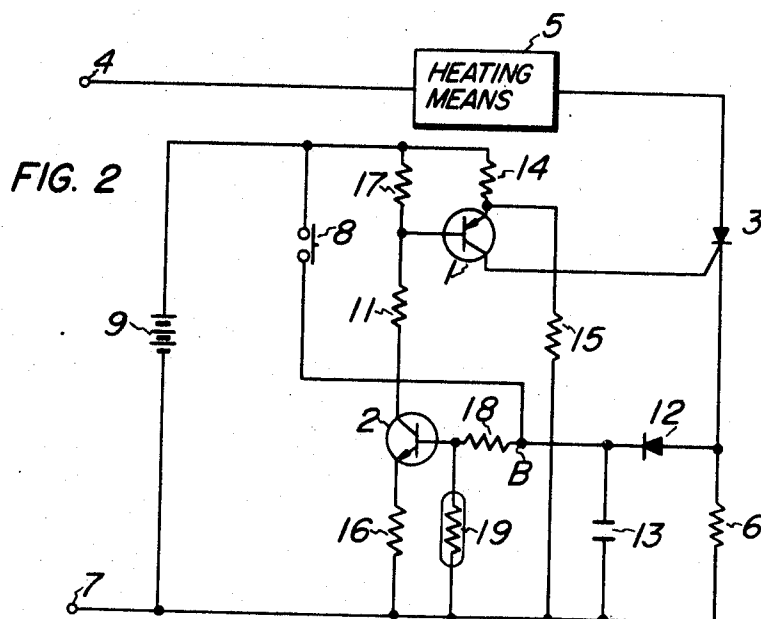
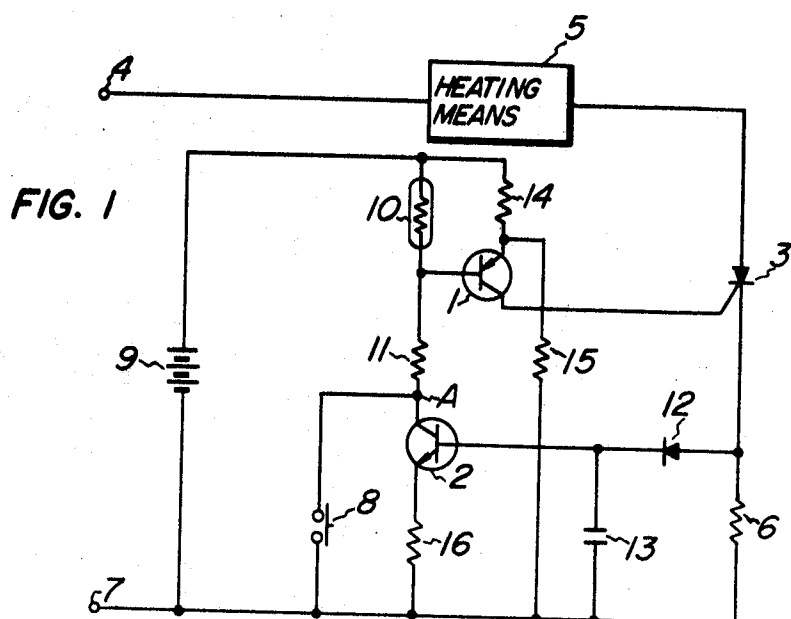
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DEFROSTING CONTROL CIRCUIT FOR ELECTRIC REFRIGERATOR

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DEFROSTING CONTROL CIRCUIT FOR ELECTRIC REFRIGERATOR

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5 Claims

ABSTRACT OF THE DISCLOSURE

A defrosting control circuit for an electric refrigerator comprising a first transistor adapted to trigger a solid-state switching element with control electrode depending upon the variable resistance of a temperature detecting element representative of the temperature in the freezer of the refrigerator and a second transistor for resetting the control circuit subsequently to completion of a defrosting operation. In the present defrosting control circuit, a defrosting operation is automatically stopped when the temperature in the freezer reaches a predetermined temperature at which accumulated frost in the freezer is completely removed, so that an excessive temperature rise in the freezer and incomplete defrosting can be prevented.

The present invention relates to defrosting control circuits for electric refrigerators capable of performing an automatic defrosting operation under electronic control by detecting the temperature within the freezer which is in defrosting operation.

It is known that when frost is accumulated in the freezer, i.e., on the surface of the evaporator of an electric refrigerator, the cooling power of the electric refrigerator is decreased. To remove such accumulated frost, conventionally, various methods have been widely employed such as circulating hot gas in the evaporator for a fixed period of time with the defrosting valve opened, generating heat by a heater for a fixed period of time, etc. The conventional defrosting systems in which the defrosting period of time is fixed beforehand have undergone such inconveniences that irrespective of the variety of defrosting conditions depending upon the amount of accumulated frost the defrosting operation is simply performed for a fixed period of time, thus resulting in an excess temperature rise within the compartments of the refrigerator, in case of a relatively small amount of frost accumulated, due to an excess length of heating operation even after the complete removal of frost, or resulting in an incomplete defrosting operation, in case of a relatively large amount of frost accumulated, due to insufficient length of heating operation notwithstanding the presence of still remaining frost.

The major object of the present invention is, therefore, to provide a defrosting control circuit for an electric refrigerator which makes it possible to finish the defrosting operation at the moment when accumulated frost is completely removed, without suffering from the above-mentioned inconveniences.

Other objects, features and various advantages of the present invention will be readily understood from the following description of preferred embodiments made in conjunction with the accompanying drawings, in which:

FIG. 1 is an electric circuit diagram of a defrosting control circuit for an electric refrigerator in accordance with an embodiment of the present invention; and

FIG. 2 is an electric circuit diagram similar to FIG. 1 in accordance with another embodiment of the present invention.

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In the drawings, similar parts are denoted by like reference numerals.

Referring first to the circuit shown in FIG. 1, transistors 1 and 2 are cut off during the cooling operation of the refrigerator. In this embodiment, the transistors 1 and 2 are of NPN and PNP type respectively. A solid-state switching element with control gate 3 such as a silicon controlled rectifier the gate electrode of which is connected to the collector of the transistor 1 is herefore non-conductive, and no electric current is allowed to flow in the main circuit consisting of a terminal 4 of a commercial power source—heating means 5 such as a heater—the silicon controlled rectifier 3—a resistor 6—a grounded terminal 7. Under such conditions, the heating means is not in operation. When it is time to start the defrosting operation, at which for example a timer is set to actuate a switch 8 across the collector of the transistor 2 (as indicated by A) and the terminal 7 to close the contacts for an instant, the point A is instantly connected to the negative terminal 7. The variable resistance characteristics of a thermistor 10 thermally coupled with the inside of the freezer and the resistance of a resistor 11 are selected such that when the switch 8 is closed the thermistor 10 and the resistor 11 serve to render the transistor 1 conductive, dividing the terminal voltage of a DC power source 9. Upon conduction of the transistor 1, the controlled rectifier 3 is triggered and switched to be conductive, thus allowing an electric current to flow in the above-mentioned main circuit. Accordingly, the heating means 5 begins to operate to remove accumulated frost. It is evident from FIG. 1 that, during the defrosting operation, the transistor 2 is biased to its conductive state by a biasing means constituted by the resistor 6 in the main circuit, a reverse current blocking diode 12 and a smoothing capacitor 13. 14 and 15 represent voltage dividing resistors for supplying an emitter bias voltage to the transistor 1, while 16 represents an emitter resistor of the transistor 2.

When accumulated frost in the freezer is removed more and more by the defrosting operation of the refrigerator owing to energization of the heating means 5 as a result of conduction of the transistors 1 and 2 and subsequent conduction of the silicon controlled rectifier 3 as explained above, the temperature in the freezer is accordingly getting higher as compared with that at the time when the defrosting operation was started. The resistance of the thermistor 10 thermally coupled with the inside of the freezer then becomes lower as compared with that at the time when the defrosting operation was started, which makes the applied bias to the transistor 1 smaller and finally results in switching the transistor 1 from conductive to non-conductive state. This switching of the transistor 1 brings the silicon controlled rectifier 3 back to the non-conductive state to open the main circuit and the operation of the heating means 5 is thereby ceased. Thus, a complete cycle of defrosting operation has been performed. It is also readily understood that by the opening of the main circuit, the transistor 2 is at the same time cut off. The circuit is so arranged that the next defrosting operation is not started until the switch 8 is again actuated to close the contacts.

Although in the circuit of FIG. 1, the switch 8, which may be driven by a timer so as to close the contacts for an instant, is connected between the point A and the negative terminal of the DC power source 9, it is possible instead while obtaining similar functional effects that the switch is connected between the base of the transistor 2 and the positive terminal of the DC power source 9. It is only required that the switch 8 should be so arranged as to make either one of the transistors 1 and 2 conductive at the time to start the defrosting operation.

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FIG. 2 shows another embodiment of the present invention, in which a switch 8 is connected between a point such as indicated by B and the positive terminal of a DC power source 9, and between the point B and the negative terminal of the DC power source 9 is connected a series connection of a resistor 18 and a thermistor 19 the junction of which is connected to the base of an NPN type transistor 2. As seen from FIG. 2, when the switch 8 closes its contacts, the series connection serves to divide the terminal voltage of the DC power source 9 and to supply a base bias to the transistor 2. The remaining part of the circuit is the same as that of FIG. 1 except for a resistor 17 which is substituted for the thermistor 10 of FIG. 1. In the circuit of FIG. 2, when the contacts of the switch 8 are closed for an instant, first the transistor 2 is made conductive thereby, subsequently the PNP type transistor 1 is also made conductive, and then the silicon controlled rectifier 3 is fired to be conductive. The heating means 5, therefore, begins to start the heating operation by an electric current flowing therethrough. When the temperature within the freezer rises up to a predetermined temperature, the resistance of the thermistor 19 which is thermally coupled with the inside of the freezer to detect the temperature therein and serves as the base resistance of the transistor 2 is decreased accordingly to thereby first cut off the transistor 2 unlike in the circuit of FIG. 1 where the transistor 1 is first cut off. As a consequence, the transistor 1 is also cut off, which results in rendering the silicon controlled rectifier 3 non-conductive. Thus a complete cycle of defrosting operation is performed.

As has been described above, the present invention basically depends on the principle that a transistor is used to trigger the control electrode of a solid-state switching element which controls the operation of a heating means, another transistor is provided to reset the defrosting control circuit subsequently to completion of a defrosting operation, and a series connection of a thermistor which is thermally coupled with the inside of the freezer, a resistor and a switch such as a push button switch constitute a bias circuit for either one of the transistors. Therefore, in the present invention, connection of a thermistor for detecting the freezer temperature may be modified in other ways so far as it constitutes a base bias circuit for one of the above-mentioned transistors during the defrosting operation, and the heating means may be heater coil or valve means through which hot gas is to be supplied to the freezer.

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As can be understood from the foregoing description, the defrosting control circuit of the present invention provides such marvelous effects that accumulated frost can be always completely removed irrespective of the accumulated amount in the freezer.

What is claimed is:

1. A defrosting control circuit for an electric refrigerator comprising a defrosting heater means, a solid-state switching element with control electrode and a control section for controlling said solid-state switching element, characterized in that, said control section includes a first transistor for triggering said solid-state switching element, a second transistor for resetting the control means subsequently to completion of a defrosting operation, means for supplying said first and second transistors with DC biases, said DC bias supplying means having a means for applying an instantaneous bias to the base of one of said transistors and having a temperature detecting element thermally coupled with the inside of the freezer of said refrigerator, said temperature detecting element being adapted to apply a DC base bias to one of said transistors during the defrosting operation, and means for supplying the base of said second transistor with a predetermined potential while said solid-state switching element is conductive.

2. A defrosting control circuit as claimed in claim 1, characterized in that said temperature detecting element is constituted by a thermistor.

3. A defrosting control circuit as claimed in claim 1, characterized in that said means for applying an instantaneous bias includes a switch.

4. A defrosting control circuit as claimed in claim 1, characterized in that said heater means is constituted by a heater.

5. A defrosting control circuit as claimed in claim 1, characterized in that said heater means includes a hot gas supply source.

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