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REFRIGERATING APPARATUS INCLUDING DEFROST CONTROL

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This invention relates to refrigerating apparatus and more particularly to a combination defrost control and power failure indicating arrangement.

It is an object of this invention to provide a light sensitive device for detecting an excessive accumulation of frost on an evaporator and for initiating defrosting of the evaporator.

It is another object of this invention to provide an improved light sensitive arrangement which makes it possible to locate the light bulb remotely from the evaporator and the light sensing device.

Another object of this invention is to provide an improved light sensing device wherein failure of the light source either due to a power failure, a burned out fuse, a burned out bulb or the like serves to give a warning to the user.

Still another object of this invention is to provide an improved photoelectric control circuit.

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

In the drawing:

FIGURE 1 is a sectional view largely schematic showing the invention applied to a household refrigerator; and

FIGURE 2 is a fragmentary perspective view showing the arrangement of the light source and the light sensitive cell.

Referring now to the drawing wherein a preferred embodiment has been shown, reference numeral 10 designates a household refrigerator having a below freezing food storage compartment 12, an above freezing food storage compartment 14 and a machinery compartment 16. Doors 18 and 20 serve to close the access opening to the compartments 12 and 14 in accordance with conventional practice. The compartments 12 and 14 are refrigerated by means of an evaporator 22 which is arranged as shown and which serves to refrigerate air circulated over the evaporator 22 and through the compartments 12 and 14 by means of a blower 24 having a first outlet 26 leading to the frozen food storage compartment 12 and a second outlet 28 leading to the above freezing food storage compartment 14. The evaporator 22 is of the type having a plurality of refrigerant passages 30 which have fins 32 attached thereto. The air circulated over the evaporator causes frost to be deposited on the evaporator and it is necessary to remove the frost from the evaporator whenever an objectionable accumulation of frost has taken place. The refrigerating system includes the usual condenser 57, restrictor 59 and motor compressor unit 56.

As best shown in FIGURE 2 of the drawing, three of the fins 32 are provided with aligned apertures 34 adjacent the forward edge of the fins 32 where the frost tends to accumulate the fastest. A polycrystalline photoconductor device 36 is provided in alignment with the apertures 34 and is adapted to receive light directed through the apertures from a light bulb 38 located adjacent one end of a Lucite or other type of plastic light transmitting rod 40 which has its one end located adjacent the light

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bulb 38 and which has its other end arranged in alignment with the openings 34.

As best shown in FIGURE 1 of the drawing, the light bulb 38 is located directly in back of a glass or transparent plastic panel 42 exposed at the front edge of the refrigerator at all times. The light bulb 38 is arranged to be energized from the main power source 44. In the event of power failure or in the event that the light bulb 38 burns out, the lack of light at the window 42 serves as a warning to the user that something is wrong, such as a burned out fuse, burned out bulb or the like.

The polycrystalline photo-conductor 36 is located in the circuit as shown. The circuit includes a silicon controlled rectifier 50 in circuit with a solenoid coil 52 which forms a part of a defrost control relay. The solenoid coil 52 operates a switch 54 which selectively closes a circuit to the motor compressor unit 56 or a defrost heater 58. With the switch 54 in the position in which it is shown in FIGURE 1 of the drawing, power is supplied to the compressor through the switch 54 and a conventional compressor cycling thermostat 59 located in the compartment 12. Upon energization of the coil 52, the switch 54 will break the circuit to the compressor motor and will close the circuit to the defrost heater 58 so as to cause defrosting of the evaporator 22. A diode 60 is provided in the gate circuit of the silicon controlled rectifier 50 so as to prevent inverse voltage from being applied between the cathode 62 and gate during the reverse part of the cycle of the alternating current power supply. A variable resistance 64 is provided in the circuit as shown and is used to control the gate current and also provides for adjustment for high or low line voltages.

By virtue of the above-described circuit arrangement, the circuit energizes the solenoid coil 52 through the silicon controlled rectifier 50 whenever the light source to the light cell is blocked by accumulated frost. The relay or solenoid coil 52 then actuates and interrupts the power to the compressor circuit and energizes the defrost heaters in the evaporator coil. Removal of frost allows the light cell to receive light and then the relay returns the compressor to the circuit. As the frost again accumulates on the evaporator, the holes 34 in the fins gradually fill with frost until the light striking the light cell through the holes becomes insufficient and the silicon controlled rectifier is allowed to conduct. It is the purpose of the light cell 36 to hold the gate 62 and silicon controlled rectifier cathode 63 at approximately the same potential. The diode 60 in this silicon controlled rectifier gate circuit is used to prevent inverse voltage from being applied between the cathode 63 and the gate 62 during the reverse part of the alternating current cycle.

For purposes of illustration the light sensing means has been shown as a polycrystalline photo conductor whereas other types of photoelectric devices could be used in so far as certain aspects of the invention are concerned. Likewise, a silicon controlled rectifier has been shown whereas any other type of semiconductor switch means such as a transistor could be used.

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

What is claimed is as follows:

1. In combination, an evaporator, a compressor, a condenser, refrigerant flow connections between said compressor, condenser and evaporator, means for controlling the flow of refrigerant to said evaporator so as to cause formation of frost on said evaporator, means for defrosting said evaporator, and a photoelectric detector means responsive to the accumulation of frost on said evaporator for controlling said means for defrosting said evaporator.

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tor, said detector means comprising a light source located remote from said evaporator, a light transmitting bar leading from said light source to a point adjacent said evaporator, a light sensitive device, said evaporator having a portion interposed between said bar and said light sensitive device, said evaporator portion having a light passage formed therein whereby accumulation of frost on said evaporator restricts the passage of light from said light source to said light sensitive device, said light source comprising a continuously energized light bulb, said light bulb being exposed to view at all times whereby failure of power or failure of said bulb to light serves as a warning.

2. In a refrigerator having an evaporator and a defrost control circuit, a source of supply of electrical current, a defrosting control means, a semi-conductor comprising a cathode, an anode, and gate, a main circuit connected across said source of supply of electrical current comprising in a series connection said cathode, anode and said defrosting control means for controlling in said main circuit the flow of current by said semi-conductor, a second circuit including said gate, and light sensitive means responsive to the accumulation of frost on said evaporator for varying the flow in said second circuit operable to connect and disconnect said source of supply of electrical current to said gate.

3. In combination, an evaporator having a refrigerant conduit, means for supplying refrigerant to said conduit, an element arranged to be cooled by refrigerant flowing in said conduit and having an aperture therein disposed in close proximity to a portion of said conduit at a point where the frost tends to accumulate on said evaporator, means for forcefully circulating air in thermal exchange with said evaporator, and means responsive to restriction of said aperture by frost in said aperture for controlling the supply of refrigerant to said evaporator, said last named means comprising a silicon controlled rectifier means.

4. In a refrigerating system, an evaporator, means for supplying refrigerant to said evaporator, said evaporator having a plurality of fins, a plurality of aligned apertures in said fins in an area where the frost tends to accumulate on said evaporator, means for forcefully circulating air through said evaporator between said fins, a light source directing light through said apertures, and light sensitive means responsive to blockage of said apertures by frost in said apertures for controlling the supply of refrigerant

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to said evaporator, said last named means comprising a silicon controlled rectifier means.

5. In a refrigerator having an evaporator and a defrost control circuit, a source of supply of electrical current, a defrosting control means, a semi-conductor comprising a cathode, an anode, and gate, a main circuit connected across said source of supply of electrical current comprising in a series connection said cathode, anode and said defrosting control means for controlling in said main circuit the flow of current by said semi-conductor, a second circuit including said gate, light sensitive means responsive to the accumulation of frost on said evaporator for varying the flow in said second circuit operable to connect and disconnect said source of supply of electrical current to said gate, and means for compensating for voltage changes in said source of supply current.

6. In a refrigerator having an evaporator and a defrost control circuit, a source of supply of electrical current, a defrosting control means, a semi-conductor comprising a cathode, an anode, and gate, a main circuit connected across said source of supply of electrical current comprising in a series connection said cathode, anode and said defrosting control means for controlling in said main circuit the flow of current by said semi-conductor, a second circuit including said gate, light sensitive means responsive to the accumulation of frost on said evaporator for varying the flow in said second circuit operable to connect and disconnect said source of supply of electrical current to said gate, and current control means operatively connected to said gate for applying an additional control of the current to said gate.

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