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(54) **Control apparatus for a refrigerating appliance of the automatic defroster type.**

(57) A control apparatus for a refrigerating appliance comprises a commutator controlled by a timer for cyclically commutating from a first position, in which electric power is supplied to a compressor motor, to a second position in which power is supplied to an evaporator defrosting resistance heater via a thermostat commutator when the latter is in a position corresponding to a low temperature of the evaporator. The thermostatic commutator switches to a second position in response to sensing a higher temperature of the evaporator. The timer is supplied with electric power via the controlled commutator when the latter is in its first position, and via the series-connection of the two commutators when in their second positions. The automatic defrosting operation is thus carried out in accordance with the actual condition of the evaporator.

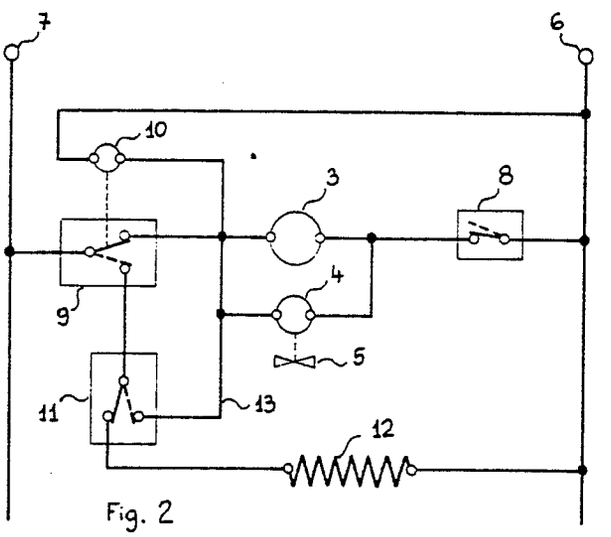

Fig. 2

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CONTROL APPARATUS FOR A REFRIGERATING APPLIANCE OF THE AUTOMATIC DEFROSTER TYPE

The present invention relates to a device for controlling the operation of refrigerating apparatus of the so-called "no frost" type, i.e. comprising at least one evaporator which is periodically defrosted in an automatic manner.

As generally known, apparatus of this type, usually refrigerators, comprise a substantially conventional refrigerant circuit including a compressor, a condenser, a throttle element and an evaporator. In particular, the evaporator is preferably of the finned type and adapted to have a fan and defrosting heater means associated thereto.

As the refrigerant circuit is normally in operation for extended periods of time, it is desirable that the ventilated evaporator be periodically defrosted in an automatic manner.

For controlling the defrosting operation it is common practice to provide refrigerant apparatus of the type comprising a ventilated evaporator with an automatic defrosting control assembly of the type shown in fig. 1. In an arrangement of this type, the motor 3 of the compressor and the motor 4 of the fan 5 associated to the evaporator are disposed in parallel and adapted to be connected to the terminals 6, 7 of an electric power supply through a thermostat breaker switch 8 and a controlled commutator switch 9 lying in series therewith. In particular, thermostat breaker switch 8 is of the normally closed type and adapted to open when the temperature of the compartment cooled by the ventilated evaporator attains the desired nominal value of for instance -18°C.

Commutator switch 9 is controlled by an electromechanic or electronic timer 10 directly connected to terminals 6, 7 of the electric power supply. Commutator switch 9 is normally in the position shown in full lines for supplying power to electric motors 3 and 4, and is cyclically, for instance once in 24 hours, actuated by timer 10 to switch to the position shown in dotted lines for supplying power to at least one defrosting resistance heater 12 of the ventilated evaporator through a thermostat breaker switch 11. Commutator switch 9 remains in its defrosting position for a preselected period of for instance 30 minutes, thermostat breaker switch 11 being normally closed an adapted to open when the evaporator attains a preselected temperature of for instance +5 °C considered sufficient for the defrosting operation. During normal operation of the refrigerating apparatus, timer 10 as well as motors 3 and 4 of the compressor and fan, respectively, are energized, so that the refrigerant circuit is maintained in operation for the entire period determined by timer 10. The latter cyclically actuates commutator switch 9 to assume the position shown in dotted lines for a fixed defrosting period during which motors 3 and 4 are deenergized while defrosting resistance heater 12 is being energized. If thermostat breaker switch 11 indicates that the evaporator has attained its defrosting temperature before termination of the fixed period, resistance heater 12 is deenergized, whereas the refrigerant circuit is only reactivated on termination of the prefixed defrosting period.

There is thus an indefinite and undesirable down time during which the ventilated evaporator is not in operation after having been sufficiently defrosted, even if thermostat 8 indicates a relatively high temperature of the interior of the refrigerated compartment.

On the other hand, on termination of the defrosting period as determined by timer 10, resistance heater 12 is deenergized and motors 3 and 4 are again energized, even if for any reason the evaporator has not yet been completely defrosted. As a result, the refrigerant circuit resumes its operation under anomalous conditions adversely affecting the overall performance of the refrigerating apparatus.

It would be desirable, and is therefore an object of the invention to provide a simple control apparatus for a refrigerating appliance capable of ensuring that the periodic and automatic defrosting of the evaporator and the operation of the refrigerant circuit are controlled in accordance with the actual operating conditions of the refrigerating appliance.

According to the invention, this object is attained in a control apparatus for a refrigerating appliance having a refrigerant circuit including a compressor and at least one evaporator of the automatic defrosting type, comprising a commutator switch controlled by timing means for cyclically switching from a first operative position, in which electric power is supplied to the motor of the compressor, to a second operative position, in which electric power is supplied to evaporator defrosting means via a thermostatic commutator switch when the latter is in a first operative position corresponding to a predetermined low temperature value of the evaporator. This control apparatus is characterized in that said thermostat commutator switch assumes a second operative position in response to a predetermined higher temperature value of said evaporator, said timing means being adapted to have electric power supplied thereto through said controlled commutator switch when in

its first operative position, and through a series-connection of said controlled commutator switch and said thermostat commutator switch when in their respective second operative positions.

The characteristics and advantages of the invention will become more clearly evident form the following description, given by way of example with reference to fig. 2 of the drawings.

Fig. 2 shows a preferred embodiment of the control apparatus according to the invention, wherein components corresponding to ones shown in fig. 1 are designated by the same reference numerals. The control apparatus of fig. 2 substantially shows only a few basic differences with respect to the embodiment of fig. 1. In particular, in a similar manner as motors 3 and 4, timer 10 is not directly connected to terminals 6 and 7 of the electric power supply, but through commutator switch 9 controlled by itself. More specifically, timer 10 is supplied with electric power through commutator switch 9 when the latter is in its normal operative position indicated in full lines in fig.2. Thermostat commutator 11, which is responsive to the temperature of the evaporator (not shown), is of the type having two operative positions. More specifically, thermostat commutator 11 assumes the position shown in full lines in fig. 2 in response to a low temperature of for instance -20 °C of the evaporator, and the position shown in dotted lines in response to a higher temperature of for instance +5 °C.

According to another aspect of the invention, a connection 13 ensures that in the same manner as motors 3 and 4, timer 10 is supplied with electric power via the series-connection of commutators 9 and 11 when they are both in the operative positions shown by dotted lines in fig. 2.

Timer 10 is effective to control commutator switch 9 in such a manner that it is normally in the operative position shown in full lines, and is cyclically, for instance once in 24 hours, switched to the operative position shown in dotted lines for a relatively short period of time of for instance 2 minutes. This period of time is preferably shorter than the period of for example 5 minutes required by thermostat commutator 11, during normal operation of the refrigerating appliance, on termination of each evaporator defrosting operation to switch from the position shown in dotted lines and corresponding to the temperature of about +5 °C, to the position shown in full lines and corresponding to the temperature of about -20 °C. The timing of this switching operation is of course calculated on the base of the operating characteristics of the refrigerating appliance as a whole.

The operation of the control apparatus according to the invention is substantially conventional and need not be described in detail. It is merely intended to point out some functional aspects deriving from the above indicated characteristics.

At the beginning of each defrosting operation, thermostat commutator 11 senses a low temperature of the evaporator (e.g. -20 °C), and is therefor in the operative position indicated in full lines, while commutator 9 is actuated by timer 10 to assume the position shown in dotted lines.

As a result, motor 3 of the compressor and motor 4 of fan 5 are deenergized, while defrosting resistance heater 12 is supplied with electric power via commutators 9 and 11 in series with one another. At the same time, timer 10 is likewise deenergized, so that the defrosting operation proceeds during a period strictly necessary for heating the evaporator to the predetermined defrosting termination temperatrue of about +5 °C. At this instant thermostat commutator 11 commutates to the position indicated in dotted lines to thereby deenergize resistance heater 12 and reestablish the electric power supply to motors 3 and 4 and timer 10. In this manner the refrigerant circuit resumes operation immediately after termination of the evaporator defrosting operation. This condition is maintained until the evaporator again attaines its predetermined low temperature value of about -20 °C, causing thermostat commutator 11 to return to its position indicated in full lines. In the meantime, however, timer 10 has already actuated commutator 9 to assume its position indicated in full lines, so that defrosting resistance heater 12 remains in its deenergized state, while motors 3 and 4 as well as timer 10 are supplied with electric power through commutator 9.

As already indicated above, this commutating operation of commutator 9 reliably occurs before that of thermostat commutator 11 to thereby ensure correct, continuous and efficient operation of the refrigeratinig appliance as a whole. In the foregoing description it has been assumed that thermostat breaker switch 8 is in its normally closed state. As a matter of fact, thermostat switch 8 is adapted to open to thereby deenergize motors 3 and 4 when the temperature of the compartment refrigerated by the ventilated evaporator attains a predetermined low value.

It is to be understood that the described control appartus may undergo any modifications falling within the scope of the invention while maintaining the specific characteristics set forth in the claims.

Claims

1. Control apparatus for a refrigerating appliance having a refrigerant circuit including a compressor and at least one evaporator of the automatic defroster type, comprising a commutator controlled by timer means for cyclically switching from a first position, in which it is adapted to supply electric power to the motor of said compressor, to a second operative position, in which it is adapted to supply electric power to evaporator defrosting means via a thermostat commutator when the latter is in a first operative position corresponding to a predetermined low temperature value of said evaporator, characterized in that said thermostat commutator (11) is adapted to switch to a second operative position in response to sensing a predetermined high temperature value of said evaporator, said timer means (19) being adapted to have electric power supplied thereto through said controlled commutator (9) when in its first operative position, and via the series-connection of said controlled commutator (9) and said thermostat commutator (11) when in their second operative positions.

2. Control apparatus according to claim 1, characterized in that said timer means (10) when supplied with electric power is adapted to maintain said controlled commutator (9) in said second operative position for a period of time shorter than the period required by said thermostat commutator (11) for switching from its second to its first operative position.

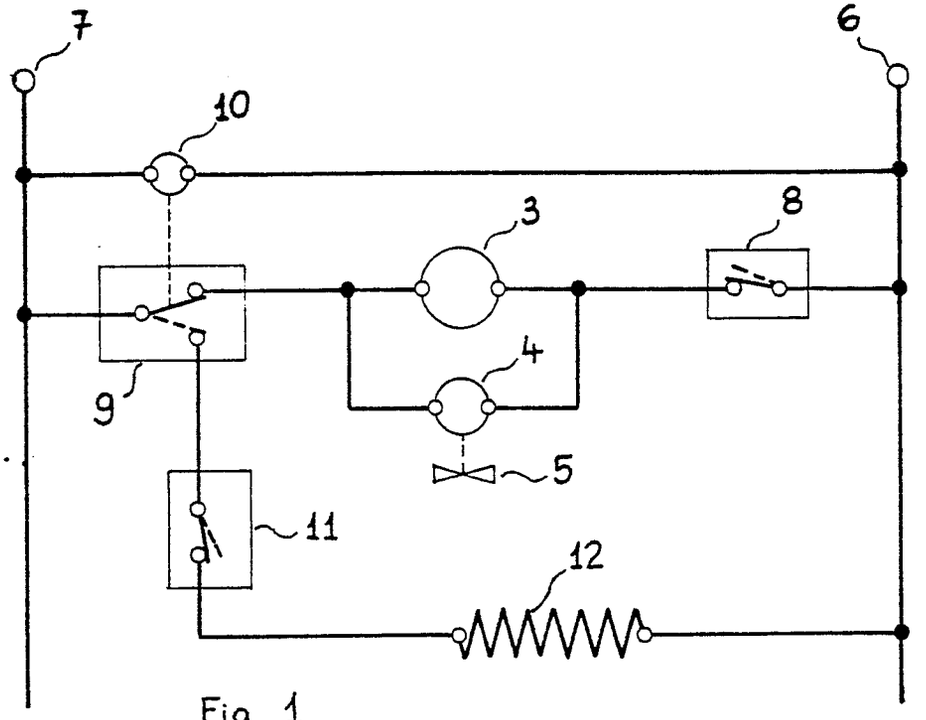

Fig. 1

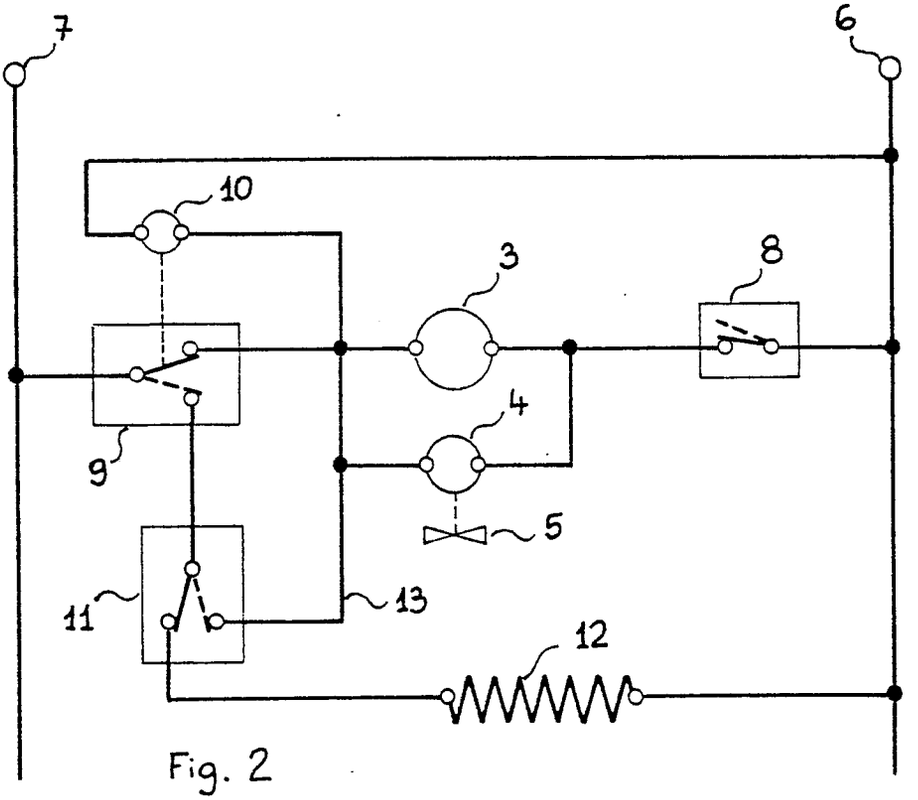

Fig. 2