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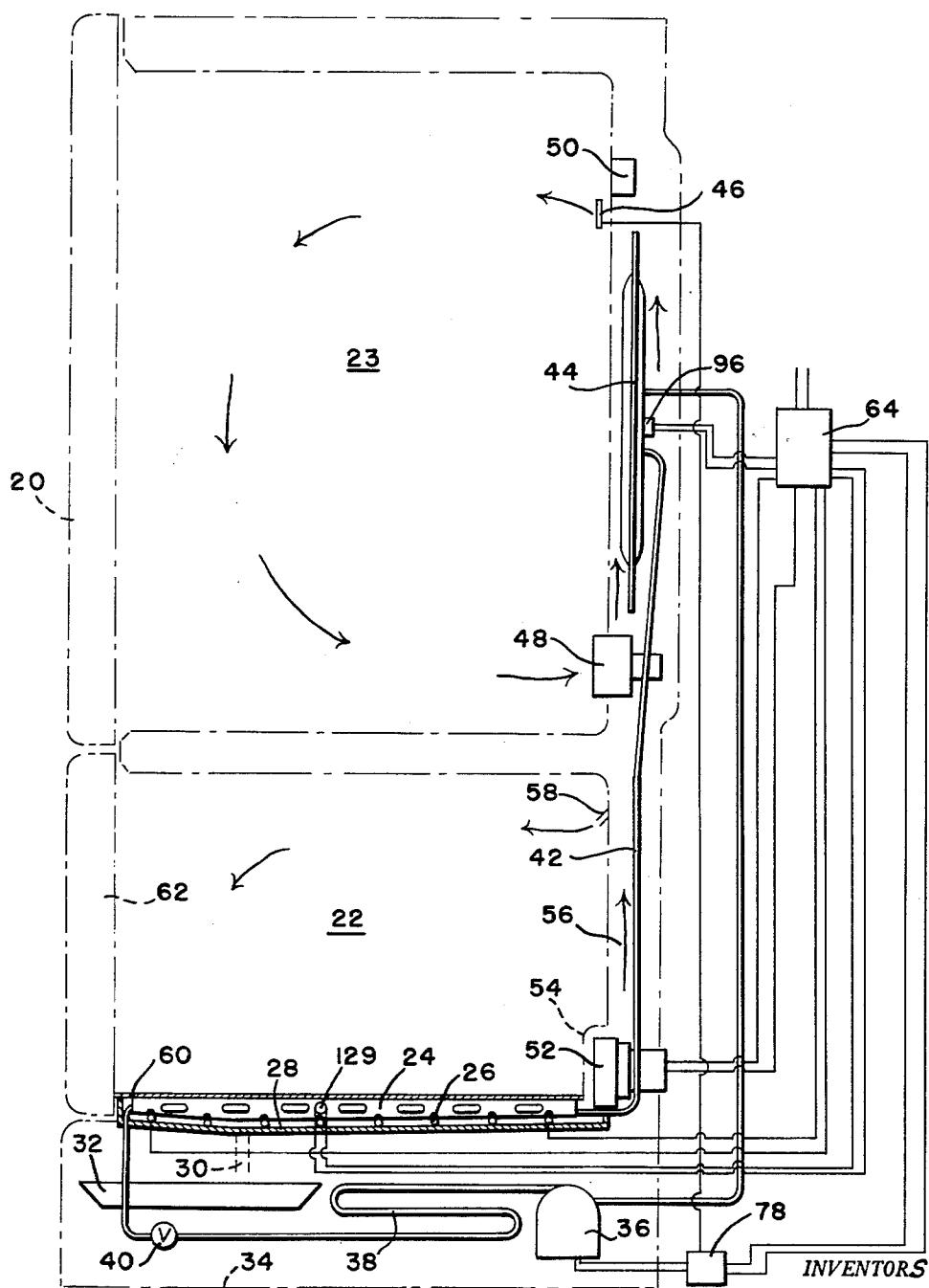
J. PAS ET AL

2,940,277

DEFROSTING SYSTEM FOR A REFRIGERATOR

Filed Nov. 19, 1956

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

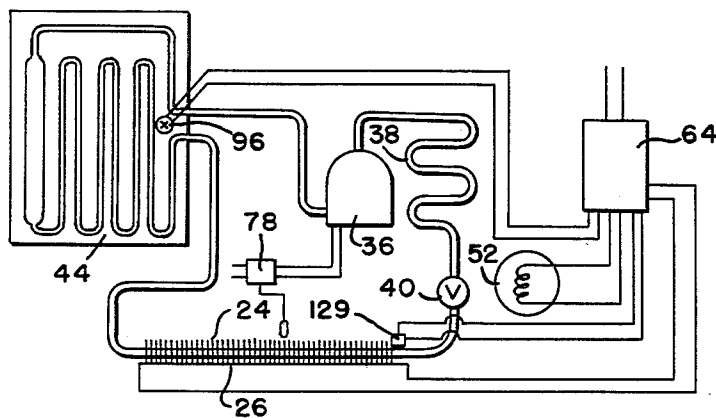


Fig. 2

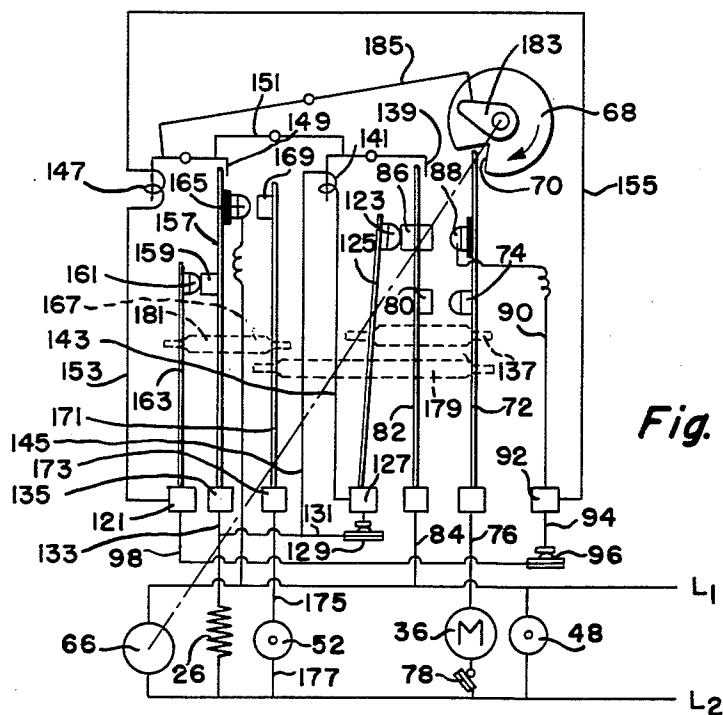


Fig. 3

	NORMAL	DEFROST	NORMAL
TIMER 66			
COMPRESSOR MOTOR 36			
FAN MOTOR 52			
DEFROST HEATER 26 ENERGIZED			
EVAP. THERMOSTAT 129 CLOSED			
PLATE THERMOSTAT 96 CLOSED			
SOLENOID 141 ENERGIZED			
SOLENOID 147 ENERGIZED			

Fig. 4

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DEFROSTING SYSTEM FOR A REFRIGERATOR

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This invention relates to refrigerating apparatus and more particularly to defrosting systems for refrigerators having serially connected evaporators.

Defrosting has always been a problem in refrigerators. It is more of a problem when there is more than one evaporator in a system.

It is an object of this invention to provide a system requiring only one principle defrost heater for defrosting serially connected evaporators of a refrigerator.

It is another object of this invention to provide a defrosting system for a refrigerator having serially connected evaporators in which the defrosting operation is controlled so that the temperature rise of each evaporator is limited and the duration is minimized.

These and other objects are obtained in the form shown in the drawings in which a timer every 24 hours opens the compressor motor circuit and the freezing evaporator fan circuit and simultaneously connects the defrost heater in the circuit. The defrost heater is in direct contact with the freezing evaporator and remains energized throughout the defrosting period. When the freezing evaporator reaches a predetermined temperature above freezing, such as 34° F., a special thermostat closes to energize momentarily a solenoid to release one set of alternate operating switches to restart the motor compressor unit. The defrost heater however continues to be energized until the food compartment evaporator reaches a predetermined temperature above freezing, such as 36° F. This second thermostat energizes momentarily a solenoid which deenergizes the defrost heater and restarts the freezing evaporator fan motor. This completes the return to normal operation.

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

In the drawings:

Figure 1 is a vertical sectional view, partly diagrammatic, through a refrigerator embodying one form of our invention;

Figure 2 is a diagrammatic view showing the refrigerating system and the control system;

Figure 3 is a wiring diagram of the electrical system; and

Figure 4 is a time-operation chart.

Referring now to the drawings and more particularly to Figure 1, there is shown diagrammatically a household refrigerator 20 in dot and dash lines including a lower freezing compartment 22 and an upper food compartment 23. The bottom wall of the freezing compartment 22 rests upon the top of a freezing evaporator 24 formed of a serpentine coil imbedded in vertical fins extending from front to rear of the refrigerator. The bottom edge of the fins are provided with flanged recesses receiving and resting upon a serpentine shaped sheathed defroster heater 26. This defrost heater 26 rests upon a drain pan 28 and keeps the fins of the evaporator 24 spaced away from the pan 28 a distance

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of about a sixteenth of an inch. The drain pan 28 drains through the tube 30 into an evaporator pan 32 which collects and evaporates the defrost water in the warm machinery compartment 34.

This machinery compartment 34 contains a sealed motor compressor unit 36 and a condenser 38 which dissipates heat sufficient to evaporate the defrost water from a pan 32. The liquid refrigerant flows from the condenser 38 under the control of a suitable valve or restrictor 40 into the freezing evaporator 24. The refrigerant evaporates within the evaporator 24 at a very low pressure to produce temperatures of below 0° F. The mixture of liquid and evaporated refrigerant leaving the evaporator 24 is conducted upwardly by the conduit 42 to a vertical plate evaporator 44 located in an air circulating passage in the rear wall of the refrigerator behind the food compartment 23. The bottom of this passage contains a continuously operating motor driven fan 48 which draws cold air from the bottom of the food compartment 23 and forces it upwardly through the passage to the discharge outlet 50 which returns the air to the food compartment. In this way proper refrigeration temperatures are maintained.

At the rear of the freezing compartment 22 is a motor driven fan 52 which is provided with an inlet shroud 54 causing it to draw air from the rear of the freezing evaporator 24. This fan 52 discharges the air through the passages 56 in the rear wall. In these passages the air is warmed and dried a small amount. The rear wall of the freezing compartment 22 is provided with openings 58 which allow the cold air to flow through the freezing compartment 22 and escape through outlets 60 at the front. The air flowing through the outlets 60 enters the spaces between the fins at the front of the evaporator 24. The air is cooled in flowing rearwardly between the fins of the evaporator 24. The bottom of the freezing compartment 22 rests on the top of the evaporator 24 providing a very cold bottom surface for quick freezing.

Frost is substantially eliminated in both compartments 23 and 22. In the passages 56, the air from the evaporator 24 is heated by conduction through the walls of the passage a small amount so that it becomes slightly dry. It has a slight capacity to pick up moisture in the freezing compartment 22 so that frost will be prevented from being deposited therein. Should any frost be formed when the freezing compartment door 62 is opened this frost will be sublimed by the slightly dry air circulated through the compartment. The compartment 23 is maintained at a suitable temperature such as 36° which is sufficiently above freezing to prevent any frost forming therein.

Although frost does not form in the compartments 22 and 23 under normal circumstances, frost does form on the evaporators 24 and 44. Since frost will readily clog the spaces between the fins of the evaporator 24 it is essential that this evaporator be defrosted before any appreciable amount of frost accumulates thereon.

According to this invention there is provided a clock timer control 64 which every 24 hours initiates a defrost period. As shown in Figure 3 a timer motor 66 diagrammatically operates a cam 68 provided with a notch 70 which presents itself to the spring blade switch member 72 once every 24 hours. The spring blade 72 has one contact 74 connected by the conductor 76 to the compressor motor 36. Connected in series with the compressor motor 36 is a thermostat switch 78 which may be controlled by a bulb 46 responsive to the temperature of the air in the compartment 23. This switch 78 in turn is connected to the supply conductor L2. The fan motor 48 is connected directly across the supply conductors L1 and L2 so that

it operates continuously whenever the system is in operation.

The contact 74 is adapted to make contact with the cooperating contact 80 on the spring blade 82 which is connected by the conductor 84 to the supply conductor L1. When the notch 70 is presented to the end of the spring blade 72 the blades 72 and 82 will be separated to separate the contacts 74 and 80 to deenergize the compressor motor 36. The spring blade 82 also carries a double contact 86 which is adapted to make contact with an insulated contact 88 mounted upon but insulated from the spring blade 72. This insulated contact 88 is connected by a flexible conductor 90 to the terminal 92. The terminal 92 is connected by the conductor 94 to a thermostat switch 96 mounted on the plate evaporator 44 near the inlet and outlet connections. This switch 96 is adapted to open at a temperature above freezing such as 36° F. This thermostatic switch 96 is connected by the conductor 98 to the terminal 121.

The double contact 86 is adapted to make contact also with a contact 123 upon a spring blade 125 fixed to the terminal 127. This terminal 127 is connected to a thermostat 129 adapted to open at a suitable temperature above freezing such as 34° F. This thermostat 129 is adapted to be located at the rear of the evaporator 24. It is connected by the conductor 131 to a conductor 133 extending between a terminal 135 and the defrost heater 26. The other terminal of defrost heater 26 is connected to the supply conductor L2.

The spring members 72, 82 and 125 are tensioned so that they tend to spring to the right with the member 72 against the periphery of the cam 68. The spring members 72 and 125 are kept separate a distance sufficient to insure that the contacts 123 and 88 will not simultaneously contact the contact 86. This is provided by the spacer 137. Also provided is a pivoted latch 139 adapted to hook the end of the spring member 82 to prevent it from following the spring member 72 so as to cause the contacts 80 and 74 and 86 and 88 to be separated when the notch 70 presents itself to the end of the spring member 72. The latch 139 is lifted by a solenoid 141 connected by the conductors 143 and 145 with the terminal 127 and the conductor 131 so as to be connected in parallel or shunt with the thermostat 129. The energization of the solenoid 141 therefore will lift the latch 139 and allow the spring member 82 to move the contacts 80 and 86 into engagement with the contacts 74 and 88.

The solenoid 147 when energized lifts the latch 149. The lifting of the latch 149 through the bell crank lever 151 also lifts the latch 139. The solenoid 147 is connected by the conductors 153 and 155 with the terminals 121 and 94. It is connected in parallel circuit or shunt arrangement with the thermostat 96 similarly connected by the conductors 98 and 94 to the terminals 121 and 92.

The latch 149 cooperates with the leaf spring 157 carrying a contact 159 cooperating with the contact 161 on a leaf spring 163 anchored to the terminal 121. The leaf spring 157 also carries an insulated contact 165 connected by a flexible conductor 167 with the supply conductor L1. This insulated contact 165 is adapted to cooperate with a contact 169 on leaf spring member 171 anchored to the terminal 173. This terminal 173 is connected by the conductor 175 to the freezing evaporator fan motor 52 in turn connected by the conductor 177 to the supply conductor L2. The leaf spring member 171 is operated simultaneously with the leaf spring member 72 by the spacer bar 179. The leaf springs 163, 157 and 171 have an inherent spring bias toward the right in Figure 3.

In operation, as long as the spring member 72 rides on the periphery of the cam 68, the contacts 80 and 74 will remain closed to keep the circuit of the compressor motor 36 energized whenever the switch 78 is closed. Likewise the contacts 86 and 88 will remain closed but no current will flow through this circuit as long as the contacts 159 and 161 remain open. The contacts 165 and

169 are normally in engagement to keep the circuit closed of the evaporator fan motor 52. The timer motor 66 and the fan motor 48 for the food compartment are continuously energized. Since the evaporator 24 operates below 0° F. it will frost rapidly. If frost is allowed to accumulate it will block the passages between the fins. The evaporator 44 may also frost. To prevent frost accumulation, once every 24 hours, the notch 70 will present itself to the spring member 72. The latch 139 will retain the spring member 82 while the latch member 149 will retain the spring member 157. The movement of the spring member 72 into the notch 70 will allow the spacer bar 179 to move to the right to allow the spring member 171 and its contact 169 to move to the right away from the contact 165. This will deenergize the fan motor 52 and the compressor motor 36. The movement of the spring member 72 to the right into the notch 70 permits the movement of the spacer bar 137 and the spring member 125 and its contact 123 to move to the right into engagement with the contact 86.

This energizes the defrost heater 26 through the conductor 133, the conductor 131, the thermostat 129, the terminal 127, the spring member 125, the contacts 123 and 86, the spring member 82 and the conductor 84. This energization heats the drip pan 28 as well as the evaporator 24 and any liquid refrigerant therein. The frost on the evaporator 24 will melt and flow on the pan 26 through the drain 30 into the pan 32 where it will evaporate by reason of the heat in the machinery compartment 34. Some hot vapor slowly rises through the refrigerant conduit 42 into the plate evaporator 44 thus beginning a slower warming process in this evaporator. Frost however will accumulate less rapidly on the evaporator 44 than on the evaporator 24 since the evaporator 24 operates at all times at a very cold temperature such as below 0° F. The evaporator 44 however may cycle at temperatures below and above freezing.

When the evaporator 24 reaches a suitable temperature above freezing such as 34° F. to indicate that it has been fully defrosted, the thermostat 129 will open. Since this thermostat 129 is connected in shunt with the solenoid 141 it will keep the solenoid 141 deenergized as long as it is closed but as soon as it opens it will energize the solenoid 141 causing the latch 139 to be lifted to free the spring member 82 for movement to the right to return the contacts 80 and 86 into engagement with the contacts 74 and 88. The spring member 125 will be prevented from following the spring member 82 by the spacer bar 137 which is held in position by the spring member 72. By preventing the movement of the spring member 125 the contact 86 will be moved away from the stationary contact 123 to open the circuit, immediately deenergizing the solenoid 141 as shown in Figure 4. The defroster heater 26 will now have its energization continued through the conductor 133, the spring member 157, the contacts 159 and 161, the spring member 163, the terminal 121, the conductor 98, the food compartment evaporator thermostat 96, the conductor 94, the flexible conductor 90, the contacts 88 and 86, the spring member 82 and the conductor 84 which connects with the supply conductor L1. The compressor motor 36 will be restarted and reenergized by the closing of the contacts 74 and 80 as indicated in the time chart Figure 4.

The continued heating of the evaporator 24 and the operation of the motor compressor unit 36 will cause heat from the heater 26 to be carried to the plate evaporator 44 until the evaporator 44 rises above a suitable freezing temperature such as 34° or 36° F. When this temperature is reached the thermostat 96 will open thus energizing the solenoid 147 which will normally release the latch 149 but through the lever 151 also will release the latch 139 in the event that it has not already been released. The releasing of the latch 149 will allow the spring member 157 to move to the right to carry the contact 165 into engagement with the contact 169 to re-

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energize the fan motor 52. The spacer bar 181 between the spring members 171 and 163 will insure the separation of the contacts 159 and 161 to deenergize the defroster heater 26. The system is now restored to normal operation with the compressor motor 36 cycling under the control of the usual thermostatic switch. The timer motor 66 will advance the notch so that the cam 68 will again present its periphery to the spring member 72 and move all the spring members to the left causing the spring members 82 and 157 to be released by their respective latches 139 and 149.

To assure the resumption of refrigeration within a reasonable time in the event that the evaporators 24 and 44 are not defrosted quickly, an additional cam 183 is provided at the side of the cam 68 in such an angular position relative to the notch 70 that after a predetermined period after the initiation of a defrost cycle, it will engage and move the lever 185 counterclockwise. The opposite end of the lever 185 will trip the latch 149 which in turn will trip the latch 139.

The system then will continue to cycle the motor compressor unit 36 under the control of a conventional thermostatic switch 78 which may be responsive to the temperature of the air in the food compartment 23. The timer is therefore prepared for the next defrosting period which will occur about 24 hours later when the notch 70 again presents itself to the spring member 72. This arrangement provides for frequent defrosting so that frost is kept at a relatively low amount so that a free flow of air continues at all times.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. A refrigerator including a cabinet provided with a freezing compartment and a food compartment, a freezing evaporator for cooling the freezing compartment and a food compartment evaporator for cooling the food compartment, refrigerant liquefying means operatively connected to said evaporators, a defroster heater for heating said freezing evaporator for defrosting, means for normally cycling said refrigerant liquefying means to maintain said compartments at desired temperatures, defrosting control means for rendering ineffective said normally cycling means and for periodically stopping said liquefying means and for coincidentally energizing said defroster heater, means responsive to the temperature of said freezing evaporator for rendering effective said normally cycling means for restarting said liquefying means, and means responsive to the temperature of said food compartment evaporator for deenergizing said defroster heater.

2. A refrigerator including a cabinet provided with a freezing compartment and a food compartment, a freezing evaporator for cooling the freezing compartment and a food compartment evaporator for cooling the food compartment, refrigerant liquefying means operatively connected to said evaporators, a defroster heater for heating said freezing evaporator for defrosting, fan means for circulating air in heat exchange with said freezing evaporator and said freezing compartment, means for periodically stopping said liquefying means and said fan means and energizing said heater, means responsive to the temperature of said freezing evaporator for restarting said liquefying means, and means responsive to the temperature of said food compartment evaporator for deenergizing said defroster heater and restarting said fan means.

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3. A refrigerator including a cabinet provided with a freezing compartment and a food compartment, a freezing evaporator for cooling the freezing compartment and a food compartment evaporator for cooling the food compartment, a refrigerant liquefying means connected with said evaporators in an operative series flow arrangement, a defroster heater in direct heat transfer relation with said freezing evaporator and through said series flow arrangement with said food compartment evaporator, defrosting control means for periodically stopping said liquefying means and coincidentally energizing said defroster heater to defrost both the freezing and food compartment evaporators, means responsive to the temperature of said freezing evaporator for operating said defrosting control to restart said liquefying means, and means responsive to the temperature of said food compartment evaporator for deenergizing said defroster heater.

4. A refrigerator including a cabinet provided with a freezing compartment, a freezing evaporator for cooling the freezing compartment below freezing temperatures, an electrically operated refrigerant liquefying means operably connected to said evaporator, an electric defroster heater for heating said freezing evaporator for defrosting, an alternately closing switch means for normally energizing said liquefying means and alternately said heater, means for operating said switch means to deenergize said liquefying means and energize said heater, latch means for holding said switch means for continuing the energization of said heater, electrically operated release means for said latch means, a thermostatic switch means located in heat transfer relation with said evaporator set for opening at above freezing temperatures and for closing at below freezing temperatures, and electrical connections connecting said release means and said thermostatic means in parallel circuit relation with each other and in series with said heater for controlling the termination of defrosting.

5. A refrigerator including a cabinet provided with a freezing compartment, a freezing evaporator for cooling the freezing compartment below freezing temperatures, an electrically operated refrigerant liquefying means operably connected to said evaporator, an electric defroster heater for heating said freezing evaporator for defrosting, an alternately closing switch means for normally energizing said liquefying means and alternately said heater, means for operating said switch means to deenergize said liquefying means and energize said heater, electrically operated means for controlling the movement of said switch means to deenergize said heater and to reenergize said liquefying means, a thermostatic switch means located in heat transfer relation with said evaporator set for opening at above freezing temperatures and for closing at below freezing temperatures, and electrical connections connecting said electrically operated means and said thermostatic means in parallel circuit relation with each other and in series with said heater for controlling the termination of defrosting.

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