Oct. 1, 1963 J. J. O'CONNELL 3,105,364

REFRIGERATING APPARATUS WITH DEFROST MEANS

Filed April 24, 1961 2 Sheets-Sheet 1

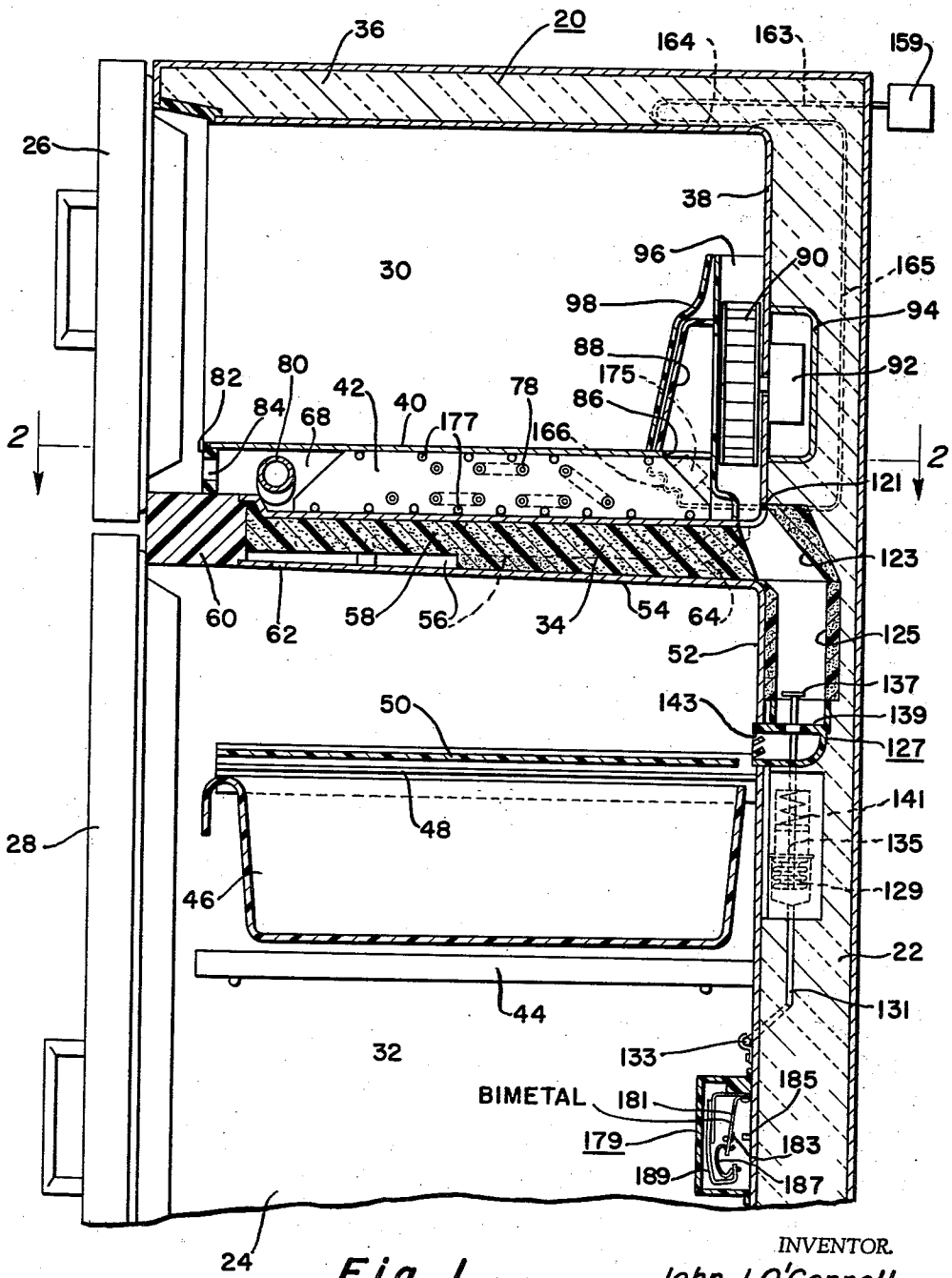

Fig. 1

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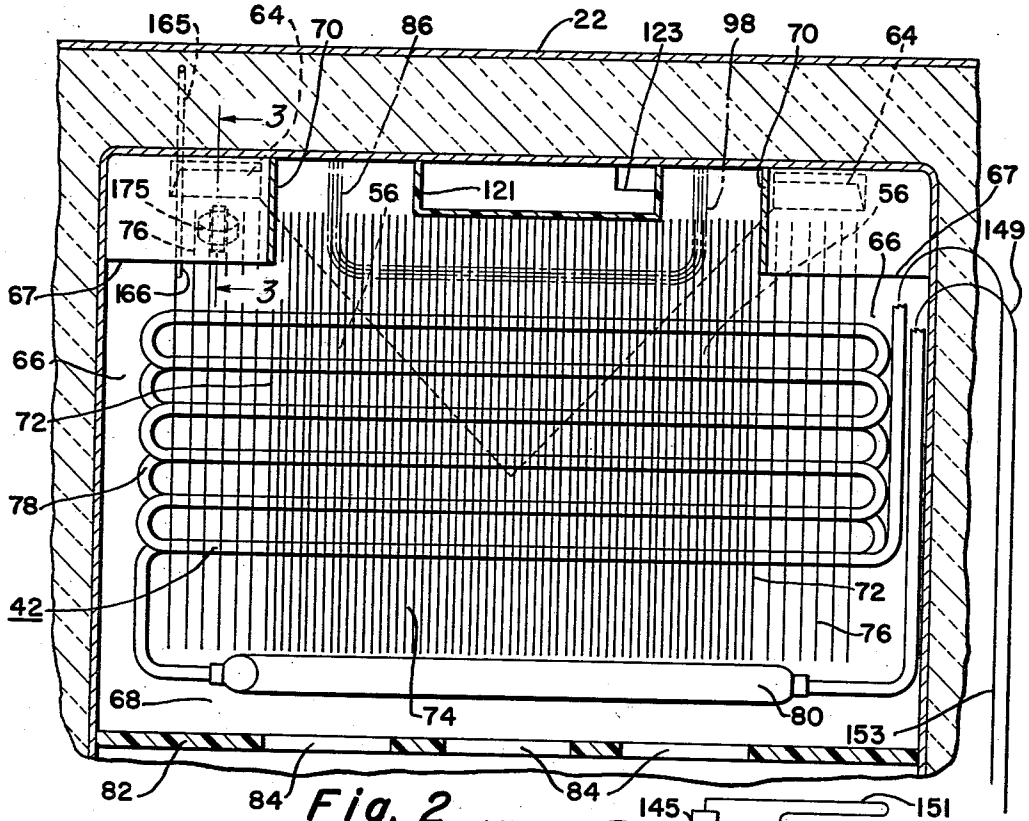

Fig. 2

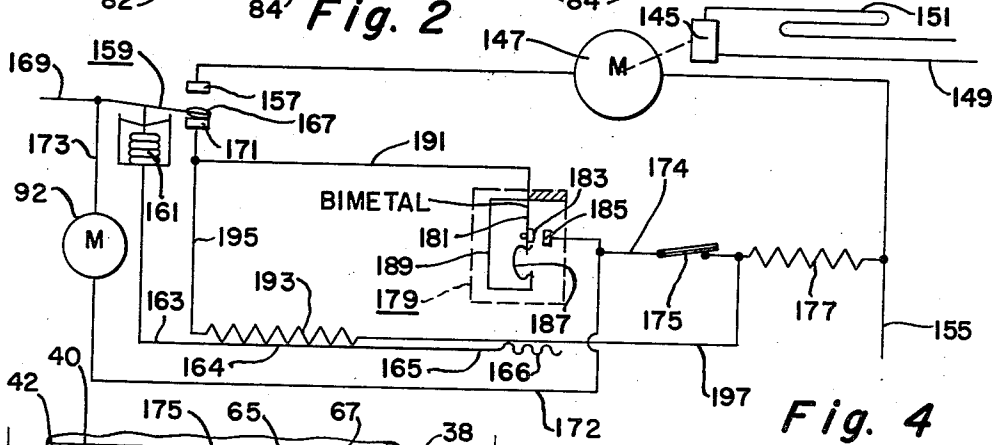

Fig. 4

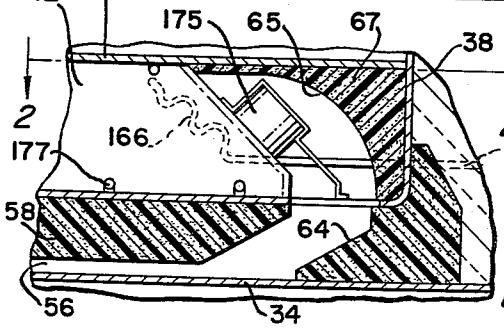

Fig. 3

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3,105,364
REFRIGERATING APPARATUS WITH DEFROST MEANS

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18 Claims. (Cl. 62—156)

This invention pertains to refrigerating apparatus and more particularly to means for defrosting the single evaporator of a single evaporator frost-proof refrigerator.

Although many devices have been devised for defrosting an evaporator when there is a predetermined buildup of frost thereon, none of such devices has achieved any widespread commercial success. Instead, whether needed or not, it has been customary to defrost the evaporator at timed intervals even though this is wasteful and unnecessarily raises the temperature of the compartments for an undesirable amount during such defrost periods.

It is an object of this invention to provide a simple economical inexpensive system for defrosting evaporators only when needed in a single evaporator frost-proof refrigerator.

It is another object of this invention to provide a simple economical inexpensive system for defrosting an evaporator only during the idle periods of the motor compressor unit arranged in such a way as to insure completion of the defrosting prior to the next running period.

It is another object of this invention to provide a simple economical inexpensive system for defrosting only when the evaporator becomes sufficiently coated with frost that it can no longer maintain the desired temperatures.

These and other objects are attained in the form shown in the drawings in which the air from the above freezing compartment is first drawn through the widely spaced fins on the edge portions of the evaporator to cool and remove moisture from this humid air by the deposit of frost upon the fins. This air is mixed at the front of the evaporator compartment with the cold dry air which is drawn from the below freezing compartment. The combined air passes rearwardly through the central closely spaced finned section of the evaporator to the inlet of the fan located at the rear of the below freezing compartment. The fan has one upward outlet discharging upwardly into the below freezing compartment and a second downwardly extending outlet extending through passages to the above freezing compartment. The above freezing compartment is kept between predetermined temperature limits above freezing by a thermostatically controlled air valve which regulates the discharge of the air over the meat container into this compartment.

The compressor motor is connected to and controlled by the warm contact of a double throw thermostatic switch responsive to the temperature of the single evaporator. The cold contact of this double throw thermostatic switch connects to the defrost system which includes a sheathed electric defrost heater associated with the single evaporator which is connected in series with parallel branch circuits, one of which includes a defrost limiter switch mounted upon a portion of the evaporator where the frost disappears last and a second thermostatic switch responsive to the temperature of the above freezing compartment and closing at a temperature slightly above the predetermined temperatures normally provided by the air valve. When the evaporator becomes sufficiently coated with frost that the temperatures in the above freezing compartment rise to its operating temperature, the second thermostatic switch will close to energize the

defrost heater subject to the movement of the double throw thermostatic switch to its cold position.

In the second branch of the parallel circuit there is provided a small wattage control heater in heat transfer with the capillary tube of the double throw thermostat. This control heater is energized when either of the thermostats in the other branch are open and the double throw thermostatic switch is in its cold position. Consequently, this heater is energized whenever the above freezing compartment is maintained between the desired predetermined limits and the evaporator is cold to reduce the temperature required to be reached before the motor compressor unit will restart. The purpose of this control heater is to prevent the restarting of the compressor before the completion of the defrosting of the evaporator. This control heater is deenergized during the defrost period so that the below freezing compartment and the single evaporator must rise to a higher temperature before the double throw thermostatic switch can be moved from the cold contact to the warm contact. This deenergization is accomplished because both the second thermostat in the above freezing compartment and the defrost limiter switch are closed during the defrost period, thereby shunting out this control heater applied to the thermostat bulb. The defrost period continues with the supply of electric energy to the defrost heater until there is a sufficient rise in temperature of the evaporator to assure complete defrosting and also to operate the defrost limiter switch to open position. This energizes the control heater applied to the thermostat bulb thereby causing the double throw thermostatic switch to move from the cold position to the warm position to restart the compressor and to return the system 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 preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a vertical side sectional view through a single evaporator frost-proof refrigerator embodying one form of my invention.

FIGURE 2 is a horizontal sectional view taken along the line 2—2 of FIGURE 1.

FIGURE 3 is a fragmentary side vertical section taken along the lines 3—3 of FIGURE 2.

FIGURE 4 is a wiring diagram.

Referring now to the drawings and more particularly to FIGURES 1 and 2, there is shown an insulated refrigerator cabinet 20 provided with an insulated rear wall 22, insulated side walls 24, an insulated top wall 36, upper and lower front doors 26 and 28 enclosing an upper below freezing storage compartment 30 and a lower above freezing storage compartment 32. The bottom insulated wall is not shown and between the compartments 30 and 32 there is provided an insulated horizontal partition wall 34.

The below freezing compartment 30 is enclosed by a liner 38 provided with a false bottom wall 40 which rests upon the top of the vertical fins of the refrigerant evaporator 42 which in turn rests upon the bottom of the inner liner 38. The above freezing compartment 32 is provided with a plurality of shelves such as the shelf 44 and a meat container 46 located above the shelf 44 provided with a lid 48 and a shield 50 located over the lid 48. The above freezing compartment 32 is enclosed within an inner liner 52 having its top wall 54 made largely false by the provision of the passages 56 in the insulation 58 of the partition wall 34. The top wall 54 extends forward to the mullion 60.

Air from the above freezing compartment 32 passes upwardly through the slots 62 in the front of the partition wall 34. The air from the above frezing compartment 32

after passing through the slots 62 flows rearwardly through the passages 56 over the top wall 54 to the apertures 64 at the rear corners of the insulation 58. This air keeps the top wall 54 warm enough to prevent condensation of moisture thereon. The air then passes upwardly through the apertures 64 and through the passages 65 in the insulation pieces 67 and thence forwardly through the side passages 66 of the evaporator and mixing compartment 68 formed between the false top wall 40 and the bottom of the inner liner 38. These passages are formed by the two dividers 70 at the rear which extend forwardly into contact with the vertical fins 72 which divided the evaporator 42 into a closely finned central section 74 and widely spaced finned edge sections 76. These vertical fins extend from the front to the rear of the evaporator and are provided with bevelled edges at the front and rear to facilitate defrosting. The fins are mounted upon serpentine refrigerant coils 78 arranged horizontally which connect at the outlet with the accumulator 80 located in front of the evaporator 42 in the front of the evaporator compartment 68.

The dividers 70 and the fins 72 also divide the evaporator and mixing compartment 68 into the previously mentioned forwardly extending passages 66 located between the fins 72 and the side edges of the evaporator compartment 68 and between the fins 72 into a central rearwardly extending passageway embracing the closing spaced fins 74. A space is provided in the front of the evaporator compartment 68 in front of the evaporator 42 for the flow of the air from the side passages 66 into the central rearwardly extending passageway embracing the fins 74. This front space also accommodates the evaporator accumulator 80 which is connected to the outlet of the sepentine refrigerant tubing 78. Between the front edge of the false bottom wall 40 and the mullion 60 is a grill 82 provided with three inlet openings 84 directly in front of the closely spaced fin portion 74 of the evaporator 42. This provides an inlet for the cold dry air from the below freezing compartment 30 into the front space of the evaporator and mixing compartment 68 directly in front of the rearwardly extending passage. This air mixes with the precooled dried air from the side passages 66 embracing the widely spaced fin portions 76. Thus, only cooled and dried air reaches closely spaced fin portions 74 of the evaporator 42. This arrangement, therefore, provides for more deposit of frost on the widely spaced fin portions 76 which are purposely spaced wider so as to accommodate more frost and where the temperature differential with the air is greater and a lesser amount on the closely spaced fin portions 74 so that a lesser amount of frost collects on the front edge of the evaporator 42 and particularly so that the frost is more evenly distributed and not concentrated at any one point of the evaporator. This minimizes clogging of the evaporator and makes it unnecessary to frequently defrost the evaporator.

The rear of the false bottom wall 40 is provided with a centrally located notch 86 which is covered by the inlet shroud 88 of the centrifugal fan 90 driven by the fan motor 92 located in a recess 94 in the rear wall 22. The fan 90 is provided with an upwardly extending discharge outlet 96 for discharging the greater portion of the cold air drawn from the evaporator compartment 68 into the below freezing compartment 30. The inlet shroud 88 and the discharge outlet 96 are enclosed within an ornamental cover 98 which prevents the air from the below freezing compartment 30 from contacting and depositing frost upon the cold surfaces of the inlet shroud 88 and the discharge outlet 96. The fan 90 has a second downwardly extending discharge outlet 121 connecting through the passages 123 and 125 in insulation pieces in the rear wall 22 with the inlet of an air valve 127.

This air valve 127 includes a fluid motor 129 operably connected through a capillary tube 131 with a thermostat bulb 133 mounted within the above freezing compartment 32 on the liner 52. The fluid motor 129 connects through a stem 135 with a rectangular valve element 137 which cooperates with a valve seat 139. The operation of the fluid motor 129 is opposed by a compression type coil spring 141 which regulates the movements so that the rectangular valve element 137 is moved to closed position when the temperature of the bulb 133 is reduced to 34° F. and it moves to fully open position when the temperature of the bulb 133 reaches 39° F. The inlet of the valve 127 connects directly with the passage 125 and its outlet 143 is provided with louvers for discharging the air directly into the above freezing compartment 32 with part of the air directed down onto the meat container 46. This air valve 127 throttles the flow of cold air so as to prevent the above freezing compartment from falling below freezing and particularly for maintaining normally its temperature between the limits of 34° and 39° F. If desired, to reduce the cost, the thermostatic actuation of the air valve 127 may be replaced by a manual adjusting and holding means which is set manually to normally maintain the above freezing compartment between the desired limits of 34° F. and 39° F.

The evaporator 42 is provided with liquefied refrigerant from a liquefying apparatus which includes a compressor 145 driven by an electric motor 147 (FIGURE 4) for drawing evaporated refrigerant through the suction line 149 from the accumulator 80 and for discharging the compressed refrigerant into a condenser 151 from which the condensed refrigerant is forwarded through a capillary tube 153 to the inlet of the serpentine refrigerant tubing 78 of the evaporator 42. One terminal of the compressor motor 147 is connected to the supply conductor 155. The opposite terminal of the compressor motor 147 is connected to the stationary warm contact 157 of a single pole, double throw snap-acting thermostat switch 159 having its movable double throw contact 167 connected to the second supply conductor 169. The switch 159 is provided with a control which causes it to be operated when the liner 38 reaches a temperature of −2° F. to move the movable double throw contact 167 out of contact with the stationary warm contact 157 and into contact with the stationary cold contact 171. This insures the maintenance of desirable frozen storage temperatures in the below freezing compartment 30. The control system for the switch 159 is arranged to move the movable contact 167 from the cold contact 171 back into contact with the warm contact 157 when the portion of the evaporator 42 nearest the incoming air from the above freezing compartment reaches a temperature of +11° F. This assures that refrigeration is quickly provided whenever the door 28 is opened to the compartment 32. It also assures the maintenance of desirable refrigeration temperatures within the compartment 32 with a minimum of fluctuation.

This dual responsiveness for the switch 159 is provided by the arrangement of the thermosensitive element of the switch 159 and the circuit arrangement shown in FIGURE 4. The switch 159 is provided with a snap-acting fluid motor 161 operatively connected to the movable double throw contact 167. This fluid motor 161 is connected by a capillary tube 163 to a dual thermostat bulb 165 having one part 164 extending into contact with and responsive to the temperature of the liner 38 surrounding the below freezing compartment 30. The thermostat bulb 165 also includes a second serpentine portion or part 166 mounted upon the inner face of one of the fins at the left rear portion of the evaporator 42 as particularly shown in FIGURE 3 where the air from the above freezing compartment 32 first contacts the evaporator 42.

To prevent the part 164 of the bulb 165 from being in control when the compressor motor 147 is idle and the contacts 167 and 171 are engaged, there is connected to the cold stationary contact 171 through the conductor 195 one terminal of a small high resistance heater 193 which is wrapped around or otherwise extended into heat trans-

fer relation with the part 164 of the bulb 165. The second terminal of this heater 193 is connected by the conductor 197 to the defrost heater circuit at a point between the defrost limiter switch 175 and the defrost heater 177 which connects the conductor with the first supply conductor 155. By this arrangement, during a normal idle period of the compressor 147, the heater 193 supplies a small amount of heat to the part 164 of the bulb 165 so as to counteract the cooling effect of the liner 138 and to raise temperature of the part 164 above the temperature of the part 166 of the bulb 165 so that the termination of the idle period of the compressor 147, under normal circumstances, will depend upon the temperature of the bulb 166. Since the heater 193 is a high resistance heater, there will be substantially no heat generated in the low resistance defrost heater 177 during this energization.

In the wiring diagram shown in FIGURE 4, the fan motor 92 is arranged to operate at all times except during the defrost period. This is accomplished by connecting one terminal of the fan motor 92 through the conductor 173 to the supply conductor 169. The second terminal of the fan motor is connected by the conductor 172 to a conductor 174 which connects through a normally closed bimetal defrost limit switch 175 and the defrost heater 177 with the second supply conductor 155. The defrost heater 177 is of such low resistance that the flow of the small current from the fan motor 92 causes a negligible amount of heating such as one watt.

The opening of the doors 26 and 28 and the storage of moist packages within the storage compartments provide a source of moisture which through the circulation of air migrates to various portions of the evaporator 42 as mentioned before. By the arrangement of the precooled widely spaced edge portions of the evaporator 42 which precool the above freezing compartment air, this collection of frost upon the evaporator 42 is substantially evenly distributed so as to minimize the concentration of frost at various points upon the evaporator 42. Eventually, this reaches a stage in which the amount of cold air supplied through the valve 127 to the above freezing compartment 32 is insufficient to keep the temperature of this compartment below 39° F. even though the valve 127 is substantially fully open. It is therefore necessary and desirable to initiate defrosting at this stage.

To control such a defrost period, I provide a bimetal thermostatic switch 179 upon the rear wall of the above freezing compartment 32 beneath the bulb 133 and the shelf 44. This small differential switch 179 is arranged to be normally open at all temperatures of the above freezing compartment 32 below 39° F.; however, when the temperature of 39° F. is reached in the compartment 32, this switch 179 is arranged to close. Since the part 166 of the thermostat bulb 165 which closes the compressor switch 169 is located near the place at which the evaporator 42 first receives the air from the above freezing compartment 32, the opening of the door of the compartment 32 immediately warms the part 166 of the bulb 165 to start the motor compressor unit. This prevents premature defrosting by preventing the compartment 32 from rising to or above the closing temperature 39° F. of the defrost control switch 179 as long as the cooling and air flow capacity of the evaporator is adequate. This also minimizes any fluctuation of temperatures in the compartments 32 and 30. This switch 179 may be of any suitable thermostatic type but, as shown, includes a cantilever bimetal arm 181 carrying a movable contact 183 normally held in the open position. It cooperates with a stationary contact 185. It is also provided with a weak C-shaped toggle spring 187 which cooperates with a hook-shaped spring arm 189. The cantilever bimetal arm is connected by the conductor 191 to the warm contact 171 of the double throw switch 159. The stationary contact 185 is connected to the conductor 174.

With this arrangement, defrosting cannot occur when the compressor motor 147 is in operation because the

double throw contact 167 of the switch 159 will be in engagement with the warm contact 157 and no current will be supplied to the cold contact 171. When the double throw switch contact 167 is moved into engagement with the warm contact 157, no substantial energization of the defrost heater 177 can take place until the temperature of the compartment 32 rises to 39° F. causing the closing of the contacts 183 and 185 to complete the circuit through the limiter switch 175 to the defrost heater 177. The defrost heater 177 is mounted in notches in the upper and lower edges of the fins of the evaporator 42. The heat provided by the defrost heater 177 is sufficient to heat rapidly the evaporator 42 and to melt the frost therefrom. This frost is removed in the form of water by suitable drain conduit means. During this defrost period, the fan motor 92 is deenergized by being shunted by the switch contacts 167 and 171, the conductor 191 and the contacts 183 and 185.

The energization of the defrost heater 177, since it supplies heat to the evaporator 42, would tend to very quickly cause operation of the switch 159 from the cold contact 171 to the warm contact 157. To prevent this from occurring and to insure the completion of the defrosting of the evaporator during the defrost period, I deenergize the previously described small heater 193 which may be wrapped around or be otherwise thermally associated with the part 164 of the thermostat bulb 165 so that this part 164 is cooled by the liner 38 sufficiently to prevent the operation of the movable contact 167 of the switch 159 from the cold contact 171 to the warm contact 157.

Thus, during the defrost period when as a result of the abnormal rise in temperature of the compartment 32, the contacts 183 and 185 are closed and the limiter switch 175 remains closed, the heater 193 is effectively shunted and deenergized by the shunt circuit provided by the closed contacts 183 and 185 and the closed limit switch 175. The resulting absence of heat for the bulb 165 and its cooling by the below freezing compartment 30 causes the switch 159 to remain with the movable contact 167 in contact with the cold contact 171 during the entire defrost period. The defrost period will, therefore, continue with the defrost heater 177 being energized through the contacts 167, 171, 183, 185 and the limiter switch 175 until the defrost limiter switch 175 is heated sufficiently (50° F.) to insure the completion of the defrosting of the evaporator 42. This switch 175 is a wide differential snap acting thermostatic switch set to open at 50° F. and to reclose at 22° F. The defrost limiter switch 175 is mounted by a suitable bracket nearest the entrance openings 64 on the beveled edges of the fins which are contacted first by the warm moist air from the above freezing compartment where the greatest amount of frost accumulates and where the frost last disappears from the evaporator 42. Therefore, the rise in temperature of this point to the opening temperature (50° F.) of the switch 175 indicates the complete removal of frost from the evaporator 42.

The opening of this defrost limiter switch 175 reenergizes the heater 193 to heat the bulb 165 to cause the operation of the movable contact 167 out of contact with the cold contact 171 and into contact with the warm contact 157 to quickly start the operation of the compressor motor 147. The fan motor 92, however, cannot start immediately since the wide differential limiter switch 175 remains open until the evaporator 42 is cooled down below the reclosing point (22° F.) of the limiter switch 175. This arrangement insures that the fan will not circulate warm air into the below freezing compartment 30 and in particular insures that the evaporator is quickly cooled to a temperature such as 22° F. before there is any fan circulation so as to prevent warming of any frozen food in the compartment 30.

Thus, through this arrangement, I have provided a control system which normally maintains the desired

temperatures with a minimum of fluctuation and which defrosts only when required and in addition prevents restarting of the fan following a defrost period until the evaporator has cooled sufficiently to prevent the warming of frozen packages in the frozen storage compartment. I have also an arrangement wherein premature defrosting is prevented and wherein defrosting takes place only when required during the idle period of the motor compressor unit and also I insure that the defrost period is continued until defrosting is complete.

While the embodiments of the present invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming a mixing compartment separated from said compartments, an evaporator portion associated with said mixing compartment, means for circulating air from said below and above freezing compartments through said mixing compartment and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above freezing temperatures, a cycling refrigerant liquefying means operatively connected to said evaporator portion having operating periods for supplying liquid refrigerant to said evaporator portion and idle periods between operating periods, and means concurrently responsive to the combination of a rise in temperature of said above freezing compartment adjacent the upper limit of said predetermined temperatures and the occurrence of an idle period for defrosting said evaporator portion.

2. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above freezing temperatures, a cycling refrigerant liquefying means operatively connected to said evaporator portion having operating periods for supplying liquid refrigerant to said evaporator portion and idle periods between operating periods, and means responsive to the combination of a rise in temperature of said above freezing compartment adjacent the upper limit of said predetemrined temperatures and the occurrence of an idle period for defrosting said evaporator portion, said last means including means for preventing the termination of the idle period prior to the termination of the defrosting of said evaporator portion.

3. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above freezing temperatures, refrigerant liquefying means operatively connected to said evaporator portion, cycling control means responsive to the temperature of said evaporator portion for starting and stopping said refrigerant liquefying means to provide running and idle periods, a defrost heater for said evaporator portion, a thermostatically controlled switch means responsive to the temperature of said above freezing compartment and operable to closed position in response to temperatures of said above freezing compartment adjacent the upper limit of said predetermined temperatures for energizing said heater, said cycling control means including means for preventing the energizing of said heater during the running periods of said liquefying means.

4. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above freezing temperatures, refrigerant liquefying means operatively connected to said evaporator portion, cycling control means responsive to the temperature of said evaporator portion for starting and stopping said refrigerant liquefying means to provide running and idle periods, a defrost heater for said evaporator portion, a thermostatically controlled switch means responsive to the temperature of said above freezing compartment and operable to closed position in response to temperatures of said above freezing compartment adjacent the upper limit of said predetermined temperatures for energizing said heater, said cycling control means including means for preventing the energizing of said heater during the running periods of said liquefying means, and means responsive to the temperature of said evaporator portion for deenergizing said defrost heater and affecting said cycling control means for starting said refrigerant liquefying means.

5. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above frozen temperatures, electrically operated refrigerant liquefying means operatively connected to said evaporator portion, a double throw temperature responsive switch means responsive to the temperature of said evaporator portion having one of its terminals electrically connected to said electrically operated liquefying means and having a second terminal, a second electric circuit connected to said second terminal, said second circuit comprising an electrical defrost heater and a normally closed defrost limiter switch associated with said evaporator portion and a normally open temperature controlled switch operated to closed position in response to temperatures adjacent the upper limit of said predetermined above freezing temperatures of said above freezing compartment.

6. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between predetermined above freezing temperatures, electrically operated refrigerant liquefying means operatively connected to said evaporator portion, a double throw temperature responsive switch means responsive to the temperature of said evaporator portion

having one of its terminals electrically connected to said electrically operated liquefying means and having a second terminal, a second electric circuit connected to said second terminal, said second circuit comprising an electrical defrost heater and a normally closed defrost limiter switch associated with said evaporator portion and a normally open temperature controlled switch operated to closed position in response to temperatures adjacent the upper limit of said predetermined above freezing temperatures of said above freezing compartment, said double throw switch means being provided with a thermosensitive element and an electric control heater thermally associated with said thermosensitive element connected in said second electrical circuit in parallel with said normally open switch and said defrost limiter switch.

7. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments containing first and second evaporator portions, means for circulating air from said above freezing compartment separately first into contact with said first evaporator portion and circulating air from said below freezing compartment together with air from said above freezing compartment after its contact with said first evaporator portion into contact with said second evaporator portion and returning the cooled air to said below and above freezing compartments, means for restricting the circulation of air between said above freezing compartment and said evaporator compartment to maintain a higher temperature in said above freezing compartment than in said below freezing compartment, refrigerant liquefying means operably connected to said evaporator portions, and control means responsive to the temperature of said first evaporator portion near the place where it is first contacted by the air from said above freezing compartment for starting said liquefying means.

8. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from asid compartments containing first and second evaporator portions, means for circulating air from said above freezing compartment separately first into contact with said first evaporator portion and circulating air from said below freezing compartment together with air from said above freezing compartment after its contact with said first evaporator portion into contact with said second evaporator portion and returning the cooled air to said below and above freezing compartments, means for restricting the circulation of air between said above freezing compartment and said evaporator compartment to maintain a higher temperature in said above freezing compartment than in said below freezing compartment, refrigerant liquefying means operably connected to said evaporator portions, and control means responsive to the temperature of said first evaporator portion near the place where it is first contacted by the air from said above freezing compartment for starting said liquefying means, and means responsive to a predetermined high temperature of said above freezing compartment for intiating the defrosting of said evaporating means.

9. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments containing first and second evaporator portions, means for circulating air from said above freezing compartment separately first into contact with said first evaporator portion and circulating air from said below freezing compartment together with air from said above freezing compartment after its contact with said first evaporator portion into contact with said second evaporator portion and returning the cooled air to said below and above freezing compartments, means for restricting the circulation of air between said above freezing compartment and said evaporator compartment to maintain a higher temperature in said above freezing compartment than in said below freezing compartment, refrigerant liquefying means operably connected to said evaporator portions, control means responsive to the temperature of said first evaporator portion near the place where it is first contacted by the air from said above freezing compartment for starting said liquefying means and responsive to the temperature of the below freezing compartment for stopping the liquefying means.

10. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, means for controlling said circulating air to normally maintain said above freezing compartment between desired above freezing temperatures, refrigerant liquefying means operatively connected to said evaporator portion, means responsive to a predetermined high temperature of said above freezing compartment for stopping said air circulating means and for initiating defrosting of said evaporator portion, means responsive to a predetermined high temperature of said evaporator portion for terminating said defrosting, and means responsive to a predetermined lower temperature of said evaporator portion for starting said air circulating means.

11. A refrigerator including means enclosing a below freezing storage compartment and an above freezing storage compartment, means forming a mixing compartment separated from said compartments, an evaporator portion associated with said mixing compartment, means for circulating air from said below and above freezing compartments through said mixing compartment and returning the cooled air to said below and above freezing compartments in amounts sufficient to maintain normally said compartments at desired below and above freezing temperatures, refrigerant liquefying means operatively connected to said evaporator portion, and means responsive to a predetermined above normal high temperature of one of said storage compartments for initiating the defrosting of said evaporator portion.

12. A refrigerator including means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments in amounts sufficient to maintain normally said compartments at desired below and above freezing temperatures, refrigerant liquefying means operatively connected to said evaporator portion, and means responsive to a predetermined high temperature of one of said compartments for initiating the defrosting of said evaporator portion and stopping the air circulation through said compartments, means for terminating the defrosting of said evaporator portion, and means responsive to a predetermined temperature of said evaporator portion for restarting said air circulation.

13. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion, means for circulating air from said below and above freezing compartments, a cooling portion in heat transfer relation with the air flowing from said above freezing compartment to said evaporator portion prior to its heat transfer with said evaporator portion, re-

frigerant liquefying means operatively connected with said evaporator portion, means for normally starting the operation of said liquefying means in response to a temperature of said cooling portion and for normally stopping said liquefying means in response to a temperature of said below freezing compartment.

14. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means associated with said insulating means forming evaporator compartment means containing evaporating means, refrigerant liquefying means operatively connected to said evaporating means, means for circulating air from said below and above freezing compartments through said evaporator compartment means in heat transfer with said evaporating means and returning the air in proportions to maintain the respective compartments at below and above freezing refrigeration temperatures, and means normally responsive to a temperature of said evaporating means for starting the operation of said liquefying means and normally responsive to a temperature of said below freezing compartment for stopping the operation of said liquefying means.

15. A refrigerator including insulating means enclosing a compartment to be kept cool, an evaporating means for cooling said compartment, an electrically operated refrigerant liquefying means operably connected to said evaporating means, a thermostatic switch means for controlling said liquefying means having an expansible chamber fluid motor and thermosensitive tubing containing a volatile liquid operatively connected to said fluid motor and having a first portion in heat transfer relation with said compartment to be kept cool and a second portion in heat transfer relation with said evaporating means, and an electric heater controlled by said thermostatic switch means and extending in heat transfer relation with one of said portions of said thermosensitive tubing.

16. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment, means forming an evaporator compartment separated from said compartments provided with an evaporator portion, means for circulating air from said below and above freezing compartments through said evaporator compartment in heat transfer with said evaporator portion and returning the cooled air to said below and above freezing compartments, a cooling portion in heat transfer relation with the air flowing from said above freezing compartment to said evaporator portion prior to its heat transfer with said evaporator portion, refrigerant liquefying means operatively connected with said evaporator portion, thermostatic switch means for controlling said liquefying means having an expansible chamber fluid motor and thermosensitive tubing containing a volatile liquid operatively connected to said fluid motor and having a first portion in heat transfer relation with said below freezing compartment and a second portion in heat transfer relation with said cooling portion, and an electric heater controlled by said thermostatic switch means and extending in heat transfer relation with one of said portions of said thermosensitive tubing.

17. A refrigerator including insulating means enclosing a below freezing compartment and an above freezing compartment insulated from each other, means for cooling said below freezing compartment to below freezing temperatures and said above freezing compartment to above freezing temperatures comprising a refrigerating system including refrigerant liquefying means and refrigerant evaporating means adapted to accumulate frost, and means concurrently responsive to the combination of a rise in temperature of said above freezing compartment to a predetermined high temperature and a fall in temperature of said below freezing compartment to a predetermined low temperature for defrosting said evaporating means.

18. A refrigerator including insulating means enclosing a below freezing storage compartment and an above freezing storage compartment insulated from each other, means forming a cooling compartment separated from said storage compartment, an evaporator portion associated with said cooling compartment, means for circulating air from said below and above freezing compartments through said cooling compartment in proportions to normally maintain said compartments at below and above freezing refrigerating temperatures, a double throw snap acting temperature responsive switch means responsive to the combination of the temperature of said evaporator portion and the temperature of the air circulated from the above freezing compartment through said cooling compartment, said switch means including first and second contacts alternately energized, electrically operated refrigerant liquefying means operably connected to said evaporator portion and electrically connected to said first contact, and means for defrosting said evaporating means electrically connected to said second contact.

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