May 21, 1957 J. M. MURPHY ET AL 2,792,691

TWO COMPARTMENT REFRIGERATOR

Filed Aug. 9, 1955 2 Sheets-Sheet 1

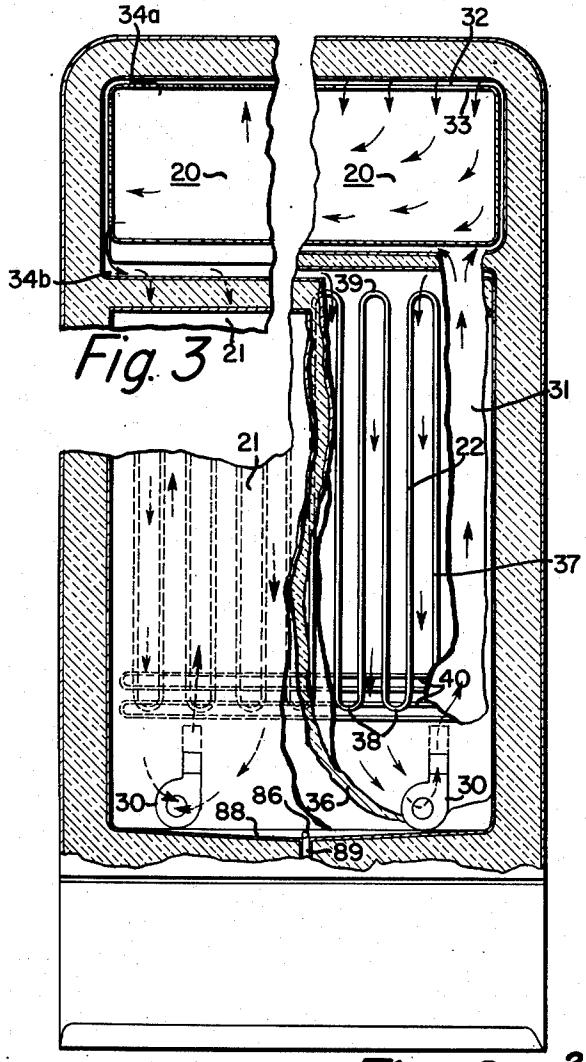


Fig. 3

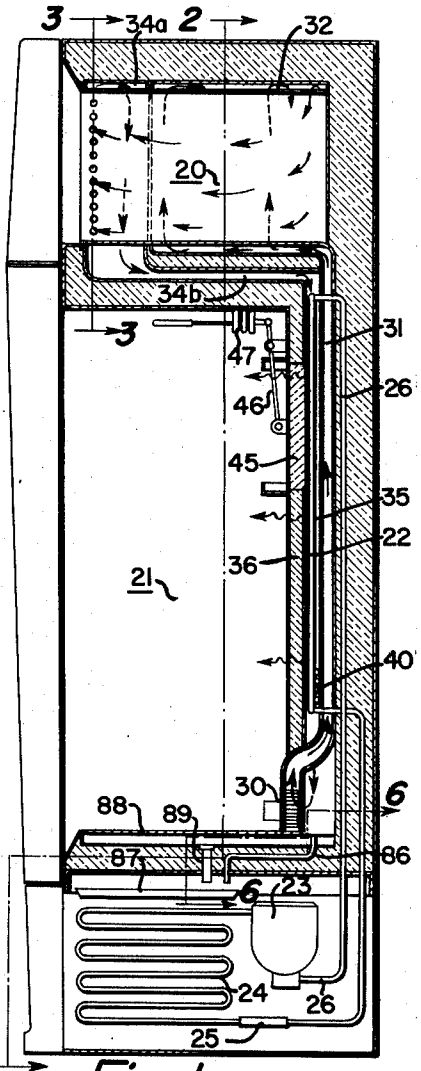


Fig. 2

Fig. 1

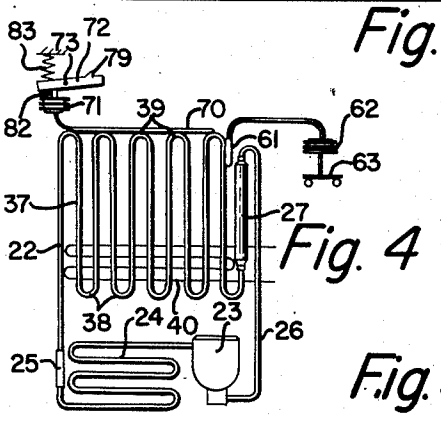


Fig. 4

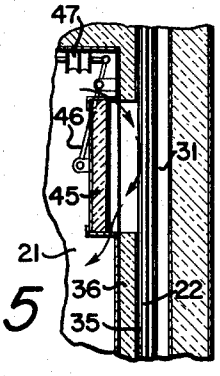


Fig. 5

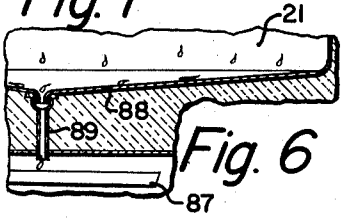


Fig. 6

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TWO COMPARTMENT REFRIGERATOR

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Fig. 7

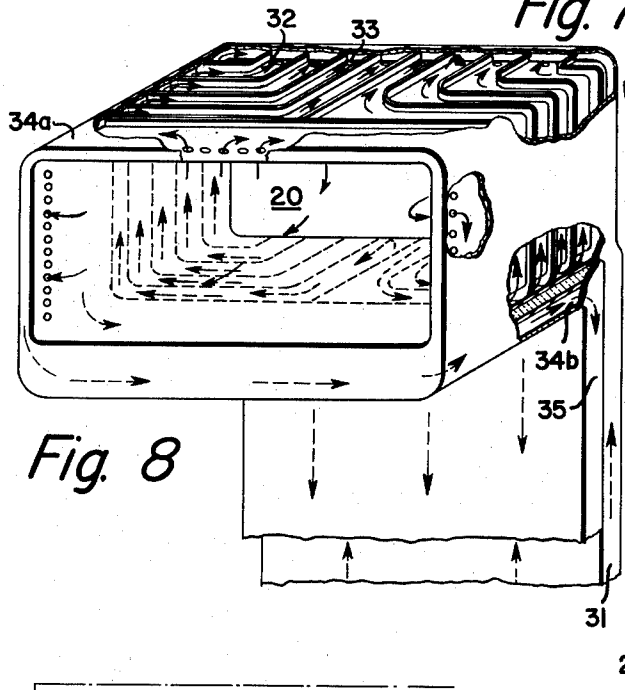
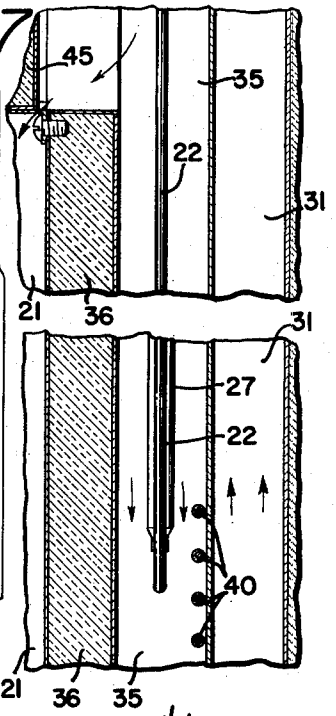


Fig. 8



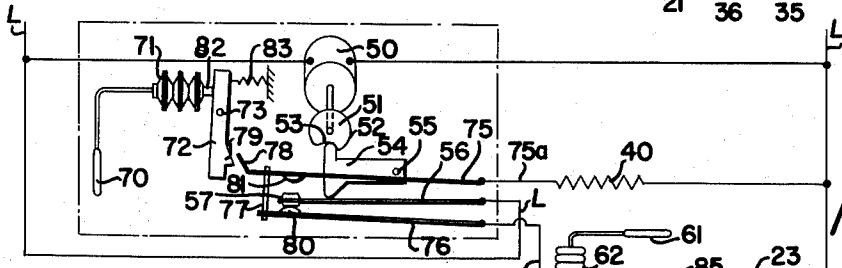


Fig. 9

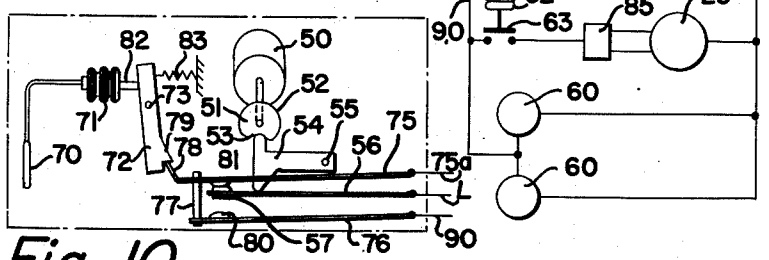


Fig. 10

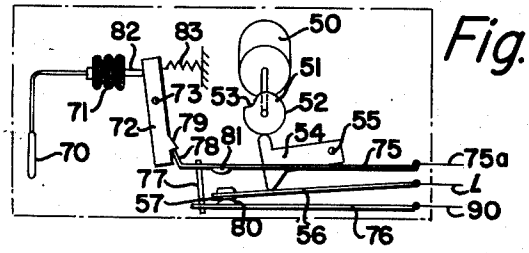


Fig. 11

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TWO COMPARTMENT REFRIGERATOR

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Application August 9, 1955, Serial No. 527,290

12 Claims. (Cl. 62—4)

This invention is directed to refrigerating apparatus and more particularly to a refrigerator with different temperature compartments in which no frost is allowed to accumulate.

An object of this invention is to provide a refrigerator having a below freezing compartment and an above freezing compartment in which no frost is allowed to accumulate in either compartment or on the foods contained therein.

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 invention is clearly shown.

In the drawings:

Figure 1 is a vertical cross-section taken along the line 1—1 of Figure 2.

Figure 2 is a vertical cross-section transverse to Figure 1 taken along the line 2—2 of Figure 1 with parts broken away.

Figure 3 is a vertical cross-section of a portion of Figure 1 taken along the line 3—3 of Figure 1.

Figure 4 is a diagrammatic representation of the refrigerating system.

Figure 5 is a partial view of Figure 1, showing a part in a different position.

Figure 6 is a vertical cross-section taken along the line 6—6 of Figure 1.

Figure 7 is an enlarged cross-section of a portion of Figure 1.

Figure 8 is a view in perspective of the below freezing compartment.

Figure 9 is a wiring diagram for the apparatus of Figures 1 through 8.

Figures 10 and 11 show a portion of Figure 9 in different positions.

A refrigerator, according to this invention, has a below freezing compartment 20 and a refrigerating, above freezing, compartment 21. A refrigeration system is provided, including a refrigerant evaporator 22 and a refrigerant liquefier in refrigerant circulating relationship with the evaporator 22. The liquefier may include a motor compressor unit 23 and a condenser 24. The liquefied refrigerant flows through the expansion valve or capillary tube 25 to the evaporator 22 and returns through the conduit 26 to the motor compressor unit 23.

If desired, the evaporator 22 may include an accumulator 27 to trap liquid refrigerant and prevent the return of slugs to the compressor 23.

Air circulating means, in the form of one or more blowers 30, is provided. Conduit means for circulating air may include the up flow conduit 31 leading to the serpentine conduits 32 around the below freezing compartment 20. These serpentine conduits 32 discharge air into the compartment 20 through openings 33. The air from compartment 20 returns through openings 34 into the front, surrounding conduit 34*a*, and the horizontal, rearwardly directed flow conduit 34*b*, which discharges into the down flow conduit 35. The conduit 35 is in

thermal exchange with the above freezing compartment 21. The conduit 35 returns the air to the air circulating means or blowers 30.

The thermal exchange between the down flow conduit 35 and the compartment 21 may be through an insulated wall 36 having a thickness sufficient to reduce the temperature in compartment 21 substantially to the temperature desired under normal operating conditions. The evaporator 22 is placed in the down flow conduit 35, and preferably is in the form of vertical runs 37 joined by 180° bends 38 and 39. The evaporator 22 is placed a small distance from the insulated wall 36.

The circulated air is chilled by the evaporator 22 to a temperature below that to be maintained in compartment 20. Hence, the frost depositing temperature of the circulated air is also below the temperature in compartment 20. Frost is deposited only on evaporator 22, and none is allowed to accumulate in either compartment 20 or compartment 21. These compartments never need defrosting, and the periodic defrosting of evaporator 22 has practically no effect on the food temperatures in these compartments. Any frost which might momentarily form on the cold surfaces in the freezing compartment when the freezing compartment door is opened is quickly removed by the process of sublimation when the door is closed.

Means are provided for periodically defrosting the evaporator 22 and this may take the form of a serpentine electric heater 40 in thermal exchange with the lower part of the evaporator 22. The heater 40 is energized periodically under the control of a timer hereafter described.

Means are provided for varying the thermal exchange of the circulated air with the above freezing compartment 21. This may take the form of a damper 45 which is moved rightward or leftward by the linkage 46 connected to a thermostat 47 responsive to the temperatures in the compartment 21. As the temperature in compartment 21 falls, the linkage 46 moves the damper 45 rightward and vice versa. The action of this construction is to maintain the temperature in compartment 21 within desired limits notwithstanding varying conditions of operation.

A defrost timer is provided having a motor 50 and a cam 51. The cam 51 has a large smooth cam surface 52 establishing a refrigerating period and a relatively small notch 53 establishing a defrost period. A pivoted follower 54 is fulcrumed at 55 and is urged upwardly by the upwardly biased contact blade 56 having double contacts 57. In general, when the smooth surface 52 engages the follower 54, a refrigerating period is established to permit the refrigerating system to produce refrigeration and the air circulating means to operate. In general, when the notch 53 is in engagement with the follower 54, a defrosting period is established which stops the refrigerating system from producing refrigeration, stops the air circulating means, and causes operation of the defrosting means. In addition, means are provided for changing the timer switch from a defrost position to a refrigeration position when the evaporator 22 has been defrosted prior to the expiration of the timed defrosting period, as will be more fully explained.

The air circulating means or blowers 30 are driven by one or more motors 60. A thermostatic bulb 61 is placed near the discharge end of the evaporator 22 and is connected to a bellows 62 which opens and closes the switch 63 as the temperatures in the evaporator 22 fall and rise respectively. The thermostatic bulb 61 tends to maintain the evaporator temperature at a substantially constant temperature within predetermined limits below the temperature selected for the compartment 20 by controlling the operation of the motor compressor 23. To this end, the thermostat 61, 62, 63 is responsive to

evaporator temperatures and prevents operation of the motor compressor 23 when the temperature of the evaporator is below a predetermined low temperature and permits operation of the motor compressor when the temperature of said evaporator is above said low temperature.

Means are provided to terminate the defrost period when the defrosting operation has been completed even while the timer notch 53 is still in engagement with the follower 54. To this end, a thermostatic bulb 70 is placed in thermal exchange with the evaporator 22, preferably at the upper return bends 39 (Figure 4). The bulb 70 is connected to a bellows 71 which operates the lever 72 fulcrumed at 73. The thermostat 70, 71 and 72 has means automatically changing the defrost switch position of the timer into a refrigerating switch position in response to a predetermined high temperature in the evaporator 22, acting on the thermostatic bulb 70. This is accomplished by providing a pair of upwardly biased contact blades 75 and 76 (Figures 9, 10 and 11) tied together by the insulating spacer 77, and by providing a tongue 78 adapted to cooperate with the detent 79 of lever 72.

During the refrigerating period, as shown in Figure 11, the circumference 52 of cam 51 moves the follower 54 downward, to cause blade 56 also to be moved downward. The double contacts 57 engage the contact 80 of the blade 76 and thus force both of the blades 75 and 76 downward causing the tongue 78 to be engaged by the detent 79, and this holds the timer circuit and its blades to provide electrical energy from line L to the refrigerator line 90 to provide refrigeration throughout the normal refrigerating period.

When the defrost period begins, as indicated in Figure 10, the notch 53 permits the follower 54 to rise upwardly, allowing the upwardly biased blade 56 to engage the contact 81 of the blade 75 and to urge the blades 75 and 76 upwardly, in readiness to snap upwardly when permitted to do so as later described. In the position of Figure 10, refrigeration is stopped by the opening of contacts 57 and 80, and defrosting is produced by the closing of contacts 57 and 81, which energize the defrost heater 40 from line L through contacts 57, 81, blade 75, line 75*a*, heater 40 and line L_1.

Figure 9 shows the termination of the defrost period and start of the refrigerating action. To this end, when all of the frost has been melted, the heater 40 is deenergized and the refrigeration cycle is started even if notch 53 is still engaging the follower 54, because the temperature of the evaporator 22 rises under the heating action of the heater 40 as soon as the frost is completely melted. The thermostatic bulb 70 then acts on the bellows 71 to move the pin 82 rightward in Figure 9 and upward in Figure 4 and to rotate the lever 72 clockwise about the fulcrum 73 against the action of spring 83. This releases the tongue 78 from the detent 79 (from the position of Figure 10) and allows the blades 75 and 76 to move upward to the position shown in Figure 9 where the double contacts 57 engage the contact 80 of the blade 76 to establish refrigerating conditions by energizing the air circulating motors 60 and permitting operation of the motor compressor unit 23 through the medium of thermostatic switch 63 and starting relay 85. The action taking place in Figure 9 changes the defrost period which had previously been established, as in Figure 10, to a refrigeration period during the unexpired portion of the timed defrost period produced by the notch 53. When the timer cam 51 rotates beyond the engagement of the notch 53 and enters into the smooth portion 52 of the cam as shown in Figure 11, the regular refrigeration cycle is resumed as previously described with respect to Figure 11.

During the defrosting operation, any moisture melted from the evaporator falls to the bottom of conduit 35 and flows through the pipe 86 to the pan 87 immediately

over the condenser 24, where the moisture is evaporated. Any moisture which is condensed on the cold walls of the compartment 21 falls to the sloping bottom 88 of compartment 21, and flows through the pipe 89 to the pan 87 also to be evaporated therein.

In the operation of the refrigerator, the motor compressor 23 ordinarily is cycled under the control of thermostat 61, 62, 63, with the timer in the position shown in Figure 11. Power flows from the line L to the blade 56 and thence to the blade 76 to the line 90 from which current flows through the switch 63 (Figure 9) and relay 85 to the motor compressor 23, which operates in the usual manner to maintain the evaporator 22 within predetermined limits established by the thermostat bulb 61. At the same time, the line 90 energizes the blower motors 60 to cause circulation of air through the conduits 31 through 35. The air flowing down through conduit 35 is refrigerated to a temperature below that maintained in compartment 20 and thus has its moisture content reduced to a frost depositing temperature below that of compartment 20. So, when the air circulates into the compartment 20, it does not deposit any frost therein, but at the same time maintains the compartment below a freezing temperature, since the air flows around the compartment 20 and through it, and then returns through the down flow conduit 35. The air is sufficiently cold to refrigerate the compartment 21 to the proper degree through the thermal exchange of the wall 36 as varied by the action of baffle 45 to maintain the temperature of compartment 21 above freezing, but at the suitable refrigerating temperature established by the thermostat 47. This operation continues as long as the smooth circumference 52 of the timer cam 51 establishes a refrigerating period as shown in Figure 11.

When the timer establishes a defrosting period as shown in Figure 10, the notch 53 allows the follower 54 to rise and permit the blade 56 to move and bias the blades 75 and 76 upward. During the defrost operation as shown in Figure 10, current flows from the line L through the blades 56 and 75 and line 75*a* to the defrost heater 40 so that the evaporator 22 is heated to a defrosting temperature.

When substantially all of the frost has been removed from the evaporator 22, it is heated to a predetermined high temperature. The thermostat 70, 71 and 72 then rotates the lever 72 clockwise to the position shown in Figure 9, at which time the defrost switch position is changed into a refrigerating position during the unexpired portion of the timed defrost period. Refrigeration is produced by current flowing from L through contacts 80 and 57 to the compressor 23 and blowers 60, through line 90.

The compartment 20 is maintained at a below freezing temperature and the compartment 21 is maintained at a predetermined refrigerating, above freezing, temperature without the formation of frost within the compartment 20 or on the food contained therein. Any moisture condensed on the rear wall of compartment 21 flows down such wall and is discharged through pipe 89 as previously described. Thus, a completely automatic defrosting refrigerator is provided.

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. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said

evaporator; and a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

2. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, around and into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; and a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

3. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; means for varying the thermal exchange of said circulated air with said above freezing compartment; and a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

4. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; means for varying the thermal exchange of said circulated air with said above freezing compartment in response to temperatures in said above freezing compartment; and a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

5. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; a thermostat responsive to evaporator temperatures preventing operation of said liquefier when the temperature of said evaporator is below a predetermined low temperature and permitting operation of said liquefier when the temperature of said evaporator is above said low temperature; and a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

6. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period; and a thermostat automatically changing said defrost period into refrigerating period in response to a predetermined high temperature.

7. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; a timer having a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period; and a thermostat automatically changing said defrost period into refrigerating period in response to a predetermined high temperature of said evaporator.

8. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; and a control means establishing a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

9. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, around and into said below freezing compartment, and adjacent and in thermal exchange with said above

freezing compartment; defrosting means for defrosting said evaporator; and a control means establishing a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period.

10. In combination: a below freezing compartment; a refrigerating above freezing compartment; a refrigeration system including an evaporator and a refrigerant liquefier in refrigerant circulating relationship; air circulating means; conduit means for circulating air from said air circulating means in thermal exchange with said evaporator, into said below freezing compartment, and adjacent and in thermal exchange with said above freezing compartment; defrosting means for defrosting said evaporator; a control means establishing a defrost period and a refrigerating period and stopping said refrigerating system from producing refrigeration, stopping said air circulating means and causing operation of said defrosting means during said defrosting period, and permitting said refrigerating system to produce refrigeration and said air circulating means to operate and stop said defrosting means during said refrigerating period; and a thermostat automatically changing said defrost period into refrigerating period in response to a predetermined high temperature of said evaporator.

11. In combination: a casing having an outer shell; insulation disposed adjacent said outer shell; means forming a hollow wall inner shell constituting a below-freezing compartment within said outer shell; means forming an above-freezing compartment within said outer shell; a refrigerating system including evaporator means and a refrigerant liquefier in refrigerant circulating relationship; means for circulating air in thermal exchange with a portion of said evaporator means and thereafter through portions of the hollow walls of said below-freezing compartment; means for directing the air leaving said hollow walls into said below-freezing compartment; said evaporator means including a portion arranged in thermal exchange relationship with air for said above-freezing compartment; defrosting means for defrosting said evaporator means; and means for cyclically energizing said evaporator defrosting means; said last-named means including means for stopping the flow of air into said freezing compartment during the defrosting of said evaporator means.

12. In combination: a casing having an outer shell; insulation disposed adjacent said outer shell; means forming a hollow wall inner shell constituting a below-freezing compartment within said outer shell; means forming an above-freezing compartment within said outer shell; a refrigerating system including evaporator means and a refrigerant liquefier in refrigerant circulating relationship; means for circulating air in thermal exchange with a portion of said evaporator means and thereafter through portions of the hollow walls of said below-freezing compartment; means for directing the air leaving said hollow walls into said below-freezing compartment; said evaporator means including a portion arranged in thermal exchange relationship with air for said above-freezing compartment; defrosting means for defrosting said evaporator means; and means for cyclically energizing said evaporator defrosting means; said last-named means including means for stopping the flow of air into said freezing compartment during the defrosting of said evaporator means; said evaporator means comprising a unitary evaporator for cooling both of said compartments.

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