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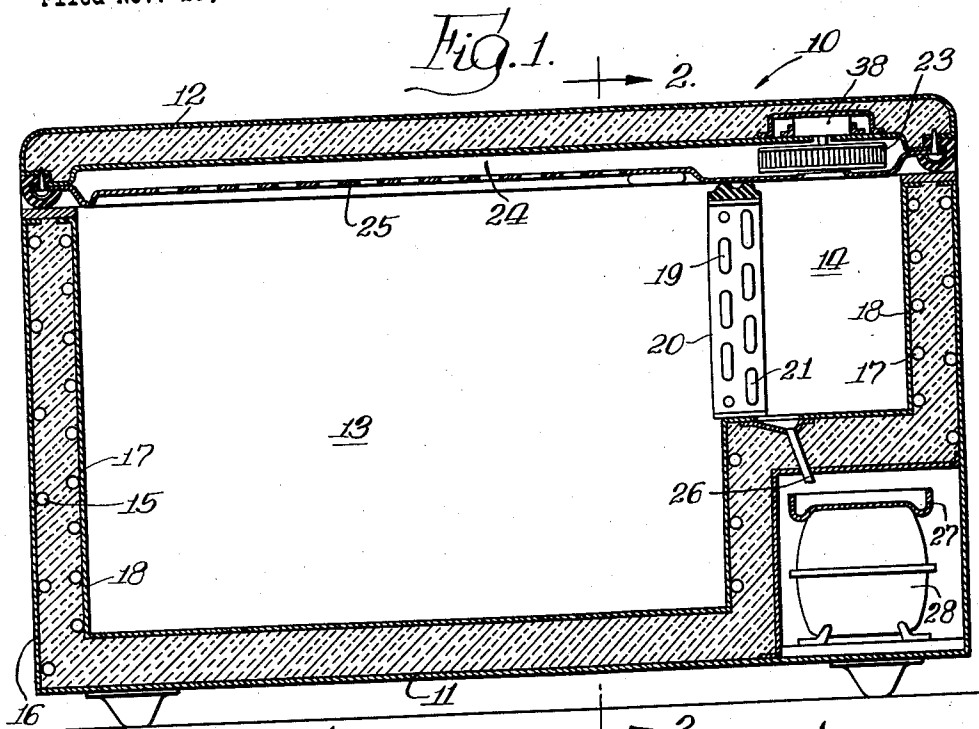
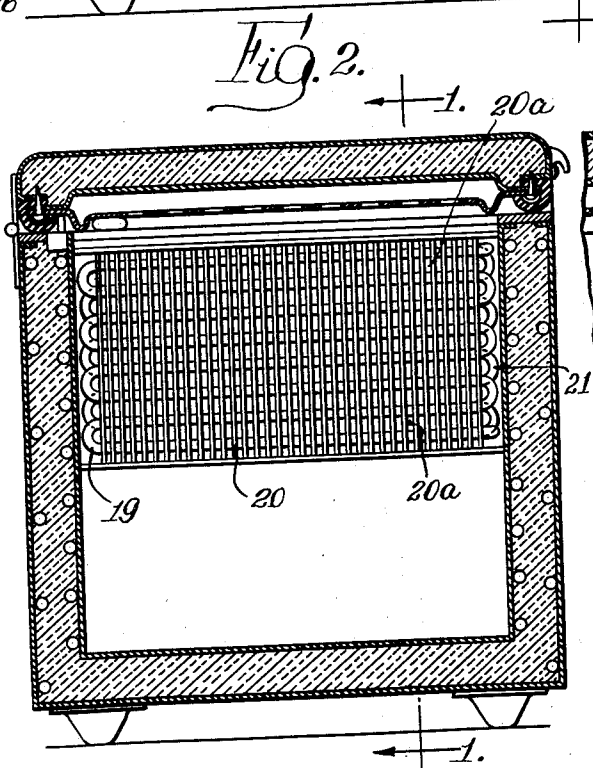
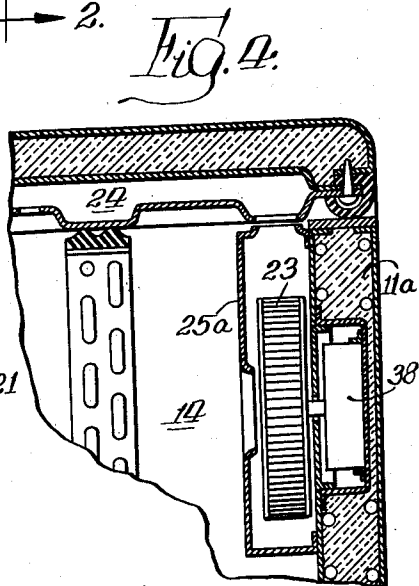
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REFRIGERATING APPARATUS WITH HOT GAS DEFROST MEANS

Filed Nov. 25, 1958

2 Sheets-Sheet 1



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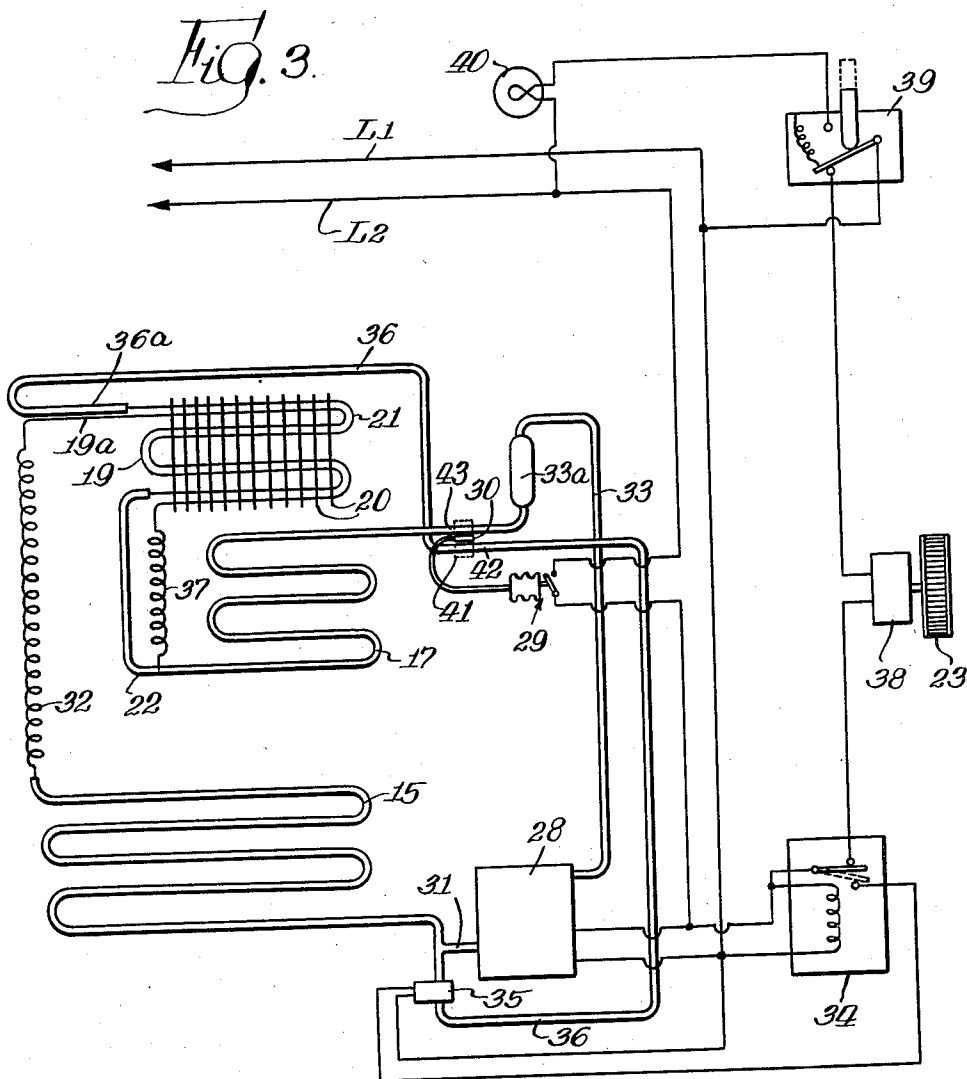
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REFRIGERATING APPARATUS WITH HOT GAS DEFROST MEANS

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4 Claims. (Cl. 62—155)

This invention relates to refrigeration apparatus.

One feature of this invention is to provide new and improved apparatus for effecting substantially frost-free refrigeration of a chamber.

Another feature of the invention is to provide such apparatus including two refrigerating means in heat transfer relationship with air in the chamber; one of which refrigerating means has a more efficient heat transfer relationship therewith to cause frost to collect substantially only on that refrigerating means.

A further feature of the invention is to provide such apparatus wherein one refrigerating means operates to maintain a desired freezing temperature in the chamber at all times, including during defrosting of the other refrigerating means.

A still further feature of the invention is the provision of such apparatus wherein the refrigerating means comprise evaporators and the pressure of refrigerant used for defrosting one evaporator is reduced prior to its return to the compressor, thereby maintaining a low suction pressure for improved efficiency of operation during both full freezing and defrosting cycles.

Still another feature is the provision of such a refrigeration apparatus arranged to use pressure differentials in the refrigerant system during a defrosting operation for substantially precluding flow of appreciable amounts of cold refrigerant through the evaporator being defrosted.

Other features and advantages of the invention will be apparent from the following description, taken in connection with the accompanying drawings, wherein:

Figure 1 is a vertical section of a refrigeration apparatus embodying the invention taken substantially along line 1—1 of Figure 2;

Figure 2 is a transverse section thereof taken approximately along the line 2—2 of Figure 1;

Figure 3 is a schematic diagram illustrating the arrangement of the elements and the electrical circuits associated therewith of the refrigeration apparatus; and

Figure 4 is a fragmentary vertical section of a modified form of apparatus.

Referring now to Figures 1 and 2 of the drawings, a refrigeration apparatus embodying the invention is illustratively shown as a chest type freezer generally designated 10. Refrigeration apparatus 10 is generally similar to and has elements similar to the refrigeration means of copending Warren A. Hanson application Serial No. 774,686, filed November 18, 1958, to which reference may be had for a detailed description of the elements thereof. For purposes of understanding the instant invention, it need merely be understood that refrigeration apparatus 10 comprises an insulated wall enclosure 11 having a removable closure or lid 12 across an access opening, and arranged to define a large refrigeration chamber 13 and a smaller, quick freeze refrigeration chamber 14. A condenser coil 15 is installed in enclosure 11 in heat transfer relationship with the inner surface of outer wall plate 16. An evaporator coil 17 is disposed in enclosure wall 11 in heat transfer relationship with the inner wall plate 18

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thereof. An evaporator coil 19 is arranged to extend vertically substantially fully across enclosure 11 between chambers 13 and 14. These coils will be identified herein as first coil 19 and second coil 17.

A plurality of fins 20 are secured in heat transfer relationship with first coil 19. The fins extend vertically and are spaced horizontally to define a plurality of passages 20a through which air flows from chamber 13 to chamber 14. A defrosting coil 21, generally similar to first evaporator coil 19, is arranged to extend across the enclosure 11 adjacent coil 19 and also in heat transfer relationship with coil 19 and fins 20.

Evaporator coils 17 and 19 are connected to conduit means as a tube 22 (Figure 3) whereby the evaporators operate at substantially the same refrigerant pressure and temperature. However, the wraps of second evaporator coil 17 are spaced apart a substantial distance, such as several inches, whereas the individual passes of the first evaporator coil 19 are more closely spaced. The more concentrated cooling of fins 20 by first evaporator coil 19, as compared to the less concentrated cooling of the inner wall plate 18, causes the average temperature of the coil 19 and fins 20 to be lower than the average temperature of the inner surface of the inner wall plate. The common temperature of evaporator coils 17 and 19 is normally maintained well below freezing. The difference between the temperature of fins 20 and the temperature of inner wall plate 18 is preferably at least 3 to 5° F. Under these circumstances, frost migrates from the walls of chambers 13 and 14 to coil 19 and fins 20 and a continual maintenance of a substantially frost-free condition in the chambers is effected.

As best seen in Figure 1, a blower 23 is mounted on the underside of closure 12 to circulate air from chamber 13, through passages 20a, past first evaporator coil 19 and fins 20, through chamber 14, and through a passage 24 defined by the underside of closure 12 and a panel 25 secured thereto, back to chamber 13. In addition to providing improved refrigeration of items in enclosure 11, the circulation of the air effects an acceleration of the migration of the moisture from the chambers to the cold surfaces of the first evaporator coil and fins. Thus, the inner surface of the inner wall plate 18 is maintained substantially frost-free.

To maintain efficient operation of refrigerator means 10, it is necessary, at intervals, to defrost first evaporator coil 19 and fins 20. To effect this, hot refrigerant is passed through defrosting coil 21 while flow of cold refrigerant through first evaporator coil 19 is substantially stopped. At the same time, flow of cold refrigerant through second evaporator coil 17 is continued to maintain the side walls of chambers 13 and 14 substantially at the desired freezing temperature. During the defrosting operation, blower 23 is stopped so that no substantial amount of heat will be transferred by air flow to the chambers. The melted frost quickly runs outwardly from chamber 14 through an outlet tube 26 into a pan 27 carried by the motor-compressor 28 wherein it is quickly evaporated by the heat of the motor-compressor.

The arrangement of the refrigerant-flow elements and the electrical control means for effecting desired automatic operation thereof is best seen in Figure 3. The operation of motor-compressor 28 from power supply leads L1 and L2 is controlled by a bellows-operated thermostat switch 29 which is actuated by a sensing element 30 adjacent a portion of the second evaporator coil 17. Thus, whenever the temperature sensed by element 30 reaches a predetermined high value, the motor-compressor 28 is operated to pump refrigerant through an outlet pipe 31. In the refrigeration cycle, refrigerant passes seriatim through outlet 31, condenser coil 15, a long capillary tube 32, first evaporator coil 19, tube 22,

second evaporator coil 17, an accumulator 33a, and through a return duct 33 back to the suction side of the motor-compressor.

As stated above, the refrigeration apparatus is arranged to provide an automatic periodic defrosting of first evaporator coil 19 and fins 20. For this purpose, a clock operated timer switch 34 is electrically associated with the motor-compressor to effect an operation of a solenoid valve 35 after a predetermined period of operation of the motor-compressor. Timer 34 records running time only of the motor-compressor 28; and hence when the timer calls for a defrost period, the compressor 28 is running to provide the flow of hot gas through defrost coil 21. Solenoid valve 35 controls flow of refrigerant from outlet 31 of the motor-compressor and through a conduit 36 to one end of the defrosting coil 21. The other end of the defrosting coil is connected by a restrictor 37 to the tube 22 which connects first evaporator coil 19 to the second evaporator coil 17. Thus, when valve 35 is opened, hot refrigerant flows, in series, from the motor-compressor 28, through outlet 31, valve 35, conduit 36, defrosting coil 21, short restrictor 37 (wherein the pressure of the refrigerant is dropped sufficiently to lower the temperature thereof to substantially the same temperature as the cold refrigerant flowing through tube 22 during a normal refrigeration cycle), second evaporator coil 17, and conduit 33 back to motor-compressor 28. As short restrictor 37 causes the pressure of the refrigerant in second evaporator coil 17 to be substantially the same as during the normal refrigeration cycle, the suction pressure of the compressor has substantially the same low value as during the normal refrigeration cycle. This results in high efficiency operation of the motor-compressor both on refrigerating and defrosting cycles. As the resistance to refrigerant flow through valve 35, conduit 36, defrosting coil 28, and short restrictor 37 to tube 22, is less than the resistance to flow of the refrigerant through condenser coil 15, long capillary tube 32, and first evaporator coil 19 to tube 22, very little if any refrigerant will flow through the latter path when valve 35 is opened. Thus, refrigeration of the first evaporator coil is substantially prevented during the defrosting operation.

Timer switch 34 is further arranged to control the operation of blower 23 to disconnect one side of the motor 38 driving the blower from the power supply whenever the timer switch is actuated to open solenoid valve 35 and effect a defrosting operation. Operation of blower 23 is also discontinued by means of a plunger switch 39 whenever closure 12 is raised. A lamp 40 is also controlled by switch 39 to illuminate the interior of the enclosure whenever the closure 12 is raised.

As best seen in Fig. 3, the conduit 36 delivering hot refrigerant to defrosting coil 21 is provided with a portion 36a in heat transfer relationship with the inlet portion 19a of first evaporator coil 19. Conduit portion 36a transfers sufficient heat to evaporator inlet 19a to prevent frosting of the first one or two passes of coil 19 which may occur due to any small amount of cold refrigerant that may pass through coil 19 from condenser 15 and long capillary tube 32 during a defrosting operation.

A clamp 41 fastens a portion 42 of hot refrigerant conduit 36 closely adjacent thermostat sensing element 30. Thus, whenever hot refrigerant flows through conduit 36, sensing element 30 is heated thereby to maintain the thermostat switch 29 closed and assure continued operation of the motor-compressor 28 during the defrosting operation. Outlet portion 43 of second evaporator coil 17 is similarly clamped closely adjacent sensing element 30.

A modified arrangement of the blower means is illustrated in Figure 4 wherein blower motor 38 is shown as mounted on end wall 11a of the enclosure 11, blower 23 being disposed within quick-freeze chamber 14. A

shroud 25a surrounds the blower to direct air from chamber 14 through the blower and to space 24.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as defined in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Refrigeration apparatus, comprising: a chamber; a first evaporator coil; a second evaporator coil, both coils being in heat exchange relationship with said chamber and normally maintained at freezing temperatures; a defrost coil in heat exchange relationship with said first evaporator coil; a refrigerant compressor having an inlet and an outlet; first conduit means connecting the outlet of the compressor to the first evaporator coil; a first capillary tube forming a part of said first conduit means; a condenser coil forming a part of said first conduit means; the condenser coil, capillary tube and first evaporator coil being connected in series; second conduit means connecting the outlet of the compressor to the defrost coil, said first conduit means having a higher resistance to refrigerant flow therethrough than said second conduit means to cause hot refrigerant from the compressor to flow primarily through said second conduit means during a defrost cycle; third conduit means including a second capillary tube connecting the defrost coil to the second evaporator coil in series flow; and defrost valve means normally closing said second conduit means but openable during said defrost cycle.

2. Refrigeration apparatus, comprising: a chamber; an evaporator coil in heat exchange relationship with said chamber and normally maintained at a freezing temperature; a defrost coil in heat exchange relationship with said evaporator coil; a refrigerant compressor having an inlet and an outlet; first conduit means connecting the outlet of the compressor to the evaporator coil; second conduit means connecting the outlet of the compressor to the defrost coil, said first conduit means having a higher resistance to refrigerant flow therethrough than said second conduit means to cause hot refrigerant from the compressor to flow primarily through said second conduit means during a defrost cycle; first flow restrictor means between the outlet and the inlet of the compressor; second flow restrictor means connecting the defrost coil to the inlet of the compressor, and defrost valve means normally closing said second conduit means but openable during said defrost cycle, said first and second flow restrictor means causing a low refrigerant pressure at the compressor inlet during both the refrigeration and defrost cycles.

3. Refrigeration apparatus, comprising: a chamber; a first evaporator coil; a second evaporator coil, both coils being in heat exchange relationship with said chamber and normally maintained at freezing temperatures; a defrost coil in heat exchange relationship with said first evaporator coil; a refrigerant compressor having an inlet and an outlet; first conduit means connecting the outlet of the compressor to the first evaporator coil; a first capillary tube forming a part of said first conduit means; a condenser coil forming a part of said first conduit means, the condenser coil, capillary tube and first evaporator coil being connected in series; second conduit means connecting the outlet of the compressor to the defrost coil, said first conduit means having a higher resistance to refrigerant flow therethrough than said second conduit means to cause hot refrigerant from the compressor to flow primarily through said second conduit means during a defrost cycle; third conduit means including a second capillary tube connecting the defrost coil to the second evaporator coil in series flow; defrost valve means normally closing said second conduit means

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but openable during said defrost cycle; and conduit means connecting the second evaporator coil to the inlet of the compressor.

4. Refrigeration apparatus, comprising: a chamber; a first evaporator coil; a second evaporator coil, both coils being in heat exchange relationship with said chamber and normally maintained at freezing temperatures; a defrost coil in heat exchange relationship with said first evaporator coil; a refrigerant compressor having an inlet and an outlet; first conduit means connecting the outlet of the compressor to the first evaporator coil; a first capillary tube forming a part of said first conduit means; a condenser coil forming a part of said first conduit means, the condenser coil, capillary tube and first evaporator coil being connected in series; second conduit means connecting the outlet of the compressor to the defrost coil, said first conduit means having a higher resistance to refrigerant flow therethrough than said second conduit means to cause hot refrigerant from the com-

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pressor to flow primarily through said second conduit means during a defrost cycle; third conduit means including a second capillary tube connecting the defrost coil to the second evaporator coil in series flow; defrost valve means normally closing said second conduit means but openable during said defrost cycle; conduit means connecting the second evaporator coil to the inlet of the compressor; temperature operated control means for said compressor arranged for operation by high temperature in said second evaporator coil and second conduit means to maintain compressor operation during both refrigeration and defrost cycles.

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