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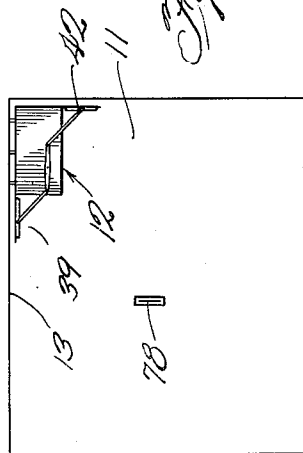
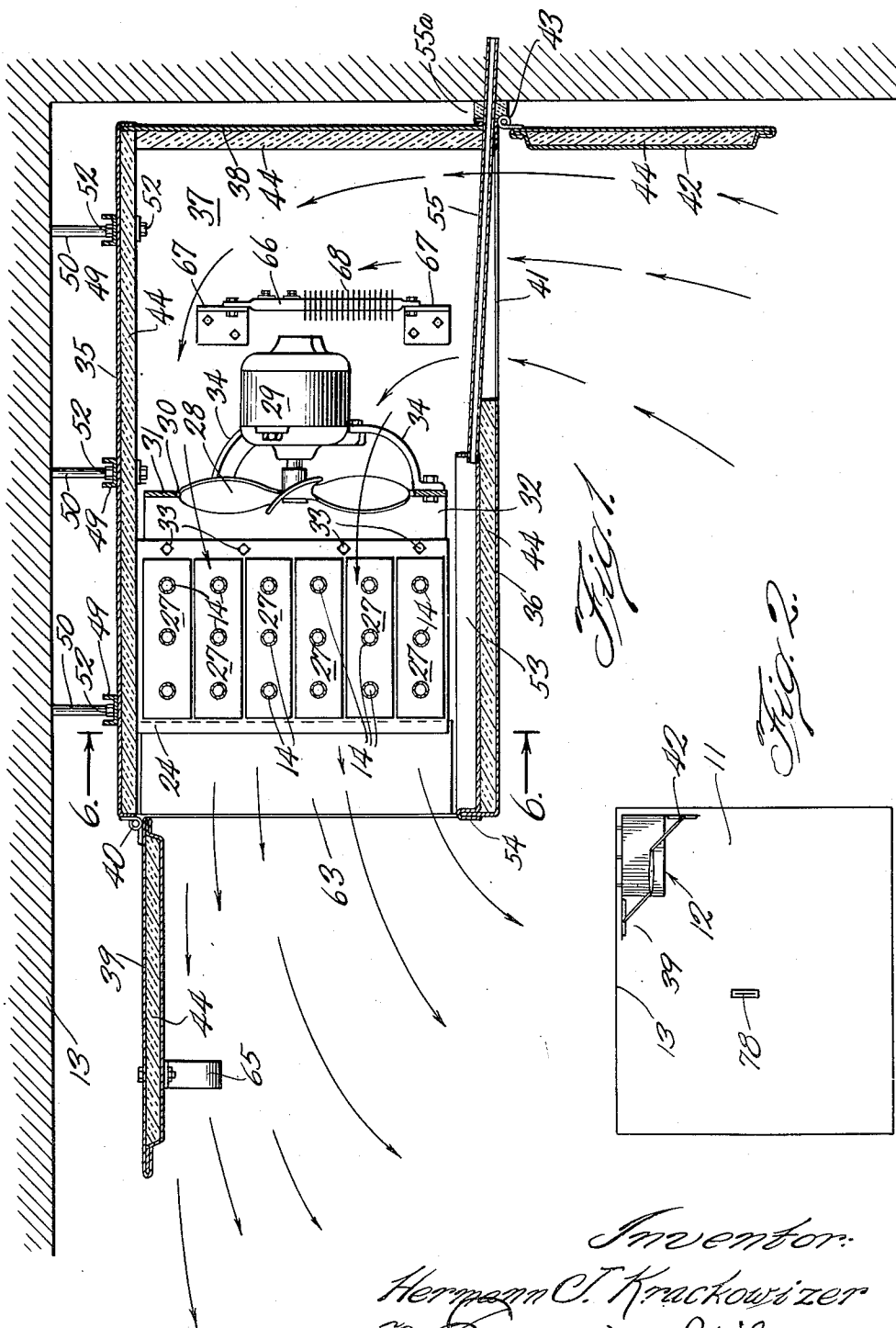
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2,272,302

DEFROSTING MEANS

Filed May 5, 1939

3 Sheets-Sheet 1



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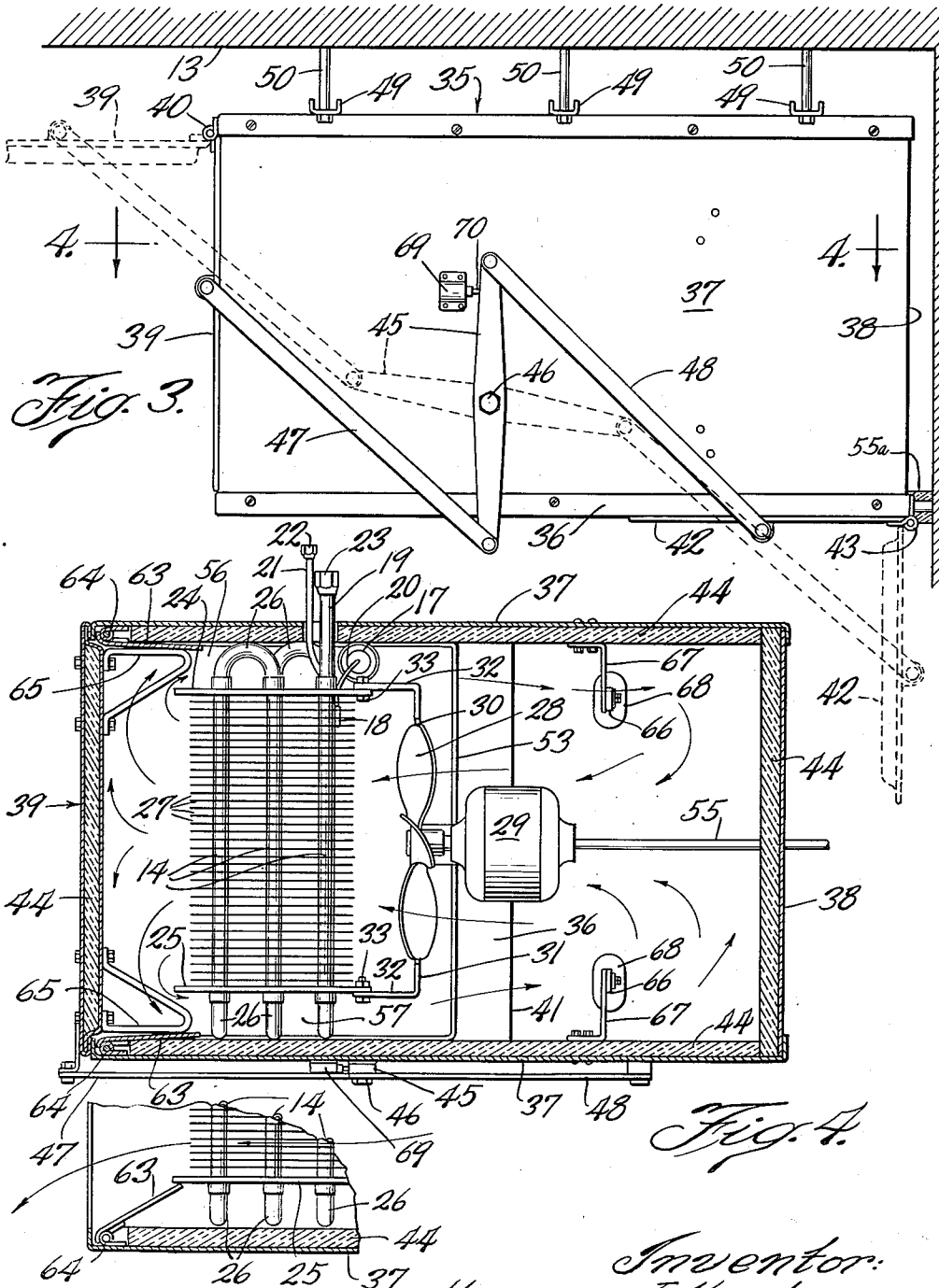


Fig. 5.

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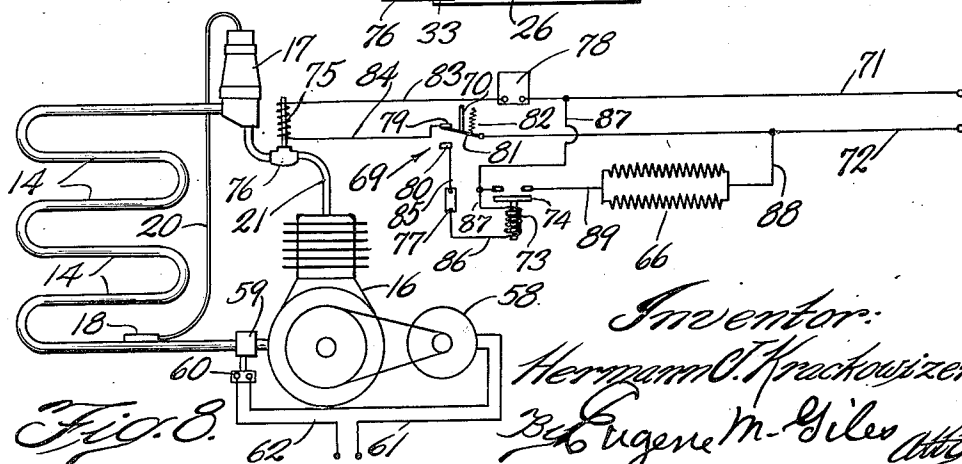
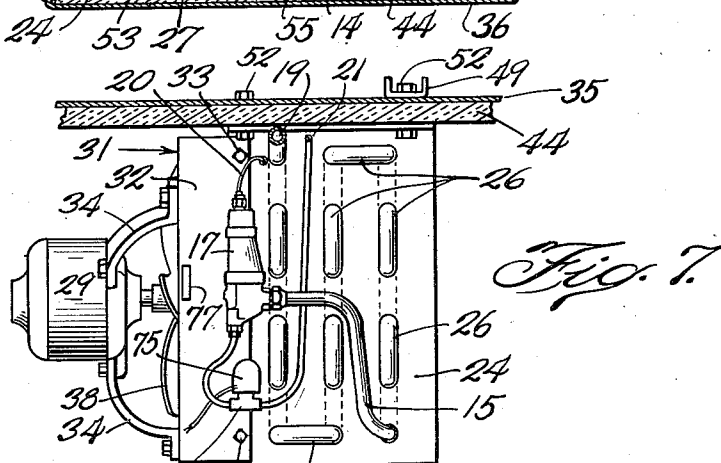
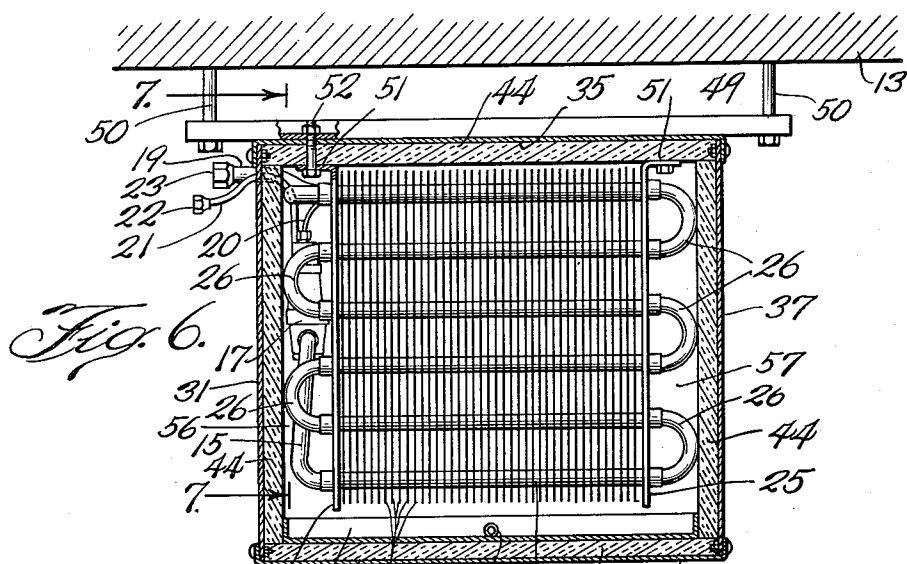
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,272,302

DEFROSTING MEANS

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Application May 5, 1939, Serial No. 271,833

5 Claims. (Cl. 62—2)

My invention relates to refrigerating equipment wherein air is cooled by circulation through a cooling unit and has reference more particularly to improved means for removing frost which may accumulate on the cooling unit.

In refrigerating equipment of the type above referred to, moisture oftentimes condenses out of the circulated air and freezes onto the surfaces of the cooling unit and it is necessary to remove the frost occasionally. This is usually accomplished by shutting off the refrigerating mechanism until the cooling unit and the surrounding air warm up sufficiently to melt the frost, although such defrosting procedure is objectionable not only on account of the length of time required during which cooling is interrupted, but also because the temperature in the compartment or other space normally cooled by the refrigerating device is elevated during the defrosting period and this not only imperils the preservation of any perishable contents of the compartment, but requires prolonged operation of the refrigerating mechanism and imposes extra load thereon after the defrosting to restore the normal low temperature of the compartment or other space which was lost during the defrosting.

The principal objects of my invention are to provide improved defrosting facilities; to minimize the time required for defrosting; to accomplish the defrosting without affecting the temperature of the compartment or space which is normally cooled by the refrigerating device; to avoid prolonged operation of or extra load on the refrigerating mechanism after defrosting; and to provide simple and convenient defrosting facilities which avoid the disadvantages previously experienced in defrosting and increase the efficiency of refrigerating equipment—these and other objects being accomplished as pointed out hereinafter and as shown in the accompanying drawings in which:

Fig. 1 is a vertical section taken lengthwise through a cooling device constructed in accordance with my invention;

Fig. 2 is a view showing somewhat diagrammatically a compartment equipped with the cooling device of Fig. 1;

Fig. 3 is a side view of the cooling device;

Fig. 4 is a section taken on the line 4—4 of Fig. 3;

Fig. 5 is a detail view showing a gate for closing a passage at the side of the cooling unit;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 1;

Fig. 7 is a side view of the cooling unit taken on the line 7—7 of Fig. 6; and

Fig. 8 is a diagrammatic view of the refrigerating mechanism and controls.

In refrigeration it is a common practice to employ a cooling unit through which air is circulated for cooling a compartment or other space, the cooling unit usually consisting of coils to which compressed refrigerant is supplied through an expansion valve so that it evaporates and expands in the coils, thereby absorbing heat, after which it is withdrawn by a compressor and after recompression is returned through the expansion valve to the coils.

Such cooling units are employed for various purposes as for example for cooling compartments in which perishable goods or articles are kept at a sufficiently low temperature to preserve same or for air conditioning rooms of buildings in which people live or congregate. Controls are usually provided to cause intermittent operation of the refrigerating device at suitable intervals and for proper lengths of time to maintain the refrigerated compartment or air conditioned room at a selected or desired temperature, a fan being ordinarily employed to circulate air through the cooling unit and discharge same into the compartment or room and usually serving also to withdraw air from the compartment or room so that it is recirculated through the cooling unit.

In the accompanying drawings which illustrate the application of my invention to a cooling device for cooling a refrigerator compartment, the reference numeral 11 (see Fig. 2) indicates the compartment which has the cooling device, indicated as a whole at 12 near the ceiling 13 at one side or end. This cooling device comprises a cooling unit composed of coils 14 to the inlet 15 of which refrigerant is supplied in the usual manner from a compressor 16 (see Fig. 8) through an expansion valve 17 which is controlled by a bulb 18 secured to the cooling unit near the outlet 19 which is connected to the intake side of the compressor 16, said bulb 18 being operatively connected with the expansion valve in the usual manner by the tube 20.

The expansion valve 17 is located adjacent to the cooling unit, and has a supply pipe 21 leading thereto and provided at its outer end with a coupling 22 by which it is detachably connectible with the outlet of the compressor, which is usually located at a remote place outside the compartment 11; and the outlet 19 also has a coupling 23 at the outer end for detachable connection with the intake of the compressor, it be-

ing understood of course, that the inlet and outlet of the cooling unit may not lead directly to the outlet and intake respectively of the compressor but are connected therewith through the usual intermediate appurtenances with which refrigerating systems are ordinarily provided.

The coils 14 are mounted in the usual end plates 24 and 25, which serve as hangers for supporting the cooling unit, with the return bends 26 of the coils and other connections at the outer sides of these plates 24 and 25, and the portions of the coils 14 between the plates 24 and 25 have the usual fin plates 27 thereon for increased heat conductivity. A fan 28, operated by an electric motor 29 is mounted to discharged through the cooling unit, that is, through the spaces between the coils 14 and fin plates 27, and is preferably located in the opening 30 of a plate 31 which has side wings 32 by which it is attached as at 33 to the end plates 24 and 25 of the cooling unit. Brackets 34 secured at intervals around the opening 30 support the motor 29 so that the fan 28 is located in said opening.

This cooling unit and fan assembly is mounted in a housing or box which has top and bottom walls 35 and 36 respectively, side walls 37 and a wall 38 at one end, the other open end of said housing being adapted to be closed by a door 39 which is hinged at 40 to the top wall 35 and at the other or closed end of the housing there is an opening 41 through the bottom adapted to be closed by a door 42 which is hinged at 43 to the end wall 38. All of the walls and doors of this housing are heat insulated as indicated at 44 so that when the doors 39 and 42 are closed a heat insulated compartment is provided containing the cooling unit and fan assembly which is located in the compartment as shown in Figs. 1 and 4 so as to discharge toward and through the open end of the compartment when the door 39 is open and against said door when the latter is closed, while the bottom opening 41 at the other end of the compartment provides an intake opening for air to be circulated through the cooling unit when the door 42 is open.

These doors 39 and 42 are connected in any suitable manner to close and open simultaneously, this being accomplished in the present structure by providing a lever 45 which is pivoted centrally at 46 to a side wall 37 and has one end connected by a link 47 with the door 39 and the other end connected by a link 48 with the door 42 as shown particularly in Fig. 3 so that closing either door swings the lever 45 to the upright position thereby swinging the other door simultaneously to the closed position, whereas opening either door rocks the lever 45 to a substantially horizontal position as shown by dotted lines in Fig. 3 and simultaneously opens the other door.

This housing has transverse supporting members such as the channel irons 49 bolted to the top wall 35 with apertured ends projecting at opposite sides of the housing to accommodate bolts 50 by which the housing is suspended from the ceiling of the compartment 11 and the top wall 35 in turn supports the assembled cooling unit and fan, the end plates 24 and 25 of the cooling unit being provided for this purpose with outturned flanges 51 at their upper ends which are secured to the top wall 35 by bolts 52, each end plate 24 and 25 preferably having one of its mounting bolts 52 engaged through the channel iron 49 thereabove.

This cooling unit is located close to the top wall 35 of the housing and spaced from the bot-

tom wall 36 sufficiently to accommodate a drain pan 53 which rests on the bottom wall 36 and has a lip 54 engaged over the margin of the front door opening of the housing to hold the pan in place, and this pan has a drain tube 55 extending therefrom to the exterior of the housing and leading outwardly through a wall of the compartment 11 or to other convenient place for discharge of drainage from the pan 53, the portion of the drain tube 55 outside the fan and cooling unit housing being preferably covered with insulation as indicated at 55^a.

The end plates 24 and 25 of the cooling unit are spaced from the side walls 37 of the housing as indicated at 56 and 57 respectively to accommodate the return bends 26 of the coils, the space 56 also containing the expansion valve 17 and the pipes 15 and 21, the latter of which as well as the outlet pipe 19 having their ends with their respective couplings 22 and 23 projecting through said side wall.

In the normal operation of this cooling device, the doors 39 and 42 are open and the fan 28 operated so as to draw air from the compartment 11 through the bottom opening 41 into the housing wherein it is propelled by the fan through the cooling unit and discharged through the open front end of the housing back into the compartment 11 at the top thereof.

The cooling unit is cooled in the usual manner to absorb heat from the air circulated there-through, by operation of the compressor 16 which supplies compressed refrigerant through the expansion valve 17 to the coils 14 in which the compressed refrigerant is evaporated or expanded and then returned to the compressor to be compressed again and recirculated through the system, it being customary to provide controls, responsive to the temperature in the compartment, for operating the compressor intermittently at suitable intervals and for varying lengths of time as required to maintain the compartment at a selected or desired temperature.

A motor, indicated at 58 in Fig. 8, is usually employed for operating the compressor 16 and the required intermittent operation of the compressor may be effected by a switch through which current is supplied to the motor, the switch in turn being operated by a thermostat in the compartment or by a pressurestat in the refrigerant circulating system or in any other convenient manner.

For illustrative purposes I have shown in Fig. 8 a pressurestat control which is well known and comprises a pressurestat 59 which is connected with and responsive to variations of pressure in the expansion or low side of the refrigerating system and operates a switch 60. Conductors 61 and 62 lead from a source of electric power (not shown) to the motor 58, said switch 60 being located in the conductor 62.

The pressurestat 59 is arranged to open the switch 60 and stop the motor and compressor when the evaporation or expansion of refrigerant in the coils 14 is insufficient, either because of reduction of temperature of the coils 14 or reduction of refrigerant supply thereto, to maintain a pressure in the expansion or low side of the system above a selected low pressure for which the pressurestat is set and this pressurestat is arranged to close the switch 60 and start the motor and compressor when evaporation or expansion is sufficient to cause a selected rise of pressure in the low side of the system. Thus it will be understood that by setting the pressurestat

for operation at the appropriate pressure or pressures, the temperature in the compartment may be controlled, or in other words the temperature in the compartment by its influence on the rate of evaporation or expansion in the coils 14 controls the operation of the compressor. Moreover, the operation of the compressor is also affected by the rate of supply of liquid refrigerant through the expansion valve 17 which in turn is controlled by the bulb 18 and if the supply of compressed refrigerant is interrupted, evaporation and expansion in the coils 14 will cease and through the pressurestat cause the motor and compressor to stop.

In operation of cooling devices of this character moisture in the circulated air condenses on the cooled surfaces of the cooling unit and, if the temperature is sufficiently high, drains therefrom into the drain pan, such as the pan 53 shown herein, which is usually provided for the purpose. However, the cooling unit is oftentimes operated at temperatures sufficiently low, at least during part of the operating periods thereof, to cause an accumulation of frost which not only interferes with heat transfer, but obstructs the air passages, and it is necessary to remove such accumulated frost occasionally. This, as pointed out above, is usually accomplished by shutting down the compressor, for a sufficient length of time to permit the cooling unit and the air surrounding same to warm up sufficiently to melt the frost and this not only requires an objectionable length of time during which normal cooling operation is interrupted, but exposes the compartment or other space normally cooled by the refrigerating device, to the rise of temperature which accomplishes the defrosting and requires prolonged operation of the refrigerating mechanism and extra load thereon, after defrosting, to restore the compartment or other space to the temperature which existed therein previous to the defrosting operation.

It is for the purpose of avoiding this warming up of the compartment or other space or loss of cool condition therein during defrosting that the cooling unit and fan are enclosed in the heat insulated housing as disclosed herein, the doors 39 and 42 of which are closed during the defrosting operation and the interior of the housing thus isolated from the compartment 11 or other space normally cooled by the refrigerating device so that the warming up for defrosting is confined to the relatively small amount of air in the housing without affecting the temperature of the air in the compartment 11 or other space through which the cooled air from the cooling unit 14 is normally circulated by the fan 28. This isolated small amount of air not only warms up more easily and quickly so that the defrosting is accomplished in a much shorter period of time than previously, but after the defrosting, when the doors 39 and 42 are opened, the amount of warmed air released from the housing is insufficient to materially affect the temperature in the compartment 11 or other refrigerated space and accordingly since the cool condition of such compartment or space has been substantially preserved during defrosting, no prolonged operation of the refrigerating mechanism or extra load thereon is required after defrosting.

Moreover, to expedite the defrosting, heating elements, preferably of electrical type are provided in the housing to heat the air therein during defrosting, at which time the fan 28 is operated to circulate the heated air through the cool-

ing unit, and as the doors 39 and 42 are closed, the air is merely circulated in the housing, the spaces 56 and 57 between the heating unit end plates 24 and 25 and the housing side walls 37 affording by-passes through which the air discharged by the fan through the cooling unit 14 is returned to the rear end of the housing behind the fan 28 for recirculation through the cooling unit. Preferably these by-passes 56 and 57 are closed at their forward ends when the door 39 is open so as to avoid back draft there-through during normal discharge through the front end of the housing, and for this purpose each by-pass 56 and 57 has a gate 63 at the forward end spring-hinged as at 64 to the forward end of the respective side wall 37 and normally held by the spring hinge against the respective cooling unit end plate 24 or 25 as shown in Fig. 5 so as to close the respective by-pass 56 or 57. For opening these gates 63 when the door 39 is closed an arm 65 is provided at each lateral edge of the door near the free end thereof and projects from the inner face of the door so as to swing into the housing as the door 39 is closed and by engagement with the gates 63 force same laterally against the respective side wall 37 as shown in Fig. 4 in which open position said gates 63 are held by said arms 65 while the door 39 is closed. Upon opening the door 39 the arms 65 are released from the gates 63 which then return by the spring tension of their spring hinges 64 to the closed position against the respective cooling unit end wall 24 or 25.

Preferably a heating element 66 is located at each side of the housing interior in the space behind the fan 28 as shown in Figs. 1 and 4 substantially in the path of the air returning through the by-pass spaces 56 and 57, each heating element being mounted on its respective side wall 37 by a pair of end brackets 67 which are secured to the side wall and hold the heating element at a distance therefrom, and each heating element may have a series of fins 68 thereon to facilitate dissipation of heat therefrom.

These heating elements are energized only while the doors 39 and 42 are closed, at which time the refrigerating device is stopped so that cooling of the cooling unit 14 does not occur during the defrosting operation, and the energizing of the heating elements and stoppage of the refrigerating device are preferably controlled by the closing of the doors 39 and 42, it being understood, however, that the fan 28 continues to operate during defrosting.

For controlling the energization of the heating elements 66 and stopping the refrigerating device when the doors 39 and 42 are closed, a switch 69 may be provided on the side wall 37 of the housing and has a plunger 70 which, when the doors 39 and 42 are closed, is engaged by the lever 45 to operate the switch. This switch 69, as shown diagrammatically in Fig. 3, is of a two way type and controls two circuits from the feed wires 71 and 72, one of which said circuits leads to a solenoid 73 which operates a switch 74 through which current is supplied to the heating elements 66 and the other of which said circuits leads to a solenoid 75 which operates a valve 76 through which liquid refrigerant is supplied to the expansion valve 17, the arrangement being such that in the normal position of the switch 69 current is supplied to the valve solenoid 75 but not to the switch solenoid 73 whereas when the doors 39 and 42 are closed the switch 69 is operated by engagement of the lever 45 with the plunger

70 so that current is then supplied to the switch solenoid 73 but not to the valve solenoid 75. Opening the doors 39 and 42 and the release of the plunger 70 which thereupon occurs, restores the switch 69 to the normal position.

Preferably a thermostatic switch is also provided in the circuit to the switch solenoid 73 and located in the cooling unit and fan housing, as for example on the side of the cooling unit as indicated at 77 and set so that the defrosting temperature in the housing does not exceed a selected maximum and preferably also there is a room thermometer in the room or compartment 11 which controls a switch in the circuit to the valve solenoid for selectively controlling the upper and lower limits of the room temperature and this thermometer and switch may be located at any convenient place in the room or compartment as indicated at 78 in Fig. 2.

The valve 76 which is located in the supply pipe 21 through which liquid refrigerant is supplied to the expansion valve 17 closes to interrupt the supply of refrigerant to the expansion valve unless current is supplied to the solenoid 75 which when energized opens the valve 76 and as the circuit through the switch 69 to the solenoid 75 is closed when the doors 39 and 42 are open, the solenoid 75 is normally energized and holds the valve 76 open subject, however, to control by the room thermometer and switch 78 which interrupts the circuit to the solenoid 75 when the room temperature reaches a selected high and closes the circuit when the room temperature reaches a selected low.

For purposes of illustration the switch 69 is shown diagrammatically in Fig. 8 with the two contacts 79 and 80 with a swinging arm 81 therebetween normally held against the contact 79 by the spring 82 and having the plunger 70 attached thereto by which the switch arm 81 is swung away from the contact 79 and against the contact 80 when the lever 45 is engaged against said plunger 70 by the closing of the doors 39 and 42, and one of the feed wires, for example the feed wire 72 leads to the switch arm 81 while the other feed wire 71 leads to the room thermostat and switch 78 which is connected by the conductor 83 to the solenoid 75 which has a conductor 84 leading therefrom to the contact 79 of the switch 69.

The other contact 80 of the switch 69 has a conductor 85 leading to the thermostatic switch 77 and from this switch a conductor 86 leads to the solenoid 73 from which a conductor 87 leads to the feed wire 71. A conductor 88 leads from the feed wire 72 to the heating elements 66 from which a conductor 89 leads to the conductor 87 through the solenoid switch 74 which is closed only when the solenoid 73 thereof is energized.

Thus in the normal operation of the device, when the doors 39 and 42 are open, at which time the fan 28 is operated, the switch arm 81 is closed against the contact 79 and current is supplied to the solenoid 75 so as to hold the valve 76 open except at such times as the current may be interrupted by the thermometer and switch 78, and while the doors 39 and 42 are open no current can be supplied to the heating elements 66.

When, however, the doors 39 and 42 are closed the switch arm 81 is swung away from the contact 79 against the contact 80 thereby interrupting current supply to the solenoid 75 and closing the valve 76 until the doors 39 and 42 are again opened and when the switch arm 81 engages the contact 80 current is supplied to the solenoid 73

which closes the switch 74 and current is thus supplied to the heating elements 66 during the time that the doors 39 and 42 are closed, subject however, to control by the thermostatic switch 77 which, when the temperature in the closed housing reaches a selected high, interrupts the circuit to the solenoid 73 which in turn permits the switch 74 to open and interrupt the current supply to the heating elements 66.

Thus, the closing of the housing doors 39 and 42 interrupts the supply of current to the solenoid 75, permitting the valve 76 to close. This interrupts the supply of liquid refrigerant to the cooling unit 14 and because of the diminished pressure in the cooling unit and throughout the expansion or low side of the system which results from this stoppage of refrigerant supply the pressurestat 59 causes the compressor to pump down and stop and to remain inactive until the valve 76 is opened. The closing of the housing doors also causes current to be supplied to the heating elements 66 and as the fan 28 operates while the doors 39 and 42 are closed, the air which is isolated in the housing and heated by the heating elements 66 is circulated through the cooling unit 14 and rapidly melts any frost which may have accumulated thereon and the resultant water drains down into the pan 53 from which it is carried away through the pipe 55. Moreover since the drain pan 53 and drain pipe 55 are located within the housing with any outside portions of the drain pipe insulated, any frost or ice which may have accumulated in the drain pan or drain pipe is at the same time melted so that overflow or stoppage of the drainage facilities is prevented.

After the defrosting is completed and the frost melted off of the cooling unit, the doors 39 and 42 are opened, and this permits return of the switch arm 81 to the normal position against the contact 79, thereby interrupting the supply of current to the solenoid 73 and heating elements 66 and closing the circuit to the solenoid 75 which opens the valve 76, whereupon refrigerant is again supplied to the cooling unit 14 and evaporates and expands therein, thus increasing the pressure in the expansion or low side of the refrigerating system which increased pressure operates through the pressurestat 59 to start the compressor 16 and the normal pressurestat controlled intermittent operation of the refrigerating device is thereby resumed.

Thus I have not only provided facilities to isolate the zone in which defrosting occurs, thereby minimizing the time required for defrosting and avoiding exposure of the compartment or other space normally cooled by the refrigerating device, to the warmer temperature required for defrosting, but I have also provided quick warming up facilities for such isolated zone which greatly decrease the time required for defrosting and with controls which simplify and assure properly timed cooperation of all the facilities which contribute to the defrosting. Obviously, since an isolated defrosting zone is provided whereby the temperature in the compartment or other space normally cooled by the refrigerating device is not affected by the defrosting, it is possible, if two or more cooling unit and fan assemblies are employed for cooling such compartment or space to continue operation of one or more of the assemblies while one or more of the other assemblies are being defrosted.

While I have shown and described my invention in a preferred form, I am aware that various

changes and modifications may be made therein without departing from the principles of my invention, the scope of which is to be determined by the appended claims.

I claim as my invention:

1. In a refrigerating device, the combination of a heat insulated housing having an inlet and an outlet, a cooling unit and a blower in the housing between the inlet and outlet, said blower being operable to supply air to the interior of the housing through the inlet and to discharge the supplied air through the cooling unit and therefrom through the outlet, doors operable to close the inlet and outlet, one or more by-passes leading from the discharge side of the cooling unit to the suction side of the blower to return air discharged through the cooling unit to the suction side of the blower when the doors are closed, gates normally closing said by-passes, means on one of the doors adapted to open said gates when said door is closed, and heating means in the housing, the operation of which is controlled by the opening and closing of the doors.

2. In a refrigerating device, the combination of a housing having an inlet and an outlet, a cooling unit in the housing between the inlet and the outlet, a blower operable to supply air to the interior of the housing through the inlet and to discharge the supplied air through the cooling unit and therefrom through the housing outlet, a by-pass through which air discharged by the blower through the cooling unit returns to the suction side of the blower when the doors are closed, and means by which the by-pass is closed when the doors are open.

3. In a refrigerating device, the combination of a heat insulated housing having an inlet and an outlet, a cooling unit and a blower in the housing between the inlet and outlet, said blower being operable to supply air to the interior of the

housing through the inlet and to discharge the supplied air through the cooling unit and therefrom through the outlet, doors operable to close the inlet and outlet, one or more by-passes leading from the discharge side of the cooling unit to the suction side of the blower to return air discharged through the cooling unit to the suction side of the blower when the doors are closed, by-pass closing means, heating means in the housing, refrigerant supply means by which compressed refrigerant is supplied to the cooling unit, and means whereby closing of said doors opens the by-pass closing means and starts the heating means and interrupts the supply of compressed refrigerant to the cooling unit.

4. The combination with a refrigerator compartment of a combined cooling and defrosting unit mounted therein, said unit comprising a housing suspended from the top wall of the compartment and having two spaced openings therefrom communicating with the compartment, each opening having a door for closing same, said housing containing cooling coils, a heater and a blower, the heater being operable when the doors are closed and the blower being operable in both the open and closed positions of the doors to circulate air in contact with the coils, said unit being self contained and insertible as a whole with respect to the refrigerator compartment.

5. As a new article of manufacture a self contained cooling and defrosting unit installable as a whole in a refrigerating compartment, said unit comprising a closed housing with two spaced openings leading therefrom, each opening having a door for closing same, said housing containing cooling coils, a heater and a blower, the heater being operable when the doors are closed and the blower being operable in both the open and closed positions of the doors to circulate air in contact with the coils.

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