Aug. 4, 1936. J. W. CANNON 2,049,413

DEFROSTING DEVICE FOR REFRIGERATORS

Filed Sept. 3, 1932 3 Sheets-Sheet 1

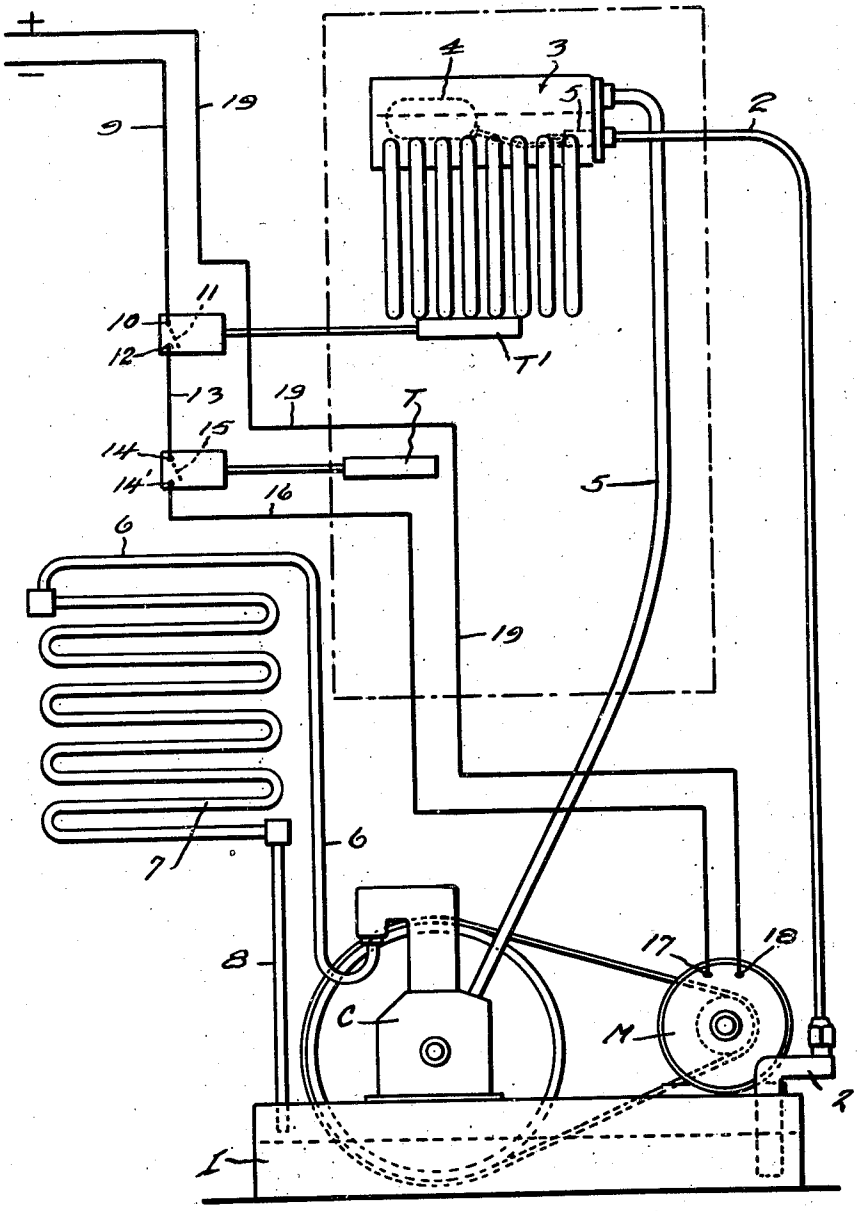


Fig. 1

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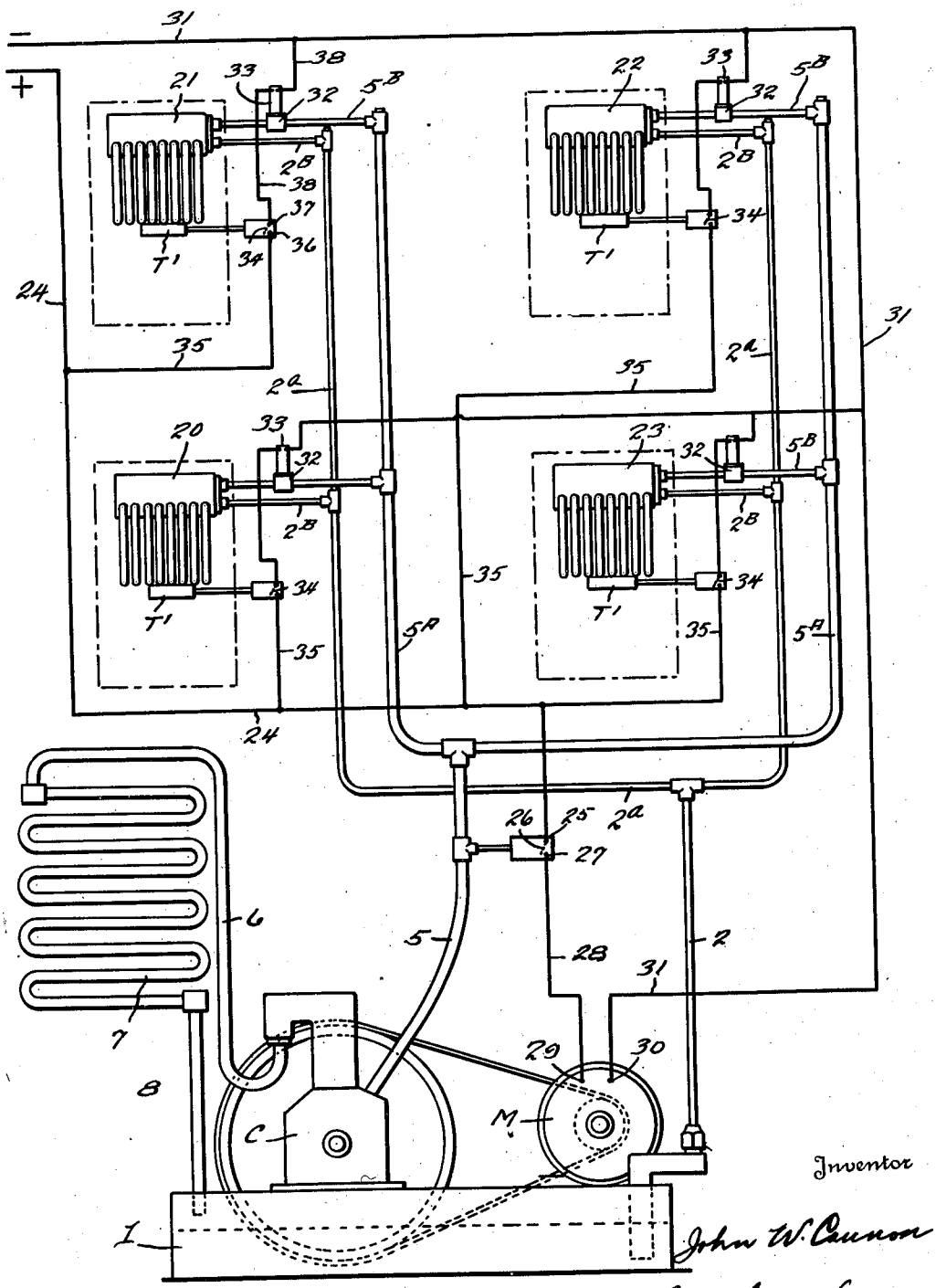


Fig. 2

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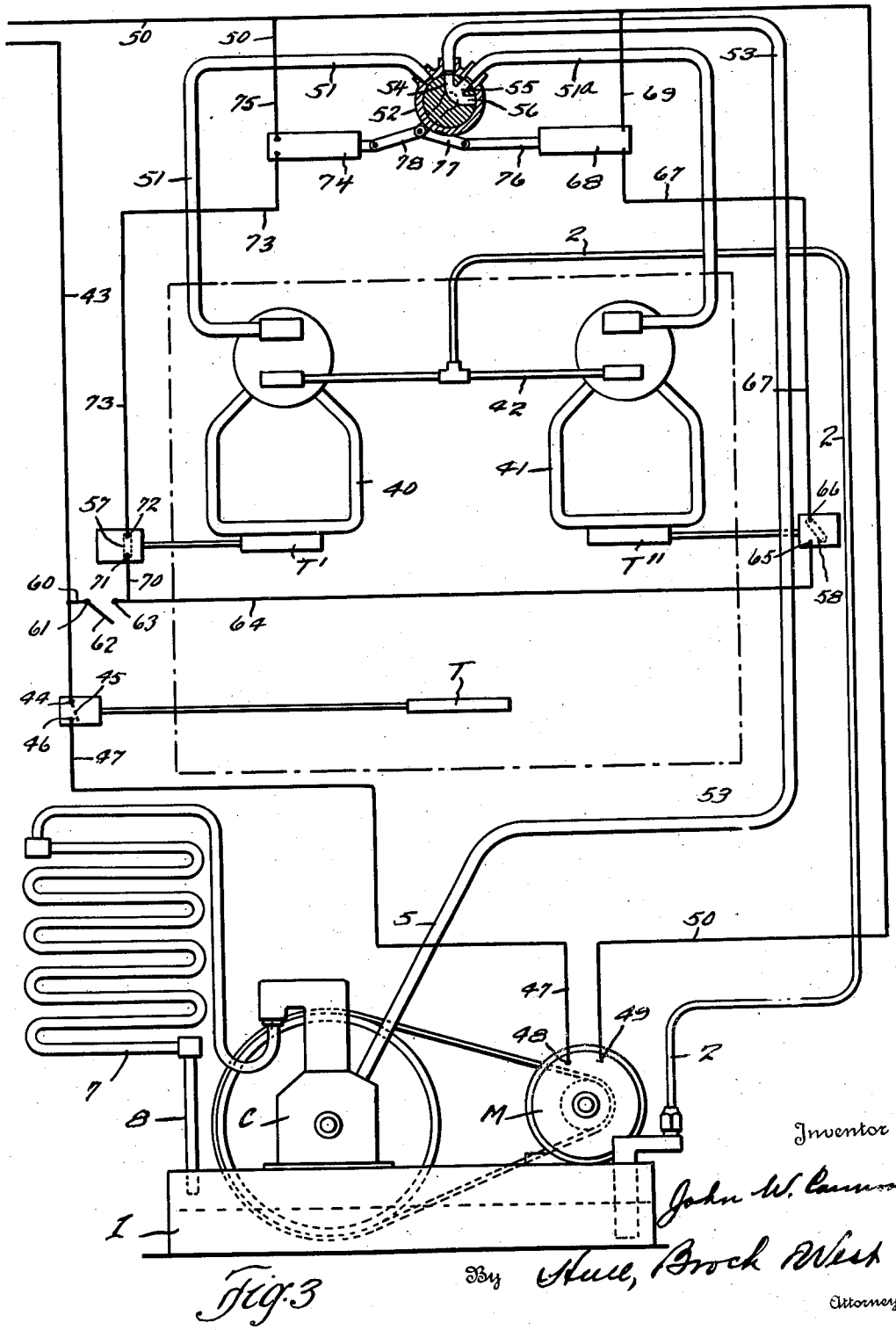


Fig. 3

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2,049,413

DEFROSTING DEVICE FOR REFRIGERATORS

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11 Claims. (Cl. 62—4)

This invention relates generally to refrigerating apparatus and more particularly to means for preventing the accumulation of ice or frost upon the evaporator of a refrigerating unit.

In refrigerating systems of the compressor-evaporator expansion-type, the evaporator which is located within the cooling chamber becomes covered with frost or ice which is caused by air within the cooling chamber being cooled down below the dew point, whereupon moisture is deposited upon the evaporator and soon becomes frozen. This moisture accumulates on the surface of the evaporator in the form of ice or frost and seriously impairs the efficiency of the system. The manufacturers of domestic refrigerating units of this general character usually recommend that the unit be cut off or disconnected at frequent intervals to permit the frost and ice which has accumulated upon the evaporator to melt. This operation is generally referred to as "defrosting". Unless the defrosting is done at frequent intervals, it requires a considerable period of time to melt the frost and ice and the refrigerator is usually cut off over night.

The main object of this invention is to obviate the difficulties hereinbefore mentioned and to provide a control unit which will automatically "defrost" the refrigerator, that is, remove the frost and ice from the evaporator at frequent intervals which will result in an increase in the efficiency of the unit and also maintain the cooling chamber at approximately the desired temperature.

Another object of the invention is to provide a control unit of the character described which is adapted for use with a single unit or with a plurality of units which are operated from a single compressor.

A further object of the invention is to provide a defrosting device of the character described which comprises very few parts and can be installed upon practically any type of refrigerator now in general use.

Further and more limited objects of the invention will appear as the description proceeds and by reference to the accompanying drawings in which Fig. 1 is a somewhat diagrammatic view illustrating my improved control unit applied to a refrigerating unit of the character now in general domestic use; Fig. 2 is a view of a modified form of control unit applied to a refrigerating system which embodies a plurality of cooling chambers and Fig. 3 is a somewhat diagrammatic view of another modification of my improved control unit which is particularly adapted for use with a refrigerating system employing two cooling units within a single cooling chamber.

Referring now to the drawings, the reference character C designates the compressor of a refrigerating unit which is operated by means of an electric motor M. The compressor and motor are supported upon a base member which is constructed to provide a tank or container 1. Leading from the tank or container 1 is a pipe 2 which connects with an evaporator 3. Arranged within the evaporator 3 is a float 4 which operates a valve 5 to maintain a constant level within the evaporator. The evaporator operates as a chiller unit or superfreezer and is located within the chamber to be cooled. It is preferably made of two sheets of steel which are shaped to provide a chamber having a series of parallel tubes extending around the outer surface thereof and opening into the refrigerant reservoir proper.

The liquid refrigerant is admitted from the float chamber into the chilling unit where it evaporates, absorbing heat from the interior of the cabinet. The interior of the superfreezer is made to accommodate suitable receptacles which contain water to be frozen into ice cubes, and which are supported in direct contact with the superfreezer for fast freezing. Leading from the container 3 is a conduit 5 which connects with the compressor C. Leading from the compressor C is a pipe 6 which connects with a condenser 7 which is preferably in the form of a coil. Leading from the condenser 7 is a return pipe 8 which connects with the container 1. The function of the compressor unit is to compress the refrigerant vapor (SO_2) so that it will liquefy upon being cooled in the condenser coil.

The motor M is an electric motor and the circuit therefor includes a wire 9 which leads from a suitable source of current and connects with one terminal 10 of a switch 11. Leading from the terminal 12 of switch 11 is a wire 13 which connects with the terminal 14 of a switch 15. Leading from the opposite terminal 14' of the switch 15 is a wire 16 which connects with one terminal 17 of the electric motor. Leading from the opposite terminal 18 of the motor M is a wire 19 which leads back to the opposite side of the line. The switch 15 is a thermostatically controlled snap-action switch which is well known to those skilled in the art and standard construction on the usual domestic refrigerator. The switch 15 is controlled by means of a thermostat T arranged within the chamber in the cooling chamber. The construction hereinbefore described is standard construction on the usual domestic refrigerator

and forms no part of this invention. However, it will be noted that I have provided a switch 11 which is connected in series with the switch 15. The switch 11 is also a snap action thermostatically controlled switch like the switch 15 and is controlled by means of a thermostat T' which is disposed immediately adjacent and preferably carried by the evaporator as shown. The thermostat T' is operatively connected to the switch 11 in such a manner that when the temperature adjacent the thermostat T' falls below a predetermined amount, the switch 11 will be open against the pressure of a spring or diaphragm which normally maintains it closed. It is a well known fact that when the air within the cooling chamber has been cooled down below a predetermined point, moisture will deposit upon the surface of the evaporator. This moisture will soon become frozen and the entire surface of the evaporator and thermostat T' will become coated with a layer of frost which materially decreases the efficiency of the unit. However, the temperature within the thermostat T' will soon become lowered to a sufficient degree to open the switch 11, thus breaking the circuit to the motor M. When the motor switch 15 and switch 11 are both closed, the motor will be started and the compressor will be operated to remove the refrigerant vapor from the superfreezer through the suction line 5. This reduces the pressure within the container 3 which contains sulphur dioxide in liquid form and allows it to boil or evaporate freely. When the motor is cut off and the compressor is not in operation, this vapor is not being drawn off by the compressor and the evaporation of the refrigerant is decreased to such an extent that the temperature within the icebox will rise to a point where the ice or frost upon the evaporator will melt. As soon as the ice and frost on the evaporator has melted, the temperature of the thermostat T' will be correspondingly raised and the snap action switch 11 will be automatically closed by the thermostat T' to again make the circuit to the motor.

The switch 15 is operated by means of the thermostat T which functions entirely independently of the thermostat T' and is usually set to maintain a temperature in the cooling chamber of from 40° to 42° F.

It will thus be seen that the thermostat T' functions to automatically break the circuit to the motor as soon as the evaporator becomes covered with a layer of ice or frost and that the switch 11 will be automatically closed when this layer of ice or frost has been melted, whereupon the refrigerator may function in the usual manner.

In Fig. 2, I have disclosed a slightly different form of my invention which is particularly adapted for use with a refrigerator system employing a single compressor and motor which operates a plurality of evaporators or cooling units.

In this form of the invention, the compressor, motor and condenser and its associated parts are substantially identical. However, the pipe 2 instead of being connected directly with the evaporator is connected with a pipe 2^a from which lead branch pipes 2^b, which connect respectively with evaporators 20, 21, 22 and 23. The pipe 5 is connected with a pipe 5^a from which lead branch pipes 5^b which also connect with the evaporators 20, 21, 22 and 23. The operation of the refrigerating system is substantially identical with that disclosed in Fig. 1, the refrigerant being drawn off from the evaporators through the pipes 5^a and 5^b and returned thereto through the pipe 2^a and 2^b. The circuit to the motor M includes a wire 24 which connects with a terminal 25 of a pressure operated switch 26. Leading from the terminal 27 of the switch 26 is a wire 28 which connects with a terminal 29 of the electric motor M. Leading from the opposite terminal 30 of the motor M is a wire 31 which leads to the opposite side of the line. The switch 26 is a pressure operated snap action switch of well known construction and is operatively connected with the suction return line 5 in such a manner that when the pressure within the return line falls below a predetermined point, the switch will be opened and break the circuit to the motor. This switch is normally maintained closed by means of a suitable spring or diaphragm. When the pressure within the return line of the system reaches a predetermined point, the circuit to the motor will be made and liquid refrigerant delivered to the several evaporators.

In each of the branch pipes 5^b, there is arranged a normally open valve 32 which is operatively connected with a solenoid 33. Also arranged within each of the cooling chambers is a thermostat T' which is operatively connected with a switch 34. Leading from the wire 24 is a wire 35 which connects with the terminal 36 of the switch 34. Leading from the opposite terminal 37 of the switch 34 is a wire 38 which leads through the electrically operated valve 33 and back to the wire 31, thus completing the circuit to the solenoid. The thermostats T' are arranged immediately adjacent and preferably supported by the evaporators in the manner described in connection with the form of the invention illustrated in Fig. 1.

With the parts in their normal position, the high pressure in the suction line will be such as to maintain the switch 26 closed, thus making the circuit to the motor which will operate the compressor which in turn pumps the refrigerant (SO_2) from each of the evaporators 20, 21, 22 and 23. This reduces the pressure within the several evaporators and increases the rate of evaporation. It is of course understood that the refrigerant is removed from the evaporators and thence delivered through the condenser to the container 1 and that liquid refrigerant is being pumped through the pipes 2^a and 2^b to the evaporators. When the pressure within the return line 5, 5^a falls below a predetermined point, the switch 26 will open and break the circuit to the motor M.

As soon as any one of the evaporators become coated with a thin layer of ice or frost, the temperature of its thermostat T' will be lowered sufficiently to permit the switch 34 to close whereupon the circuit to the solenoid 33 will be made and the valve 32 will be moved to closed position. As the refrigerant vapor is not being removed by the compressor or pump, the pressure within the corresponding evaporator will be increased and the rate of evaporation of the refrigerant correspondingly decreased. The temperature within the particular cooling chamber will then immediately rise until the thermostat T' operates to break the circuit to the solenoid 33 and allow the valve 32 to open whereupon refrigerant will again be allowed to escape from the evaporator and be drawn off by the compressor. This rise in temperature within the particular cooling chamber will be for a sufficient period of time to permit the thin layer of ice or frost which has accumulated upon the evaporator to melt. As soon as

the layer of ice or frost has melted, the thermostat T' breaks the circuit through the solenoid and again permits the refrigerant to be drawn off. The several valves 32, thermostats 33 and the circuits for operating the same are identical and detailed description of each is not considered necessary.

It will therefore be seen that each of the several evaporators will be automatically defrosted independently of the other and without affecting the operation of the system as a whole. This particular embodiment of my invention is especially adapted for use in hotels, apartment houses and similar places where a plurality of similar units are operated by a single compressor.

In Fig. 3, I have disclosed a second modification of my invention which is particularly adapted for use with a system employing two cooling units or evaporators in a single cooling chamber. In this form of the invention, the compressor, condenser, motor and associated parts are identical with that disclosed in Figs. 1 and 2. However, in this unit, I make use of two cooling units or evaporators which are indicated by the reference characters 40 and 41. The pipe 2 through which the liquid refrigerant is delivered is connected with a branch pipe 42, the opposite ends of which are connected with the evaporators 40 and 41, respectively. The circuit to the motor M includes a wire 43 leading from the line and which connects with a terminal 44 of an automatic snap action switch 45 of well known construction. Leading from the opposite terminal 46 of the switch 45 is a wire 47 which connects with a terminal 48 of the motor. Leading from the opposite terminal of the motor is a wire 50 which connects with the opposite side of the line. A thermostat T is located within the cooling chamber and is operatively connected with the switch 45 in such a manner as to make the circuit to the motor when the temperature within the cooling chamber exceeds a predetermined amount. Leading from the evaporators 40 and 41 are pipes 51 and 51a which connect with a three-way valve casing 52. Leading from the valve casing 52 is a pipe 53 which connects with the pipe 5 through which the refrigerant is drawn off by the compressor. Arranged within the valve casing 52 is the valve proper which has ports 54, 55 and 56 which are adapted to be connected in communication with the pipes 51, 51a and 53 in a manner to be hereinafter described. Arranged adjacent each of the evaporators 40 and 41 are a pair of thermostats T' and T'' which are operatively connected with switches 57, 58. Leading from the wire 43 is a wire 60 which connects with a terminal 61 of a manually operable switch 62. Leading from the opposite terminal 63 of the switch 62 is a wire 64 which connects with the terminal 65 of the switch 58. Leading from the opposite terminal 66 of the switch 58 is a wire 67 which connects with a solenoid 68 from which leads a wire 69 which connects with the wire 50. Leading from the wire 64 is a wire 70 which connects with the terminal 71 of the switch 57. Leading from the opposite terminal 72 of the switch 57 is a wire 73 which connects with a solenoid 74 from which leads a wire 75. The solenoids 68 and 74 are operatively connected with the three-way valve by means of pivotally connected links 76, 77 and 78 in such a manner that the valve may be moved through an arc of 90° in either direction depending upon which solenoid is energized.

With the parts in the position shown in Fig. 3, the thermostat T has closed the switch 45 and the motor and compressor are in operation. The switch 72 has been closed by the thermostat T' of the evaporator 40 and the switch 58 has been opened by the thermostat T'' of the evaporator 41. The evaporator 41 is in operation and the refrigerant vapor is being withdrawn therefrom through the pipe 51a, ports 55 and 54, pipe 53 which connects with the pipe 5 leading to the intake side of the compressor. Liquid refrigerant is being delivered through the pipe 2 and through the pipe 42 to both of the evaporators 40 and 41. As the switch 72 is closed, the circuit to the solenoid 74 is made and the three-way valve is in such a position that no vapor can escape from the pipe 51. As the thermostat T' for the evaporator 40 warms up, it opens the switch 57 which breaks the circuit to the solenoid 74. However, this has no effect upon the valve and it remains in the position shown in Fig. 3 until the evaporator 41 requires defrosting and its thermostat T'' cools to a point where it closes the switch 58 whereupon the solenoid 68 will be energized and move the three-way valve to connect the port 55 with the pipe 75 and the port 56 with the pipe 53 whereupon refrigerant vapor will be drawn from the evaporator 40 through the pipe 51, port 55, pipe 53 by the compressor. When the valve has been moved to this position, no refrigerant can escape from the evaporator 41 and it remains in inoperative condition whereupon it warms up and thermostat T'' will open the switch 58, thus breaking the circuit to the solenoid 68 and setting everything in readiness for the valve to be again operated when the evaporator 40 needs defrosting, which will again close the switch 57.

It will thus be seen that the two evaporators work alternately and that one is being defrosted while the other is in operation. Should it be desired to use both of the evaporators simultaneously, the manual switch 62 may be opened and the valve manually turned to a position to connect pipes 51 and 51a with the pipe 53, in which case both of the evaporators will operate simultaneously and the defrosting unit will be rendered inoperative. The thermostat T functions entirely independently of the two thermostats T' and T'' and starts the motor whenever the temperature within the cooling chamber exceeds a predetermined point.

My control unit is also adapted for use in a refrigerating system of the gas fired type having an evaporator, a generator and a condenser, the generator taking the place of the compressor and motor in the compression type of system. When used with this type of system, I control the flow of heating gas to the generator by means of a thermostat and the electrically operated valve. The electrically operated valve of the character herein disclosed is connected in the fuel supply line and operated by means of a suitable thermostat to control the supply of fuel to the heating unit.

In the specification I have referred to the thermostat T' as being disposed immediately adjacent the evaporator. This thermostat may have slight contact with the evaporator or be partially insulated therefrom by a thin layer of poor conducting material or by a small air gap in which case it will not operate to break the circuit until the air gap is bridged by a layer of ice forming on the evaporator. The thermostat T' may have slight actual contact with the evaporator, such as point or line contact so long as it is disposed in the path of thermally circulating

air and positioned so as to be contacted by the ice forming on the surface of the evaporator. When such layer of ice becomes sufficiently thick or dense, the heat is conducted away from the thermostat T' sufficiently rapidly to cause the thermostat to actuate the switch to break the circuit to the motor. The thermally circulating air passing over the thermostat T' maintains it at such temperature as to keep the switch 11 closed until a layer of ice forms on the surface of the evaporator of sufficient thickness or density to cause the thermostat to actuate the switch. It is to be understood also that the thermostat T' may be set to break the circuit at different temperatures depending upon the specific conditions encountered.

It will now be clear that I have provided an automatic control unit for defrosting evaporators of a refrigerating system of the character described which will accomplish the objects of the invention as hereinbefore stated. Various changes may be made in the details of construction as well as in the arrangement of parts without departing from the spirit of my invention as the embodiments of the invention herein disclosed are merely illustrative and are not to be considered in a limiting sense as the invention is limited only in accordance with the scope of the appended claims.

Having thus described my invention, what I claim is:

1. In a refrigerating system, the combination of a cooling chamber, a condenser, a compressor, and an electric motor for operating the compressor, a plurality of evaporators arranged within the cooling chamber and connected in parallel in the system, a thermostatic switch for controlling the temperature in the cooling chamber at a point remote from the evaporators, and a defrosting device including a plurality of thermostatic switches associated with the evaporators for rendering first one evaporator and then the other inoperative in accordance with the temperature upon the surface of the defrosting device.

2. In a refrigerating system, the combination of a cooling chamber, a condenser, a compressor and an electric motor for operating the compressor, a pair of evaporators arranged within the cooling chamber and connected in parallel in the system, a thermostatic switch for controlling the temperature within the cooling chamber at a point remote from the evaporators and a defrosting device associated with each evaporator and operable independently of the other evaporator for decreasing the rate of evaporation of the refrigerant within the evaporators in accordance with the temperature upon the surface of the defrosting device.

3. In a refrigerating system, the combination of a cooling chamber, a condenser, a compressor and an electric motor for operating the compressor, a pair of evaporators arranged within the cooling chamber, a pair of thermostatic switches connected with the motor so as to alternately render operative first one evaporator and then the other.

4. In a refrigerating system, the combination of a cooling chamber, a condenser, a compressor, and a pair of evaporators arranged within the cooling chamber, and defrosting means including a pair of thermostats operable in accordance with the temperature on the surface thereof for controlling the decrease in rate of evaporation of the refrigerant within the evaporators respectively in accordance with the temperature upon the surface of said thermostats.

5. In a refrigerating system, the combination of a cooling chamber, a condenser, a compressor, an electric motor for operating the compressor, a pair of evaporators arranged within the cooling chamber, defrosting means associated with each of said evaporators for defrosting the evaporators when the temperature on the surface of said defrosting means falls below a predetermined point and additional means for discontinuing the operation of the evaporators when the temperature within the cooling chamber at a point remote from the evaporators falls below a predetermined point.

6. In a refrigerating system, the combination of a cooling chamber, a compressor, an electric motor for operating said compressor, a pair of evaporators arranged within the cooling chamber and thermostatically controlled means for alternately and independently connecting first one evaporator and then the other with the compressor.

7. In a refrigerating system, the combination of a compressor, an electric motor for operating said compressor, a pair of evaporators and thermostatically controlled means for alternately connecting first one and then the other evaporator with the compressor, said thermostatically controlled means including an electrically operated valve, the circuit for such valve including a pair of thermostats one of which is disposed immediately adjacent the bottom of each of the evaporators and serving to make and break said circuit in accordance with the temperature conditions upon the surface of such thermostat whereby the evaporators are rendered ineffective alternately.

8. In a refrigerator, a refrigerating apparatus including a compartment to be cooled, an evaporator for cooling said compartment, control means for regulating the normal operation of the evaporator, a thermostat disposed below said evaporator and positioned to be wiped by air thermally circulating in said compartment and to receive an ice coating from a formation of ice spreading from the lowermost portion of said evaporator, means, independent of said control means, for suspending the operation of said evaporator, said thermostat being constructed and arranged to start and stop the operation of said suspending means, respectively, when such coating occurs and is substantially melted from said thermostat.

9. In a refrigerator, a refrigerating apparatus including a compartment to be cooled, an evaporator for cooling said compartment, control means for regulating the normal operation of the evaporator, a thermostat disposed in close proximity to said evaporator and adjacent to the lower portion thereof and positioned to be wiped by air thermally circulating in said compartment and to receive an ice coating from a formation of ice spreading from the lowermost portion of said evaporator, means, independent of said control means, for suspending the operation of said evaporator, said thermostat being constructed and arranged to start and stop the operation of said suspending means, respectively, when such coating occurs and is substantially melted from said thermostat.

10. In a refrigerating system including a plurality of compartments to be cooled, the combination of a compressor, an electric motor for operating said compressor, a plurality of evaporators arranged one in each of said compartments,

conduit means connecting each of said evaporators to said compressor, a valve controlling the flow from each evaporator through said conduit means, a circuit for energizing said motor and controlling the operation of said valves, and means for controlling said circuit, the latter means including a thermostat disposed in close proximity to each evaporator and adjacent to the lower portion thereof and positioned to be wiped by air thermally circulating in the respective compartment and to receive a coating from a formation of ice spreading from the lowermost portion of the evaporator, each thermostat being constructed and arranged to operate said circuit to respectively close or open the associated valve when such coating occurs or is substantially melted from said thermostat.

11. In a refrigerator, a refrigerating apparatus including a compartment to be cooled, an evaporator for cooling said compartment, control means for regulating the normal cycle of operation of the evaporator, means operable independent of said normal control means for suspending the operation thereof under predetermined conditions including a defrosting thermostat disposed in close proximity to said evaporator and adjacent the lower portion thereof and positioned to be wiped by air thermally circulating in said compartment and to receive an ice coating from a formation of ice spreading from the lowermost portion of said evaporator, said defrosting thermostat being operable to render said normal control means ineffective when such coating occurs and to render said normal control means effective when such coating has substantially melted from said thermostat.

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