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EVAPORATOR DEFROSTING MEANS

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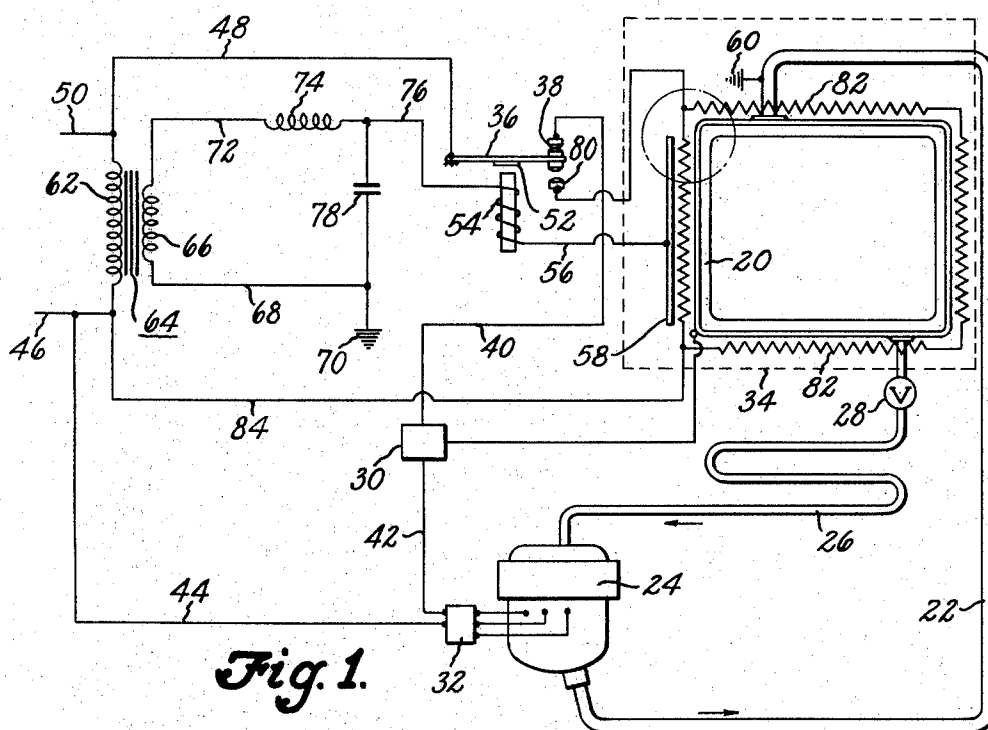


Fig. 1.

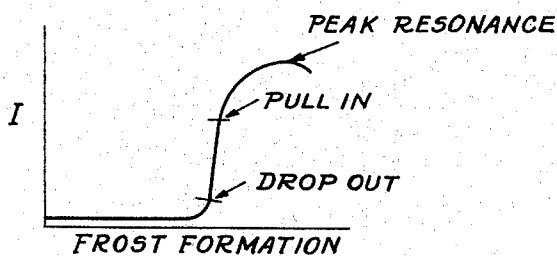


Fig. 2.

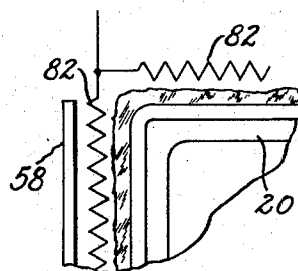


Fig. 3.

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1

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This invention relates to refrigerating apparatus and more particularly to automatic defrosting effected from time to time as the frost builds up.

The common procedure is to defrost the refrigerant evaporator manually or by some form of timer to defrost the evaporators at regular periodic intervals. Since the frost accumulation varies in proportion to the time the door is open and to the humidity in the room at the time the door is open, the timing device must be set to defrost the evaporator at intervals sufficiently long and frequent with sufficient heat developed during the defrosting period to accomplish the defrosting under the worst frosting conditions. While attempts have been made to initiate and control defrosting cycles by the thickness of the frost, as far as I am aware, none has proved practical.

It is an object of this invention to provide a practical method of and apparatus for defrosting refrigerant evaporators whenever there is a predetermined accumulation of frost and for continuing the defrosting until the frost has substantially disappeared.

It is another object of this invention to provide a defrosting system in which the accumulation of frost causes a change in a resonant circuit to initiate a defrosting period and the cessation of refrigeration and in which the return to normal of the resonant circuit causes the termination of the defrost period and the resumption of refrigeration.

These and other objects are obtained in the form of the invention shown in the drawings in which a metal plate is positioned close to and parallel to a vertical surface of the evaporator but insulated therefrom so as to form a capacitor with the adjacent metal wall surface thereof. The metal plate and the evaporator are connected as a capacitor in a resonant electric circuit including a relay. The circuit is arranged so that under normal conditions when there is no frost between evaporator and the metal plate, substantially no current flows through the relay coil and the relay contacts connect the refrigeration system to the power supply. When sufficient frost accumulates between the evaporator and the plate, the dielectric constant is increased, the current flow in the circuit increases as the circuit approaches resonance, causing the relay to operate to disconnect the refrigerating system from the power supply and to connect an electric heat defrosting system to the power supply. Under such circumstances the electric heat quickly defrosts the evaporator. The defrost water can readily flow away from the space between the conductor metal plate and the evaporator. The dielectric constant is thereby restored to the original condition at the completion of the defrosting and the resonant circuit is returned to the state in which substantially no current flows through the relay. The relay will then return to its normal position in which the defrost heater is deenergized and the refrigerating system is reenergized to resume refrigeration.

Further objects and advantages of the present invention will be apparent from the following description, ref-

2

erence being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a diagrammatic view of a refrigerating and automatic defrosting system embodying one form of my invention;

Figure 2 is a diagram showing the current-opening and current-closing points of the relay relative to the formation of frost; and

Figure 3 is an enlarged fragmentary view of a portion of Figure 1 showing the frost upon the evaporator surfaces.

Referring now to the drawings there is shown a refrigerant evaporator 20 provided with hollow metal walls within which the liquid refrigerant evaporates and is drawn through the return conduit 22 by the sealed motor compressor unit 24. This sealed unit 24 compresses the refrigerant and forwards it to the condenser 26 where it is liquefied and flows under the control of a suitable valve or restrictor 28 back to the hollow walls of the evaporator 20. The sealed unit 24 may be controlled by any suitable form of thermostatic switch 30 responsive to the temperature of the evaporator 20 or the medium cooled thereby. A starting relay 32 may also be provided. The evaporator 20 may be located within an insulated household refrigerator cabinet 34 provided with an access door.

Since the evaporator 20 is used for the freezing of the ice as well as for cooling the air within the insulated cabinet 34, the evaporator 20 must operate at freezing temperatures. Whenever air is cooled at freezing temperatures below the dew point, some of the moisture in the air will be deposited as frost upon the freezing surfaces. When the access door is open, the warm air from the room enters the cabinet and moisture from the air is deposited as frost upon the surfaces of the evaporator 20. The amount of frost deposited varies with the length and frequency of the open periods of the door and with the humidity of the air which enters the door.

According to my invention whenever a predetermined amount of frost accumulates on the outer surface of the evaporator 20, refrigeration is discontinued and a defrosting period is begun which continues until the frost is substantially all melted from the evaporator. This is accomplished by a high impedance resonant circuit which includes a double throw switch 36 having a spring blade with double contacts at one end which is normally sprung so as to make contact with the upper contact 38. This upper contact 38 connects through the conductor 40, the thermostatic switch 30, the conductor 42 and the starting relay with the sealed unit 24. The starting relay 32 and the sealed unit 24 are also connected by the conductor 44 to the supply conductor 46. The double throw switch 36 is connected by the conductor 48 to the second supply conductor 50. The double throw switch 36 is provided with an armature 52 cooperating with the electromagnet 54 to form a relay. This electromagnet 54 has one terminal connected by a conductor 56 with a thin metal plate 58 spaced from and insulated from the adjacent walls of the evaporator so that the two metal surfaces become a capacitor with the air, water, or frost between them serving as the dielectric. The refrigerating system, particularly the evaporator, is grounded to the metal parts of the cabinet as indicated by the reference character 60.

Connected between the supply conductors 50 and 46 is the primary coil 62 of a transformer 64. The transformer 64 has a secondary winding 66 supplying a low voltage such as 30 volts, and having one terminal connected by the conductor 68 to the ground 70. The other terminal of the secondary winding 66 is connected by the conductor 72, the coil 74 and the conductor 76 to the second terminal of the electromagnet 54. Connected between the con-

ductors 68 and 76 is a capacitor 78. This high impedance circuit is so designed that the combined impedance of the coils 74 and 54 equals the combined impedance of the capacitors 78 and 58—20 when frost accumulates to an undesirable extent upon the surface of the evaporator 20 and particularly between the plate 58 and the adjacent metal wall surface of the evaporator 20, the circuit approaches resonance. This circuit includes the secondary winding 66, the conductor 72, the coil 74, the conductor 76, the electromagnet coil 54, the conductor 56 and plate 58, the evaporator 20, the grounds 60 and 70, the conductor 68 and the capacitor 78.

When the circuit approaches resonance, sufficient current flows through the electromagnet coil 54 to attract the armature 52 and pull the double throw switch 36 downwardly into engagement with its lower contact 80. The lower contact 80 connects to this one terminal of the heaters 82 which surround the outer surface of the evaporator 20 in such a way that the frost will be heated to the point of melting. The electric heaters 82 have a second terminal connected by the conductor 84 to the supply conductor 46. This operation causes a cessation of the operation of the refrigerant liquefying means which includes the unit and the condenser 26 and the valve 28 and causes the generation of heat by the heaters 82 until the frost substantially all melts from the evaporator 20. The melting of the frost between the metal plate 58 and the adjacent metal wall of the evaporator 20 provides decreased dielectric constant between the plate 58 and the metal wall of the evaporator 20 to restore its capacitance to its normal value. This throws the circuit out of resonance and restores the high impedance thereof which reduces the current flow through the electromagnet 54 to a minimum as shown in Figure 2. This weakens the attraction for the armature 52 and causes the spring force of the double throw switch 36 to move away from the lower contact 80 back to engagement with the upper contact 38 to restore the refrigerating system to normal operation and to deenergize the electric heaters 82.

Similar defrosting cycles will occur whenever sufficient frost accumulates between the metal plate 58 and the adjacent metal wall of the evaporator 20. In this way defrosting as much and no more than necessary is provided automatically. The circuit and the arrangement are simple and inexpensive.

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 refrigerating apparatus including refrigerant evaporating means having an electrically conductive surface and refrigerant liquefying means operatively connected to said evaporating means, means associating an electrical conductor plate in spaced relation to said conductive surface of said evaporating means to form capacitor means, and electrical means responsive to a change in capacitance of said capacitor means for initiating a defrosting cycle of said evaporating means.

2. In refrigerating apparatus including refrigerant evaporating means having an electrically conductive surface and refrigerant liquefying means operatively con-

nected to said evaporating means, a resonant circuit including said conductive surface and an electrical conductor plate associated in spaced relation to said conductive surface, and means responsive to a change in resonance of said resonant circuit for initiating a defrosting cycle of said evaporating means.

3. In refrigerating apparatus including refrigerant evaporating means having an electrically conductive surface and refrigerant liquefying means operatively connected to said evaporating means, means associating an electrical conductor plate in spaced relation to said conductive surface of said evaporating means to form capacitor means, a capacitance connected in parallel electric circuit arrangement with said conductive surface and said conductive plate, a power supply having supply conductors connected to said circuit arrangement on opposite sides of said capacitance, a choke coil connected in series with one of said supply conductors, a relay having its operating element connected in series with said parallel circuit arrangement, said relay having means for initiating a defrosting cycle.

4. In refrigerating apparatus including refrigerant evaporating means having an electrically conductive surface and refrigerant liquefying means operatively connected to said evaporating means, means associating an electrical conductor plate in spaced relation to said conductive surface of said evaporating means to form capacitor means, a capacitance connected in parallel electric circuit arrangement with said conductive surface and said conductive plate, a power supply having supply conductors connected to said circuit arrangement on opposite sides of said capacitance, a choke coil connected in series with one of said supply conductors, a relay having its operating element connected in series with said parallel circuit arrangement, electrically operated defrosting means for said evaporating means, said relay having one alternate position for operating said liquefying means and for rendering inoperative said defrosting means and a second alternate position for operating said defrosting means and rendering inoperative said liquefying means.

5. In refrigerating apparatus including refrigerant evaporating means having an upright electrically conductive surface exposed to air to be cooled and refrigerant liquefying means operatively connected to said evaporating means, a resonant circuit including said conductive surface and an upright electrical conductor plate associated in spaced insulated relation to said conductive surface in the air to be cooled to form a capacitor in which the capacitance will change according to the amount and distribution of frost between said plate and said conductive surface, and means responsive to a change in resonance of said resonant circuit for initiating a defrosting cycle of said evaporating means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,432,669	Kliever	Dec. 16, 1947
2,506,775	Calabrese	May 9, 1950
2,558,063	Seyffert	June 26, 1951
2,704,441	Morton	Mar. 22, 1955
2,717,957	Ohlheiser	Sept. 13, 1955