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DEFROSTING REFRIGERATION APPARATUS

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DEFROSTING REFRIGERATION APPARATUS

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3 Claims. (Cl. 62-4)

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This invention relates to refrigerating apparatus and more especially to defrosting devices for such apparatus.

In defrosting devices wherein heat is applied to the cooling unit to defrost the same, it is desirable to apply a large quantity of heat for a short period of time to defrost the cooling unit before the frozen food adjacent to the cooling unit is defrosted. When such a large amount of heat is applied, it is desirable that the heating be discontinued as soon as the cooling unit is defrosted so that no excess heat is introduced into the refrigerator. Where such a defrosting period is controlled by an automatic device it is also important that the frost on all portions of the apparatus be melted, for if any frost remains on a portion of the apparatus after a defrosting period, the frost will thicken during the next refrigerating period. While the next defrosting period will remove some of the frost on this portion, more will remain than after the previous defrosting period. The frost on this portion will thus successively increase until it becomes of such size that it interferes with the proper functioning of the refrigerating apparatus.

Accordingly, it is an object of this invention to provide automatic means for terminating the defrosting operation of a cooling unit only after the frost on all portions thereof has melted.

It is a further object of this invention to locate the thermo-sensitive element of a thermostat at a plurality of points on the refrigerating apparatus.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a somewhat schematic drawing of a vertical sectional view of a refrigerator embodying the defrost terminating device of this invention; and

Fig. 2 is a schematic drawing of elements of the defrost terminating device.

Referring to the drawings for a description of the invention, the reference numeral 10 designates a refrigerator cabinet having a food storage chamber 12 in the upper portion thereof and a machine compartment 14 below the food storage chamber. The food storage chamber 12 is surrounded by thermal insulation 16. A sealed casing 18 in the machine compartment 14 contains a compressor 20 and an electric motor 22 for driving the same. An inlet port 24 of the compressor 20 communicates with the interior of the

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sealed casing 18. A pressure conduit 26 leads the refrigerant vapor compressed by the compressor 20 to an air-cooled condenser 28. A capillary tube 30 conducts the refrigerant liquid formed in the condenser 28 to a larger tube 32 located in the thermal insulation 16 of the cabinet 10. The refrigerant liquid vaporizes in part in the tube 32 and then flows into an accumulator 34 forming a part of the rapid defrosting device of the refrigerator.

A second tube 36 communicates at one end 38 with a lower portion of the accumulator 34, then rises upwardly above the accumulator 34 and returns downwardly through the accumulator 34 and at its other end 40 connects with an evaporator 42.

The evaporator 42 is formed of sheet brass and is of the general type shown in the patent application of Jules N. Saler, Serial No. 668,950, filed May 10, 1946, which matured into Patent No. 2,551,465, May 1, 1951. The refrigerant passages 43 in the evaporator 42 comprise groups of parallel passages, each of which groups is connected in series. Each group of parallel passages is relatively narrow so that the refrigerant flowing through the cooling unit is confined to a fairly definite path. This path should preferably be in close heat-exchange relationship with all portions of the evaporator 42.

A small hole 44 in the tube 36 communicates with an upper portion of the accumulator 34. During the refrigerating operation of the apparatus, the accumulator 34 is filled with refrigerant liquid to the level of the hole 44, and the refrigerant liquid and vapor flows through this hole 44 and through the lower portion of the tube 36 into the evaporator 42.

A suction tube 46 conduits the vaporized refrigerant from the evaporator 42 downwardly to the casing 18. The suction tube 46 has a portion 48 in heat-transfer relationship with a portion 50 of the capillary tube 30 and a lower portion 52 in heat-transfer relationship with the pressure conduit 26.

The electric motor 22 receives its power from the lines 58 through the leads 60. A thermostatic switch 62 is connected in one of the leads 60 and is controlled by a temperature-sensitive bulb 64 located on the evaporator 42. The bulb 64 contains a volatile fluid, the vapor pressure of which is transmitted to the thermostatic switch 62 through a tube 66. The switch 62 and bulb 64 control the motor 22 to maintain the temperature of the evaporator 42 at a substantially constant value near 0° F.

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A heater 68 is located adjacent the tube 32 to heat the same and is controlled by a switch 69 located in a controller 70. Leads 72 connect the heater 68 and the switch 69 of the controller 70 in series and this series circuit is connected in parallel with leads 60. The controller 70 is of the type described and claimed in the patent application, Serial No. 143,788, filed February 11, 1950, by the inventor of this invention and comprises a counting device which is actuated through a plunger 74 to close the switch 69 of the controller 70 by means of a push rod 76 when the door 75 of the refrigerator has been opened and closed a certain number of times, such as sixty times. The closing of the switch 69 bridges contacts 78 to energize the heater 68 provided the switch of the thermostatic switch 62 is also closed.

The defrosting action of this refrigerator is described and claimed in Patent No. 2,459,173, issued January 18, 1949, to the inventor of this invention and is as follows: When the heater 68 is energized, some of the refrigerant liquid in the tube 32 vaporizes so that an abnormal quantity of refrigerant vapor enters the accumulator 34. This vapor is too large in volume to flow through the opening 44 in the tube 36 at the prevailing pressure. Consequently, the pressure in the accumulator 34 rises until the refrigerant liquid is forced from the accumulator 34 through the end 38 of the tube 36. This refrigerant liquid is warmed by the warm vapor generated in the tube 32.

The added refrigerant liquid transferred to the evaporator 42 from the accumulator 34 floods the evaporator 42 and runs downwardly through the suction tube 46 and through the portion 52 thereof which is in heat-exchange relationship with the pressure conduit 26. The liquid refrigerant is vaporized completely in the portion 52 of the suction conduit 46 by the heated vapor in the pressure conduit 26. This raises the suction pressure in the entire apparatus so that no further vaporization occurs in the evaporator 42 and so that the latter is defrosted by the warm refrigerant issuing from the accumulator 34.

The device which terminates the defrosting action and which device is the subject matter of the invention comprises a metal bellows 80 located adjacent the switch 69 and adapted to move the switch 69 to the left through a push rod 82 when the bellows expands. The bellows 80 connects through a tube with a somewhat larger blind metal tube 86 located in heat-transfer relationship with the suction tube 46 and extends for a substantial distance along the suction tube 46 from the evaporator 42. The blind tube 86 contains a small amount of volatile liquid sufficient to wet only a small portion of the blind tube 86.

When the defrosting action is effected by energizing the heater 68, a portion of the refrigerant flowing through the evaporator 42 will be in the vapor phase. This vapor flows through all portions of the evaporator 42 because of the series arrangement and distribution of the refrigerant passages 43. This vapor condenses in the evaporator 42 and thereby gives up heat units to melt the frost. The refrigerant flowing through the evaporator 42 in turn is cooled and as the refrigerant flows into the portion 88 of the suction tube 46 adjacent the evaporator 42 it reflects the coldest temperature of any portion of the evaporator 42. Thus when the refrigerant in this portion 88 of the suction tube 46 reaches a temperature of above 32° F., such as 42° F., all portions of evaporator 42 will have been defrosted.

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When this temperature is attained the fluid pressure in the blind tube expands the bellows 80 and moves the switch 69 to the left to deenergize the heater 68 and thereby terminate the defrosting action.

During certain conditions of operation, frost may form on the suction tube 46 at a point beyond the portion 88. When this happens, the portion 88 of the suction tube 46 will be defrosted before the more remote portions 90 thereof are defrosted. When this condition prevails, the control point of the blind tube 86 shifts to the coldest portion of the suction tube 46 in contact therewith. This action is caused by the vaporization of the volatile fluid in the warmer portion of the blind tube 86 and its condensation on the colder portion thereof as is well-understood in the art. The defrosting action of the apparatus, therefore, will be continued until all portions of the suction tube 46 which are in contact with the blind tube 86 are defrosted.

The control element consisting of the blind tube 86, the tube 84, and the bellows 80 should be so located that a portion thereof which is in heat-transfer relationship with the evaporator 42 or the suction tube 46 is at all times colder than any portion of the element which is not in heat-transfer relationship with the evaporator 42 or the suction tube 46. Such location is essential during the latter part of the defrosting action so that the defrosting action is not unnecessarily prolonged by the shifting of the control point to a portion of the refrigerator which is not to be warmed to a temperature of 42° F.

It will be apparent from the above that this invention provides a device for terminating the defrosting action of a refrigerator when all frost on the evaporator and on portions of the suction tube remote from the evaporator are defrosted. It also provides for the prompt termination of the defrosting operation when the evaporator is defrosted and no frost has gathered on the suction tube.

While I have shown the invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What I claim is:

1. In a refrigerator including an insulated chamber, a cooling unit for cooling the interior of said chamber, fluid-circulating means located exteriorly of said chamber, first and second conduits connecting said cooling unit with said fluid-circulating means, said fluid-circulating means being adapted to periodically supply a cooling fluid to said cooling unit through said first conduit and withdraw said fluid from said cooling unit through said second conduit, said cooling fluid being adapted to cool said cooling unit to below 32° F., said fluid-circulating means being also adapted to periodically supply a warming fluid to said cooling unit and withdraw said warming fluid through said second conduit, said warming fluid being above 32° F. to melt the frost which may have formed on said cooling unit and said second conduit, and control means for said fluid-circulating means to cause said fluid-circulating means to terminate said supply of warming fluid, said control means including an elongated thermo-sensitive motivating element in heat-transfer relationship with said second conduit from a point adjacent the connection between said conduit and said cooling unit within said

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chamber to a point on said conduit exterior of the chamber.

2. In a refrigerator including an insulated chamber, a cooling unit for cooling the media in said chamber, fluid circulating means arranged exteriorly of the chamber, first and second conduits connecting said cooling unit with the fluid circulating means, means associated with at least one of said conduits for varying the temperature of the fluid supplied to said cooling unit, said temperature varying means being adjustable to supply fluid at a temperature below 32° F. for cooling said unit and at a temperature above 32° F. for melting frost formed on the cooling unit and said conduits, and control means for adjusting the temperature varying means and effective to terminate the supply of fluid at a temperature above 32° F. and for initiating the supply of fluid at a temperature below 32° F., said control means including an elongated thermosensitive motivating element in heat transfer relationship with respective portions of one of said conduits within the insulated chamber and exteriorly thereof.

3. In a refrigerator including an insulated chamber, a cooling unit within said chamber, condensing means including a compressor located exteriorly of said chamber, means including an expansion device for conveying refrigerant from said condensing means to said cooling unit, a suction conduit for conveying refrigerant from said cooling unit to said condensing means, first con-

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trol means for periodically energizing said condensing means to supply refrigerant to said cooling unit and withdraw refrigerant through said suction conduit to cool said cooling unit below 32° F. whereby frost collects on said cooling unit, means for periodically warming the refrigerant flowing through said cooling unit to raise the temperature of said cooling unit to above 32° F. to melt the frost thereon, and second control means for terminating the operation of said refrigerant warming means when said cooling unit has been warmed to a temperature above 32° F., said second control means including a thermosensitive motivating element in heat-transfer relationship with a first portion of said suction conduit, adjacent said cooling unit and within said chamber, and a second portion of said suction conduit exterior of said chamber.

GRAHAM S. McCLOY.

REFERENCES CITED

The following references are of record in the file of this patent:

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