

May 14, 1935.

H. J. DICK

2,001,323

REFRIGERATING APPARATUS

Filed April 29, 1931

2 Sheets-Sheet 1

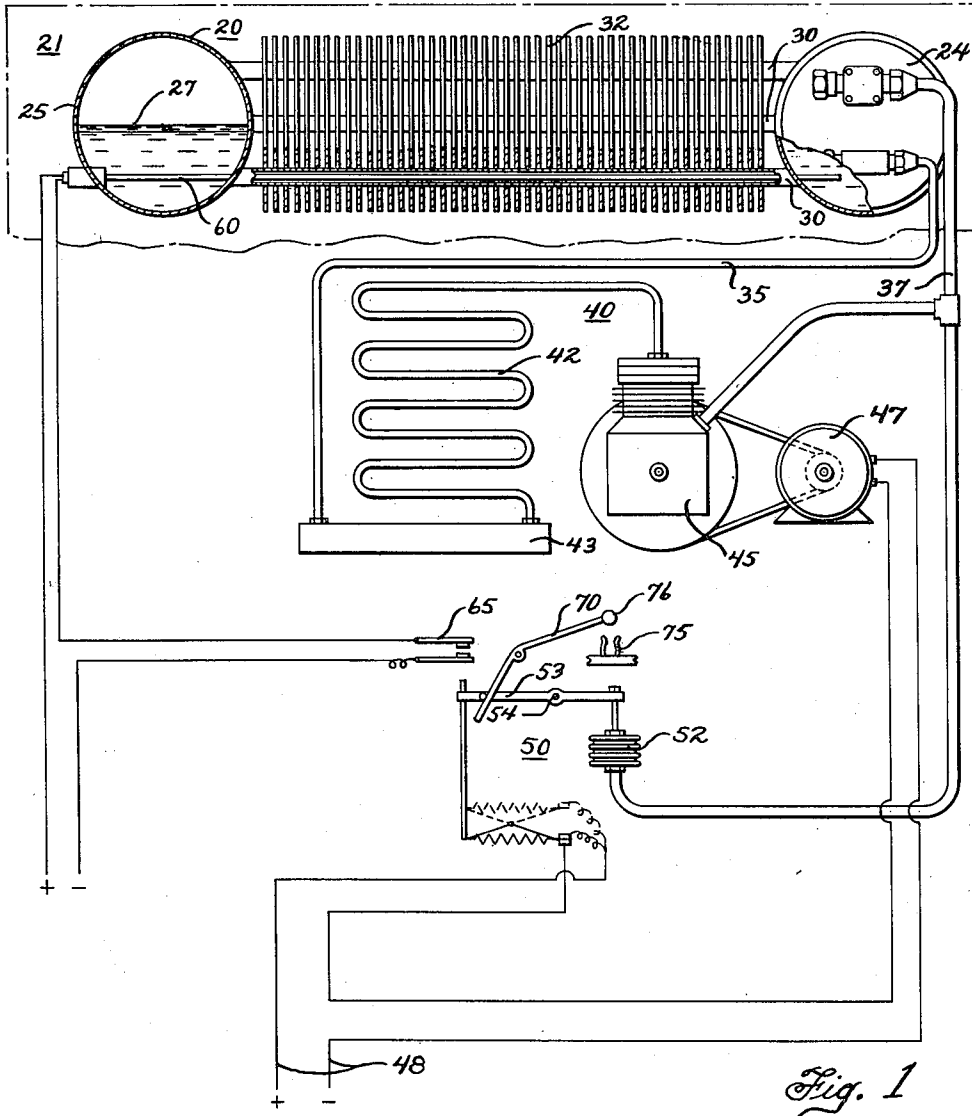


Fig. 1

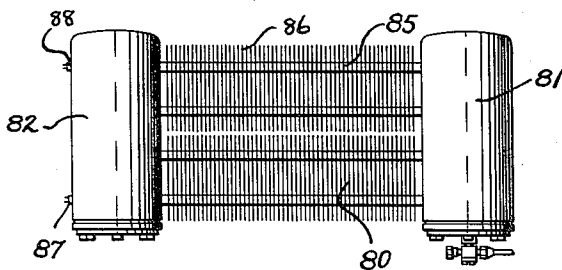


Fig. 3

INVENTOR
Herman J. Dick
BY
Spencer, Hardman and Fehr
ATTORNEY

May 14, 1935.

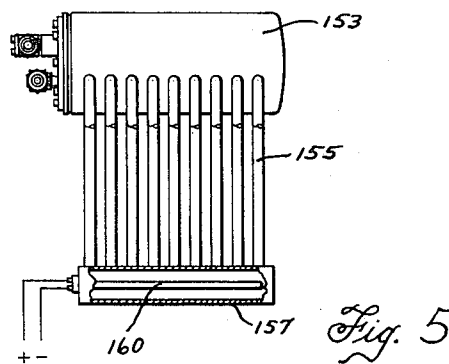
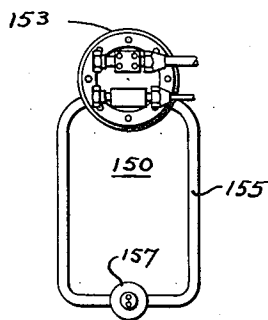
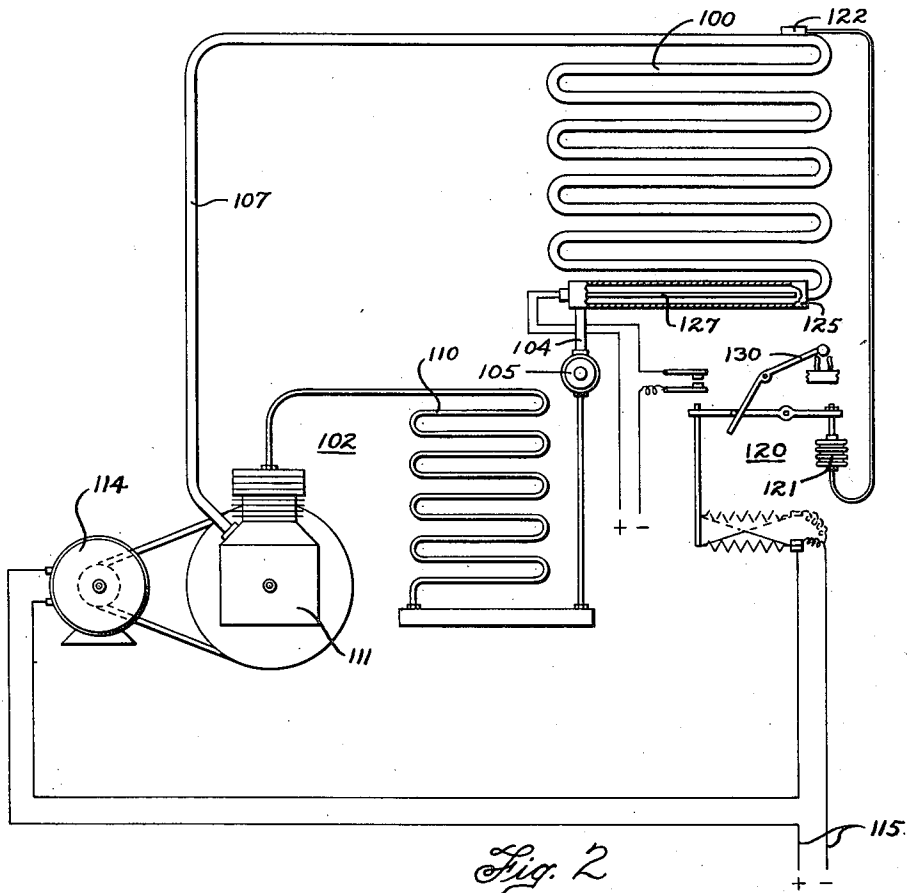
H. J. DICK

2,001,323

REFRIGERATING APPARATUS

Filed April 29, 1931

2 Sheets-Sheet 2



INVENTOR
Herman J. Dick
BY
Spencer, Hardman and Zehr
ATTORNEY

UNITED STATES PATENT OFFICE

2,001,323

REFRIGERATING APPARATUS

Herman J. Dick, Dayton, Ohio, assignor, by
mesne assignments, to General Motors Corpo-
ration, a corporation of Delaware

Application April 29, 1931, Serial No. 533,739

9 Claims. (Cl. 62—4)

This invention relates to refrigerating apparatus of the type which includes a cooling element adapted to be placed in the path of a cooling medium and which is adapted to be maintained normally at a temperature causing solidification of a part of such medium flowing thereover and more particularly to improved means for quickly removing the solidified medium accumulated on said cooling element.

One of the objects of this invention is to provide improved means for freeing the cooling element from frost and ice accumulated thereon.

More specifically it is an object to provide an artificial heating element within the confines of the cooling element for applying its heat to the refrigerant in the cooling element so as to cause melting of the ice or frost on the walls of the cooling element to thereby quickly remove the frost and ice from the cooling element.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of the present invention are clearly shown.

In the drawings:

Fig. 1 is a diagrammatic illustration of a refrigerating system embodying features of the invention;

Fig. 2 is a diagrammatic illustration of a modified form of refrigerating system embodying features of the invention.

Fig. 3 is a top plan view of a cooling element embodying features of the invention;

Fig. 4 is a front view of a cooling element embodying my invention; and

Fig. 5 is a side view of the cooling element shown in Fig. 4 and showing a portion thereof in elevation and a portion in cross section.

In refrigerating rooms, compartments, cabinets and the like it is usual to place a cooling element such as an evaporator in the space to be cooled and to circulate refrigerant through the cooling element by means of a refrigerant circulating element which usually operates automatically in response to normal conditions within the system to chill the cooling element and induce circulation of air in the space to be cooled. The cooling element soon becomes coated with frost and ice formed by the freezing water condensing on the cooling element from the circulating air and this frost and ice forms a resistance to the transfer of heat from the air to the cooling element and thus reduces the efficiency of the system. Since the refrigerating requirements of the space vary from time to time and since re-

frigeration is produced by the apparatus at a fairly uniform rate, which rate must be slightly higher than the maximum requirement of the space to be cooled, it is usual to operate the refrigerating system intermittently in order to prevent cooling the space below the desired temperature.

In practicing this invention it is a further object to prevent operation of the refrigerant circulating element in response to normal conditions within the system when it is desired to defrost the cooling element. This is preferably accomplished by providing means for rendering the refrigerant circulating element ineffective to operate in response to normal conditions within the system and simultaneously rendering the defrosting device operative to free the cooling element of frost and ice. I have also arranged for the automatic restoration of said means to its normal position in the event certain abnormal conditions occur within the system to thus render the defrosting means ineffective to produce its function and to place the refrigerant circulating element in readiness for operation.

Referring to the drawings, and particularly to Fig. 1, 20 designates the cooling element for cooling the compartment 21, the cooling element being shown for the purpose of illustration as including headers 24 and 25 forming reservoirs for liquid refrigerant, the level of which I have indicated at 27. This level is maintained substantially constant by a float valve not shown herein but fully described in the patent to Osborn 1,556,708, October 13, 1925. In the specific embodiment, the cooling element also includes a plurality of conduits 30 communicating with both headers, and thermal conducting fins 32 in contact with the conduits.

Liquid refrigerant is supplied to the cooling element by a liquid conduit 35 and the evaporated refrigerant is withdrawn from the cooling element through a vapor conduit 37, both conduits being suitably connected to a refrigerant circulating element 40. The element 40 includes a condenser 42, a receiver 43 to which the conduit 35 is connected, a compressor 45 and a motor 47 for driving the compressor. The motor is supplied with current through the power mains 48 under the control of an automatic switch 50. The switch 50 is actuated in response to normal conditions within the system for starting and stopping the motor, and for instance, in response to change in pressure of refrigerant within the cooling element and in the vapor conduit 37 which change in pressure corresponds uniformly with changes in tem-

perature of the cooling element and refrigerant contained therein. The switch includes an expandable bellows 52 and suitable leverage mechanism 53 pivoted at 54.

5 In many instances the cooling element 20 is employed to maintain frozen food articles in their frozen condition and consequently to maintain the temperature of the storage or display compartment in which they are stored below the thawing point of such articles. For this reason
10 it is desirable to quickly defrost the cooling element so as to prevent the temperature in said compartment from rising above the thawing point of said articles. Thus it is desirable to rapidly
15 defrost the cooling element.

In accordance with this invention I provide means for quickly defrosting the cooling element. This means comprises an electric heating element 60. In order to rapidly defrost the cooling element I have placed this electric heating element within the confines of the cooling element and have arranged for applying its heat directly to the refrigerant in the cooling element before applying the heat to the walls of the cooling element.
25 In such instance it is obvious that the connection of the heating element at the point where it passes through a wall of the cooling element must be insulated. As shown in Fig. 1 the portion of the heating element extending into the cooling element is preferably spaced from walls thereof and is immersed in the liquid refrigerant in the element 20. In this embodiment the heating element passes through the lowermost conduit 30 and extends into both headers 24 and 25 below the level
30 of liquid refrigerant therein. Thus it will be apparent that the heating element gives up its heat directly to the refrigerant which causes it to boil and circulate warm refrigerant throughout the entire cooling element. The temperature of the
40 walls of the cooling element will be increased by the heated refrigerant causing the ice and frost to melt loose from the walls and drop from the cooling element in large chunks.

The circuit throughout the heating element is completed upon closure of a set of contacts 65 which takes place in a manner about to be described.

During defrosting periods of the cooling element it is desired to render the refrigerant circulating element inoperative and in order to accomplish this I have provided a suitable arrangement which renders the switch 50 ineffective to normal conditions within the system for causing operation of the circulating element while at the same time the circuit through the electric heating element is completed. I have provided a pivoted lever 70 which moves the leverage mechanism 53 upwardly to engage the movable member of the contacts 65 to close the electric heating circuit and by this upward movement of the leverage mechanism the switch is moved out of its normal operating position and is ineffective to normal pressures in the bellows 52. In order to maintain the heating circuit closed
65 and to maintain the leverage mechanism 53 out of its operating position I have provided a resilient locking device 75 which receives the handle end 76 of lever 70. This locking device keeps the lever 70 locked in position during the
70 defrosting period and prevents the downward movement of the leverage mechanism during the defrosting operation. However, if the user of the apparatus should forget to actuate the lever 70 after the cooling element has been defrosted to
75 thus return the leverage mechanism 53 to its

position where it is in condition to control operation of the circulating element, and to interrupt the heating circuit, the lever 70 will be automatically actuated in response to abnormal conditions, such as extreme pressures created under the influence of the heating element within the cooling and conduit 37 by means of the bellows 52 which at that time moves the leverage mechanism to separate the lever 70 from its resilient locking device 75 and also interrupts the heating circuit by causing the movable member of contacts 65 to be separated from the stationary member of said contacts. The pressure at which the bellows 52 renders the defrosting device ineffective and restores switch 50 to normal operating position occurs after the cooling element has been entirely defrosted.

Fig. 3 shows a cooling element 80 similar in all respects to the cooling element 20 and this cooling element comprises in general a pair of headers 81 and 82, interconnecting conduits 85 and fins 86 all of which correspond to similar parts of the cooling element 20. In this view there is shown a heating element 87 and a second heating element 88 located at opposite ends of the cooling element. In some instances it has been found on large cooling elements that the two heating elements were desirable to more quickly remove the frost and ice from the cooling element. The heating elements 87 and 88, corresponding to the heating element 60, are positioned within the heating element in the same manner as the element 60 is positioned in the cooling element 20 and the manner of operation of said heating elements 87 and 88 is the same as the manner of operation of heating element 60, and if desired these two heating elements 87 and 88 may be connected in series and controlled by a single set of contacts in the same manner as heating element 60.

Referring now to Fig. 2 there is shown a modified form of refrigerating system commonly known as a dry expansion system. In this modification I have shown a cooling element or expansion coil 100, and a refrigerant circulating element 102. The refrigerant circulating element 102 supplies liquid refrigerant to the cooling element 100 through conduit 104 under the control of an expansion valve 105. Evaporated refrigerant is returned to the circulating element through a vapor conduit 107. Refrigerant circulating element 102 corresponds in all respects to refrigerant circulating element 40 shown in Fig. 1. Thus the refrigerant and its circulating element includes condenser 110, compressor 111 and motor 114 which drives the compressor. The motor is supplied with current through power mains 115 and is controlled in response to the temperature of the cooling element 100 by means of an automatic switch 120. The switch 120 includes an expandable bellows 121 actuated by means of a thermostatic bulb 122 which in this illustration is shown in contact with the last coil of the cooling element 100. In this particular embodiment refrigerant in the cooling element 100 during the off cycle of the system will collect in the lowermost portion of said cooling element at which place I have provided a reservoir 125 for liquid refrigerant.

In the reservoir 125 I have disposed an electric heating element 127 which corresponds to the heating element 60 and is controlled in a similar manner as the heating element 60 is controlled. Thus the automatic switch 120 may be employed for cyclically operating the refrigerant circulat-

ing element 102 and by means of a leverage mechanism 130 the automatic switch 120 is rendered ineffective to normal conditions within the system to thus prevent operation of the system and also by the leverage mechanism 130 the heating circuit through the electric heating element is closed for heating the refrigerant within the cooling element 100 to thus rapidly defrost the cooling element 100. The leverage mechanism 130 is arranged in a similar manner as the leverage mechanism 70 shown in Fig. 1 and in the event of abnormal conditions within the system such as for instance extremely high temperature within the cooling element 100 created under the influences of the heating element located within the cooling element 100 to thus cause the thermostatic bulb 122 to expand bellows 121 sufficiently to return the switch 120 to its normal operating position and to interrupt the circuit through the electric heating element in a similar manner as the device described in Fig. 1.

Figs. 4 and 5 show views of a modified form of cooling element embodying features of the present invention. In these figures there is disclosed a cooling element or evaporator 150 which is of the flooded, float controlled type having float valve mechanism similar to the type disclosed in the patent to Osborn 1,556,708, issued October 13, 1925. Evaporator 150 comprises in general a header 153 adapted to provide a reservoir for liquid refrigerant and a plurality of depending ducts 155 for circulating the liquid refrigerant. At the lowermost portion of the cooling element 150 there is provided a liquid refrigerant manifold 157 which communicates with each of the depending ducts 155. In this manifold 157 I have disposed an electric heating element 160 for rapidly removing frost and ice from the cooling element 150 in the manner hereinbefore described. Thus it will be noted that the heating element 160 is immersed in the liquid refrigerant and applies its heat directly to the refrigerant within the cooling element for defrosting the element. The heating element and the control of the supply of liquid to the element 150 may be accomplished in the same manner as described with reference to Fig. 1.

While the forms of embodiments of the invention as herein disclosed, constitute preferred forms, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An intermittently operated refrigerating system comprising in combination a cooling element, a refrigerant circulating element adapted to supply refrigerant to said cooling element, said cooling element being maintained normally below a predetermined temperature range, means responsive to normal conditions within said system for controlling the operation of said refrigerant circulating element, an artificial heating element located within the walls of said cooling element and arranged to apply its heat directly to refrigerant in the cooling element for defrosting said cooling element, and means for simultaneously rendering said heating element effective and for rendering said first named means ineffective to normal conditions within said system.

2. An intermittently operated refrigerating system comprising in combination a cooling element, a refrigerant circulating element adapted to supply refrigerant to said cooling element, said cooling element being maintained normally

below a predetermined temperature range, means responsive to normal conditions within said system for controlling the operation of said refrigerant circulating element, an artificial heating element located within the walls of said cooling element and arranged to apply its heat directly to refrigerant in the cooling element for defrosting said cooling element, and means for rendering said heating element effective and for rendering said first named means ineffective to normal conditions within said system, and said first named means being responsive to abnormal conditions within said system for rendering said heating element ineffective and for automatically restoring itself in normal operating position.

3. Refrigerating apparatus comprising in combination a cooling element adapted to contain a quantity of liquid refrigerant and upon which frost and ice accumulate, an electric heating element enclosed within walls of the enclosure formed by said cooling element and disposed in direct contact with refrigerant therein, and means actuated automatically in response to conditions of said refrigerating apparatus for controlling the electric circuit of said heating element.

4. Refrigerating apparatus comprising in combination a cooling element adapted to contain a quantity of liquid refrigerant and upon which frost and ice accumulate, an electric heating element enclosed within walls of the enclosure formed by said cooling element and disposed in direct contact with refrigerant therein, and means actuated automatically in response to pressures of refrigerant within said refrigerating apparatus for controlling the electric circuit of said heating element.

5. The method of defrosting a cooling element of a refrigerating system containing a quantity of refrigerant which consists in, causing heat generated by an electrical heating element to be applied inside the walls of the cooling element and directly to refrigerant contained therein automatically in response to conditions of the refrigerating system.

6. The method of defrosting a cooling element of a refrigerating system containing a quantity of refrigerant which consists in, causing heat generated by an electrical heating element to be applied inside the walls of the cooling element and directly to refrigerant contained therein automatically in response to pressures of refrigerant within the refrigerating system.

7. A refrigerating system comprising in combination, a cooling element, a refrigerant circulating unit adapted to supply refrigerant to said cooling element, means for controlling the operations of said circulating unit, an electrical heating element located within the walls of said cooling element and arranged to apply heat generated thereby directly to refrigerant within the cooling element for defrosting said cooling element, and said means being actuated automatically in response to conditions of said system and being constructed and arranged to simultaneously render said circulating unit inoperative and said heating element effective.

8. A refrigerating apparatus comprising, a cooling element having a refrigerating medium therein for maintaining same at a sufficiently low temperature to cause frost to accumulate on the outer walls thereof, and a heating device within the walls of said cooling element for imparting heat to the refrigerating medium in said element

to cause melting of frost from the walls thereof by flow of heat from the interior to the exterior of the element.

- 5 9. A refrigerating apparatus comprising, a cooling element having a refrigerating medium therein for maintaining same at a sufficiently low temperature to cause frost to accumulate on the outer walls thereof, a normally ineffective electric

heater within the walls of said cooling element, and automatically actuated means for rendering said electric heater effective to cause heat to be imparted to the refrigerating medium in said element whereby frost accumulated on walls thereof is melted by the flow of heat from the interior to the exterior of said cooling element. 5

HERMAN J. DICK.