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REFRIGERATION APPARATUS

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Fig. 1

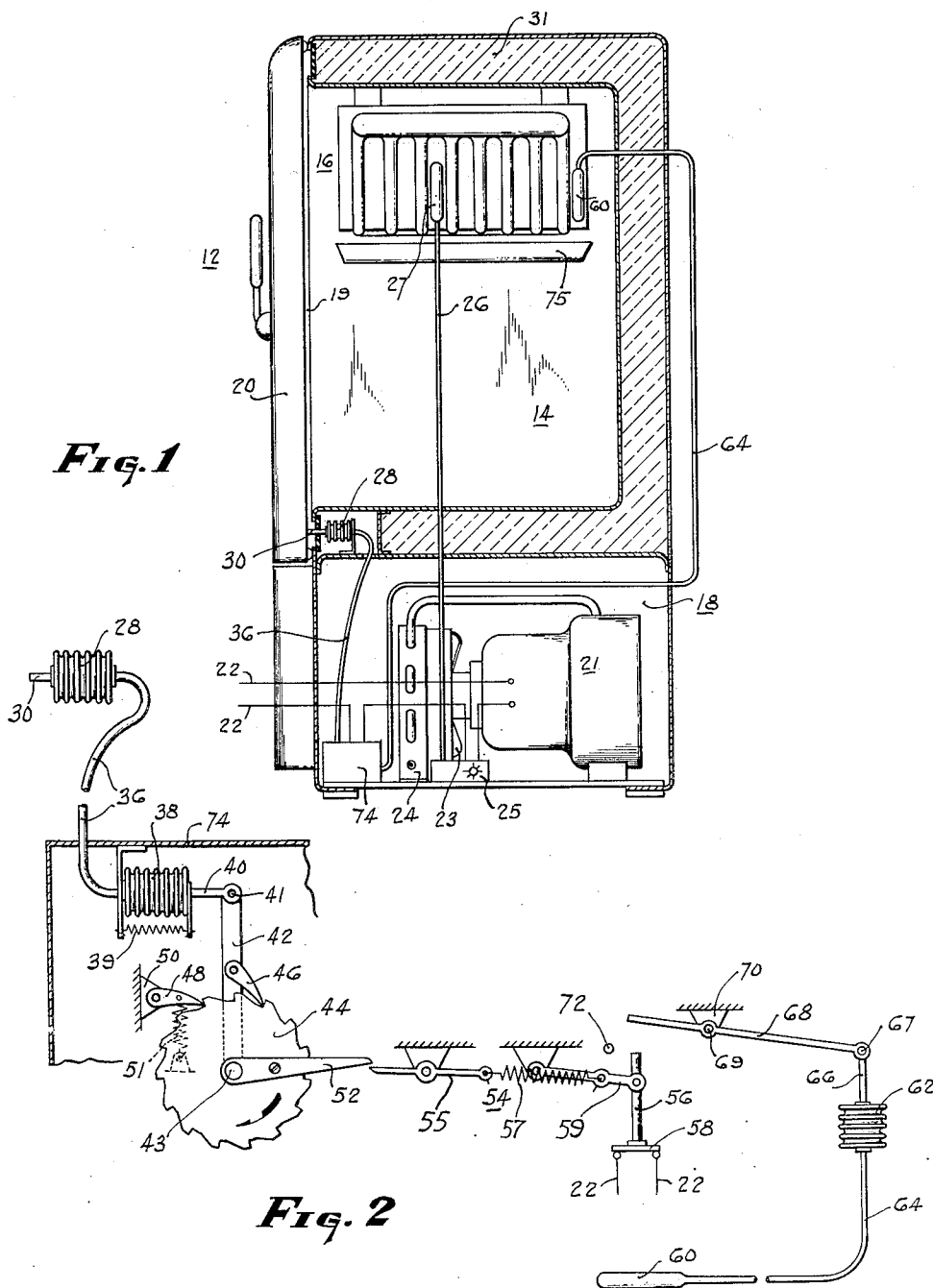


Fig. 2

WITNESSES:

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REFRIGERATION APPARATUS

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8 Claims. (Cl. 62-4)

My invention relates to refrigeration apparatus and more particularly to means for automatically and periodically defrosting the cooling unit of such apparatus.

The accumulation of ice or frost on the cooling unit of a refrigerator is due to condensation and freezing of air-borne moisture on the effective surfaces of the unit. While some of this moisture is derived from foods stored in the refrigerator, a considerable portion of the moisture is condensed from moist, warm room air which is drawn into the refrigerator every time the door is opened. For practical purposes, it may be stated that the accumulation of ice on the cooling unit is closely, if not directly, related to the frequency with which the door of the refrigerator is opened during any given period.

It is, therefore, an object of my invention to produce an improved cooling unit defrosting mechanism responsive to the opening and closing of the door of a refrigerator for periodically arresting the operation of the refrigerating machinery which cools said unit, which mechanism is also responsive to the temperature of the unit to cause said refrigerating machinery to resume operation when the temperature of the unit has reached a predetermined upper limit.

Another object of my invention is to produce a defrosting mechanism of the type set forth which in the process of manufacture can be readily and accurately calibrated for satisfactory operation in different locations having different prevailing conditions of temperature and humidity.

Another object of my invention is to produce a reliable and inexpensive defrosting mechanism of the type set forth.

Another object of my invention is to produce an improved defrosting mechanism which is compact and flexible and which can be incorporated in any type of mechanical refrigerator without any interference with the normal structure or operation of such refrigerator.

A further object of the invention is to provide a hydraulic mechanism for initiating defrosting in response to opening and closing of the refrigerator cabinet door and, furthermore, to provide such a defrosting mechanism wherein the switch which is actuated for defrosting may be disposed at any convenient location in the refrigerator cabinet, remote from the door if desired.

A still further object of this invention is to produce an automatic defrosting mechanism which may be in the nature of an auxiliary device operating independently of the standard temperature control of a refrigerator, or which

may be connected directly to the standard control unit as desired.

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 drawing, forming a part of this invention, in which:

Fig. 1 is a vertical sectional view of a refrigerator provided with a defrosting means embodying my invention; and,

Fig. 2 is an enlarged schematic view of the defrosting means.

Referring now to the drawing in detail, 12 designates a conventional refrigerator provided with a food compartment 14 which is cooled by a heat-exchange unit 16. 18 designates a machinery compartment which, in this case, is shown at the bottom of the cabinet. The food compartment 14 is provided with an access opening 19 which is closed by a door 20. The machinery in the compartment 18 includes a motor-compressor 21 energized by the conductors 22, a fan 23, and a condenser 24 connected by suitable means (not shown) to the evaporator or cooling unit 16. The operation of the motor-compressor 21 is controlled by a conventional temperature control 25 to which temperature variations in the unit 16 are transmitted by a conventional tube 26 and bulb 27. The parts thus far described may be of any conventional well-known type and hence are not shown nor described in detail, it being sufficient to state that when the temperature in the unit 16 has reached a predetermined upper limit to which the apparatus is adjusted, the refrigerating machinery in the compartment 18 is energized, and that, when the temperature in the unit 16 has reached a lower predetermined limit, the refrigerating machinery is deenergized so as to maintain a predetermined average temperature in the food compartment 14.

In order to deenergize the machinery automatically, periodically, and independently of the temperature of the unit 16, I provide a novel defrosting mechanism which includes a bellows 28 which is provided with a pin or plunger 30. In the present instance, the bellows 28 is shown concealed in the bottom of the food compartment 14 but it is to be understood that it may be positioned at any other desired point, as in the top 31 of the compartment 14 or in either of the vertical side jambs of the door opening, it merely being necessary that the pin 30 be so disposed as to project beyond the plane of the door opening so as to be actuated inwardly when the door 20 is closed. The bellows 28 is connected, as by

means of a tube 36, to a remotely placed bellows 38 which is also provided with a pin or plunger 40. The bellows 28, tube 36 and bellows 38 contain a suitable pressure-transmitting fluid, and the bellows 38 is preferably biased into contracting position by a spring 39. The spring 39 can be dispensed with and the pressure of the fluid in the system may be regulated to operate the bellows 28 and 38.

The pin 40 is pivoted at 41 to an arm 42 which is pivoted at 43 to a ratchet wheel 44. The arm 42 carries a pawl 46 which is adapted successively to engage the teeth of the ratchet wheel 44. The arm 42 is preferably constantly retracted (to the left in Fig. 2) by the spring 39, or a separate spring not shown. A retaining dog 48 is suitably pivoted to a support 50 and tensioned by a spring 51 into constant engagement with the ratchet wheel 44. The ratchet wheel 44 also rigidly carries an arm 52 which is adapted to actuate a snap-acting device 54 with every complete revolution of the ratchet wheel 44. The snap-acting device 54 carries an arm 56 which carries a contactor 58. A bulb 60 is positioned in or near the unit 16 and is connected to a bellows 62 by a tube 64. The bulb 60, tube 64, and bellows 62 contain an expansible fluid. The bellows 62 is provided with an arm 66 which is pivoted at 67 to an arm 68. The arm 68 is pivoted at 69 to a suitably fixed support 70. A stop 72 limits the movement of the snap-acting device 54. All the parts shown in Fig. 2, except the bellows 28 and part of the tube 36, are preferably housed in a box 74 and, due to the use of the hydraulic power transmission mechanism, the box 74 can be placed at any available point close to or remote from the bellows 28.

Operation

The snap-acting device 54 may be of any desired conventional construction. As shown, it includes a pivoted arm 55 adapted to be engaged or tripped by the arm 52, and a spring 57 which connects the arm 55 to a pivoted arm 59 which is connected to or carries the arm 56. The arrangement is such that when the arm 52 depresses the adjacent end of the arm 55, the opposite end of the arm 55 is raised above the pivot point of the arm 59. This causes the spring 57 to pull on the arms 55 and 59 along a line above the pivot point of the arm 59 thus raising the arm 56 and separating the contactor 58 from the terminals of the wires 22.

When the refrigerator door is opened, the bellows 38 contracts and the bellows 28 expands and moves the pin 30 outwardly or to the left in Fig. 1, in which position the pin 30 is ready to be actuated when the door is closed. The contraction of the bellows 38 and the expansion of the bellows 28 may be the resultant of the spring structure of these bellows and the properly balanced fluid pressure in said bellows and in the interconnecting tube 36, or, as shown, it is brought about by contraction of the bellows 38 under the action of the spring 39. The contraction of the bellows 38 also retracts the pawl 46 out of engagement with one tooth of the ratchet and into a position to engage the next succeeding tooth. When the door 20 is closed, the pin 30 is moved inwardly to compress the bellows 28. This expands the bellows 38 and moves the pin 40 and arm 42, against the force of the spring 39 (to the right in Fig. 2), to rotate the ratchet wheel 44 through one notch. The dog 48 serves to prevent counter-clockwise rotation of the ratchet wheel 44 during

retraction of the pawl 46. As shown in Fig. 2, the arm 52 is about to engage and trip the snap-acting device 54. It will, however, be understood that after the arm 52 has tripped and moved past the adjacent end of the arm 55, the door 20 may be opened and closed a number of times equal to the number of teeth on the ratchet wheel 44, to cause the ratchet wheel 44 to make one complete revolution, and to cause the arm 52 to engage and actuate the snap-acting device 54 to raise the arm 56 and thus separate the contactor 58 from the terminals of the wires 22, which are connected in series with the standard temperature control 25. This deenergizes the refrigerating apparatus in the compartment 18, and the temperature of the unit 16 gradually rises until the ice or frost accumulated thereon melts and drops into the drip pan 75. The rise in temperature of the unit 16 causes the liquid in the bulb 60 to vaporize, thus expanding the bellows 62. This raises the arm 66 and tilts the free end of the lever 68 downwardly against the upper end of the arm 56 to return it into the position shown in Fig. 2. In this position, the circuit is completed through the conductors 22 to energize the refrigerating apparatus in the compartment 18. The refrigerator now operates subject to the action of its own conventional temperature control 25 until the door 20 has again been opened and closed a number of times equal to the number of teeth in the ratchet 44 when the refrosting cycle is again repeated.

It will be seen from the foregoing that I have produced a flexible defrosting mechanism in the sense that it lends itself to easy installation in a number of different ways and in a number of different locations in a refrigerator cabinet. This renders the construction easily adaptable to different makes of refrigerator of present as well as of future design. This advantage flows directly from the use of the bellows 28, connection 36, and bellows 38 as the hydraulic power-transmitting means, whereby the bellows 38 and the remaining structure enclosed in the box 74 can be located at any desired point in the cabinet structure, while the bellows 28 and pin 30 can also be placed at any desired point in the cabinet structure, while the bellows 28 and pin 30 can also be placed at any desired point at which the pin 30 will be actuated every time the door 20 is opened and closed. Since the rate of accumulation of ice on the cooling unit 16 is affected by the prevailing humidity, it becomes necessary to adapt the defrosting mechanism for use in different climates. By my construction, this can be readily accomplished by increasing or decreasing the number of teeth on the ratchet wheel 44 as may be dictated by the varying requirements of localities having different degrees of relative humidity.

While I have shown my 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, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. The combination with a refrigerator including a food compartment having an access opening thereto, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature,

of hydraulic means responsive to the opening and closing of said door for rendering said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times, and means for again rendering said refrigerating apparatus operative.

2. The combination with a refrigerator including a food compartment having an access opening, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of hydraulic means responsive to the opening and closing of said door, and control means actuated by said hydraulic means each time said door is opened and closed, said control means being effective to render said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times.

3. The combination with a refrigerator including a food compartment having an access opening, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of hydraulic means responsive to the opening and closing of said door, control means actuated by said hydraulic means each time said door is opened and closed, said control means being effective to render said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times, and means responsive to the rise in temperature of said unit for again rendering said refrigerating apparatus operative.

4. The combination with a refrigerator including a food compartment having an access opening, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of door-actuated means responsive to the opening and closing of said door, remotely disposed defrosting control means, and hydraulic actuating means operatively connected to said door-actuated means and said defrosting control means for actuating said defrosting control means to render said defrosting apparatus inoperative when said door has been opened and closed a predetermined number of times.

5. The combination with a refrigerator including a food compartment having an access opening, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of door-actuated means responsive to the opening and closing of said door, remotely disposed defrosting control means, hydraulic actuating means operatively connected to said door-actuated means and said defrosting control means for actuating said defrosting control means to render said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times, and means responsive to increased temperature in said unit for again rendering said refrigerating apparatus operative.

6. The combination with a refrigerator including a food compartment having an access opening

thereto, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature of hydraulic means adapted to be actuated by the opening and closing of said door, a hydraulic power-transmitting tube having one end thereof operatively connected to said hydraulic means, a second hydraulic means connected to the other end of said tube and operable in response to the operation of said first hydraulic means, and means actuated by said second hydraulic means for rendering said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times.

7. The combination with a refrigerator including a food compartment having an access opening thereto, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of hydraulic means adapted to be actuated by the opening and closing of said door, a hydraulic power-transmitting tube having one end thereof operatively connected to said hydraulic means, a second hydraulic means connected to the other end of said tube and operable in response to the operation of said first hydraulic means, means actuated by said second hydraulic means for rendering said refrigerating apparatus inoperative when said door has been opened and closed a predetermined number of times, and means responsive to rise in temperature of said unit for again rendering said refrigerating apparatus operative.

8. The combination with a refrigerator including a food compartment having an access opening therefor, a door for closing said opening, a heat-exchange unit for cooling said compartment, and a refrigerating apparatus for maintaining said unit at a below-freezing temperature, of means responsive to the number of times said door is opened and closed for rendering said refrigerating apparatus inoperative comprising a bellows, a projection connected to said bellows, said projection and said bellows being so constructed and arranged that when said door is open said projection moves beyond the plane of said door frame by expansion of said bellows, and when said door is closed, said projection moves in the opposite direction to compress said bellows, a hydraulic power-transmitting element connected at one end to the interior of said bellows, a second bellows interiorly connected to the other end of said power-transmitting element, a pressure-transmitting fluid in said element and said bellows, a ratchet wheel having a predetermined number of teeth, a pawl engaging said ratchet wheel and operatively connected to and actuated by expansion and contraction of said second bellows to turn said ratchet wheel through a predetermined distance with every opening and closing of said door, and means controlled by said ratchet wheel to render said refrigerating apparatus inoperative after said ratchet wheel has moved a predetermined distance.

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