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REFRIGERATOR CONTROL

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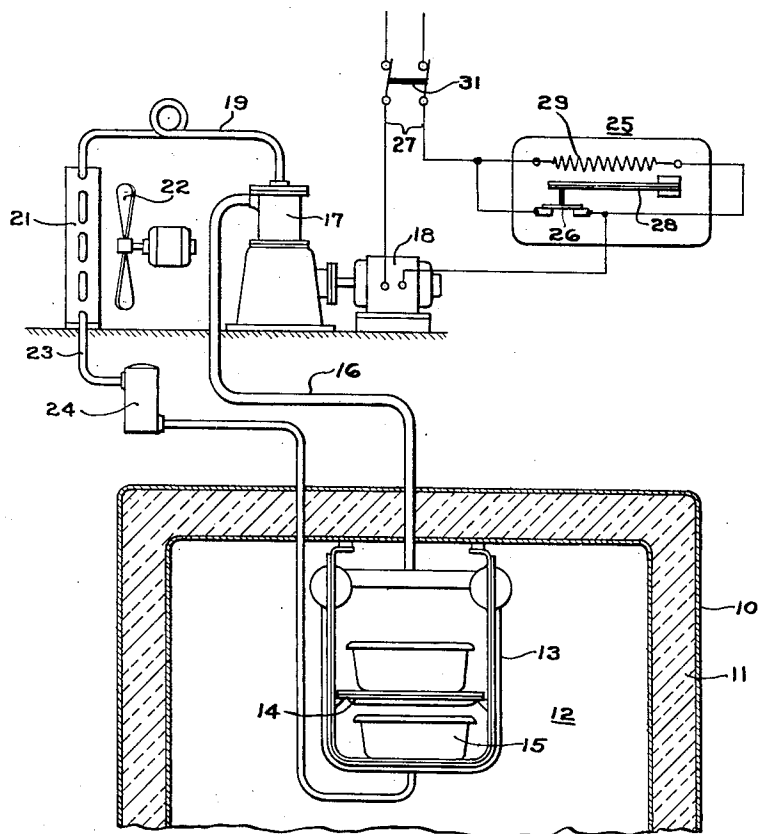


FIG. 1.

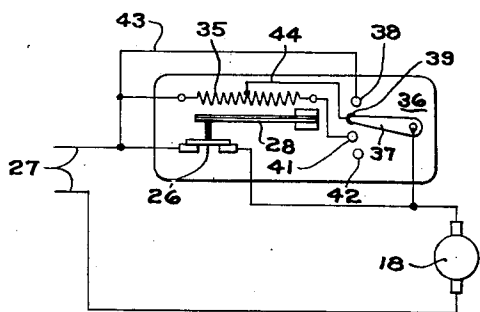


FIG. 2.

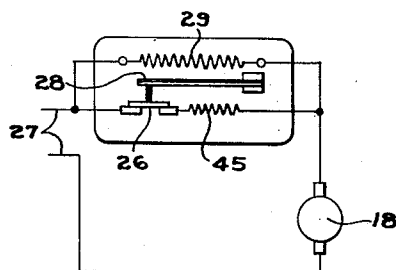


FIG. 3.

WITNESSES:

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REFRIGERATOR CONTROL

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13 Claims. (Cl. 62-4)

My invention relates to control mechanisms for refrigerating apparatus and has for an object to provide improved mechanisms of this character.

5 A further object of my invention is to provide an improved control mechanism that is inexpensive to construct and which will be reliable in operation.

10 A further object of the invention is to periodically operate a refrigerating machine for predetermined periods of time and to vary the duration of the periods in response to variations in temperature of the ambient atmosphere.

15 A still further object of my invention is to provide an improved control for a refrigerating machine that is responsive to the load on the machine.

20 It is a still further object of the invention to provide an improved control of the recited type having provisions for manually varying at will the duration of the operating periods of the refrigerating machine.

25 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 application, in which:

30 Fig. 1 is a diagrammatic view of a refrigerator having my improved control mechanism applied thereto;

Figs. 2 and 3 are diagrammatic views showing second and third embodiments of my control mechanism.

35 Referring now to Fig. 1, I show my improved control applied to refrigerating apparatus of the household type and including a cabinet 10 formed of insulated wall members 11 and defining a chamber or zone 12 for the storage of articles to be refrigerated. The air in the zone 12 is cooled by an evaporator 13 of any suitable type and which may be provided with shelf members 14 for the support of trays 15 in which fluid to be congealed may be disposed.

40 Refrigerant vaporized in the evaporator 13 is withdrawn through a conduit 16 by a compressor 17, driven by a motor 18. The withdrawn vapor is compressed by the compressor 17 to a relatively high pressure and is discharged through a conduit 19 into a condenser 21; the latter being cooled in any suitable manner, such as, for example, by a fan 22. The refrigerant in the condenser 21 is condensed at relatively high pressure and the liquid refrigerant is conveyed to the evaporator by means of a conduit 23 having a suitable expansion device 24 connected therein, the latter

functioning to reduce the pressure of the condensed refrigerant to the value maintained in the evaporator 13. Vaporization of the condensed refrigerant is effected in the evaporator 13 at relatively low pressure. The apparatus described in the foregoing paragraphs operates on the well known compressor-condenser-expander cycle as will be apparent to those skilled in the art.

5 In accordance with my invention, the compressor 17 is periodically operated for predetermined periods of time, which periods are varied in accordance with the temperature of the ambient or room atmosphere. As the heat leakage through the walls 11 varies with variations in the temperature of the ambient atmosphere, it is desirable and necessary to increase or decrease the cooling effect of the evaporator 13 in order that the refrigerating temperature be maintained at a substantially constant value. This result is accomplished by my control mechanism which operates to increase the duration of the operating period of the compressor when the temperature of the atmosphere exterior of the cabinet 10 increases and, conversely, the control reduces the duration of the operating periods when the temperature of said atmosphere decreases.

25 My improved control mechanism is shown generally at 25 and includes a switch 26 for controlling the energization of the motor 18 and connected in motor leads 27. The switch 26 is actuated by a thermal responsive member 28 shown by way of example, as a bimetal element. Preferably, the member 28 operates to open and close the switch 26 in a snap-acting manner. The thermal responsive element 28 is so arranged that it closes the switch 26 when heated to a predetermined temperature and opens the switch 26 when its temperature has been depressed to a lower predetermined value. An electrical heater 29 is disposed in heat transfer relation with the member 28 and is connected in shunt with the switch 26.

40 When the switch 26 is closed, the motor 18 is energized for operation and the heater 29 is short-circuited and, therefore, deenergized. During periods when the switch is open, the heater is energized by the conductors 27 in series with the motor 18. The resistance of the heater is relatively high so that the amount of current energizing the heater 29 and motor 18 is low and insufficient to operate the latter. The member 28 is located outside of the refrigerator cabinet and is, therefore, subjected to the ambient atmosphere and responds to temperature changes thereof for varying the duration of the periods

when the switch 26 is open and closed. A switch 31 may be provided for rendering the apparatus active and inactive and is connected between a source of power, not shown, and the conductors 27.

Operation

As shown in the drawing, the switch 31 is closed so that the apparatus is active for refrigerating purposes. The switch 26 is shown closed as the temperature of the thermal responsive member is above the value at which it opens. Accordingly, the heater is deenergized and the motor 18 is connected directly to the conductors 27 and is energized at the full line voltage. Operation of the compressor 17 effects vaporization of refrigerant in the evaporator 13 for cooling the media in the chamber 12.

The member 28 which has previously been heated by the heater 29, is now cooled by the ambient atmosphere and when its temperature has been depressed to a predetermined value, say 140° F., it moves the switch 26 to its open position. Operation of the motor 18 and compressor 17 is thereby terminated. Opening of the switch 26 energizes the heater 29 in series with the motor 18 as described heretofore, the voltage drop across the heater being a substantial portion of the line voltage.

When the heater 29 has raised the temperature of the member 28 to, say 180° F., the latter closes the switch 26 for operating the refrigerant compressor 17 and for initiating cooling of the chamber 12. The heater 29 is again short-circuited and deenergized and cooling of the member 28 is initiated. A complete cycle of operation has now been described.

As the thermal responsive member 28 is subjected to the temperature of the ambient or room atmosphere, the periods of time required to heat and cool the same vary in response to said temperature. When the ambient temperature is relatively high, the member 28 is more rapidly heated and is more slowly cooled whereby the switch 26 is closed for relatively long periods and is open for relatively short periods. When the ambient temperature is relatively low, the converse is true and the closed and open periods of the switch are relatively short and long, respectively. Accordingly, the refrigerating apparatus is operated for longer periods when the temperature of the surrounding atmosphere is high and, therefore, compensation for the additional flow of heat from the room atmosphere to the air in the chamber 12 is effected. When the temperature of the ambient atmosphere is low, the machine operates for shorter periods and compensates for the smaller flow of heat through the walls 11 to the chamber 12.

From the foregoing, it will be seen that no controlling impulse is necessarily taken from the refrigerated zone for regulating the refrigerating machine. However, the various elements of the system may be proportioned for maintaining an average temperature within the zone being cooled regardless of the temperature of the atmosphere exterior thereof, compensation for fluctuations in the latter being effected by the control.

In Fig. 2, I have shown an embodiment of the control device 25 in which a manually adjusted device is included for varying the duration of the period of time that the compressor is operated. The device shown in Fig. 2 includes a heater 35 and a multi-position switch 36, the latter including a movable contact 37 for engaging stationary

contacts 38, 39, 41 and 42. The contact 38 is connected by a conductor 43 to the line side of the heater 35 and the contact 39 is connected to a mid portion of the heater 35 by a conductor 44. The contact 41 is directly connected to a terminal of the heater 35 and, when engaged by the movable contact 37, defines a circuit similar to the circuit shown in Fig. 1.

Continuous operation of the motor is effected by moving the movable contact into engagement with the contact 38 as a shunt circuit including the conductor 43 is formed across the switch 26. More frequent operation of the compressor may be effected by moving the movable contact into engagement with the contact 39 as the resistance of the heater 35 is reduced and its wattage and heating effect is increased. Accordingly, the element 28 is more rapidly heated and duration of the periods when the compressor is idle is reduced.

An inactive or "off" position of the control device is provided by the contact 42 which, when engaged by the movable contact 37, open circuits the heater 35 and renders the switch 26 incapable of being closed. If the switch 26 is closed at the time that the movable contact is moved into engagement with the contact 42, the motor will continue to operate until the element 28 cools and opens the switch 26, but, thereafter, the element 28 is ineffective to close the switch while the movable contact engages the contact 42.

It will be apparent that the temperature maintained within the zone or chamber 12 may be adjusted by the operator at will when controlled in accordance with the device shown in Fig. 2. Furthermore, the operator may effect continuous operation of the compressor or may render the same inactive.

Reference will now be had to Fig. 3 for a description of a further embodiment of my invention. The construction of the control device is similar to the one shown in Fig. 1 except that a second heater 45 of smaller capacity than the heater 29 is connected in series with the motor 18 and between the motor and the switch 26. The heater 45 is energized during operating periods of the motor and, as it is connected in series with the motor 18, the heating effect of the heater varies in proportion to the amount of current flowing in the motor and the load thereon. The amount of heat imparted to the member 28 by the heater 45 is insufficient to prevent cooling of the member even during periods of heavy load. The heating effect of the heater 45 does, however, retard the cooling of the member 28 and, as the load increases, the period of time that the member 28 maintains the switch 26 closed increases proportionately.

The control mechanism disclosed in Fig. 3 is therefore responsive to load on the evaporator as an increase in temperature and pressure in the evaporator increases the load on the compressor due to the higher density gas that is withdrawn from the evaporator for compression. This increased load is imposed on the motor and is reflected in the amount of current drawn thereby. Furthermore, a change in the temperature of the ambient air that is employed for cooling the condenser, effects a change in the load on the motor so that the heater 45 also compensates for varying conditions of the ambient or room atmosphere.

The load compensating means provides for additional operation of the compressor when the heat load is increased because of some reason other than a change in the ambient temperature,

such as, for example, when a relatively large quantity of water is to be frozen in the trays 15. I consider the load compensating means an important feature of this invention and it will be understood that, while I have shown it applied to a specific form of control mechanism, it is not so limited and may be applied equally well to various other forms of refrigerator control mechanisms.

From the foregoing description, it will be apparent that I have provided an improved control for a refrigerating machine that is responsive to variations in the ambient temperature and to the heat load on the machine for varying the operating periods of the machine.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In refrigerating apparatus, the combination of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through said evaporator, and means for intermittently effecting operation of the circulating means for predetermined periods of time and irrespective of temperature conditions within said zone, said means including an element responsive primarily to the temperature of the air exterior of said zone for varying the duration of said periods of time that the circulating means is operated.

2. In refrigerating apparatus, the combination of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through said evaporator, means for intermittently effecting operation of the circulating means so that it is active and inactive for predetermined periods of time and irrespective of temperature conditions within said zone and means responsive primarily to the temperature of the atmosphere exterior of said zone for varying the relation between the period of time that the circulating means is active and the period of time that it is inactive.

3. In refrigerating apparatus, the combination of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through said evaporator, a motor for driving the circulating means, and means for intermittently effecting energization of the motor for predetermined periods of time and irrespective of temperature conditions within said zone, said means including an element responsive primarily to the temperature of the air exterior of said zone for varying the duration of said periods of time that the motor is energized.

4. In a control for a refrigerating machine having an evaporator, means for circulating refrigerant through the evaporator and a motor for driving the circulating means, the combination of a switch for controlling energization of the motor, a thermal responsive device for actuating the switch, and a heater disposed in heat transfer relation with the thermal device and controlled by said switch so that the heater is energized when the switch is open and deenergized when the switch is closed.

5. In refrigerating apparatus, the combination

of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through the evaporator, a motor for driving the same, a switch for controlling energization of the motor, a thermal responsive device disposed in heat transfer relation with the ambient atmosphere exterior of said zone for actuating the switch, a heater disposed in heat transfer relation with the device, and means for energizing the heater during periods when the motor is inactive and for deenergizing the heater during periods when the motor is active.

6. In a control for a refrigerator, the combination of a cabinet, an evaporator for absorbing heat for the cabinet, means for circulating refrigerant through the evaporator, temperature-responsive means for intermittently energizing and deenergizing the circulating means, and means responsive to the amount of energy supplied to the circulating means for varying the action of the temperature-responsive means.

7. In a control for a refrigerating machine having an evaporator, means for circulating refrigerant through the evaporator and a motor for driving the circulating means, the combination of a switch for controlling energization of the motor, a thermal responsive device for intermittently opening and closing the switch so that during normal operation of the machine the circulating means is intermittently rendered inactive and active, respectively, and means responsive to the load on the motor for imparting heat to said thermal responsive means, whereby the duration of the operating periods of the motor is increased and decreased as the load thereon is respectively increased and decreased.

8. In refrigerating apparatus, the combination of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through said evaporator, means for intermittently effecting operation of the circulating means so that it is active and inactive for predetermined periods of time and including means responsive to the temperature of the atmosphere exterior of said zone for varying the relation between the period of time that the circulating means is operated and the period of time that it is inactive and means for imparting heat to said temperature responsive means in proportion to the load on said circulating means, so that the duration of the operating periods of the circulating means is increased with increase in load.

9. In refrigerating apparatus, the combination of means defining a zone to be cooled, an evaporator for cooling the media in said zone, means for circulating refrigerant through said evaporator, a motor for driving the circulating means, means for intermittently effecting energization of the motor for predetermined periods of time and including an element responsive primarily to the temperature of the air exterior of said zone for varying the duration of said periods of time that the motor is energized, and a heater disposed in heat transfer relation with said element, said heater being energized during operating periods of the motor and to a value bearing a direct relation to the degree of energization of the motor.

10. In a control for a refrigerating machine having an evaporator, means for circulating refrigerant through the evaporator and a motor for driving the circulating means, the combination of a switch for controlling energization of the motor, a thermally actuated device for open-

ing and closing the switch so that the circulating means is rendered inactive and active during normal operating periods of the machine, and a heater disposed in heat transfer relation with said device and controlled by said switch, said heater being energized with said motor and to a degree proportional to the load on the motor whereby, the duration of periods of operation of the circulating means is increased with increases in load thereon and vice versa.

11. In refrigerating apparatus, the combination of a cabinet defining a zone to be cooled, an evaporator for cooling said zone, a compressor for circulating refrigerant through the evaporator, a motor for driving the compressor, a switch controlling energization of the motor, a thermal responsive element for opening and closing the switch, a heater disposed in heat transfer relation with said element and connected in shunt with said switch, and a second heater connected in series with said motor and disposed in heat transfer relation with said thermal responsive element.

12. In refrigerating apparatus, the combination of means defining a zone to be refrigerated, an evaporator for cooling media in said zone, a

compressor for circulating refrigerant through the evaporator, a motor for driving the compressor, a switch for controlling the energization of the motor, a thermal responsive element for actuating the switch, a heater disposed in heat transfer relation with said element, means for energizing and deenergizing the heater during periods when said motor is deenergized and energized, respectively, and means for selectively varying the degree of energization of the heater.

13. In refrigerating apparatus, the combination of means defining a zone to be refrigerated, an evaporator for cooling media in said zone, a compressor for circulating refrigerant through the evaporator, a motor for driving the compressor, a switch for controlling the energization of the motor, a thermal responsive element for actuating the switch, a heater disposed in heat transfer relation with said element, means for energizing and deenergizing the heater during periods when said motor is deenergized and energized, respectively, and manually operated means movable to a plurality of positions for varying the degree of energization of the heater and movable to a position wherein the heater is rendered inactive.

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DISCLAIMER

2,163,744.—*Leslie B. M. Buchanan*, Springfield, Mass. REFRIGERATOR CONTROL.
Patent dated June 27, 1939. Disclaimer filed February 17, 1940, by the
assignee, *Westinghouse Electric & Manufacturing Company*.
Hereby enters this disclaimer to claims 1, 2, and 3.
[*Official Gazette March 12, 1940.*]

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