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REFRIGERATING APPARATUS

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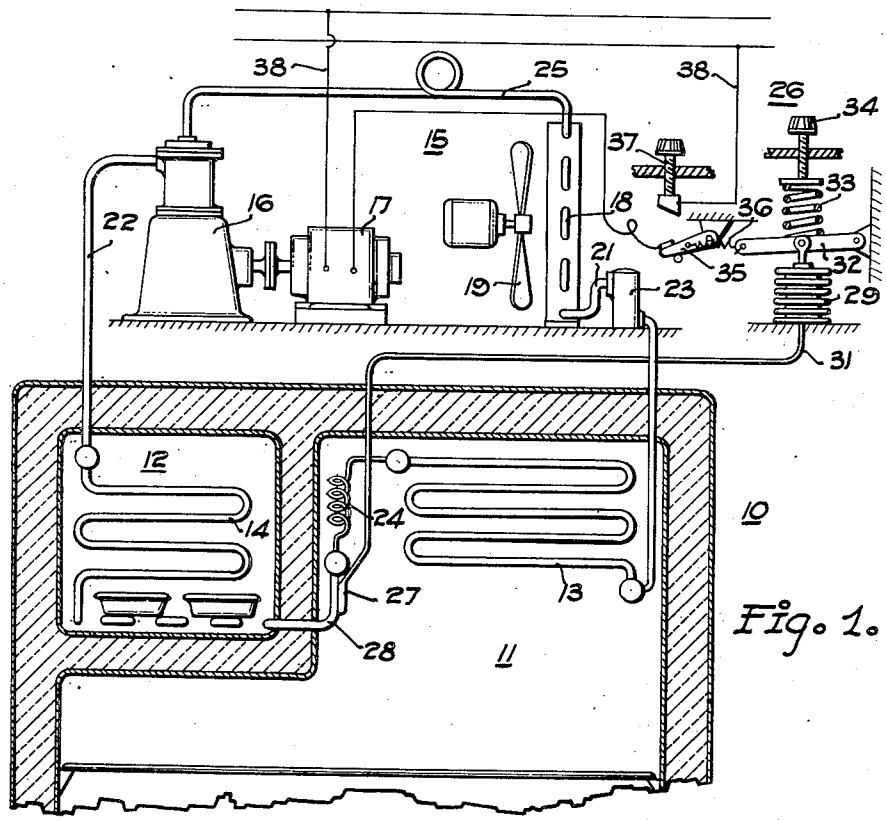


Fig. 1.

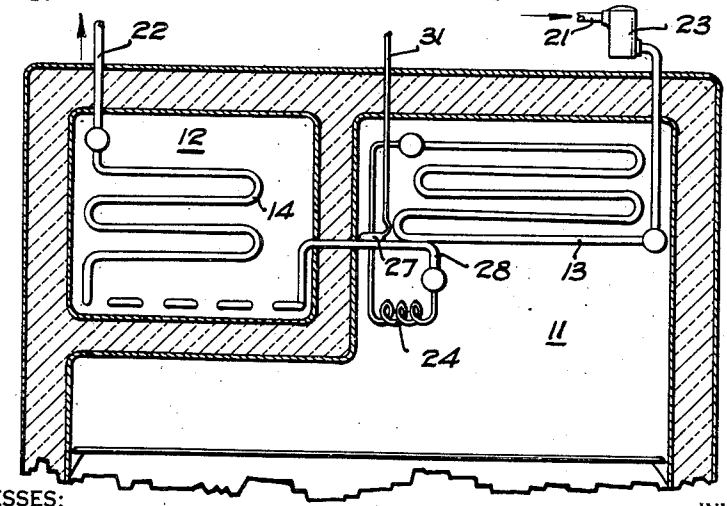


Fig. 2.

WITNESSES:

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REFRIGERATING APPARATUS

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10 Claims. (Cl. 62—4)

My invention relates to refrigerating apparatus and has for an object to provide improved means for controlling the operation of such apparatus.

A further object of the invention is to control the operation of a two-temperature refrigerating system by a single control mechanism.

It is still a further object of my invention to provide single thermal responsive mechanism for controlling a two temperature refrigerator whereby the temperatures of the refrigerated zones are maintained at different desired values.

It is another object of my invention to limit the maximum temperature of the media cooled by a refrigerator and the minimum temperature of the cooling element thereof.

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:

Fig. 1 of the drawing is a diagrammatic view of a two-temperature refrigerator controlled in accordance with my invention; and,

Fig. 2 is a view of a portion of the elements of Fig. 1 rearranged for defining a second embodiment of the invention.

Reference will now be had to Fig. 1 of the drawing wherein the numeral 10 generally indicates a cabinet structure that defines relatively high and low temperature zones or chambers 11 and 12 for the storage of perishables. High and low temperature evaporators 13 and 14 of suitable construction are disposed within the zones for refrigerating the same and are supplied with condensed refrigerant by a condensing unit, generally shown at 15, and including a compressor 16, driven by an electric motor 17, and a condenser 18. The latter is cooled in any well known manner, such as, for example, by a fan 19.

The refrigerating system which I have chosen to show has the evaporators 13 and 14 connected in series for the flow of refrigerant; the higher temperature evaporator 13 receiving condensed refrigerant from the condenser 18 through a conduit 21 and the refrigerant vaporized in both evaporators being returned to the compressor 16 through a suction conduit 22. A suitable expansion device, such as a high side float valve 23 may be connected in the conduit 21 for reducing the pressure of the condensed refrigerant to the value maintained in the evaporator 13 by the compressor 16. In order that the evaporators are operated at different pressures and temperatures, a restricting device, such as, for example, a capillary tube 24 is interposed between the evaporators 13 and 14.

During operation of the compressor 16, vaporized refrigerant at relatively low pressure is withdrawn by the compressor 16 from the evaporator 14 and is compressed to a relatively high pressure. The high pressure vapor is conveyed by a conduit 25 to the condenser 18 wherein it is cooled and condensed. Liquid refrigerant is conveyed through the conduit 21 to the evaporator 13, the valve 23 reducing the pressure of the liquid to the pressure of vaporization in the evaporator 13. A portion of the liquid is vaporized in the evaporator 13 and the remaining liquid and the gaseous refrigerant pass through the restricting device 24 to the low temperature evaporator 14. Vaporization of the liquid refrigerant is completed in the low temperature evaporator 14 at low pressure and temperature. The difference in temperatures of the two evaporators is obtained by the restricting device 24 which effects a suitable difference in vaporizing pressures.

In accordance with my invention, a single thermostat 26 having a thermal responsive element or bulb 27 is employed for controlling the operation of the condensing unit 15. The thermostat 26 operates to initiate operation of the compressor 16 in response to temperature conditions in the high temperature zone 11 and to terminate operation of the same in response to temperature conditions in the low temperature zone, 12. As shown, the low temperature evaporator 14 includes a loop or portion 28 that extends into the high temperature zone 11 and which is disposed in heat transfer relation with the bulb 27. During inactive periods of the compressor 16, the evaporator portion 28 is heated by the air in the zone 11 to a value substantially equal to the temperature of the high temperature evaporator 13. During operation of the compressor 16, the evaporator portion 28 is depressed to the temperature of the evaporator 14. Accordingly, the thermostat 26 operates to initiate operation of the compressor 16 in response to a predetermined high temperature of the higher temperature evaporator 13 and to terminate operation of the compressor in response to a predetermined low temperature of the low temperature evaporator 14. As the portion 28 of the evaporator 14 is relatively small, it has but little cooling effect on the higher temperature air in the zone 11.

The thermostat 26 is of the conventional gas type and includes a bellows 29 connected by a tube 31 to the bulb 27. The bellows 29 actuates

a lever 32 and is biased by a spring 33 that may be adjusted by an adjusting screw 34. A movable switch member 35 is connected to the lever 32 by a snap-acting over center spring 36 and is engageable with a stationary adjustable contact 37. The contacts 35 and 37 are connected in an electrical circuit 38 for controlling energization of the motor 17. The adjusting screw 34 is made accessible to the operator and determines the temperatures at which the motor 17 is started and stopped. By adjusting the contact 37, the temperature differential or the difference between the temperatures at which the motor is started and stopped, may be varied.

Operation

As shown in the drawing, the motor 17 and compressor 16 are idle as the switch contacts 35 and 37 are disengaged, the temperature of the bulb 27 being below the value at which the thermostat 26 starts operation. Accordingly, the temperatures of the evaporators 13 and 14 are increasing due to the heat load in their respective compartments. The temperature of the portion 28 of the low temperature evaporator 14 increases faster than the remainder of the evaporator 14 as it is subjected to the relatively high temperature of the air in the compartment 11 and attains a temperature substantially equal to the temperature of the evaporator 13. When the temperature of the bulb 27 increases to a value of say 35°, the thermostat 26 effects engagement of the contacts 35 and 37 for starting operation of the compressor 16. Vaporization of refrigerant in both evaporators 13 and 14 is initiated and both of the zones 11 and 12 are cooled.

The pressures of vaporization are progressively depressed in both evaporators 13 and 14. The temperature of the evaporator portion 28 is depressed to a value substantially equal to the remainder of the evaporator 14 and when a predetermined low value of say 5° F. is obtained, the thermostat 26 operates to terminate operation of the compressor 16. At this time, the temperature of the higher temperature evaporator 13 is at a higher value of approximately 25° F. due to the higher vaporizing pressure effected by the restricting device 24.

During the inactive periods of the compressor 16, the pressure of the refrigerant in the evaporators 13 and 14 tends to equalize whereby the temperature of the low temperature evaporator 14 would be increased somewhat by the condensing of gas discharged from the higher temperature evaporator. As the media in the zone 12 is at a relatively low temperature, the increase in temperature of the evaporator 14 is not as rapid as the temperature increase of its portion 28 or of the high temperature evaporator 13.

Description of Fig. 2

In Fig. 2, I have shown a second embodiment of my invention that is similar to the embodiment shown in Fig. 1 except that the high temperature evaporator 13 is disposed in heat transfer relation with the low temperature evaporator portion 28. The thermostat bulb 27 is attached to the evaporator portion 28 and is responsive to the temperature thereof. In this embodiment, the temperature of the evaporator portion 28 attains, substantially, the temperature of the evaporator 13 during inactive periods of the compressor so that the latter is started in response to the temperature of the high temperature evaporator 13. As the temperature of the evaporator portion 28 and thermostat bulb 29 attain, substantially, the temperature of the low temperature evaporator 14 during active periods of the compressor, the latter is stopped in response to the temperature of the low temperature evaporator 14.

The condensing unit 15 and thermostat 26 of Fig. 1 are not shown in Fig. 2 but it will be understood that these elements are connected to the conduits 21, 22 and 23 in the manner shown in Fig. 1. Elements common to both embodiments are shown by similar reference characters.

Operation—Fig. 2

During active periods of the condensing unit 15, vaporization of refrigerant is effected in the evaporators 13 and 14 at relatively high and low pressures, respectively, as described, heretofore. The temperature of the bulb 27 and the evaporator portion 28 is depressed, substantially, to the temperature of the low temperature evaporator 14 and, when a value of say 5° is attained, the condensing unit 15 is stopped.

The temperatures of the evaporators 13 and 14 increase during the shut down period due to the heat loads thereon, the temperature of the portion 28 of the low temperature evaporator 14 and the bulb 27 increasing rapidly and attaining the temperature of the high temperature evaporator 13. Operation of the condensing unit is initiated when the temperature of the bulb 27 has been increased to a value of say 35° F.

It will be apparent from the foregoing that the operation of both systems is similar. In Fig. 1, the evaporator portion 28 attains, substantially, the same temperature as the evaporator 13 during inactive periods of the compressor as both are subjected to the temperature of the air in the chamber 11. In Fig. 2, the same result is obtained for the same reason and further by the direct exchange of heat between these elements.

Another embodiment of my invention is disclosed and claimed in my copending application, Serial No. 243,279, filed November 30, 1938, and assigned to the assignee of the present application, said copending application having claims therein which are generic to all embodiments of both applications.

It will be apparent from the foregoing that I have provided improved refrigerating apparatus wherein a single control may be employed for controlling the temperature in both compartments of a two temperature 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 relatively low and high temperature zones to be refrigerated, means for refrigerating the zones including first and second evaporators associated with the respective zones, one of said evaporators having a relatively small portion thereof disposed in heat transfer relation with the media being cooled by the other of the evaporators, and a thermostat responsive to the temperature of said evaporator portion for controlling the operation of the refrigerating means.

2. In refrigerating apparatus, the combination of means defining first and second zones to be refrigerated, relatively low and high temperature evaporators associated with the first and second zones, respectively, means for circulating refrigerant through the evaporators, said low temperature evaporator having a relatively small portion thereof disposed in heat transfer relation with the media being cooled in the higher temperature zone, and means responsive to the temperature of said evaporator portion for controlling the operation of the refrigerant circulating means.

3. In refrigerating apparatus, the combination of a cabinet structure defining relatively low and high temperature zones to be refrigerated, a low and a high temperature evaporator disposed for cooling the air in said low and high temperature zones, respectively, a compressor for circulating refrigerant through said evaporators, said low temperature evaporator having a relatively small portion thereof extending into the air in the higher temperature zone, and means responsive to the temperature of said evaporator portion for controlling the operation of said compressor.

4. In refrigerating apparatus, the combination of means defining relatively low and high temperature zones to be refrigerated, low and high temperature evaporators disposed for cooling the respective low and high temperature zones, means for circulating refrigerant through the evaporators and effecting vaporization in the low and high temperature evaporators at relatively low and high pressures, respectively, and thermal responsive means for controlling the operation of the refrigerant circulating means and disposed in heat transfer relation with the low pressure refrigerant and the media cooled by the higher pressure refrigerant.

5. In refrigerating apparatus, the combination of means defining relatively low and high temperature zones to be refrigerated, low and high temperature evaporators disposed for cooling the respective low and high temperature zones, means for circulating refrigerant through the evaporators and effecting vaporization in the low and high temperature evaporators at relatively low and high pressures, respectively, and thermal responsive means for controlling the operation of the refrigerant circulating means, said thermal responsive means being responsive, primarily, to the temperature of the media cooled by the high temperature evaporator for initiating operation of the refrigerant circulating means and responsive, primarily, to the temperature of the refrigerant evaporated at relatively low pressure for terminating operation of the refrigerant circulating means.

6. In refrigerating apparatus, the combination of a cabinet structure defining first and second zones to be refrigerated, relatively low and high temperature evaporators connected in series for the flow of refrigerant and disposed, respectively, for cooling the first and second zones, means for circulating refrigerant through the evaporators, a device for controlling the flow of refrigerant from one evaporator to the other and for effecting a pressure difference therein, said low temperature evaporator having a portion thereof disposed in heat transfer relation with the media cooled by said high temperature evaporator, and means disposed in heat transfer relation with said portion of the low temperature evaporator for controlling the operation of the refrigerant circulating means.

7. In refrigerating apparatus, the combination of a cabinet structure defining first and second zones to be refrigerated, relatively low and high temperature evaporators connected in series for the flow of refrigerant and disposed, respectively, for cooling the first and second zones, means for circulating refrigerant through the evaporators, a device disposed intermediate the evaporators for controlling vaporization of refrigerant in the evaporators, said low temperature evaporator having a portion thereof disposed in heat transfer relation with the media cooled by said high temperature evaporator, and means disposed in heat transfer relation with said portion of the low temperature evaporator for controlling the operation of the refrigerant circulating means.

8. In refrigerating apparatus, the combination of a cabinet structure defining first and second zones to be refrigerated, relatively low and high temperature evaporators connected in series for the flow of refrigerant and disposed, respectively, for cooling the first and second zones, means for circulating refrigerant through the evaporators, a device having an elongated passage of fixed flow area for refrigerant and disposed intermediate the evaporators, said low temperature evaporator having a portion thereof disposed in heat transfer relation with the media cooled by said high temperature evaporator, and means disposed in heat transfer relation with said portion of the low temperature evaporator for controlling the operation of the refrigerant circulating means.

9. In refrigerating apparatus, the combination of means defining first and second zones to be refrigerated, relatively low and high temperature evaporators associated with the first and second zones, respectively, means for circulating refrigerant through the evaporators, said low temperature evaporator having a relatively small portion thereof disposed in heat transfer relation with the higher temperature evaporator, and means responsive to the temperature of said evaporator portion for controlling the operation of the refrigerant circulating means.

10. In refrigerating apparatus, the combination of means defining first and second zones to be refrigerated, relatively low and high temperature evaporators associated with the first and second zones, respectively, a compressor for circulating refrigerant through the evaporator, said low temperature evaporator having a relatively small portion thereof disposed within the high temperature zone, and thermal responsive means disposed in heat transfer relation with said evaporator portion and the high temperature evaporator for controlling the operation of said compressor.

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