

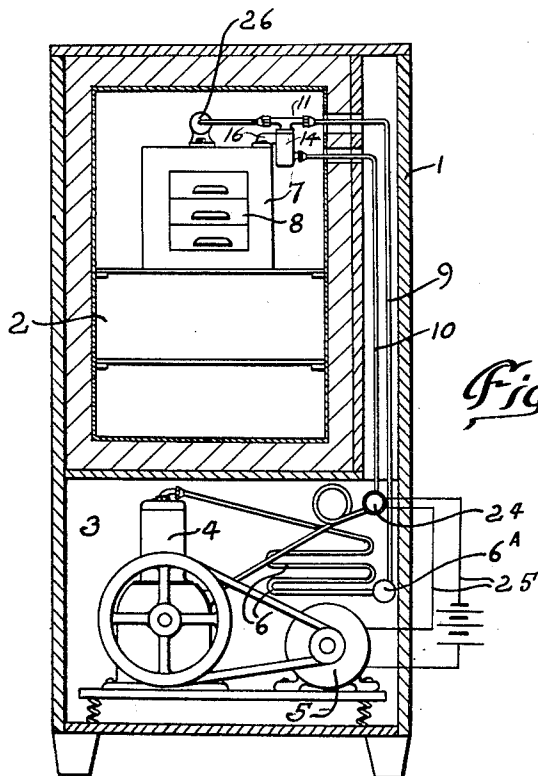
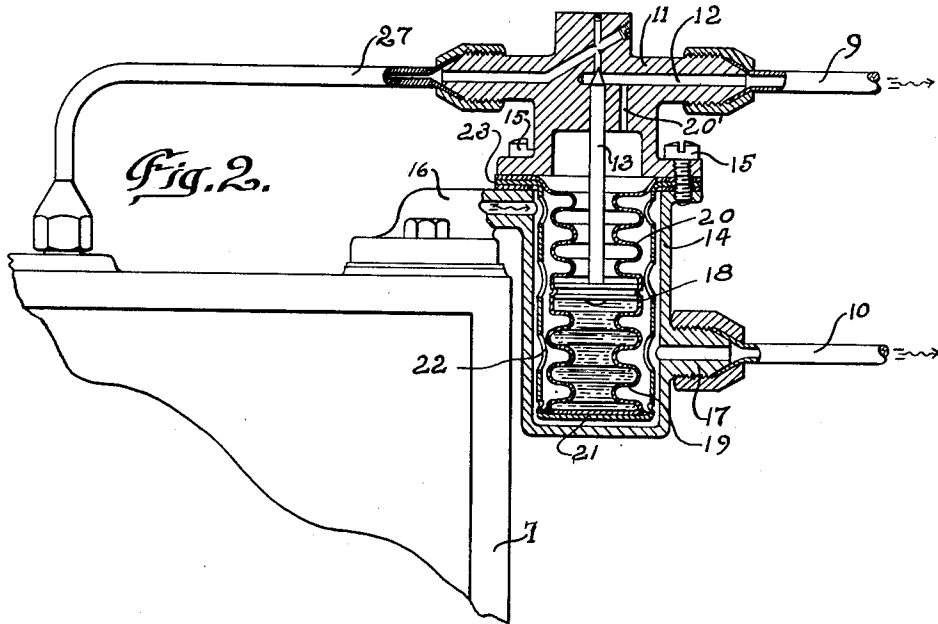
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REFRIGERATING MECHANISM

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REFRIGERATING MECHANISM

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This invention relates to mechanical refrigeration systems and particularly to systems employing a circulating fluid adapted to withdraw heat from the area surrounding one portion of its circuit through its evaporation from liquid to gaseous form.

wise utilizing the low temperature there prevailing.

Refrigerant is delivered from the compressor 4 to the condenser 6 and thence through the receiver 6a and a delivery (or high pressure) line 9 to the evaporator 7, opening preferably into the upper portion of the latter, and a return (or low pressure) line 10 for the refrigerant connects the upper portion of the evaporator with said compressor.

One object is to subject a confined body of liquid of predetermined freezing point to the temperature reduction effected in a circulatory refrigerating system, and to utilize the expansion of said body resultant from its freezing to automatically shut off circulation through the system when the same reaches said temperature.

For automatically controlling circulation, there is inserted in the delivery line 9 a control valve comprising a body 11 having a refrigerant passage 12 therethrough, and having a stem 13 reciprocatory transversely to said passage and adapted to control the flow therethrough. Said stem projects downwardly into a housing 14 attached to the body 11 by bolts 15 or the like, and through which the return flow of refrigerant from the evaporator is effected. Thus, as best appears in Fig. 2, the evaporator is surmounted by an outlet fitting 16 supporting the unit 11, 14 and opening into the upper portion of the housing 14, the latter being formed in its lower portion with a discharge fitting 17 connected to the line 10.

Another object is to utilize the pressure variation resulting from interrupting circulation as above described to automatically deenergize the means inducing circulation.

Within the housing 14, the stem 13 terminally carries a head 18 closing and sealing the upper portion of an annularly corrugated expansible and contractible metallic chamber 19 which is integrally closed at its lower end. The chamber 19 is completely filled with a liquid of a freezing point substantially equal to the minimum desired temperature to be established by the system, as water or water treated with sufficient alcohol, salt or the like, to effect a predetermined lowering of its freezing point.

Still another object is to provide a valve, controlling circulation in a refrigerating system, and to control said valve by the expansion and contraction of a confined fluid, incident to its transformation.

These and various other objects in the invention attain by the construction herein described and illustrated in the accompanying drawings, wherein:

Fig. 1 is a more or less diagrammatic view in front elevation and vertical section of a refrigerator equipped with the herein disclosed system.

Fig. 2 is a vertical sectional view of a valve automatically regulating the flow of refrigerant through said system, showing a fragmentary portion of the evaporating chamber which carries said valve.

In these views the reference character 1 designates the usual box or casing of a refrigerator, its upper portion forming a chamber 2 to be cooled, and a lower compartment 3 receiving a unit comprising a compressor 4, a motor 5 driving said compressor, a condenser 6 connected to the outlet of said compressor and a receiver 6a into which the condenser discharges. Within the chamber 2 and preferably in the upper portion thereof is installed an evaporator 7 which may be variously formed, but as illustrated has a central opening 8 within which provision may be made for forming ice cubes or other-

It is highly important to avoid any flow of refrigerant from the high pressure passage 12 to the low pressure chamber 14, such as might possibly occur around the valve stem 13. As a safeguard against such leakage, an expansible corrugated chamber 20 having sealing engagement with the head 18 extends upwardly therefrom and is outwardly flanged at its upper end and clamped between the body 11 and housing 14. The chambers 19

and 20 may be, and preferably are integral, as shown.

Downward expansion of the chamber 19 is prevented by enclosing said chamber in a cup-shaped sheet metal member 21, the wall of which is perforated, as indicated at 22, and the upper end of which is outwardly annularly flanged at 23 and clamped between the casing 11 and housing 14.

It will be evident that when the valve member 13 is seated the refrigerant will no longer be circulated through operation of compressor 4 but will be continuously withdrawn from the evaporator through the housing 14 and line 10 and accumulated in the receiver 6a. The pressure reduction which gradually results in the line 10 is utilized to control operation of the compressor. Thus, at some suitable point in said line and preferably in the compartment 3 there is connected a regulator 24 responsive to predetermined pressure variations in said line and adapted as well known in this art to control a switch exercising control of the electric circuit 25 of the motor 5 to start or stop said motor according as the pressure in the line 10 rises or falls between said predetermined limits.

Discharge of the refrigerant into the evaporator 7 from the line 9 may be controlled by an expansion valve 26, as shown in Fig. 1, or by providing a discharge connection from the passage 12 to the evaporator through a highly restricted pipe connection 27, as Fig. 2 illustrates, commonly known as a capillary tube, or by other means.

In the operation of the described system, when the compressor is running, such refrigerant as occupies the evaporator 7 in gaseous form is continuously withdrawn through the pipe line 10 and delivered, after compression, to the condenser 6, where it is liquefied. From the condenser the refrigerant passes through the receiver 6a and back to the evaporator through the delivery line 9.

The expansion valve 26, or the restricted pipe connection 27, acts to control the refrigerant delivery to the chamber 7, which results, in accordance with well understood principles, in a gradual reduction of temperature in the chamber 7 through the expansion of the incoming refrigerant. When the temperature of the refrigerant leaving the chamber 7 and passing through the chamber 14 has been reduced to the freezing point of the fluid body in the chamber 19, said body will congeal and consequently expand, thereby raising the stem 13 and seating the valve formed by the upper end of said stem.

Circulation of the liquid refrigerant being thus interrupted, the continued operation of the compressor will serve only to accumulate the liquefied refrigerant in the receiver 6a and to continually withdraw the gaseous refrigerant from the chamber 7, so as to progressively lower the pressure of gas in said

chamber and in the suction line 10. When the pressure reaches a predetermined minimum value, the control device 24 responds by opening the motor circuit and stopping the motor 5 and compressor 4.

The system then remains idle until the gradual rise of temperature in the compartment 2 has resulted in melting of the frozen liquid in the lower portion of the chamber 19 with an accompanying contraction acting to unseat the valve 13. There immediately follows a delivery of refrigerant from the line 9 to the chamber 7 owing to the relatively low pressure still existing in said chamber as compared to that in the line 9 and the refrigerant so delivered accumulates in gaseous form in said chamber and in the line 10 until the pressure rise reaches the predetermined point at which the regulator 24 acts to close the motor circuit and again start the motor 5 and compressor 4.

It is preferred to form the liquid-receiving portion of the chamber 19 of a sufficiently small size that the transformation of the conditions of said portion from liquid to solid state and vice versa, may be quite rapidly accomplished when the temperature necessary to such transformation is reached.

While it will be apparent that the illustrated embodiment of my invention herein disclosed is well calculated to adequately fulfill the objects and advantages primarily stated, it is to be understood that the invention is susceptible to variation, modification and change within the spirit and scope of the subjoined claims.

What I claim is:

1. A refrigerant control valve comprising a body formed with a refrigerant passage, a stem reciprocatory in said body to control said passage, a head carried by said stem and spaced from said body, an expansible container engaging said head at one end thereof for actuating the stem, an abutment carried by said body for the other end of said container, a housing surrounding the container carried by said body and formed with a refrigerant inlet and outlet, an expansible container connecting said head with said body, the body being formed with an opening from said passage to the last named container.

2. A refrigerant control valve comprising a body formed with a refrigerant passage, a valve member controlling said passage, a housing secured to said body, a head carried by said stem within said housing, an expansible container within said housing secured at one end to said head, an abutment for the other end of said container within said housing, and an expansible sealing member surrounding the stem within said housing engaging said head at one extremity and secured at its other extremity between said housing and body, said housing having a refrigerant inlet and outlet.

3. In a refrigerant circulating system, in combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a duct
5 connecting said compressor and said condenser, means in the first mentioned duct for throttling the flow of refrigerant therethrough, means in said first mentioned duct and between the condenser and the last mentioned means for stopping the flow of refrigerant therethrough, and means responsive to
10 temperature changes in said evaporator for controlling the second mentioned means.
4. In a refrigerant circulating system, in combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a
20 duct connecting said compressor and said condenser, means in the first mentioned duct for throttling the flow of refrigerant therethrough, means in said first mentioned duct and between the condenser and the last mentioned means for stopping the flow of refrigerant therethrough, and means responsive to
25 temperature changes at the refrigerant outlet of said evaporator for controlling the second mentioned means.
5. In a refrigerant circulating system, in combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a
30 duct connecting said compressor and said condenser, means in the first mentioned duct for throttling the flow of refrigerant therethrough, a valve in said first mentioned duct for stopping the flow of refrigerant therethrough, and means responsive to temperature
40 changes in said evaporator for controlling said valve.
6. In a refrigerant circulating system, in combination, a compressor, a condenser and
45 an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a duct connecting said compressor and said condenser, an expansion valve in the first
50 mentioned duct, a shut-off valve in said first mentioned duct for stopping the flow of refrigerant therethrough, and means responsive to temperature changes in said evaporator for controlling said shut-off valve.
7. In a refrigerant circulating system, in
55 combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a duct
60 connecting said compressor and said condenser, means in the first mentioned duct for throttling the flow of refrigerant therethrough, means in said first mentioned duct for stopping the flow of refrigerant therethrough, and means responsive to temperature
85 changes in said evaporator for controlling the second mentioned means, the last mentioned means comprising a member actuated by a liquid adapted to at least partially freeze during normal operation of said system.
8. In a refrigerant circulating system, in combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a
75 duct connecting said compressor and said condenser, an expansion valve in the first mentioned duct, a shut-off valve in said first mentioned duct for stopping the flow of refrigerant therethrough, and a member containing a liquid adapted to at least partially
80 freeze during normal operation of said system exposed to the temperature of said refrigerant adjacent the evaporator outlet opening and operatively connected to said shut-off valve.
9. In a refrigerant system, in combination, a condenser, a compressor, and an evaporator, a duct connecting said condenser and
90 said evaporator, a duct connecting said evaporator and said compressor, a duct connecting said condenser and said compressor, means in the first mentioned duct for throttling the flow of refrigerant therethrough, means in said first mentioned duct and between the condenser and the last mentioned
95 means for stopping the flow of refrigerant therethrough, and means responsive to temperature changes in said evaporator for controlling the second mentioned means.
10. In a refrigerant circulating system, in combination, a compressor, a condenser and an evaporator, a duct connecting said condenser and said evaporator, a duct connecting said evaporator and said compressor, a
105 duct connecting said compressor and said condenser, means in the first mentioned duct for throttling the flow of refrigerant therethrough, means in said first mentioned duct and between the condenser and the last mentioned means for stopping the flow of refrigerant therethrough, means responsive to temperature
110 changes at the refrigerant outlet of said evaporator for controlling the second mentioned means.
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