Aug. 28, 1934. C. E. PLOEGER 1,971,695

EXPANSION VALVE

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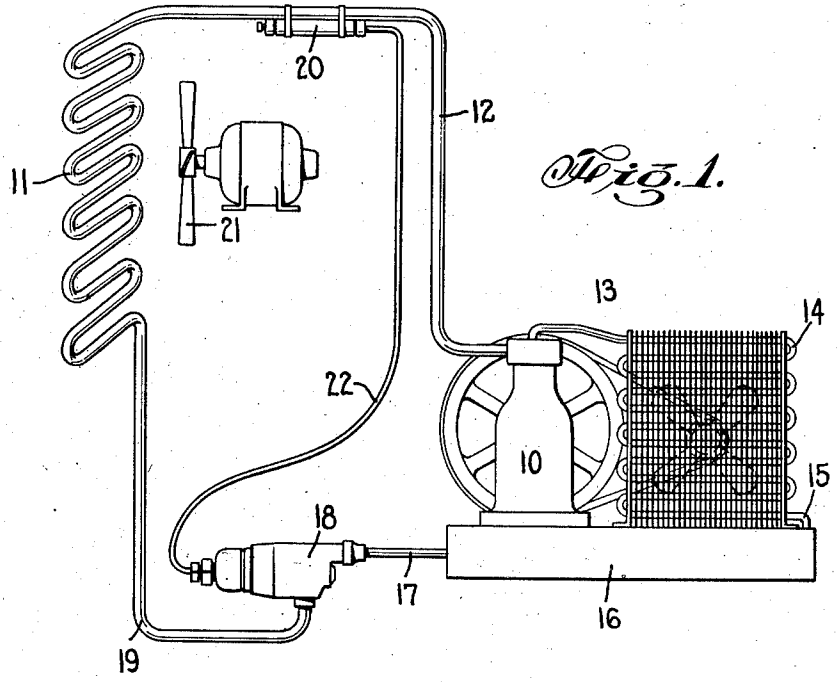
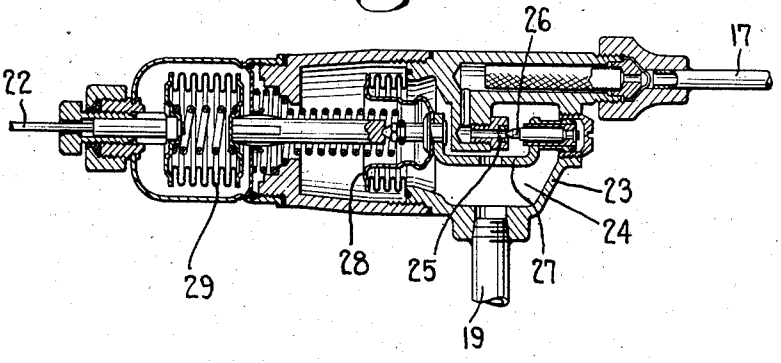


Fig. 1.

Fig. 2.



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EXPANSION VALVE

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13 Claims. (Cl. 236—92)

This invention relates to thermostatically controlled expansion valves for compression type refrigeration systems and more particularly to charging the expansible fluid control thermostats for such valves.

In a compression type refrigeration system provided with a thermostatic expansion valve, operating characteristics of the expansion coil are similar to those of a flooded type system, whereby flooded coil efficiency and performance are obtained in a so-called dry system. However, there is also obtained a disadvantage inherent in the flooded type system in that the suction pressure always corresponds to the temperature of the evaporator. After a long idle period the compressor must operate at a high suction pressure during the next pull-down period, thus usually necessitating an oversized motor to carry the excessive load imposed during such periods.

It is an object of this invention to provide a thermostatic expansion valve charged with thermostatic fluid in such a manner that the refrigeration apparatus is not overloaded during the pull-down periods.

Other objects and advantages will be apparent from the following description taken in connection with the accompanying drawing, in which,

Fig. 1 shows diagrammatically a compression type refrigeration system provided with a thermostatic expansion valve embodying this invention; and

Fig. 2 is a sectional view of the control valve shown in Fig. 1.

Referring to Fig. 1 of the drawing, a compressor 10 withdraws refrigerant vapor from the expansion coil 11 through suction line 12 and discharges compressed gas through conduit 13 into a condenser 14. Refrigerant is liquefied in the latter and flows through conduit 15 into a reservoir 16 from where it flows through conduit 17 to an expansion valve 18 which controls the admission of refrigerant at reduced pressure into the expansion coil 11 through conduit 19. The thermostat bulb 20 connected to the control valve 18 through a capillary tube 22 is attached in thermal conductive relation at the outlet of the expansion coil 11 on the suction line 12. A fan 21 is indicated for circulating air to be cooled over the expansion coil 11.

As shown in Fig. 2, the expansion valve is of a conventional type, the structure of which forms no part of this invention. The valve body 23 encloses a chamber 24 provided with an inlet connection for conduit 17 from the receiver and an outlet connection for conduit 19 to the expansion coil. In the inlet connection is an orifice 25 controlled by a needle 26 movable with respect to the orifice by a yoke 27. One end of the latter is connected to a bellows 28 which seals the chamber 24, whereby the valve may be operated by movement imparted from the exterior of chamber 24 through the bellows 28. The control thermostat bellows 29 is suitably arranged for operation of the valve by imparting motion through the sealing bellows 28.

The bellows 29, capillary tube 22, and sensitive bulb 20 form a fluid tight system adapted to contain an expansible fluid, as well known in the art. Heretofore such thermostats have been charged with fluid in the form of liquid or gas at high pressures so that the valve is operated on a variable suction pressure. After a long shut-down period the expansion valve will open when the pressure in chamber 24 around the needle 26 is reduced slightly below the pressure in the thermostat bellows 29, thus giving back pressure or suction line pressure corresponding to the temperature of the evaporator, which results in an excessive load on the motor driving the compressor.

In accordance with this invention, the thermostat is charged with vapor at such a pressure that the valve will remain closed, that is, does not operate until a suction pressure, and corresponding temperature, is reached which is approximately equal to the pressure at which the thermostat was charged, whereby the compressor is not overloaded during the pull-down period.

It has been found in the case of refrigeration machines utilizing methyl chloride as refrigerant that by charging the expansion valve thermostat with methyl chloride vapor at 35 pounds gauge pressure the machine was able to pull-down without any difficulty under the same conditions under which a thirty per cent larger motor was necessary when a thermostatic valve charged in the usual manner was used.

It will be obvious that this difference in charging in no way affects the normal operation of the valve or refrigeration system. In the case referred to above, where methyl chloride vapor was charged into the thermostat at 35 pounds gauge pressure, the expansion valve did not open until the pressure in chamber 24 around the valve needle 26 was reduced below 35 pounds gauge pressure since the pressure on the sealing bellows 28 acts to maintain the valve closed against the pressure in the thermostat bellows 29. When the valve opens, refrigerant is admitted to the expansion coil through conduit 19 and the temperature of the thermostat bulb 20 decreases and the

pressure in the thermostat bellows 29 decreases correspondingly. The thermostatic valve now assumes normal operation, that is responsive to temperature of the thermostat bulb 20 which is proportional to the suction pressure.

It will be obvious to those skilled in the art that various changes may be made in the construction and arrangement without departing from the spirit of the invention and therefore the invention is not limited to what is shown in the drawing and described in the specification but only as indicated in the following claims.

I claim:

1. In a refrigeration system, a condensing unit, an expansion element, pressure and suction lines connecting said unit and element, a pressure reducing control valve for said element urged toward its closed position by pressure on the low-side, and an expansible fluid thermostat for controlling said valve responsive to temperature at the suction side of said element, said thermostat containing fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure below the pressure in said expansion element at temperatures above the saturation temperature corresponding to said predetermined pressure.

2. In a refrigeration system of the compression type, a condensing unit, an expansion coil, pressure and suction lines connecting said unit and coil, an expansion valve for said coil, and an expansible fluid thermostat for controlling said valve containing fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure below the pressure in said expansion coil at temperatures above the saturation temperature corresponding to said predetermined pressure.

3. In an expansion valve for refrigeration apparatus, an expansible fluid thermostat for operating said valve containing fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure, said predetermined pressure being lower than the saturation pressures corresponding to temperatures above the saturation temperature corresponding to said predetermined pressure.

4. In a refrigeration system containing fluid refrigerant, an expansion valve, and a thermostat for operating said valve containing refrigerant fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure below the pressure in the low pressure side of said system at temperatures above the saturation temperature corresponding to said predetermined pressure.

5. In a refrigeration system utilizing methyl chloride as refrigerant, an expansion valve, and a thermostat for operating said valve containing methyl chloride which is partly in liquid phase and wholly in vapor phase respectively below and above a pressure of 35 pounds per square inch gauge at the desired operating temperature of the valve.

6. In a thermostatic expansion valve for refrigeration apparatus, that improvement in the method of charging which comprises introducing vapor of a volatile fluid in the power element at a predetermined pressure and at a temperature above the saturation temperature corresponding to said predetermined pressure.

7. In a thermostatic expansion valve for refrigeration apparatus utilizing methyl chloride as refrigerant, that improvement in the method of charging which comprises introducing methyl chloride vapor in the power element under a pressure of 35 pounds per square inch gauge at a temperature above the corresponding saturation temperature.

8. In a compression type refrigeration system, a thermostatic expansion valve including an expansible element containing the same kind of fluid as that utilized in said system and in such quantity as to develop a pressure less than the pressure in the low pressure side of said system above the desired operating temperature of the valve.

9. In a compression type refrigeration system, a thermostatic expansion valve including an expansible element containing the same kind of fluid as that utilized in said system and in such quantity as to develop a pressure less than the pressure in the low pressure side of said system above a predetermined temperature, said predetermined temperature being higher than the normal operating temperatures of said system.

10. In a compression type refrigeration system, a thermostatic expansion valve including an expansible element containing the same kind of fluid as that utilized in said system and in such quantity as to exist partially in liquid phase in the range of normal operating temperatures of said system and be entirely in vapor phase at any point above said range.

11. In a compression type refrigeration system, an expansion element, and a thermostatic expansion valve including an expansible element containing fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure, said predetermined pressure being above the range of normal operating pressures in said expansion element and below the pressures in said expansion element at temperatures above the saturation temperature corresponding to said predetermined pressure.

12. In a compression type refrigeration system, an expansion element, and a thermostatic expansion valve including an expansible element containing fluid which is partly in liquid phase and wholly in vapor phase respectively below and above a predetermined pressure, said predetermined pressure being below the pressures in said expansion element at temperatures above the saturation temperature corresponding to said predetermined pressure.

13. In a compression type refrigerating system, a cooling element and a thermostatic expansion valve including a hermetically sealed expansible element in heat transfer relation with the outlet of said cooling element, said expansible element containing a volatile fluid, the quantity of said fluid being such that the pressure thereof below a predetermined pressure corresponds to the pressure in said cooling element, and the pressure of the fluid above said predetermined pressure being less than the pressure in said cooling element at corresponding temperatures.

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