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AUTOMATIC CONTROL VALVE FOR REFRIGERATION SYSTEMS

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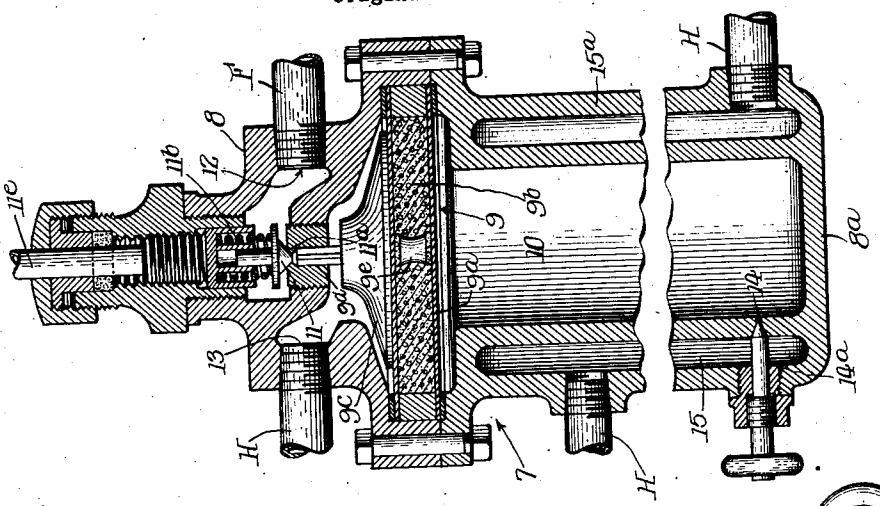


Fig. 2

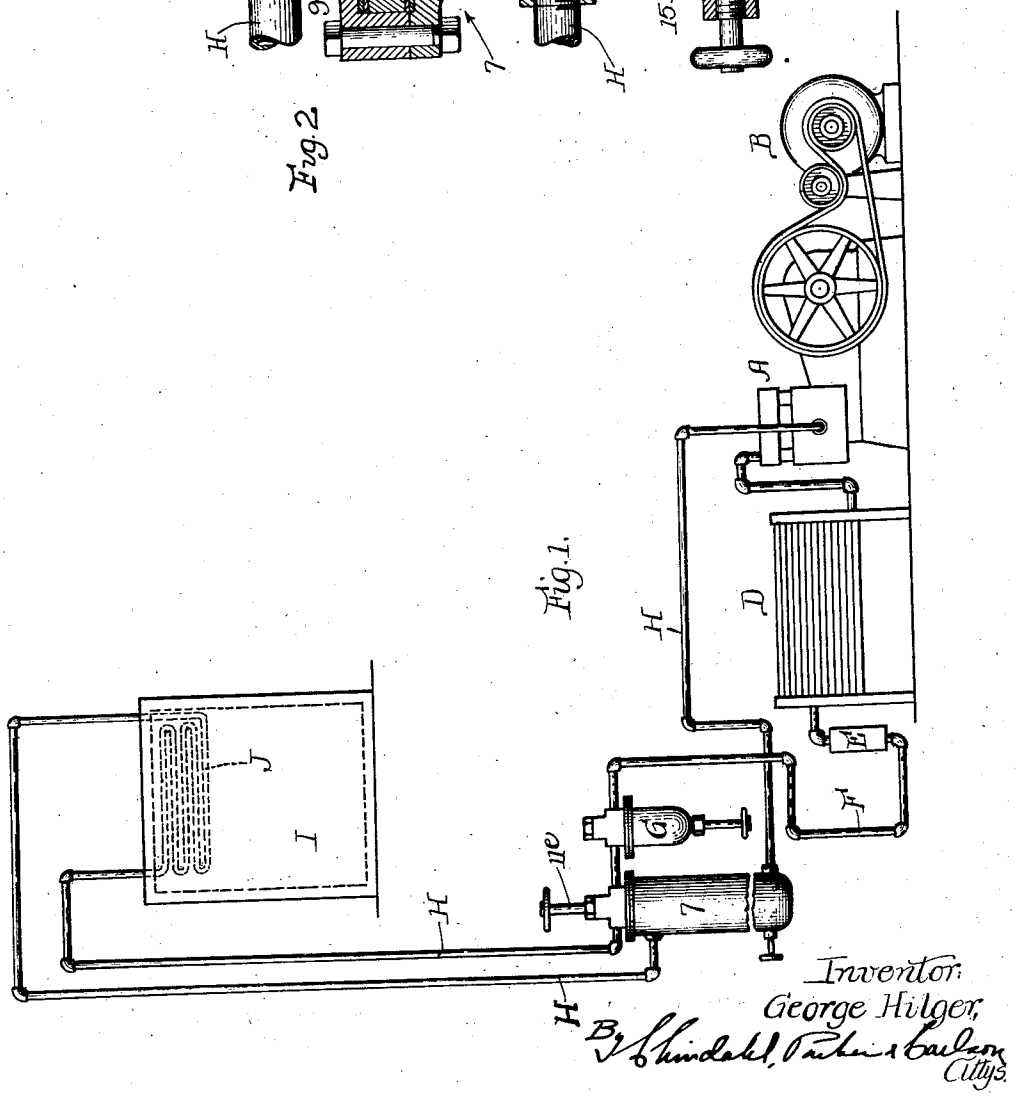


Fig. 1.

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AUTOMATIC CONTROL VALVE FOR REFRIGERATION SYSTEMS.

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The invention pertains to refrigeration systems of the compression type and the primary object is to provide for the automatic control of the flow of the refrigerant through the cooling coil, operating to supply the refrigerant initially at a pressure such as to effect a freezing of the coil as rapidly as possible, and then at a reduced pressure, thus insuring the operation of the system under conditions closely approaching the ideal for maximum efficiency.

In the accompanying drawings, Figure 1 is a diagrammatic illustration of a refrigeration system embodying my invention.

Fig. 2 is a fragmentary vertical sectional view through my improved automatic control valve.

Referring now to Fig. 1, the system comprises a compressor A actuated by an electric motor B. The compressor A discharges into a condenser D, which in turn discharges into a liquid receiver E. From the receiver the liquid flows by way of a pipe F to the expansion valve indicated at G; and from the latter the ammonia discharges under the control of an automatic valve 7 into the main pipe line H. I indicates a storage room having a cooling element or coil J communicating at its opposite ends with the pipe line H which finally returns the expanded gas to the compressor A for recompression.

The compressor A, actuating motor B, condensers D, liquid receiver E and expansion valve G, may be of any suitable or preferred construction.

The controlling valve 7 (Fig. 2) comprises a sectional casing, including an upper section 8 and lower section 8^a. Between said sections, a diaphragm 9 is interposed so as to be secured in position. Said diaphragm constitutes one wall of a closed chamber 10 formed within the lower section of the casing. Preferably the walls of this chamber are made relatively thick for purposes which will appear later. Operatively associated with the diaphragm in the upper section of the casing is a valve 11, arranged to control the flow of gas entering an inlet port 12 into which the pipe F discharges, through a central port 11^a, to an outlet port 13 leading to the pipe line H.

In the present instance, the diaphragm 9 is responsive to variations in the temperature of the gas returned by the pipe line, through the medium of a gas under pressure in the chamber 10; but it will be apparent that any other suitable means responsive to temperature changes may be employed for actuating the valve 11.

The diaphragm 9 is in accordance with the present arrangement, preferably formed of two thin flexible discs 9^a spaced apart and having interposed therebetween suitable insulating material 9^b, which serves to prevent temperature changes in the upper portion of the casing from affecting the gas in the chamber 10. A spacing member 9^e may also be employed to insure that the discs shall be maintained in properly spaced relation and at the same time allow for flexing of the discs. This construction of the diaphragm it will be seen is such as to reinforce it, each of the discs serving to transmit the pressure uniformly throughout its area, to the other disc through the insulating material and said spacer member.

The connection between the diaphragm and the valve member 11 consists of a bearing member 9^c acting through a stem 9^d upon the valve member 11, said stem passing through the central port 11^a. A coiled expansion spring 11^b tends to move the valve member 11 toward its seat upon the upper end of the port 11^a, and the tension of said spring is arranged to be varied at will by means of a suitable adjusting screw 11^c mounted in the upper section of the casing.

The chamber 10 is arranged to communicate by way of a port 14 controlled by a manually operated valve 14^a, with an annular chamber 15 formed by a jacket 15^a. Said chamber 15 is interposed in the return side of the pipe line H leading to the compressor. Thus it will be seen that the chamber 10 is arranged to be charged with ammonia gas discharged from the pipe line into the chamber 15. Preferably this is accomplished when all of the coils of the system have become frozen and a freezing back to the compressor initially occurs so that the gas with which the chamber 10 is charged is in a partially saturated condition. It will be noted also that the pressure of the charge in the chamber 10 will be line pressure, so as to balance the pressure upon the upper side of the diaphragm as it passes from the intermediate valve controlled port 11^a to the outlet 13 and into the pipe line. The spring 11^b is adjusted so as to equalize any excess

in the pressure of the gas in the chamber 10 due to radiation. After the chamber 10 has been charged with refrigerant, the valve 14 should be closed to retain the refrigerant in the chamber.

It will be observed that the rigid walls of the chamber 10 will prevent pressure fluctuations in the chamber 15 from affecting the diaphragm. Thus, the diaphragm will respond to but one variable, that is, temperature changes in the return line, it being apparent that the pressure on the upper side of the diaphragm can be maintained constant. Furthermore, since the walls of the chamber 10 are of substantial thickness, the flow of heat through them will be relatively slow; consequently, the diaphragm will not respond to sudden temperature changes in the return line, but only to changes extending over relatively long intervals of time.

The cooling or storage room into which the gas is discharged from the pipe line H is herein shown as being equipped with a cooling coil J, one end of which communicates with the pipe line H, and the other end of which discharges into the pipe line.

In operation the expansion valve G is set so as to supply gas to the pipe line at a pressure such that the coil shall be frozen as quickly as possible. Thus the initial pressure is preferably relatively high. Until the coil is thus entirely frozen, the ammonia gas returning to the compressor through the return side of the pipe line H, is heated, so that in passing through the chamber 15 surrounding the lower section 8^a of the controlling valve casing, the pressure of the gas in the chamber 10 is such as to hold the valve member 11 open, allowing free passage of the gas into the pipe line. When, however, the coil becomes entirely frozen, the lowered temperature of the returning gas is imparted to the gas in the chamber 10 and the decreased pressure causes the valve 11 to close partially, thus automatically reducing the pressure of the gas discharged into the line in accordance with the changed requirements. The result, it will be apparent, is a saving in the power consumed in providing the necessary refrigeration at any given time. In the first place, the coil, because of the initial high pressure of the gas discharged into the pipe line, becomes frozen in a relatively short time, so that the system rapidly becomes operative in its entirety. In the second place, by reducing the pressure of the gas after such initial operation, the temperature thereof becomes lowered and the system continues in operation at maximum efficiency, effecting a saving in the power consumption, avoiding injury to the compressor by preventing the return thereto of liquid ammonia caused by an excessive freezing back; and insuring that the gas shall be returned to the compressor in a saturated or partially saturated condition. When the system is shut down, the chamber 10 will remain charged with gas at a temperature somewhat above the normal operating temperature, and the pressure of the gas in the chamber on the diaphragm will serve to hold the valve open. The valve will therefore be positioned to admit refrigerant whenever the system is again started in operation.

It will thus be observed that I have through the provision of a relatively simple control device rendered it possible to operate a refrigeration system entirely automatically and in such a way as to increase substantially the efficiency of the system as a whole, to accomplish a higher compressor efficiency and avoid injury to the compressor. At the same time, the elimination of manual control results in a saving in time and labor, while loss due to the production of temperatures too low or too high, occurring through carelessness on the part of an attendant, is avoided.

This application is a division of my copending application Serial No. 658,254, filed August 20, 1923.

I claim as my invention:

1. A controlling valve for refrigeration systems comprising a casing providing a closed chamber adapted to contain an expansion element, a diaphragm forming one wall of said chamber and a wall of a second chamber, a valve in said second chamber arranged to be actuated by said diaphragm, and a jacket surrounding the first chamber into which the refrigerant returning from the cooling element is arranged to be discharged whereby to transmit the temperature of such refrigerant to said chamber, said valve being adapted to admit refrigerant under pressure to said second chamber.

2. A control valve for refrigeration systems comprising a casing providing a closed chamber, a diaphragm forming one wall of said chamber, a valve arranged to be actuated by said diaphragm, an annular chamber surrounding the first mentioned chamber and adapted to receive the refrigerant returning from the cooling element whereby to transmit the temperature of such refrigerant to said chamber, and manually operated means for admitting to said first chamber from said second chamber a charge of the refrigerant under pressure.

3. A control valve for an automatic refrigeration system comprising a casing, a diaphragm in said casing forming on one side thereof a closed thermostatic chamber in the casing, a valve member operatively associated with said diaphragm, the opposite side of said diaphragm being arranged to be subjected to the pressure of the gas supplied to the system, and means for supplying

to said chamber gas under pressure from the return line of said system.

4. A control valve for an automatic refrigeration system comprising a casing, a diaphragm in said casing forming a closed chamber on one side thereof, and a valve member operatively associated with said diaphragm, the opposite side of said diaphragm being arranged to be subjected to the pressure of the gas supplied to the system, and said chamber being adapted to enclose an expansion element for operating said diaphragm.

5. A control valve for an automatic refrigeration system comprising a casing, a diaphragm in said casing forming a closed chamber in the casing adapted to contain an expansion element, a valve member operatively associated with said diaphragm, the opposite side of said diaphragm being arranged to be subjected to the pressure of the gas supplied to the system, and means for subjecting the expansion element in said chamber to the gas returned from the system whereby to vary the temperature of the element in the chamber and actuate said valve member accordingly.

6. A control valve for refrigeration systems comprising, in combination, a casing providing a closed chamber, an insulated pressure member forming one wall of said chamber said chamber being adapted to contain an expansion element, a valve member operatively associated with said pressure member, and means for subjecting said chamber to the refrigerant discharged from the system whereby to vary the temperature of said expansion element in accordance with the temperature of the discharged refrigerant.

7. An automatic control device for refrigeration systems having valve means for controlling the flow of a refrigerant, and temperature responsive means for actuating said valve means comprising a chamber having an insulated diaphragm forming one wall thereof.

8. An automatic control device for refrigeration systems having valve means for controlling the flow of a refrigerant, and temperature responsive means for actuating said valve means comprising a chamber having a diaphragm forming one wall thereof and including a pair of plates spaced apart and insulating material between said plates.

9. An automatic control device for refrigeration systems having valve means for controlling the flow of a refrigerant, and temperature responsive means for actuating said valve means comprising a chamber having an insulated diaphragm forming one wall thereof, said chamber being adapted to contain an element responsive to temperature changes, and means for transmitting to said element the temperature of the refrigerant discharged from the cooling element.

10. A unitary control valve for a refrigerating system comprising, in combination, a casing providing a chamber containing a thermo-responsive element, said chamber having rigid walls of substantial thickness, a diaphragm closing said chamber and arranged to respond to the pressure changes within the chamber, a valve member operatively associated with said diaphragm, adapted to control the flow of refrigerant to said system, and means providing a second chamber within the casing about the walls of said first chamber, said second chamber being adapted to be connected in the return line of the refrigerating system.

11. A control valve for refrigerating systems comprising, in combination, a casing providing a chamber having rigid walls, said chamber being adapted to contain a termostatic element, means for exposing the walls of said chamber to the temperature of the refrigerant in the return line of the system, a valve member controlling the supply of refrigerant to the system, and a diaphragm responsive to said thermostatic element and operatively connected to said valve member, said diaphragm comprising two flexible discs closing said chamber and having insulating material between them.

12. In an automatic control valve, a valve member, and thermo-responsive means for actuating said valve member including a diaphragm comprising two flexible discs, insulating material between said discs and means for holding said discs in spaced apart relation.

13. A unitary control valve for a refrigeration system comprising, in combination, a casing, a flexible disk dividing said casing into two chambers, means providing a passageway through one of said chambers to permit the flow of refrigerant to said system, a valve member connected to said disk and adapted to control the flow of refrigerant through said passageway, a thermostatic element in said other chamber, responsive to temperature changes in the refrigerant returning from said system, said element acting on said disk whereby to actuate said valve member, and a heat insulating medium between said passageway and said last mentioned chamber.

In testimony whereof, I have hereunto affixed my signature.

GEORGE HILGER.