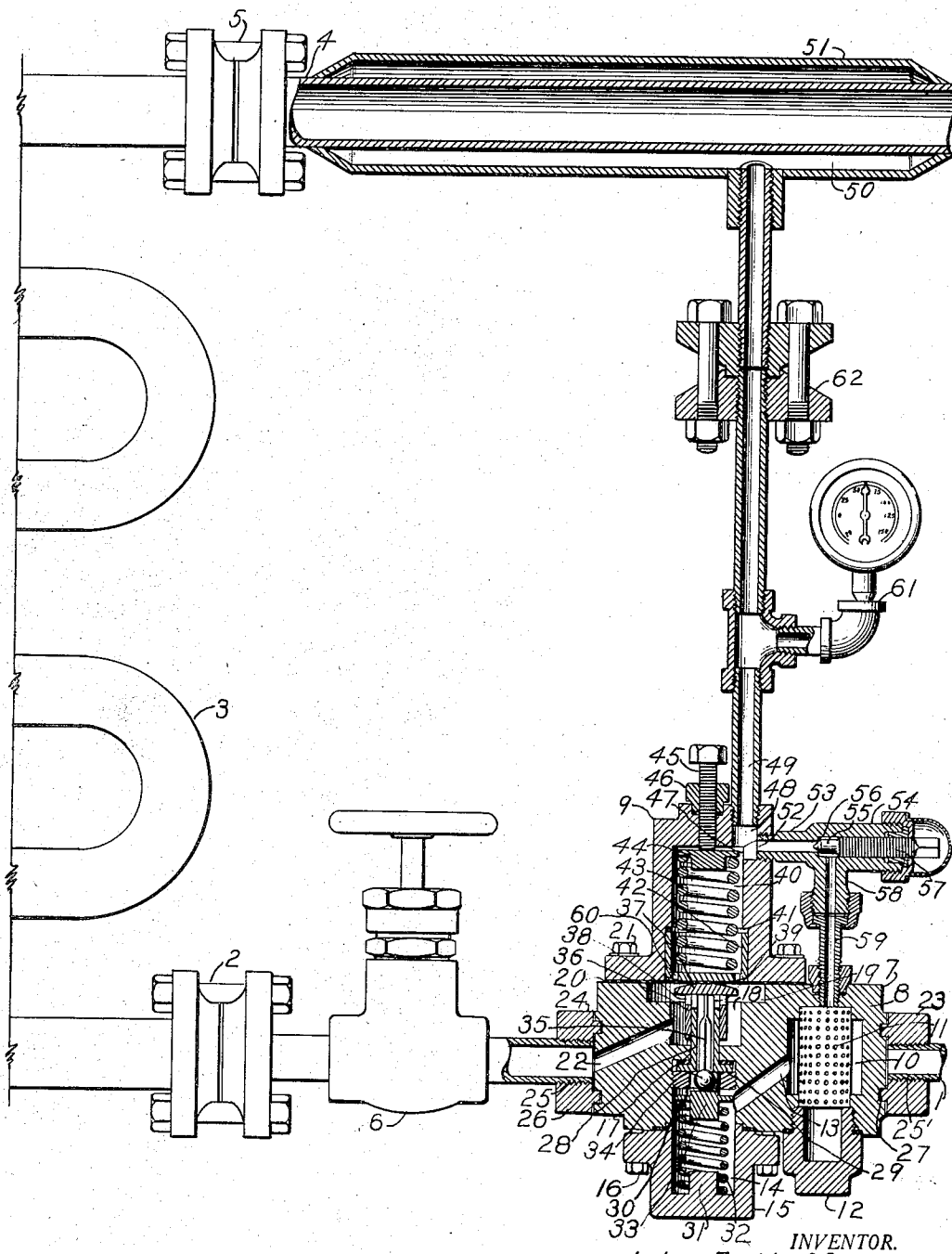
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TEMPERATURE RESPONSIVE REGULATING VALVE

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TEMPERATURE RESPONSIVE REGULATING VALVE

Application filed April 21, 1928. Serial No. 271,754.

My invention relates to refrigerating apparatus and more particularly to apparatus of that character wherein a low boiling point liquid, such as anhydrous ammonia, is compressed and circulated through condensing and cooling coils to effect temperature equalization by expansion and evaporation of the refrigerating agent in the cooling coils, the principal object of the present invention being to control supply of the refrigerating agent to the cooling coil by differential in temperature at the outlet end of the coil.

It is a further and particular object of the invention to control the passage of the refrigerating agent to the coil by pressure means responsive to the temperature of the agent as it passes from the coil.

In a device providing for the control of a supply inlet valve by pressure of a restrained fluid influenced by changes in temperature of the refrigerating agent as at the outlet end of the coil, the changes in temperature of the refrigerating agent at the inlet end of the coil might cause the agent to exert changing pressure influences opposed to the influence of the valve-controlling fluid. Further objects of the device, therefore, are to prevent interference by the refrigerating agent in a coil with the supply-controlling means, and to effect an exchange of temperature between the coil-contained refrigerating agent and the supply-controlling fluid whereby a balance will be produced to offset the changes in temperature of the refrigerating agent.

The device is to be understood to be installed in a refrigerating system comprising means for delivering a refrigerant such as ammonia to a coil for expansion therein to withdraw heat from the coil and the atmosphere surrounding the same; the system including also a compressor for setting up a vacuum in the return line for removing the expanded refrigerant and conditioning the same for another cycle of operation. Such features of the system may be of any desired construction and since they do not form part of the present invention they are not illustrated or described.

The present application is a continuation in part of my copending application Serial No. 209,690, in which a suitable refrigerating system is illustrated and described in detail, said application disclosing the supply-control means herein more particularly described and claimed.

In accomplishing the above and other objects of the invention I have provided improved details of structure, the preferred forms of which are illustrated in the accompanying drawing, wherein:

The figure is a view partly diagrammatic and fragmentary, of a refrigerating coil and the inlet and outlet thereof, and a central vertical section of my improved supply-control device installed in functioning relation with said inlet and outlet.

Referring in detail to the drawing:

1 designates a supply line for conducting an expansible refrigerant such as ammonia to the inlet end 2 of a coil 3, and 4 designates a suction or return line connected to the outlet end 5 of the coil. The refrigerant passing through the coil expands therein, exchanging heat with the coil and with the atmosphere in a compartment in which the coil may be located. The supply of refrigerant is ordinarily controlled by a manually operated valve, such as 6, in the supply line, for reducing, increasing or shutting off the supply suitably to produce a desired degree of cold in the compartment, or for maintaining a desired temperature, as well understood. The temperature of the refrigerant at the outlet end of the coil is one factor indicating the temperature condition of the compartment for guidance in the manipulation of the valve 6.

In order to control the supply automatically, I provide a temperature controlled valve indicated generally by the housing 7 interposed in the supply line 1 adjacent the inlet end 2 of the coil, and comprising a body member 8 and its cap 9. Formed in the body 8 at one side thereof is a chamber 10 into which the supply line delivers. A screen 11 is supported in the chamber by a plug 12 which closes its open lower end.

Leading from the chamber 10 is a duct 13 which opens to a chamber 14 formed partly

within the body 8 and partly within a cap 15 suspended from the body 8 by bolts 16.

The chamber 14 communicates through a throat 17 with a chamber 18 in the body 8, the upper part of the chamber being preferably enlarged at 19 to provide a substantial area of contact of refrigerating agent with a diaphragm 20 interposed between the body 8 and the cap 9 and held in place by the bolts 21 which attach the cap 9 to the body 8.

A duct 22 leads from the chamber 18 to conduct refrigerating agent from the chamber to the coil 3.

The ends of the supply line between which the valve is interposed are connected with the opposite sides of the valve by collars 23 and 24 respectively threaded on the supply line portions 25 and 25′ and having flanges 26 engaging similar annular grooves 27 in the body.

Extending through the throat 17 into the chamber 18 is a tube 28 having a head 29 clamped against the top of the chamber 14 by a collar 30 threaded into the upper portion of the chamber above the outlet of the duct 13.

Supported on the bottom of the cap 15 about a boss 31 is an expansion spring 32 carrying a seating plate 33 which supports a valve ball 34 within the collar 30, and urges the ball to contact with the open lower end of the tube 28, thereby constituting the end of the tube a valve seat.

Supported on the ball 34 and extending through the bore of the tube 28 is a squared pin 35.

Slidable on the upper end of the tube 28 is a sleeve 36 having a rounded head 37 engaging the diaphragm 20 at its upper face and contacted by the squared pin 35 on its under face. The sleeve 36 is provided with port openings 38 and the tube 28 with openings 39 through which fluid may pass from the tube to chamber 18 when the valve 34 is open, as will presently be described.

The cap contains a vertically extending chamber 40 enlarged at its lower end to provide the shoulder 41. Slidable in the enlarged portion of chamber 40 for vertical movement limited by the shoulder 41 is a cup 42, seating an expansion spring 43 engaging at its upper end a thrust plate 44 adjustable by set screw 45 which extends through the top of the cap and held in adjusted position by a lock nut 46. The spring 43 tends to expand the diaphragm 20 downwardly to push the pin 35 against the valve ball 34 to open the valve and provide flow through chamber 40 to the coil.

Opening through the cap 9 from the chamber 40 is a port 47 through which the chamber communicates with a vertical channel 48 into which is threaded the end of a vertical conduit 49 leading to and communicating with an annular chamber 50 within a housing 51 on the return line 4 adjacent the outlet end of the coil 3.

The port 47 also provides communication with a port 52 into which the nipple 53 of a valve housing 54 is connected, the housing containing a needle valve 55 operable against a seat 56 to control flow of fluid through the port 52, the valve having a threaded steam 57 engaged with the housing for operating the same.

Suitable means are provided for supplying an expansible fluid to the condenser jacket and chamber 40, and preferably from the supply line. For this purpose a nipple 58 communicating with the interior of the housing is threadedly connected with a tube 59 engaged with the inlet side of the body 8 and communicating with the screen chamber 10 therein, the needle valve 55, therefore, controlling flow of fluid from the supply line into the chamber 40, and into conduit 49 and condenser jacket 51.

The expanding fluid moves the diaphragm to displace the valve; and is permitted to pass through the cup to spread over the upper surface of the diaphragm when the same is moved downwardly, by the provision of openings 60 in the bottom of the cup 42.

An indicator 61 is interposed in the conduit 49 for indicating the pressure of fluid in the conduit, jacket and chamber 40. The conduit preferably comprises upper and lower sections respectively connected with the condenser jacket and the valve 7, and joined by a coupling 62, for convenient installation.

Further important characteristics of the control mechanism, which influence the method of control, will be disclosed in the course of description of operation, for example, the relative size of the conduit 49.

In the operation of a system equipped with my improved control means, the system is assumed to be empty, and the springs 32 and 43 adjusted for effecting a desired response of the control mechanism to the conditions of the refrigerant, and to properly balance the pressure influence of the incoming refrigerant which tends to close the valve. The condenser jacket and chamber 40 are provided with an expansible fluid, preferably from the supply line. The hand valve 6 is closed, and refrigerant is delivered to the supply line. The needle valve 57 is then opened to admit fluid through the port 52 to supply the chamber 40 and condenser jacket 51. When the presence of a sufficient supply of expansible refrigerant is indicated by the indicator 61, the port 52 is closed by the needle valve, and the hand valve 6 is opened to permit refrigerant to flow through the coil. The initial temperatures of the fluid confined in the conduit, and of the outgoing refrigerant, to which the springs 32 and 43 are

adjusted, cause opening of the inlet valve to permit refrigerant to enter the coil.

The refrigerant expands while in the coil and passing therethrough, and takes up heat from the coil. The temperature of the refrigerant passing through the portion of the return line adjacent the coil outlet influences the temperature of the fluid in the condenser jacket and causes expansion or contraction of said fluid, the fluid correspondingly influences the diaphragm 20 which is operatively engaged with the inlet-controlling members including the ball valve 34.

Expansion of the fluid due to relatively high temperature of the departing refrigerant causes pressure on the diaphragm and tendency to urge the ball valve away from its seat against the retaining influence of the spring 32; and contraction of the fluid due to relatively low temperature of the departing refrigerant causes relief to pressure on the diaphragm to permit the spring 32 to close the inlet and shut off the supply of refrigerant to the coil.

The supply of refrigerant is, therefore, accurately and automatically increased or diminished according to the demand of the coil, and suitable to the preliminary adjustments of the springs 32 and 43.

One possible handicap exists, however, to efficient and prompt response of the valve-control means to temperature changes of the departing refrigerant, namely, the pressure influence of the refrigerant adjacent the coil inlet that may be exerted upwardly against the diaphragm 20. Said pressure influence might oppose the fluid pressure above the diaphragm sufficiently to permit the valve to be closed by the spring 32. Such interference is avoided, however, by the fact that as the pressure of the expanded fluid in the jacket tends to increase, so does the temperature of the refrigerant increase. Advantage is taken of this condition, and exchange of heat occurs by conduction through the diaphragm between the fluids above and below the diaphragm, thereby establishing a balance of temperature and pressure between the two fluids.

In other words, when the rising temperature of the refrigerant tends to produce resistance to the fluid above the diaphragm, heat is transferred to the fluid through the diaphragm, the pressure of the confined fluid in the chamber 43 is proportionately increased, and the fluid continues to govern the valve.

Attention is particularly called to factors which make possible the stabilization of control by the fluid influenced by the departing refrigerant. The jacket must be located above the valve, for draining thereinto, and for efficient action of the fluid therein. The conduit between the jacket and the valve must have sufficient area to permit free exchange of temperature between the jacket and the chamber 40, by the natural tendency of heated gases to move upwardly and of cooled gases to move downwardly.

A substantial area of the diaphragm should be exposed to the refrigerant and to the actuating fluid. The members should be so related that the described exchange of heat between the fluid and the refrigerant can take place.

The device illustrated and above described meets the conditions stated for accomplishing the results named.

What I claim and desire to secure by Letters Patent is:

In a device of the character described including a valve housing having aligned pressure and fluid supply chambers, a diaphragm dividing said chambers, and a valve controlling flow through the supply chamber, means including a perforate cup slidable in the pressure chamber and engaging said diaphragm for operating said valve.

In testimony whereof I affix my signature.

JOHN F. HOFFMAN.