April 3, 1945. J. N. ROTH 2,372,684

REFRIGERATOR VALVE

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Fig. 1.

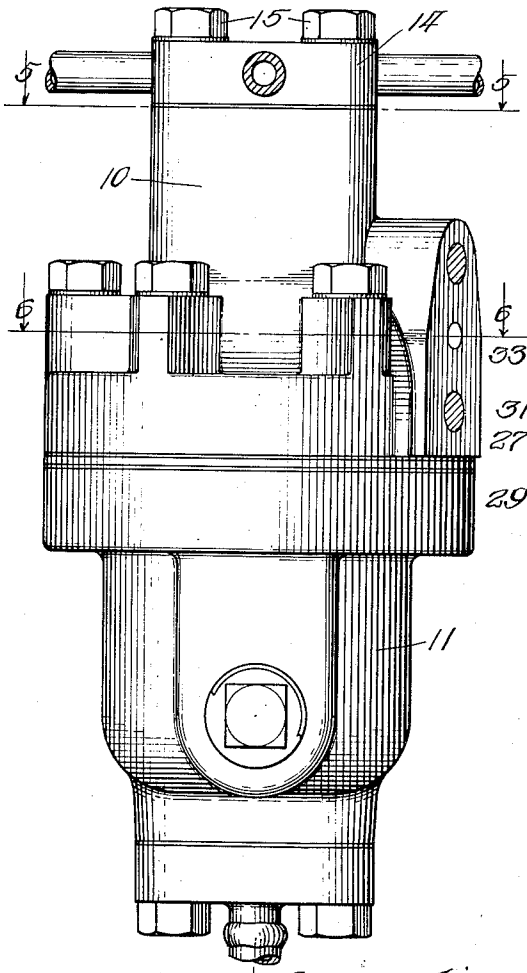

Fig. 3.

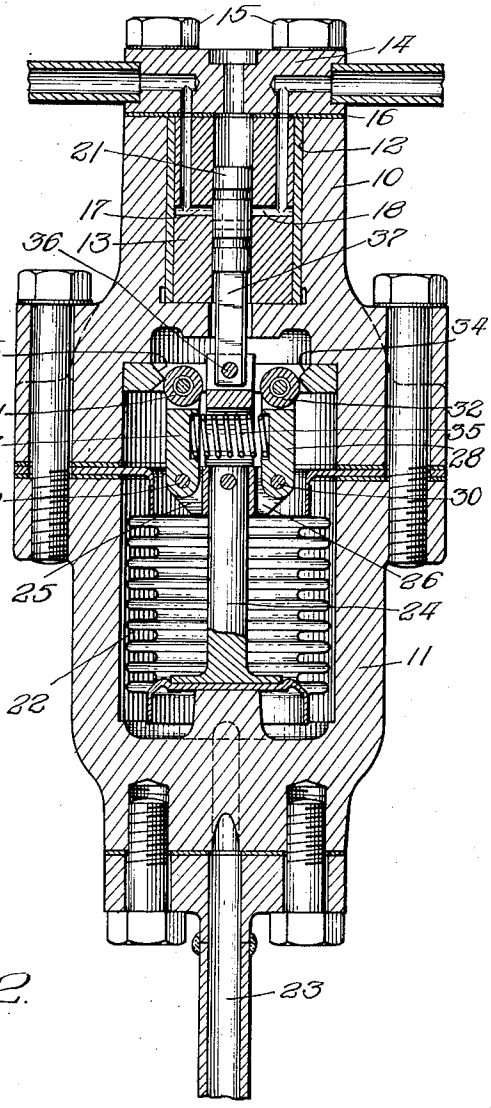

Fig. 2.

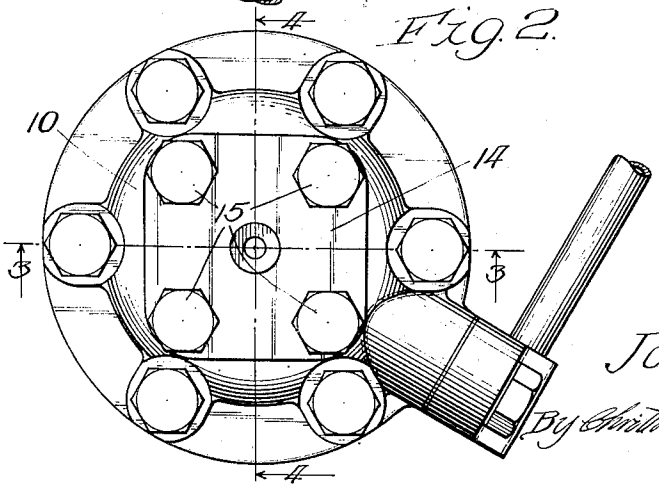

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Fig. 4.

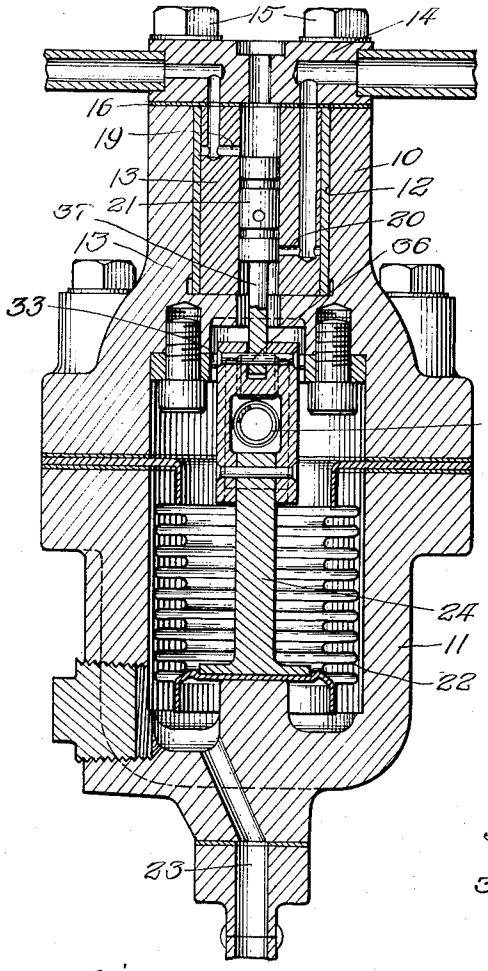


Fig. 6.

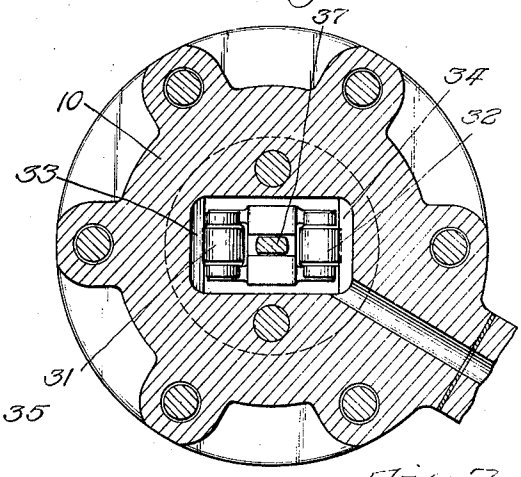


Fig. 7.

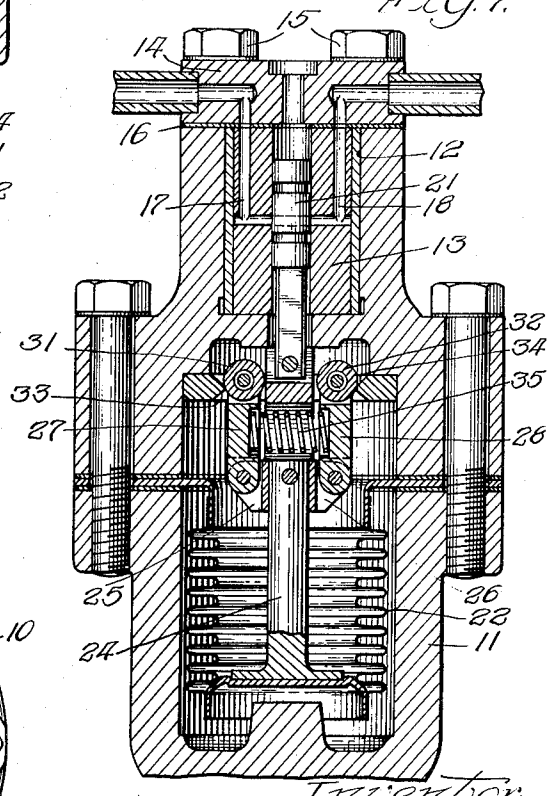
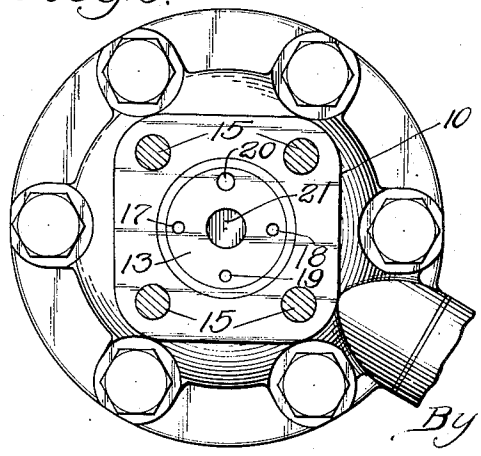


Fig. 5.



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UNITED STATES PATENT OFFICE

2,372,684

REFRIGERATOR VALVE

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Application September 4, 1941, Serial No. 409,576

1 Claim. (Cl. 251—76)

This invention relates to a refrigerator valve, and more particularly to a precision valve adapted to control flow of fluid under substantial pressure.

One feature of this invention is that it provides an improved valve for controlling a plurality of flow paths in a continuous absorption refrigeration system; another feature of this invention is that it provides an improved assembly, by clamping the valve cylinder between top and bottom plates, which avoids distortion of the cylinder and misalignment of the parts; another feature of this invention is the provision of improved snap action mechanism, wherein opposed balancing snap action parts are yieldingly urged in the desired direction by a single spring, insuring avoidance of undesired side components of force; other features and advantages of this invention will be apparent from the following specification and the drawings, in which:

Figure 1 is an elevational view of a valve embodying my invention; Figure 2 is a top plan view of the valve; Figure 3 is a vertical sectional view along the line 3—3 of Figure 2; Figure 4 is a transverse vertical sectional view along the line 4—4 of Figure 2; Figure 5 is a horizontal view, partly in section, along the line 5—5 of Figure 1; Figure 6 is a horizontal sectional view along the line 6—6 of Figure 1; and Figure 7 is a view similar to that of Figure 3, but showing the valve plunger in a different position.

Certain continuous absorption refrigeration systems continuously boil off refrigerant from a mixture of refrigerant and absorbent, rectify and condense the high pressure refrigerant vapor, and pass it through pressure reducing means into the evaporator or cooling coils, from which it passes to an absorber where it is reabsorbed. The still and condenser, of course, operate at high pressure, frequently in the neighborhood of three hundred pounds to the square inch on a summer day; while the evaporator and absorber operate at low pressure, as ten to twenty pounds gauge pressure. Weak liquor from the still may be readily moved to the absorber by reason of this pressure differential, such flow generally being controlled by a float valve; but moving rich liquor back from the absorber to the still presents a more difficult problem. To avoid the necessity of pumps this rich liquor is sometimes moved by flowing it from the absorber to a transfer chamber at low pressure, then raising the pressure in the transfer chamber until it equals that in the still, and flowing it from the chamber to the still. An early form of such a system is shown in Schurtz Patent 1,414,527, and more recent forms of such a refrigeration system are shown in a number of copending joint and sole applications of myself and said Schurtz, one such copending application being Serial No. 400,089, filed June 27, 1941.

In order to operate a refrigeration system of this character various high and low pressure gas and liquid flow paths must be controlled by valve means, and I have devised and am here disclosing an improved valve for such a purpose. Referring now more particularly to the specific embodiment of my invention disclosed in the accompanying drawings, the valve assembly includes upper and lower casing members 10 and 11 (the upper member being sometimes hereafter termed an end member) providing a chamber for the actuating and snap action mechanism. The member 10 is provided at its upper end with a deep socket or pocket 12 adapted to receive a cylinder 13 in a sliding fit. The socket is preferably of such a depth as to receive the entire cylinder, so that the upper edge of the cylinder is level with the upper edge of the surrounding portion of the member 10. An upper end member 14 is adapted to be drawn down upon the cylinder by bolts 15 passing through it and engaging the member 10, so that the cylinder 13 is clamped between the members 10 and 14, these providing the sole support for the cylinder.

The valve must, of course, be a precision job, and the bottom end of the socket 12 is ground flat and adapted to receive the cylinder 13 in metal-to-metal engagement. A gasket 16 lies between the lower surface of the member 14 and the cooperating surfaces of the cylinder providing the entire fluid sealing arrangement. As can be readily seen from the drawings, the members 10 and 14 not only provide support and housing means for the valve cylinder 13, but also provide fluid connections to ports in the walls of the cylinder, as the ports 17, 18, 19 and 20. The connections between such ports and pipes leading to other parts of the system will be readily apparent from the drawings, and it is to be understood that these ports and pipes are parts of fluid flow paths designed to pass refrigerant in either liquid or vapor phase and at high or low pressure. Any fluid leakage which might take place between the bottom of the cylinder and the cooperating surface of the member 10 is stopped at the upper end of the cylinder by the gasket 16.

A valve piston or plunger member 21 is reciprocably mounted in the bore of the cylinder 13

and adapted to control flow of fluid through the various ports. When the valve member is in the position shown in Figures 3 and 4, for example, both liquid and gas flow paths may be provided between the absorber and the transfer chamber to fill the transfer chamber; whereas when the valve member is in its other position as shown in Figure 7 high pressure vapor and liquid connections may be provided between the transfer chamber and the still to drain its contents to the still.

It will be apparent that it is desirable to have only two positions of the valve member, either in upper position or a lower position, and to prevent the valve member from resting in intermediate positions I have provided snap action mechanism in conjunction with the actuating mechanism. Movement of the valve member is effected by difference in fluid pressures within and without the Sylphon bellows 22. For example, still pressure may be admitted to the upper side of the bellows and balanced against thermostat bulb pressure delivered through the pipe 23 to effect the desired movements of the valve member when one of these pressures exceeds the other by a desired amount determined by the resistance of the snap action mechanism. Movement of the bottom of the bellows 22 effects longitudinal movement of a rod 24. Near its upper end this rod is provided with oppositely extending arms 25 and 26 on which are pivotally mounted upwardly extending links 27 and 28, these links being pivotal about the pins 29 and 30.

At their upper ends the links carry rollers 31 and 32 adapted to cooperate with V-shaped shoulder elements 33 and 34 fixedly mounted in the valve unit. A single spring 35 has its ends in engagement with and carried by the links 27 and 28, this spring tending to urge the links apart and yieldingly urging the rollers toward their cooperating shoulder elements.

When the parts are in the position shown in Figure 3 the centers of the rollers are slightly below the apexes of the V-shaped shoulder elements 33 and 34, and any upward movement of the rod 24 can be effected only by compression of the spring 35. Moreover, once the center of the rollers has passed the line of the apexes of the shoulder elements the force of the spring 35 causes the mechanism to move on to its upper position. A pivotal connection is provided, by the pin 36, between the rod element 24 and a depending rod-like portion 37 of the reciprocable valve member 21, so that movement of the actuating and snap action mechanism effects movement of the valve member and desired variation in the fluid flow paths.

The use of opposed shoulders and rollers in conjunction with a single spring, and a pivotal connection to the valve member, completely prevents undesired side forces which have heretofore been encountered in such valves. Because of the high pressures handled by the valve the fit between the valve member and its cooperating cylinder must be very close, and any slight distortion or side thrust upon the valve member causes it to stick. Heretofore difficulty has been encountered with the use of snap action mechanisms because such mechanisms resulted in a considerable side thrust and undesired misalignment of the parts. Even though there are slight variations in manufacture, the fact that the two links are pivotally connected to the rod element 24 and urged outwardly into conjunction with similarly arranged shoulder elements by a single spring, causes them to automatically align themselves in such a way that there is always equal force between each roller and its cooperating shoulder element, and no side thrust on the rod element. Moreover, any slight misalignment between the rod element 24 and the bore in the valve cylinder 13 is taken care of by the pivotal connection provided by the pin 36, preferably rather loosely received by its cooperating holes to provide some play in all directions. Moreover, the provision of a metal-to-metal contact between the bottom of the cylinder and its cooperating lower end member, with all of the sealing being done at the top and with all clamping force being longitudinal of the cylinder, prevents any stresses being set up in the cylinder which distort it from its true and desired shape. Providing the cylinder with bottom flanges or other means for clamping it directly to another member has heretofore caused stresses and strains in the cylinder which showed up in distortion in its bore and sticking of the valve member.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claim.

I claim:

A valve of the character described for controlling a plurality of fluid flow paths in a continuous absorption refrigeration system, including: a sleeve member with a central bore having ports in its walls in a plurality of spaced planes transverse to its axis and longitudinal passages in said walls communicating with said ports, all of said passages opening at one end of said sleeve member; a very closely fitted valve piston reciprocable in the bore of the sleeve member to control flow through said ports; and means for supporting the sleeve member and for providing all fluid connections to the sleeve member at the ends thereof, comprising end members clamping the sleeve member therebetween, all sealing being effected at said one end of the sleeve member, the bore opening at the other end and providing a flow path, and one of the end members being provided with a socket substantially equal in length to the sleeve member and adapted to receive the sleeve member in a sliding fit, whereby the sleeve member is readily separable from the remainder of the refrigeration system.

JOSEPH N. ROTH.