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CONTROL VALVE

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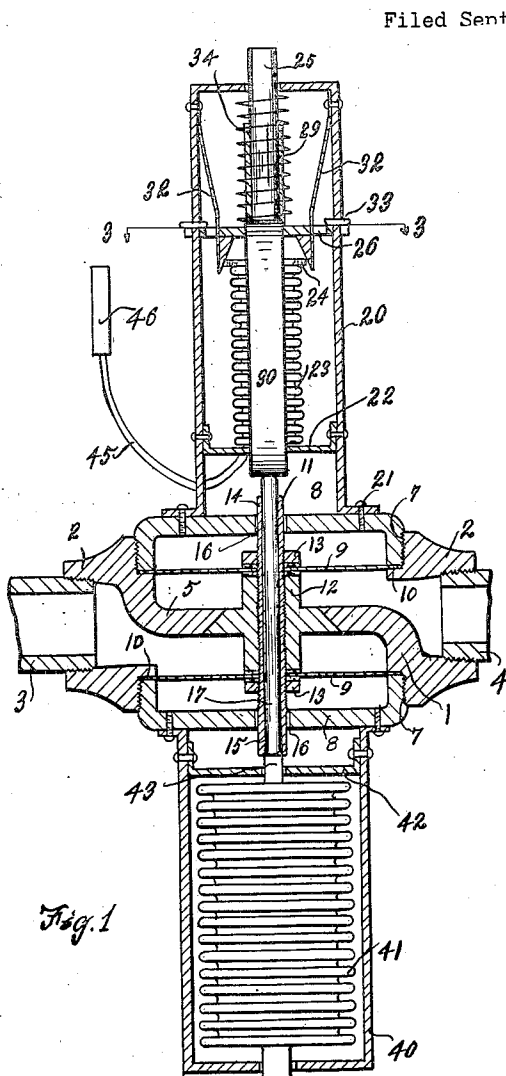


Fig. 1

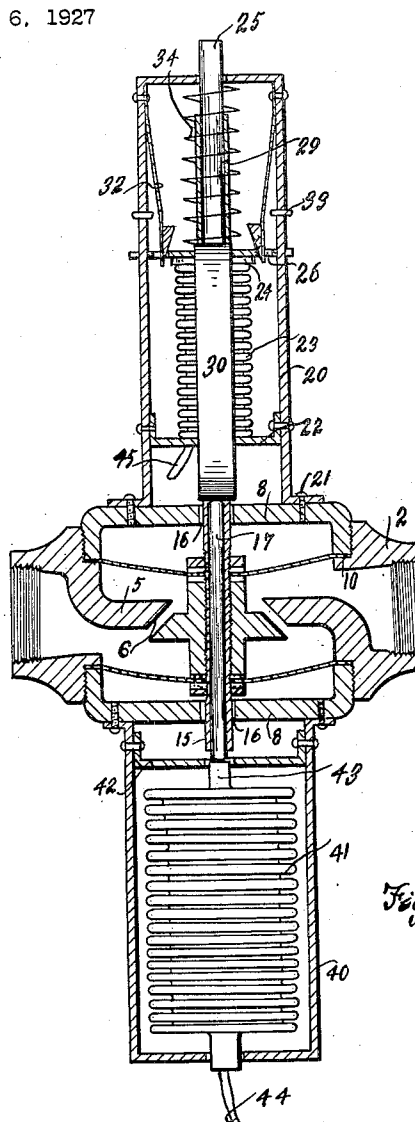


Fig. 2

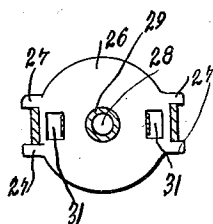


Fig. 3

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CONTROL VALVE

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The present invention relates to thermostatic control valves for use particularly in refrigeration systems of the absorption type. More particularly the present invention provides a floating valve structure to control the flow of fuel gas with means for automatically opening and closing this valve and for sealing the valve against leakage. Temperature operated means are employed both for opening of the valve and closing of the same and in addition, means are provided whereby one of the thermostatic means will act to force the valve opening means into its inoperative locked position from which it is tripped by the second temperature control means when the valve is to be again opened. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings:—

Fig. 1 is a vertical section through the valve mechanism, showing the valve in its closed position; Fig. 2 is a similar view showing the valve in its open position; and Fig. 3 is a sectional view on the line 3—3 of Fig. 1.

The valve mechanism proper consists of a valve casing 1 having an interiorly threaded projection 2 at each end for connection with the inlet and outlet pipes 3 and 4 for the fuel gas. In the valve casing is a centrally located valve seat member 5 having an aperture with a conical seat 6. At the top and bottom, the casing is open and is interiorly threaded as at 7 to receive a closing disk or cup 8 and to seal the casing a diaphragm 9 is mounted between each closing disk and the shoulder 10 at the bottom of the threaded portion 7 of the casing. The valve proper consists of a tube 11 threaded throughout the major portion of its length on which is mounted the valve plug 12, this valve being connected to the diaphragms by means of two nuts 13 which are screwed down on the tube

so as to form a tight seal between the tube, the valve member proper and the diaphragm. This tube has unthreaded extending ends 14 and 15 passing through suitable apertures 16 formed in the disks or cups 8 which hold the diaphragms in place and in the tube is slidably mounted an operating plunger 17, the action of which will be explained in detail hereinafter.

Mounted on the top cup 8 is a U-shaped strap or bracket 20 which is held to the cup by means of screws 21 or is otherwise suitably secured thereon and this U strap is provided near the cup with a cross member 22 preferably riveted to the sides of the strap. Mounted on this cross member is a temperature operated device in the form of a bellows 23 which is provided at its top with an operating cam disk 24 carrying a bearing stem 25. Slidably mounted in the U strap is a plate 26 having a pair of projecting ears 27 at each side which extend past the side members of the strap to form a sliding guide therewith, this plate having a central aperture 28 and an upwardly extending tube 29 adapted to receive the bearing stem 25 of the bellows and the plate is provided with an operating yoke 30 extending downwardly and surrounding the bellows and having its bottom portion mounted below the cross member 22 of the U-shaped strap. This plate is also provided with two rectangular apertures 31 and the U-shaped strap carries two spring latch members 32 which are adapted to extend through the rectangular apertures in the plate and lock thereunder as shown in Fig. 1, the upward movement of the plate being limited by pins 33 extending through the side straps so as to engage with the plate at a height to allow the spring latch members to engage under the plate. A coil spring 34 is mounted between the top of the U strap and the plate so as to normally force the plate downwardly into operating engagement with the valve tube and plunger.

On the bottom cup 8 of the valve casing is mounted a second U-shaped strap or supporting bracket 40, this bracket carrying at the bottom a second temperature responsive element in the form of a metal bellows 41, the

strap being provided adjacent the top with an apertured cross member 42 to receive and act as a bearing for the plunger stem 43 of the bellows. The lower bellows is connected
5 through a tube 44 and a heat responsive cylinder 47 to the boiler or other heating chamber of an absorption refrigerating system, while the upper so-called "frost" bellows is similarly connected by a tube 45 and cylinder 46 to the cold portion of the system.
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The valve is shown in its closed position in Fig. 1, in which position the lower bellows 41 is extended with its stem 43 in engagement with the extending end 15 of the valve tube and the tube and valve plug have been moved upwardly into closing position. The sealing diaphragms are so set as to aid in holding the valve in its closed position. In this closed valve position, the loose plunger 17 has been forced upwardly through the valve tube and has engaged the yoke 30 and moved the yoke and plate 26 upwardly into its latch engaging position as shown in Fig. 1. After the valve 12 has been closed, the refrigeration system will cool off as far as the boiler portion is concerned, since the fuel supply has been cut off, and the bellows 41 will contract into the position shown in Fig. 2. As the boiler cools off and ceases to pass refrigerant gas through the system, the frost chamber, to which the cylinder 46 is connected, warms up, and ice in the cylinder melts releasing the pressure on the fluid in bellows 23 which then contracts. Previously, during the period when the frost chamber was at its coldest, the bellows 23 will have expanded to bring the cam disk 24 up against the plate 26 thus spreading the latches 32 out of engagement with plate 26 and as soon as the upper bellows again contracts which will be as soon as the "frost" chamber rises to a predetermined temperature, the plate 26 will move downwardly into the position shown in Fig. 2, thus moving the yoke against the upper portion 14 of the valve tube so as to open the valve against the action of the diaphragms and this valve opening action is accomplished by the coil spring 34 which forces the plate downwardly. It is of course understood the bellows 23 will not begin to expand until frost begins to form in the frost chamber and this does not occur for some time after heat has been turned off by closing the valve which regulates the admission of fuel.
55 Consequently bellows 23 remains in the contracted state while fuel gas flows through the valve and also for an interval after the fuel has been cut off. It results that the upper bellows remains down while the lower bellows closes the valve and pushes plate 26 over the latches 32. After the supply of heat to the system has been cut off, the pressure goes down and frost begins to form, whereupon the bellows 23 will expand until
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with the plate 26 and supports this plate against the spring 34. The plate 26 will be held by the upper bellows until the frost chamber begins to warm up again, permitting the bellows to contract and allowing the spring to force the valve open. More fuel will then be admitted to heat the system, cause refrigerant gas again to flow and eventually to regenerate the frost in the frost chamber.
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The present control valve is thus positively actuated in both directions, the opening of the valve being controlled by the coil spring acting through the plate and its operating yoke, while the closing of the valve is accomplished by the lower or heat bellows acting together with the spring tension of the two sealing diaphragms. The upper or "frost" bellows function is merely to accomplish the release of the spring latches and to hold the plate and yoke in inoperative position until such time as the temperature rises sufficiently to need further valve opening and flow of fuel gas. The valve structure proper provides a tightly sealed casing, the diaphragms forming a gas tight seal with the valve and valve tube and the entire control is positive in its action and may be set to operate within satisfactorily close limits.
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Supposing the valve to be open, as shown in Fig. 2, fuel gas passes through the valve to burners where it heats the boiler. The heat from the boiler, after a certain time, will cause fluid to be forced through the line 44 into the lower bellows 41 which will expand and push the valve upward into its seat, thus cutting off the flow of fuel. At the same time, the plunger 17 will communicate the upward movement of the bellows to the yoke 30, which pushes the plate 26 upwardly against the spring 34 until this plate locks over the latch members 32. The upper bellows 23 is at this time in a contracted position, since the frost chamber has warmed up during the last interval when fuel supply was cut off. It now begins to expand as the cylinder 46 grows colder, together with the frost chamber, due to the effect of refrigerant gases circulated by virtue of the fuel consumed when the valve was open. Ice forms in the cylinder 46 and the consequent expansion forces fluid into the bellows 23 expanding this and forcing the latches 32 outwardly so that they no longer support the plate 26 which would now descend under the pressure of the spring 34 were it not that the expanded bellows 23 supports it. Consequently, the valve will remain closed as long as the frost chamber is cooled, but this chamber will gradually warm up and in so doing will permit the cylinder 46 also to become warm, so that the ice therein melts and the fluid in the bellows 23 flows out, permitting the bellows to contract. The plate 26 and the yoke 30 will now descend, due to the ten-
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sion of the spring 34, and open the valve. Fuel gas will flow through the valve until lower bellows 41 again commences to expand and close the valve, and the sequence of operations commences anew.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In a thermostatic control mechanism, a valve consisting of a casing open at each side and having an inlet and an outlet and a central valve seat member, an apertured cup mounted in each side, a sealing diaphragm mounted between each of said cups and said casing, and a valve member mounted in said casing and consisting of a tube extending through said diaphragms and said apertures in said cups, and a valve plug mounted on said tube between said diaphragms and sealed thereto and temperature responsive devices mounted on the two sides of the casing and operable against said tube to control movement of said valve.

2. In a thermostatic control mechanism, a valve consisting of a casing open at each side and having an inlet and an outlet and a central valve seat member, an apertured cup mounted in each side, a sealing diaphragm mounted between each of said cups and said casing, and a valve member mounted in said casing and consisting of a tube extending through said diaphragms and said apertures in said cups, a valve plug mounted on said tube between said diaphragms and sealed thereto, the spring tension of said diaphragms normally holding said plug in its closed position, spring actuated means mounted on one side of said casing and adapted to force said valve open, a temperature responsive element mounted on the other end and adapted to force said valve shut upon a predetermined rise in temperature, and a second temperature responsive device adapted to control the action of said spring actuated means.

3. In a thermostatic control mechanism, a valve consisting of a casing open at each side and having an inlet and an outlet and a central valve seat member, an apertured cup mounted in each side, a sealing diaphragm mounted between each of said cups and said casing, and a valve member mounted in said casing and consisting of a tube extending through said diaphragms and said apertures in said cups, a valve plug mounted on said tube between said diaphragms and sealed thereto, the spring tension of said diaphragms normally holding said plug in its closed position, spring actuated means mounted on one side of said casing and adapted to force said

valve open, means locking said spring actuated means in inoperative position, a temperature responsive device adapted to release said spring actuated mechanism to open said valve, and a second temperature responsive device mounted on the other side of said casing and adapted to close said valve and to move said spring actuated means to its locked position.

4. In a thermostatic control mechanism the combination of a valve consisting of a casing open at each side and having an inlet and an outlet, and a central valve seat, sealing diaphragms mounted at such open sides and a valve member mounted in said casing and attached to said diaphragms, said valve member being hollow and having tubular ends extending out beyond said diaphragms, a thermostatic member mounted on one side of said casing and adapted to move said valve member by engagement with one of said ends, a plunger mounted through said hollow valve member, and control means mounted on the other side of said casing and adapted to be actuated by movement of said plunger to control actuation of the valve in the opposite direction.

5. In a thermostatic control mechanism, a valve comprising a casing open at each side and having an inlet and an outlet and a central valve seat member, a valve member mounted in said casing, ends on said valve member extending out through said valve casing, a hot-expanded temperature responsive device and a cold-expanded temperature responsive device, said devices being positioned to act upon said extended ends to control the operation of said valve.

6. In a thermostatic control mechanism, a valve comprising a casing open at each side and having an inlet and an outlet and a central valve seat member, a valve member mounted in said casing, ends on said valve member extending out through said valve casing, a temperature responsive device positioned to act directly upon one of said ends to close said valve, and a second temperature responsive device adapted to delay the action of an element positioned to act directly upon the other end of said valve member to open said valve.

7. In a thermostatic control mechanism, a valve comprising a casing and an inlet and an outlet, a central valve seat member, a valve member mounted in said casing, ends on said valve member extending out through said valve casing, a hot-expanded bellows mounted so as to press against one of said ends and close said valve, a spring mounted to press on the other of said ends to open the valve, and a cold-expanded bellows positioned to delay the action of said spring.

8. In a thermostatic control mechanism, the combination which comprises a valve, operating means including temperature-re-

sponsive means positioned adjacent said valve, and a spring positioned adjacent one of said temperature responsive means, contacting means between said valve and said operating means, one of the aforesaid temperature responsive means being adapted to expand and thus close said valve when hot, and the other of said temperature responsive means being adapted to expand to prevent the opening of said valve by said spring when cold.

Signed by me this 29th day of August, 1927.

FREDRICK E. BEEBE.