

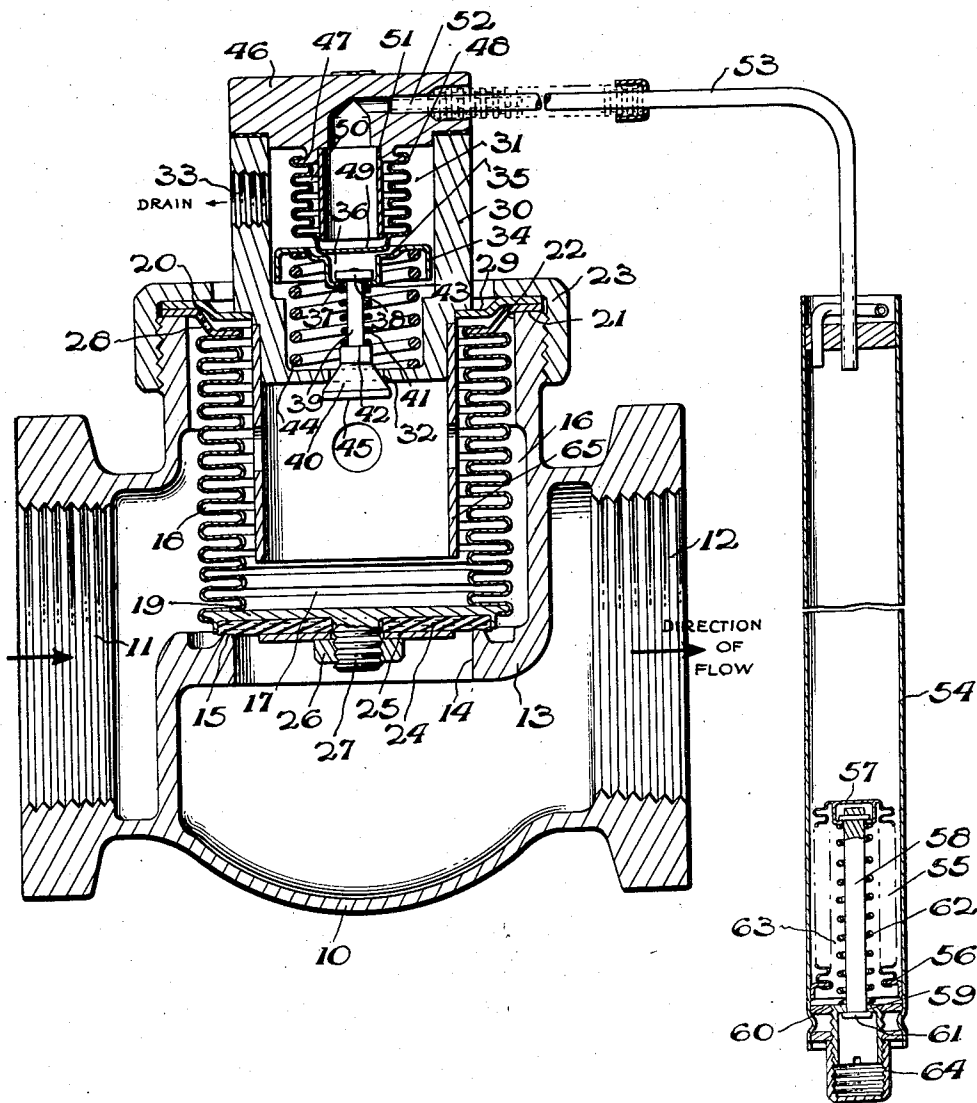
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THERMOSTATICALLY ACTUATED PILOT OPERATED VALVE

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THERMOSTATICALLY ACTUATED PILOT
OPERATED VALVE

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This invention relates to thermostatically actuated pilot operated valves and more particularly to such pilot operated valves which move rapidly between closed and wide open positions.

There are various services to which pilot operated valves are desirably put wherein the main valve should be either in closed position or in wide open position. For example, in a sprinkler system wherein water is discharged as a spray through nozzles when a predetermined control temperature has been reached, the main valve controlling the supply of water should move quickly to wide open position when the desired temperature is reached so that the nozzles may function efficiently in producing the desired sprays, and when the sprays are to be cut off, said valve should close quickly so as to avoid a period wherein the water is dribbling through the nozzles.

To obtain rapid opening and closing of a main valve it has heretofore been proposed to provide a pilot valve actuated by a thermostat of the snap acting type. Devices of this character have been open to several objections among which are the lack of power derivable from thermostats of the snap acting type, the difficulty of rendering the thermostatic actuator of the pilot valve responsive to temperatures at points relatively remote from the pilot operated valve, the complexity and cost of the construction if gradual opening and closing of the pilot operated valve are to be avoided, etc.

It is an object of this invention to provide an improved thermostatically actuated pilot operated valve wherein the latter moves quickly between closed and wide open positions.

Another object of this invention is to provide an improved device of the type characterized wherein the point of temperature control can be readily made as remote as desired from the pilot operated valve.

Another object of this invention is to provide an improved device of the type characterized wherein the thermostatic actuator has adequate power to assure operation of the pilot valve notwithstanding variations in the pressure of the fluid being controlled.

Another object of this invention is to provide an improved device of the type characterized wherein the pilot valve will be positively moved to open position in the event that it fails to respond to pressure differentials as contemplated for normal operation.

Another object of this invention is to provide an improved device of the type characterized

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which is simple and rugged in construction, composed of parts that are inexpensive to manufacture and assemble, and highly efficient when applied to a wide variety of services in which the pilot operated valve should move quickly between closed and wide open positions.

The invention is capable of receiving a variety of mechanical expressions only one of which has been shown on the accompanying drawing, and therefore it is to be expressly understood that the drawing is for purposes of illustration only, and is not to be construed as a definition of the limits of the invention, reference being had to the appended claims for that purpose.

The accompanying drawing shows somewhat schematically a cross section through a thermostatically actuated pilot operated valve embodying the present invention.

As shown, a valve housing 10, of any suitable size, construction and material, has an inlet 11 and an outlet 12 and, interiorly, a partition 13 through which passes a valve port 14. As illustrated, the rim of the port 14 is properly formed to provide a valve seat 15, but if desired a separate valve seat member may be used.

Mounted in the chamber 16 at the inlet side of port 14 is an expansible and collapsible chamber 17 the movable end wall of which is operatively connected to any suitable main valve member. As shown, said chamber 17 is formed by an expansible and collapsible corrugated tubular wall or bellows 18 suitably secured at one end to a movable end wall 19 and at its opposite end to an annular member 20, here shown as clamped to the wall 21 surrounding a lateral opening 22 in said housing, as by a threaded collar 23. While the movable end wall 19 may itself be a valve member, the construction shown includes a valve disk 24 of any suitable material secured to the outer face of end wall 19 by a plate 25 and nut 26, the latter being threadedly mounted on a stud 27 secured to or formed on said movable wall 19. Annular member 20 is provided in any suitable way with a bleed opening 28 for a purpose to be explained.

Also secured in position by the threaded collar 23, as by means of an interposed annular member 29, is the housing 30 of the pilot valve proper. As here shown, said housing takes the form of a hollow or tubular member providing an interior chamber 31 which is in communication with chamber 17 through a pilot valve port 32. Said chamber 31 also has a drain pipe opening at 33.

Mounted in the chamber 31 is a cup-shaped

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member 34, shown as depressed at 35 to provide a seat for a purpose to be explained, having a central portion which is shaped or recessed to provide a chamber 36 having an aperture 37 through its bottom wall. Extending through said aperture 37 and provided in any suitable way, at or adjacent its end, with a collar 38 in chamber 36 is a pilot valve stem 39 to which is suitably secured a pilot valve member 40 for cooperation with the port 32. A coil spring 41 reacts between a shoulder 42 on said valve member and the bottom wall 43 of the chamber 36 so that the collar 38 on stem 39 is normally held in contact with said bottom wall 43. A second and stronger coil spring 44 reacts between the cup-shaped member 34 and the wall of the chamber 31 surrounding the valve port 32 and normally urges said cup-shaped member 34 together with the pilot valve member mounted thereon in the direction for closing said pilot valve member 40. Pilot valve member 40 is preferably so constructed that it presents a surface 45 of substantial area to the pressure in chamber 17.

Also mounted in the chamber 31 is the motor vessel of a thermostat of the type wherein the motor vessel is in communication with a bulb that may be disposed at any suitably remote distance from the motor vessel. As illustrated, chamber 31 is closed by a block 46, secured to the end of the pilot valve housing 30 in any suitable way, and has formed thereon or secured thereto a flange 47 to which is hermetically sealed an expansible and collapsible corrugated tubular wall or bellows 48 whose opposite end is integrally formed with or suitably attached to a movable end wall 49. The chamber 50 enclosed by the bellows 48, its movable end wall 49 and the stationary block 47 constitute an expansible and collapsible chamber or motor vessel whose movable end wall 49 is so disposed that it is adapted to engage seat 35 on the cup-shaped member 34 and move the latter downwardly, as viewed in the drawing, when said chamber 50 is expanded as hereinafter explained. A collar 51 is shown as secured to the block 46 within chamber 50 and projects into proximity of the movable end wall 49 to limit the extent to which chamber 50 may be contracted.

Block 46 is provided with a suitable passage 52 which communicates with motor vessel 50 at one end and which communicates at its opposite end with a conduit 53, which may be of any suitable size, length and construction, and either rigid or flexible, leading to a bulb 54 of any suitable construction and size and mountable in position in any suitable way. As shown, bulb 54 has an overrun provision in the form of an expansible and collapsible corrugated tubular wall or bellows 55 hermetically sealed at one end to a flange 56 secured interiorly to the wall of the bulb and at its opposite end having a movable end wall 57 to which is attached in any suitable way a post 58 that extends through an opening 59 in the end wall 60 of the bulb, where it is provided with a collar 61. A coil spring 62 reacts between the movable end wall 57 and the end wall 60 of the bulb and normally holds the collar 61 against the exterior of said end wall 60. In the event of excess pressure in the bulb 57, however, the expansible and collapsible chamber 63 interiorly of the bellows 55 can be collapsed by the pressure on the movable end wall 57, causing the post 58 to slide downwardly as viewed in the drawing through the opening 59 until the excess pressure is relieved. The exterior cham-

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ber in which collar 61 is disposed may be closed by any suitable threaded cap 64.

Bulb 54, tube 53 and chamber 50 are filled with any suitable thermostatic liquid so that upon increase of temperature at the bulb 54 the resulting expansion of the liquid will effect expansion of the motor vessel 50 and operate the pilot valve in a manner to be explained.

If it is desired to limit the extent to which the main valve may be opened a collar 65 may be mounted in any suitable way on the pilot valve housing 30 and have its inner end so disposed with respect to the movable end wall 19 of chamber 17 that a predetermined limit of contraction of chamber 17 is prescribed.

Assume that the bulb 54 is subjected to any suitable source of temperature and that the inlet 11 to housing 10 is connected to any suitable source of liquid while outlet 12 is connected to any suitable provisions for utilizing such liquid. If the temperature at the bulb 54 is such that motor vessel 50 is not expanded, coil spring 44 reacts on the cup-shaped member 34 to hold the pilot valve member 40 in its position for closing port 32. The liquid to be controlled entering through the inlet 11 can bleed through aperture 28 into the chamber 17 and thereby produce an unbalanced pressure in said chamber on the movable end wall 19, in a downward direction as viewed in the drawing, holding the main valve member 24 in contact with seat 15 to prevent flow of liquid through the port 14. The pressure in the chamber 17 also acts upwardly, as viewed in the drawing, on the face 45 of pilot valve member 40, acting adjunctively with the spring 44 to urge member 40 into its position for closing the port 32.

Now suppose the temperature at the bulb 50 approaches that degree at which main valve member 24 should move to its wide open position permitting maximum flow of liquid through the port 14. Expansion of the charge in the thermostat 50, 53, 54 will gradually develop pressure in the motor vessel 50 and, when the movable end wall 49 of said vessel is in engagement with the seat 35 of the cup-shaped member 34, the latter member develops resultant tension in the springs 44 and 41. When the tension of spring 41 slightly exceeds the pressure in the chamber 17 on the face 45 of pilot valve member 40 the latter will be opened to a small amount. This effects a release of pressure in the chamber 17, because only a slight opening of the pilot valve member 40 permits an outflow of liquid through the port 32 well in excess of what enters the chamber 17 through the bleed opening 28. This diminution of pressure on the face 45 of pilot valve member 40 in turn permits the stored tension of spring 41 to open the pilot valve member 40 rapidly, by snap action, whereupon the pressure in the chamber 17 is rapidly released, the liquid therein flowing out through port 32, chamber 31 and drain opening 33, and the main valve member 24 is thereby moved to its wide open position by the unbalanced fluid pressure acting on the main valve member, or by the tension developed in bellows 18 when it is extended by the pressure in chamber 17 to close the main valve member, or by any suitable spring associated with said chamber if preferred.

If for any reason the pilot valve member 40 is not opened by the tension of spring 41 as the latter is compressed, member 34 will slide over the pilot valve stem 39, downwardly as viewed in the drawing, until movable end wall 49 engages

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the collar 38 and positively moves the pilot valve member 40 off of its seat. Therefore, the pilot valve is positively opened to release the pressure in chamber 17 before the temperature at bulb 54 can rise very much above that at which the pilot valve is supposed to be opened.

Upon drop of temperature at the bulb 54 the motor vessel 50 contracts and spring 44 moves the cup-shaped member 34, upwardly as viewed in the drawing, until pilot valve member 40 nearly reaches its seat. At this point the pressure in the chamber 17 on the inner face 45 of the pilot valve member 40 becomes active to act adjunctionally to the spring 44 in moving the pilot valve member 40 rapidly to closed position. Thereupon the pressure quickly accumulates in the chamber 17, moving the main valve member 24 to its seat by reason of the unbalanced pressure that quickly develops in said chamber 17 because of inflow of liquid through the bleed opening 28. However, the closing movement of the main valve member 24 is slightly retarded by reason of the necessity of the pressure accumulating in the chamber 17 through bleed opening 28, and therefore there is no pounding or water hammer by reason of the main valve being closed too quickly.

It will therefore be perceived that by reason of the present invention the main valve moves quickly from closed to wide open position and vice versa notwithstanding that the pilot valve is under the control of a thermostat whose rate of expansion and contraction is gradual. Thereby a thermostat of the bulb and motor vessel type can be used to assure adequate power in operating the pilot valve while the bulb may be disposed at any suitably remote distance from the motor vessel so that the pilot operated main valve may respond to temperatures at points relatively remote therefrom. While in the normal operation of the thermostatically actuated pilot operated valve the pilot valve is given a snap action by reason of the existing differential pressures when its associated spring has been predeterminedly tensioned by the thermostat, positive actuation of the pilot valve from the thermostat is assured if the pilot valve sticks or temporary pressure conditions prevent opening of the pilot valve by differential pressure. The structure is composed of relatively simple parts that are inexpensive to fabricate and assemble, so that a compact and rugged thermostatically actuated pilot operated valve unit is provided, while at the same time the construction is such as to assure efficient operation of such unit under widely varying conditions where it is desired that the main valve move quickly between closed and open positions.

While the embodiment of the invention illustrated on the drawing has been described with considerable particularity, it is to be expressly understood that the invention is not limited thereto as the same is capable of receiving a variety of mechanical expressions as will now be apparent to those skilled in the art, while changes may be made in the details of construction, arrangement, proportion, size, etc., and parts may be replaced by equivalent parts, without depart-

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ing from the spirit of this invention. Reference is therefore to be had to the claims hereto appended for a definition of said invention.

What is claimed is:

1. In a device of the type characterized in combination with a main valve, an expansible and collapsible chamber having its movable wall operatively connected to said main valve and provided with a bleed opening, means providing a pilot port in communication with said chamber, and a pilot valve member cooperatively associated with said port, a thermostat including an expansible and collapsible motor vessel and a communicating bulb, a movable member associated with the movable wall of said motor vessel, a spring cooperating with said movable member to oppose movement of said member until said motor vessel has overcome the tension of said spring, and an operative connection between said movable member and said pilot valve member including a stem mounted on and movable relatively to said movable member and having a head for engagement with said movable member, and a second spring cooperating with said stem and movable member for normally holding said head in contact with said movable member.

2. In a device of the type characterized, in combination with a main valve, an expansible and collapsible chamber having its movable wall operatively connected to said main valve and provided with a bleed opening, means providing a pilot port in communication with said chamber, and a pilot valve member cooperatively associated with said port, a thermostat including an expansible and collapsible motor vessel and a communicating bulb in communication with said motor vessel through an intermediate conduit, a movable member associated with the movable wall of said motor vessel, a spring cooperating with said movable member to oppose movement of said movable member until said motor vessel has overcome the tension of said spring, and an operative connection between said movable member and said pilot valve member including a stem mounted on and movable relatively to said movable member and having a head for engagement with said movable member, and a second spring cooperating with said stem and movable member for normally holding said head in contact with said movable member, said movable member having a recess in which said head is disposed and from which it becomes engaged with the movable wall of said motor vessel after a predetermined movement of the latter.

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