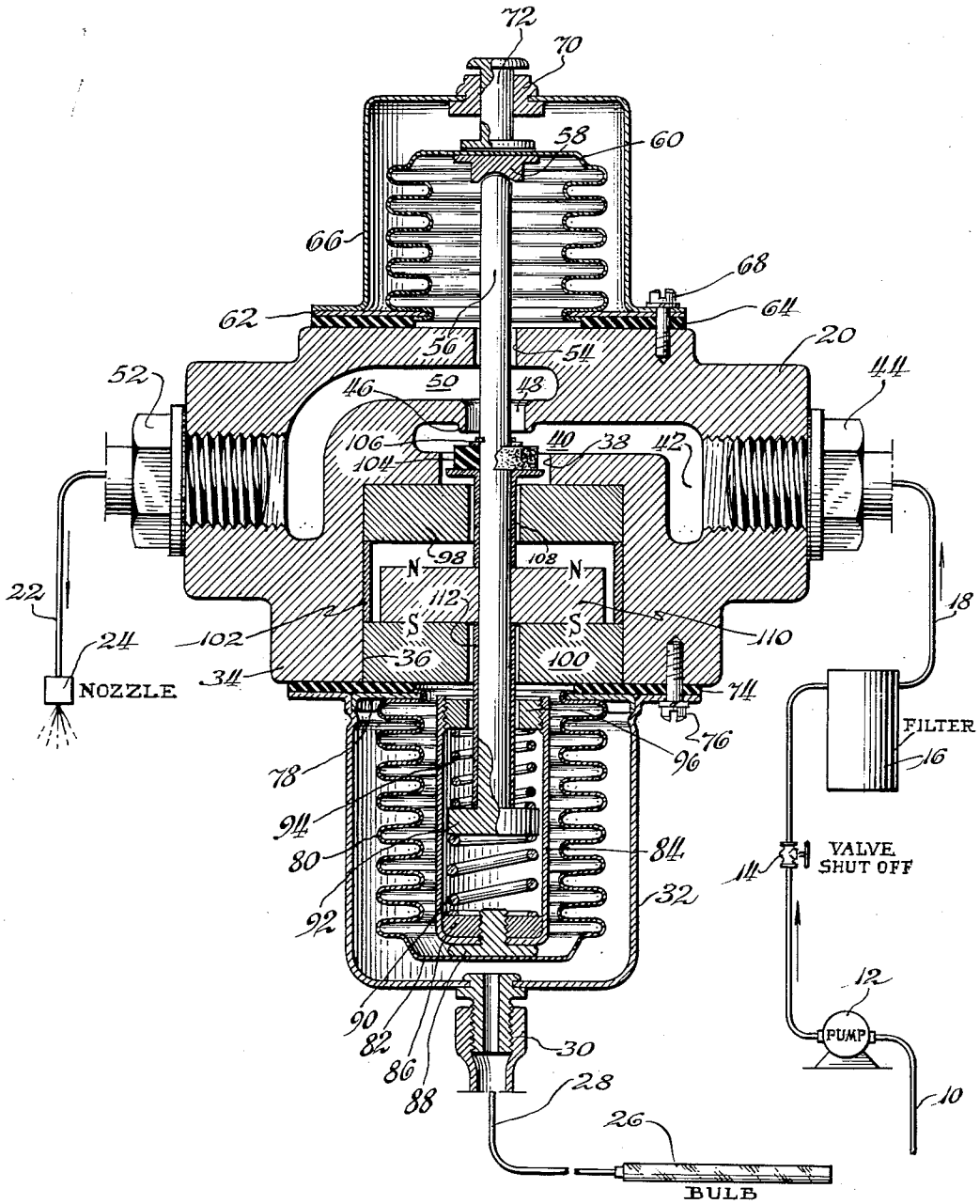
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SNAP ACTING THERMOSTATIC VALVE

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SNAP ACTING THERMOSTATIC VALVE

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This invention has as its principal object to provide a novel snap acting thermostatic valve which is positive in its operation and which may be manufactured at relatively low cost.

Yet another object is to provide an improved valve of this character which is proof against leakage, either from the valve to the outside or through the valve when it is in closed position.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawing.

In the drawing, the single figure shows a vertical medial sectional view through a snap acting valve embodying the present invention with typical equipment of one type ordinarily used therewith shown diagrammatically.

In the operation of heating equipment, particularly heaters supplied with liquid fuel, there is among other things the advisability of providing a valve for interrupting the flow of fuel to the nozzle or other fuel consuming device if the heater or some other portion of the heating equipment becomes too hot. Preferably the valve closing action should be abrupt rather than gradual because a certain minimum rate of of fuel flow is required in order to insure combustion and thus fuel flowing in less quantity will accumulate inasmuch as it is not consumed by the combustion process. Snap action is practically a necessity for control of a heater of the spray nozzle type, since otherwise the nozzle will become choked with carbon when the pressure drops below that essential for good atomization. Preferably, also, once the valve has closed it should remain closed until manually reset if it is to be used as a safety shut-off valve.

The drawing shows the valve of the present invention in such a typical application. Fuel from any suitable source is brought through a tube 10 to a pump 12 and from the pump through any customary shutoff valve 14 to a filter 16 which is for the purpose of removing solid particles from the fuel, and thence by way of the tube 18 to the valve 20 which forms the subject matter of the present invention. From the valve the fuel passes by way of a tube 22 to a burner nozzle 24. The purpose of the valve 20, therefore, is to stop the flow of fuel to the nozzle 24 automatically under certain conditions to be explained below .

The valve is intended to be operated by a conventional thermostatic bulb 26 which supplies fluid under pressure through a tube 28 to a fitting 30 connected to a chamber forming member 32 of the valve 20. The situation, therefore, is that whenever the bulb 26 has its temperature increased it will raise the pressure in the tube 28 and cause liquid to flow into the chamber 32. Conversely, lowering the temperature of the bulb 26 causes liquid to flow from the chamber 32.

The valve 20 is comprised of a body casting 34 having a generally cylindrical chamber 36 extending there-

into from the bottom. At a point well within the casting the chamber 36 communicates through an axial opening 38 with a valve chamber 40 which is cored or drilled so as to have an inlet passage 42 communicating with a valve inlet fitting 44. This inlet passage 42 surrounds a downwardly facing valve seat 46 through the center of which there is an opening 48 communicating with an outlet cored passage 50 which leads in turn to an outlet fitting 52. There is also a drilled opening 54 leading through the top portion of the casting and concentric with the valve seat 46.

A poppet valve stem 56 extends through the passages from top to bottom of the device, with its upper end bearing against a socket forming member 58 carried inside and at the end of a corrugated bellows 60. The lower end of this bellows is soldered or brazed to a ring 62 which lies against the upper face of a gasket 64 seating in turn against a machined face on the casting 20. A flanged, deeply drawn cup shaped cap 66 loosely encloses the bellows 60 and has its flange in face to face contact with the top face of the ring 62, the cap, ring, gasket and casting being secured tightly together in the relative positions indicated by means of screws 68.

The upper end of the cap 66 is provided with a bushing 70 which carries a headed stem or button 72 loosely fitted therein such that the outer end of the stem 72 is above the end of the cap 66, whereas the lower end rests against the outer end of the bellows 60 in alignment with the valve stem 56. The button 72, therefore, is available to an operator for pushing the stem 56 downwardly, while the bellows 60 prevents the possibility of leakage to the outside which might occur if ordinary packing were depended upon to provide sealing around the axially movable stem 56.

At the lower end of the device there is the drawn sheet metal cup 32 previously referred to which is sealed against the lower face of the casting 20 by a gasket 74, this assembly being accomplished by passing screws 76 through an outwardly turned flange of the cup 32 so that these screws pass through the flange and through the gasket 74 and are threaded into the casting 20. The cup member 32 at its upper end carries an inwardly extending flange or ring 78 which around the opening at its center is soldered or otherwise suitably secured to the upper end of a corrugated bellows member 80. The lower end of this bellows is closed by a flat end 82 and the space within the cup 32 and surrounding the bellows 80 is filled with the fluid which also is present in the bulb 26. Thus, the bulb 26, the tube 28, and the space within the cup 32 surrounding the bellows 82 constitute together a sealed hydraulic system with the result that heating of the bulb 26 causes the lower end 82 of the bellows member 80 to move upwardly slightly.

Within the bellows 80 there is a tubular member 84 having its lower end closed as at 86, this closed end being provided with a button 88 which bears against the inner surface of the flat end 82 of the bellows 80. Within the tubular member 84 there is a comparatively stiff coil spring 90 which rests against the inner surface of the tube end 86 at one end while its upper end supports an enlarged head 92 formed at the lower end of the valve stem 56. Above this head 92 there is a second and much lighter spring 94 which extends between the head 92 and a collar 96 threaded into the upper opening of the tubular member 84. The tubular member 84 therefore floats relative to the head 92 of the valve stem 56 between the springs 90 and 94.

Before the lower cup member 32 is assembled with its gasket 74 to the lower face of the valve body 34, a steel or iron disc 98 is dropped into the cavity 36 after which a second similar disc 100 is inserted with a spacing sleeve 102 between the two. The thicknesses of the two iron

discs, plus the length of the sleeve **102** equals the depth of the cavity **36** and therefore the discs are maintained in position with a space therebetween by the same rubber gasket **74** which seals the cup member **32** to the valve body.

A resilient valve disc **104**, formed of rubber or similar material, is positioned a proper distance below the valve seat **46** and is secured to the valve stem **56** by being placed between a washer and pin or split ring **106** secured to the valve stem in a position directly thereabove and a headed tubular member **108** which surrounds the valve stem **56** with its head against the lower surface of the resilient ring **104**. This tubular member **108** extends into the cavity formed between the iron rings **98** and **100** where its lower end rests against a magnetic ring or bar **110**. Preferably this magnetic member is made of Alnico or a similar material. This magnetic disc or bar **110** is somewhat smaller in diameter or length than the internal diameter of the spacing ring **102** and has an opening through its center fitted to the valve stem **56**. The lower surface of the magnet rests against the end of a tubular spacer **112**, the opposite end of which passes through the center of the light coil spring **94** and bears against the back surface of the valve stem head **92**.

The lengths of the tubular spacing members **112** and **108** are such that when the valve disc **104** is spaced from the valve seat **46** an appropriate distance so that the valve is open, the magnet **110** rests against the top surface of the iron disc **100** and adheres thereto because of the magnetic attraction between these members. The valve therefore, is positively held open by the force of this magnetic attraction.

As the pressure in the bulb **26** rises with an increase in temperature, this increases the pressure within the chamber between the cup **32** and the bellows **80**, thereby compressing the bellows **80** so as to shorten the length of the stiff spring **90**. Eventually this spring is shortened sufficiently so that it develops a force just sufficient to push the magnet **110** away from the iron ring **100**. Inasmuch as the force exerted by a spring is a direct function of the amount of its compression, whereas magnetic attraction is a function of the square of the distance between the members forming the magnetic circuit, it will be apparent that as soon as the magnet **110** is pushed slightly away from the iron disc **100** the valve stem **56** will be thrown upwardly with a snap action. When the resilient valve disc **104** is brought against the valve seat **46** so as to seal the valve, the upper surface of the magnet **110** will be just short of contact with the top iron disc **98** with the result that both the magnetic attracion beween the members **110** and **98** and the pressure of the spring **90** will maintain the valve in tightly closed position. Even after the pressure in the bulb **26** subsequently decreases because of cooling, the elongation of the bellows **80** which follows will not cause the valve to open inasmuch as the forces due to lengthening of the spring **90** and the simultaneous compression of the light spring **94** will not be sufficient to overcome the magnetic attraction between the members **110** and **98**. The valve therefore remains closed after it has once been actuated.

At any time thereafter, such as after the difficulty which caused original operation of the valve has been corrected, an operator can depress the button **72**, thereby pushing the valve stem **56** downwardly to its original position, under which condition the magnet **110** will snap from its top position to one in contact with the iron ring **100** thereby reconditioning the valve for a new cycle of operation.

It should be noted that because of the bellows at each end of the valve stem, leakage around the valve stem to the outside is not possible even though the valve is free to move in an axial direction. It should also be noted that the valve acts positively in a snap action manner between its open and closed position and that when in the closed position it does not automatically reopen until an

operator has had an opportunity to investigate the situation and push downwardly upon the button **72**. Further it is evident that when the valve is in the closed position it is positively held tightly against its seat by the magnetic attraction between the members **110** and **98**.

It is desired that the valve be of the automatically resetting, snap acting type, the button **72** can be eliminated and the spring **94** strengthened, so that upon elongation of the bellows **80** a point will be reached where the compressed spring **94** will pull the magnet **110** away from the disc **98** and snap it into engagement with the lower disc **100**, thereby opening the valve.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States is:

1. In a snap acting valve, a valve body having inlet and outlet passages formed therein with a valve seat providing communication between said passages, a valve member movable toward and away from said seat to close and open said valve, a valve stem carrying said valve member and mounted for axial movement, resilient means for biasing said valve stem for axial movement in one direction or the other, depending upon the position of said resilient means, an actuator for positioning said resilient means to determine the direction and amount of bias, said actuator including a corrugated metal bellows enclosing said resilient means and one end of said valve stem and said bellows acting to center said resilient means and said one end of said valve stem, a magnetic member carried by and movable with said valve stem, a member of magnetic permeability positioned to be in contact with said magnetic member when said valve is in open position and to exert a magnetic force on said valve stem to hold said valve stem in open position, a second member of magnetic permeability so positioned as to be immediately adjacent said magnetic member when said valve is in closed position and to exert a magnetic force on said valve stem to hold said valve stem in closed position, means including a second corrugated metal bellows for enclosing the other end of said valve stem and for centering said other end of said valve stem, and means available to an operator exteriorly of the last said bellows for moving the end of the last said corugated metal bellows so as to push said valve stem from one end of its stroke to the opposite end thereof.

2. In a snap acting valve, a valve body having inlet and outlet passages formed therein with a valve seat providing communication between said passages, a valve member movable toward and away from said seat to close and open said valve, a valve stem carrying said valve member and mounted for axial movement, resilient means for biasing said valve stem for axial movement in one direction or the other, depending upon the position of said resilient means, said resilient means floating freely with said valve stem, an actuator for positioning said resilient means to determine the direction and amount of bias, means for moving said actuator in opposite directions, a magnetic member carried by and movable with said valve stem, a second magnetic member having an attraction for the first magnetic member and positioned to be in contact with said first magnetic member when said valve is in open position so as to exert a magnetic force on said valve stem to hold said valve stem in open position, and a third magnetic member adapted to have an attraction for said first magnetic member and so positioned as to be immediately adjacent said first magnetic member when said valve is in closed position.

3. In a snap acting valve, a valve body having inlet and outlet passages formed therein with a valve seat providing communication between said passages, a valve member movable toward and away from said seat to close and open said valve, a valve stem carrying said valve member and mounted for axial movement, comparatively strong resilient means for biasing said valve stem for axial movement in a direction to close said

valve, comparatively weak resilient means for biasing said valve stem in an opposite direction so as to maintain said valve stem under the influence of said strong resilient means, an actuator for moving both said resilient means together, a magnetic member carried by and movable with said valve stem, a member of magnetic permeability positioned to be in contact with said magnetic member when said valve is in open position and to exert a magnetic force on said valve stem to hold said valve stem in open position against the influence of both said resilient means until both said resilient means have been moved together to a predetermined compressed position, and a second member of magnetic permeability so positioned as to be immediately adjacent said magnetic member when said valve is in closed position, said second member of magnetic permeability exerting a magnetic force on said

valve stem sufficient to overcome the force developed by said weak resilient member when said weak resilient member is compressed, and manual means for moving said valve stem in a direction for opening said valve.

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