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M. W. HUBER

2,277,491

VALVE STRUCTURE

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Fig. 1

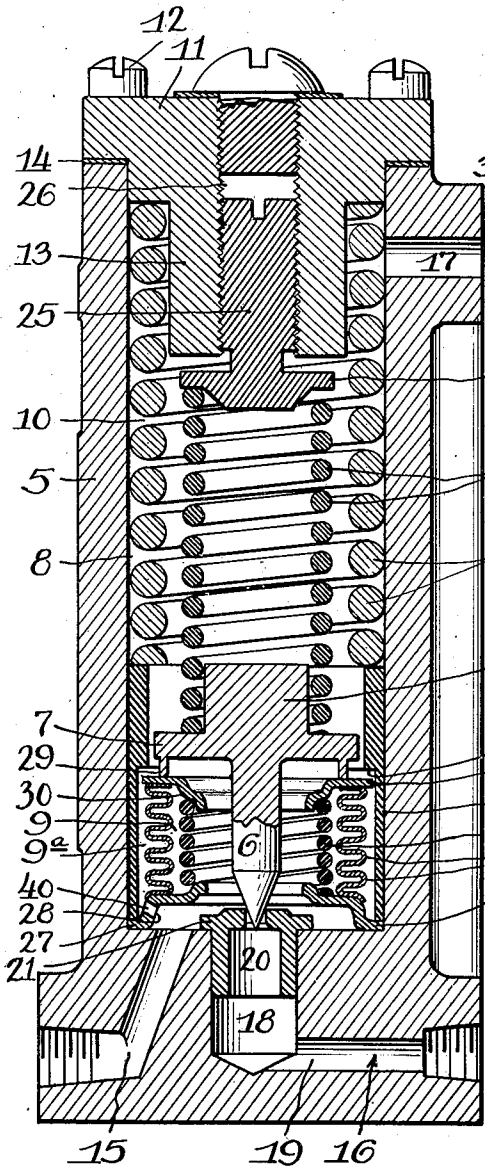


Fig. 2

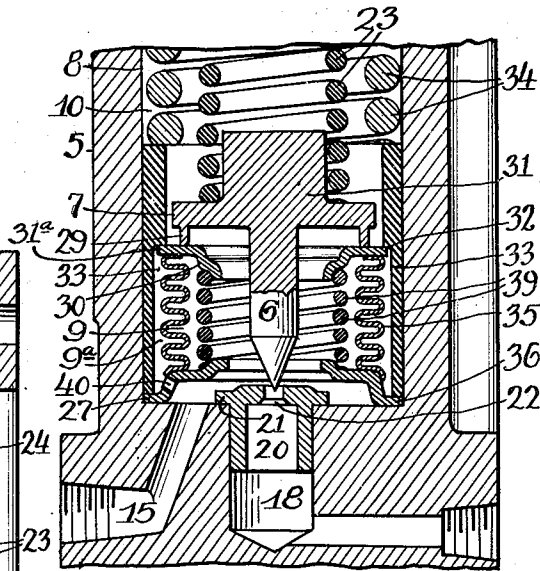
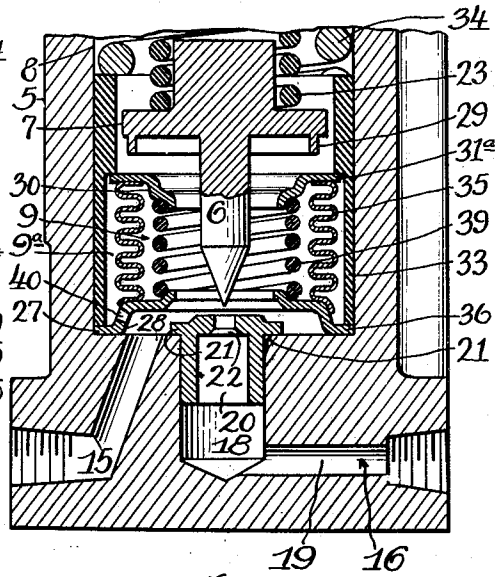


Fig. 3



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UNITED STATES PATENT OFFICE

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VALVE STRUCTURE

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8 Claims. (Cl. 137—153)

This invention relates to improvements in valve structures especially designed for controlling the outflow of liquid under pressure from pumps and maintaining a uniform pressure in a supply line, as for instance in the nozzle of an oil burner.

The present invention is directed more specifically to the type of pressure valve mechanism broadly disclosed in my co-pending application for valve structure filed January 26, 1940, and bearing Serial No. 315,789, and has for its principal object to provide an improved arrangement of purging orifice for valve structures of the character therein disclosed so as to insure a quick or sharp cut-off action of the valve.

A further object of the invention is to provide a structure wherein the purging orifice is arranged to afford direct communication between the interior and exterior of the bellows member which forms a yieldable mounting for the by-pass valve seat, so as to relieve the walls of said bellows member of excessive hydrostatic pressure and assist in the proper functioning of the by-pass valve mechanism. Other objects of the invention will appear from time to time as the following description proceeds.

The invention may best be understood by reference to the accompanying drawing, in which

Fig. 1 is a longitudinal section of a valve structure embodying the invention, the needle and by-pass valves being shown in their closed position, that is, the position in which they are disposed when the pump with which the structure is associated is not in operation and as a result there is no inflow of pumped liquid into the pressure chamber.

Fig. 2 is a fragmentary section showing the structure immediately after starting of the pump, that is, with the needle valve in its open position but the by-pass valve closed.

Fig. 3 is a similar fragmentary section showing both valves in their open position as the result of normal operation of the pump with which the structure is associated.

The embodiment of the present invention illustrated in the drawing is shown as applied to a valve structure, the main elements of which are substantially the same as those disclosed in my co-pending application, Serial No. 351,789 above referred to. Although the particular feature of novelty of the present invention relates to the location of the purging orifice, the invention will best be understood by first describing the main elements of the valve structure to which it is applied.

In the drawing, the valve structure is enclosed in the vertically elongated casing 5 having a bore 8 therein with a liquid inlet 15 and a supply outlet 16 at the bottom thereof and a by-pass outlet 17 adjacent the top. The valve structure is primarily designed for use with a liquid pump (not shown) such as is used for supplying fuel oil to the nozzle of an oil burner, said pump having suitable connection to the inlet 15, and the oil burner nozzle being suitably connected to the supply outlet 16. As usual, the by-pass outlet 17 may have connection with a return line to the fuel supply tank.

The supply outlet 16 is controlled by a needle valve member 6 which engages a seat member 20 having a head 21 with an orifice 22 there-through. Said seat member is fitted in a bore 18 formed concentric with the main bore 8 of casing 5 and communicating through the laterally extending duct 19 to the supply outlet 16.

The needle valve member 6 is herein shown as being integrally connected to a head or plate member 7 which forms the closure member of the by-pass valve structure, as will presently be more fully described. A coiled compression spring 23 engages the upper face of head 7 which is provided with an upstanding integral boss 31 for retaining the lower end of said coiled spring. The upper end of said spring is seated against a head-like enlargement 24 in the lower end of an adjusting screw 25 for controlling the compression of spring 23. As shown in Fig. 1, said adjusting screw is threaded in a hole 26 formed within a reduced portion 13 of a cap 11 which forms a closure for the upper end of the casing 5. The cap 11 is suitably secured on the casing as by bolts 12. A gasket 14 may be interposed as usual between the cap and the top face of the casing.

Referring now to the by-pass valve structure including the head 7, the latter consists of an extended flat plate having an annular depending flange 29 adapted to be seated in abutting engagement with the upper face of a valve seat member 30. Said seat member is mounted for vertical yielding movement on the upper end of a diaphragm or bellows member 35 which surrounds the needle valve stem 6.

The bellows member 35 is suitably fixed at its lower end within the casing so as to define a chamber 9 within said bellows member below the by-pass valve plate 7. In the form shown herein, the lower end of said bellows member is welded or otherwise connected by a suitable liquid-tight joint to a ring-shaped disc 36 having

a projecting skirt 27 at its bottom which is anchored to the bottom of the bore 8 by pressure of the lower end of a sleeve 33, as will hereinafter more fully appear. A portion of the disc 36 immediately adjacent the projecting skirt 27 is dished upwardly to the point where it is connected to the lower end of the bellows member 35 so as to form an annular side wall portion 28. A coil compression spring 39 is disposed within the bellows member 35 between the valve seat 30 and the disc 36. This spring is lighter than the control spring 23 and operates in opposed relation thereto.

The bottom end of the sleeve 33 presses the flanged skirt 27 of the disc 36 into liquid-tight engagement against the lower end of the bore member 8. Said sleeve extends upwardly to a point substantially above the by-pass valve 7, and is held in place by a relatively heavy retaining spring 34 which surrounds the valve control spring 23 and the reduced part 13 of cap 11. The retaining spring 34 abuts the head of said cap and is maintained under substantial compression thereby when the cap is normally in place on the casing.

The sleeve 33 also has a downwardly facing annular shoulder 32 formed on the inner face thereof normally spaced slightly above the valve seat member 30, but arranged to limit the upward movement of the latter when the pressure from below the valve seat member 30 reaches a predetermined value, as will presently be more fully described. The sleeve 33 is spaced from the side wall of the bellows member 35 so as to form an annular chamber 9^a surrounding the latter.

The by-pass valve plate 7 is spaced from the inner wall of sleeve 33 as indicated in the several figures, so that when said valve plate is in open position relative to its valve seat, liquid may flow freely around its outer margin and into the by-pass chamber 10 for escape through the by-pass outlet 17.

Referring now more particularly to the novel features of the present invention, I provide one or more purging orifices 40 each consisting of a relatively small fixed aperture so disposed as to afford direct communication between the interior and exterior of the bellows member 35 at a point below the valve seat member 30. As shown herein, one such orifice is provided, consisting of an aperture of fixed size formed in the upstanding side wall portion 28 of the disc 36. The arrangement is such that the purging orifice 40 affords direct communication between the interior of the bellows member and the annular chamber 9^a which surrounds said bellows member. This annular chamber 9^a has communication with the main by-pass port 17 through the annular passage between the outer flange 31^a of valve seat 30 and the overhanging shoulder 32 on the sleeve 33. The arrangement is such, however, that when the outer rim 31 of valve seat 30 comes into engagement with the overhanging shoulder 32, communication between the purging orifice 40 and the by-pass outlet 17 is cut off.

The general operation of the valve structure above described is as follows: When the pump with which the valve structure is associated is not in operation so that there is no pressure in the chamber 9, the needle valve 6 and the by-pass valve 7 are maintained in their closed positions as shown in Fig. 1, under pressure of the control spring 23. When the pump is started, sufficient pressure is built up in the chamber 9 to exert pressure on the under face of the by-

pass valve 7, so as to cause said by-pass valve together with the needle valve 6 to move upwardly together in unison against the pressure of spring 23. During the initial upward movement of the two valve members, however, only the needle valve 6 is opened, because the valve seat 30 acting under the yielding tension of bellows member 35 and the coiled spring 39 therein, follows the by-pass valve member 7 upwardly until the outer flange 31 of valve seat 30 comes into engagement with the fixed shoulder 32 on sleeve 33 so as to limit further upward movement of said valve seat member.

Any further increase in pressure acting on the under face of the by-pass valve member 7 will unseat the flange 29 of the latter relative to the valve seat 30 and permit direct escape of excess liquid through the by-pass valve 7 into the by-pass chamber 10. When the pump stops or pressure is otherwise reduced within the chamber 9, the compression spring 23 moves the by-pass valve head downwardly, and the flange 29 is first brought into engagement with the valve seat 30 to close the by-pass valve. A further reduction of pressure then permits continued downward movement of the two valve members, together with the seat member 30 under yielding action of the bellows member 35 and spring 39, until the needle valve 6 becomes closed.

Referring more particularly to the purging action effective through the purging orifice 40 during the operation of the valve structure above described, it will be observed that when liquid is initially introduced in the chamber 9, any air or gases in the liquid may escape through the orifice 40, outer chamber 9^a, by-pass chamber 10, and port 17. Such purging action is effective, however, only while the valve seat member 30 is being extended upwardly, and ceases when the outer flange 31^a of said valve seat member contacts with the shoulder 32 on the sleeve 33. In other words, when the outer flange 31^a engages the shoulder 32, further communication between the purging orifice 40 and the by-pass outlet 17 is cut off. Nevertheless, while so cut off from the by-pass outlet, communication is maintained through the orifice 40 between the chamber 9 within the bellows member and the chamber 9^a surrounding the bellows member so as to maintain substantially equal pressure on opposite sides of the bellows walls. The pressure in the outer chamber 9^a is directly effective upon the outer flange 31^a of the valve seat member 30 so as to assist in maintaining said valve member in closed position against the shoulder 32 and resist any fluttering tendency of the latter while the liquid is escaping through the by-pass valve 7 from the inner chamber 9.

When excessive pressure on the by-pass valve 7 is relieved so that it is closed against the valve seat 30 by action of spring 23, further closing movement of both valve members causes the outer flange 31^a of the valve seat member to move away from the shoulder 32. As soon as this occurs, any excess pressure in the chamber 9^a is suddenly released, and communication is re-established between the purging orifice 40 and the by-pass outlet 17 so as to cause a quick closing of the needle valve 6.

It will thus be observed that the outer flange 31^a and shoulder 32 operate both as a limiting means for the by-pass valve seat 30 and as an auxiliary means for closing the outer chamber 9^a. It will be observed further that the purging orifice 40 communicates with the chamber 9^a be-

low the outer flange 31* so as to equalize the pressure effective on opposite sides of the expansible side walls of the bellows member 35 at all times, and particularly when the pressure within the bellows member is relatively high and the liquid is being by-passed through valve 7. Thus the side walls of the bellows member are relieved of any excessive pressure from within, which might tend to bulge them outwardly or otherwise interfere with the endwise yielding movement of the valve seat 30 as it follows the by-pass valve member 7 under pressure of the spring 23.

Although I have shown and described one particular embodiment of my invention, it will be understood that I do not wish to be limited to the exact construction shown and described, but that various changes and modifications may be made without departing from the spirit and scope of my invention as defined in the appended claims.

I claim as my invention:

1. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a supply expansible bellows member in said casing, with one end enclosing said inlet and supply outlet to define an expansible chamber, said bellows member also having a by-pass valve seat at the other end mounted for movement toward and away from said supply outlet and affording communication with said by-pass outlet, a valve member for said by-pass outlet valve seat and a valve member for said supply outlet movable with said by-pass valve member, said expansible chamber having a purging orifice independent of said by-pass valve member affording direct communication between the interior and exterior of said chamber tending to equalize the pressure effective on opposite sides of the expansible side walls of said bellows member.

2. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a supply expansible bellows member in said casing, with one end enclosing said inlet and supply outlet to define an expansible chamber, said bellows member also having a by-pass valve seat at the other end mounted for movement toward and away from said supply outlet and affording communication with said by-pass outlet, a plate valve member for said by-pass outlet valve seat directly responsive to pressure in said expansible chamber, a needle valve member for said supply outlet movable with said plate valve member, said expansible chamber having an orifice disposed between said inlet and said by-pass valve seat and affording direct communication between the interior and exterior of said bellows member tending to equalize the pressure effective on opposite sides of the expansible walls of said bellows member.

3. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a supply expansible bellows member in said casing with one end enclosing said inlet and outlet and with its sides spaced from said casing so as to define interior and exterior chambers, said bellows member having a purging orifice affording direct communication between said interior and exterior chambers tending to equalize the pressure effective in said chambers, said bellows member also having a by-pass valve seat at its free end mounted for movement relative to said supply outlet and affording communication with said by-pass outlet from said interior chamber, a plate valve member coacting with said by-pass valve seat and directly responsive to pressure within

said interior chamber, and a needle valve member for said supply outlet movable with said plate valve member.

4. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a yieldable bellows member in said casing with one end enclosing said inlet and supply outlet and with its sides spaced from said casing so as to define interior and exterior chambers, said bellows member having a purging orifice therein affording direct communication between said interior and exterior chambers, said bellows member also having a by-pass valve seat at one end movable relative to said supply outlet and affording communication with said by-pass outlet from said interior chamber, a plate valve member coacting with said by-pass valve seat and directly responsive to pressure within said interior chamber, a needle valve member for said supply outlet movable with said plate valve member, and valve means movable with said bellows member adapted to cut off communication between said exterior chamber and said by-pass outlet when said bellows member is in a predetermined extended position.

5. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a supply extensible bellows member in said casing with one end enclosing said inlet and supply outlet and with its sides spaced from said casing so as to define interior and exterior chambers, a by-pass valve seat on the opposite extensible end of said bellows member affording communication between said interior chamber and said by-pass outlet, a valve member for said by-pass valve seat directly responsive to pressure within said interior chamber, a valve member for said supply outlet movable with said by-pass valve member, said interior chamber having a purging orifice communicating directly with said exterior chamber, and an auxiliary valve member carried on the extensible end of said bellows member adapted to limit the expansion of the latter relative to said casing and control communication between said exterior chamber and said by-pass outlet when the pressure on said by-pass valve member reaches a predetermined value.

6. In a valve structure, a casing having an inlet, a supply outlet and a by-pass, a yieldable bellows member in said casing with one end enclosing said inlet and supply outlet and with its sides spaced from said casing so as to define interior and exterior chambers, said bellows member also having a by-pass valve seat at one end mounted for movement relative to said supply outlet and affording communication with said by-pass from said interior chamber, a plate valve member for said by-pass valve seat, a needle valve member for said supply outlet movable in unison with said plate valve member, means affording limited direct communication between said interior and exterior chambers, and means for limiting the movement of said by-pass valve seat relative to said supply outlet, said limiting means also controlling communication between said exterior chamber and said by-pass.

7. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, a supply expansible bellows member defining interior and exterior chambers in said casing, both having communication with said inlet and supply outlet, two valve means on the expansible bellows member respectively controlling communication between said by-pass outlet and one of said chambers, one of said valve means being arranged to

be opened when the other valve means is closed, and vice versa, and a third valve means controlling said supply outlet and movable with the valve means controlling communication between the interior chamber and the by-pass outlet.

8. In a valve structure, a casing having an inlet, a supply outlet and a by-pass outlet, an expansible bellows member defining interior and exterior chambers in said casing, both having communication with said by-pass outlet, the interior chamber also having communication with said inlet and supply outlet, and said interior chamber having limited direct communication with said exterior chamber, two valve means on the expansible bellows member, one of which

5 valve means operates to close communication between said exterior chamber and said by-pass outlet by limited extensible movement of said bellows, the other of said valve means having a third valve means movable therewith for controlling said supply outlet, said second valve means operating to establish communication between said interior chamber and said by-pass outlet when said first named valve means is closed, and to be closed when said first named valve means is opened, whereby accumulated pressure in said outer chamber is quickly released by the opening of the first valve means to facilitate rapid closing of said third valve means.

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