

July 3, 1928.

1,676,084

C. N. FLAGG

COMBINATION FLOAT AND DIAPHRAGM VALVE

Filed May 9, 1927

2 Sheets-Sheet 1

*Fig. 1.*

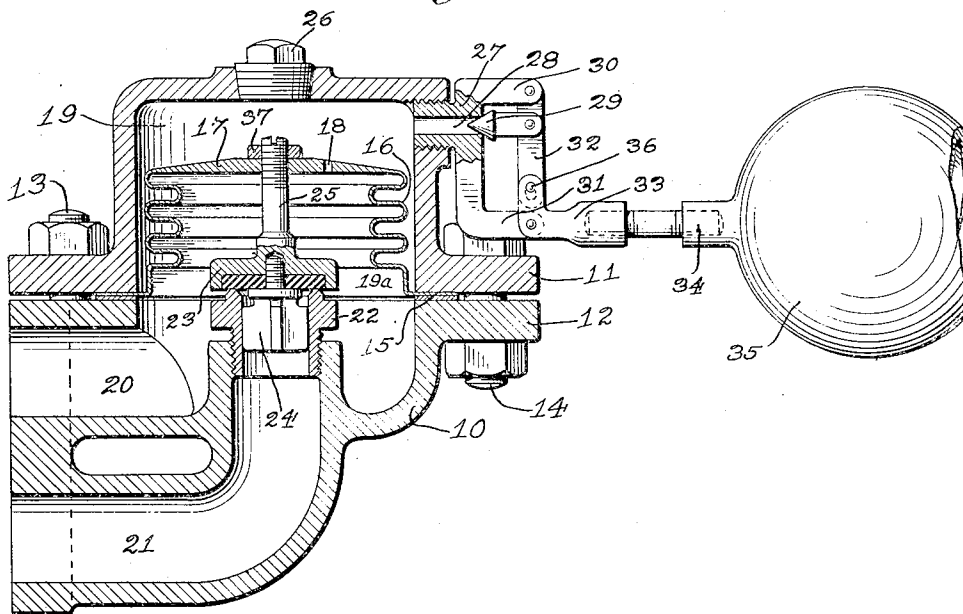
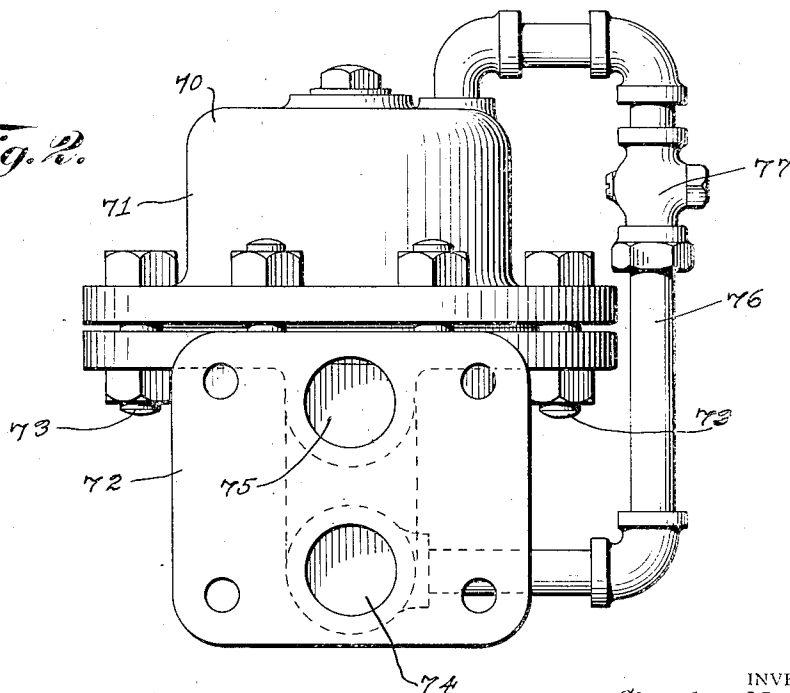


*Fig. 2.*



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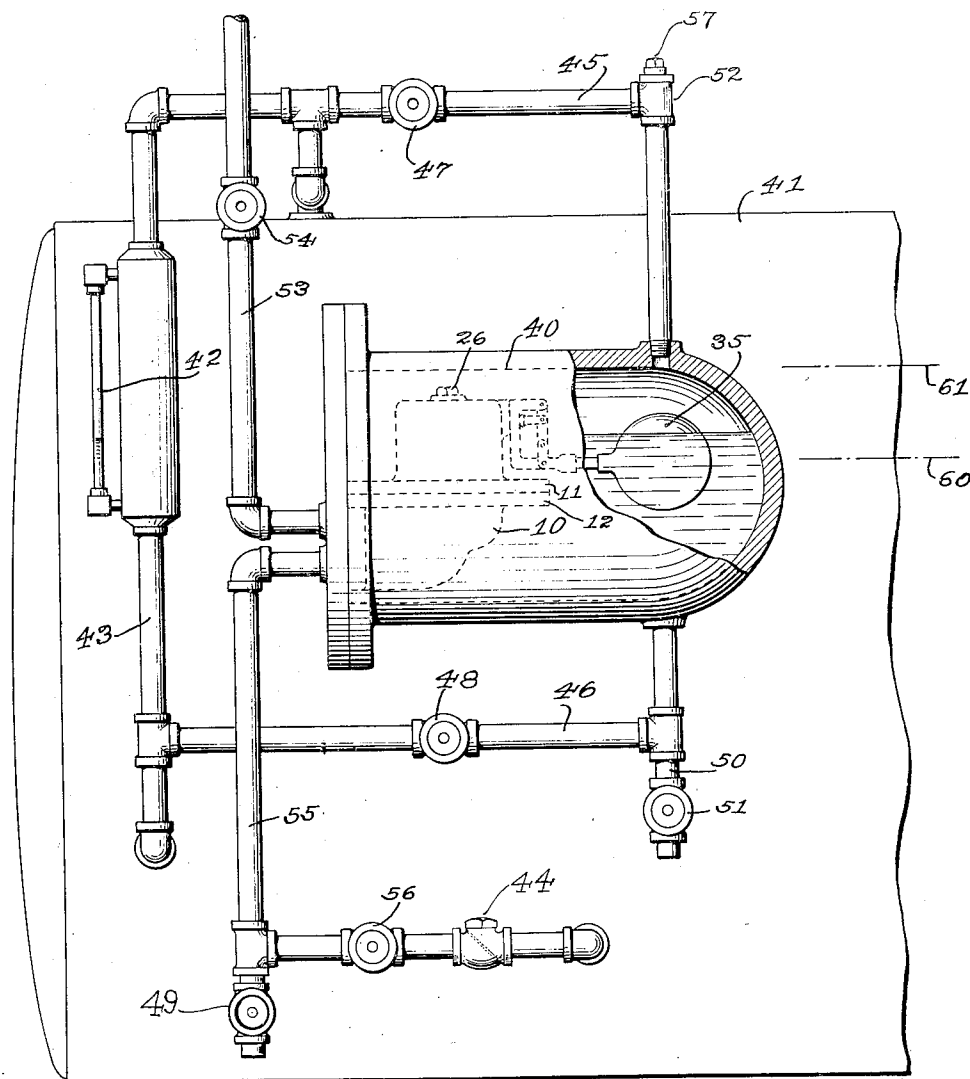
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*Fig. 3.*



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## UNITED STATES PATENT OFFICE.

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## COMBINATION FLOAT AND DIAPHRAGM VALVE.

Application filed May 9, 1927. Serial No. 189,808.

This invention relates to a liquid level control device, and more particularly to a combination float and diaphragm valve designed to regulate the flow of liquid from a source of liquid supply into a reservoir or vessel having a lower pressure, such as a heating boiler.

One object of this invention is to provide a liquid level control device of the above nature having a main liquid control valve which is adapted to operate intermittently and positively in such a manner that it is either fully open, fully closed, or opening or closing, but never remains stationary at a balanced partially-open position, thereby entirely avoiding wire drawing.

A further object is to provide a level-control device of the above nature employing a diaphragm valve which will be automatically operated by the pressure of the source of liquid supply under the control of a float-operated relief valve.

A further object of the invention is to provide a device of the character described which may be readily tested and wherein the several operating parts are at all times readily accessible for inspection or repair.

A further object is to provide a device of this nature which is of relatively simple construction, inexpensive to manufacture, easy to install and manipulate, compact, and efficient and durable in use.

With these and other objects in view there have been illustrated on the accompanying drawings two forms in which the invention may be conveniently embodied in practice.

Fig. 1 is a sectional view of a portion of the first form of the invention, showing the relative arrangement of the diaphragm-operated main control valve and float-operated relief valve.

Fig. 2 is a side view in elevation of a modified form of the invention having an outside by-pass.

Fig. 3 is an elevational view partly in section, illustrating the first form of the invention as it appears when connected to a heating boiler of conventional type, and showing one arrangement of connecting pipes.

*Description.*

Referring now to the drawings, in which like reference numerals denote corresponding parts throughout the several views, the numeral 10 indicates generally a valve body

or casing preferably formed of separate castings 11 and 12 firmly secured together as by bolts 13 and 14. The edges of the castings 11 and 12 clamp the periphery 15 of a convoluted diaphragm 16 having a plate 17 at its upper end, said plate 17 being provided with a by-pass opening 18 for a purpose to be hereinafter explained.

The space 19 above the diaphragm 16 will hereinafter be called the "control chamber", while the space 19<sup>a</sup> below the diaphragm will be termed the "main chamber". The main chamber 19<sup>a</sup> is provided with an inlet passage 20 and an outlet passage 21 separated by an adjustable valve seat 22 with which a control valve 23 cooperates to open and close the communication between the inlet and outlet passages. The control valve 23 may be provided with a facing of soft metal or other suitable material for insuring proper contact with the valve seat 22, and a depending valve guide 24 may be provided on said control valve 23 for insuring correct seating thereof at all times. The control valve 23 has an upwardly extending stem 25 which may be threaded into the plate 17 and secured thereto, as by a nut 37.

A removable plug 26 is inserted in the casing 10 directly above the valve stem 25 whereby the valve 23 may be adjusted whenever desired without making it necessary to entirely dismantle the casing. A relief valve block 27 is threaded within an opening formed in the casing of the control chamber 19, and said block 27 is provided with an opening 28 communicating with the control chamber 19. The opening 28 is made considerably larger than the by-pass opening 18 and is adapted to be closed by a relief valve 29.

The relief valve block 27 is provided with spaced arms 30 and 31, to which are pivoted respectively a lever arm 32, carrying the relief valve 29, and an elbow lever 33. One arm 34 of the elbow lever 33 carries a float 35, and the other arm of said elbow lever 33 is loosely pivoted to the lever arm 32 as at 36.

If desired, the apparatus shown in Fig. 1 may be enclosed within a float chamber 40 (Fig. 3) separate from the liquid reservoir, such as a boiler 41. In such case, 42 designates the usual water gauge carried by a pipe 43 having connections with the boiler 41 both above and below the water level. The float chamber 40 is similarly connected

with the boiler 41 above and below the water level by means of pipes 45 and 46, which are provided with hand-operated valves 47 and 48 respectively, whereby the water level in the float chamber 40 will normally be the same as the water level in the boiler 41 but may be made independent thereof by closing the valves 47 and 48.

In order to draw off the water from the float chamber 40 whenever desired, provision is made of a drain 50 controlled by a valve 51. A liquid feed pipe 53 connects with the inlet passage 20 in the valve casing 10 and is provided with a hand-operated valve 54, while a pipe 55 connects the outlet passage 21 of the casing 10 with the boiler 41 adjacent the lower portion of the boiler, and this pipe is provided with a hand-operated valve 56 and a hand-operated test valve 49. The ordinary limits of the water level in the boiler 41 are indicated by the dotted lines 60 and 61. A check valve 44 is employed to prevent the possibility of back flow of water from the boiler 41 in case the hand-operated valve 56 should be inadvertently left open. The pipe 45 is also provided with a T 52 having a detachable screw plug 57 for testing purposes.

It will be understood that while the valve body or diaphragm chamber has been herein disclosed located within a float chamber separate from the reservoir, it is within the spirit and scope of the invention to install said valve body directly within the reservoir, in which case the float would lie in the main body of liquid therein.

#### Operation.

The operation of the device shown in Figs. 1 and 3, assuming the valves 47, 48, 54, and 56 to be open, is as follows:

When the liquid in the boiler 41 falls below the predetermined level 60, the float 35 will fall, opening the relief valve 29 which will reduce the pressure in the control chamber 19. The unbalanced pressure of the water in the main chamber will then lift the valve 23 from its seat 22, since the area of the plate 17 greatly exceeds the area of the control valve 23. Communication between the inlet 20 and the outlet 21 will thus be established and water will flow into the boiler 41, causing the level therein to rise. When the liquid in the boiler 41 has risen to the predetermined level 61, the float 35 will cause the relief valve 29 to close. The pressure in the control chamber 19 will then be equalized with that in the main chamber 19<sup>a</sup> by the flow of liquid through the by-pass 18, whereupon the control valve will close. The above-described operation will continue indefinitely.

#### Testing.

Whenever it is desired to determine

whether the device as illustrated in Fig. 3 is functioning properly, it will only be necessary to close the valves 47, 48, and 56, thereby disconnecting the boiler 41. To test whether the main control valve 22 is leaking, the valve 49 will be opened, and a continued flow of water therefrom will then indicate a leak.

To find out whether the control valve 23 is properly functioning in response to the lowering of the level of the liquid in the float chamber, the valve 51 will be opened to permit the escape of part of the liquid from the float chamber. The float 35 will thereby be caused to drop and open the relief valve 29, allowing liquid to flow out through the passage 28 and reducing the pressure in the control chamber 19. The overbalancing pressure under the diaphragm 16 should then force the main control valve 22 up from its seat 23 and open communication between the inlet and outlet. If the device is properly operating, this will be indicated by a flow of water out through the valve 49.

To determine whether the control valve is being closed properly by the float 35 when the level of liquid in the reservoir or boiler 41 rises, the valve 51 will be then closed and the valves 47 and 48 will be opened thus again establishing connection with the boiler 41. Liquid will then flow from the boiler into the float chamber causing the liquid therein to rise to its normal level, thereby raising the float 35 and closing the relief valve 29. Water will then flow from the main chamber 19<sup>a</sup> through the by-pass opening 18 in the plate 17 into the control chamber 19, until the pressure on both sides of the diaphragm 16 is equalized and permitting the control valve 23 to automatically close and shut off the flow of water from the valve 49.

In the form of the invention illustrated in Fig. 2 of the drawings, the casing 70 is formed of upper and lower sections 71 and 72 secured together as by bolts 73, similar to the corresponding parts shown in Figs. 1 and 3. In fact, the construction of this form of the device is the same as that of the first form, except that the by-pass opening 18 in the plate 17 is omitted, the relative location of the inlet and outlet passages is reversed so that 74 becomes the inlet passage and 75 the outlet passage, and a small by-pass tube 76 is provided to connect the inlet passage 74 with the control chamber 19 above the diaphragm valve. The tube 76 is also provided with an adjustable valve 77 for varying the rate of flow of liquid from the inlet passage 74 to the control chamber.

The operation of the modified form of the invention shown in Fig. 2 will be the same as that above described, except that when

the relief valve closes, the pressure will equalize through the external by-pass, and because the area of the diaphragm plate 17 is very much in excess of the area of the control valve 22, the latter will be positively forced to its seat.

This type of device will be especially useful in cases where it is desirable to have an extremely positive and absolutely reliable closing action of the valve, such as gasoline pump discharges, etc.

One advantage of the present invention is that in operation the control valve will allow a flow of liquid equal to the capacity of the pipe supplying the liquid.

A further advantage is that variations in temperature will not affect its operation, and it will operate satisfactorily on any liquid that can be made to flow through the valve ports, such as crude oil or other thick viscous liquids.

A further advantage is that no liquid will pass into the float chamber except that from the relief valve which is in such small quantities as not to cause any agitation or surging in the float chamber which would cause the valve to close prematurely.

A still further advantage is that the opening and closing movements of the control valve 23 will be quite rapid, thus eliminating the possibility of wire drawing and owing to the large area of the diaphragm compared to the main valve, the latter will always open positively without sticking even after long periods out of use.

While there have been disclosed in this specification two forms in which the invention may be embodied, it is to be understood that these forms are shown for the purpose of illustration only, and that the invention is not to be limited to the specific disclosures but may be modified and embodied in various other forms without departing from its spirit. In short, the invention includes all the modifications and embodiments coming within the scope of the following claims.

Having thus fully described the invention, what is claimed as new and for which it is desired to secure Letters Patent, is:

1. In a combination float and diaphragm valve, a float chamber, a float in said chamber, a casing having an inlet and an outlet, a valve in said casing for controlling the flow of liquid from said inlet to said outlet, a flexible diaphragm in said casing operatively connected to said control valve and dividing the interior of said casing into a main chamber and a control chamber, a bracket having a passage communicating with the interior of said casing, a relief valve for opening said passage to permit the escape of liquid for causing said main valve to open, said relief valve being operatively connected to said float.

2. In a combination float and diaphragm

valve, a float chamber, a float in said chamber, a casing having an inlet and an outlet, a valve in said casing for controlling the flow of liquid from said inlet to said outlet, a flexible diaphragm in said casing operatively connected to said control valve, a hollow bracket connected to said casing for supporting said float and having a passage communicating with the interior of said casing, a relief valve for opening said passage to permit the escape of liquid for causing said main valve to open, said relief valve being operatively connected to said float.

3. In a combination float and diaphragm valve, a float chamber, a float in said chamber, a casing having an inlet and an outlet, a valve in said casing for controlling the flow of liquid from said inlet to said outlet, a flexible diaphragm in said casing operatively connected to said control valve, a bracket member comprising a float support and a relief valve to permit the escape of liquid from said casing when the level of liquid in the float chamber falls to a predetermined point for causing said main valve to open.

4. In a combination float and diaphragm valve, a float chamber, a float in said chamber, a casing having an inlet and an outlet, a valve in said casing for controlling the flow of liquid from said inlet to said outlet, a flexible diaphragm in said casing operatively connected to said control valve and dividing the interior of said casing into a main chamber and a control chamber, means connected to said casing for supporting said float and including a relief valve to permit the escape of liquid from said casing when the level of liquid in the float chamber falls to a predetermined point for causing said main valve to open.

5. In an automatic feed-water regulator, a float chamber containing a float and communicating with a reservoir, a casing having an inlet and an outlet, a compact quick-acting bellows type diaphragm dividing said casing into a main chamber and a control chamber, a by-pass to equalize the pressure between said chambers, a main valve connected to said diaphragm for closing said outlet, a float-operated relief valve connected to said casing for reducing the pressure in said control chamber when the float falls to a predetermined level for causing said diaphragm to open said main valve.

6. In an automatic feed-water regulator, a float chamber containing a float and communicating with a reservoir, a casing having an inlet and an outlet, a compact quick-acting bellows type diaphragm dividing said casing into a main chamber and a control chamber, a by-pass to equalize the pressure between said chambers, a main valve connected to said diaphragm for closing said

outlet, a float-operated relief valve connected to said casing for reducing the pressure in said control chamber when the float falls to a predetermined level for causing said diaphragm to open said main valve, the full pressure of the inlet feed being exerted upon said main valve to normally keep it closed.

7. In an automatic feed-water regulator, a float chamber containing a float and communicating with a reservoir, a casing having an inlet and an outlet, a compact quick-acting bellows type diaphragm dividing said casing into a main chamber and a control chamber, a by-pass to equalize the pressure between said chambers, a main valve connected to said diaphragm for closing said outlet, a float-operated relief valve connected to said casing for reducing the pressure in said control chamber when the float falls to a predetermined level for causing said diaphragm to open said main valve, the full pressure of the inlet feed being exerted up-

on said main valve to normally keep it closed, said full pressure also being exerted on the underside of said diaphragm for quickly and positively opening said main valve.

8. In an automatic feed-water regulator, a float chamber containing a float and communicating with a reservoir, a casing having an inlet and an outlet, a compact quick-acting bellows type diaphragm dividing said casing into a main chamber and a control chamber, a by-pass to equalize the pressure between said chambers, a main valve connected to and enclosed by said diaphragm for closing said outlet, a float-operated relief valve connected to said casing for reducing the pressure in said control chamber when the float falls to a predetermined level for causing said diaphragm to open said main valve.

In testimony whereof, I have affixed my signature to this specification.

CHARLES N. FLAGG.