May 2, 1933. E. R. WILLIAMS 1,907,025

FLUID AND LIQUID CONTROL DEVICE FOR CONTAINERS

Filed Dec. 15, 1930 4 Sheets-Sheet 1

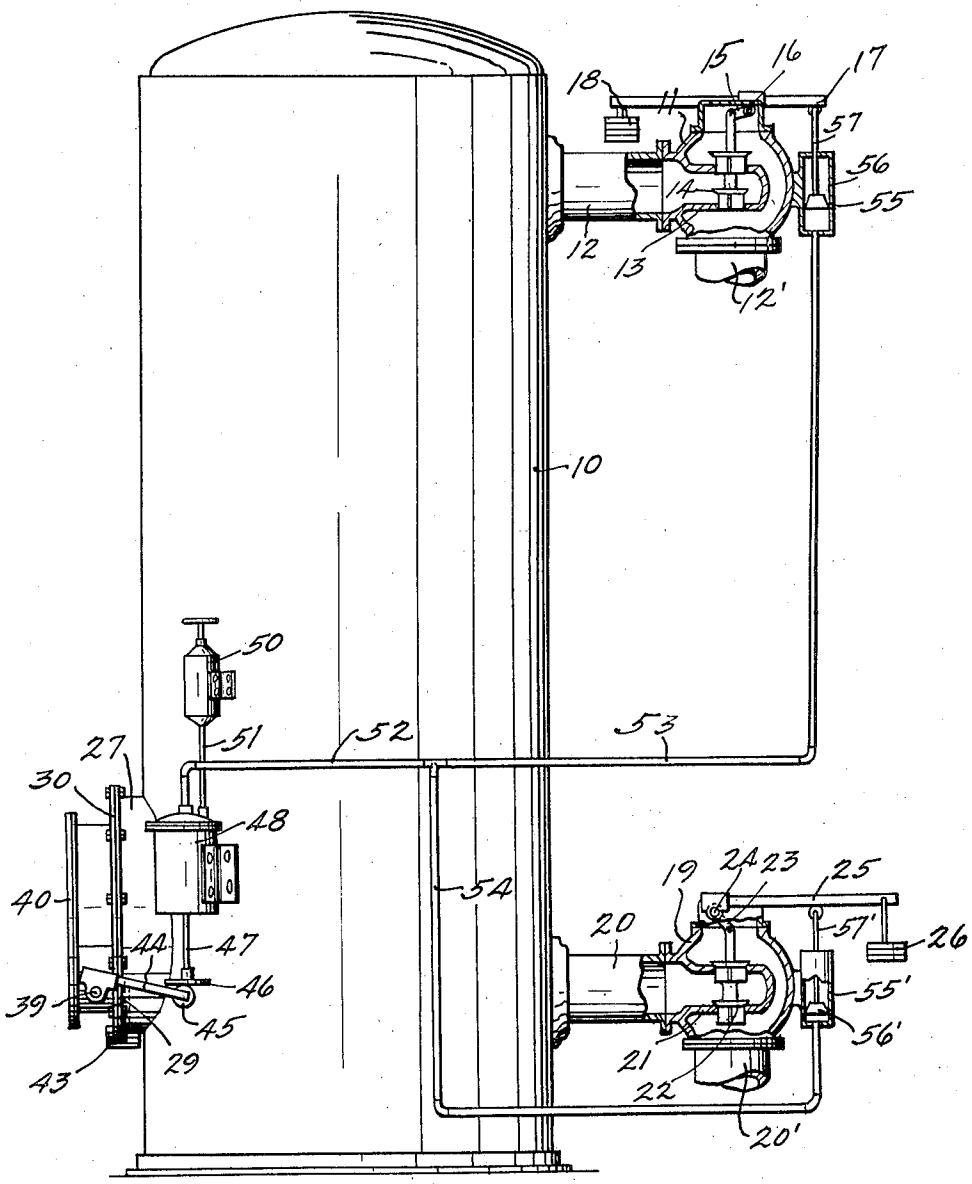


Fig. 1

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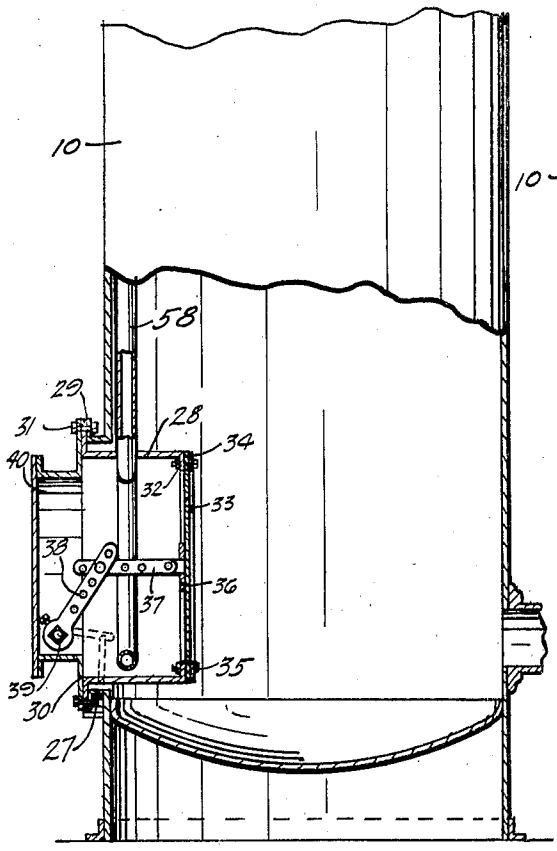


Fig. 2

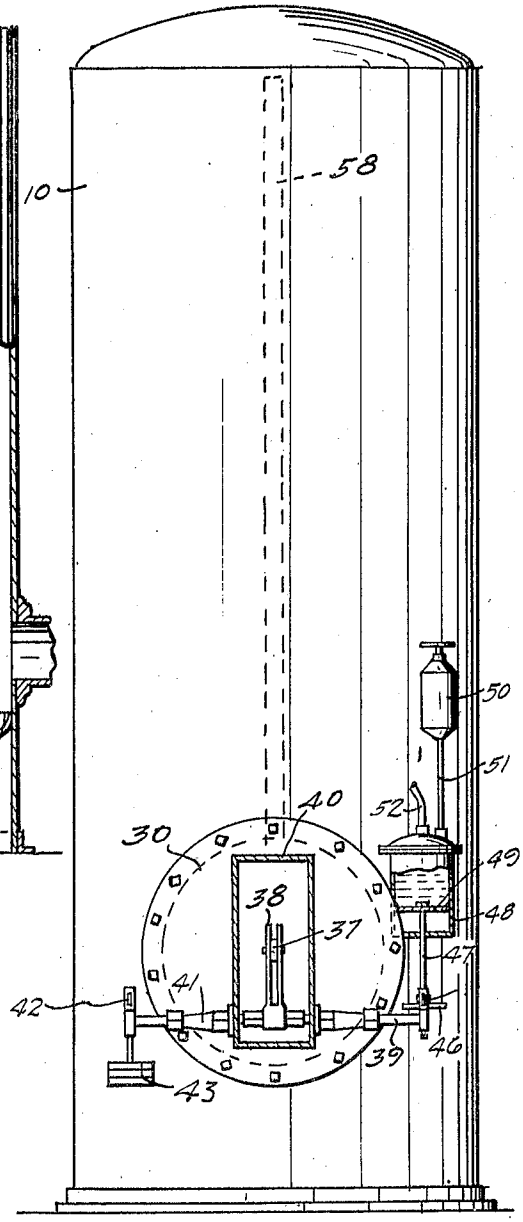


Fig. 3

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FLUID AND LIQUID CONTROL DEVICE FOR CONTAINERS

Filed Dec. 15, 1930 4 Sheets-Sheet 3

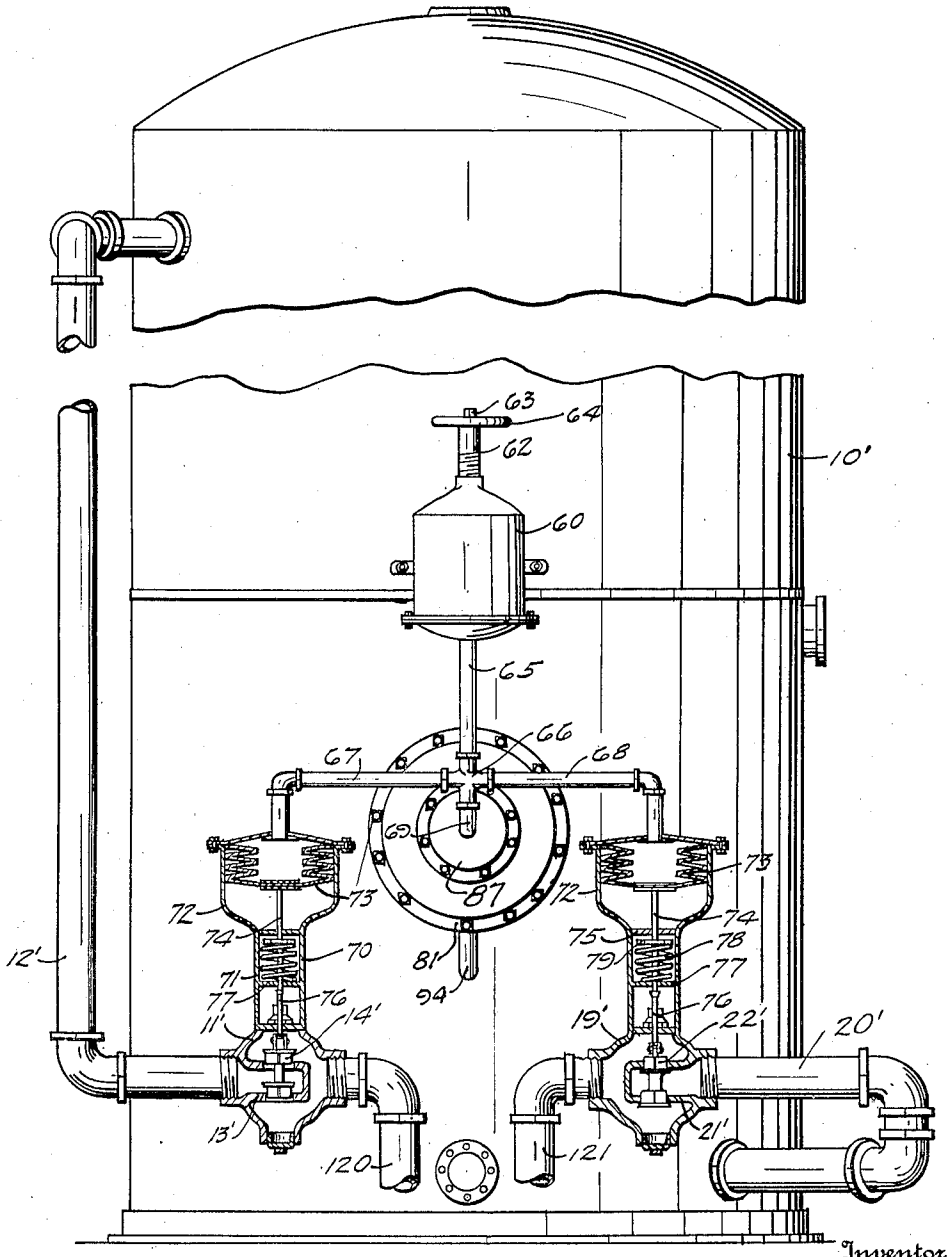


Fig. 4

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FLUID AND LIQUID CONTROL DEVICE FOR CONTAINERS

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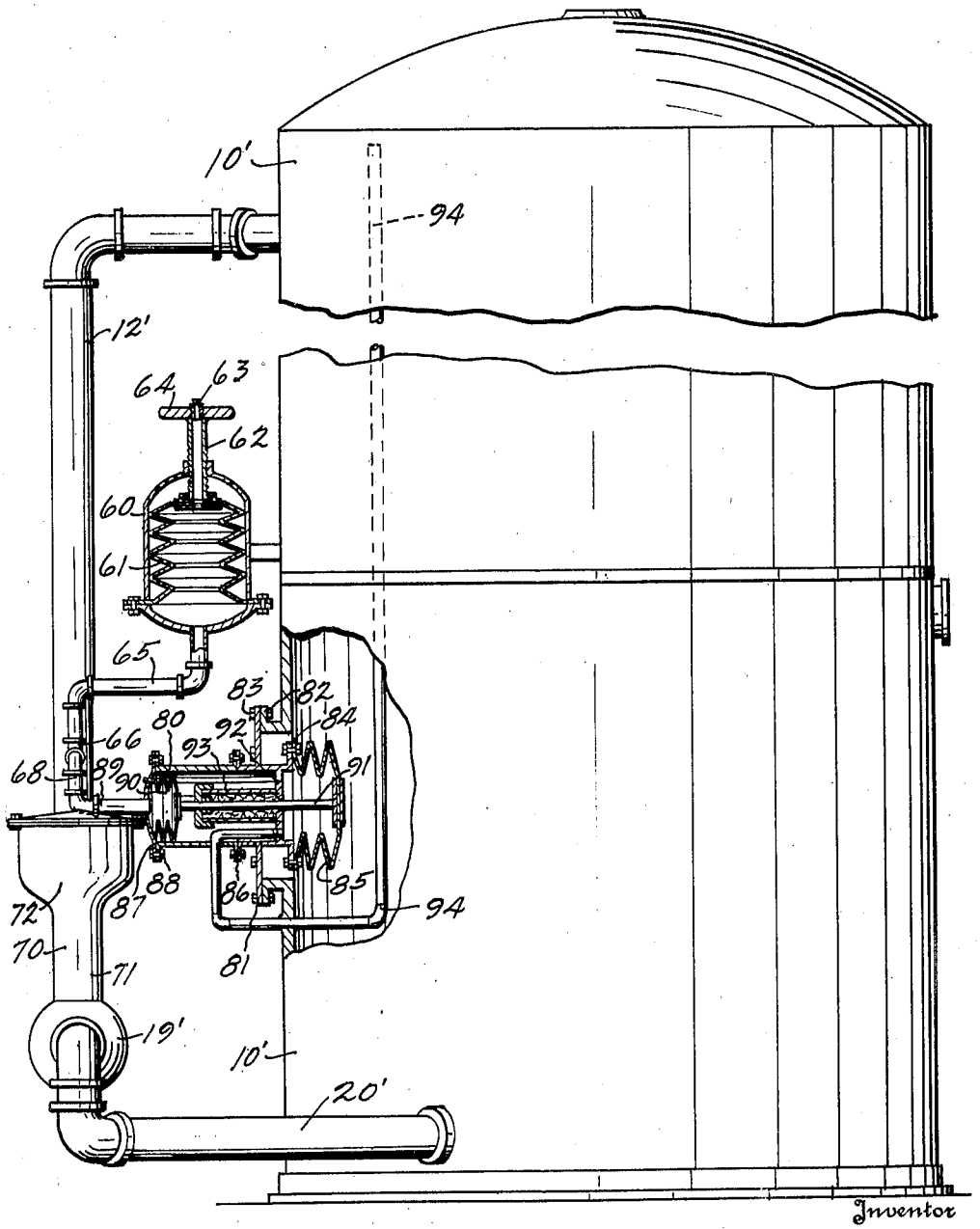


Fig. 5

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UNITED STATES PATENT OFFICE

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FLUID AND LIQUID CONTROL DEVICE FOR CONTAINERS

Application filed December 15, 1930. Serial No. 502,304.

This invention relates to new and useful improvements in fluid and liquid control devices for containers.

One object of the invention is to provide an improved fluid and liquid control wherein the outlet valves are operated by hydraulic pressure, rather than by levers or other mechanical elements.

A further object of the invention is to provide a diaphragm type of operator exposed to the weight of the liquid in the container and also equalized by the gas pressure, for operating means for displacing the hydraulic liquid and causing the actuation of the valves.

A construction designed to carry out the invention will be hereinafter described together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings in which an example of the invention is shown, and wherein:

Fig. 1 is an elevation of a container equipped with controlling means constructed in accordance with the invention,

Fig. 2 is a view of the lower portion of said container, partly in section and partly in elevation,

Fig. 3 is a similar view at right angles to Figure 2,

Fig. 4 is an elevation of a container equipped with a modified form of controlling means, parts of which are in section and parts in elevation, and

Fig. 5 is a view at right angles to Figure 4, parts being in elevation and parts in section.

In the drawings the numeral 10 designates a tank or container having a gas outlet valve housing 11 connected to its upper end by a short pipe 12. The gas valve is of the usual type having a bonnet 13 connected to the pipe 12 and receiving the valves 14, which are arranged to be opened by the pressure of the gas. It is customary to make the upper valve 14 larger than the lower valve as is indicated in Figure 1, so that the gas pressure will open the valves. The valves are suspended from a crank 15 carried by the rock shaft 16.

For counter-balancing the valves 14 a lever 17 is secured on the shaft outside of the housing and has weights 18 suspended from its outer end. These weights are sufficient to close the valves and hold them in such position against a predetermined gas pressure. An increase in the gas pressure will open the valves, while a decrease in pressure will permit the valves to partially or fully close. A gas discharge pipe 12′ leads from the housing.

A liquid outlet valve housing 19 is connected to the lower end of the tank by a short pipe 20. This valve is also of the usual type and has a bonnet 21 connected to the pipe 20. Valves 22 seat in the bonnet and are suspended from a crank 23 carried by a rock shaft 24 mounted in the top of the housing. A lever 25 is fastened at its inner end to the shaft and has a weight 26 suspended from its outer end. It will be noted that the pivoting of the liquid valve is opposite from that of the gas valve, so an upward swing of the outer end of the gas lever 17 closes the gas valves 14; while an upward swing of the lever 25 opens the liquid valves 22. A liquid discharge pipe 20′ leads from the bottom of the housing 19.

The tank 10 has a flanged manhole 27 and a drum 28 is inserted in this hole so as to extend into the tank. The drum has an outwardly directed flange 29 on its outer end engaging the flange of the manhole. A circular cover plate 30 is fitted over the outer end of the drums and bolts 31 fasten the drum flange and the cover to the manhole flange.

The drum has an inwardly directed annular flange 32 at its inner end for receiving a circular diaphragm 33 held on said flange by a retaining ring 34 and bolts 35. An ear 36 clamped to the inner side of the diaphragm within the drum is pivoted to one end of a link 37 which in turn is pivoted to the upper end of a crank arm 38 secured on a horizontal rock shaft 39 journaled in a hood 40 on the cover plate. The shaft extends through stuffing boxes 41 on each side of the hood (Figure 3).

A lever 42 is fastened on one end of the shaft and a counterbalancing weight 43 is suspended from the outer end of the lever.

The weight tends to rock the shaft 39 in a clockwise direction (Figure 2), thus forcing the diaphragm outwardly against the liquid in the tank. On the opposite end of the shaft 39 a lever 44 is secured and has a roller 45 on its outer end.

The roller 45 engages under a disk 46 carried in the lower end of a plunger rod 47 which enters the bottom of a vertical cylinder 48 and is secured to a plunger 49 operating in said cylinder. A non-compressible (substantially) liquid is supplied to the cylinder from a force feed reservoir 50 by a pipe 51 extending from the top of the cylinder.

A feed pipe 52 leads from the top of the cylinder and is connected with branch pipes 53 and 54. The branch pipe 53 leads to the bottom of a small plunger cylinder 55 mounted on the housing 11 of the gas valve. A plunger 56 in this cylinder has a rod 57 extending through the top of the cylinder and connected with the lever 17. A cylinder 55′ has a plunger 56′ and a rod 57′ connected with the lever 25 for opening the liquid outlet valve.

A pipe 58 leads from the top of the tank 10 down into the drum 28 for supplying gas under pressure to said drum. The drum is located well below the liquid level in the tank. The diaphragm 33 is subjected to the weight of the liquid on one side; while on the other side it is exposed to the gas pressure. By conducting the gas to the drum, the gas pressure above the liquid and the gas pressure in said drum are equalized. The counterweight 43 acts to resist displacement of the diaphragm by the liquid.

The operation is as follows:

The gas valve 14 being held closed by the weight 18 will be opened by the pressure of the gas accumulating in the top of tank 10 when such accumulated pressure is sufficient to overcome the weight of the weights 18. For instance if sufficient weights were placed on the lever to hold 40 pounds pressure in the tank and the gas pressure increases above 40 pounds, the gas pressure would then open the valve and release the excess pressure and close when the pressure was reduced to 40 pounds. By this arrangement a predetermined gas pressure may be maintained in the tank.

Whatever gas pressure was carried in the top of the tank and on top of the liquid would be exerted through the pipe 58 and against the inner side of the diaphragm 33, whereby the gas pressure on top of the oil and the gas pressure on the inner side of the diaphragm would be equalized. This would leave the diaphragm free to be actuated by the liquid except for the opposition offered by the counterbalancing weight 43 which must also be overcome before the shaft 39 can be rocked.

From the foregoing it is evident that the liquid in the tank must be built up to such a height in the tank as to provide sufficient weight to operate the diaphragm. By varying the weight 43, the liquid level may be varied and regulated. When the liquid rises above the normal level and displaces the diaphragm, the shaft 39 is rocked in a counter-clockwise (Figure 2) direction. This swings the arm 44 upwardly, whereby the plunger 49 is pushed upwardly, thus displacing the liquid from the cylinder 48 into the feed pipe 52.

The liquid in the feed pipes 53 and 54 being displaced forces the plungers 56 and 56′ upwardly. While the gas valves 14 are normally open the oil valves are normally closed, being so held by the weight 26. Where a gas pressure is being carried in the tank the valves 14 will be partially open. Unless this pressure was reduced it would resist closing of the gas valve, so that the hydraulic pressure exerted through pipes 53 and 54 would find less resistance from the liquid outlet valves 22 and the gas valve would not be disturbed under normal working conditions.

By the arrangement described the liquid would have a high level and a low level and any point between these levels would be considered a normal liquid level, because the valves 22 would be open when the high level was reached by the liquid in the tank and would be closed when the liquid drained out to the low level. Thus under normal conditions there would be no occasion to close the gas valve so long as the predetermined gas pressure was present in the tank.

However should the liquid in the tank rise above the high level or to an abnormal level, the increased specific gravity would generate sufficient force by further rocking the shaft 39 and building up the hydraulic pressure, to displace the plunger 56 upwardly thereby closing the outlet valves 14. The further the liquid valves are opened, the more the gas valves are closed. When the gas valves are closed a gas pressure is built up in the tank, which will force out the surplus of liquid. When the liquid reaches its normal level the diaphragm will be returned to its normal position, as shown in Figure 2.

Another form of the invention is set forth in Figures 4 and 5. An exterior gas pipe 12′ leads from the top of the tank 10′ to a gas valve housing 11′ and connects with a bonnet 13′ therein. Valves 14′ seat in said bonnet. A gas discharge pipe 120 leads from the housing. A liquid discharge pipe 20′ leads from the bottom of the tank to a valve housing 19′ and connects with a bonnet 21′ in which valves 22′ are seated. A liquid discharge pipe 121 leads from the housing.

A force feed reservoir 60 mounted on the tank contains a bellows 61 connected to the bottom of said reservoir. The bellows is filled with a substantially non-compressible

liquid. A tubular stem 62 screwed into the top of the reservoir has rotatable connection with the top of the bellows. A filler plug 63 closes the top of the stem and a hand wheel 64 is fastened on the stem. The reservoir above the bellows is vented.

A feed pipe 65 leads from the bottom of the reservoir to a four-way coupling 66. Branch pipes 67, 68 and 69 lead from said coupling. On top of each valve housing is mounted a hydraulic operator 70, each including an upward barrel 71 having an enlarged head or chamber 72 at its upper end. In each head a bellows 73 is suspended. The pipes 67 and 68 lead to the heads 72 and discharge the hydraulic liquid into the bellows. Each head is vented below its bellows.

Each operator has a plunger rod 74 extending down through a guide 75 at the top of the barrel. Each plunger is connected to a valve stem 76. The valves 14′ and 22′ are attached to the stems. It will be noted that the valves operate oppositely and thus the gas valves are closed by moving them downward onto the seats, while the liquid valves are closed by moving them upward to their seats.

A supporting partition 77 is fastened in each barrel 71 and the plunger passes through this partition. Each partition supports a coiled spring 78 which is placed under tension by a nut 79 screw-threaded on the plunger 74. The springs act to elevate the nuts, thus moving the plunger upwardly. Normally the gas valves 14′ will be elevated and thus opened, while the liquid valves 22′ will be elevated and closed. When the bellows 73 are extended downwardly by the hydraulic liquid the plungers will be moved downwardly, thus closing the gas valves and opening the oil valves.

A cylindrical sleeve 80 has an annular flange 81, whereby it is secured to the manhole flange 82 by bolts 83. The sleeve extends into the tank 10′ and has an outwardly directed flange 84 to which a diaphragm or bellows 85 is fastened. The sleeve may be made in two parts and joined together as indicated at 86. A crowned cap 87, is fastened to the outer end of the sleeve by bolts 88 and is connected with the coupling 66 by a pipe 89.

Within the cylinder a pump bellows 90 is mounted adjacent the cap and is connected to one end of a plunger 91. The plunger extends through a partition 92 adjacent the diaphragm 85 and this partition supports a stuffing box 93 through which the plunger slides. By this arrangement a gas-tight chamber is provided within the diaphragm bellows 85 on the inner side of the partition. The plunger 91 is connected at its inner end to the diaphragm and the diaphragm is exposed to the weight of the liquid in the tank so that upon being forced outwardly the plunger will operate the bellows at 90 and it will likewise operate it when the diaphragm is retracted. By this arrangement the hydraulic liquid in the pipes will extend and retract the bellows 73.

A gas supply pipe 94 extends from the top of the tank through the cylinder 80 and then to the partition 92 so as to discharge gas under pressure into the bellows diaphragm 85. This serves to equalize the pressure of the gas on both sides of the diaphragm so that fluctuation of gas pressure within the tank cannot cause any actuation of the diaphragm. Of course the weight of the liquid in operating the diaphragm valve must overcome the tension of the springs 78 in order to cause an operation of the valves 14′ and 22′. By increasing the tension of the spring 78 of the gas valve with respect to the spring of the liquid valve, it is obvious that the former would offer more resistance than the latter and, therefore, the liquid valve could be made to open in advance of the gas valve. The pressure of the gas on the inner side of the diaphragm acts as a support for the same.

It is pointed out in connection with both forms of the invention which have been illustrated that in each case substantially the entire area of a relatively large diaphragm is exposed to direct contact with the liquid in the tank so that the weight is applied to the entire exposed surface without reduction through a restricted opening as is usually the case. This is necessary in order to provide sufficient force to guarantee a quick and positive operation. Where the liquid is supplied to the diaphragm through a restricted opening the whole diaphragm is not exposed to the impact of the liquid entering the tank and the direct action is only equal to the transverse area of the opening through which the liquid is supplied.

Experiments have shown that where the valves have a tendency to stick on their seats, due to the viscosity of oil, or for other reasons, considerable force is required to move them and liquid supplied through a two inch pipe to a twelve inch diaphragm failed to move the valves where upon a later experiment the same amount of liquid applied directly to the entire surface of the diaphragm quickly dislodged the valves.

Various changes in the size and shape of the different parts, as well as modifications and alterations may be made within the scope of the appended claims.

Having illustrated and described preferred forms of the invention, what I claim, is:

1. In a controlling device, a tank, a liquid outlet valve connected to the tank, a gas outlet valve connected to the tank, hydraulic operators for the valves, means for supplying a hydraulic liquid to the operators, means for displacing said hydraulic liquid for actuating the operators, and means in the tank sub-

ject to operation by the weight of the liquid therein for operating the displacing means.

2. In a controlling device, a tank, a liquid outlet valve connected to the tank, a gas outlet valve connected to the tank, hydraulic operators for the valves, means for supplying a hydraulic liquid to the operators, means for displacing said hydraulic liquid for actuating the operators, and a diaphragm in the tank exposed to the weight of the liquid therein for operating the displacing means.

3. In a controlling device, a tank, a liquid outlet valve connected to the tank, a gas outlet valve connected to the tank, fluid operated means connected to the valves for oppositely operating the same, whereby one is opened and the other closed, and a liquid operated diaphragm for actuating the fluid operated means.

4. In a control device, a container adapted to hold liquid and gas, a liquid outlet valve connected to the container, a gas outlet valve connected to the container, a displaceable element exposed to the weight of the liquid in the container and operated thereby, valve actuators connected to the valves, and a hydraulic transmitter between the liquid operated element and the valve actuators.

5. A control device as set forth in claim 4, and means for resisting operation of the valve actuating means and acting to return the valves to their normal positions.

6. A control device as set forth in claim 4, with means for resisting operation of the valve actuating means and acting to return the valves to their normal positions, one of said resisting means being adjustable to cause the operation of one of the valves in advance of the other.

7. In a control device, a tank adapted to hold liquid and gas, a liquid outlet valve connected to the tank, a gas outlet valve connected to the tank, bellows connected to the valves for operating them, a diaphragm exposed to the liquid in the tank, and a conductor between the diaphragm and the bellows containing a hydraulic fluid.

8. A control device as set forth in claim 7, and coiled springs opposing operation of the valves by the bellows.

9. A control device as set forth in claim 7, and means for supplying hydraulic fluid to the conductor and also for placing it under a low pressure.

10. In a control device, a tank adapted to hold liquid and gas, a liquid outlet valve connected to the tank, a gas outlet valve connected to the tank, bellows connected to the valves for operating them, a diaphragm bellows having its outer side exposed to the liquid in the tank, means for conveying gas from the tank to the interior of the diaphragm bellows, a pump bellows positively connected with and actuated by the diaphragm bellows, a conductor containing hydraulic fluid extending from the pump bellows to the valve bellows, and coiled springs connected with the valve connections for returning the valve bellows.

11. A control device as set forth in claim 4 in which the displaceable element has one side exposed to weight of the liquid in the container and its other side exposed to the gas in the container, whereby the gas pressure on both sides of the displaceable element is equalized.

In testimony whereof I affix my signature.

ELMER R. WILLIAMS.