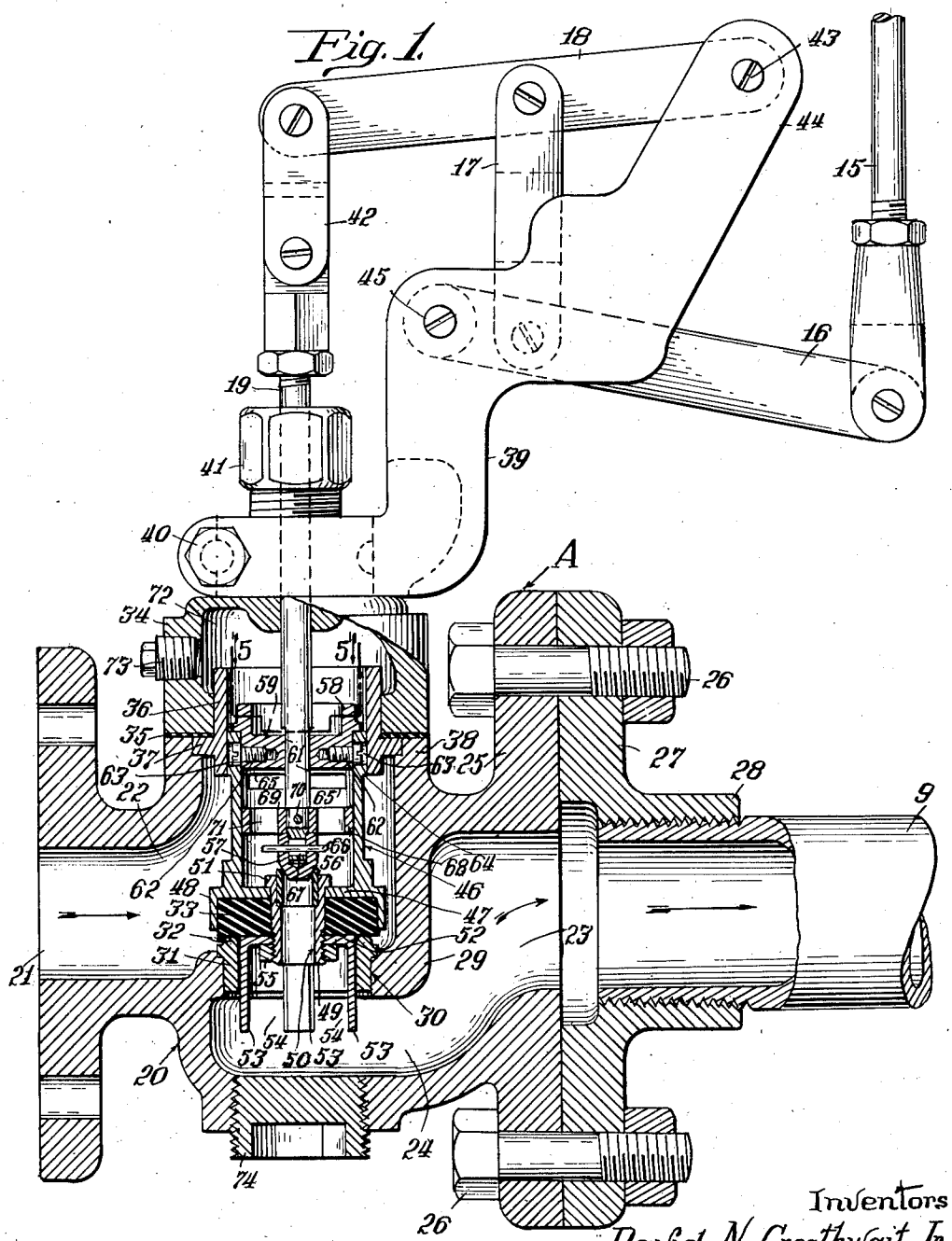
March 3, 1942. D. N. CROSTHWAIT, JR., ET AL 2,275,132

DISCHARGE VALVE

Filed Aug. 3, 1940 2 Sheets-Sheet 1

Fig. 1.



Inventors
David N. Crosthwait Jr
and Everett W. Werts
By Barnett & Truman
Attorneys

March 3, 1942. D. N. CROSTHWAIT, JR., ET AL 2,275,132

DISCHARGE VALVE

Filed Aug. 3, 1940 2 Sheets-Sheet 2

Fig. 2.

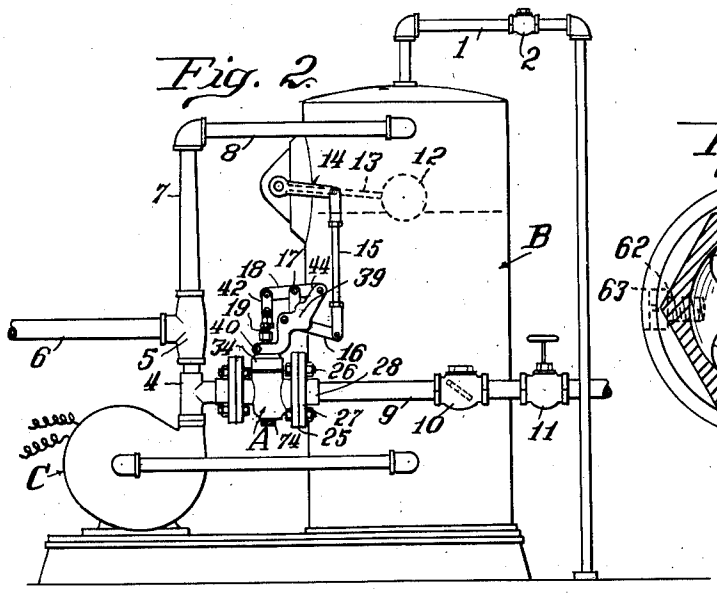


Fig. 5.

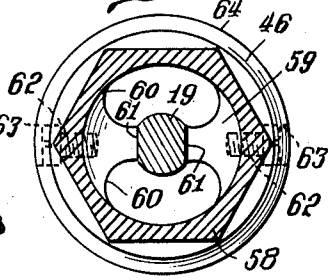


Fig. 3.

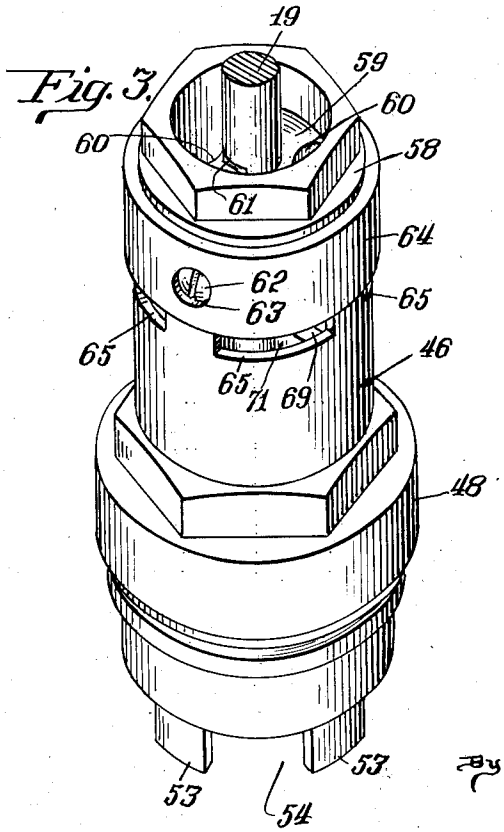
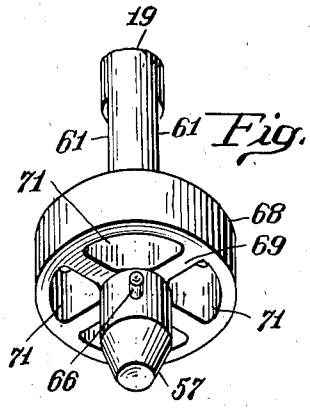


Fig. 4.



Inventors.
David N. Crosthwait Jr.
and Everett W. Werts
By Barnett & Truman
Attorneys

Patented Mar. 3, 1942

2,275,132

UNITED STATES PATENT OFFICE

2,275,132

DISCHARGE VALVE

David N. Crosthwait, Jr., Chicago, Ill., and Everett W. Werts, Michigan City, Ind., assignors to C. A. Dunham Company, Marshalltown, Iowa, a corporation of Iowa

Application August 3, 1940, Serial No. 350,180

6 Claims. (Cl. 277—36)

This invention relates to a new and improved discharge valve, more particularly a valve normally holding back the flow through a conduit of a liquid under rather high pressure but adapted to be opened at selected intervals to permit the flow of this liquid.

While this valve is of a type that can be used for various purposes, it has been especially designed for use in connection with the exhausting apparatus which withdraws fluids from a steam heating system, the gases being vented and the water collected and circulated under pump pressure to cause the suction action in the exhauster. As the water accumulates in excess of a predetermined maximum, the discharge valve is automatically opened and the excessive portion of the circulating water is forced out under pump pressure, and usually returned to the steam generator.

If this valve is of the single-seating type, the main movable valve member of the discharge valve is usually held closed by the high pressure at the supply or inlet side of the valve. It is desirable to substantially equalize or balance the pressures at the two sides of the movable valve member before it is opened. According to the present invention a smaller or auxiliary valve is provided to balance the pressures on the main valve, while this smaller valve is also adapted to provide a smaller but substantial discharge of liquid through the valve assembly, this lesser discharge often being sufficient to remove the accumulation and make it unnecessary to open the main valve. The assembly comprises a valve stem controlled from outside the valve casing by a float connection. The first movement of the stem in a valve-opening direction will open a relatively small valve passage in the main valve, which cooperates with normally open passages in the movable assembly at the high pressure side of the main valve so that a free discharge of water is permitted to the maximum capacity of this smaller valve opening. If this flow is not sufficient, a further movement of the valve stem in the same direction serves to close the normally open passages in the movable valve assembly so that the still open auxiliary valve passage will permit the low pressure from the discharge chamber to be established above the main valve, whereupon an additional movement of the valve stem in this direction will lift the now balanced main valve to permit a larger and unrestricted discharge of the water through the main valve opening.

The principal object of this invention is to provide an improved discharge valve of the type briefly described hereinabove and disclosed more in detail hereinafter.

Another object is to provide a single-seated discharge valve which is normally held shut by the pressure differential on its two sides, together with means for balancing the differential when the valve is to be opened.

Another object is to provide a discharge valve of this type comprising an auxiliary valve adapted to provide a low rate of discharge without opening the main valve.

Another object is to provide a discharge valve comprising a composition disk for finally and effectively closing the valve, but having metal parts which prevent erosion of the composition when the flow of liquid is being throttled or restricted.

Another object is to provide a valve in which the separable elements can be taken apart or re-assembled with ordinary tools such as a wrench and screw driver.

Another object is to provide a valve in which the action is smooth since there are no large volumes of water in rapid motion which are quickly accelerated or decelerated.

Other objects and advantages of this invention will be more apparent from the following detail description of one approved form of apparatus constructed and operating according to the principles of this invention.

In the accompanying drawings:

Fig. 1 is a central vertical section through the assembled valve, showing the valve in closed position.

Fig. 2 is an elevation, on a smaller scale, of an exhausting assembly for a heating system, involving this improved discharge valve.

Fig. 3 is a perspective view of the main movable valve assembly.

Fig. 4 is a perspective view of the inner movable valve assembly (which is housed within the assembly shown in Fig. 3).

Fig. 5 is a transverse horizontal section taken substantially on the line 5—5 of Fig. 1.

Reference will first be made briefly to Fig. 2 which illustrates somewhat diagrammatically an exhausting mechanism as used in one well known type of heating system. The discharge valve which forms the particular subject matter of the present invention is illustarted in elevation at A. The tank B receives the returned fluid from the heating system, the water accumulating in this tank and the non-condensable gases being vented through pipe 1 provided with check

valve 2. The motor-driven pump C withdraws water from the lower portion of tank B and discharges this water under pressure through the T-fitting 4 into and through the ejector 5 which draws in fluids (non-condensable gases and condensate) through pipe 6 from the heating system, all of the fluids being discharged from the ejector through pipes 7 and 8 into the upper portion of tank B. The other branch of the T-fitting 4 connects with the discharge valve A which is connected in the conduit 9, provided with check valve 10 and gate-valve 11 and leading back into the steam generator. Usually valve A will be closed so that all of the water discharged from pump C will be forced through the ejector as already described.

When condensate has accumulated in tank B above a predetermined level, the float 12, shown in dotted lines, will be lifted and through the series of levers and links 13, 14, 15, 16, 17 and 18 (or any other equivalent linkage system) will lift the valve stem 19 (hereinafter disclosed more in detail) and open the valve A so as to discharge a portion of the accumulated water under pump pressure. Obviously this discharge valve A could be used for any other similar purpose.

The valve A will now be described referring more particularly to Figs. 1, 3, 4 and 5.

The main valve casing 20 is formed with an inlet port 21 leading into the upper relatively high-pressure inlet chamber 22, and the outlet port 23 leading from the lower relatively low-pressure discharge chamber 24. In the form here shown the outstanding disk flange 25 at the outlet side of the valve is connected by bolts 26 with a similar flange 27 on the threaded fitting 28 which receives the discharge conduit 9. The valve is similarly connected at the inlet side with the conduit system which holds the circulating high-pressure pump water.

The high and low-pressure chambers 22 and 24 are separated by an internal web 29 formed with a vertical valve pasasge 30 in which is fitted a small cylindrical bushing 31 formed at its top with the rounded annular valve seat 32. The annular composition disk 33 is adapted to be clamped down against seat 32 in order to cut off the flow of water through the main valve.

A large opening in the top of casing 20 is closed by bonnet 34 which is clamped down in any suitable manner against gasket 35. An inner hollow cylindrical guide member 36 is provided with an outstanding collar 37 which is clamped in place between the bonnet 34 and neck 38 at the upper end of the valve casing. A bracket member 39 comprising a split lower collar is clamped by bolt 40 about the upper end of bonnet 34 so that this bracket can be adjusted to any rotary position with relation to the vertical axis of valve stem 19. This stem 19 projects upwardly through an opening in bonnet 34 and through the packing 41 and is connected by a short link 42 with one end of lever 18. Lever 18 is pivoted at its opposite end 43 to an upwardly extending arm 44 of bracket 39. An intermediate portion of lever 18 is connected by link 17 with an intermediate portion of lever 16 pivoted at 45 on the bracket 39. The outer end of lever 16 is connected by link 15 with the float operated levers. It will be apparent that this system of levers is merely shown by way of example, the only thing that is essential being to provide such levers that the raising and lowering of the float will impart a sufficient vertical movement to the operating valve-stem 19.

The main longitudinally movable valve assembly within the upper high-pressure chamber 22 is shown in perspective in Fig. 3 and in central vertical section in Fig. 1. This comprises in its central portion a hollow cylindrical tube 46 having an external diameter of substantially the same size as the main valve opening in valve seat 32. The lower end of cylinder 46 is partially closed by plate 47 which forms the top of a chamber in head 48 adapted to receive and hold the composition valve disk 33. A relatively small hollow cylindrical tube 49 enclosing the small valve passage 50 has a head 51 at its upper end resting on plate 47 and extends centrally downward through the composition disk 33 and also centrally through the plate or washer 52 which forms the top of a hollow cylindrical guide member 53 which extends downwardly with a fairly close fit within the main valve seat member 31. This guide cylinder 53 is vertically slotted at 54 so as to permit a free flow of water through the valve when the valve disk 33 has been lifted from the valve seat 32 and the washer 52 has been lifted far enough to permit the water to flow through the passages 54 in the guide. A nut 55 is threaded on the lower end of cylinder 49 so as to securely clamp the guide member up against the composition disk 33 and hold this disk in place. A short hollow cylindrical valve seat member 56 is renewably fitted within the upper end of cylinder 49, the upper end of this member serving as a valve seat to be engaged by the auxiliary valve member 57 hereinafter described.

Tightly fitted within the upper end of the main cylinder 46 is a head 58 having an internal web 59 provided with a pair of large passages 60 to permit free flow of water therethrough. The two sides of the lower portion of stem 19 are flattened at 61 so as to fit a central opening in the web 59 and thus prevent rotation of head 58 with relation to the valve stem 19. A pair of screws 62 extend through openings 63 in the upper end of cylinder 46 and are threaded into the head 58 thus preventing rotation of the main cylinder 46. It will be understood that the upper head portion 64 of cylinder 46 has a fairly close sliding fit within the fixed guide cylinder 36. Since the valve stem 19 is non-rotatably connected at its upper end with the operating lever system, all of the assembled valve parts are also held against rotation although they may move vertically with relation to one another. This prevents unnecessary grinding action between the engaging surfaces. A circumferential series of arcuate slots or openings 65 are formed in the outer wall of cylinder 46 closely beneath the head 58.

The inner valve assembly is shown in perspective in Fig. 4 and in central vertical section in Fig. 1. The small auxiliary valve 57 (which cooperates with valve seat 56) is loosely connected with the lower end of valve stem 19 by a pin 66 which extends freely through a slot 67 in the stem. This permits the valve to accurately engage the valve seat. Directly above this valve an annular slide valve or collar 68 closely engages the inner surface of cylinder 46, this collar being connected by a central spider 69 with the valve stem 19 to which it is pinned at 70. The large passages 71 between the arms of the spider permit a free flow of liquid past this valve. However when the collar 68 is raised sufficiently to cover the slots 65 the flow of water from without

into the large cylinder 46 will be substantially cut off.

When the valve parts are in the normal closed position shown in Fig. 1, water under high or pump pressure from chamber 22 will flow into cylinder 46 through openings 65 and 71 and will also flow up through openings 60 in the head member 58 to fill the space 72 in the upper part of the valve chamber. In other words, the entire upper face of the valve disk 33 will be subject to the high pressure at the inlet side of the valve, whereas the central bottom portion of this disk will be subject only to the low pressure in discharge chamber 24, therefore the main valve will be held closely to its seat 32 by this difference in pressure. The first lifting movement of the stem 19 will lift the small valve 57 from its seat but will be insufficient to move the annular valve 68 up to cover the openings 65. Consequently there will be a free discharge of water through this smaller valve and the valve passage 50. It may be noted that the total area of the valve openings 65, also the total area of the valve openings 71, are in excess of the opening of the smaller valve passage 50 so that water can be freely discharged up to the total capacity of this smaller valve. Under ordinary conditions this rate of flow may be ample to discharge the necessary amount of water and it will be unnecessary to lift the main valve from its seat. However, if there has been a large accumulation of water the valve stem 19 will be further lifted until the valve collar 68 has cut off the flow of water through openings 65. There will be no further flow of water into the large cylinder 46 aside from the leakage between openings 65 and the valve collar 68, and between the sliding head 64 and the guide tube 36. This leakage is easily taken care of by the open auxiliary valve, and as a result the lower pressure in the discharge chamber 24 will soon be established in the hollow cylinder 46 and in the chamber 72 above the slidable assembly. Consequently this low pressure will be established at both sides of the main valve so that this valve will be substantially balanced and it will be easy to lift the main valve from its seat when the valve stem 19 is further raised so that valve collar 68 engages beneath the head 58. The excessive accumulation of water can then be quickly discharged through the main valve opening.

It should be noted that there is a fairly close fit between the upper portion of guide sleeve 53 and the valve-seat ring 31 so that when the main valve is only slightly lifted the greatest restriction to flow will be between these metal parts instead of between the valve seat 32 and the composition disk 33. The composition disk only has to close off the leakage between the metal parts and consequently there will be little erosion or wear on this composition valve disk.

A plug 73 normally closing an opening leading into the upper chamber 72 is available to release air from this chamber when the apparatus is initially started. Ordinarily this air is readily relieved but in those instances where it is not the valve may have a chattering action which is readily eliminated by loosening the plug 73 for a sufficient length of time to permit the air to be released and then tightening it when the appearance of water issuing from this opening indicates that the air has been expelled.

A drain port 74 is removable from the lower portion of the valve casing, and it will be apparent that the entire interior assembly can be removed by taking off the bonnet 34. The parts can be readily taken apart and re-assembled with only ordinary tools such as a wrench and screw driver. By removing the nut 55, the composition disk 33 may be removed and replaced. By removing the screws 62, the head 58 may be withdrawn, permitting access to the inner valve parts.

It will be noted that the action of the valve is smooth at all times since at no time is a large volume of water in rapid motion quickly accelerated or decelerated. When closing the valve, the main valve will first gradually cut down the rate of flow and then the auxiliary valve will close so that there is no abrupt stoppage of the water-flow and hence no appreciable "water hammer" action.

We claim:

1. A discharge valve comprising a casing divided by an internal web into a high-pressure inlet chamber and a low-pressure outlet chamber, the web being formed with a main valve opening connecting the chambers, a main valve assembly movable in the high-pressure chamber to open or close the valve opening, upper and lower auxiliary valve openings in the movable assembly through which liquid can flow in series, a second movable valve assembly comprising a valve stem, a valve member on the stem adapted to normally close the lower auxiliary opening so that there will be no liquid discharge and high pressure will be maintained in the movable assembly above the main valve, and a second valve member on the stem adapted to close the upper auxiliary valve opening, so that a first upward movement of said stem will open the lower auxiliary valve to permit a discharge of liquid through the auxiliary openings in series, a further upward movement of the stem moving the second valve member to close the upper auxiliary opening so that the main valve is balanced under low pressure, and a final upward stem movement causing a portion of the second valve assembly to engage and lift the main valve assembly to open the main valve.

2. A discharge valve comprising a casing divided by an internal web into a high-pressure inlet chamber and a low-pressure outlet chamber, the web being formed with a main valve opening connecting the chambers, a valve-seat at the inlet end of the opening, a main valve assembly movably guided in the inlet chamber in line with the valve opening, said assembly comprising a hollow cylinder of an internal diameter similar to the valve opening and carrying at its inner end a main valve member adapted to engage the valve seat and close the valve, there being a smaller valve-opening through the main valve member, there also being openings in the side wall of the cylinder of greater total area than the smaller valve-opening, and means operable from outside the casing and normally closing the smaller valve opening and movable for successively opening the smaller valve, then closing the cylinder openings, and then opening the main valve.

3. A discharge valve comprising a casing divided by an internal web into a high-pressure inlet chamber and a low-pressure outlet chamber, the web being formed with a main valve opening connecting the chambers, a valve-seat at the inlet end of the opening, a main valve assembly movably guided in the inlet chamber in line with the valve opening said assembly comprising a hollow cylinder of an internal diameter similar to the valve opening and carrying

at its inner end a main valve member adapted to engage the valve seat and close the valve, there being a smaller valve-opening through the main valve member, there also being openings in the side wall of the cylinder of greater total area than the smaller valve-opening, and means operable from outside the casing and normally closing the smaller valve opening movable step by step in one direction to first open the smaller valve to permit a continuous liquid flow up to the capacity of the smaller valve, second to close the cylinder openings and thus balance the low pressure at both sides of the main valve, and finally to open the main valve.

4. A discharge valve comprising a casing divided by an internal web into a high-pressure inlet chamber and a low-pressure outlet chamber, the web being formed with a main valve opening connecting the chambers, a valve-seat at the inlet end of the opening, a main valve member movable in the high-pressure chamber to engage the seat and close the valve, a hollow cylinder of an internal diameter similar to the valve opening and movably guided in the high-pressure chamber in line with the valve opening and carrying the main valve member at its inner end, there being a smaller auxiliary valve-opening through the main valve member, a smaller movable valve member to close said auxiliary opening, a valve-stem operable from outside the casing and projecting axially through the hollow cylinder, there being openings in the hollow cylinder of greater area than the auxiliary valve-opening, and means on the stem whereby a first outward movement of the stem will unseat the smaller valve and permit a continuous free flow through the openings in the cylinder and the smaller valve opening, a further outward movement will close the cylinder openings and balance the pressures at the two sides of the main valve and a final outward movement will open the main valve.

5. A discharge valve comprising a casing divided by an internal web into an upper high-pressure inlet chamber and a lower low-pressure outlet chamber, the web being formed with a main vertically extending valve-opening with a valve-seat at its upper end, a hollow cylindrical guide collar in the upper portion of the inlet chamber, a vertically movable valve assembly in the inlet chamber comprising a hollow cylindrical portion guided near its open upper end in the collar, a main valve near the lower end of the cylinder adapted to engage the valve seat, a slotted guide member extending downwardly through the main valve opening, a smaller auxiliary valve opening formed centrally through the main valve member, a valve-stem guided through the upper portion of the casing and the movable assembly, a valve member carried at the lower end of the stem to engage and close the auxiliary valve opening, a plurality of openings in the main hollow cylinder, a valve member carried by the valve stem and movable thereby to close the cylinder-openings, and means for connecting the stem and main movable assembly to permit limited relative longitudinal movement but not to permit relative rotation, whereby a minimum upward movement of the stem will lift the small valve from its seat to permit a continuous limited flow of fluid through the valve assembly, a further upward movement of the stem will close the cylinder openings, and a maximum upward movement of the stem will lift the main valve member from its seat.

6. A discharge valve comprising a casing divided by an internal web into a high-pressure inlet chamber and a low-pressure outlet chamber, the web being formed with a main valve opening connecting the chambers, a main valve assembly movable in the high-pressure chamber to open or close the valve opening, upper and lower auxiliary valve openings in the movable assembly through which liquid can flow in series, and a second movable assembly having a limited vertical movement with respect to the main valve assembly and having portions adapted to cooperate with the auxiliary valve openings so that the lower auxiliary opening will normally be closed, a first upward movement of the movable assembly opening the lower auxiliary valve opening, a further upward movement closing the upper auxiliary valve opening thereby balancing the pressures at the two sides of the main valve, and a final upward movement of the second assembly engaging and lifting the main valve assembly to open the main valve.

DAVID N. CROSTHWAIT, JR.
EVERETT W. WERTS.