March 22, 1927. A. THOMSON ET AL 1,621,910

VALVE

Filed May 23, 1925

Fig. 1.

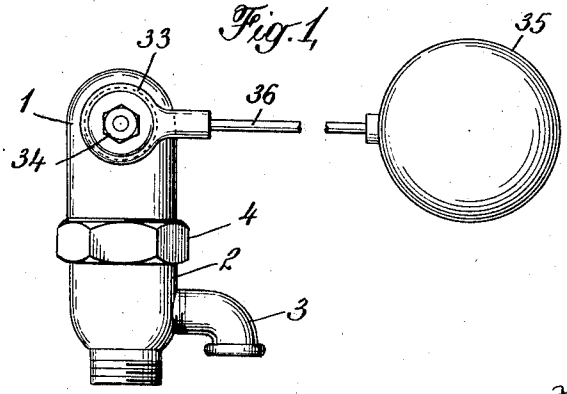


Fig. 2.

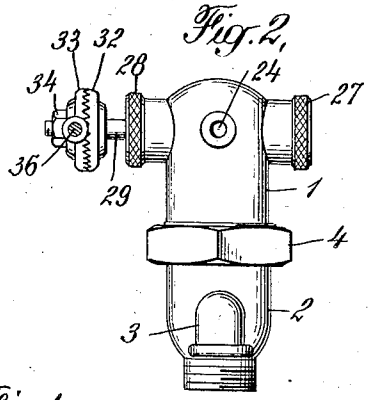


Fig. 3.

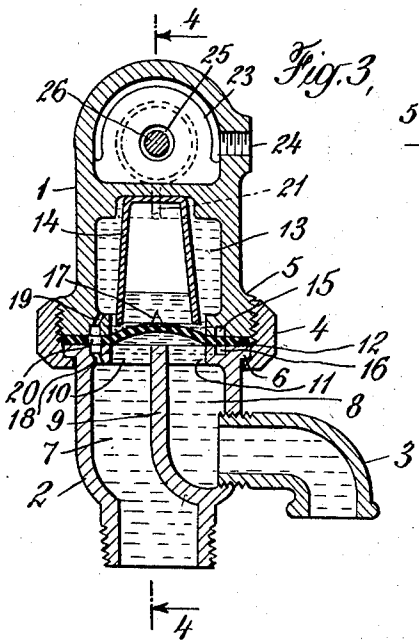


Fig. 4.

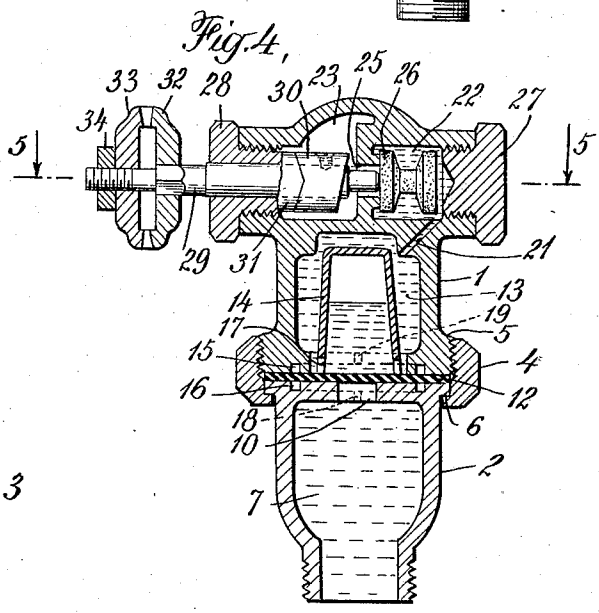
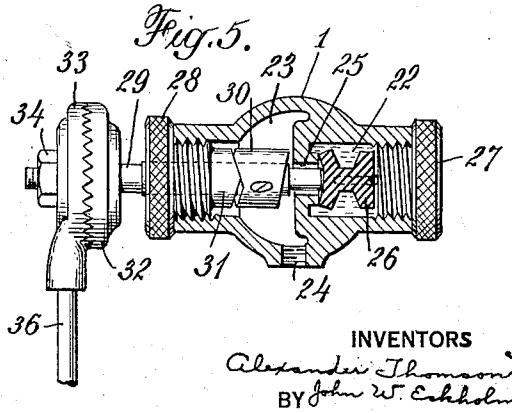


Fig. 5.



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UNITED STATES PATENT OFFICE.

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VALVE.

Application filed May 23, 1925. Serial No. 32,282.

This invention relates to improvements in valves for controlling the escape of fluid under pressure and more particularly to that type in which the main valve in the form of a diaphragm is held in closed position by the action of the fluid in a pressure chamber the escape from which is controlled by an auxiliary valve. The invention includes a novel construction of auxiliary valve and a novel combination of auxiliary valve and main valve.

In the Patent No. 1,158,869 of November 2, 1915, a valve structure was described, consisting of a main valve in the form of a flexible diaphragm held in closed position by the pressure of fluid in a pressure chamber and operated by an auxiliary valve acting as a by-pass to relieve pressure from the pressure chamber. The by-pass valve of the prior patent was operated by the rotation of a threaded shaft causing the valve plunger to open or close a by-pass channel. The by-pass valve was both opened and closed mechanically.

The present invention constitutes an improved valve of the general type described in the prior patent and includes an improved construction of the auxiliary by-pass valve and an improved main valve construction. It is one of the objects of the present invention to provide a by-pass valve which is opened mechanically but is closed by the pressure of the fluid itself and which automatically takes up wear on the valve. A further object is to provide a removable air chamber in communication with the liquid in the pressure chamber to constitute a flexible cushion and prevent hammering in the fluid pipes. Additional advantages of the improved construction of the present invention consist in a very rapid wide opening of the by-pass valve, the elimination of screw operated devices and reduction of power required to open and close by-pass valves. Other and further advantages will be apparent from the following more detailed description taken in connection with the drawings, in which

Fig. 1 shows a side elevation of a ball-cock valve embodying the features of the present invention;

Fig. 2 is an elevation at right angles to Fig. 1;

Fig. 3 is a central vertical section through the valve;

Fig. 4 is a central vertical section through the valve along the line 4—4 of Fig. 3;

Fig. 5 is a horizontal section through the by-pass valve along the line 5—5 of Fig. 4;

Fig. 3 shows the main valve in the open position; Fig. 4 shows the main and by-pass valve in the closed position; and Fig. 5 shows a by-pass valve beginning to open.

The drawings and specific description relate to a ball-cock valve for use in controlling the admision of water to a flush tank or other float chamber but it should be understood that the invention is not limited to this particular type of device and can be applied to any valve for controlling the escape of fluids. The by-pass valve may be operated either manually or by means of a float or other automatic device.

The main valve consists in an upper dome shaped casting 1, a lower casting 2 and an outlet pipe 3. The castings 1 and 2 are provided with the flanges 5 and 6 the flange 5 being threaded and connected to the flange 6 by the threaded nut 4. The lower casting contains an inlet chamber 7 and an outlet chamber 8 which are separated by the wall 9. Chambers 7 and 8 are provided with the adjacent openings 10 and 11 in a flat surface of the lower casting controlled by the flexible diaphragm 12. The casting 1 contains a pressure chamber 13 and a removable air-trap 14 comprising an inverted cup shaped element provided with a notch 17. The flanges 5 and 6 are provided with the grooves 15 and 16. Chamber 7 communicates with the groove 16 by means of the passage 18 and similarly the chamber 13 communicates with the groove 15 by the passage 19. Communication between the two grooves is provided for by the opening 20 in the flexible diaphragm 12. The pressure chamber 13 communicates with the by-pass valve through the passage 21.

The by-pass valve the body of which is a part of the casting 1 contains two chambers 22 and 23, the latter being cylindrical and communicating with the outside through the passage 24. Chambers 22 and 23 are joined by the passage 25 which is opened or closed by the flexible plug or valve 26. The valve chamber 22 is also closed by the plug 27. The outlet chamber 23 is closed by the hollow-threaded plug 28. Shaft 29, one end of which is of somewhat smaller diameter than the passage 25, is mounted in the plug

28. The member 30 having a bevelled cam surface is rigidly fastened to the shaft 29 and engages with the cam surface 31 of the hollow plug 28. The toothed collar 32 is keyed on the shaft 29 and the adjustable toothed collar 33 is clamped into engagement with the collar 32 by the nut 34. A ball 35 and rod 36 are connected to the collar 33.

When the valve is to be used in connection with devices other than ball cocks, any suitable turning means may be used instead of the ball and rod with the two toothed collars. The operation of the by-pass valve may be either automatic or manual.

The operation of the ball cock in a flush tank is as follows: The chambers 7, 13 and 22 are filled with water as shown in Fig. 4. The air-trap 14 which is in communication with the chamber 13 through the notch 17 is partly filled with water and partly with compressed air. As the by-pass valve is shut the pressure in the chambers 7, 13, 22 and the air-trap 14 are approximately the same and the flexible diaphragm 12 is seated firmly but is not subjected to great pressure over its entire surface irrespective of the pressure existing in the various chambers since for a large part of its surface the diaphragm is subjected to the same pressure on both sides.

When the tank is flushed the float 35 falls and rotates the shaft 29 together with the bevelled cam 30 which is rigidly attached to this shaft. The camming action between the cam 30 and the cam surface 31 moves the shaft 25 into the chamber 22 bending the flexible plug 26 as shown in Fig. 5. As soon as the shaft 25 has moved the plug 26 back far enough so that the passage 25 is uncovered, the water in the chamber 22 suddenly rushes through the passage 25 into the chamber 23 and out through the opening 24, thus relieving the pressure in the chamber 22 and correspondingly in the chamber 13 which is in communication with the chamber 22 through the channel 21. As the channel 21 is of larger diameter than the channel 19, water flows out of the pressure tank 13 faster than it can flow in through the passage 19 and a pressure differential is established between the chamber 7 and the chamber 13. As a result the flexible diaphragm 12 is bowed up as is shown in Fig. 3 and uncovers the openings 10 and 11 so that water flows from chamber 7 through chamber 8 and out through the outlet pipe 3. As long as the by-pass valve remains open the pressure differential between the chambers 7 and 13 will continue and water will flow through the valves.

As the tank fills the float 35 gradually rises, reversing the rotation of the shaft 29 and gradually retracting the shaft from the chamber 22. The plug 26 which is only lightly pressed against the end of the shaft 29 due to the flow of water through the passage 25 follows the shaft until it covers the passage 25 when it is suddenly forced tight against this opening by the pressure existing in chamber 22. This stoppage of the outflow from chamber 22 causes pressure to build up rapidly in chamber 13 and the diaphragm 12 is forced down on the openings 10 and 11 thus closing the valve.

As the closing of the by-pass valve is very rapid, an action similar to a water hammer may take place in the piping leading to the main valve. In order to avoid this the movable air-trap 14 is provided which covers the portion of the flexible diaphragm 12 over the openings 10 and 11. The closing of the diaphragm 12 is therefore not sudden owing to the cushioning effect of the compressed air in the air-trap and to the fact that water from the pressure chamber 13 flows into the air-trap through the small notch 17 so that the application of pressure from the chamber 13 through the diaphragm 12 is not instantaneous and does not cause a hammering action in the pipe.

It will thus be seen that the valve of the present invention possesses a number of important advantages. The opening and closing of the main valve is accomplished by the pressure of the fluid to be controlled and is not effected by the range of pressures used as for the most part the flexible diaphragm which is the only moving part of the main valve is subjected to approximately the same pressure on both sides. The diaphragm being detachably mounted can be readily and rapidly replaced without the use of special tools. Moreover, the provision of grooves in the flanges of the two castings makes it unnecessary to align the aperture in the flexible diaphragm with the passages leading to the inlet chamber and the pressure chamber thus making the valve easy to install and reliable in action.

The valve cannot be closed by mechanical or manual means and can not therefore be subjected to excessive pressure through careless manipulation. As a result, the life of the valve is greatly lengthened and its reliability increased.

The valve operates only on the differential pressure between the upper and lower chambers which may be made independent of the absolute pressure in the chambers by a proper proportioning of the passages 18, 19 and 21. The operation of the valve takes place by reason of the reduction of pressure on one side and this reduction may be gradual or instantaneous depending on the size and arrangement of the passages connecting the various chambers. Thus it is readily possible to provide valves with any desired rapidity of action.

The provision of a removable air-trap or auxiliary air chamber above the flexible di-

aphragm avoids shocks due to sudden opening and closing, thus greatly lengthening the life of the valve and assuring a quiet operation.

The improved by-pass valve of the present invention is opened mechanically by a rugged cam device but is closed by the force of the fluid itself. The by-pass valve presents numerous advantages over the construction in the prior Patent No. 1,158,869 in which the by-pass valve is operated by a screw and nut mechanism and both the opening and closing were effected mechanically. The improved construction of the present invention by substituting a cam for the screw and nut renders the construction more simple and rugged and requires less power to operate owing to the reduced friction. The automatic closing of the valve by fluid pressure greatly reduces the power required to close the valve, thus permitting the use of a much smaller float where the device is incorporated in a ball cock and resulting in a rapid and powerful closing of the valve. Moreover, since it is necessary to use yielding plugs, such as rubber and similar plugs, a mechanical closing results in a gradual wear of the plugs which must be compensated by adjustment in order to prevent the valve leaking. In the improved construction of the present application, the plug moves freely and is kept constantly pressed against the end of the shaft by fluid pressure. This automatically takes up for any wear and always insures a positive fluid tight closing. Moreover, it is exceedingly simple to renew the plug in the construction of the present invention, it being only necessary to remove plug 27 and insert a new rubber plug, or reverse the old one.

The preferred shape of the plug in the by-pass valve is illustrated in the drawings and is roughly that of a spool or dumbbell. This construction presents the important advantage that when the valve starts to open the pressure of the shaft 29 on the center of the plug causes the flange-shaped end in contact with the opening 25 to bend. This is shown in Fig. 5 which illustrates the auxiliary valve as it begins to open. The movement of the shaft gradually increases the curvature of the plug flange until finally the passage 25 is uncovered whereupon the plug flange immediately straightens out, being no longer subjected to the high fluid pressure on one side and the fluid starts flowing immediately. This very rapid wide opening of the valve presents the important advantage that the fluid starts flowing at once and through a passage which is opened to its full opening almost instantaneously, thus preventing the rushing of fluid under high pressure through a narrow opening with resultant whistling noises. The relatively silent rapid wide opening which can be produced with the dumbbell-shaped plug is of course of particular importance in connection with ball cocks to be used in flush tanks when silence is one of the features aimed at.

While the drawings illustrate the preferred shape of plug or valve 26 with its corresponding advantages, it should be understood that the invention in its broader aspects is not limited to valves of this particular shape, but on the contrary can be used with any valve having a roughly cylindrical shape and comparatively thin flexible edges with or without the deep central groove which is characteristic of the valve of the preferred structure shown. The valve should of course have a flexible resilient face in order to tightly seal the passage, but it is not necessary that the whole of the valve should be made of the same material and the invention is not limited to a valve made throughout of flexible resilient material, and on the contrary includes any valve which may contain a flexible face capable of closing the outlet passage.

The valve of the present invention is not only reliable and long-lived, but can be repaired with great ease and without the services of a skilled mechanic. Thus a new diaphragm may be inserted by simply unscrewing the nut 4 and lifting off the upper casting, placing the new diaphragm on top of the lower flange. Similarly, as has been pointed out above, the resilient plug in the by-pass valve can be readily and easily replaced. As the only moving parts subjected to strain are the flexible diaphragm and plug and the pressure exerted on the moving parts is reduced to a minimum, the valve is capable of giving long and reliable service even where the fluid pressure is very high.

A further advantage of the invention consists in the fact that it is not necessary to adjust the movements of the shaft 29 with great accuracy as the shaft need not engage the by-pass valve when it is closed, and may move this valve to any desired extent when it is open.

The novel structure of the by-pass valve of the present invention has been described in connection with the particular structure of the main valve shown in the drawings. It should be understood, however, that the novel by-pass valve may be used in connection with other valves of different structures and the invention is not limited to the by-pass valve in combination with the particular type of main-valve shown.

We claim:

1. A fluid by-pass valve comprising in combination a chamber, an inlet into the chamber, a loosely mounted flexible valve in said chamber, an outlet out of the chamber so positioned that the fluid pressure in the chamber tends to force the valve against said

outlet and mechanical means for flexing and forcing the valve out of contact with the outlet.

2. A fluid by-pass valve comprising a casing having a cylindrical chamber, a flexible valve loosely disposed in said chamber and guided by the walls thereof, an outlet port in one end of the said chamber, an inlet port in a plane different from that of the outlet port, a shaft mounted in the valve casing and extending into the outlet port and having a diameter considerably smaller than the port and means for causing said shaft to move into the chamber parallel to the axis thereof whereby the valve is flexed and forced out of contact with the wall surrounding the outlet port, said valve being moved into contact with said wall solely by fluid pressure in said chamber when said shaft is withdrawn.

3. A fluid by-pass valve comprising in combination a casing having a cylindrical chamber, a flexible valve loosely mounted in said chamber, a circular outlet port in one end of said chamber, an inlet port into said chamber, the inlet and outlet port being in different planes, a shaft mounted in the valve casing and extending into the outlet port and of diameter considerably smaller than the port and cams on said shaft for cooperating with the valve casing dimensioned to move the shaft inward and outward when rotated.

4. In a fluid by-pass valve as claimed in claim 2 the flexible valve comprising a cylindrical body having a deep triangular groove around the center of the cylindrical surface.

5. In a fluid by-pass valve as claimed in claim 3 the valve comprising a cylindrical body of flexible material having a deep groove around the center of the cylindrical surface.

6. A fluid by-pass valve comprising in combination a cylindrical valve chamber, a circular outlet port in one end of the valve chamber, an inlet port, the inlet and outlet ports being in different planes, a resilient flexible valve loosely mounted in said chamber, an outlet chamber parallel to the valve chamber and communicating therewith through the outlet passage, a shaft of considerably smaller diameter than the outlet passage mounted in the wall of and extending through the outlet chamber, a cam rigidly mounted on said shaft, a cam surface on the wall of the outlet chamber and registering with the shaft cam whereby rotation of the shaft causes it to move axially into the valve chamber thereby flexing and forcing the flexible valve out of contact with the wall of the valve chamber surrounding the outlet port.

7. In a fluid by-pass valve as claimed in claim 6, means including a portion of said cam on said shaft for preventing the closure of said outlet port by said cam.

8. In a fluid escape valve comprising an inlet chamber, an outlet chamber, passages from the inlet and outlet chambers having adjacent openings in a flat surface, a flexible diaphragm covering the openings, a dome-shaped element fitted on said diaphragm and forming therewith a pressure chamber, channels connecting the inlet chamber to the pressure chamber and means for reducing pressure in the pressure chamber, comprising an inverted cup-shaped element loosely positioned in the pressure chamber and resting on the diaphragm and provided with a small aperture near its open end.

9. A fluid escape valve comprising in combination an inlet chamber, an outlet chamber, passages from the inlet and outlet chambers having adjacent openings in a flat surface, a flexible diaphragm covering the openings, a cup-shaped element, a dome-shaped element secured on said diaphragm and forming therewith a pressure chamber, said cup-shaped element lying within said chamber, loosely fitted on said diaphragm and forming therewith an air trap, a channel connecting the inlet chamber with the pressure chamber, a by-pass valve connected to the pressure chamber by a passage of capacity greater than the connecting channel between inlet and pressure chambers, said valve being capable of rapidly opening and closing.

10. A fluid escape valve as claimed in claim 9, in which the by-pass valve is opened mechanically but is closed by fluid pressure.

11. A fluid escape valve comprising adjacent inlet and outlet chambers forming a single unit, having a substantially flat top, passages from the inlet and outlet chambers having ends adjacent each other in said flat top, a diaphragm mounted on said top, a dome-shaped casting mounted on said diaphragm and forming therewith a pressure chamber, passages connecting the inlet chamber and pressure chamber, an inverted cup-shaped element loosely positioned in the pressure chamber and resting on the diaphragm and provided with an aperture near its lower end, a by-pass valve in the pressure chamber casting comprising a cylindrical valve chamber, a circular exhaust passage in one end of the chamber, an inlet passage leading from the pressure chamber and of diameter considerably larger than the passage connecting the inlet chamber with the pressure chamber, said inlet and exhaust passages not being in the same plane, a loosely mounted valve in said valve chamber comprising a cylindrical body and provided with a deep groove around its median circumference, an exhaust chamber parallel to the valve chamber and communicating

with the outside air, a shaft of diameter smaller than the exhaust passage mounted in the wall of and extending through the exhaust chamber, a cam rigidly attached to said shaft and a second cam rigidly mounted in the wall of the exhaust chamber and engaging with the cam on the shaft to cause the latter to move in and out of the valve chamber when rotated and means including an inclined surface on said cam on said shaft for preventing the shaft cam from closing the exhaust passage.

12. A ball cock comprising in combination a fluid escape valve and controlling by-pass valve as claimed in claim 11, a ball float attached to a rod, and adjustable means for clamping the rod on to the shaft of the by-pass valve so as to cause rotation of the latter when the float alters its level.

In testimony whereof we affix our signatures.

ALEXANDER THOMSON.
JOHN W. ESKHOLME.

CERTIFICATE OF CORRECTION.

Patent No. 1,621,910. Granted March 22, 1927, to

ALEXANDER THOMSON ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, lines 86 to 90, claim 9, strike out the words "a dome shaped element secured on said diaphragm and forming therewith a pressure chamber, said cup-shaped element lying within said chamber", and insert the same to follow after the word "trap", line 91, same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 19th day of April, A. D. 1927.

M. J. Moore,
Acting Commissioner of Patents.

Seal.