

Aug. 10, 1948.

R. O. WALTON

2,446,680

WELL FLOW DEVICE

Filed Oct. 21, 1944

2 Sheets-Sheet 1

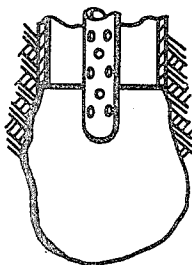
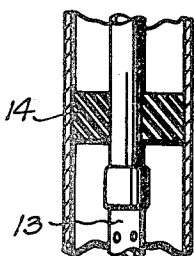
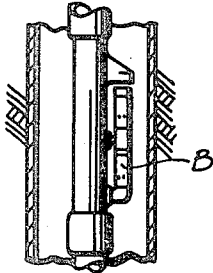
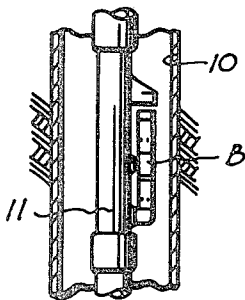
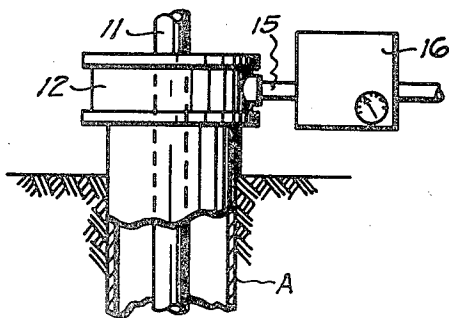


Fig. 1

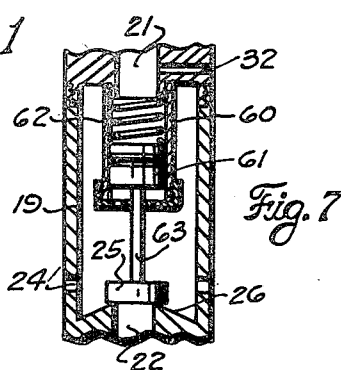


Fig. 7

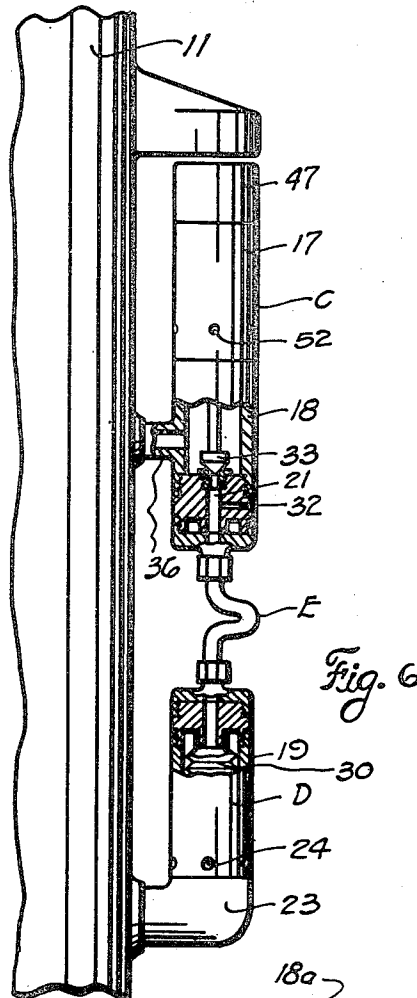


Fig. 6

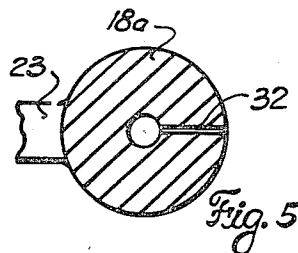


Fig. 5

Robert O. Walton
INVENTOR

BY *John E. Edwards*
ATTORNEY

Aug. 10, 1948.

R. O. WALTON

2,446,680

WELL FLOW DEVICE

Filed Oct. 21, 1944

2 Sheets-Sheet 2

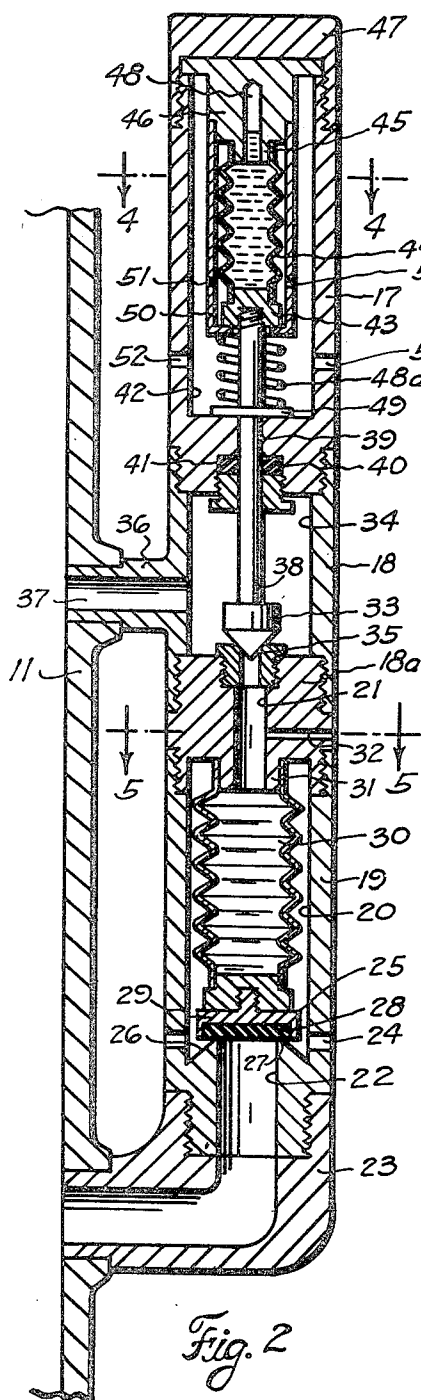


Fig. 2

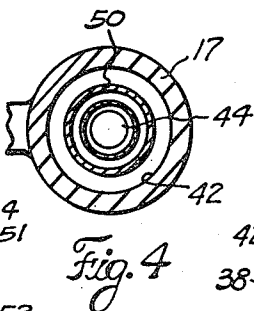


Fig. 4

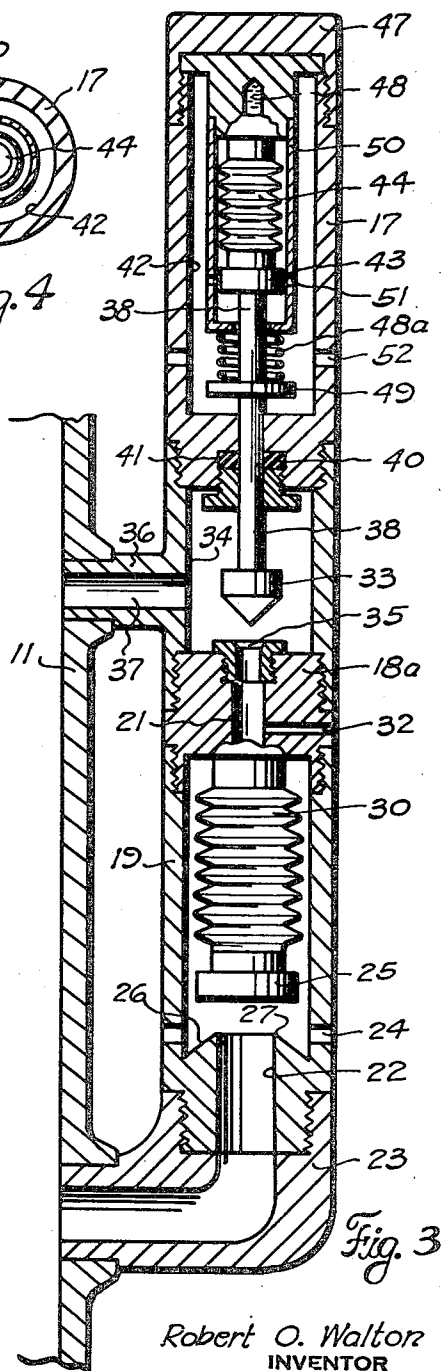


Fig. 3

Robert O. Walton
INVENTOR

BY *for E. Edwards*
ATTORNEY

UNITED STATES PATENT OFFICE

2,446,680

WELL FLOW DEVICE

Robert O. Walton, Dallas, Tex., assignor to Merla Tool Corporation, Dallas, Tex., a corporation of Texas

Application October 21, 1944, Serial No. 559,709

16 Claims. (Cl. 103—232)

1

This invention relates to new and useful improvements in well flow devices.

The invention is a modification of and improvement on the device shown in my co-pending applications, Serial No. 451,570, filed July 20, 1942, and Serial No. 539,424, filed June 9, 1944, which latter application has now matured into Patent 2,385,316, issued September 18, 1945.

One object of the invention is to provide an improved device for controlling the admission of a lifting fluid, such as gas, into a liquid column within a well tubing or conductor for lifting or raising the liquid to the surface, said device being particularly adapted for use as an intermitter to intermittently admit the lifting gas at predetermined intervals in accordance with well conditions.

An important object of the invention is to provide an improved well flow device having all of the advantages of the devices disclosed in my prior co-pending applications, above referred to, and in addition having an improved main valve arrangement which is constructed so that said valve moves entirely out of the line of flow of the admitted lifting fluid when the valve is in its open position, whereby an unrestricted flow of lifting fluid is admitted to the tubing and also whereby the main valve is not subjected to excessive wear caused by the velocity of the flowing fluid.

A particular object of the invention is to provide an improved well flow device having a main valve for controlling the admission of a lifting fluid into a well tubing, the pressure of the lifting fluid normally acting on both sides of said valve together with a resilient means acting on the valve to urge and maintain the valve in a closed position; there being pilot valve means for "bleeding off" or releasing the lifting fluid pressure acting against one side of the valve when said pressure reaches a predetermined point, whereby the main valve is automatically moved to an open position by the pressure acting against the opposite side thereof; the use of the lifting fluid pressure as the actuating means providing for a "snap action" or quick opening of the valve to admit the lifting fluid into the tubing in a substantially unrestricted or unmeasured flow.

Still another object of the invention is to provide an improved device, of the character described, wherein the main valve is attached to a pressure actuated element, such as a bellows or piston, with such element being exposed to and actuated by the pressure of the lifting fluid; said pressure actuated element being of a greater area than the fluid admission port controlled by the valve and also being subjected to the full pressure of said fluid through ports which have a greater area than the fluid admission port which the main valve controls, whereby when the valve

2

opens it moves with a "snap action" to a wide open position and the admission of lifting fluid to the tubing is restricted only by the actual cross-sectional area of the valve-controlled admission port.

A specific object of the invention is to provide an improved main valve for a well flow device, of the character described, which comprises a minimum number of parts and which includes a simplified seating arrangement, whereby maximum sealing efficiency, when the valve is in its closed position, is obtained.

The 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, wherein an example of the invention is shown, and wherein:

Figure 1 is a view, partly in section and partly in elevation of a well bore having a well tubing extending therethrough and showing a plurality of well devices, constructed in accordance with the invention, mounted in said tubing,

Figure 2 is an enlarged, transverse vertical sectional view of the flow device with the main valve and pilot valve closed,

Figure 3 is a similar view with both pilot and main valves open,

Figure 4 is a horizontal, cross-sectional view taken on line 4—4 of Figure 2,

Figure 5 is a horizontal, cross-sectional view, taken on line 5—5 of Figure 2,

Figure 6 is a view, partly in section and partly in elevation of a modified form of the invention, wherein the device is made in two separate sections, and,

Figure 7 is a sectional detail showing another form of main valve construction.

In the drawings, the letter A designates a well bore having a well casing 10 therein. A well tubing 11 extends downwardly through the casing 10 and has its upper end supported in the usual casing head 12 which is mounted on the upper end of said casing. The lower end of the well tubing has the conventional well screen 13 through which the well fluids are admitted into said tubing attached thereto. A suitable well packer 14 which is schematically illustrated packs off between the tubing and casing above the perforated screen 13.

A plurality of valve devices B, constructed in accordance with the invention, are connected in the tubing 11 and are located at various elevations or levels therein. As will be hereinafter described, each device B is adapted to control the admission of a lifting fluid, such as gas, into the well tubing string and such fluid is utilized to lift the well liquids upwardly through said tub-

ing to the surface. The invention will be hereinafter described as operating with an auxiliary lifting fluid, such as gas, but it is noted that the lifting fluid may be gas from a sub-surface formation which is conducted into the well casing. When auxiliary lifting fluid is employed, said lifting fluid or gas is conducted to the annular space between the well casing 10 and the well tubing through an inlet pipe 15 which is connected to the casing head 12, the admission of said gas being controlled by a time-controlled intermitting device 16. The time controlled intermitter 16, as is well known, controls the admission of gas to admit the same in predetermined volumes at desired intervals and said device is adjusted in accordance with the particular conditions of each well.

The devices B are all of identical construction and each device includes a tubular housing which is constructed of three sections, an upper section 17, an intermediate section 18 and a lower section 19, the latter being connected to the section 18 by a coupling 18a. The lower section is provided with an axial bore 20 and the coupling 18a has an axial bore which forms a reduced counterbore 21 to the main bore at the upper end of the section 19. A gas admission port 22 is provided in the lower portion of the section by counterboring said section. The extreme lower end of the section 19 is threaded into one end of an angular tubular nipple 23, the latter having its opposite end connected into the tubing 10 and obviously the port 22 and nipple 23 establish communication between the interior of the section 19 and the bore of said tubing. Communication between the exterior of the section and the interior thereof is established by a plurality of inlet openings or ports 24 which are provided in the wall of said section and which are disposed circumferentially therearound. It is noted that the combined cross-sectional area of the openings 24 is greater than the cross-sectional area of the admission port 22 whereby a flow of fluid from the well casing through said openings and into the port 22 will not be restricted by said openings.

For controlling the flow of fluid through the admission port 22, a main valve 25 is mounted within the section 19 and is adapted to engage an annular valve seat 26 which surrounds said port. The valve seat is tapered or inclined to present a relatively sharp annular edge 27 which is arranged to be engaged by a valve disk 28 constructed of a resilient material, such as rubber or Duprene, the disk being mounted within and forming part of the valve head 29 of the valve 25. The valve head is connected to the lower end of a main valve bellows 30 which is disposed within the bore of the section 19. The upper end of the bellows is suitably fastened to an annular collar 31 which surrounds the lower end of the counterbore 21 and said bellows is constructed so that its spring action normally urges it toward an extended or expanded position, whereby said bellows tends to hold the main valve 25 in its lowered or seated position as shown in Figure 2. It is obvious that the exterior of the bellows 30 is exposed to the pressure which may be present in the well casing since this pressure may enter the bore of the section 19 through the openings 24 and manifestly, such pressure will tend to collapse or depress the bellows, as shown in Figure 3, to raise or open the main valve.

To normally counteract the pressure acting on

the exterior of the bellows 30 and thereby permit the inherent spring action of the bellows to maintain the valve 25 in its seated or closed position, the interior of said bellows is also exposed to the pressure within the annular space between the well tubing 11 and well casing 10 through a radially extending passage 32. The passage is disposed in the upper portion of the section 18 and communicates with the counterbore 21. With this arrangement the pressure of the fluid within the casing, which is actually the lifting fluid or gas, acts against the interior of the bellows through passage 32 and counterbore 21; simultaneously, this same fluid pressure is acting on the exterior of the bellows through openings 24 and therefore, the inherent spring tension of said bellows is utilized to hold the bellows expanded and the main valve 25 closed. So long as the pressures acting interiorly and exteriorly of the bellows are equal the valve 25 remains closed.

The pressure within the casing which is acting upon the bellows 30 is that of the lifting fluid or gas and when this pressure reaches a predetermined point, it is desirable to open the main valve 25 to admit the lifting fluid into the well tubing to effect raising of the well liquid within the tubing. In order to actuate the main valve 25 and move it to its unseated or open position when the lifting fluid reaches a predetermined pressure, a pilot valve 33 is mounted within the bore 34 of the intermediate section 18 of the device. The pilot valve is adapted to engage a valve seat 35 mounted in the upper end of the counterbore 21 and when said valve is seated the pressure is trapped within the bellows to equalize pressures interiorly and exteriorly of the bellows and thereby maintain the valve 25 seated or closed. Upward movement of the pilot valve 35 opens the counterbore 21 to permit escape of pressure from within the bellows into the section 18; the section 18 communicates with the interior of the well tubing through a tubular nipple 36 and it is noted that the bore 37 of the nipple is of considerably larger diameter than the supply passage 32 through which the fluid pressure is admitted to the bellows. Thus, as soon as the pilot valve 33 is opened, the pressure escapes from the interior of the bellows 30 at a faster rate than such pressure can be replenished through the relatively small passage 32, with the result that the pressure acting on the interior of the bellows is reduced. The pressure acting on the outside of the bellows is substantially constant and as a pressure reduction occurs interiorly of the bellows, the external pressure depresses said bellows, as shown in Figure 3, to unseat or open the valve 25 and thereby admit lifting fluid to the tubing 11 through the port 22. It is pointed out that the external area of the bellows 30 is considerably larger than the area of the admission port 22, whereby a rapid depression of the bellows will occur. The large area of the bellows together with the fact that the combined cross-sectional area of the openings 24 is larger than the admission port 22 will assure a quick depression of the bellows to its upper position, whereby a "snap action" in opening the valve 25 is had. In other words, as the valve 25 begins to move off its seat and fluid begins to flow through the port 22, the bellows will continue to move the valve to a full open position because the pressure within the section 19 will not be rapidly dissipated but will remain substantially constant since it cannot escape through port 22 as fast as it enters the section

19. This is an important feature of the invention because it assures quick movement of the valve to its full open position.

In order to open the pilot valve 33 when the pressure of the lifting fluid reaches the predetermined desired point, said valve is actuated solely by the lifting fluid pressure. As is clearly shown in Figures 2 and 3, the pilot valve includes a stem 38 which extends upwardly through a reduced counterbore 39 formed in the lower portion of the upper section 17. A suitable packing ring 40 is disposed within a recess 41 in the counterbore and surrounds the stem to seal off around said stem. The upper end of the stem extends upwardly into the main bore 42 of the section 17 and has its extreme upper end fastened to a plug 43. The plug 43 is attached to and closes the lower end of an operating bellows 44 which is disposed within the upper portion of the section 17. The upper end of the bellows is fastened to a depending collar 45 which is formed integral with a cap member 46, the latter being mounted in position between the upper end of the section 17 and a closure 47 having threaded connection with said section.

The bellows 44 is constructed so that its normal spring action tends to expand the bellows whereby the pilot valve attached to its lower end is normally urged toward its seated position.

The interior of the bellows is filled (Figure 2) with a suitable fluid such as water or oil and the upper end of said bellows communicates with a recess 48 in the cap member 46. When the bellows is expanded and the pilot valve seated (Figure 2) the fluid does not completely fill the recess, whereby the bellows may be depressed until this recess is completely filled. The volume of fluid within the bellows will determine the amount of movement which the bellows may undergo and thus the fluid acts as a positive stop to limit the travel of the pilot valve. Also, it is apparent that when the bellows is fully depressed the fluid completely fills said bellows and recess and since said fluid is non-compressible, rupturing or breaking of the bellows by an excessive external pressure on said bellows cannot occur. Thus, the fluid not only acts as a stop for limiting movement of the pilot valve but also acts to prevent rupturing of said bellows by external pressure and this is an important feature of the invention.

In addition to the normal action of the bellows urging the pilot valve to its seated position, a coiled spring 48a surrounds the pilot valve stem 38 within the upper section 17. This spring has its lower end engaging an external annular flange or ring 49 which is secured to the stem, while its upper end is confined against the lower end of a fixed sleeve 50. The sleeve 50 has its upper end fastened to the cap member 46 and encircles the pilot bellows 44. The plug 43 which closes the lower end of the bellows and has the stem attached thereto is arranged to engage the flanged lower end of the sleeve when the pilot valve is in a lowered or closed position (Figure 2). The sleeve 50 has a plurality of ports or openings 51 therein while the upper section is provided with inlet ports 52 whereby the pressure of the lifting fluid in the casing may enter the section and then the sleeve to act upon the bellows 44 to depress the same. It is noted that the sleeve 50 could be replaced by elongate stop arms which would serve the same purpose.

The spring 48a which urges the pilot valve to its closed position is of a predetermined tension and obviously, the pressure of the lifting fluid

acting against the pilot bellows 44 must reach a predetermined pressure before the pilot valve will open. By changing the tension of this spring, the pilot valve may be arranged to open at any desired lifting fluid pressure. No differential of pressure across the valve is depended upon because the spring exerts a constant fixed pressure on the valve which can be overcome only when the lifting fluid pressure exceeds such constant.

In operation, a plurality of valve devices B are connected in the tubing string 11 and are disposed at various elevations therein. Each valve device has its spring 48a properly adjusted so as to exert a predetermined pressure upon its pilot valve 33, it being preferable that the uppermost device be set for the highest pressure. For example, the uppermost valve device in the tubing may be set to open the pilot valve at 450 pounds per square inch, the next set to open at 425 pounds, the third at 400 and so on progressively to the lowermost device in the tubing which would, of course, be operated by the lowest pressure.

Normally each valve device has its ports in the position shown in Figure 2, with the main valve 25 held closed by the inherent spring in the main bellows 30 and the pilot valve held closed by the coiled spring 48a and pilot bellows 44. After the liquid in the casing outside of the tubing and above the packer 14 has been removed and replaced by the lifting fluid, the pressure of said lifting fluid is maintained at a point below that at which the lowermost valve is set to operate. Thus, a lifting fluid pressure is normally maintained within the well casing but such pressure is not sufficient to actuate the valve devices. At this time, the apparatus is ready for operation to admit lifting fluid into the tubing.

It might be pointed out that the pressure within the casing 10 enters the lowermost section 19 through openings 24 and acts against the exterior of the main bellows 30. This same pressure enters the interior of the bellows 30 through the passage 32 and counterbore 21 to equalize pressures exteriorly and interiorly of the bellows whereby the inherent spring tension of said bellows holds the main valve 25 seated. The lifting fluid pressure is also acting against the pilot valve 33 through the counterbore 21 and is acting through openings 52 in the section 17 and opening 51 in the sleeve 50 against the exterior of the bellows 44; however, at this time such pressure is insufficient to open said pilot valve because of the resistance of the spring 48a and the pilot bellows which are acting to hold said pilot valve seated.

The liquid column in the well tubing is permitted to build up to its standing level after which the intermitter 16 actuates to admit a charge of lifting fluid into the well casing to increase the pressure of said fluid within said casing. As this pressure reaches the point at which the lowermost valve is set, said pressure acting on the pilot bellows 44 overcomes the resistance of the spring 48a and depresses said bellows to cause upward movement of the pilot valve 33 from its seat. As soon as this occurs, the pressure within the main valve bellows 30 may escape upwardly through the counterbore 21 and nipple 36 into the tubing (Figure 3) with the result that the pressure within the main bellows is reduced. The lifting fluid pressure acting on the exterior of the bellows is substantially constant and immediately upon the reduction of pressure within said bellows, the bellows is depressed to lift the main valve 25 from its seat 26, whereby the lifting fluid is admitted into the tubing through the admission port 22

7

and angular nipple 23. The admitted lifting fluid will lift the well liquid within said tubing to the surface in the usual manner. The main valve 25 will remain open as long as the pressure acting upon the pilot bellows 44 is sufficient to hold the pilot valve open against the pressure of the spring 48a. However, when the fluid pressure in the casing drops below the pressure of the spring 48a the pilot valve closes to again permit equalization of pressures across the main bellows 30, whereby the main valve 25 is again seated.

As has been explained, the combined cross-sectional area of the inlet openings 24 is greater than the cross-sectional area of the admission port 22; this, together with the fact that the external area of the bellows exposed to the pressure is also greater than the cross-sectional area of the admission port assures that the valve 25 will be quickly opened to a wide-open position because the pressure acting on the bellows will not be reduced immediately following the initial opening of said valve. Further, as the valve 25 moves to its upper open position, as shown in Figure 3, it is out of the direct line of flow of the admitted lifting fluid, whereby said valve forms no restriction to the flow and is not subjected to "cutting out" or excessive wear caused by contact with the flowing fluid.

Although a bellows has been found satisfactory as the operating medium for the main valve 25, the invention is not to be limited to such bellows and in Figure 7, a modified form of the invention is illustrated. In this form, a co-axial cylinder 60 is mounted within the lowermost section 17 of the device, said cylinder having its upper end surrounding and secured to the depending collar 31. A piston 61 is slidable within the cylinder and is normally urged downwardly therein by a relatively light coiled spring 62. A valve stem 63 is secured to the lower end of the piston and has the main valve 25 attached to its lower end, whereby movement of the piston within the cylinder lowers and raises the main valve 25 with respect to its seat.

The operation of this form of the invention is obvious, the piston being actuated by pressures in the same manner as the bellows 30 is operated. The upper end of the piston is exposed to the lifting fluid pressure through the passage 32 and counterbore 21, while the lower end of said piston is subjected to the same pressure. Thus, pressures across the piston are equalized and the coil spring 62 holds the valve 25 seated. When the pilot valve 33 is opened, the pressure acting against the upper end of the piston is released, whereby the piston is moved upwardly by the pressure exerted against its lower end. Such upward movement of said piston will lift the main valve 25 to open the admission port 22 and admit gas into the well tubing.

As illustrated in Figures 1 to 5, each valve device is constructed of the three sections 17, 18 and 19 which are connected to each other to form a complete unit. The section 18 has connection with the tubing through the nipple 36 while the lower section 19 is also connected to said tubing by the angular nipple 23. Because of the double connection with the tubing, it may be more desirable to divide the device into two units and such an arrangement is shown in Figure 6. In this instance, the sections 17 and 18 form an upper unit C and the section 19 forms a lower unit D. The units are each mounted individually on the well tubing 11 by the nipples 36 and 23 respectively and are connected to each other by a flexible connection

8

or tubing E. The upper end of the connection E is fastened into the bore 21 of the coupling and its lower end is attached to a cap member 64 which closes the upper end of the section 19. The cap member 64 has an axial bore 65 which communicates with the interior of the main bellows 30 and thus, the flexible connection E establishes communication between the well casing and the interior of said bellows. The operation is, of course, the same as has been hereinbefore described.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. A flow device including, a well tubing, a housing adapted to be connected in said tubing having a flow passage for establishing communication between the exterior and interior of the well tubing, a main valve element for controlling the flow through said passage, movable means connected to the main valve and having opposite sides thereof exposed to the pressure exteriorly of the tubing whereby the pressures across said means are equalized, resilient means for normally holding said means in a position maintaining the main valve closed, and pilot valve means arranged to be actuated when the pressure exteriorly of the tubing reaches a predetermined point for releasing the pressure acting on one side of the movable means, whereby said movable means may be actuated to open the main valve and admit flow into the tubing.

2. A flow device as set forth in claim 1, wherein the movable means is a depressible bellows having its interior and exterior exposed to the pressure exteriorly of the tubing and also wherein the inherent resiliency of the bellows is the resilient means which maintains the main valve seated when pressures interiorly and exteriorly of the bellows are equalized.

3. A flow device as set forth in claim 1, wherein the pilot valve means is a movable valve normally closed to prevent escape of the pressure acting on one side of the movable means and when open permits escape or dissipation of said pressure to allow operation of the movable means.

4. A well flow device including, a well tubing, a housing adapted to be connected in said tubing having a flow passage extending therethrough for establishing communication between the exterior and interior of the tubing, a main valve element within the passage and movable to open and closed positions within said passage for controlling the flow therethrough, pressure actuated means connected with the valve and having opposite sides thereof exposed to the pressure exteriorly of the tubing whereby the pressures are normally balanced across said means, means associated with the main valve for urging the valve to a closed position and functioning to hold said valve closed when pressures across the pressure actuated means are equalized, and operating means also acted upon by the pressure exteriorly of the tubing for releasing the pressure acting upon one side of the pressure actuated means whereby the pressure acting on the opposite side thereof may actuate said means to open the main valve and admit flow into the well tubing.

5. A well flow device as set forth in claim 4, wherein the operating means is actuated only

upon the attainment of a predetermined pressure exteriorly of the tubing.

6. A well flow device as set forth in claim 4, wherein the operating means is a pilot valve arrangement which is normally closed to prevent escape of pressure acting on one side of the pressure actuated means and when opened releases such pressure to permit opening of the main valve.

7. A well flow device as set forth in claim 4, wherein the pressure-actuated means is a depressible bellows having its interior and exterior exposed to the pressure exteriorly of the tubing and also wherein the inherent resiliency of said bellows is the means associated with the main valve for holding said valve seated when pressures exteriorly and interiorly of said bellows are equalized.

8. A well flow device including, a well tubing, a housing adapted to be connected in said tubing having a flow passage extending therethrough for establishing communication between the exterior and interior of the tubing, a main valve element within the passage and movable to open and closed positions within said passage for controlling the flow therethrough, pressure actuated means connected with the valve and having opposite sides thereof exposed to the pressure exteriorly of the tubing whereby the pressures are normally balanced across said means, means associated with the main valve for urging the valve to a closed position and functioning to hold said valve closed when pressures across the pressure actuated means are equalized, the housing having an enlarged escape port extending from one side of the pressure actuated means to permit escape of the pressure acting on that side of said means to allow actuation of the means to open the main valve, a pilot valve for controlling the flow through the escape port, whereby said pilot must open before the main valve may be opened, and a pressure operated means exposed to and actuated by the pressure exteriorly of the tubing for moving the pilot valve to an open position.

9. A well flow device including, a well tubing, a tubular housing mounted on the well tubing and having an admission port establishing communication between the interior of the housing and said tubing, the housing also having an inlet in its wall for admitting the fluid pressure from exteriorly of the tubing, a main valve element for controlling the flow through the admission port, movable means within the housing connected with the main valve and having opposite sides thereof exposed to the pressure exteriorly of the tubing whereby the pressures across said means are normally equalized, resilient means associated with said movable means for normally holding said means in a position maintaining the main valve closed, and pilot valve means arranged to be actuated when the pressure exteriorly of the tubing reaches a predetermined point for releasing the pressure acting on one side of the movable means, whereby the latter is actuated to open the main valve and permit flow through the admission port into the tubing.

10. A well flow device as set forth in claim 9, wherein the main valve element is a disk-type valve adapted to cover one end of the admission port and also wherein said valve is disposed out

of the direct line of flow when in an open position.

11. A well flow device including, a well tubing, a tubular housing mounted on the well tubing and having an admission port establishing communication between the interior of the housing and said tubing, the housing also having an inlet in its wall for admitting the fluid pressure from exteriorly of the tubing, a main valve element for controlling the flow through the admission port, pressure-actuated means within the housing connected with the main valve and having one end exposed to the pressure exteriorly of the housing which has been admitted into the housing through the inlet, the opposite end of said means also being exposed to the pressure exteriorly of the tubing, whereby pressure across said means are equalized, resilient means associated with the main valve for holding the same closed when pressures across the pressure-actuated means are equal, and pilot valve means for releasing the pressure acting upon one end of the pressure-actuated means to unbalance the pressures thereacross and permit the pressure within the housing to actuate the pressure actuated means to open the main valve.

12. A well flow device as set forth in claim 11, wherein the cross-sectional area of the inlet in the housing is greater than the cross-sectional area of the admission, whereby immediate dissipation of pressure within the housing upon initial opening of the main valve is prevented.

13. A well flow device as set forth in claim 11, wherein the pressure actuated means is a depressible bellows having its exterior exposed to the pressure which enters the housing from exteriorly of the tubing and having its interior exposed to the same pressure, and also wherein the resilient means associated with the main valve is the inherent resiliency of said bellows which holds the valve closed when pressures across said bellows are equal.

14. A well flow device as set forth in claim 1, wherein the movable means is a piston and the resilient means is a spring acting on said piston to urge the same in a direction holding the main valve closed when pressure across said piston are equalized.

15. A well flow device as set forth in claim 4, wherein the pressure actuated means is a movable piston and wherein the means associated with the main valve for urging the valve is a spring acting upon one side of said piston.

16. A well flow device as set forth in claim 11, wherein the pressure actuated means is a movable piston and wherein the resilient means associated with the main valve is a spring acting upon one side of said piston.

ROBERT O. WALTON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,278,017	Parks	Mar. 31, 1942
2,342,301	Peters	Feb. 22, 1944
2,358,944	Taylor	Sept. 16, 1944
2,361,718	Taylor	Oct. 31, 1944
2,385,316	Walton	Sept. 18, 1945