Sept. 2, 1958 C. C. BROWN 2,850,102

VALVES

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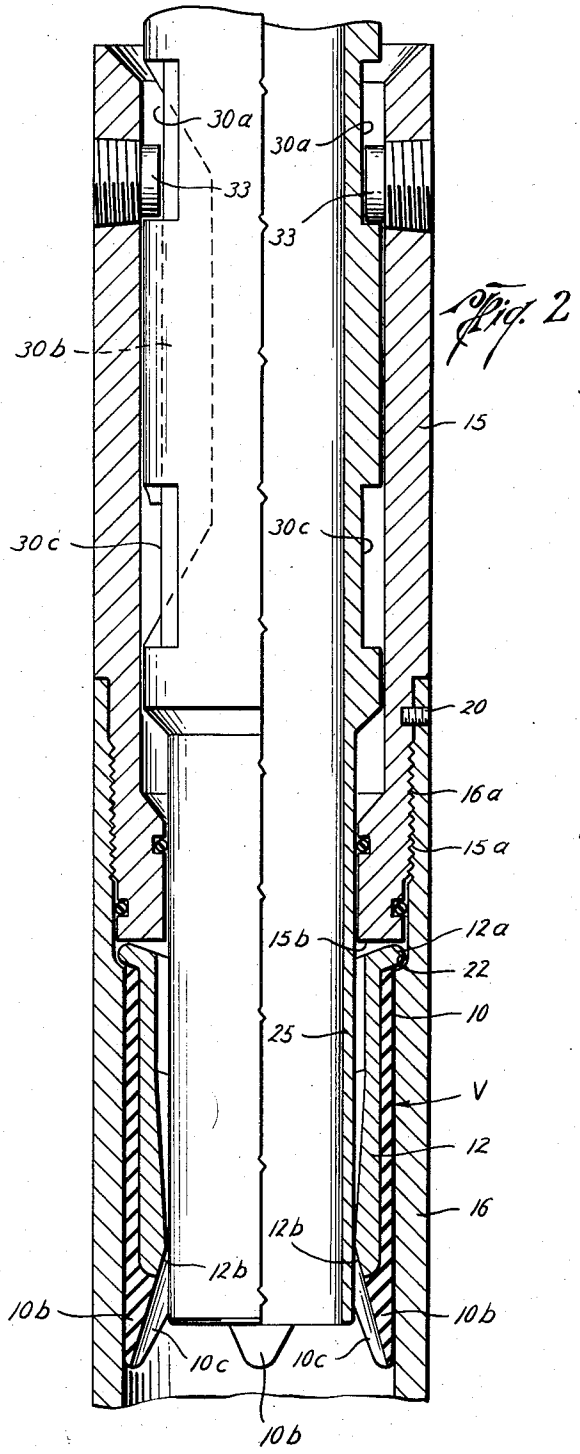

Fig. 2

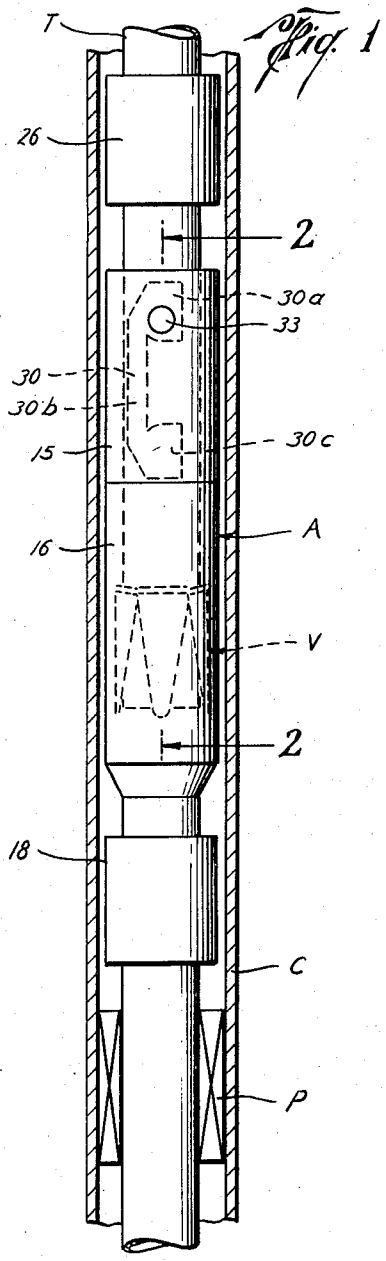

Fig. 1

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Fig. 3

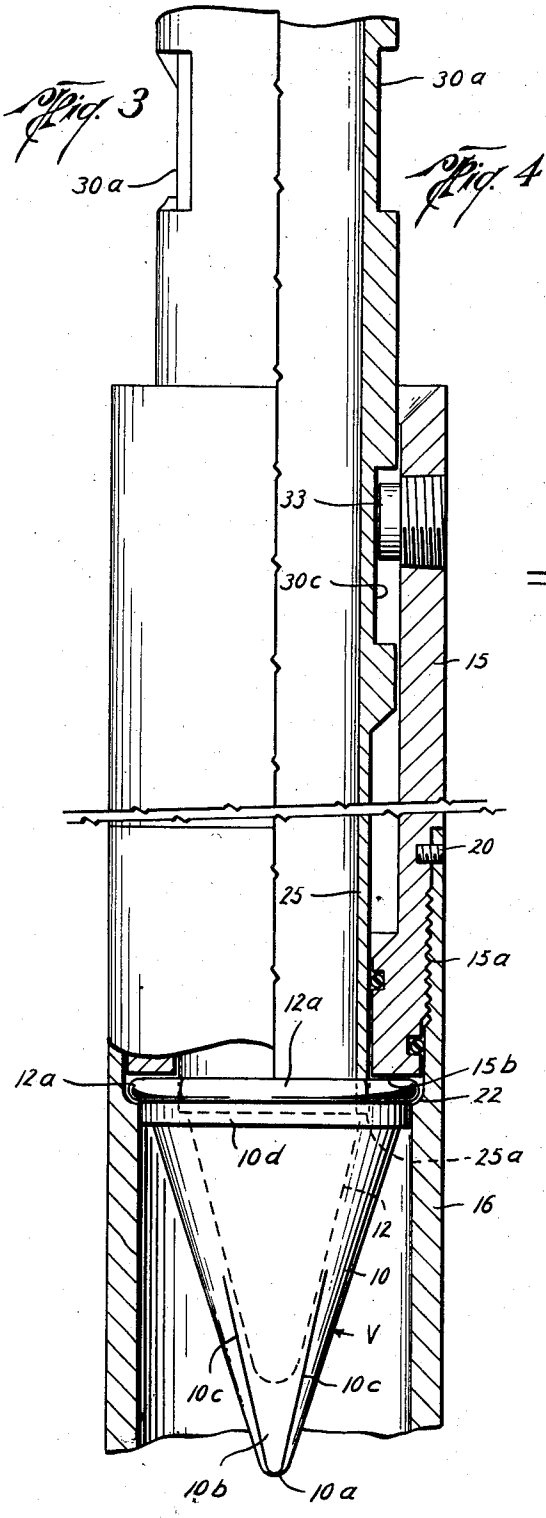

Fig. 4

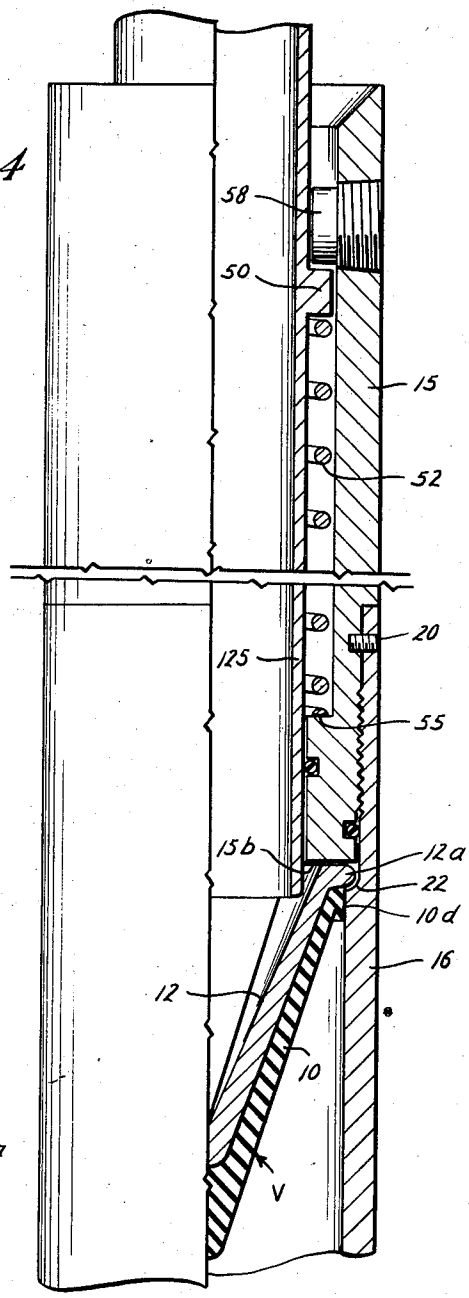

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Fig. 5

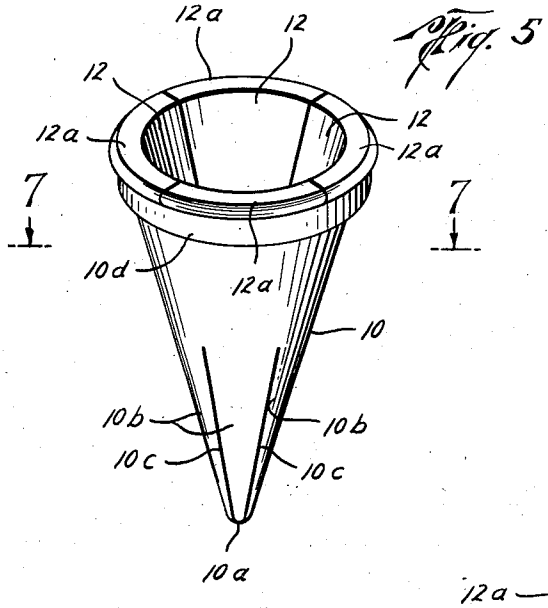


Fig. 6

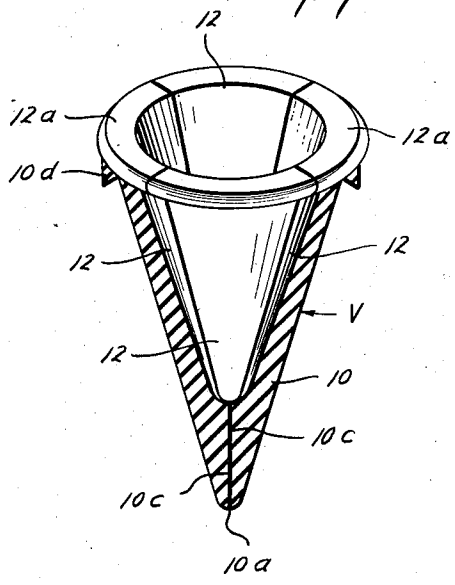
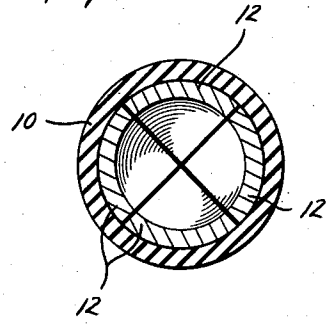


Fig. 7



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2,850,102

VALVES

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Application October 29, 1954, Serial No. 465,559

4 Claims. (Cl. 166—226)

This invention relates to new and useful improvements in valves.

An object of this invention is to provide a new and improved valve for use in a well tubing or other tubular means, said valve being adapted for full opening whereby the bore of the well tubing or other tubular means is unobstructed when said valve is open.

An important object of this invention is to provide a new and improved valve assembly for use in a well pipe or the like, wherein the valve of the valve assembly is adapted to provide a full opening to leave the bore of the well pipe unobstructed when the valve is opened upon a manipulation of the well pipe.

Another object of this invention is to provide a new and improved valve which is adapted to be disposed in a pipe string for preventing fluid flow in one direction in the pipe string, and being adapted for opening to the full diameter of the pipe forming the pipe string.

A further object of this invention is to provide a new and improved valve which is capable of being opened upon a longitudinal movement of a tubular member into the valve.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

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

Figure 1 is a view, partly in elevation and partly in section, illustrating the valve assembly of this invention in a tubing string.

Figure 2 is a view, partly in elevation and partly in section, illustrating in detail the valve assembly of this invention in its open position.

Figure 3 is a view, partly in elevation and partly in section, illustrating the valve assembly shown in Figure 2 in its closed position.

Figure 4 is a view, partly in elevation and partly in section, illustrating a modified construction of the valve assembly shown in Figures 1–3.

Figure 5 is an isometric view of the valve of this invention.

Figure 6 is an isometric view, partly in section, of the valve of this invention.

Figure 7 is a horizontal sectional view taken on line 7—7 of Figure 5.

In the drawings, the letter A designates generally the improved valve assembly of this invention. The valve assembly A is preferably mounted in a tubing string T or the like which extends from the surface of a well and which has thereon a hook-wall packer P or some equivalent packer connected therewith for sealing and gripping engagement with a well casing C. As explained in detail hereafter, the valve assembly A includes a valve which is capable of being opened to substantially the same diameter as the bore of the tubing in the string T upon a manipulation of the tubing string T from the surface of the well whereby the bore of the tubing string T is unobstructed by the valve V so as to permit the unobstructed movement of well tools within the tubing string T.

The valve V (Figures 2, 3, 5 and 6) has an outer valve member 10 which is substantially conical and which is formed of rubber or any suitable flexible or elastic material. The outer valve member 10 is provided with a plurality of slits extending from the lower pointed end 10*a* (Figures 3 and 5) to about the mid-portion of the valve member 10 whereby a plurality of flaps 10*b* are formed in the lower end of the valve member 10. The flaps 10*b* are adapted to be separated from each other to permit fluid flow downwardly through the valve, but the sides 10*c* of the flaps 10*b* engage each other to form a fluid-tight seal when the fluid flows upwardly against the valve.

A plurality of inner support members 12 are provided within the outer member 10, each of which is arcuate so that the members 12 together form a complete circle at the upper end thereof. The members 12 are thus seated within the outer member 10 and each member 12 has a laterally-extending upper lip or shoulder 12*a* which rests upon the top of the annular flange 10*d* of the outer member 10. The members 12 are preferably formed of metal or other similar substantially rigid material so as to reinforce the flexible or elastic valve member 10 against the collapse from fluid pressure acting from below the valve V. Also, the members 12 prevent wear or damage to the outer flexible member 10 during the opening and closing of the valve V as will be more evident hereafter. It will also be noted that each of the members 12 has its sides or edges 12*b* in contact with the adjacent sides or edges 12*b* of the other members 12 so that the inward movement of the members 12 is limited. Although any number of the inner reinforcing members 12 may be employed, the valve V preferably has four of the members 12 and preferably four of the flaps 10*b* with lower portion of each of the members 12 extending downwardly below the upper end of the flaps 10*b*.

The valve V is positioned in the tubing string T between an upper tubular adapter 15 and a lower tubular adapter 16. The lower end of the adapter 16 is connected to the lower part of tubing string T through a suitable conventional coupling 18 (Figure 1) or by any other suitable means, while the upper end of the adapter 16 is threaded to the upper adapter 15 by a threaded engagement of threads 15*a* and 16*a* on the adapters 15 and 16, respectively. A set screw 20 extends from the upper end of the lower adapter 16 into the lower portion of the upper adapter 15 so as to retain the threads 15*a* and 16*a* at a predetermined position relative to each other. The upper inner bore of the lower adapter 16 is of an increased diameter so as to provide the annular curved shoulder 22 for receiving the laterally-extending flanges 12*a* of the reinforcing members 12 of the valve V. In such manner, the valve V is supported in the tubing string between the upper and lower adapters 15 and 16. The valve V is prevented from moving upwardly by reason of the lower annular end of the upper adapter 15 which extends inwardly and directly above the flanges 12*a*. The annular end 15*b* of the adapter 15 thus serves as a stop in the upward direction for the valve V, but it does not interfere with the swinging movement of the flanges 12*a* during the opening and closing of the valve V.

A tubular actuator 25 is connected to the upper portion of the tubing string T by a suitable coupling 26 (Figure 1). When the valve V is closed, the lower end

25*a* of the actuator **25** is preferably substantially adjacent the flanges **12***a*, but at any rate, the actuator **25** is normally positioned so that it does not open the valve V.

The actuator **25** has an enlarged upper portion which is formed with a connector slot **30** (Figures 1–3) which has an upper offset **30***a*, a vertical slot portion **30***b* and a lower offset **30***c*. One or more of such slots **30** may be formed in the external surface of the upper portion of the tubular actuator **25**, and for each slot **30**, a pin **33** is mounted in the upper adapter **15** so as to extend inwardly into such slot **30**. When the valve V is in its normal operating position (Figure 3) so that it acts as a back check-valve to prevent upward fluid flow through the tubing while permitting downward fluid flow through the valve and the tubing, the actuator **25** is in a raised position with the pin or pins **33** being in the lower offset portion or portions **30***c* of the slot or slots **30**. Upon turning the tubing T to move the pins **33** out of the lower offsets **30***c* and following such turning with a lowering of the tubing T, the actuator **25** is lowered to cause its lower end **25***a* to pass into contact with the members **12** for urging same outwardly against the resiliency of the outer member **10**. The continued lowering of the actuator **25** effects an outward expansion or spreading of the valve V to fully open same so that substantially the same diameter opening is provided through the valve V as is available through the rest of the tubing string (Figure 2).

Thus, in the operation or use of the valve assembly A of this invention in the form shown in Figures 1–3, the valve V is normally in the position shown in Figure 3. When in such position, fluid from above the valve V can force the valve V open to permit downward fluid flow through the tubing, but upon a reverse or upward flow of fluid in the tubing B, the flaps **10***b* of the valve V co-act with each other so that their edges **10***c* are in sealing contact to prevent fluid flow upwardly through the tubing. The members **12** reinforce the outer flexible valve member **10** and the edges **12***b* abut each other to prevent the collapse of the member **10** when the upward fluid pressure is acting on the exterior of the valve V. When the valve is in such normal operating position, the actuator **25** is in its upper position with the pin **33** extending into the lower offset **30***c* of the slot **30**.

When it becomes desirable to lower well tools through the tubing string T, the valve V is fully opened so as to prevent obstruction to the passage of such well tools. The opening of the valve V to its full bore position is accomplished by turning the tubing string T so as to move the pin **33** out of the lower offset **30***c* and into the longitudinal portion **30***b* of the slot **30**. As viewed from the top of Figure 3, such turning of the actuator **25** would be in a counterclockwise direction. Thereafter, lowering of the tubing string B causes the actuator **25** to be lowered and the lower end of **25***a* of the actuator **25** rides downwardly on the inner surfaces of the members **12** to spread same outwardly and to thereby also spread or expand outwardly the outer flexible member **10** of the valve. Such spreading or expansion of the valve V continues until the valve actuator **25** has passed below the lower portion of the members **12**. The actuator **25** is again rotated to move the pin **33** into the upper offset **30***a* so as to hold the actuator **25** in its lower position whereby the valve V is maintained in its full open position. As viewed from the top of Figure 3, the tubing T and the actuator **25** are rotated in a clockwise direction to position the pin **33** within the offset **30***a*.

In order to return the actuator **25** to its inactive position (Figure 3) from its active position (Figure 2), the tubing T is turned and raised so as to move the pin **33** from the upper offset **30***a* through the vertical portion **30***b* and into the lower offset **30***c*. It should be pointed out that it may not be necessary to actually rotate the tubing T to effect the turning of the actuator **25** during the opening and closing of the valve V since the curved walls of the slot **30** serve to guide the pin **33** into the offsets **30***a* and **30***c* as the tubing T is moved longitudinally.

In Figure 4, a modified form of the valve assembly A is illustrated, wherein the means for actuating the valve V has been modified as compared to Figures 1–3. In the form of the invention of Figure 4, the actuator sleeve **125** carries an annular shoulder **50** which extends radially outwardly from the tubular actuator **125**. A coil spring **52** is mounted between the annular shoulder **50** on the actuator **125** and an inwardly-extending annular shoulder **55** on the upper adapter **16**. Therefore, the spring **52** acts to urge the actuator **125** upwardly at all times and the upward movement of the actuator **125** with respect to the valve V is limited by one or more stop pins **58** extending inwardly from the adapter **16** so that the upper side of the annular flange **50** contacts such pin or pins **58**. Therefore, it will be evident that the spring arrangement shown in Figure 4 is utilized in place of the pin **33** and slot **30** of Figures 1–3. The other parts of the valve assembly of Figure 4 are identical with the other parts of the valve assembly of Figures 1–3 and preferably the assembly of Figure 4 would be mounted in a tubing string in the same manner as illustrated in Figure 1.

In operation, the valve assembly of Figure 4 is normally as shown in Figure 4 so that the valve V opens and closes by fluid flow as described above in connection with Figure 3. When it is desired to open the valve V to its full open position, the tubing string is lowered against the action of the spring **52** so as to move the actuator **125** relative to the valve V for spreading or expanding the segments **12** and the outer flexible member **10** in the same manner as described above in connection with Figure 2.

It should be pointed out that both of the illustrated modifications of Figures 2 and 4 could be run upside down or reversed from the positions illustrated. In such case, it will be evident that the actuators **25** (Figure 2) and **125** (Figure 4) will extend downwardly from the inverted valve V and will be anchored to the packer P. The outer members **15** and **16** will be moved longitudinally by the tubing extending to the surface of the well. Both valves will therefore be operated in the same manner as illustrated, except that the valve V will be moved relative to the actuator rather than moving the actuator relative to the valve as previously described in connection with Figures 2–4.

The foregoing disclosure and description of the invention is illustrative and 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 is claimed is:

1. A valve assembly for use in a tubular string, comprising, a valve normally closed and preventing fluid flow through the string in one direction, a tubular actuator for effecting a full opening of said valve, means connecting said valve to a first portion of said string including a resilient means urging said actuator away from said valve, said resilient means being compressible upon a longitudinal movement of said actuator toward the valve to permit said actuator to move said valve to its full open position, means connecting said actuator to a second portion of said string, and means for connecting said actuator to said first portion of said string for limited longitudinal movement of the actuator relative thereto and relative to said valve to effect the full opening of said valve.

2. The structure set forth in claim 1, wherein said valve includes, a flexible member having flaps adapted to be urged into sealing contact with each other when the fluid flow is in said one direction, and substantially rigid members seated within said flexible member for

reinforcing same to prevent collapse of the flexible member when the fluid flow is in said one direction.

3. A valve adapted to be mounted in a pipe string, comprising a hollow conical-shaped flexible member slitted at its lower end to provide flaps adapted to be urged into sealing contact with each other by fluid pressure acting thereagainst in one direction of flow, and substantially rigid cone-forming segmental members pivotally seated within said flexible member and adapted to seat against each other to form a cone-shaped solid back-up member for the flexible member for reinforcing same to prevent collapse thereof when the flaps are in sealing contact with each other.

4. A valve assembly for use in a tubing, comprising, a valve normally adapted to prevent fluid flow through the tubing in one direction, said valve including a hollow flexible member seated within the tubing and slitted at one end to provide flaps adapted to be urged into sealing contact with each other when the fluid flow is in said one direction, and substantially rigid members pivotally seated within the tubing and within said flexible member

in annular arrangement and swingingly movable into contact with each other for reinforcing the flexible member to prevent collapse of the same when the fluid flow is in said one direction, and tubular means connected to and operable by manipulation of said tubing for effecting a full opening of said valve whereby well tools may be passed through the tubing without obstruction by the valve.

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