United States Patent [19]

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[11] **3,845,784**

[45] **Nov. 5, 1974**

[54] **FLOAT VALVE FOR DRILL STRINGS**

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[22] Filed: **Mar. 30, 1971**

[21] Appl. No.: **129,592**

Related U.S. Application Data

[63] Continuation of Ser. No. 818,261, April 22, 1969, abandoned.

[52] **U.S. Cl.**..... **137/515,** 137/536, 137/543.15, 166/225

[51] **Int. Cl.**..... **F16k 15/02**

[58] **Field of Search** 137/543.15, 515, 536, 522, 137/515.5, 515.7, 542, 540, 533.27; 166/225

[56] **References Cited**

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2,725,076 11/1955 Hansen et al. 137/543.15

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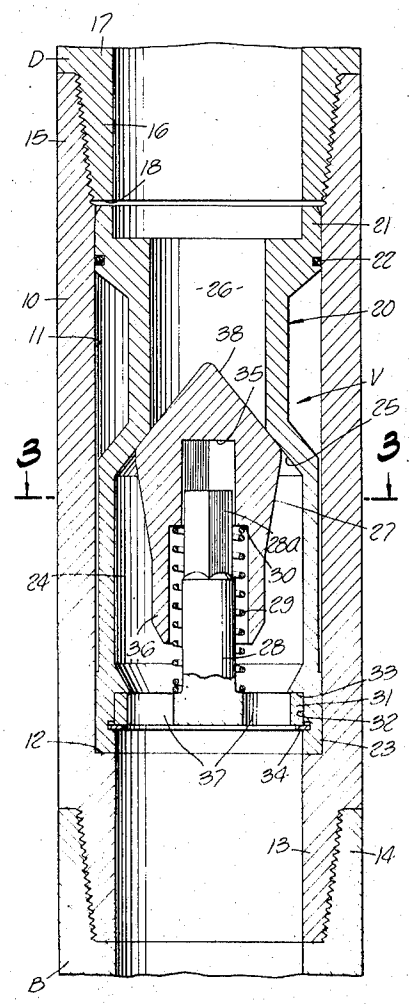
[57] **ABSTRACT**

A float valve for a string of well drilling pipe, the valve being disposed in a sub above the drill bit and including a downwardly facing annular seat engageable by an upwardly closing valve head, the head having non-circular opening in its underside into which extends a correspondingly non-circular guide stem projecting upwardly from a spider support, a spring encircling the stem and acting upwardly on the valve head.

7 Claims, 6 Drawing Figures



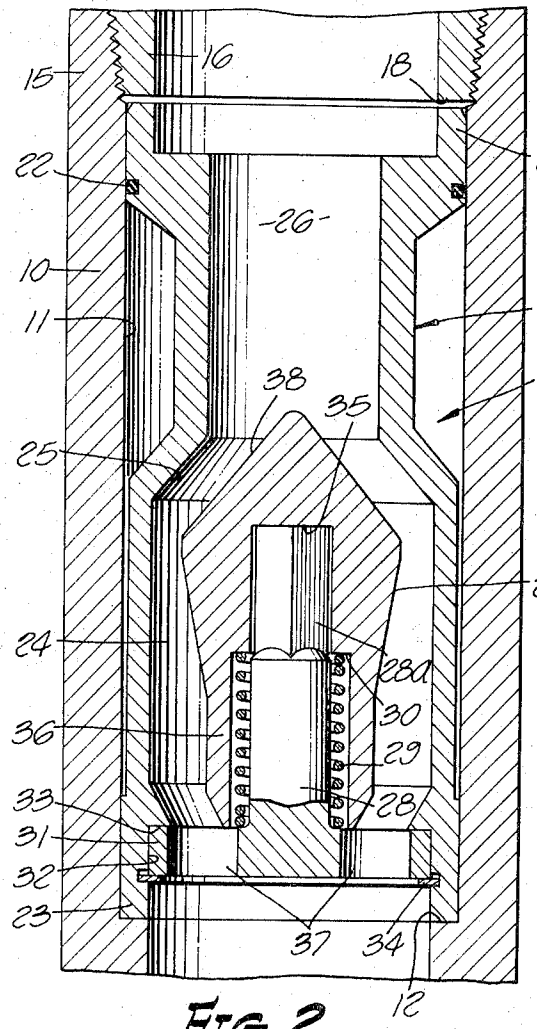


FIG. 2.

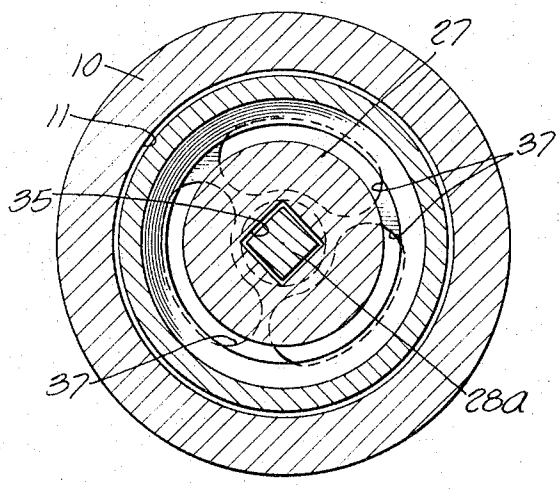
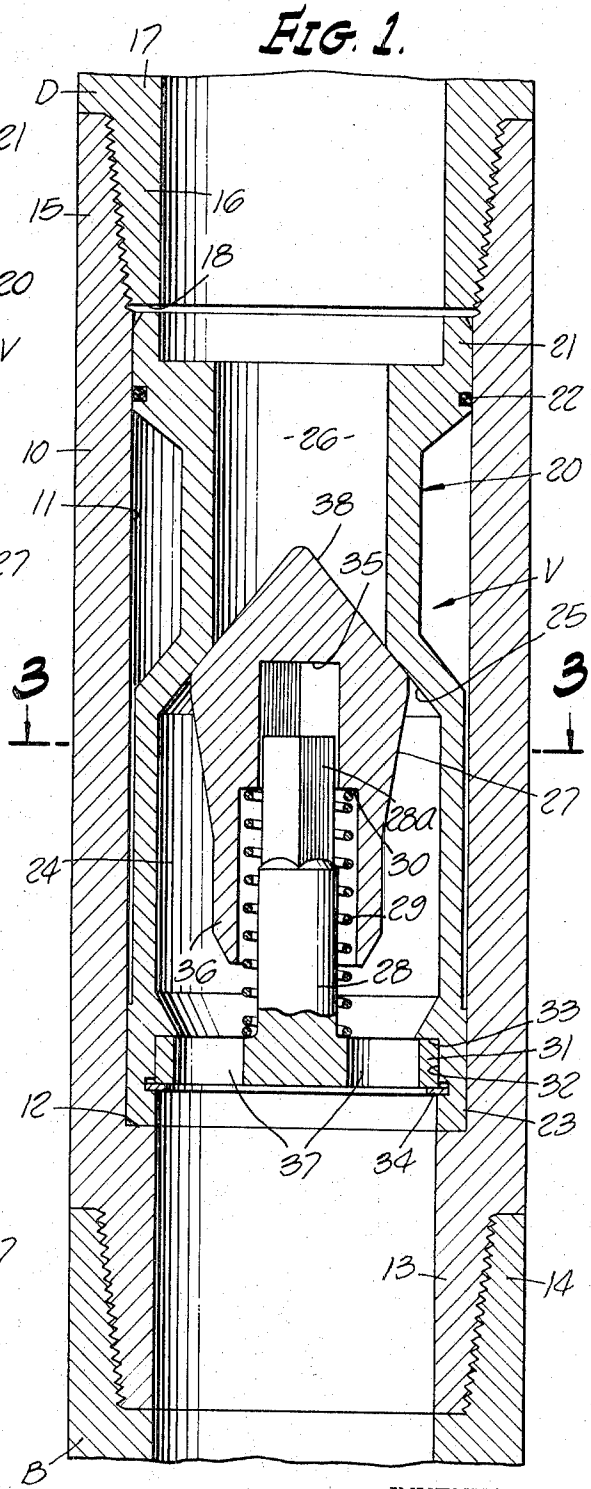


FIG. 3.

FIG. 1.



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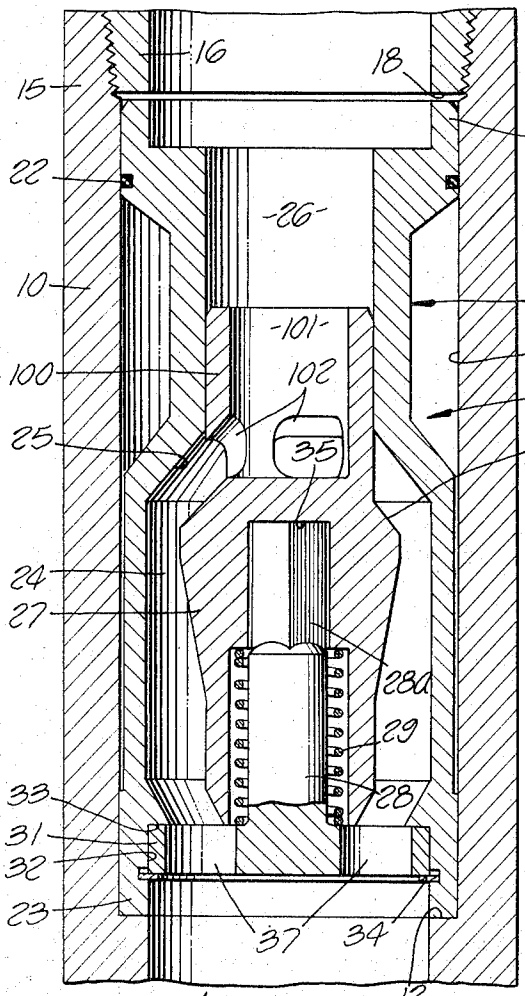


FIG. 5.

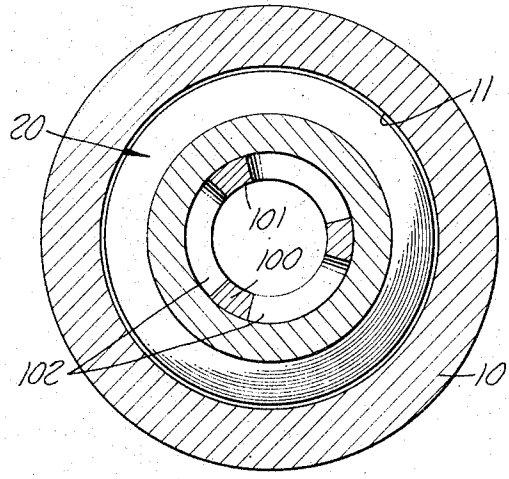
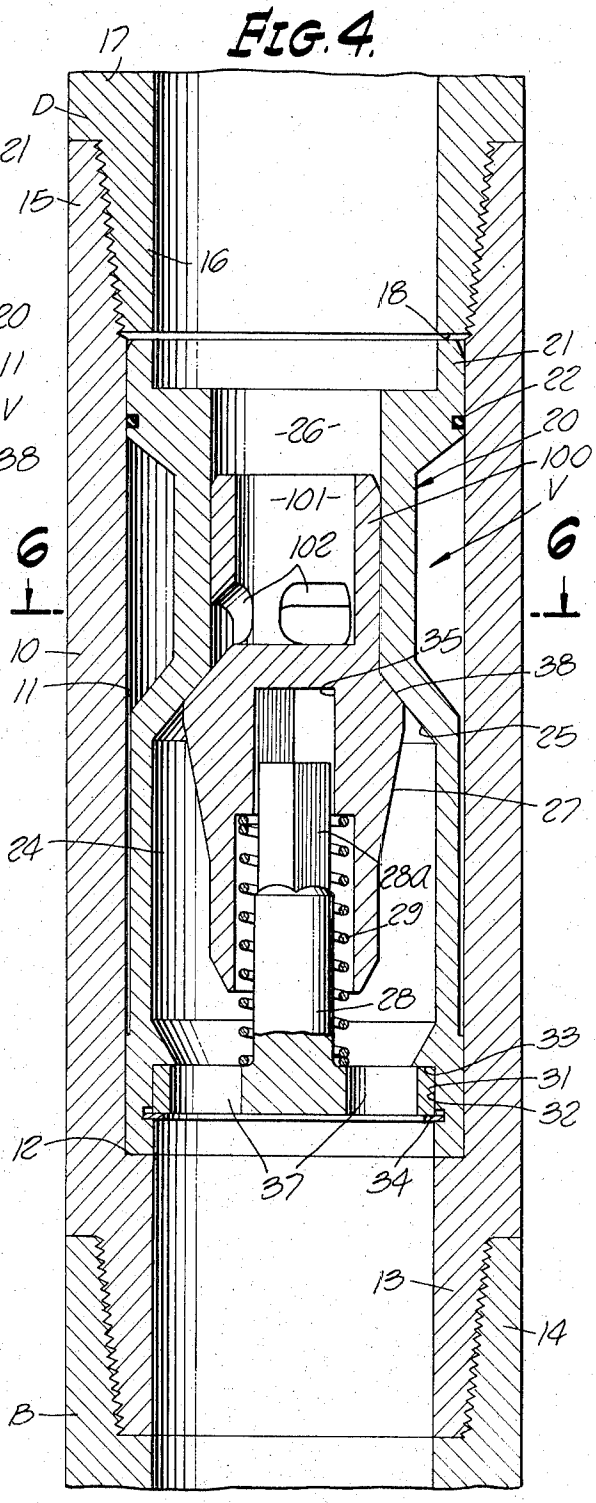


FIG. 6.

FIG. 4.



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FLOAT VALVE FOR DRILL STRINGS

This application is a continuation of application Ser. No. 818,261, filed Apr. 22, 1969 and now abandoned.

BACKGROUND OF THE INVENTION

In the drilling of wells, such as oil and/or gas wells, it is the practice to circulate a drilling fluid, such as mud or gas, downwardly through the drill pipe string, the fluid passing through openings in the drill bit into the bore hole, and the fluid then flowing upwardly through the annular space between the drill string and the bore hole wall, carrying the cuttings to the surface. The running of drill pipe back into the bore hole after removal to, for example, replace the drill bit, on the one hand, and the cessation of drilling fluid circulation, on the other hand, may cause problems which have heretofore been to some extent alleviated by the use of drill pipe float valves. Such valves are called float valves because they close upwardly and prevent the passage of drilling fluid into the drill string during running of the string, so that the drill string remains dry above the float valve and somewhat bouyant.

Another advantage of a float valve is that it prevents plugging of the bit openings or orifices when circulation is ceased, as well as when the drill string is being run into the well. This advantage is realized even if the drilling fluid is air or other gas and the valve causes no real floating action.

Heretofore, float valves have been subject to problems of wear and breakage resulting in the necessity that the drill string be round tripped excessively, that is unnecessarily, to unplug the bit, or fluid is allowed to flow into the drill string as it is being lowered into drilling mud, resulting the surging of fluid onto the drilling platform where it wets the equipment and personnel.

SUMMARY OF THE INVENTION

The present invention provides a drill pipe valve of the upwardly closing type, generally referred to as a float valve, which is rugged in its construction and which resists wear, the valve therefore being more durable and long lived than float valves heretofore available.

More particularly, the present float valve provides a massive and one piece valve head which resists breakage yet is fully functional as a valve, the assembly further including a one-piece head support or stem on which the valve is reciprocable, such support being mounted in the supporting body, the assembly therefore consisting of few parts and being therefore, not subject to disintegration into small pieces capable of clogging the bit against the downward flow of fluid, even if the components should ultimately break due to long, hard service and the erosive action of drilling fluid.

Furthermore, the invention provides a structure in which the valve head is held against spinning relative to its support, thereby reducing the tendency to wear. In accomplishing this, the valve head has a non-circular opening in its underside for receiving the valve stem on which the head reciprocates, the stem having a similar non-circular configuration.

According to one embodiment, the valve combines the structure of a poppet valve with an upwardly extended sleeve which functions like a sleeve valve, such a structure being more particularly suited for drilling

with air or other gas. The upward extension also functions, in addition to its sleeve valve function, as a centering means whereby vibration of the head due to high velocity fluid flow is eliminated, resulting in longer life of the stem.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those skilled in the art, and the novel features of the invention will be defined in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a longitudinal section showing a valve made in accordance with the invention and installed in a drill string, in the normally closed condition;

FIG. **2** is a view corresponding to FIG. **1**, but showing the valve open;

FIG. **3** is a view in transverse section, as taken on the line **3—3** of FIG. **1**;

FIG. **4** is a view corresponding to FIG. **1**, but showing a modified valve construction, particularly adapted for air or gas drilling, the valve being in its normally closed condition;

FIG. **5** is a view corresponding to FIG. **4**, but showing the valve open; and

FIG. **6** is a view in transverse section, as taken on the line **6—6** of FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, a valve mechanism V is incorporated in a string of drill pipe or drill collar D which is adapted to extend to the top of the well bore, and through which drilling fluid is pumped in a downward direction as the drill string is rotated to rotate a drill bit on its lower end, the drill bit sub being designated B. The valve V may be incorporated at any convenient location along the drill string D, but, as here shown, it is mounted in a short drill collar sub **10** ordinarilly placed just above the bit sub B. The drill collar sub **10** has an enlarged bore **11** providing a cylindrical wall and a lower radial shoulder **12**. Illustratively, the sub **10** has a lower threaded pin **13** engaged in the upper threaded box **14** of the bit sub B. The upper end of the sub **10** is constituted as a threaded box **15** secured to the lower pin end **16** of the adjoining drill collar or pipe section **17**. The lower shoulder **12** and the lower end **18** of the collar or pipe section **17** provide axially spaced abutments between which the valve assembly V now to be described is disposed.

The valve assembly V includes a body **20** adapted to fit in the bore **11** of collar **10**, and the length of the body **20** may be slightly less than the distance between the shoulders **12** and **18**. Illustratively, the body **20** includes an upper cylindrical portion **21** provided with sealing ring means, such as an O-ring **22** for sealing engagement within the bore **11** to prevent bypass of fluid about the outside of the body **20** and resultant erosive wear.

At its lower end, the body **20** has a lower cylindrical portion **23** adapted to fit within the bore **11**. Otherwise, the body **20** may be of lesser diameter than the bore **11**.

Internally, the body is provided with a valve chamber **24** having an upwardly tapered conical surface **25** constituting a valve seat which circumscribes a flow passage **26** which extends between the upper end of the body **20** and the valve chamber **24**. Reciprocable in the

valve chamber **24** is a valve head **27,** this head being supported and centered in a valve stem **28** and spring biased to a seated position (FIG. **1**) by a coiled compression spring **29** which abuts at its upper end on an internal shoulder **30** in the head **27** and which seats at its lower end on a spider-like supporting disc **31.**

This disc **31** seats in a bore **32** at the lower end of the valve body **20,** there being a downwardly facing shoulder **33** engaged by the disc **31,** and a snap ring **34** or other retainer means being employed to retain the disc **31** in place. The valve stem **28** is formed integral with the disc **31** and projects upwardly therefrom into a reduced cavity **35** formed in the underside of the valve head **27.** Depending, in encircling relation to the spring **29,** from the shoulder **30** is a skirt **36** which, when the valve is open (FIG. **2**) shields the spring **29** and the stem **28** from the erosive action of drilling fluid flowing downwardly past the valve head and through a number of ports **37** formed in the disc **31.** The upper end of the valve head **27** is formed as a cone **38** corresponding to the seat cone **25** for effectively sealing the valve assembly against the upward flow of fluid when the valve is closed.

The construction described above is a durable one, in that the head **27** is separate from the stem **28** and is a one piece construction. The stem **28** is durable in that it is an integrated unit with the disc **31** and is shielded by the skirt **36** during exposure to maximum wear.

Reference to FIG. **3** shows to best advantage that the cavity **35** in the valve head **27** is non-circular or square in cross section, and likewise, the upper end portion **28*a*** of the stem **28** is correspondingly non-circular or square in cross-section, whereby the valve head is incapable of spinning on the stem **28** as would be the case were the pin circular. Thus, the connection between the valve head **27** and the stem is not subject to rapid wear due to relative movement in an abrasive environment during drilling operations.

In use, the valve V will be normally closed during running of the pipe string into the well bore, so that the entry of fluid into the drill string with cuttings entrained in the fluid is prevented, the tendency of the bit orifices to be plugged thereby being substantially reduced. However, when drilling fluid circulation resumes, the valve will be opened but held against spinning of the head by the non-circular engagement between the stem and head, the stem and the valve spring being protected from the erosive action of the drilling fluid.

Referring to FIGS. **4 – 6** a similar valve structure is shown and the same reference characters are applied. However, this embodiment is particularly adapted for use when drilling with air or other gaseous drilling fluid.

In this embodiment of the invention, the valve is a combined poppet and sleeve valve in that above the conical portion **38** of the valve head **27** it has an upwardly extended sleeve section **100.** This sleeve section **100** extends upwardly into the flow passage **26** of the valve body **20** a distance greater than the permitted downward movement of the valve head **27** and serves as a pilot for the upper end of the valve head **27,** whereby vibration of the head due to high velocity drilling fluid flow is precluded.

In order to permit the downward flow of drilling fluid or air where the valve is open (FIGS. **5** and **6**) the sleeve **100** has a central bore **101** therein and a plurality of radially open and circumferentially extended ports **102.** Preferably, the combined flow area of the ports **102** is equal to or greater than the flow area through the valve in the absence of such sleeve and ports so that no restriction to flow is caused thereby.

Other variations in the details of construction may be resorted to without departing from the spirit of the invention.

I claim:

1. In a drill pipe float valve assembly having a valve body provided with portions adapted to be engaged in the bore of a drill collar sub, an upwardly tapered valve seat in said body, a flow passage circumscribed by said seat, a valve head below said seat and having an axial cavity in one end and a valve surface on the other end complementally engageable with said valve seat, said valve head being reciprocable in said body between a closed position whereat said surface is engaged with said seat and an open position displaced downwardly from said seat, a valve stem extending into said cavity and supporting said head for slidable reciprocation thereon, a spring disposed about said stem and acting on said head to bias the same into said closed position, and a spider supported in said body and retained in place therein, said spider mounting said valve stem, said valve head being movable from said closed position to said open position in response to downward flow of drilling fluid through said flow passage, the improvement wherein said stem and said cavity are of corresponding non-circular cross-section to prevent spinning of said valve head on said valve stem when said valve head is moved to said open position in response to downward flow of drilling fluid through said flow passage.

2. A drill pipe float valve assembly as defined in claim **1,** wherein said stem and said spider are integral.

3. A drill pipe float valve assembly as defined in claim **1,** wherein said flow passage is cylindrical, and including a hollow sleeve extending from said head into said flow passage, said sleeve having a radially opening port therein that is closed by the wall of said cylindrical flow passage when said valve head is in said closed position, and that is open for the flow of fluid therethrough when said head is in said open position.

4. A drill pipe float valve assembly as defined in claim **1,** wherein said cavity and said stem are square in cross-section.

5. A drill pipe float valve assembly as defined in claim **1,** wherein said head has a skirt depending therefrom and encircling said stem and said spring for the full length thereof to protect the same when said head is in said open position.

6. A drill pipe float valve assembly as defined in claim **1,** wherein said stem and said spider are integral, and including means removably supporting said spider in said body.

7. A drill pipe float valve assembly as defined in claim **1** wherein said stem and said spider are integral, and including means removably supporting said spider in said body, and said head is provided with a skirt depending therefrom and encircling said stem and said spring for the full length thereof to protect the same when said head is in said open position.

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