Jan. 2, 1968 J. S. PAGE, JR 3,361,212

STRING FLUID CONTROLLED SLEEVE VALVE

Filed Sept. 3, 1965

FIG. 1.

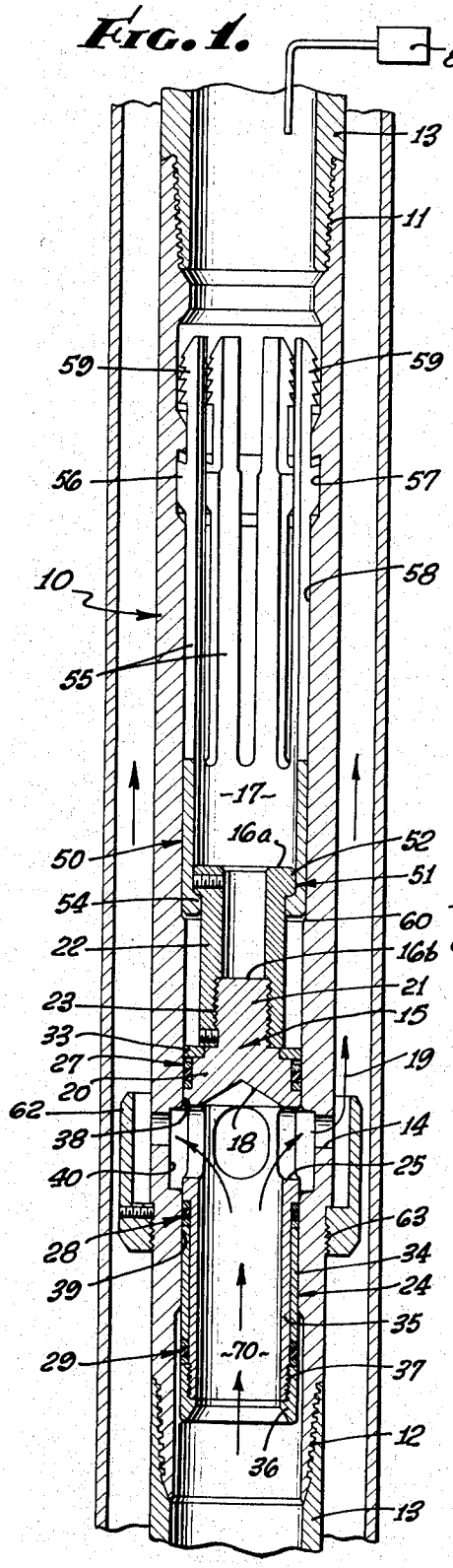
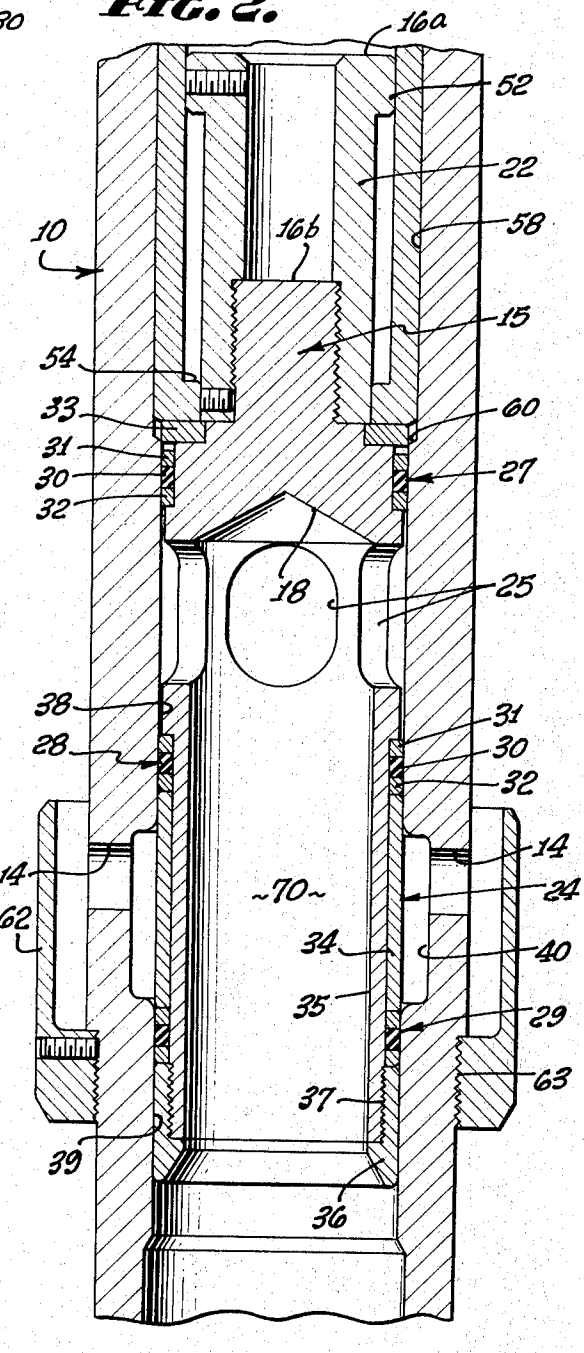


FIG. 2.



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STRING FLUID CONTROLLED SLEEVE VALVE

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ABSTRACT OF THE DISCLOSURE

The disclosure concerns a sub-surface well valve of sleeve type, for controlling upward flow of well fluid in tubing and to the tubing exterior in response to changes in control fluid pressure transmitted downwardly in the tubing string. The sleeve remains downwardly open and centrally unobstructed, and sealing means seals off against leakage of well fluid from the sleeve interior to the string exterior in up position of the sleeve.

This invention relates generally to sub-surface well valves usable to control the flow of fluid in pipe or tubing. More particularly, the invention concerns improvement embodied in a sub-surface well valve that is controllable in response to changing the pressure of control fluid in the tubing string above the valve.

It is a major object of the invention to provide an improved sub-surface well valve of unusually advantageous construction and mode of operation, not found in prior valves of which I am aware. Basically, the valve apparatus is connectible in a string of tubing and comprises tubular means having side porting through which well fluid is flowable between the interior and exterior of the tubular means; structure movable within and lengthwise of the tubular means for controlling the flow of well fluid through the porting in response to a change in downward pressure transmission by control fluid within the string interior, the structure having a first surface exposed to such downward pressure application as well as a second surface out of communication with the first surface to be exposed to upward pressure application exerted by well fluid flowable through the porting; and the structure including a sleeve movable lengthwise of the tubular means to control the well fluid flow through the porting. Typically, the movable structure plugs the tubular means above the level of the porting, the sleeve is tubular to pass the flow unobstructedly and upwardly within the sleeve interior and through a sleeve side port toward the side porting in the tubular means when the sleeve is in down position, and the sleeve side port is out of flow passing communication with side porting in the tubular means when the sleeve is in up position. As a result, an unusual degree of advantageous simplicity is achieved, with the upward flow being generally unobstructed as it approaches the porting; at the same time, the valve is advantageously controllable by changing the downward pressure exertion of control fluid standing in the string above the valve structure.

It is another object of the invention to provide sealing rings carried to seal off between the movable structure and the tubular means above and below the level of the side porting in the latter when the sleeve is in a down position allowing well fluid flow only through the porting, and also when the sleeve is in an up position blocking upward flow of well fluid. Typically, the sealing rings sealing off between the movable structure and tubular means in sleeve down position are confined against direct exposure to the well fluid flow, so that they remain protected against erosion by abrasive materials in the flow. In addition, the tubular means has sealing bores protected in sleeve down position from direct exposure to the well fluid flow, to block erosion of those bores.

These and other objects and advantages of the invention, as well as the details of illustrative embodiments, will be more fully understood from the following detailed description of the drawings in which:

FIG. 1 is a vertical section of a typical valve apparatus connected in a tubing string and installed in a well, the valve movable structure including the sleeve being in down or open position; and

FIG. 2 shows the FIG. 1 valve structure in up or closed position.

In accordance with the invention, tubular means is provided to have side porting through which well fluid is flowable between the interior and exterior thereof. As one example of this, the tubular means may include a body **10** connectible at **11** and **12** in a tubing string **13**, and having side ports **14**.

Further in accordance with the invention, structure is provided for movement within and lengthwise of the tubular means for controlling the flow of well fluid through the porting in response to a change in downward pressure transmission by control fluid within the string interior. Typical of such movable structure is that indicated generally at **15**, having first surfaces **16***a* and **16***b* exposed to receive downward pressure application of control fluid in the string interior **17**, and a second surface **18** out of communication with surface **17** to be exposed to upward pressure application exerted by well fluid the upward flow of which is indicated by arrows **19** in FIG. 1. Surface **18** is defined by body **20** having a stem **21** to which a support member **22** is coaxially attached at **23**.

The invention also contemplates that the movable structure includes a sleeve unit or assembly, as for example is seen at **24**, movable lengthwise of the tubular means **10** to control the well fluid through the side porting **14**. Typically, the sleeve is tubular to pass the well flow unobstructedly and upwardly within the sleeve interior **70**, and it has a side port or ports **25** to pass the well flow from within the sleeve toward the side porting **14** when the sleeve is in a down position as seen in FIG. 1. In this regard, the flow is not obstructed by any valve plug contained centrally of the body **10**.

Sealing rings or ring assemblies indicated generally at **27** and **28** are carried to seal off between the structure **15** and the tubular means **10** above and below the level of the porting **14** when the sleeve is in a down position, allowing well fluid flow through the porting, as is clear from FIG. 1. Ring **28** and an additional sealing ring **29** seal off between structure **15** and means **10** above and below the level of porting **14** when the sleeve is in an up position blocking well fluid flow through the porting. The ring assemblies **27**, **28** and **29** are alike, their construction being illustrated by that of assembly **27** comprising a sandwich formed by non-metallic plastic or elastomer ring **30** between and bonded to two metal rings **31** and **32**. Ring assembly **27** is retained on body **20** by stop ring **33**, and an annular spacer **34** comprising part of the sleeve **24** locates the ring assemblies **28** and **29** in spaced relation on sleeve core **35**. A nut **36** is threaded at **37** to the core to retain the lower ring assembly **29** in position. Note that the bore **37** of the sleeve is open and unobstructed.

It is a further feature of the invention that the plastic or elastomer sealing rings such as **30** in each of the assemblies **27** and **29** are confined against direct exposure to the well fluid flow, as is clear from FIG. 1. Also, the tubular body **10** has sealing bores **38** and **39** protected by the rings **27** and **29** in sleeve down position against direct exposure to the well fluid flow, which carries abrasive particles such as sand. Accordingly, erosion of these parts is forestalled to prevent leakage and

malfunction of the valve. The bore of body **10** is enlarged at **40** between the sealing ring assemblies in FIG. 1, to reduce obstruction to the flow at the porting locus.

A collet **50** is releasably retained in the body **10** and supports structure **15** for vertical movement, the collet and structure having telescopic interconnection at **51**. In the example, a flange **52** on part **22** pilots in the collet bore as the structure **15** shifts vertically. Thus when downward control pressure on surfaces **16***a* and **16***b* is reduced sufficiently in relation to upward pressure on surface **18**, the structure shifts upwardly to FIG. 2 position. Engagement of the flange **52** with collet flange **54** limits downward shifting whereas engagement of ring **33** with collet flange **54** limits upward shifting. Collet **50** has cantilever arms **55** spring urged outwardly to seat the lugs **56** in groove **57** formed in the bore **58** of the body **10**, thereby locating the collet axially of the body. A suitable wire line tool is operable to latch onto the upper terminals **59** of the collet fingers for urging them inwardly to release the collet for upward retrieval of the valve apparatus. A shoulder **60** in body **10** lands the collet when run into the body **10**.

An annular deflector **62** has attachment to the body **10** at **63** and is spaced outwardly from side porting **14** to receive impingement of the outward and upward flow of abrasive well fluid. Accordingly, the well casing **65** is protected from abrasive erosion at the valve location.

Numeral **80** indicates a means to effect control of fluid pressure standing in the string above the valve. Such means may for example include surface pumping apparatus.

I claim:

1. Apparatus connectible in a string of tubing in a well, comprising tubular means having side porting through which well fluid is flowable between the interior and exterior of said tubular means, structure movable within and lengthwise of said means for controlling the flow of well fluid through said porting in response to a change in downward pressure transmission by control fluid within the string interior and above the level of said means, the structure having a first surface exposed to receive downward pressure application of control fluid and a second surface out of communication with said first surface to be exposed to upward pressure application exerted by well fluid flowable upwardly and through said porting, and said structure including a sleeve movable lengthwise of said means to control the well fluid flow through said porting, said structure plugging said tubular means above the level of said tubular means side porting, said sleeve being downwardly open and centrally unobstructed in all sleeve positions to pass the well flow unobstructedly upwardly into the sleeve interior, said sleeve having a side port to pass the well flow from within the sleeve interior toward said tubular means side porting when the sleeve is in a down position, and sealing means carried to extend about the sleeve for sealing off between the sleeve and tubular means and both up and down positions of the sleeve and both above and below the level of said tubular means side porting, said sealing means sealing off against leakage of well fluid from the sleeve interior to the tubular means porting in up position of the sleeve.

2. Apparatus as defined in claim **1** wherein said sealing means includes sealing rings sealing off between the structure and tubular means in sleeve down position during which the rings are confined against direct exposure to the well fluid flow.

3. Apparatus as defined in claim **3** in which the tubular means has sealing bores protected by said rings in sleeve down position from direct exposure to the well fluid flow.

4. Apparatus as defined in claim **1** including a collet releasably retained in said tubular means and supporting said structure for vertical movement.

5. Apparatus as defined in claim **4** in which said collet and structure have telescopic interconnection.

6. Apparatus as defined in claim **1** including a well tubing string supporting said tubular means in a well.

7. Apparatus as defined in claim **1** including a well fluid flow deflector spaced directly outwardly of said side porting and carried by said tubular means.

References Cited

UNITED STATES PATENTS

2,633,916	4/1953	Barker et al.	166—224
3,054,415	9/1962	Barker et al.	166—224
3,156,300	11/1964	Barker et al.	166—224
3,294,174	12/1966	Vincent	166—224

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,361,212 January 2, 1968

John S. Page, Jr.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 12, "and", second occurrence, should read -- in --.

Signed and sealed this 9th day of September 1969.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents