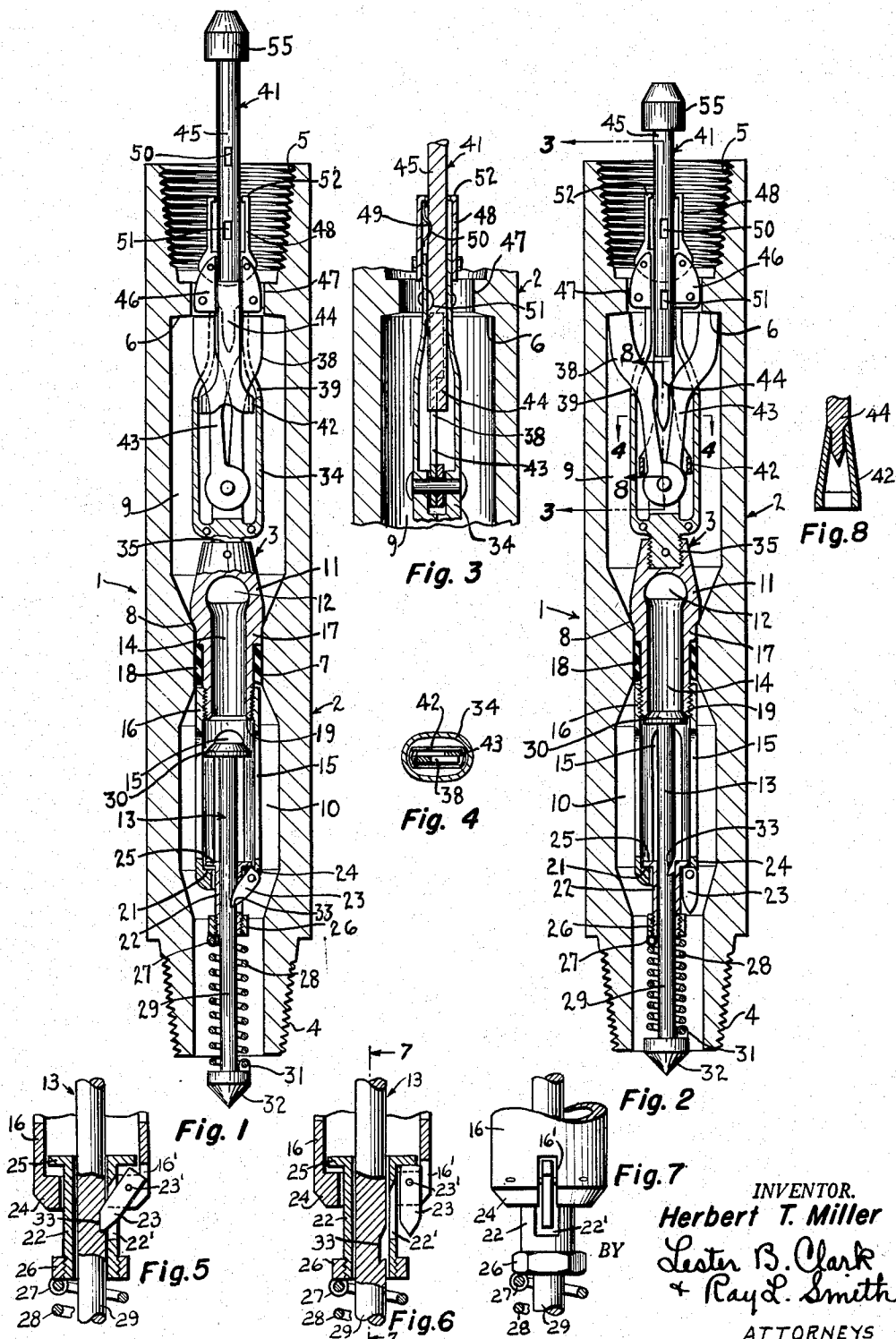


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REMOVABLE DROP-IN TYPE BACK-PRESSURE
VALVE FOR DRILL STRINGS
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REMOVABLE DROP-IN TYPE BACK-PRESSURE VALVE FOR DRILL STRINGS

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2 Claims. (Cl. 255—28)

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This invention relates to a back pressure valve which is adapted to be dropped into position in a drill string employed in the rotary method of drilling wells and which is adapted to be removed from the string by means of a wire line without requiring the removal of the string from the well.

It is an object of this invention to provide a back pressure valve which may be dropped into position in a drill string so as to seat therein while the drill string is in the well.

It is a further object of this invention to provide a back pressure valve which may be raised from its seated position in a drill string without requiring the removal of the drill string from the well.

It is also an object of this invention to provide a back pressure valve which is adapted to permit the passage of fluid therethrough as it descends into position in a drill string.

It is still a further object of this invention to provide a back pressure valve of this class which is adapted to latch into seated position in a drill string and which is adapted to be unlatched when it may be desired to remove the valve from the drill string.

It is a further object of this invention to provide a back pressure valve of this class which is adapted to permit fluid to flow downwardly therethrough when it is seated in a drill string which is being removed from the well.

It is yet another object of this invention to provide a back pressure valve which is adapted to remain seated while permitting fluid to pass therethrough during the drilling operation, and which is adapted to close upon the exertion of back pressure from below the seat thereof, thereby providing a blowout preventer means within the drill string as it drills.

Other and further objects of this invention will be apparent when the specification is considered in connection with the drawings, in which:

Figure 1 is a sectional elevation showing the valve with the mandrel thereof seated therein and before the seating member thereof has seated, to close the mandrel;

Fig. 2 is a sectional elevation showing the valve when the seating member has seated to close the passage through the mandrel;

Fig. 3 is a fragmentary sectional elevation taken along line 3—3 of Fig. 2;

Fig. 4 is a sectional plan view taken along line 4—4 of Fig. 2.

Fig. 5 is an enlarged sectional elevation of the

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mandrel valve latching and operating mechanism, as shown in Fig. 1;

Fig. 6 is a sectional elevation, similar to Fig. 5, showing the mandrel valve unlatched;

Fig. 7 is a sectional elevation taken along line 7—7 of Fig. 6;

Fig. 8 is a fragmentary sectional elevation taken along line 8—8 of Fig. 2.

The valve 1 in general comprises a body or sub 2 and a mandrel or mandrel assembly 3. The sub or housing 2 is adapted for connection, as to a drilling bit, by the pin or threaded male end 4 at the lower end, and at the upper end thereof it has a female or threaded box portion 5 which adapts it for connection to drill string elements, as drill collars or tool joints, above the bit. A shoulder 6 is also provided at the upper end of an enlarged inner tubular portion 9, which is tapered downwardly and inwardly at the lower end 8 and which is connected by a restricted bore 7 to a similar enlarged inner tubular portion 10. The tapered lower end 8 of the tubular portion 9 and the restricted bore 7 combine in forming the seating and sealing surface for the mandrel 3, as shown in Figures 1 and 2.

The body of the mandrel assembly 3 has a radial port or ports 12 therein, which communicate with an axial passage 14, which communicates downwardly with slotted ports 15 through the periphery of the lower section 16 of the body 11. The upper section 17 of the body 11 has a seal member 18 therearound which fits within the sealing seat 7 of the sub 2; and the upper section 17 also provides a valve seat 19 at the lower end thereof.

As shown in Fig. 5, the flange 25 of the tubular flange member 22 fits within the lower mandrel body section 16. The latch 23 is shown pivoted upon the pin 23' which extends across the slot 16', as shown in Fig. 7, to be supported in the mandrel end 24 on either side of the slot 16'. When this latch 23 is engaged in the notch 33 in the valve stem 29, and when the tension spring 28 is connected at its upper end into the ring 27 on the nut 26 on the lower end of the member 22, and at its lower end into the ring 31 on the spear 32, the flange 25 bears upon the latch 23, and the mandrel body 3 is connected to the valve stem 29 by these elements hereinabove described, including the resilient member or spring 28. At the upper end of the valve stem 29 the valve seating member 30 of the valve member 13 is provided to seat within the valve seat 19.

A cage member 34 is threaded at 25 into the

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mandrel body 11, and this cage member has pivotally mounted therein the latching arms 38, which are adapted to swing inwardly and outwardly through the slots 39 in the upper portion of the cage member 34.

A spear 41 is provided which terminates downwardly in the ring member 42, which in assembly surrounds the lower portions 43 of the latching arms 38. The point 44, a central extension of the stem 45 of the spear 41, is of a configuration to spread the arms 38 outwardly to latch beneath the shoulder 6 of the sub 2, as shown in Fig. 2.

The cage 34 terminates upwardly in side guide plates 46 which are adapted to guide the mandrel assembly 3 through the opening 47 within the sub 2 above the shoulder 6. These side guide plates 46 have the spring housing 48 connected to the tops thereof, and this housing has the spring 49 therein to bear in the notches 50 and 51 of the spear stem 45, which passes through the top 52 of the spring housing. The stem 45 terminates upwardly in the spear head 55, to which a wire line or similar lifting means may be attached.

The back pressure valve 1 may be utilized by installing the sub or housing 2 thereof in the bottom portion of a drill string, preferably just above the bit. Then when it is desired to bring the drill string out of the well, as when the bit is to be changed, the mandrel assembly 3 may be dropped into the drill string at the top of the well and it will descend thereinto, the latch 23 being in the notch 33, as shown in Fig. 1. In its descent, fluid within the drill stem may pass through the slotted ports 15, the annular passage 14, and out through the ports 12 as the mandrel assembly 3 passes downwardly, thereby minimizing the resistance of fluid within the mandrel assembly to its downward passage. In cases, as when substantial fluid resistance may be expected within the drill string, fluid may be pumped from the top of the well with sufficient force to overcome such resistance and force the mandrel assembly 3 downwardly.

When the mandrel assembly 3 contacts the sealing seat 7, the seal 18 therearound seals within this seat and the mandrel is stopped by the tapered portion 8 of the sub 2. Then fluid is pumped with considerable force from the top of the well, and this fluid acts upon the seating member 30 at the top of the valve stem 29, and also upon the upper surface of the spear point 32, to force the valve member 13 downwardly. When this occurs the latch 23 is freed from the notch 33, and the flange 25 of the tubular flange member 22 bears on the top of the latch 23 as it seats on the shoulder 21 and thereby retains it in the position shown in Fig. 2. Then the pump at the top of the well is stopped, and this relief of pressure upon the valve member 13 permits the tension spring 28 to contract and move it upwardly to seat against the valve seat 19, the notch 33 passing upwardly past the latch 23 to the position shown in Fig. 2.

When the mandrel 3 comes in contact with the portion 8 of the sub 2, the impact resulting moves the spear 41 downwardly, so that the point 44 extends in between the arms 38 to force them outwardly into latching position against the shoulder 6. When this occurs, the notch 51 passes out of engagement with the spring 49 and the notch 50 passes into engagement therewith, thereby latching the spear 41 against undesired upward motion which might prematurely unlatch the mandrel assembly 3 from its position within the sub 2.

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With the mandrel assembly 3 thus in latched position within the sub 2, when the drill stem is raised, as in making trips out of the well, the weight of the fluid in the upper portion thereof will force the seating member 30 downwardly, but just sufficiently so that fluid may flow downwardly through the seat 19. Then when the upward motion of the drill string is discontinued, the valve member 30 will seat again; its functioning in this manner being determined by the pre-regulated reaction of the tension spring 28. Thus as the drill string is raised, stand by stand, from the well, the fluid therein is transferred step by step downwardly through the valve seat 19, and the pipe of the drill stem, which is removed at the top of the well, comes out in a substantially dry condition so that a minimum of the circulating fluid is wasted.

The provision of the back pressure valve of this invention serves an additional purpose in this manner. Should an excessive pressure be encountered in the vicinity of the bottom of the well, as the finding of gas or oil under excessive subterranean pressures, the seating element 30 of the valve member 13 will be forced upwardly to seat against the seat 19, thereby providing against the gas or oil blowing upwardly and out at the top of the well.

It is also a feature of this invention to provide a mandrel assembly 3 which may be easily withdrawn from a drill string when it may be no longer needed therein. This is simply accomplished by lowering a means, as a wire line, to attach to the spear head 55, and then the exertion of an upward pull on the wire line will move the spear 41 and the ring 42 thereof upwardly to bring the arms 38 in the position shown in Fig. 1 so that they may pass through the opening 47 and so that the elements of the mandrel assembly 3 therebelow may also be withdrawn upwardly therethrough.

Broadly this invention considers a back pressure valve having a mandrel, or a mandrel assembly, which may be dropped or pumped into position in the valve sub thereof and which may be withdrawn therefrom, leaving the valve sub as a part of the drill string assembly.

What is claimed is:

1. In a well tool, the combination of, a tubular housing having a shoulder therein and being adapted for connection into the tubular pipe string employed in the rotary method of drilling wells, a valve seat in said housing, a tubular mandrel having an external seating means thereon and a valve seat therein and being adapted to descend said pipe string to position said seating means in seated position in said housing valve seat to seal off said housing, a valve in said mandrel adapted to seat in said mandrel valve seat to seal off said mandrel, said mandrel comprising a latch means pivoted thereto and a latch setting means adapted to move axially with relation to said latch means upon the impact of the seating of the mandrel to force said latch means outwardly to latch under said shoulder to anchor said mandrel in said housing, said mandrel also including means to maintain said valve latched in open position and operable responsive to fluid pressure exerted from the top of the well to release said valve for closing, said tubular mandrel having communicating openings from the interior thereof above and below said mandrel valve seat to permit fluid to pass through said mandrel with said mandrel valve latched in open position.

2. A well tool as claimed in claim 1 in which

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said latch setting means has means thereon adapted to be grasped by a wire line grapple means on a wire line lowered from the top of the well, said latch setting means also having means thereon adapted, upon the lifting upwardly on said wire line, to retract said latch means inwardly whereby said mandrel may be raised through said housing to pass by said shoulder.

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