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Mott

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[45] **July 3, 1973**

[54] **MUD SAVER VALVE**

[75] Inventor: **James D. Mott**, Houston, Tex.

[73] Assignee: **Hydril Company**, Houston, Tex.

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[52] **U.S. Cl.** **166/113**, 137/553, 166/224, 251/31, 251/58, 251/95

[51] **Int. Cl.** **E21b 43/00**, E21b 33/00

[58] **Field of Search** 166/224, 113; 137/315, 539, 540, 508, 553; 251/341, 348, 58, 62, 31

[56] **References Cited**

UNITED STATES PATENTS

3,236,255	2/1966	Sizer	251/58
3,566,907	3/1971	Sime et al.	137/553
3,200,837	8/1965	Brown	251/58
R25,471	11/1963	Fredd	251/31
3,007,669	11/1961	Fredd	251/31
2,894,715	7/1959	Bostock	251/58
3,233,860	2/1966	Dollison et al.	251/58
3,360,235	12/1967	Myers	251/95
3,543,793	12/1970	Dollison	137/614.2

Primary Examiner—James A. Leppink

Attorney—Pravel, Wilson & Matthews

[57] **ABSTRACT**

A mud saver valve adapted to be disposed below a kelly for controlling the discharge of mud through the kelly into the drill string and for preventing loss of mud at the derrick floor from the kelly when it is disconnected with the mud saver valve from the drill string, wherein means are provided for preventing a closure of the mud saver valve, even though the mud supply pressure to the kelly is cut off, if there is well pressure in the drill string which might blow out upon a disconnection of the kelly, whereby the danger of having a well blowout upon a disconnection of the kelly may be avoided.

8 Claims, 5 Drawing Figures

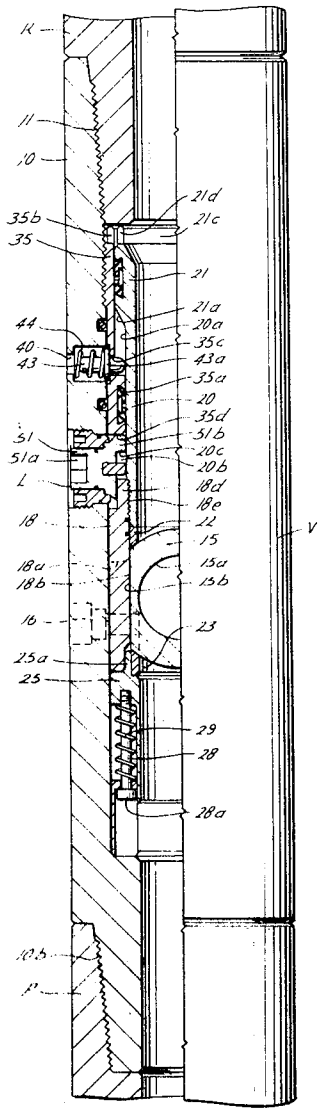


Fig. 1

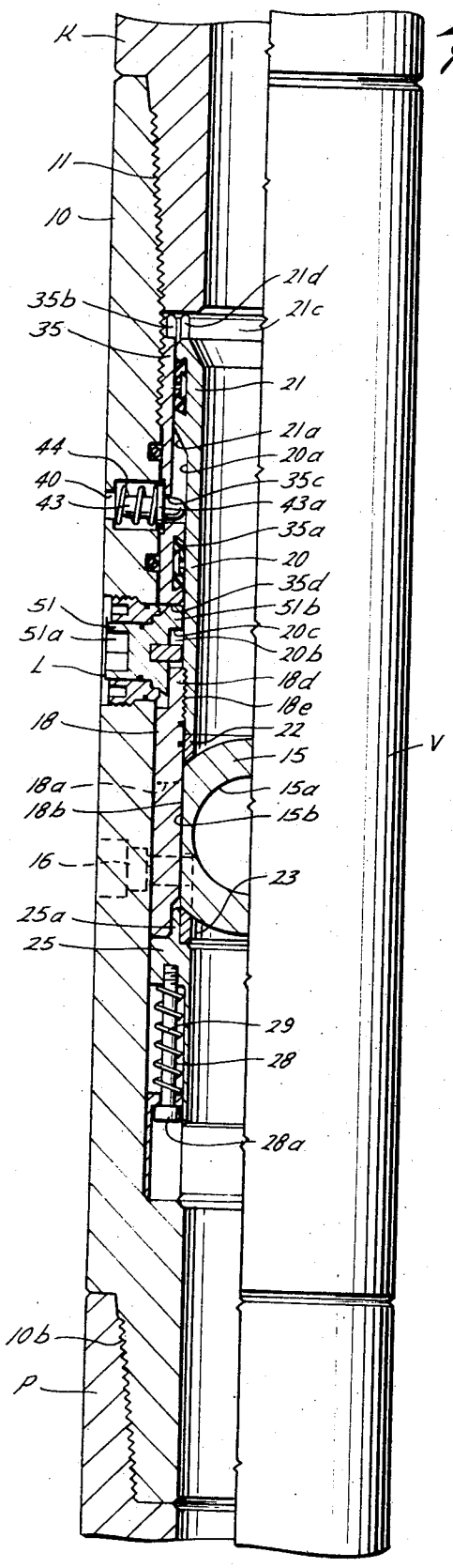
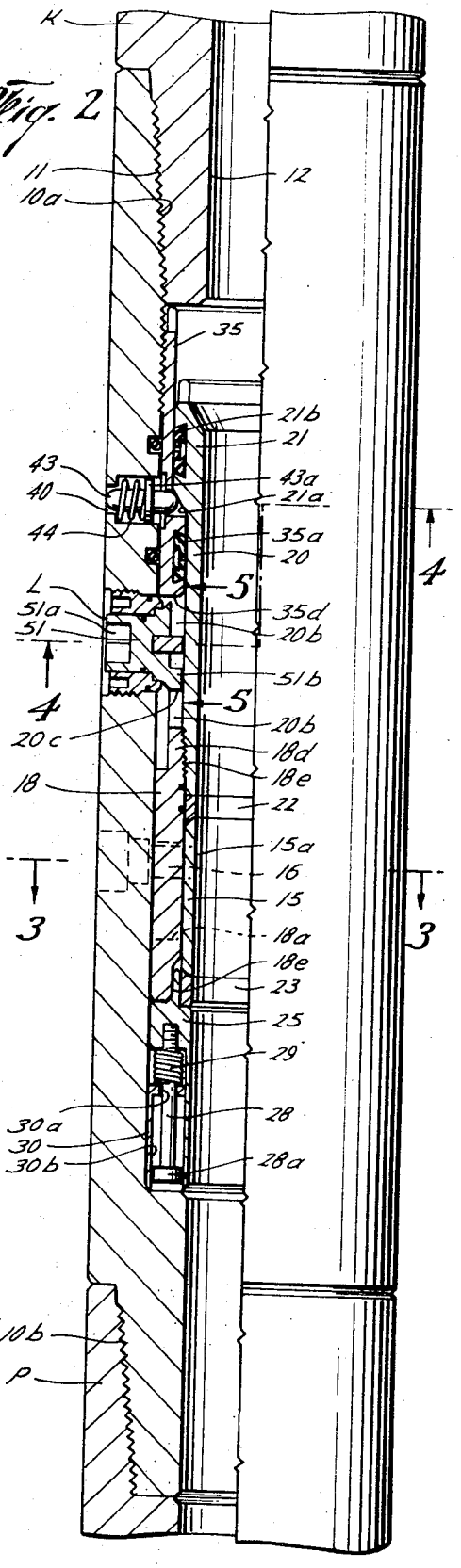

K
11
10
35b
35
21d
21c
21
21a
44
20a
40
35c
43
43a
35a
20
35d
51
51b
51a
20c
L
20b
18d
18e
18
22
15
V
18a
15a
18b
15b
16
23
25a
25
29
28
28a
10b
P

Fig. 2


K
11
12
10a
35
21b
21
43
43a
40
21a
44
35a
20
4
L
5
51a
35d
51
20b
4
51b
5
20c
20b
18d
18e
18
22
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30
28a
30b
10b
P

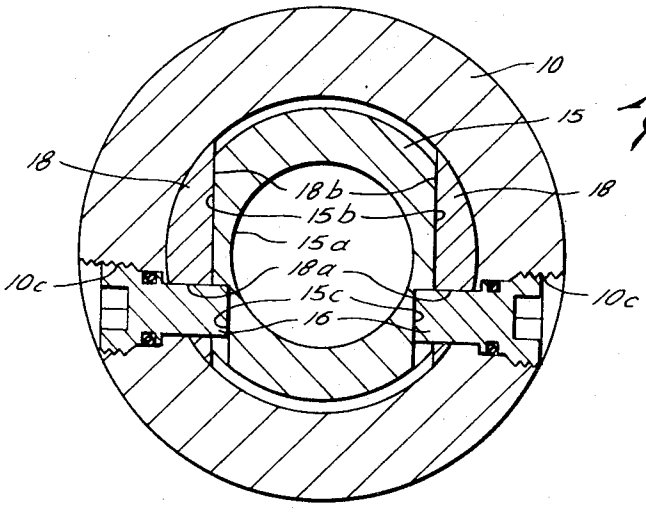


Fig. 3

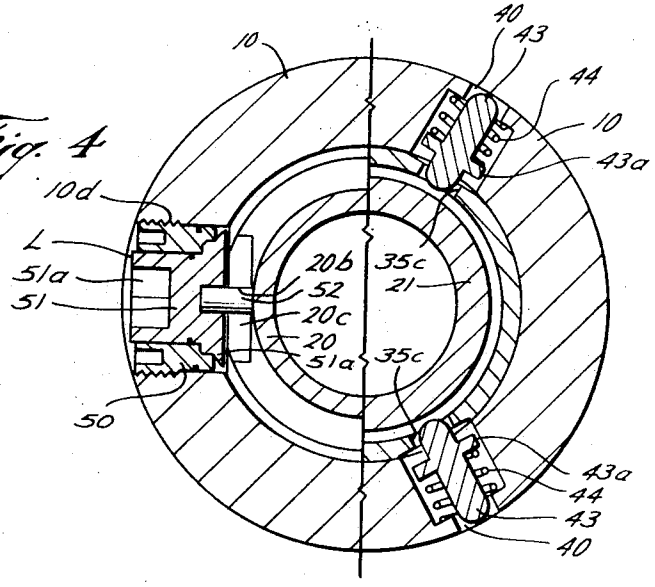


Fig. 4

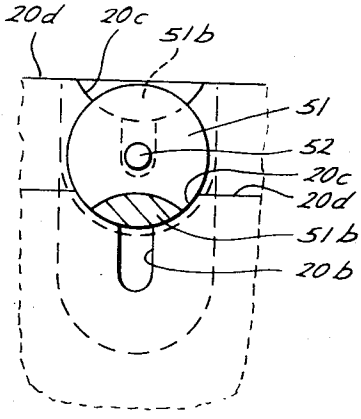


Fig. 5

MUD SAVER VALVE

BACKGROUND OF THE INVENTION

The field of this invention is mud saver valves for connection between a kelly and a drill string.

Mud saver valves of different types are well known, but so far as is known, such valves have heretofore been constructed so that they closed when the mud supply pressure to the kelly was cut off. As a result, the operator could not tell what the well pressure was after the mud saver valve was closed, so that the operator did not know if the well pressure was high enough to cause a well blowout when the valve and kelly were disconnected from the drill string. Such prior constructions thus created a serious danger in instances where the well pressure was high enough to cause a well blowout, because until the kelly and mud saver valve were disconnected from the drilling string, the operator did not know whether a blowout would occur, and then it was already too late to bring the well under control.

SUMMARY OF THE INVENTION

The present invention relates to a new and improved mud saver valve adapted to be connected below a kelly for controlling the flow of mud through the kelly into a drill string, wherein means are provided for preventing a closure of the mud saver valve after the mud supply pressure to the kelly is cut off if there is well pressure in the drill string which would cause a blowout upon a disconnection of the kelly and mud saver valve from the drill string. Means are also provided for indicating to the operator that such well condition exists so that such disconnection may be avoided until the well is brought under control. The mud saver may be selectively locked open to bleed off well pressure or perform other operations with the kelly connected to the drill string.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view, partly in elevation, illustrating the mud saver valve of this invention connected between a kelly at its upper end and a drill string at its lower end, and with the valve in the closed position;

FIG. 2 is a view similar to FIG. 1, but illustrating the valve in the open position;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 2; and

FIG. 5 is a view showing a portion of the mud saver valve of FIG. 1 and 2, the view being taken on line 5—5 of FIG. 2 and illustrating in particular the lock means with the valve.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter V indicates generally the mud saver valve of this invention which is connected below a kelly K during normal operations. The lower end of the valve V is periodically connected and disconnected from a string of drill pipe P, a portion of which is shown in FIGS. 1 and 2.

The mud saver valve V includes a body 10 which is generally cylindrical in shape and which has upper internal threads 10*a* and lower external threads 10*b*. The upper internal threads 10*a* are adapted to receive corresponding threads 11 on the lower end of a conventional kelly K, a portion of which is shown in FIGS. 1 and 2. The kelly K is connected in the conventional manner in an oil well derrick, through a conventional swivel (not shown) to a source of drilling mud or fluid under pressure, which is supplied through the bore 12 of the kelly 11 to the valve V as will be more fully explained.

The valve V has a closure element 15 which is essentially a ball valve having a bore 15*a* therethrough in one direction so that by turning the ball or closure element 15 ninety degrees, the element 15 may be moved from the closed position (FIG. 1) to the open position. The closure element 15 preferably has substantially flat parallel sides 15*b* (FIGS. 1 and 3), with pivot slots 15*c* formed therein, in the well known manner for receiving pivot pins 16 therein, whereby the ball valve or closure element 15 is caused to rotate to and from the closed and open positions when pressure is exerted thereon, as will be well understood.

The pivot pins 16 are preferably threaded or are otherwise engaged in suitable openings 10*c* (FIG. 3) of the body 10, and each of the pins 16 also extends through an opening 18*a* in the two side plates 18 disposed on each side of the closure element 15. Such plates 18 have internal flat surfaces 18*b* which are in sliding engagement with the flat surfaces 15*b* to prevent the turning of the valve element 15 about its vertical axis as it is being turned to and from the closed and open positions. The opening 18*a* in each of the guide plates 18 is actually a slot for receiving the pin 16 as can be seen by comparison of FIGS. 1 and 2. Thus, such slots 18a permit the guide plates 18 to move longitudinally or vertically relative to the pins 16, as will be more evident hereinafter.

The upper ends of the guide plates 18 are preferably joined together by a circular portion 18*d* having internal threads 18*e* (FIGS. 1 and 2), which threads 18*e* are in threaded engagement with corresponding threads on a tubular valve operator 20 having a piston 21 at its upper end.

The lower end of the valve operator 20 engages an upper wear ring 22 which is seated in coacting engagement with the upper portion of the closure element 15 as seen in FIG. 1 and 2. A similar wear ring 23 is disposed below the closure element 15 and in engagement therewith, and it is engaged by a force transmitting ring 25. The ring 25 preferably has an extension 25*a* which extends into a recess 18*e* of the lower end of the plates 18 so that the ring 25 travels with the plates 18, as will be more evident hereinafter.

Preferably, a control bolt 28 is threaded or is otherwise connected to the lower end of the annular ring 25, at two or more points to provide for guiding a coil spring 29 therewith. There may be more than one such coil spring, but only one is illustrated in the drawings. Normally, there are at least two of such coil springs and they function in the same manner as hereinafter described in connection with the spring 29 which is illustrated in FIGS. 1 and 2.

The coil spring 29 as illustrated in FIG. 1 and 2 is disposed above a retaining collar 30 having an opening 30*a* therethrough, through which the bolt 28 extends. The collar 30 has a hollow bore 30*b* so that the head 28*a* of the bolt 28 may move freely therein. When the spring or springs 29 are in the compressed condition as illustrated in FIG. 2, they are exerting a predetermined

upward force tending to rotate the ball element **15** from the open position of FIG. **2** to the closed position of FIG. **1**.

Such resilient spring pressure acting on the closure element **15** is overcome by fluid pressure in the bore of the valve V acting on the piston **21**. As best seen in FIGS. **1** and **2**, the piston **21** is annular and is enlarged in its external diameter as compared to the lower portion of the annular actuating member **20** therewith, so as to provide an inclined annular surface **21***a* below the piston **21**, for a purpose to be hereinafter described. An annular seal **21***b* of rubber or other suitable resilient material is provided on the external surface of the piston **21** for engagement with a retainer sleeve **35** which is threaded or is otherwise mounted in the bore of the body **10** as shown in FIGS. **1** and **2**. The lower end of the retainer sleeve **35** has a seal **35***a* which is annular and which is preferably formed of rubber or other resilient material which engages the external surface of the annular valve actuator **20** for sealing therewith. The upper portion of the liner **35** preferably has spanner openings **35***b* for receiving a spanner wrench to facilitate the threading of the sleeve **35** into the position shown in FIGS. **1** and **2**, and the upper portion of such sleeve **35** is then engaged by the lower end of the kelly K to secure the sleeve **35** in the body **10**. The piston **21** may also have a stop section **21***c* at its upper end with suitable spanner wrench openings **21***d* so that such piston **21** and the valve actuator **20** may be threaded into the threads **18***e*, as previously noted. Also, the stop section **21***c* serves to contact the lower end of the kelly K to limit the upward travel of the actuator **20** so as to stop the rotation of the closure element **15** when it reaches the closed position shown in FIG. **1**.

The area externally of the piston **21** in the body **10** is exposed to the atmosphere and thus to a second or atmospheric pressure through one or more lateral openings **40** formed in the wall of the body **10** (FIGS. **1**, **2** and **4**). As illustrated in the drawings, there are three of such openings **40** and they all communicate with the area below the piston **21** and above the seal **35***a*. An opening **35***c* is provided through the liner **35** in direct alignment with each of the openings **40** in the body **10** so that the lower portion of the piston **21** is exposed to atmospheric pressure while the upper portion of the piston **21** is exposed to whatever fluid pressure exists within the bore of the valve actuating member **20**, as will be more fully explained. The differential in pressure thus acts across the piston **21**, causing a downward force to urge the piston **21**, its annular portion **20** therebelow and the guide plates **18** downwardly. The ring **25** is also urged downwardly from the position of FIG. **1** to compress the spring **29** as the element **15** is moved from the closed position of FIG. **1** to the open position of FIG. **2**.

The ports or openings **40** also serve an additional purpose in that each has an indicator button or elongated element **43** slidably mounted therein and urged inwardly by a coil spring **44** which engages an annular flange **43***a*. When the piston **21** is in the raised position, so that the element **15** is in the closed position (FIG. **1**) the spring **44** with each indicator button **43** acts to urge the indicator button **43** inwardly into contact with the external surface **20a** of the annular sleeve portion **20** of the valve actuator. In this position, the outermost end of each of the indicator buttons **43** is retracted so that it is not readily seen by an operator. However, when the piston **21** moves downwardly to the open position, the inclined or tapered actuating surface **21***a* on the lower part of the piston **21** forces each of the indicator buttons **43** outwardly so that the outer end of each of such buttons **43** is then substantially flush with the external surface of the body **10** (FIGS. **2** and **4**) at which time such indicator buttons are readily visible to an operator so that he knows that the closure element **15** is in the open position.

In some instances, it is desirable to lock the valve V in the open position illustrated in FIG. **2**, wherein fluid may flow through the valve element **15**. For this purpose, a lock means L is provided in the body **10**. The lock means L is mounted in an opening **10***d* of the body **10**, which preferably has threads for receiving an annular bushing **50** in threaded engagement therewith. A rotatable locking member **51** having a recess **51***a* with wrench flats therein for rotation therein by a wrench, is rotatably mounted in the bushing **50**. The inner end **51***a* of the member **51** is enlarged to prevent the member **51** from moving radially outwardly from the bushing **50** when it is rotated. A guide pin **52** is formed integrally with or is connected with the member **51** and it extends into a longitudinal slot **20***b* formed in the valve actuator member **20**. The locking member **51** has a moon shaped locking segment **51***b* formed on the inner portion thereof (FIGS. **1**, **2** and **5**) which is disposed so that when it is in its lowermost position (FIGS. **2** and **5**) it fits within a curved recess **20***c* of the annular portion **20** (FIG. **5**). Thus, when the locking member **51** is in the locking position shown in FIGS. **2** and **4**, the locking segment **51***b* is disposed in the recess **20***c* so as to prevent upward movement of the guide plate **18** therebelow and the annular portion **20** and the piston **21** thereabove. Since the valve actuator is thus prevented from moving longitudinally relative to the body **10**, the valve element **15** is prevented from moving from the open position and is therefore locked in the open position.

The locking member **51** may be rotated from the position shown in FIG. **2** to the position shown in FIG. **1** by the use of a wrench in the wrench opening **51***a*, or by any other suitable means. When the locking member **51** is in the position shown in FIG. **1**, which is indicated by the dotted lines **51***b* in FIG. **5**, the annular portion may then move upwardly until the recess **20***c* is at the uppermost position with the surface **20***d* then in contact with the lower annular edge **35***d* of the liner **35**. So long as the locking member **51** is in the upper or inactive position shown in FIG. **1**, it does not have any effect upon the operation of the valve actuator **20** and thus on the opening and closing of the closure element **15**.

In the operation or use of the mud saver valve V of this invention, it is connected below the kelly K as illustrated in FIGS. **1** and **2**, with the kelly K connected below a swivel (not shown) and with the bore of the kelly and thus the bore of the mud saver valve V in communication with a source of mud under pressure. Normally, this would be a mud pump (not shown) of conventional construction. When it is desired to lower a stand of pipe into the well, the lower threads **10***b* on the mud saver valve V are threaded into the upper end of the stand of pipe P which is to be lowered with the rest of the drill string therebelow. Such operation is conducted in the normal manner and as soon as drilling is commenced with the drill string P in the well and a

drill bit therebelow, drilling mud is circulated down through the kelly K from the source or supply of such drilling mud. The pressure of the drilling mud acts to urge the piston **21** downwardly by creating a differential pressure across the piston **21** since the lower part is exposed to the atmosphere through the opening or openings **40** as previously explained. The downward movement of the piston **21** causes it together with the parts connected therewith, including the annular portion **20** and the actuating plates **18** to rotate the valve element **15** from the closed position of FIG. **1** to the open position of FIG. **2,** thereby compressing the spring or springs **29.** So long as there is sufficient pressure within the bore of the valve V to overcome the spring pressure of the spring or springs **29,** the closure or valve element **15** thus remains in the open position.

Also, if desired, the valve element **15** may be locked in the open position by rotating the locking member **51** from the inactive position of FIG. **1** to the locking position of FIG. **2.** This occurs normally only when it is desirable to keep the valve **15** open for running tools therethrough or for bleeding pressure from the well. Normally, the locking assembly L is in the inactive position of FIG. **1.**

When the supply of mud pressure is cut off at the source so that there is no longer any mud pressure supplied through the kelly K to the mud saver valve V, if there is no well pressure acting upwardly through the string of drill pipe P, the valve element **15** will be forced upwardly to the closed position by the spring or springs **29** as soon as the supply mud pressure is cut off to the kelly. However, if the pressure within the drill pipe string P is sufficiently high to overcome the spring pressure of the spring or springs **29,** which would be indicative of a sufficient pressure to cause a well blowout, then the well pressure will act upon the piston **21** even after the mud pressure supply through the kelly is cut off and this will hold the valve **15** in the open position. The operator will observe that the indicator buttons **43** are substantially flush as shown in FIG. **2** after he has cut off the mud supply pressure to the kelly K and he will then know that the pressure within the mud saver valve V is caused by high pressure within the drill pipe string P which might cause a blowout if the valve V is disconnected from the drill pipe string P.

In the event the operator discovers that the well pressure in the pipe string P is thus high enough to possibly cause a blowout if the mud valve V is disconnected from the pipe string P, the usual well operations are conducted such as increasing the density of the mud to bring the well pressure in the pipe string under control. After the density of the drilling mud is increased, the supply mud pressure is again cut off and then, if the indicator buttons **43** do not come out to the flush indicator position of FIG. **2,** the operator knows that the well is then under control and he can safely disconnect the threads **10b** of the mud saver valve from the upper end of the pipe string P.

It will of course be understood that the mud saver valve V performs the function of preventing the loss of the drilling mud within the kelly K from dropping therefrom when the valve V is disconnected from the pipe string P since the closure element **15** confines the drilling mud thereabove.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

I claim:

1. A mud saver valve adapted to be connected between a kelly and a drill string, comprising:
- a valve body having a longitudinal bore therethrough;
- a valve closure element disposed in said valve body having a valve bore opening formed therethrough for rotational movement to and from an open position in which fluid may flow therethrough and a closed position in which fluid flow through said bore is closed off to confine the drilling fluid above said valve closure element;
- a valve operator means in said bore for moving said valve closure element to and from said closed position and said open position;
- means acting on said valve operator means to urge said valve closure element from said open position to a closed position;
- said valve operator means having piston means therewith, with one side thereof exposed to fluid pressure in said bore and the other side thereof exposed to a second fluid pressure, for moving the valve operator means to hold said valve closure element in the open position in response to fluid pressure in said bore sufficient to overcome the closing urging of said means and the second fluid pressure on said operator means; and
- an opening formed in said valve body for communicating said second fluid pressure from adjacent said valve body with said piston means for providing a differential pressure urging on said piston means the same as the pressure differential between the pressure in said bore and the second pressure adjacent said valve body wherein said valve closure element is operated closed when said valve body may be safely disconnected from the drill string.

2. The structure set forth in claim **1** wherein said second fluid pressure is atmospheric pressure.

3. The structure set forth in claim **1,** including:
- indicator means in said valve body for indicating to an operator that said valve closure element is in the open position for thereby indicating the presence of well pressure in said bore after the fluid supply pressure to said bore is cut off.

4. The structure set forth in claim **3,** wherein said indicator means includes:
- an indicator element;
- said valve body having an opening in its wall for slidably receiving said indicator element; and
- means on said valve operator co-acting with said button for moving it to an indicator position when said closure element is in the open position.

5. The structure set forth in claim **4,** including:
- means for moving said indicator button to a retracted position when said closure element is in the closed position.

6. The structure set forth in claim **1,** including:
- lock means for locking said closure element in said open position.

7. The structure set forth in claim **6,** wherein said lock means includes:
- means operable from externally of said body for actuating said lock means.

8. The structure set forth in claim **6,** wherein said lock means includes:
- means for moving said lock means to an inactive position wherein it has no operational effect on said closure element as it is moved to and from said open and closed positions.

* * * * *