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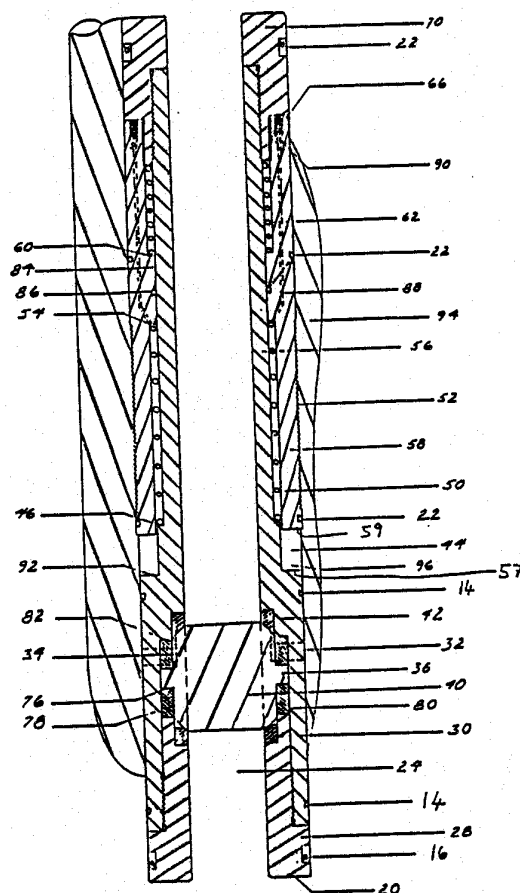
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(54) Title: BOTTOM HOLE BLOWOUT PREVENTER

(57) Abstract

A ball valve type bottom hole blowout preventer (10) operates under normal drilling conditions in a fully open position with an unrestricted bore. This operating condition is maintained by a combination of spring (50, 62) and mud flow pressure acting against the upper surfaces of the valve. In the event of a well kick or blowout pressures from gas or fluid volumes acting against the lower surfaces of the valve force it into the fully closed position. A system of ports and check valves (90) within the blowout preventer forces hydraulic fluid from one chamber (44) to another (66). The metering effect of these ports determines the rate of closure of the valve, thereby allowing normal running and pulling of the drill string or tubing, without interference to pipe fill-up or drainage, from valve closure. This blowout preventer is placed in a sub (94) that is an integral part of the drill string and can be incorporated in a string in any location.



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TITLE OF INVENTION:

BOTTOM HOLE BLOWOUT PREVENTER

10 FIELD OF INVENTION

This invention relates to blowout preventers used near the bottom of a well during drilling of the well.

15

BACKGROUND OF THE INVENTION

The bottom hole blowout preventer is a device used to control backflow or displacement of drilling fluids within the drill string by high pressure gas or hydrocarbons encountered while normal drilling or well servicing activities are in progress.

Downhole blowout preventers are known which include a housing engageable in a drill string and which use a ball valve pivotally mounted in the bore of the housing, where the ball valve is rotated from an open to a closed position by means of a cooperating cam sleeve, the cooperating cam sleeve being operated by a solenoid valve in response to a signal received by a downhole unit. The solenoid valve opens up a passage into a chamber above a flanged end of the cam sleeve, and mud pressure entering the chamber forces the cam sleeve down, thus closing the ball valve. Such a downhole blowout preventer is operated from instructions from the surface, and is described, for example, in European Patent Application No. 86304179.4, published December 17, 1986.

Surface controllable rotary valves, actuated by a sleeve, have also been used in the oil industry in production. That is, in the production of well fluids, such as oil or gas from wells, it has been the practice to provide automatically closeable shut-off or safety valves which are located downhole in the

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well which are held open by control fluid pressure, the valves closing automatically when control fluid pressure is purposely reduced to allow the valves to close or when damage occurs to the control fluid system at the well head or on an offshore platform. An example of such a safety valve which includes a lateral opening for ease of installing the valve, is described in United Kingdom Patent No. 1,416,085.

However, there does not exist an adequate automatic downhole blowout preventer useable for drilling purposes. Automatic rotary valves tend to close at times when closure is not desired, for example, from excess running-in rates, which interferes with pipe fill-up or drainage.

SUMMARY OF THE INVENTION

The inventor has provided a bottom hole blowout preventer for a drill string, the bottom hole blowout preventer having a ball valve pivotally mountable in the drill string; an actuating sleeve disposable about the ball valve within the drill string and having a flow passage, the actuating sleeve being slidable in relation to the drill string in response to downhole over pressure conditions from a first position in which the ball valve is at least partly open to a second position in which the ball valve is closed; and reset means disposable against the actuating sleeve for biasing the actuating sleeve to a chosen position; characterized in that the reset means is adjustable. As a specific example, the reset means (a spring, in this case) is adjusted to bias the ball valve to a half-open position during running in, and a fully open position during normal drilling.

In another aspect, the bottom hole blowout preventer is further being characterized by including:

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means connectable to the actuating sleeve to regulate the closure rate of the ball valve.

The means to regulate the closure rate of the ball valve may include a first chamber closeable by the
5 actuating sleeve upon sliding of the actuating sleeve to the second position;

a second chamber closeable by the actuating sleeve upon sliding of the actuating sleeve to the first position;

10 a passageway connecting the first and second chambers; and

a check valve disposed in the passageway.

The reset means allows the valve to be set to a chosen position. The regulated closure prevents the
15 unexpected closure of the valve due to temporary over pressure conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

20 There will now be described a preferred embodiment of the invention, with reference to the figures in which like elements are indicated by like numerals, by way of example, and in which:

Figure 1 is a schematic section of a ball valve
25 type bottom hole blowout preventer;

Figure 2 is a schematic section of a ball valve type blowout preventer depicting a vertical cross-section at 90 degrees to the section of Figure 1;

Figure 3A is an end view of a ball valve for a
30 bottom hole blowout preventer according to the invention; and

Figure 3B is a side view, partially broken away, of the ball valve of Figure 3A.

DESCRIPTION OF THE BEST MODE OF THE INVENTION

Referring to Figures 1 and 2, the bottom hole
5 blowout preventer 10 includes a cylindrical sleeve 56
having a bore 24 for the passage of drilling fluids
and suitably disposed within the drill string sub 94.
The sleeve 56 has a top cap 70, and a bottom cap 28,
with suitable threaded connections to enable them to
10 be threaded onto sleeve 56. In the sleeve bore 24
there is a valve ball 40 which is rotatably mounted on
pivot pins 36, which allow it to rotate on a single
axis only normal to the bore 24. The valve ball pivot
pins 36 fit in suitably drilled holes 76 in collets 80
15 fitted to either side of the ball valve 40, and facing
up to flats 78 machined on either side of the ball
valve 40.

The collets 80 fit into suitably machined
sockets 82 in the sleeve 56.

20 The ball valve 40 seats spherically between the
upper seat 42 and the lower seat 30 in the bore 24 of
the sleeve 56. The valve ball 40, and the seats 42
and 30 are retained within the sleeve 56 by the
threaded bottom cap 28. There is a bore in the valve
25 ball 40 extending perpendicular to the pivotal axis of
the valve ball 40.

Machined into the flats 78 of valve ball 40 are
slots 34 extending radially at 45 degrees from the
vertical axis as shown in Figure 3A, and as shown in
30 the broken away portion 35 in Figure 3B. Each slot
34 is designed to be engaged by an actuating pin 32
attached to the drill string sub 94 and travelling
within a milled slot 38 in the sleeve 56. An
identical set of slots and actuating pins (not shown)
35 are on the other side of the valve to the side seen in
Figure 2.

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Fitted over the upper outside diameter of sleeve 56 is a retainer 58 with a machined collar 84 on its inside diameter, made to have a close tolerance fit over the sleeve 56 and with an O-ring seal 86
5 between the sleeve outside diameter and the retainer inside diameter. The retainer 58 limits the vertical movement of the sleeve 56. For high pressure applications, the surface of the shoulder 57 on the sleeve 56 and the surface of the corresponding
10 shoulder 59 on the retainer 58 should be pre-finished to produce a metal to metal high pressure seal.

Two drilled channels 88 in the retainer 58 connect a lower hydraulic chamber 44 to an upper hydraulic oil chamber 66 through a ball check valve 90
15 that meters oil flow in the upper direction (towards chamber 66) and allows free oil passage in the opposite direction. The size of the orifice in the check valve may be varied according to the desired closure rate of the ball valve 40. The two channels
20 88 and the chambers 44 and 66 comprise means to regulate the closure rate of the ball valve 40. They are hydraulically connected to the actuating sleeve 56 and it will be understood that "connected" as used in the claims includes hydraulic connection.

25 The outside diameter of the retainer 58 is threaded at 52 over the lower half of its length and has O-ring seal grooves 22 in its outside diameter above and below the threads 52. The retainer 58 threads into a sub 94 or other sub that becomes an
30 integral part of the drill string and retains the entire blowout preventer assembly in place within the sub. O-ring seals 14 on the sleeve 56 and moulded lip seals 16 on the bottom cap 28 help seal the chambers 44 and 66.

35 Opposing compression springs 50 and 62 preferably bias the sleeve 56 to a ready position (not shown) in which the valve ball 40 is neither fully

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closed nor fully open. Pressure from drilling fluid during drilling forces the sleeve 56 to the first position shown in Figure 1, in which the valve ball 40 is fully open. Alternatively, the valve can be pre-set to be fully open during running in by appropriate adjustment of the compression springs 50 and 62, for example for use with stuck pipe conditions and fishing tools. Adjustment of the springs may be accomplished by changing the lengths of the springs.

10 The spring 62 is held between shoulder 60 of the retainer 58 and the shoulder 64 of the sleeve 56. The spring 50 is held between shoulder 46 of the sleeve 56 and shoulder 54 of the retainer 58. Together the springs 50 and 62 constitute reset means disposed
15 against the actuating sleeve 56 for biasing the ball valve to a chosen position.

 The manner of operation of the bottom hole blowout preventer is as follows. Forces resulting from a bottom hole over pressure condition act on the lower
20 surfaces 20 of the sleeve 56 and cause it to move vertically within the drill string sub 94 and retainer 58. This upward motion causes the actuating pins 32 to move downward within the milled slots 38 of sleeve 56. The engagement of the actuating pins 32 with the
25 machine slots 34 and the valve ball 40 causes the valve ball 40 to rotate 90 degrees around the pivot pin 36 between the open position shown in Figure 1 and the closed position shown in Figure 2.

 As the sleeve 56, top cap 70 and bottom cap 28
30 traverse vertically up within the sub 94, a chamber 66 is created between the bottom shoulder 68 of the top cap and the top shoulder 72 of the retainer 58. At the same time, the lower hydraulic fluid chamber 44 closes, and forces hydraulic fluid through channel 88
35 and the check-valve 90, into the top chamber 66. As these chambers 44 and 66 are sealed to ensure fluid tight integrity one from the other, and from the outer

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well fluids, the flow of hydraulic oil 96 from the lower chamber 44 through the metering effect of check valve 90 inhibits the rotating closure rate of the valve ball 40.

5 In the event of a well kick or blowout, pressure forces acting on the lower blowout preventer surfaces force valve closure at a predetermined rate, and ensure a delayed closure. In the case of closure during running in, the delayed closure allows a
10 controlled amount of bypass before closure is initiated. As pressure is equalized across the valve, the valve is automatically reset by the springs 50 and 62 to a chosen position such as an open position. By allowing limited flow at the surface, resulting from
15 the delayed closure, the bottom hole pressures can readily be taken.

If the drill string is run in the hole at an excess rate, bottom hole pressures will tend to urge the valve ball 40 towards closure, but will re-open as
20 the drill pipe fills. The metering effect of the check valve 90 avoids unwanted closure due to variable pressure conditions, including those resulting from drill pipe fill up during running in.

Drilling ahead procedures retain the valve in
25 the fully open position with fluid pressures acting upon the upper surfaces of the sleeve 56. During normal running in procedures, the ball valve 40 will normally stay in the half-open position.

In summary, in the absence of forces from
30 pressure on either of the top or bottom surfaces of the sleeve 56, the compression springs 50 and 62 preferably bias the ball valve 40 in a central half-open position. Forces acting on the upper surfaces of the sleeve, for example during drilling, will bring
35 the valve to a fully open position. Forces acting on the lower surfaces of the sleeve 56 will bring the ball valve 40 to a fully closed position at a rate

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that is regulated by the metered closure system. With the relaxation of either the upward or downward force, the blowout preventer will always return to the ready position.

5 The bottom hole blowout preventer as described may be run anywhere in the drill string, and is not restricted to bottom hole operations, although it is most commonly used in bottom hole operations.

10 Immaterial modifications can be made to the invention described here and these are intended to be covered within the scope of the invention.

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I claim:

1. A bottom hole blowout preventer for a drill
5 string, the bottom hole blowout preventer having a
ball valve pivotally mountable in the drill string; an
actuating sleeve disposable about the ball valve
within the drill string and having a flow passage, the
10 actuating sleeve being slidable in relation to the
drill string in response to downhole over pressure
conditions from a first position in which the ball
valve is at least partly open to a second position in
which the ball valve is closed; and reset means
15 disposable against the actuating sleeve for biasing
the actuating sleeve to a chosen position;
characterized in that the reset means is
adjustable.

2. The bottom hole blowout preventer of claim 1
20 further being characterized by including:
means connectable to the actuating sleeve to
regulate the closure rate of the ball valve.

3. The bottom hole blowout preventer of claim 2 in
25 which the means to regulate the closure rate of the
ball valve includes:

a first chamber closeable by the actuating
sleeve upon sliding of the actuating sleeve to the
second position;

30 a second chamber closeable by the actuating
sleeve upon sliding of the actuating sleeve to the
first position;

a passageway connecting the first and second
chambers; and

35 a check valve disposed in the passageway.

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4. The bottom hole blowout preventer of claim 1 in which the reset means is adjusted to bias the actuating sleeve to a half open position.
- 5 5. The bottom hole blowout preventer of claim 4 further being characterized by including:
means connectable to the actuating sleeve to regulate the closure rate of the ball valve.
- 10 6. The bottom hole blowout preventer of claim 5 in which the means to regulate the closure rate of the ball valve includes:
a first chamber closeable by the actuating sleeve upon sliding of the actuating sleeve to the
15 second position;
a second chamber closeable to the actuating sleeve upon sliding of the actuating sleeve to the first position;
a passageway connecting the first and second
20 chamber; and
a check valve disposed in the passageway.
7. A bottom hole blowout preventer for a drill string, the bottom hole blowout preventer having a
25 ball valve pivotally mountable in the drill string; an actuating sleeve disposable about the ball valve within the drill string and having a flow passage, the actuating sleeve being slidable in relation to the drill string in response to downhole over pressure
30 conditions from a first position in which the ball valve is at least partly open to a second position in which the ball valve is closed; and reset means disposable against the actuating sleeve for biasing the actuating sleeve to a chosen position;
35 characterized by including:
means connectable to the actuating sleeve to regulate the closure rate of the ball valve.

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8. The bottom hole blowout preventer of claim 7 in which the means to regulate the closure rate of the ball valve includes:

- 5 a first chamber closeable by the actuating sleeve upon sliding of the actuating sleeve to the second position;
- a second chamber closeable to the actuating sleeve upon sliding of the actuating sleeve to the
- 10 first position;
- a passageway connecting the first and second chamber; and
- a check valve disposed in the passageway.

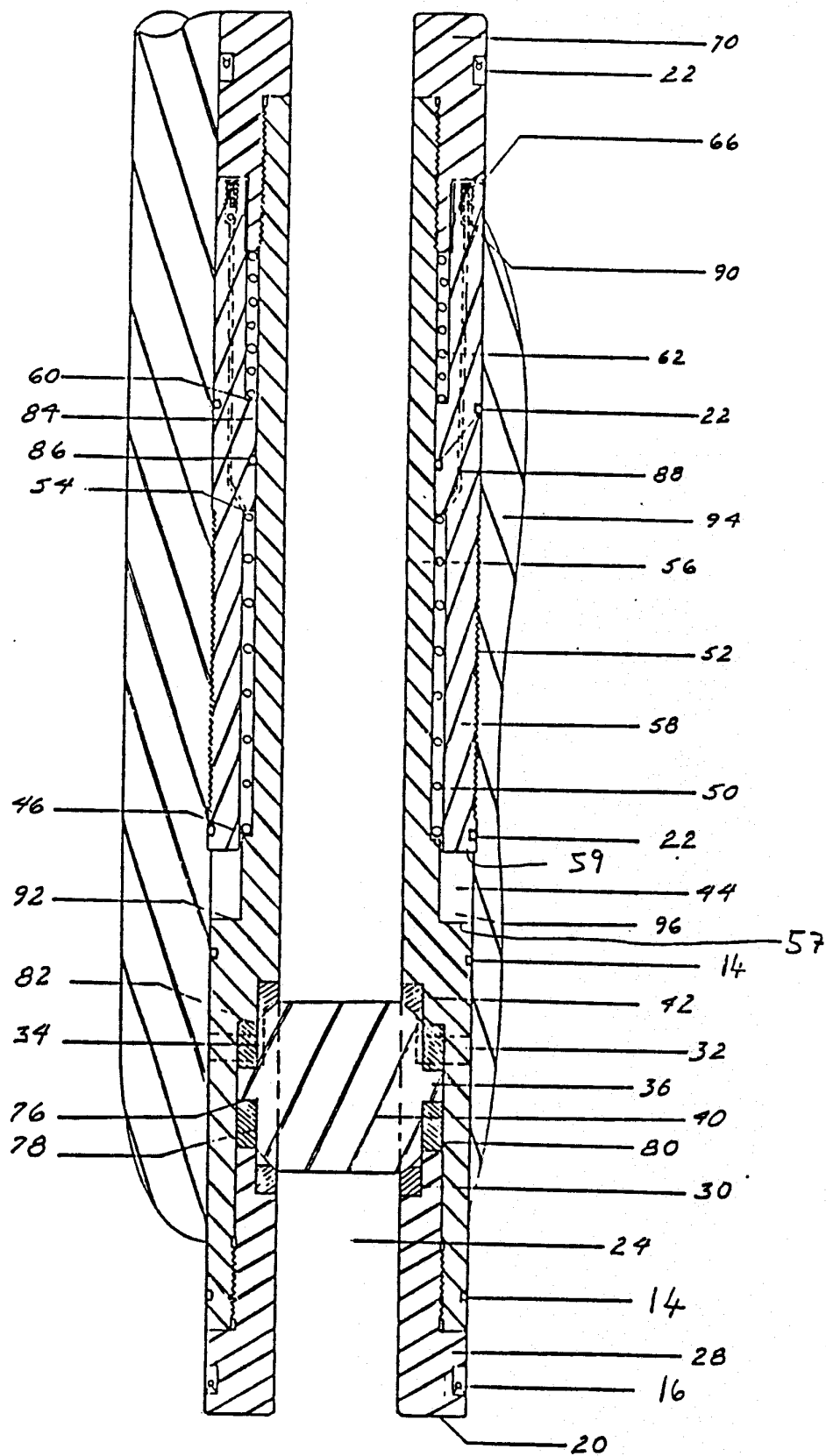


FIG. 1

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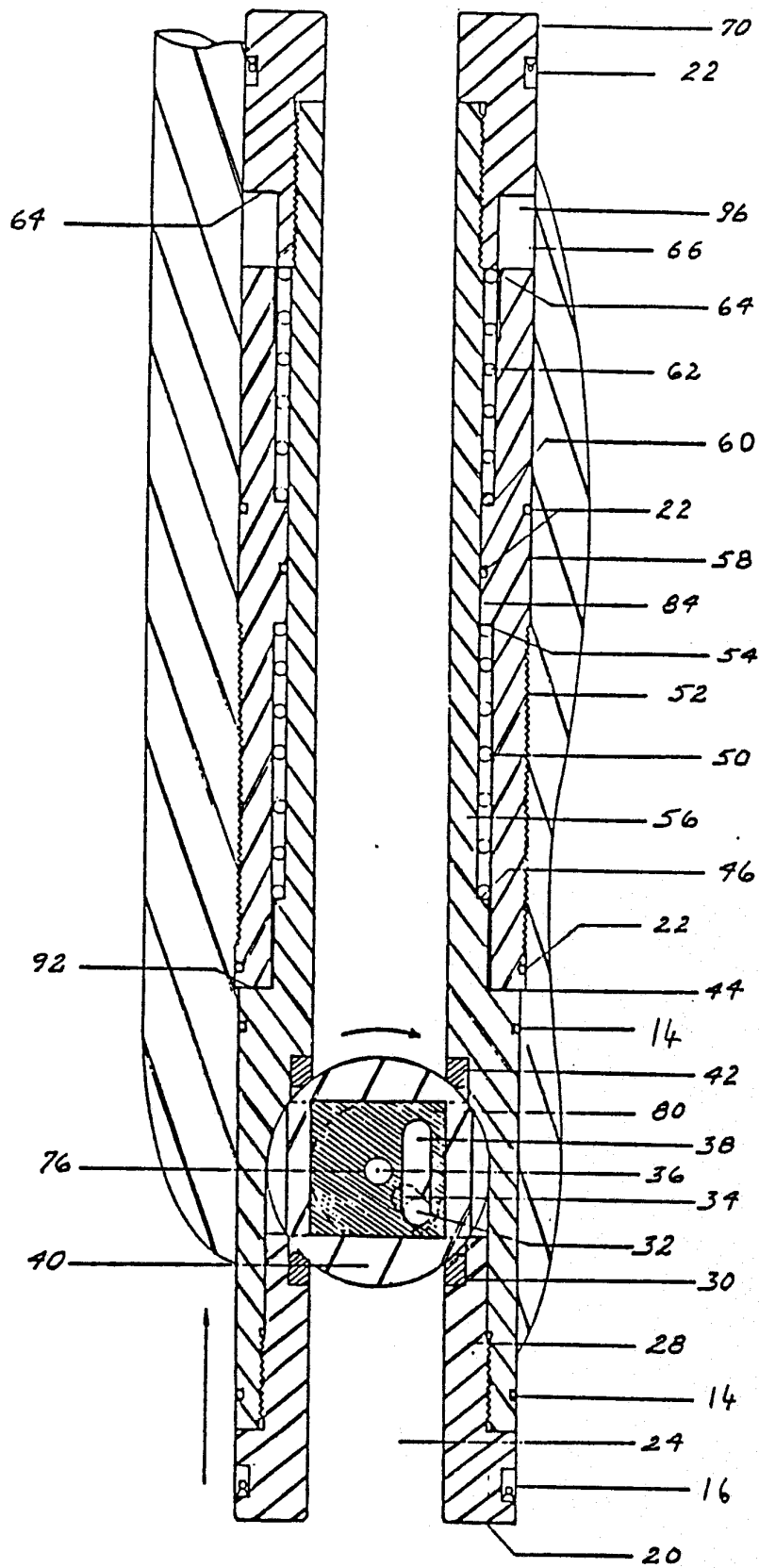


FIG. 2

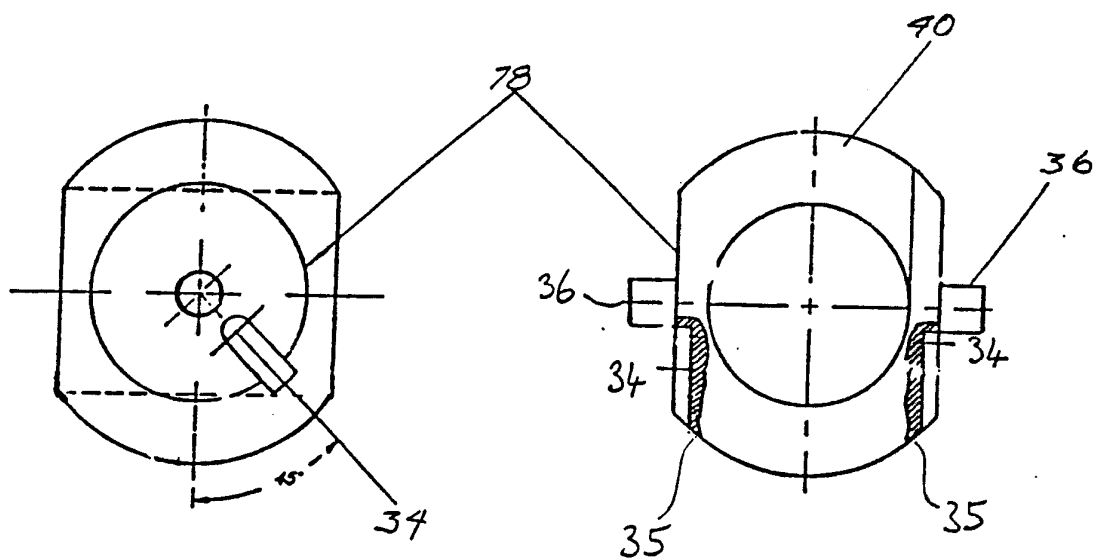


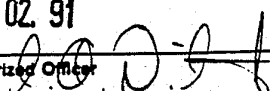
Fig. 3A

Fig. 3B

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 90/00368

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC ⁵ : E 21 B 34/08, E 21 B 21/10		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC ⁵	E 21 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 3126908 (G.C. DICKENS) 31 March 1964 see column 1, lines 43-50; column 4, lines 2-54; figures 1,2	1,2,7
Y	---	3-6,8
Y	CA, A, 1058477 (R.G. REAY) 17 July 1979 see page 1, lines 19,20; pages 4-5, 10-13; figure 5	3-6,8
X	US, A, 4074761 (J.D. MOTT) 21 February 1978 see abstract; figures 1A,1B,2A,2B	1
	. / .	
¹⁰ Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "Z" document member of the same patent family		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 12th February 1991	Date of Mailing of this International Search Report 28.02.91	
International Searching Authority EUROPEAN PATENT OFFICE	Signature of Authorized Officer  MISS D. S. KOWALCZYK	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	US, A, 4660596 (R.A. ASHFORD) 28 April 1987 see abstract; figure 1 ---	1
A	US, A, 4083409 (B.Q. BARRINGTON) 11 April 1978 see column 5, lines 43-49; column 13, lines 44-61; figures 1A,1B ---	3,6,8
A	US, A, 3794112 (T.H. HILL) 26 February 1974 see column 1, lines 37-41; column 3, lines 45-49; figures 2,3 -----	3,6,8

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

CA 9000368
SA 40948

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 25/02/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3126908		None	
CA-A- 1058477	17-07-79	GB-A, B 2036131	25-06-80
US-A- 4074761	21-02-78	DE-A, C 2263036	05-07-73
		FR-A, B 2166038	10-08-73
		JP-A, B, C 48078001	19-10-73
US-A- 4660596	28-04-87	None	
US-A- 4083409	11-04-78	CA-A- 1076955	06-05-80
		DE-A, B, C 2817844	16-11-78
		GB-A- 1580312	03-12-80
		NL-A- 7804457	06-11-78
US-A- 3794112	26-02-74	US-A- 3850238	26-11-74