Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2587752 A1 2008/11/07

(21) 2 587 752

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2007/05/07

(41) Mise à la disp. pub./Open to Public Insp.: 2008/11/07

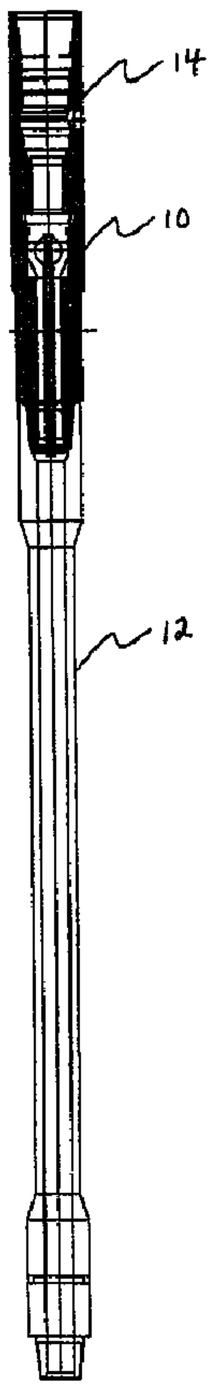
(51) Cl.Int./Int.Cl. *E21B 21/10* (2006.01),
E21B 34/06 (2006.01)

(71) Demandeur/Applicant:
VICTORY RIG EQUIPMENT CORPORATION, CA

(72) Inventeurs/Inventors:
FOLK, ROBERT, CA;
LACHANCE, ADRIAN, CA

(74) Agent: BENNETT JONES LLP

(54) Titre : VANNE A BOISSEAU A BOITE A BOUE
(54) Title: MUD SAVER VALVE



(57) Abrégé/Abstract:
A valve for retaining drilling fluid when a drill string is disconnected from the drive mechanism. The valve has a valve body defining a central fluid passage. The fluid passage has a constriction which forms a seat for a ball. The ball is raised and lowered by a lift rod that engages the upper end of a drill pipe.

ABSTRACT

A valve for retaining drilling fluid when a drill string is disconnected from the drive mechanism. The valve has a valve body defining a central fluid passage. The fluid passage has a constriction which forms a seat for a ball. The ball is raised and lowered by a lift rod that engages the upper end of a drill pipe.

MUD SAVER VALVE

FIELD OF THE INVENTION

The present invention relates to an apparatus for preventing the spillage of drilling mud or other drilling fluids when a top drive or a kelly is disconnected from a tubular string.

BACKGROUND OF THE INVENTION

During drilling operations, a tubular string of drill pipe is lowered into and raised out of the well bore. The string of drill pipe is rotated using either a top drive system or a kelly and rotary table system. Drilling fluid is pumped down the drill pipe to lubricate and cool the drilling bit and to flush out the cuttings and to strengthen the sides of the hole. Drilling fluid is commonly referred to as "drilling mud" and is typically a mixture of clays and chemicals in water and diesel. A mud pump is used to circulate the drilling mud. The drilling mud is pumped into the top of the uppermost drill pipe through a contained fluid connection.

When the addition of a new section of drill pipe is required, the fluid connection is broken to permit disengagement of the top drive or kelly from the drill string. The new length of pipe is connected to the top end of the drill string, the fluid connection is reestablished and drilling operations resume. When the fluid connection is disconnected, there should preferably be a means to prevent the spillage of drilling mud into the drilling environment. Uncontrolled loss of drilling mud is hazardous to rig workers, is economically disadvantageous and poses a threat to the environmental integrity of the surrounding area. The common solution is the use of a valve mechanism, commonly known as a mud saver valve, which assists to prevent the escape of drilling mud.

The mud saver valve may be inserted between the kelly and the drilling string, or immediately below the top drive depending on the drive system being employed. Mud saver valves are commonly placed in series with the primary well control valve. A number of the prior art valves employ spring loaded systems wherein the valve mechanism is actuated by the

compression or release of an integral spring. Such valves are prone to wear and failure, and are often physically complex and cumbersome. Further, some of the valves require manual actuation which does not negate the problem of human error during the disengagement process. Other prior art valves systems rely on the pressure of the fluid flow to actuate,but these systems are also often complex and further, they require a fluctuation in drill pressure fluid to activate. The pressure fluctuation usually results in from the shut down of the mud pump. Such a system does not address the situation whereby a rig worker forgets to shut off the mud pump prior to breaking the drill string.

Therefore, there is a need in the art for an improved mud saver valve which mitigates the difficulties of the prior art.

SUMMARY OF THE INVENTION

In one aspect, the invention may comprise a valve for retaining drilling fluid, the valve comprising:

(a) a valve body defining a central fluid passage, the valve body having an upper end and a lower end;

(b) the lower end of the valve body being adapted to releasably engage the upper end of a drill pipe;

(c) wherein the central fluid passage defines a valve constriction;

(d) a valve ball disposed in the fluid passage above the valve constriction, the ball having a diameter greater than the diameter of the valve constriction, the ball being moveable between a closed position resting against the valve constriction thereby blocking the central fluid passage and an open position whereby it is elevated from the valve constriction and fluid may pass around the ball;

(e) a lift rod attached to and extending downwards from the valve ball, wherein a lower end of the lift rod comprises means for engaging the upper end of the drill pipe;

(f) whereby the ball is lifted by the lift rod from its closed position to its open position when the drill pipe engages the lower end of the valve body.

In one embodiment, the means for engaging the upper end of the drill pipe comprises a perforated plate. In one embodiment, the valve constriction comprises a tapered insert, which removeably engages the valve body. The ball or tapered insert, or both the ball and the tapered insert, may comprise a wear resistant material. In one embodiment, the lower end of the valve body comprises a male threaded connection.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of an exemplary embodiment with reference to the accompanying simplified, diagrammatic, not-to-scale drawings. In the drawings:

Figure 1 is a diagrammatic depiction of one embodiment of the present invention attached to a primary well valve and a drilling tube.

Figure 2 is a diagrammatic depiction of one embodiment of the present invention attached to a primary well valve and detached from a drilling tube.

Figure 3 is a cross sectional side view of one embodiment of the present invention.

Figure 4 is a cross sectional side view of one embodiment of the present invention.

Figure 5 is a cross sectional side view of the valve body of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides for a valve for retaining drilling mud during a drilling operation. When describing the present invention, all terms not defined herein have their common art-recognized meanings. To the extent that the following description is of a specific embodiment or a particular use of the invention, it is intended to be illustrative only, and not limiting of the claimed invention. The following description is intended to cover all alternatives, modifications and equivalents that are included in the spirit and scope of the invention, as defined in the appended claims.

During drilling operations there is a need to repeatedly disconnect the top drive or kelly from the drill string. This can be to insert a new length of drill pipe, or for other reasons. Upon such disconnect occurring, it is essential to stop the flow of drilling fluid that is forced down the drill string to aid the drilling process. The present invention is directed to a valve for retaining drilling fluid when the top drive or kelly is disconnected from the drill string. Figure 1 depicts one embodiment of a valve (10) of the present invention in series with a primary well valve (14) and a drill pipe (12). Although not shown in Figure 1, one skilled in the art will understand that the drill pipe is attached at its lower end to the drill string which extends down the borehole and terminates with a drill bit. Figure 2 shows the valve (10) connected to the primary well valve (14) but disconnected from the drilling tube (12). The valve (10) must be sufficiently robust to carry the load and torque produced by a top drive or kelly.

As shown in Figures 3 and 4, the valve (10) comprises a valve body (16) having an upper end (17) and a lower end (19). The upper end (17) is adapted to connect to a top drive assembly, including a primary well valve as shown in Figures 1 and 2, or to a kelly if a rotary table drive system is employed. The lower end (19) is adapted to attach to the upper end of a drill pipe. The attachment means employed may comprise any suitable means employed by those skilled in the art but will most commonly be a threaded connection, which may be a tapered thread.

As shown in Figure 5, the valve body (16) defines a central fluid passage (32) through which the drilling fluid can flow. The drilling fluid passes into the upper end of the valve body

(17), through the central fluid passage (32) and out of the lower end of the valve body (19) and into the attached drill pipe (12). The central fluid passage (32) has two sections, a lower section (30) and an upper section (28). The central fluid passage (32) defines a valve constriction which serves as a valve seat. In one embodiment, the upper section (28) has a greater diameter than the lower section (30), thus where the sections meet an annular perpendicular shoulder (24) is formed. A tapered insert (34) having a tapered inner diameter is inserted into the upper section (28) so it rests on the shoulder (24) as shown in Figures 3 and 4 and thus forms a valve seat for the valve ball (18). Preferably, the valve seat (34) is removeable and replaceable as it is a wear item. As shown in Figure 4, the valve seat is machined to closely fit in the central passage, and may be retained by friction. O-ring seals (39) maybe provided to seal out drilling fluid, and to assist in the friction fit of the valve seat.

Situated in the upper section (28) and above the shoulder (24) is a valve ball (18) having a diameter that is smaller than the upper section (28) but larger than the valve constriction. There is no exact size that the diameter of the ball (18) must be, however it must allow sufficient flow of fluid around its perimeter as will be discussed further below. The ball (18) is attached to a lift rod (20) that extends down through the lower section of the central fluid passage (30) towards the lower end of the valve body (19). The lift rod (20) also serves to centralize the ball within the valve (10). As seen in Figures 3 and 4, the lift rod (20) may have fins (37) that engage the walls of the central fluid passage (32) to centralize the rod and associated ball. As shown in Figures 3, 4 and 7A and 7B, the ball (18) can have a channel through its center, facilitating attachment using bolts (36) on each side of the ball (18), or the ball (18) can have a threaded hole. Other suitable attachment means such as welding may also be used to attach the ball (18) to the rod (20). As may be appreciated by those skilled in the art, the ball need not be spherical, it is only required that it mate with the valve seat to close the valve and prevent flow of drilling mud through the valve.

At the other end of the rod (20) is means for engaging the upper end of a drill pipe. The means can be a perforated disc (22) that is attached in an orientation that is substantially perpendicular to the longitudinal axis of the central fluid passage (32) and the rod (20). The perforations allow the flow of fluid through the disk (22) but act as a screen to trap larger debris.

Like the ball (18), as shown in Figures 8A and 8B, a channel and bolts (36) may be employed to attach the rod (20) to the disc (22) however, such other suitable attachment means may also be employed. A protective sleeve (38) may be placed over the rod and bolts as shown in Figures 3 and 4.

As seen in Figure 3, when the valve (10) is disconnected from the drill pipe (12) the force of the fluid entering the valve from the first end (17) pushes the ball down driving it into the seat (34). Thus lodged, the ball (18) blocks the flow of fluid through the central fluid passage (32) and drilling fluid cannot escape into the external environment. It can be understood that even absent the pressure of the drilling fluid, gravity would pull the ball (18), with its attached rod (20) and disc (22) down into the seat (34) when disconnected from a drill pipe. When the ball (18) is in the seat as shown in Figure 3, the rod (20) and disc (22) protrude out of the lower end of the valve (19).

When the upper end of a drill pipe (12) engages the lower end of the valve body (19), the protruding disc (22) on the end of the rod (20) contacts the drill pipe (12), as the disc (22) has a larger diameter than inner bore of the drill pipe. In one embodiment, the disc (22) has a diameter similar to the diameter of the lower end (19) of the valve body. Thus, the disc (22) passes through the threaded portion of the upper end of a drill pipe and contacts a shoulder (40) in the drill pipe (12). As may be appreciated by those skilled in the art, alternative configurations to a perforated disc may be used with satisfactory results. A disc or circular shape may be preferable to centralize the mechanism within the central passageway.

As the drill pipe (12) is threaded onto the lower end of the valve body (19), the disc (22) is pushed upwards until it reaches the position shown in Figure 4. It is retained in this position by the drill pipe (12) and cannot descend until the drill pipe is removed. As the disc (22) is moved upwards, there is corresponding upwards movement of the lift rod (20) and attached ball (18), moving the ball (18) up from its closed position on the seat (34) to its open position as shown in Figure 4. Once in the open position, drilling fluid can move around its perimeter and down into the lower section (30) of the central fluid passage. The fluid flows through the perforations of the disc (22) and into the attached drill pipe (12).

All wear items in the valve, including the valve body, the ball, the valve seat, the lift rod, and/or the disc may be manufactured from a metal, a hardened metal, a ceramic material, or the like. It may be coated with a wear-resistant material which may include, without limitation, a thermal spray coating such as a cermet coating like tungsten carbide/cobalt, a chromium carbide/nickel chromium, oxide ceramics like chromium oxide and alumina, fused self fluxing alloys (NiCrSiB), or various hard alloys of iron, nickel, chromium or cobalt.

The foregoing discussion of the invention has been presented for purposes of illustration and description. The foregoing is not intended to limit the invention to the form or forms disclosed herein. Although the description of the invention has included description of one or more embodiments and certain variations and modifications, other variations and modifications are within the scope of the invention, e.g., as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative embodiments to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

WHAT IS CLAIMED IS:

1. A valve for retaining drilling fluid, the valve comprising:

(a) a valve body defining a central fluid passage, the valve body having an upper end and a lower end;

(b) the lower end of the valve body being adapted to releasably engage the upper end of a drill pipe;

(c) wherein the central fluid passage defines a valve constriction;

(d) a valve ball disposed in the fluid passage above the valve constriction, the ball having a diameter greater than the diameter of the valve constriction, the ball being moveable between a closed position resting against the valve constriction thereby blocking the central fluid passage and an open position whereby it is elevated from the valve constriction and fluid may pass around the ball;

(e) a lift rod attached to and extending downwards from the valve ball, wherein a lower end of the lift rod comprises means for engaging the upper end of the drill pipe;

(f) whereby the ball is lifted by the lift rod from its closed position to its open position when the drill pipe engages the lower end of the valve body.

2. The valve of claim 1 wherein the means for engaging the upper end of the drill pipe comprises a perforated plate.

3. The valve of claim 1 wherein the valve constriction comprises a tapered insert, which removeably engages the valve body.

4. The valve of claim 3 wherein the ball or the tapered insert, or both the ball and tapered insert, comprises a wear-resistant material.

5. The valve of claim 1 wherein the lower end of the valve body comprises a male threaded connection.

6. The valve of claim 1 wherein the lift rod comprises means to centralize the lift rod within the central fluid passage.

FIG 1

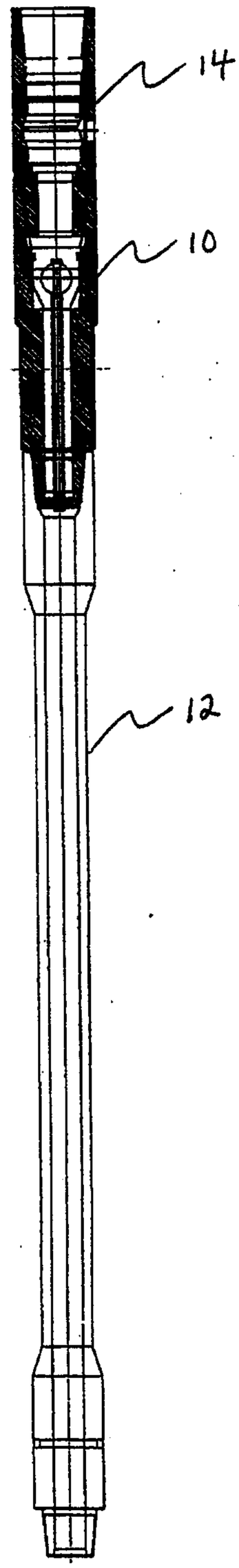


FIG 2

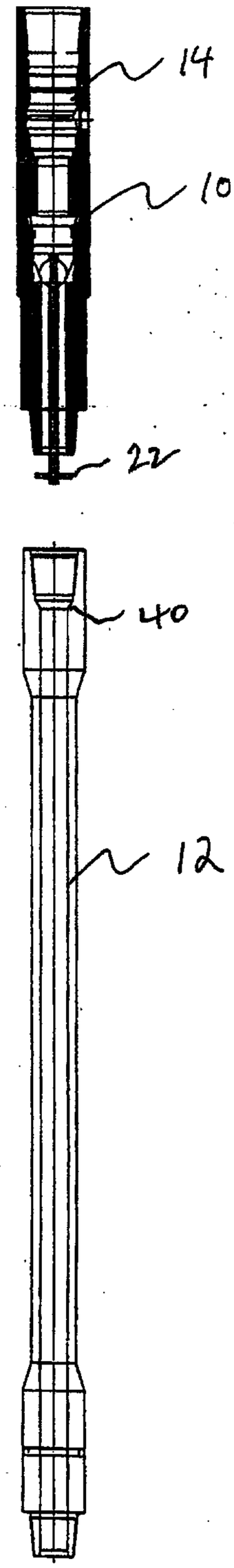


FIG 3

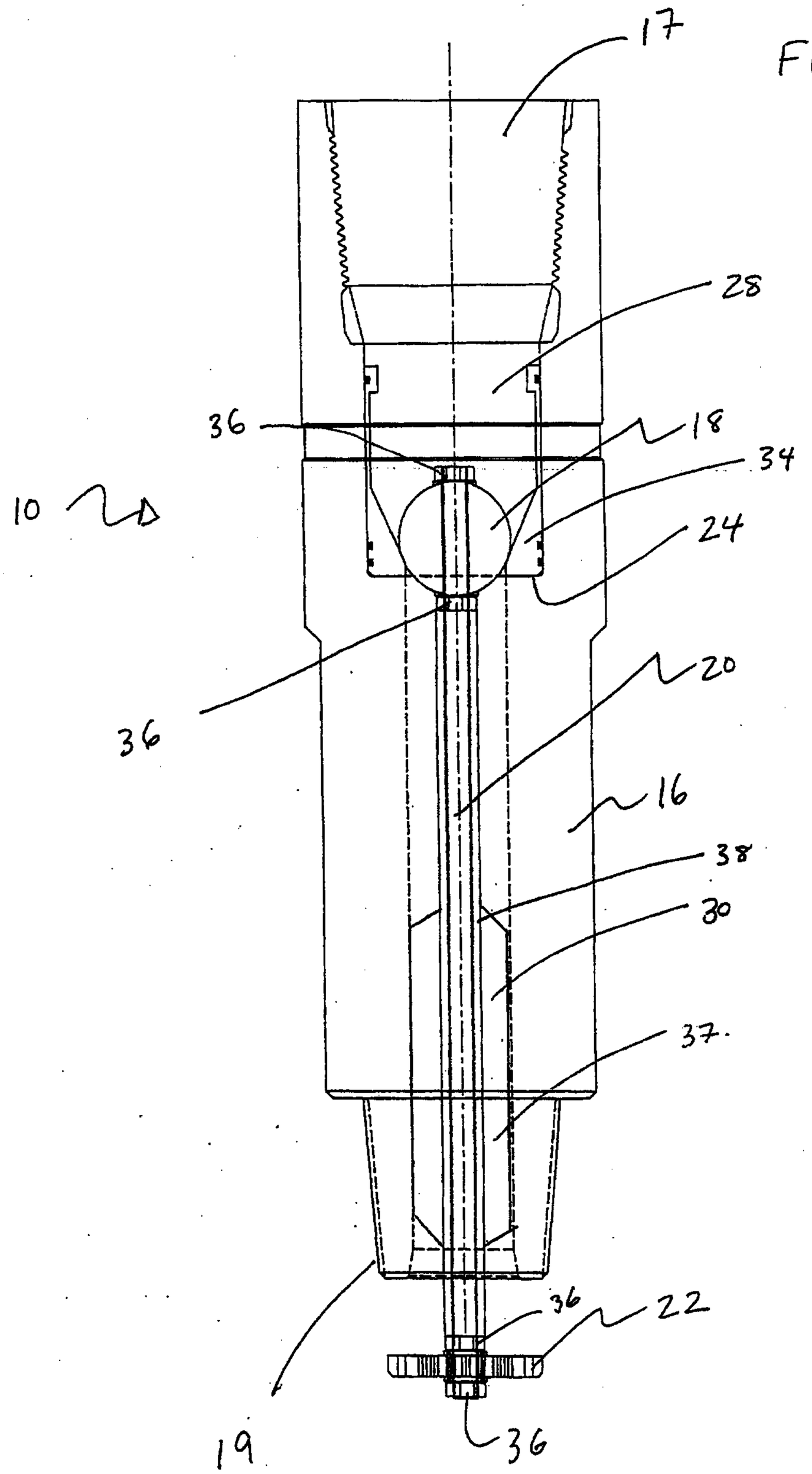


FIG 4

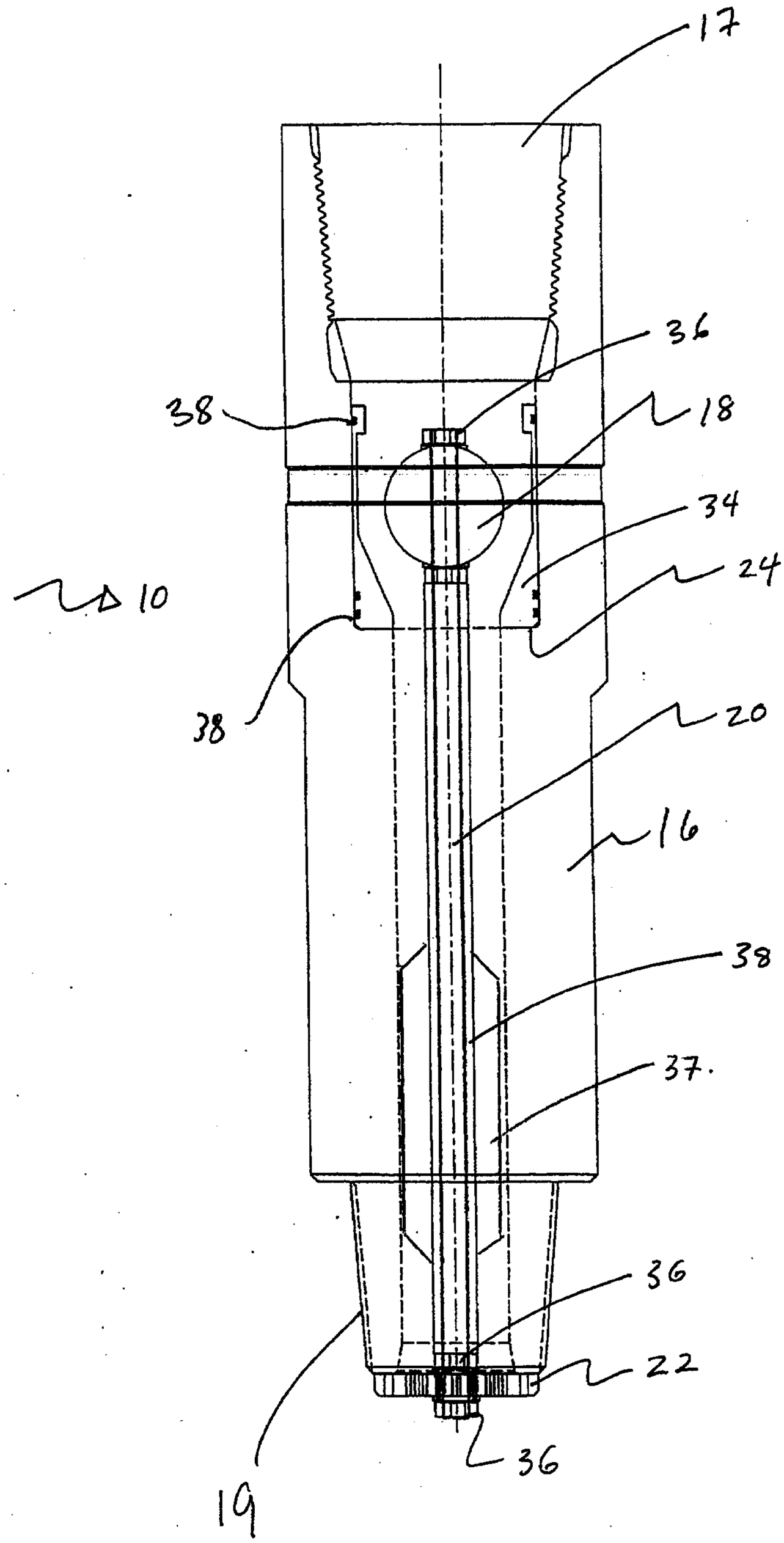
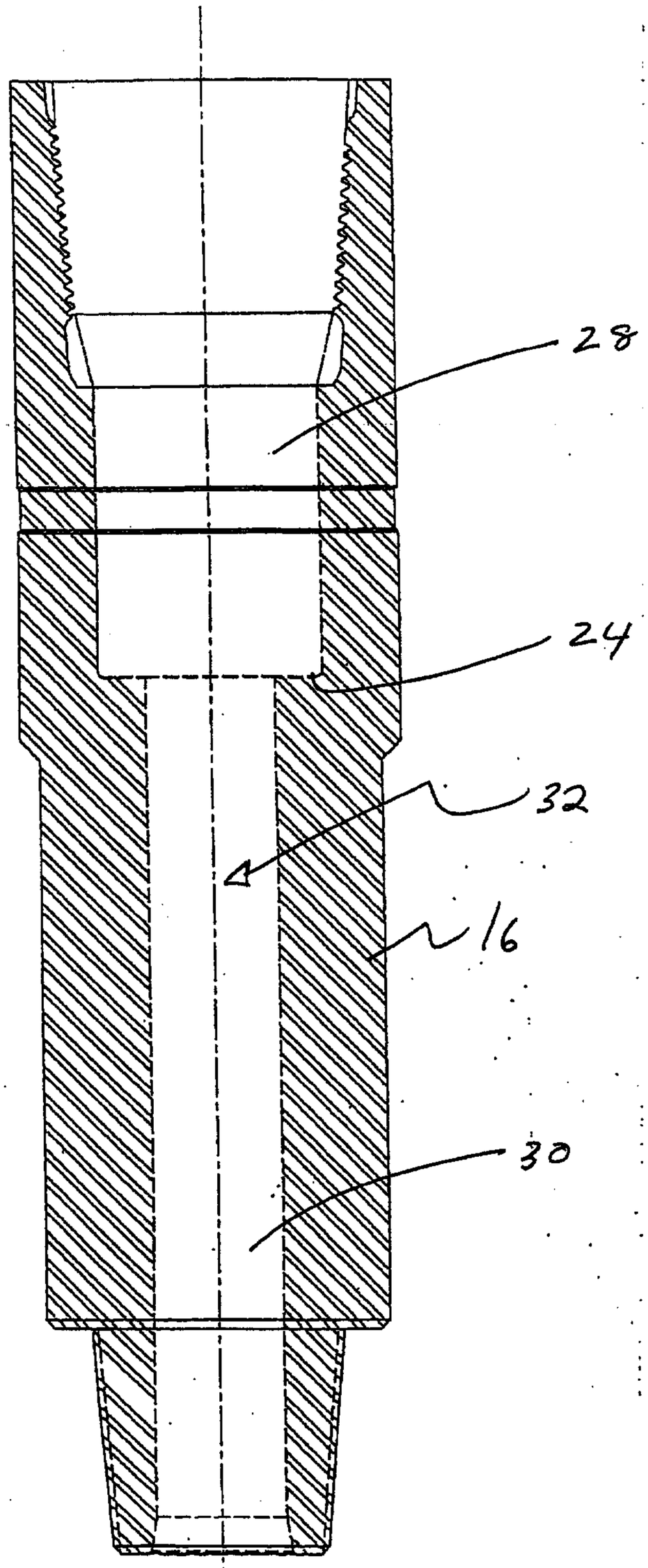


FIG 5




14
10
12