CONVENTION

AUSTRALIA

Patents Act 1990

REQUEST FOR A STANDARD PATENT

AND NOTICE OF ENTITLEMENT

The Applicant identified below requests the grant of a patent to the nominated person identified below for an invention described in the accompanying standard complete patent specification.

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[54]Invention Title:

A BIT RETENTION DEVICE FOR A BIT AND CHUCK ASSEMBLY OF A DOWN-THE-HOLE, PERCUSSIVE DRILL

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[31,33,32]

Details of basic application(s):-
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Applicant states the following:

1. The nominated person is the assignee of the actual inventor~~(s)~~.

2. The nominated person is
~~- the applicant~~
- the assignee of the applicant
~~- authorised to make this application by the applicant~~
of the basic application.

3. The basic application~~(s)~~ was/~~were~~ the first made in a convention country in respect of the invention.

The nominated person is not an opponent or eligible person described in Section 33-36 of the Act.

17 April 1997

Ingersoll-Rand Company
By PHILLIPS ORMONDE & FITZPATRICK
Patent Attorneys for the Applicant
By

Our Ref : 486018 David B Fitzpatrick

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A BIT RETENTION DEVICE FOR A BIT AND CHUCK ASSEMBLY OF A DOWN-THE-HOLE, PERCUSSIVE DRILL

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(56) Prior Art Documents
US 5390749
US 4961469
US 4805705

(57) Claim

1. A bit retention device for a bit and chuck assembly of a down-the-hole, percussive drill, for retaining a head section of a bit should the head section separate from a shank of the bit including:

(a) a cylindrical chuck adapted for threadable connection to a drill casing, said chuck terminating in a radially extending lower end face surface;

(b) a drill bit including:

(i) an axially extending shank in driving engagement with said chuck, said shank terminating in a radially extending shoulder, said shoulder having an upper driving surface facing said end face surface of said chuck;

(ii) a bit head having a working bit face;

(iii) an upper bit head portion adjacent to said driving surface forming a radially extending bit retaining lower surface oriented in a direction facing toward said bit working face; and

(iv) an annular undercut head portion adjacent to said shoulder, said annular undercut portion extending axially along said bit head, said undercut portion having a radial diameter that is smaller than a radial diameter of said shoulder;

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(c) a wear collar of hollow cylindrical form concentric about a lower portion of said chuck, said shoulder and said annular undercut portion; and

(d) a flexible retaining member removably connected to an inner surface of said wear collar, said retaining member positioned axially between said shoulder and said bit working face, said retaining member extending radially between said wear collar and said bit head a sufficient distance to stop said shoulder should said bit drop axially downwardly, whereby said drill bit is movable axially between said chuck end face and said retaining member, but retained within said chuck by said shoulder and said retaining member.

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Invention Title:

A BIT RETENTION DEVICE FOR A BIT AND CHUCK ASSEMBLY OF A DOWN-THE-HOLE, PERCUSSIVE DRILL

Our Ref : 486018
POF Code: 1428/1428

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):

A BIT RETENTION DEVICE FOR A BIT AND CHUCK ASSEMBLY OF A DOWN-THE-HOLE, PERCUSSIVE DRILL

BACKGROUND OF THE INVENTION

This invention relates generally to down-the-hole, percussive drills, and more particularly to retention devices for retaining a head section of a bit should the head section separate from a shank of the bit.

In percussion downhole drilling, broken bits are a common occurrence because of the severe impact and rotational loads necessary to accomplish the drilling effect. Failures in the shank result in the head portion of the bit remaining in the hole. Time consuming and expensive procedures are required to remove the head before drilling can continue. If the head cannot be removed, the hole must be abandoned.

It is common practice to provide external "fishing" threads on the rear portion of the bit head to facilitate removal of the broken bit head by use of an internally threaded "fishing" tool. This is a somewhat difficult separate operation and results are very often futile.

Therefore it would be very advantageous to provide a system where the broken portion of the bit is automatically retrieved with the drill string and hammer.

One device for this purpose as described in U.S. Patent No. 5,065,827 (Meyers, et. al.). This device includes an attachment piece with internal threads and a corresponding external thread on the bit. Such devices have several disadvantages. The threaded engagement may be lost if reverse rotation occurs after bit failure, resulting in bit head loss. Meyers suggests that a pin may be installed to prevent this, but this complicates removal even more. Also, if the threads are damaged in normal drilling, the removal of an unbroken bit for sharpening or other service is difficult or impossible without destroying the device.

The foregoing illustrates limitations known to exist in present drill bit retention devices. Thus, it is apparent that it would be advantageous to provide an alternative directed to overcoming one or more of the limitations set forth above.

Accordingly, a suitable alternative is provided including features more fully disclosed hereinafter.

SUMMARY OF THE INVENTION

According to one aspect of this invention there is provided a bit retention device for a bit and chuck assembly of a down-the-hole, percussive drill, for retaining a head section of a bit should the head section separate from a shank of the bit including:

(a) a cylindrical chuck adapted for threadable connection to a drill casing, said chuck terminating in a radially extending lower end face surface;

(b) a drill bit including:

(i) an axially extending shank in driving engagement with said chuck, said shank terminating in a radially extending shoulder, said shoulder having an upper driving surface facing said end face surface of said chuck;

(ii) a bit head having a working bit face;

(iii) an upper bit head portion adjacent to said driving surface forming a radially extending bit retaining lower surface oriented in a direction facing toward said bit working face; and

(iv) an annular undercut head portion adjacent to said shoulder, said annular undercut portion extending axially along said bit head, said undercut portion having a radial diameter that is smaller than a radial diameter of said shoulder;

(c) a wear collar of hollow cylindrical form concentric about a lower portion of said chuck, said shoulder and said annular undercut portion; and

(d) a flexible retaining member removably connected to an inner surface of said wear collar, said retaining member positioned axially between said shoulder and said bit working face, said retaining member extending radially between said wear collar and said bit head a sufficient distance to stop said shoulder should said bit drop axially downwardly, whereby said drill bit is movable axially between said chuck end face and said retaining member, but retained within said chuck by said shoulder and said retaining member.

According to a still further aspect of this invention there is provided a bit retention device for a bit and chuck assembly of a down-the-hole, percussive drill, for retaining a head section of a bit should the head section separate from a shank of the bit including:

(a) a cylindrical chuck adapted for threadable connection to a drill casing, said chuck terminating in a radially extending lower end face surface;

(b) a drill bit including:

(i) an axially extending shank in driving engagement with said chuck, said shank terminating in a radially extending shoulder, said shoulder having an upper surface facing said end face surface of said chuck;

(ii) a bit head having a working bit face and an upper bit head portion;

(iii) the upper bit head portion including said shoulder and having an outer surface with a first annular groove therein; and

(iv) a second annular groove in said upper bit head portion axially below said first annular groove, said first annular groove having a radial diameter that is smaller than a radial diameter of second annular groove;

(c) a wear collar of hollow cylindrical form concentric about a lower portion of said chuck, said first and second annular bit grooves, said wear collar having a radially extending bit retaining shoulder, said retaining shoulder having an upper surface facing said second annular bit groove; and

(d) a flexible retaining member removably positioned in said second bit annular groove, said retaining member positioned axially between said shoulder upper surface and said bit working face, said retaining member extending radially between said wear collar and said bit head a sufficient distance to stop said bit should said bit drop axially downwardly, whereby said drill bit is movable axially between said chuck end face and said retaining member, but retained within said chuck by said retaining shoulder and said retaining member.

The foregoing and other aspects will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing figures.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

Fig. 1 is a schematic, longitudinal, cross-sectional view of the device according to the invention, with a prior art bit head working end shown in phantom, an unbroken bit depicted to the left of the centerline and a broken bit to the right of the centerline;

Fig. 2 is a view along 2-2 of Fig.1;

Fig. 3 is a schematic, longitudinal, cross-sectional view of an alternate embodiment of the invention, with a prior art bit head working end shown in phantom; and

Fig. 4 is a view along 4-4 of Fig. 3.

DETAILED DESCRIPTION

Now referring to the drawings, Fig. 1 is a schematic, longitudinal, cross-sectional view of the assembly 1 of the invention, with a bit 3 depicted unbroken to the left of the centerline 5 and depicted broken to the right of the centerline 5. A prior art bit head working end 7 is shown in phantom, for illustrative comparison.

The assembly of the invention includes a cylindrical chuck 10 adapted for connection by threads 12 to a drill string casing 14, as is conventional. Chuck 10 terminates in a radially extending lower end face surface 16. Drill bit 3 includes an axially extending shank 20 in driving engagement with chuck 10, as is conventional. Bit 3 terminates in a radially extending shoulder 32 having an upper surface 24 facing end face surface 16 of chuck 10. Bit 3 further includes a bit head 26 having a working face 28. Shoulder 32 forms a radially extending bit retaining lower surface 34 oriented in a direction facing toward bit working face 28. Annular undercut head portion 36 adjacent to shoulder 32 extends axially along bit head 26. Undercut portion has a radial diameter 38 that is smaller than radial diameter 40 of retaining shoulder 32.

Wear collar 42, of hollow cylindrical form, is concentrically positioned about lower chuck portion 44, shoulder 32 and annular undercut portion 36. Wear collar 42 can be, but need not be, rotatable with respect to chuck 10. If non-rotatable, wear collar 42 and chuck 10 can be a single piece, or if two pieces, they can be fixed together with a pin 45.

Flexible retaining member 50 is removably connected to an inner surface 52 of wear collar 42. Retaining member 50 is positioned axially between shoulder 32 and bit working face 28. Retaining member 50 extends radially between wear collar 42 and bit head 26 a sufficient distance to stop retaining shoulder 32 should shank 20 break and a portion of bit head 26 drop axially downwardly. Thus, it can be understood that bit 3 is movable axially between chuck 10 and retaining member 50, but retained in chuck 10 by shoulder 32 and retaining member 50. At upper end 54 of

shank 20 bit 3 is retained in chuck 10 by split ring 56 and shank shoulder 58, as is well known. Axial distance 57 between shoulder 58 and split ring 56 is less than axial distance 59 between shoulder 32 and retaining member 50, in order to assure that retaining member 50 is not contacted by shoulder 32 during normal operations.

Retaining member can be any flexible material. However, I prefer a flexibly expandable and contractible split ring 60, of material similar to split ring 56, commonly used in down-the hole drill applications. Split ring 60 is removably positioned in groove 62 of wear collar 42. Split ring 60 terminates in spaced apart end portions 64 that contain apertures 66 for gripping by an adjustment tool (not shown). Access to apertures 66 is through wear collar aperture 68 extending through the wall 70 of collar 42 (Fig. 2).

The device is assembled by first, dropping or forcing the retaining ring 60 over the shoulder 32 and onto the smallest diameter of the bit head (annular undercut 36). The wear collar 42 is slipped or pressed over the chuck 10 as shown in Fig. 1. The chuck 10 and wear collar 42 assembly are then assembled over the shank 20 of the bit 3 as in present designs. Snap ring pliers with 90° bent tips are inserted into apertures 66 provided for this purpose via aperture 68. The snap ring 60 is compressed (reduced in diameter) by the pliers until the wear collar 42 can be assembled over the snap ring 60. The snap ring 60 is guided into the groove 62 in the wear collar 42 provided for that purpose. The snap ring 60 is allowed to expand into its groove 62 and the pliers removed. The balance of assembly of the downhole drill is then completed as required. Rotation of the drill string in either direction has no effect on the function of the device.

Figs. 3 and 4 show an alternate embodiment of the assembly of the invention. Similar elements carry designations already assigned. Chuck 10 is unchanged. However, a radially extending bit retaining shoulder 80 is now formed in lower end 82 of collar 42. A first annular split ring groove 84 is provided in an upper portion 30 of bit head 26. A second annular split ring groove 85 is provided in an upper portion 30 of bit head 26 axially below first groove 84. First groove 84 has a radial diameter 86 that is smaller than a radial bore diameter 88 of wear collar 42 and radial diameter 87 of groove 85. Bit retaining shoulder 80 has an upper surface 90 facing second groove 85. Split ring 60 is removably positioned in groove 85, as described hereinafter. Split

ring 60 terminates in spaced apart end portions 64 that contain apertures 66 for gripping by an adjustment tool. Access to apertures 66 is through wear collar aperture 68 extending through the wall 70 of collar 42 (Fig. 4).

The device is assembled by first, expanding split ring 60 onto upper end 30 and allowing split ring 60 to snap into first groove 84. The wear sleeve is shipped or pressed over the chuck 10 and split ring 60. The chuck and sleeve assembly are then assembled over the shank of the bit as in present designs. A snap ring pliers with 90° bent tips is inserted into the lower side of the snap ring 60 into holes provided for this purpose. The snap ring is expanded by the pliers until it can be positioned into second groove 85. Diameter 87 of groove 85 assures that snap ring 60 extends radially between wear sleeve 42 and bit 3 a sufficient distance to prevent shoulder 80 from passing thereover, should shank 20 break and bit head 26 drop axially downwardly. The balance of assembly of the downhole drill is then completed as required. Rotation of the drill string in either direction has no effect on the function of the device.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A bit retention device for a bit and chuck assembly of a down-the-hole, percussive drill, for retaining a head section of a bit should the head section separate from a shank of the bit including:

(a) a cylindrical chuck adapted for threadable connection to a drill casing, said chuck terminating in a radially extending lower end face surface;

(b) a drill bit including:

(i) an axially extending shank in driving engagement with said chuck, said shank terminating in a radially extending shoulder, said shoulder having an upper driving surface facing said end face surface of said chuck;

(ii) a bit head having a working bit face;

(iii) an upper bit head portion adjacent to said driving surface forming a radially extending bit retaining lower surface oriented in a direction facing toward said bit working face; and

(iv) an annular undercut head portion adjacent to said shoulder, said annular undercut portion extending axially along said bit head, said undercut portion having a radial diameter that is smaller than a radial diameter of said shoulder;

(c) a wear collar of hollow cylindrical form concentric about a lower portion of said chuck, said shoulder and said annular undercut portion; and

(d) a flexible retaining member removably connected to an inner surface of said wear collar, said retaining member positioned axially between said shoulder and said bit working face, said retaining member extending radially between said wear collar and said bit head a sufficient distance to stop said shoulder should said bit drop axially downwardly, whereby said drill bit is movable axially between said chuck end face and said retaining member, but retained within said chuck by said shoulder and said retaining member.

2. The bit retention device of claim 1 wherein said retaining member is a flexibly expandable and contractible split ring removably positioned in an annular groove in said wear collar inner surface.

3. The bit retention device of claim 1 or claim 2 further including: aperture means in said wear collar for permitting access to said retaining member by an adjustment tool.

4. A bit retention device for a bit and chuck assembly of a down-the-hole, percussive drill, for retaining a head section of a bit should the head section separate from a shank of the bit including:

(a) a cylindrical chuck adapted for threadable connection to a drill casing, said chuck terminating in a radially extending lower end face surface;

(b) a drill bit including:

(i) an axially extending shank in driving engagement with said chuck, said shank terminating in a radially extending shoulder, said shoulder having an upper surface facing said end face surface of said chuck;

(ii) a bit head having a working bit face and an upper bit head portion;

(iii) the upper bit head portion including said shoulder and having an outer surface with a first annular groove therein; and

(iv) a second annular groove in said upper bit head portion axially below said first annular groove, said first annular groove having a radial diameter that is smaller than a radial diameter of second annular groove;

(c) a wear collar of hollow cylindrical form concentric about a lower portion of said chuck, said first and second annular bit grooves, said wear collar having a radially extending bit retaining shoulder, said retaining shoulder having an upper surface facing said second annular bit groove; and

(d) a flexible retaining member removably positioned in said second bit annular groove, said retaining member positioned axially between said shoulder upper surface and said bit working face, said retaining member extending radially between said wear collar and said bit head a sufficient distance to stop said bit should said bit drop axially downwardly, whereby said drill bit is movable axially between said chuck end face and said retaining member, but retained within said chuck by said retaining shoulder and said retaining member.

5. The bit retention device of claim 4 wherein said retaining member is a flexibly

expandable and contractible split ring removably positioned in said annular groove.

6. A bit retention device substantially as hereinbefore described with reference to any one of the embodiments illustrated in the accompanying drawings.

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DATED: 15 June 1998

PHILLIPS ORMONDE & FITZPATRICK

Attorneys for:

INGERSOLL-RAND COMPANY

ABSTRACT

A bit retention device (1) for a bit (3) and chuck assembly (10) of a down-the-hole, percussive drill, for retaining a head section (26) of a bit (3) should the head section separate from a shank (20) of the bit (3) includes a chuck (10) adapted for threadable connection to a drill casing (14), a drill bit (3), a bit retaining shoulder (32) in the the assembly (10); a wear collar (42) concentric about the chuck (10) and bit (3) and a flexible retaining member (50) removably connected to the assembly (10), the retaining member (50) extending radially between the wear collar (42) and bit (3) a sufficient distance to contact the retaining shoulder (32) should the bit (3) drop axially downwardly.

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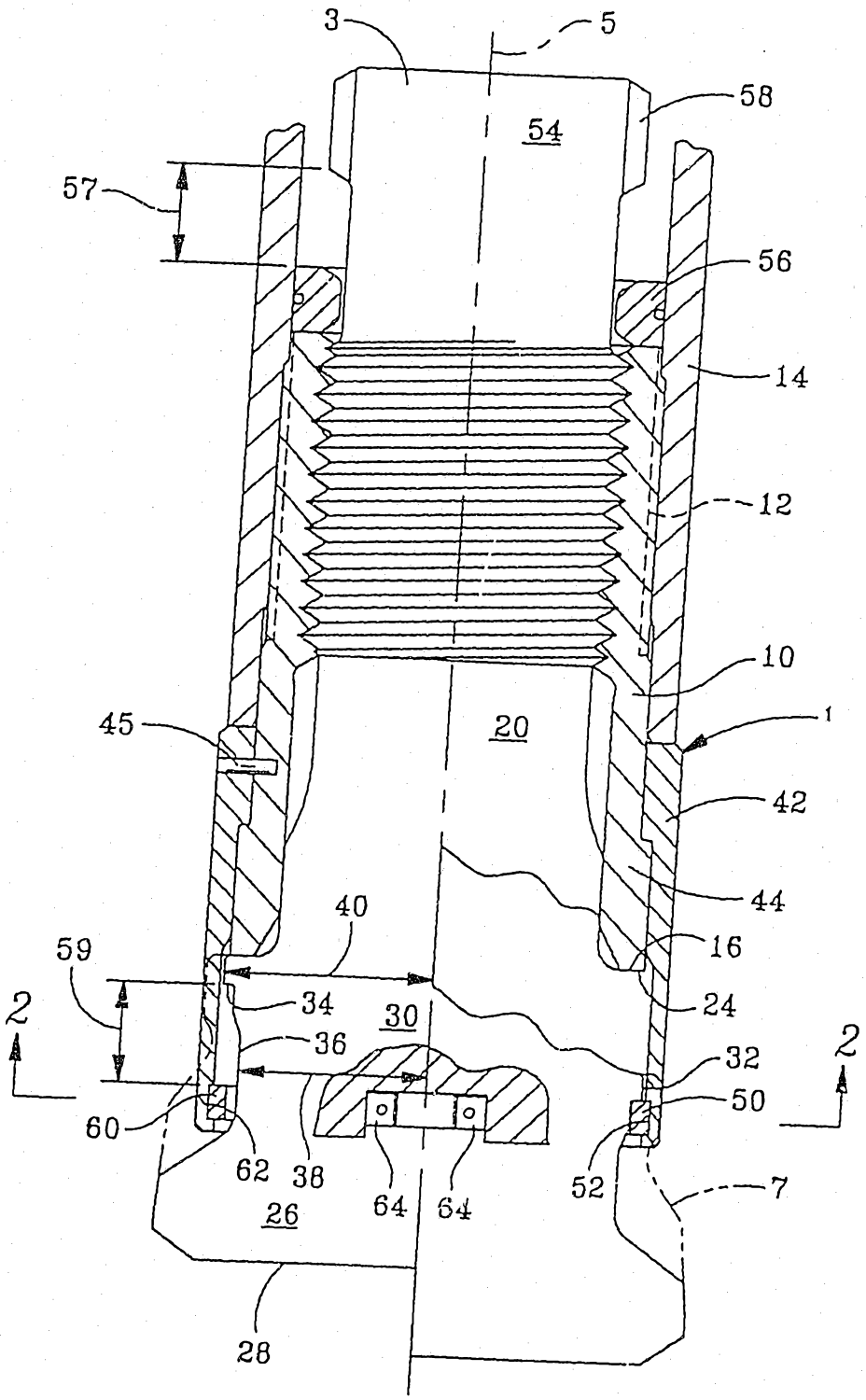

FIG. 1

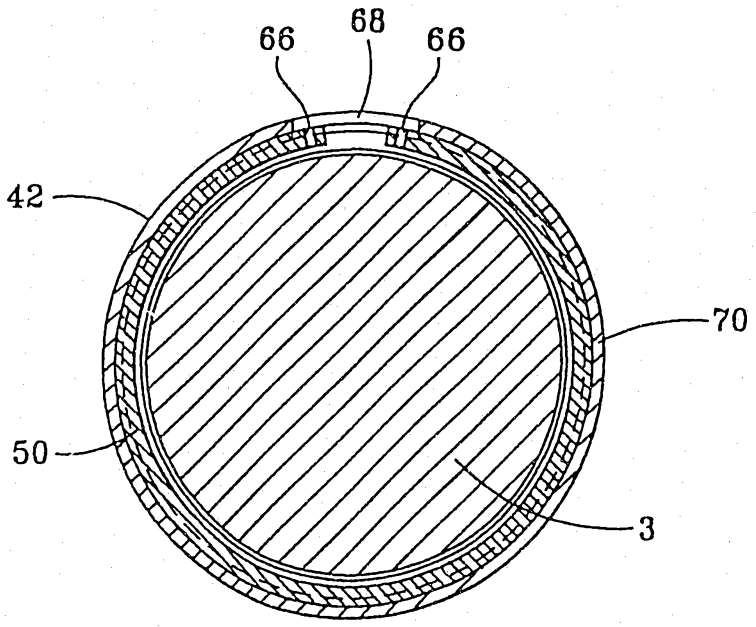

FIG. 2

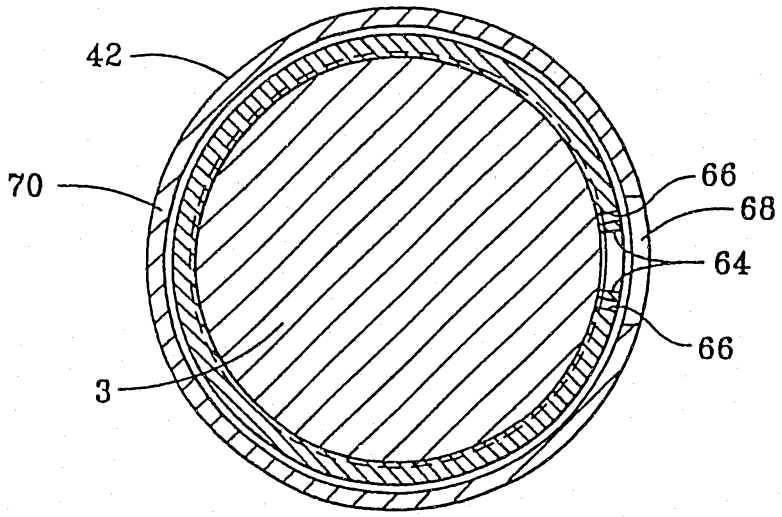

FIG. 4

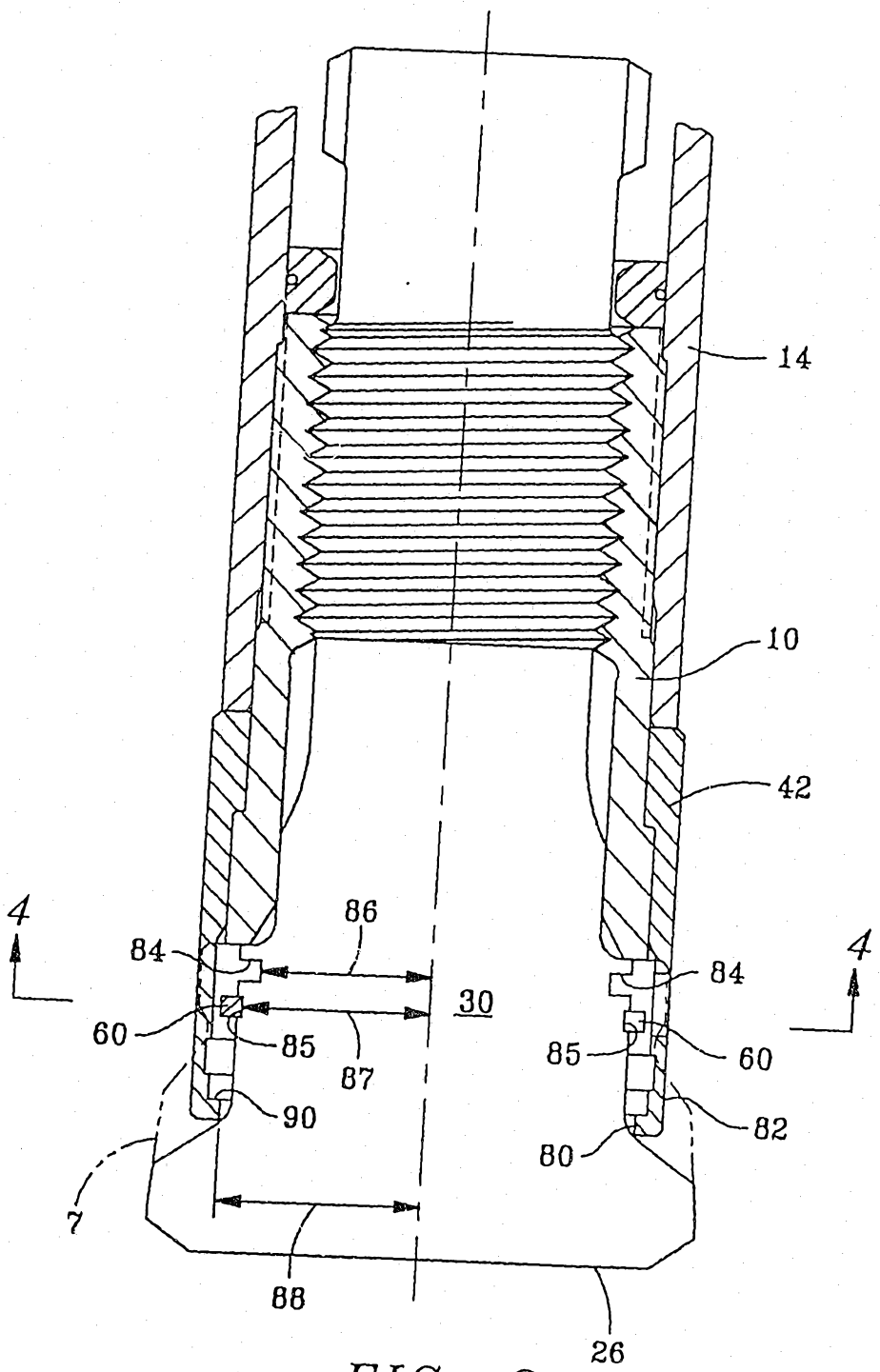

FIG. 3