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(71) Applicant *(for all designated States except US)*: **SHELL-JET PTY LIMITED** [AU/AU]; 44 Leewood Drive, Orange, New South Wales 2800 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **ANDERSON, Leslie, Michael** [AU/AU]; 98 Prince Street, Orange, New South Wales 2800 (AU).

(74) Agent: **MAXWELL, Peter, Francis**; Peter Maxwell & Associates, Level 6, 60 Pitt Street, Sydney, New South Wales 2000 (AU).

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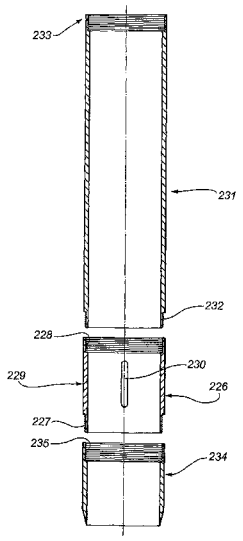
(54) Title: A LINE MARKER



(57) Abstract: A line marker adapted to be attached to the lower portion of the upper end of the inner tube of a core drill includes a tubular body (226) having an elongated slot (227) which is parallel to the central axis of the marker body (226) which provides access from the exterior of the line marker to a core sample located within the line marker body when the upper end of the inner tube and the line marker are removed from the drill hole.

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A LINE MARKER

TECHNICAL FIELD

This invention relates to core drilling and more particularly to a line marker for use with the upper end of a core drill.

BACKGROUND ART

Many forms of geological survey depend on core drilling for samples. Some surveying requires that the orientation of a core be determined accurately and reliably. In many situations the angle of the longitudinal axis of the core drill relative to the "plane" of the earth at the drill site is other than 90 degrees. This is the drilling angle and it may be ascertained in a number of ways. It is sometimes also important to determine, after removing the core for inspection, the rotational orientation or compass orientation of the core sample relative to the surrounding terrain from which it was extracted. Known prior methods are not reliable, particularly at low angles of inclination from the vertical. There is a need, therefore, for a simple, reliable means of marking a core.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided a line marker adapted to be attached to the lower portion of the upper end of the inner tube of a core drill comprising a tubular body adapted to receive a core and having an elongated slot providing access from the exterior of the line marker to a core sample located within the line marker body.

The line marker may also include comprising a core tube at the upper end of the body for connecting the line marker to the tube cap at the lower portion of the upper end of the inner tube of a core drill.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross section of an upper end of a core drill inner tube;

Fig. 2 is a cross section of the track;

Fig. 3 is a perspective view of the indent washer;

Fig. 4 is a cross section of the casing of the upper end; and

Fig. 5 is a perspective view of an inner tube and upper end, showing the use of the levels and indent washer in marking the core;

Fig. 6 is an exploded perspective view showing the ball, track and indent washer;

Fig. 7 is a cross section of another upper end of a core drill inner tube;

Fig. 8 is an enlarged view of the coupling portion of the embodiment shown in Fig. 6;

Fig. 9 is an exploded cross-sectional view of another upper end of a core drill inner tube, and

Fig. 10 is a cross-sectional view of a line marker according to the invention adapted for use with the upper end of the core drill inner tube shown in Fig. 9.

MODES FOR CARRYING OUT THE INVENTION

A core drill usually comprises and outer tube and an inner tube. The outer tube is rotated and transmits rotational power to a cutting head. A drill bit on the cutting head forms a core which rises up through the inner tube as the drill progresses into the earth or substrate. The inner tube and separated core may be lifted up through the outer tube by lowering a latching body through the outer tube and latching onto a spindle carried by the upper end of the inner tube. The latching body is lowered on a steel cable and engages the upper end of the spindle. Tension on the rod string is translated, by a core lifter within the drill, into a compressive force which acts to fracture the core and

separate it from the substrate. The separated core can then be lifted, within the inner tube, by the cable attached to the upper end.

As shown in Figure 1, an upper end 10 includes a spindle 11 a casing 12 and a shield 13. Threads 14 at the lower end of the shield engage the upper threads of the inner tube of the core drill. The spindle 11 passes through the plug 15 which caps the top of the casing 12. A compression spring 16 is trapped between the plug 15 and a nut 17 which is threaded on to the spindle 11 and secured thereto by pin 18. The lower end of the spindle 11 passes through a bronze bushing 19 and terminates in a threaded stub 20.

When the rod string is raised, the spindle 11 is placed into tension. As shown in Figs. 1 and 8, this causes a nut 21 threaded onto the stub 20, to bear against a washer 22 and consequently onto a track 23. The track 23 surrounds the spindle 11 and faces upwardly or away from the threads 14. A groove 24 is formed in an upper face of the track. The groove 24, when the track is installed, also surrounds the spindle 11. An indent washer 25 is positioned between the track 23 and the lower end of the casing 12. A non-magnetic steel or other non-metallic hard ball 30 rolls freely in the groove. The diameter of the ball is slightly larger than the depth of the groove 24. In all non-vertical drilling, the track 23 is tilted. When the track is tilted, as in the case of non-vertical drilling, the ball rolls to the lowest point in the plane of the groove 24. The track 23 is shown in Figure 2.

Until the track 23 is brought into the proximity of the lower end of the casing, the indent washer 25 and the track 23 are kept apart by a spring 26. The spring keeps the indent washer 25 in contact with the lower end of the casing 12. The indent washer 25 (shown in Figure 3) is formed from a relatively soft metal such as copper or brass that can be impressed or indented

with a steel ball. The indent washer has a central opening for receiving the spindle 11 and an alignment hole or pilot 29.

As shown in Figure 4, the lower end of the casing is fitted with a pin 27. The pin 27 extends in the direction of the drilling axis 28 and extends into the pilot or hole 29 formed in the indent washer 25. This keeps the rotational or compass orientation of the indent washer 25 indexed or fixed, relative to the casing 12. The pin 27 does not interfere with the rolling of the ball in the groove.

When a core is being separated by raising the rod string, the spring 26 compresses as the track 23 is brought toward the indent washer 27. Before contact, the ball 30 has rolled to the lowest point in the groove 23. Eventually, the ball becomes trapped between the track 23 and the indent washer 25. Further tension in the rod string causes the ball 30 to be driven into the surface of the indent washer 25. This action makes an impression or indent in the washer 25 and the indent is known to be formed at the time the core is separated. When the drill is other than absolutely vertical, the angular (or "compass") position of the impression marks the bottom or lowest (vertical) point in the groove 24 and therefore in the plane of the washer 25. Both the groove 24 and the washer 25 are perpendicular to the long axis of the drill.

Because the indent washer 25 is pinned to the casing, its orientation relative to the casing is known. Thus, the impression can later be related to a reference mark or groove 31 formed on the outer surface of the casing. This is shown in Figure 5.

Figure 5 show how the core's orientation is determined. In this example, the pin 27 and reference groove or mark 31 are aligned during the manufacture of the casing 12. To be exact, the reference mark defines a plane through the drill axis 28. Preferably and conveniently, the pin is formed in this plane (on

the same side of the centreline 28 as the mark 31). The pin and reference mark 31 need not be in the same plane so long as the angular relationship of the two different planes is known. This relationship allows the location of the alignment hole 29 in the indent washer 25 to be related to the location of the reference mark 31.

This means that the indent washer 25 can be removed after drilling and the indent washer 25 can be used to mark the bottom or low point of the core. This is done by laying the re-assembled top end 10 and inner tube 40 horizontally and rotating them together until the reference mark 31 faces straight up. To do this, a specially adapted level 41 is used.

The level is in the form of a saddle 44 which conforms to the circumference of the upper end 10. The level includes a central reference mark 42. A spirit level or other levelling device 45 attached to the saddle indicates when the reference mark 42 is at its vertical maximum. When the reference mark 42 is at its maximum and also aligned with the reference mark 31 on the casing 12, the reference mark 31 is known to be in a vertical plane which passes through the drill axis 28. Next, the same or a second level 43 is used to note the vertical maximum of the lower end of the inner tube 40 and therefore of the core sample within. By aligning the hole 29 of the indent washer 25 with the indicated vertical maximum of the lower end of the inner tube 40, the impression 32 can be used to indicate where to mark an index point onto the core.

The index point indicates the location of the "bottom" of an inclined slice of the core sample. It should be apparent that an imaginary line which passes radially from the drill axis 28 through the index point defines the compass orientation of the core. This is because the inclination of the drill axis in the earth can be related to a compass direction. This may be done before, during

or after drilling by observing the compass orientation of the vertical plane which contains the drill axis 28 at the cutting head at the time when the core is separated.

As shown in the embodiment of Figs. 6 and 7, the spindle 110 may be split so that the lower portion 111 of the spindle rotates independently of the upper portion 112 of the spindle 110 thereby minimising wear on the bushing 19. Tension is transmitted from the upper portion 112 to the lower portion 111 by a coupling 113. The coupling 113 is at one end threaded to a lock nut 114 and serves to restrain the lower portion of the spindle 111 between a pair of thrust bearings 115, 116. The lock nut 114 is threaded onto the bottom end of the upper spindle 12 and has a threaded exterior to engage the coupling 113.

The lower portion of the spindle 111 carries an integral flange 117 which is trapped by the coupling but which rotates freely within it. Ball bearings 118 support the lower portion 111 within the coupling 113. The coupling arrangement allows the lower portion 111 to rotate independently of the upper portion 112. This arrangement minimises the rotation of the lower portion 111 and minimises wear on the seals 120, preferably two in number, which seals prevent grease, water and mud from interfering with the operation of the track, ball and washer arrangement 125.

The upper end shown in Figs. 9 and 10 consists of a spindle 201, a shut off valve 202, shut off valve washer 203, thrust bearing 204, spindle bearing 205, hanger bearing 206, nyloc nut 207, bronze bush 208, and an extended stub shaft 209. Above the stub shaft 209 there is a spring 210, circlip 211, bronze bush 212, seal 213, bronze bushes 214 and 215 and centre housing 216.

Above the centre housing 216 there is an aluminium washer housing 217, a seal 218, bronze bush 219, circlip 220, aluminium disc 221, separation

spring 222, race track 223, race track nut 224 and fixed tube cap 225, or in a modification of the upper end, a ballmark cap 225A, lock nut 225B and tube cap 225C.

The line marker shown in Fig. 10 consists of a tubular body 226 having an external threaded portion 227 at one end and an internal threaded portion 228 at the other end. Extending longitudinally along the line marker body 226 is an elongated slot 230 through which a marker can be placed in order to mark a line on the core sample when the upper end and line marker are removed from the drill hole. The slot 230 is formed in the central portion 229 and is parallel to the central axis of the marker body 226.

A core tube 231 has an external threaded portion 232 which engages the internal threaded portion 228 of the line marker body 226. The other end 233 of the core tube 231 is engaged with the tube cap 225 of Fig. 9 so that the slot will be spaced from the top end of the core sample within the core tube 231 and the marker body 226. The end 233 of the core tube 231 could be coupled to the fixed tube cap 225 of Fig. 9. Prior to use, the slot 230 in the body 226 is aligned with the hole 29 in the indent washer 25 and the line marker sub-assembly 226/231/234 is locked on to the tube cap 225 by lock nut 224.

Below the marker body 226 there is a core lifter case 234 which has an internal threaded portion 235 which engages the external threaded portion 227 at the lower end of the marker body 226.

CLAIMS:

1. A line marker adapted to be attached to the lower portion of the upper end of the inner tube of a core drill comprising a tubular body adapted to receive a core and having an elongated slot providing access from the exterior of the line marker to a core sample located within the line marker body.

2. A line marker according to claim 1 further comprising a core tube at the upper end of the body for connecting the line marker to the tube cap at the lower portion of the upper end of the inner tube of a core drill.

3. A line marker according to claim 1 where the elongated slot extends longitudinally along the body parallel to the longitudinal axis of the body.

4. A line marker according to claim 1 and further including a core lifter case at the lower end of the marker body.

5. A line marker according to claim 1 wherein the marker body has an upper end, a lower end and a central portion therebetween and wherein the elongated slot is formed in the central portion.

6. A line marker according to claim 5 wherein the upper end of the marker body has a threaded portion adapted to engage the tube cap at the lower portion of the upper end of the inner tube of a core drill.

7. A line marker according to claim 5 wherein the lower end of the marker body has a threaded portion adapted to engage a core lifter case.

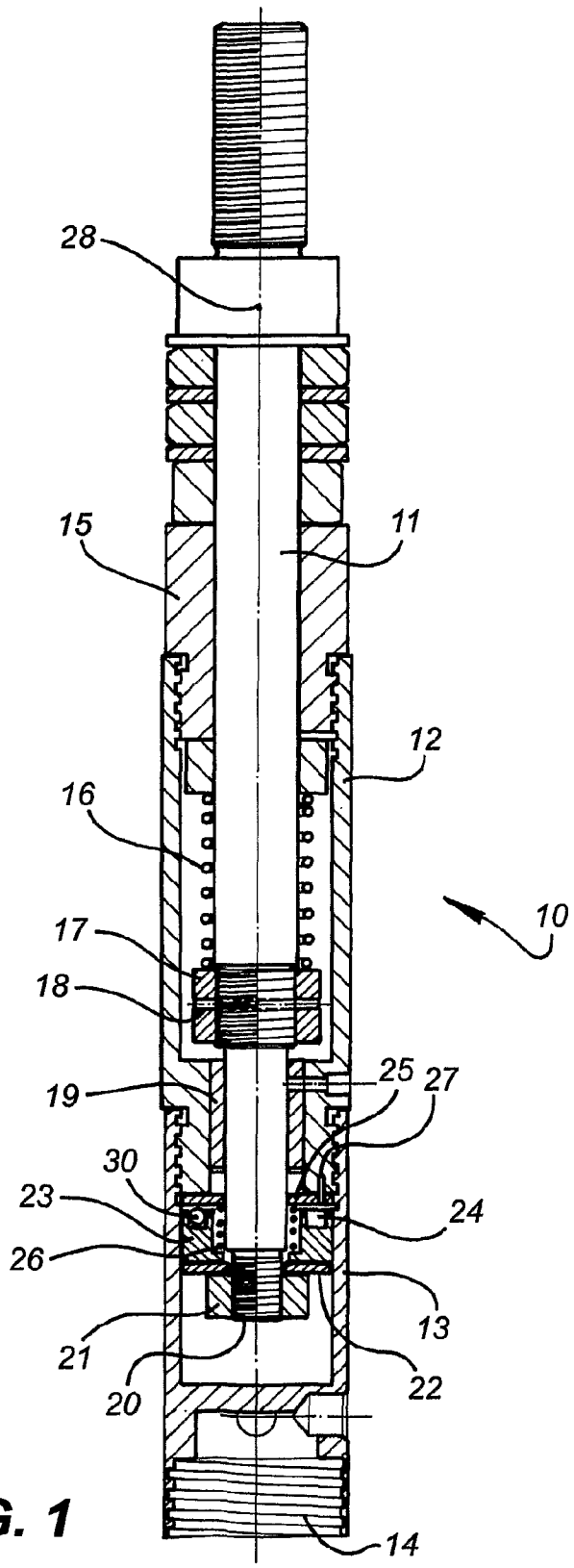

FIG. 1

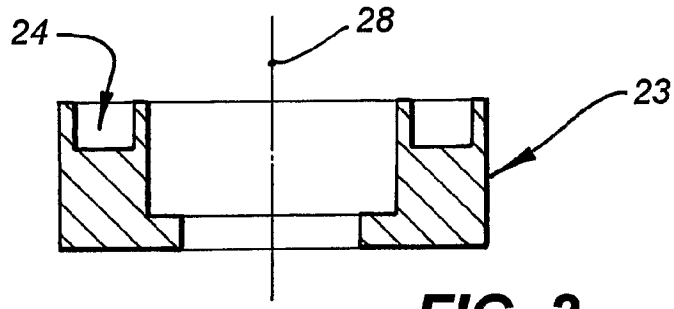

FIG. 2

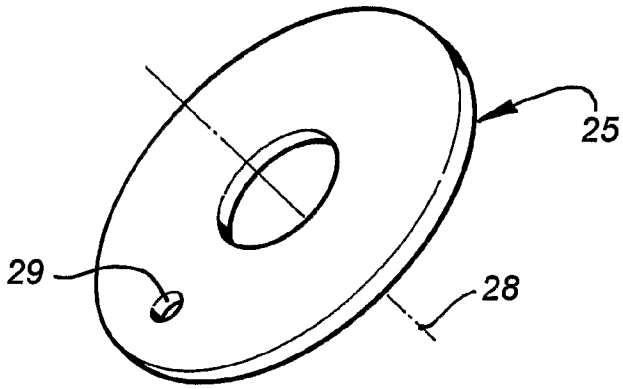

FIG. 3

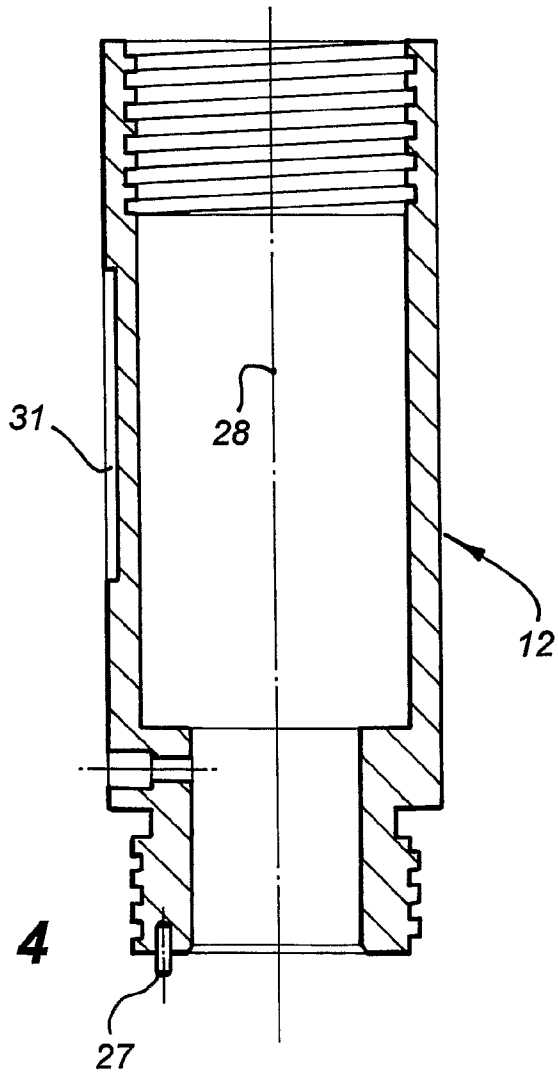

FIG. 4

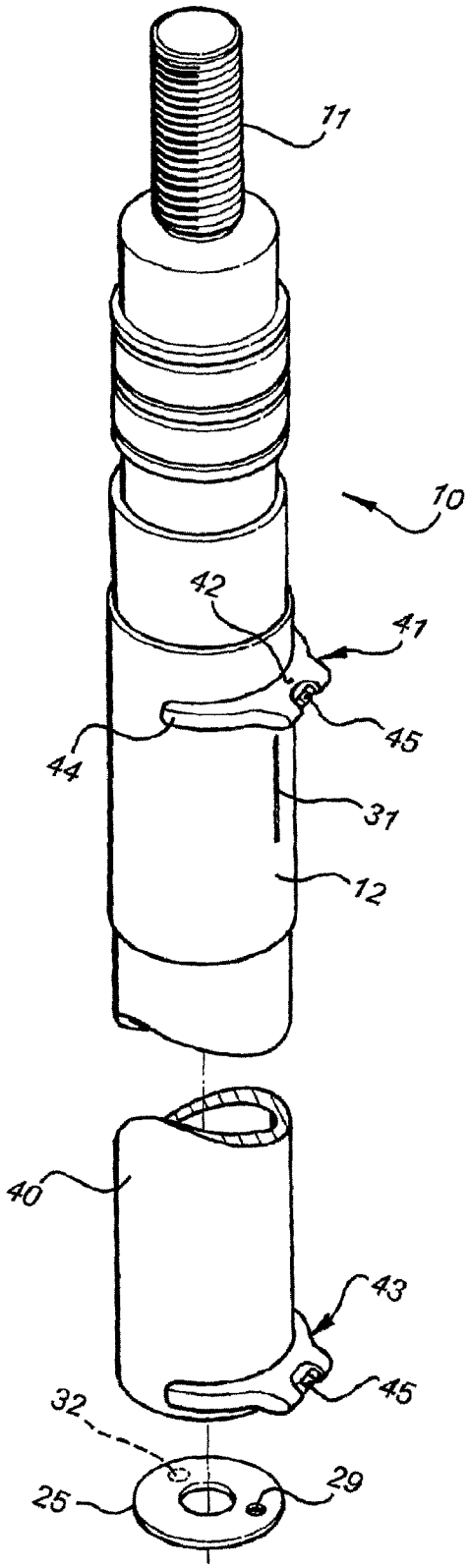

FIG. 5

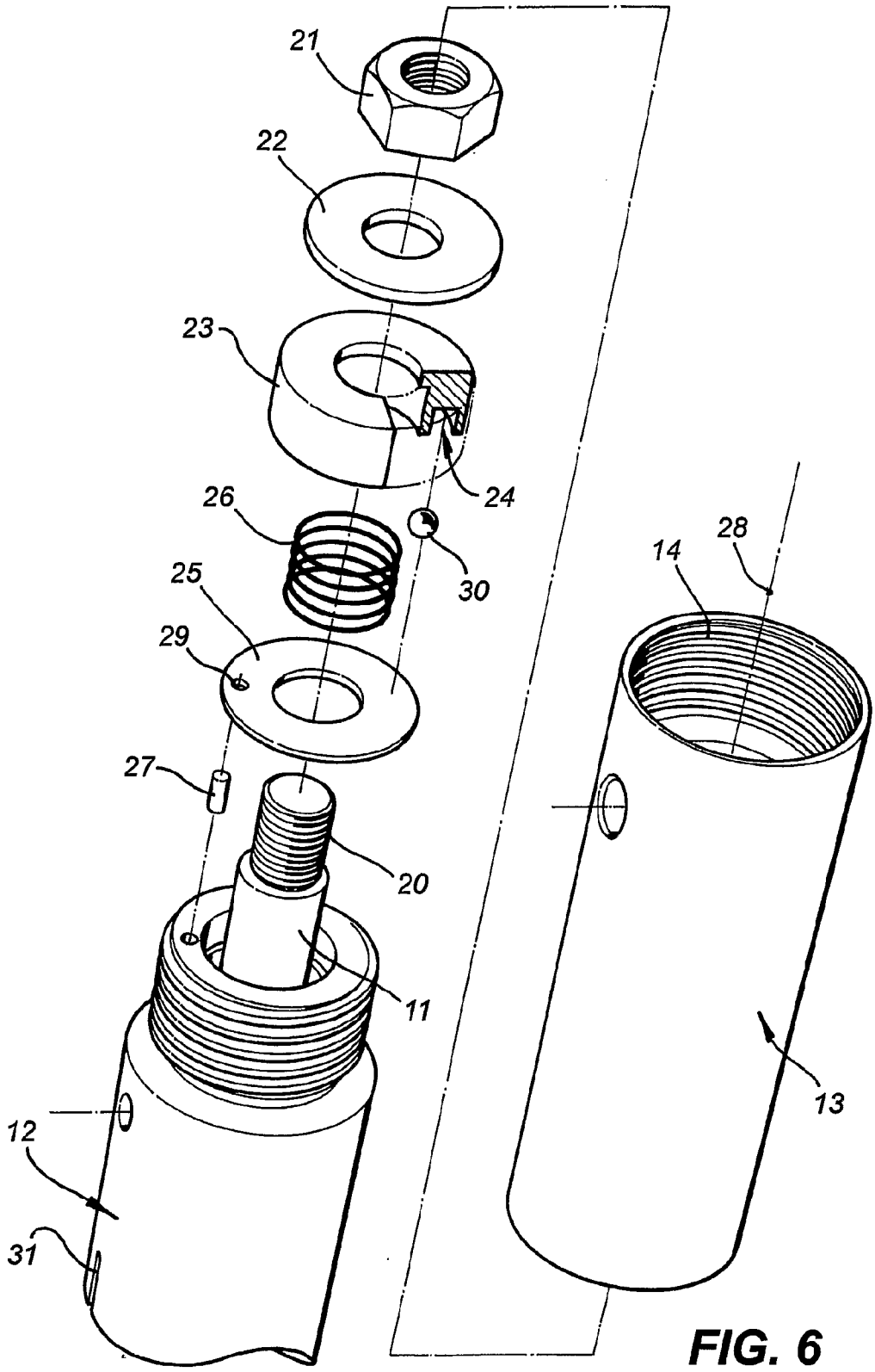

FIG. 6

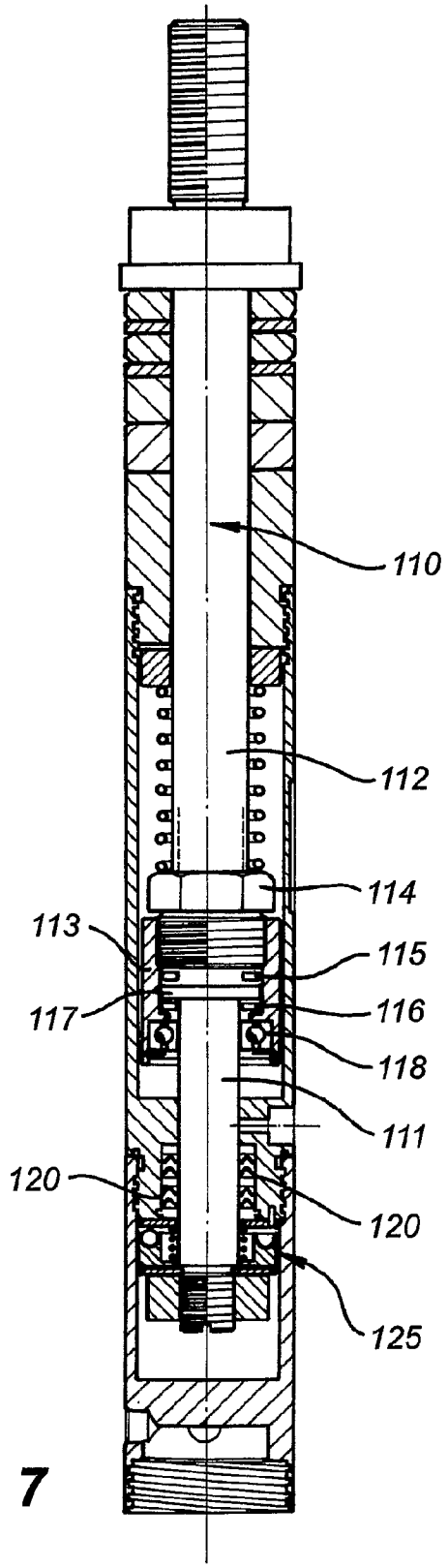

FIG. 7

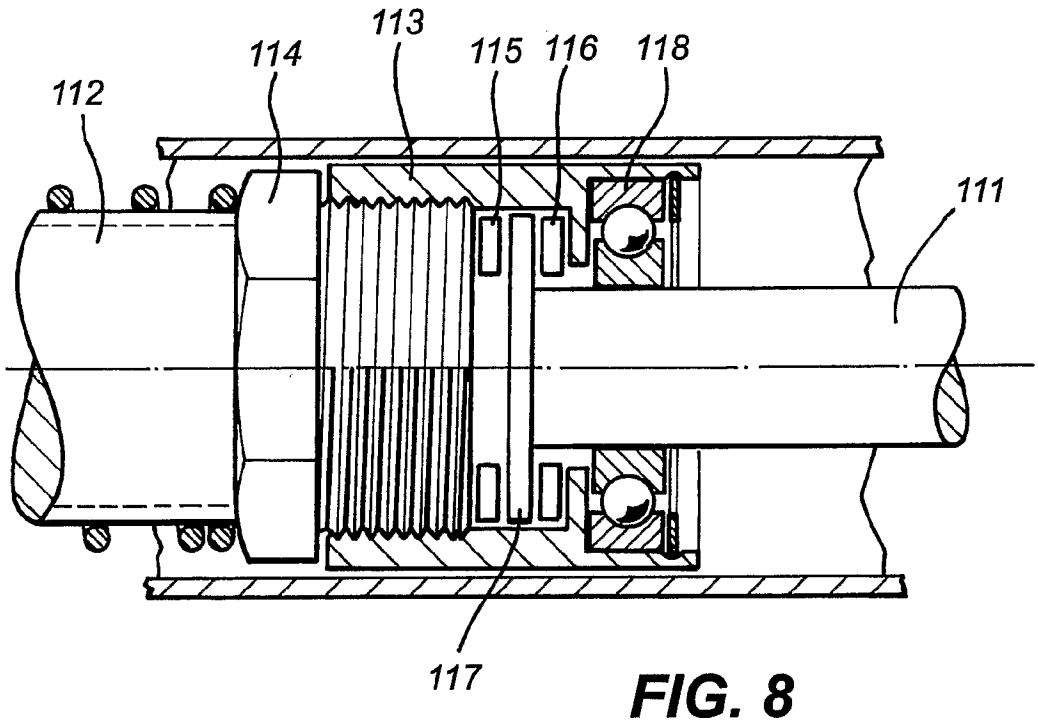

FIG. 8

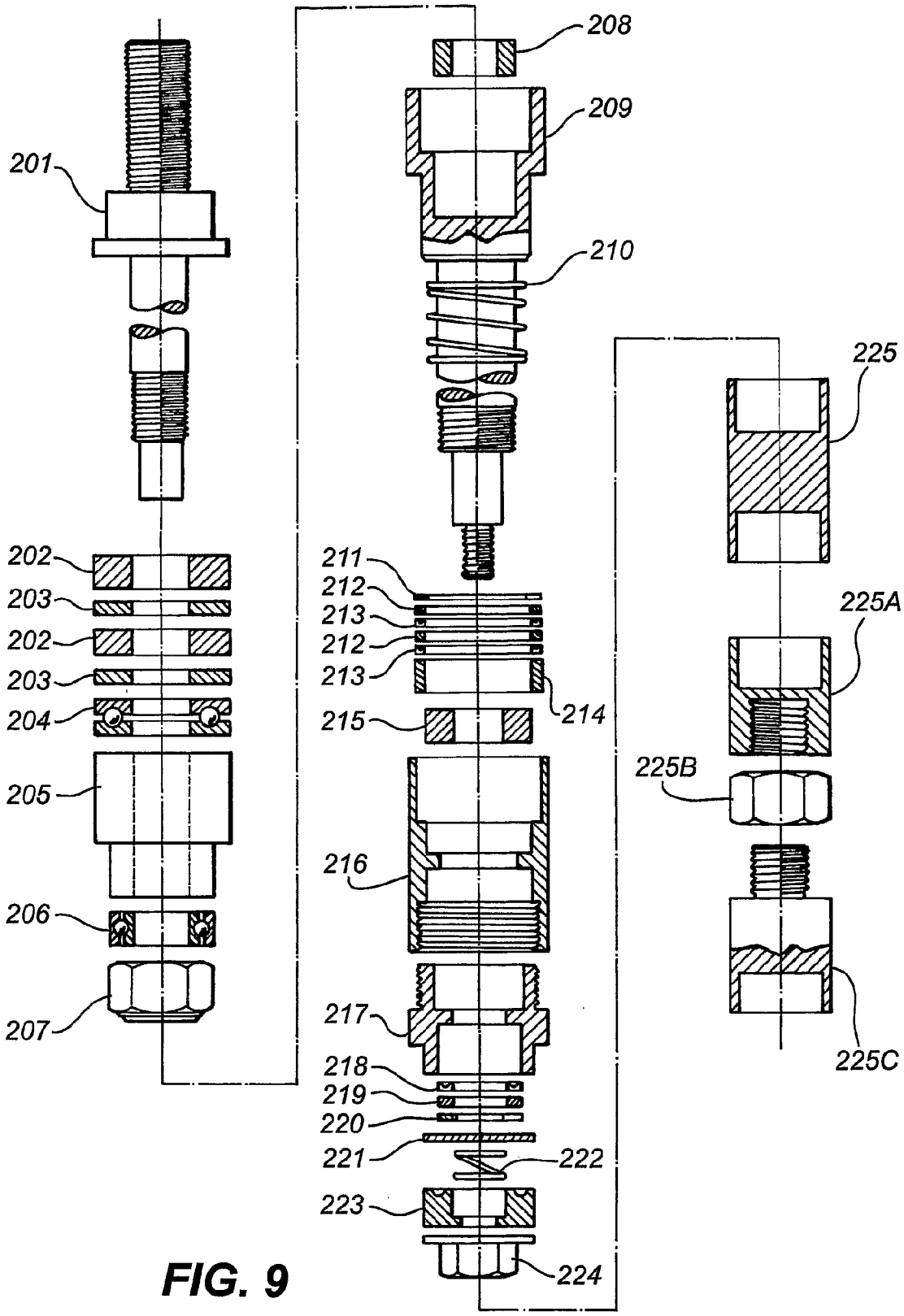
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FIG. 9

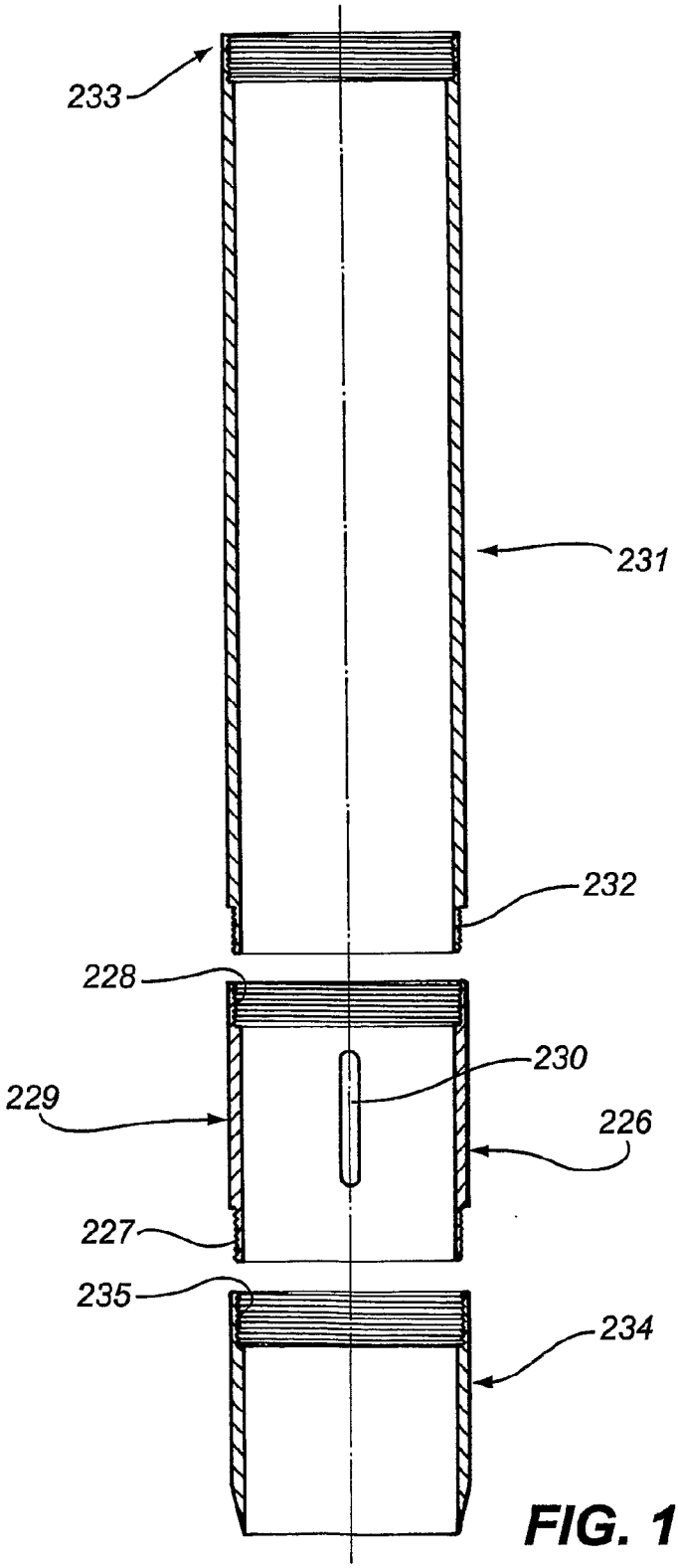

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2006/001017

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

E21B 25/16 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI : IPC as above and Keywords (mark+, slot+, slit+, opening, aperture, tube, tubular)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2000/075480 A1 (SHELLJET PTY LTD) 14 December 2000	
A	US 4311201 A (STEWART et al) 19 January 1982	
A	Derwent Abstract Accession No. 83-843301/50, Class Q49, SU 996717 A(KAZA MINERALS RES) 15 February 1983	

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 September 2006	8 SEP 2006
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **S. GHOSH** Telephone No : (02) 6283 2163

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2006/001017

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	0075480	AU	49004/00	CA	2294409	CA	2378748
		EP	1198657	GB	2370589	US	6659196
		ZA	200110321				
US	4311201						

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX