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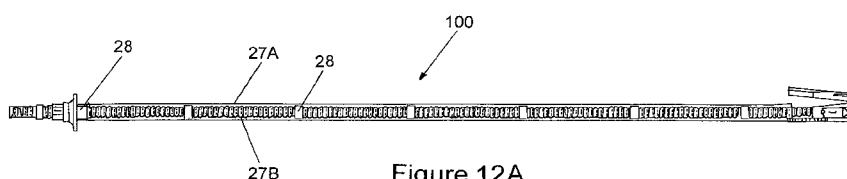


Figure 12A

(57) Abstract: In an anchoring device, a drill head and expansion element(s) are configured to cooperatively interlock with each other to provide for directed movements of the drill head relative to a longitudinal axis of the shaft. Co-operating contact surfaces between the drill head and the expansion element(s) are configured such that relative longitudinal movement of the drill head with respect to the expansion element(s) displace(s) the expansion element(s) outwardly so the expansion element(s) can provide frictional contact with a borehole once inserted therein. A stop is configured to restrict or prevent longitudinal movement of the expansion element(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).

Anchoring Device

TECHNICAL FIELD

This invention relates to an anchoring device.

In particular, the present invention relates to anchoring devices in the form of rock
5 bolts and a method for installing rock bolts and in particular to rock bolts suitable for
use in the mining and tunnelling industry to provide roof and wall support. The
invention has been developed primarily for rock bolts used in mining applications and
will be described hereafter with reference to this application.

However, it will be appreciated that the invention is not limited solely to mining
10 applications. For example, other materials and applications may include coal,
concrete, dams, retaining walls, civil engineering, building construction and the like.

BACKGROUND ART

Rock bolts are now a common apparatus used to support the roof and walls of
tunnels and mines worldwide. There are a wide variety of rock bolts available
15 including steel, fibreglass and plastic rock bolts. Rock bolts usually consist of a long
elongate shaft which is anchored into a borehole in rock or coal to provide
reinforcement support to the rock or coal mass.

Rock bolts can be anchored into a borehole by having a frictional contact with an
internal surface of the borehole itself. For example, US Patent No. 5,219,248
20 discloses a mine roof expansion anchor having a conventional tapered camming plug
and radially expandable shell formed as two identical, physically separate halves which
engage the wall of a borehole.

In use, the anchor enters the hole with little or no frictional resistance until outwardly
extending portions contact the surface of the rock formation at the entrance to the

hole. Continued advancement of a bolt causes inward deformation of bail portions or barbs. Due to the springy, resilient nature of the bail material, the terminal ends tend to engage the borehole wall in a tightly gripping engagement, enhanced by the sharp edges and corners of the terminal ends.

- 5 Securing the anchor is performed by rotation of the bolt to move a plug axially down the bolt thread, forcing leaves of the shell halves into a tightly gripping engagement with the walls of the borehole.

However, a disadvantage of this configuration is that the shell halves or wedges need to be held together by studs which extend through holes in the shell halves and the
10 studs do not provide a robust means for connection. Also, the rock bolt embodiment described in US 5,219,248 is not self drilling and requires a pre-drilled hole before the rock bolt can be inserted increasing the installation time. Further, the rock bolt may not be easily re-configured for self drilling as the studs holding the wedges are unlikely to withstand the rotational forces of a drilling operation potentially leading to
15 destruction of the rock bolt during that operation.

International Patent Application No. WO 00/47871 also discloses a rock anchor which is configured to be inserted into a pre-drilled hole. It has an elongate body member which defines a longitudinal wedging surface that tapers outwardly in the direction of the leading end of the anchor. The anchor also has a wedging member that can slide
20 along the wedging surface from a retracted position to an extended position where it engages the inner surface of the borehole and wedges the body member within the borehole. There is also an actuator in the form of a resilient finger formation for moving the wedging member to its extended position.

Like US 5,219,248, a disadvantage of this configuration is that the wedging member
25 is secured by an additional component, in this case a (preferably frangible) band or strap which permits sliding movement of the wedge. This band is unlikely to be of a

sufficient strength to retain the wedge member in position during a self drilling rock bolt operation (leading to destruction of the wedging element).

As discussed above, a disadvantage of these conventional types of rock bolts is that a borehole needs to be drilled before the rock bolt can be inserted and secured within
5 the rock or coal face. To overcome this problem, self drilling rock bolts were developed.

Initially such self drilling rock bolts were predominantly chemically set.

One example is the self drilling rock anchor manufactured by Hilti Corporation of Liechtenstein and sold under the trade mark OneStep rock anchor (HILTI HOS-W
10 250/320). This rock anchor is a single action (or one step) rock anchor whereby the anchor can be driven into place (without pre-drilling). The anchor includes a hollow tube which functions as a drill rod, and a chemical connection anchor to an integrated adhesive cartridge. The tube allows a chemical resin from the cartridge to secure the anchor into the rock or coal face.

15 A disadvantage of this rock anchor is that for the resin to work, it has to be fast-setting. This is not particularly suitable for coal faces as the resin in action can generate sufficient heat to cause a fire. Further only a limited amount of material that can be applied by the integrated adhesive cartridge leading to a weak bond.

To address these problems self drilling mechanically set or friction anchored rock
20 bolts were developed.

As with the non-self drilling rock bolts previously discussed, the mechanical or frictional anchoring device may be of several different designs.

One common frictional anchoring device is an expansion shell mechanism which is located at the leading end of the rock bolt and which is expanded against the wall of
25 the borehole by rotating the rock bolt. The expansion shell mechanism typically has a

wedge (such as a mandrel) which is pulled between two or more moveable shells such that the shells are forced outwards against the wall of the borehole. This is typically achieved by using a screw thread located on a leading end of the rock bolt with a complementary thread on the expansion mechanism. Reverse rotation of the
5 rock bolt causes the shaft and wedge to retract (relative to the shells) thereby pulling the wedge between the expansion shells and forcing them against the sides of the borehole.

An example of this configuration can be seen in International Patent Application No. WO 2007/053893. This document discloses a self drilling rock bolt incorporating a
10 shaft and an anchoring device. A first end of the bolt has a drill tip to penetrate rock and a second end is adapted to be connected to a drilling apparatus. A circulation passage is provided to allow fluid to be passed to the drill tip and a central passage is formed in the shaft to form part of this circulation passage. The anchoring device has a mandrel having one or more inclined external surfaces where the expansion
15 elements overlay the mandrel. The expansion elements are displaced radially outwardly when movement occurs between the mandrel and the expansion elements.

A disadvantage of this configuration is that the expansion elements or wedges are connected by a band of material to the shaft. This configuration does not provide a robust means for connection and hence a weak mechanical set.

20 These limitations of self drilling mechanically set rock bolts led to the development of yet another type of rock bolt: a combined mechanical and chemically set rock bolt. This type of rock bolt uses a resin compound in combination with a mechanical expansion assembly to form an anchor.

For example, International Patent Application No. WO 2008/00015 discloses a self
25 drilling rock bolt similar to the invention disclosed in WO 2007/053893 discussed above. However this rock bolt also includes a sleeve along a major part of the shaft.

The sleeve extends from adjacent the anchoring device or expansion assembly through to and adjacent the nut end. The purpose of the sleeve is to provide at least part of a circulation path to allow fluid or resin to be passed between the nut end to the drilling end and provide an additional chemical set combined with the mechanical
5 set.

Again, a disadvantage of this configuration is that the expansion elements or wedges are connected by a band of material to the shaft. This configuration does not provide a robust means for connection and hence a weak mechanical set (leading to the need for an additional, chemical set).

10 Furthermore, as with other chemically set rock bolts, this type of rock bolt may not be suitable for use in the coal mining industry as a fast setting chemical resin can generate sufficient heat to cause a fire as aforesaid.

From the above, it can be seen that there is a requirement for an improved rock bolt or anchor which is of a robust construction for self drilling, provides a strong
15 connection to the rock mass, reduces the risk of fire in coal mining operations, has minimal components, is cost effective to manufacture and assemble and is easy to use.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

20 All references, including any patents or patent applications cited in this specification are hereby incorporated by reference. No admission is made that any reference constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior
25 art publications are referred to herein, this reference does not constitute an admission

that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

Throughout this specification, the word “comprise”, or variations thereof such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated
5 element, integer or step, or group of elements integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF THE INVENTION

10 According to one aspect of the present invention there is provided an anchoring device including:

a drilling assembly including an elongate shaft with a drill head at one end, and another end configured to connect to a drilling apparatus;

at least one expansion element; and

15 a stop

wherein

the drill head and expansion element(s) are configured to cooperatively interlock with each other to provide for directed movements of the drill head relative to a longitudinal axis of the shaft;

20 co-operating contact surfaces between the drill head and the expansion element(s) are configured such that relative longitudinal movement of the drill head with respect to the expansion element(s) displace(s) the expansion element(s) outwardly so the expansion element(s) can provide frictional contact with a borehole once inserted

therein; and

characterised in that

the stop is configured to restrict or prevent longitudinal movement of the expansion
element(s) upon relative longitudinal movement of the drill head with respect to the
5 expansion element(s).

Preferably, the stop is configured to restrict or prevent backward longitudinal
movement of the expansion element(s) upon backward longitudinal movement of the
elongate shaft and drill head.

In a preferred embodiment the drill head and expansion element engage with each
10 other via a first engagement portion on the drilling assembly cooperatively fitting with
a second engagement portion on the expansion element.

Preferably, the first engagement portion is a protrusion configured to co-operatively
engage with a second engagement portion in the form of a corresponding channel.

More preferably, the combination of first and second engagement portions forms a
15 dovetail arrangement.

It should be appreciated by those skilled in the art that the engagement portions may
include any number and other types of 'key and lock' configuration(s) that allows or
guides movement on the drill head relative to a longitudinal axis of the drilling
assembly shaft. Also, a 'key and lock' configuration may be referred to as an
20 interlock mechanism which includes interlock portions to facilitate outward radial
displacement of the expansion elements. For example, this may occur with a tapered
outer surface of a drill head co-operating with a reverse taper on the expansion
element and/or other such combinations described later in the specification.

In a preferred embodiment the engagement configuration restricts radial and thus,

circumferential movement of the expansion element relative to the longitudinal axis of the drilling assembly shaft.

Preferably, the first engagement portion is positioned on the inner surface of the expansion element and the second engagement portion is positioned on the outer
5 surface of the drilling assembly.

More preferably, the second engagement portion is positioned on or about the leading edge of the drill head of the drilling assembly.

It will be apparent to those skilled in the art that the drill head and expansion element(s) of the present invention may be retrofitted to existing rock bolts known in
10 the art.

According to another aspect of the present invention there is provided an anchoring device including:

- a drilling assembly including an elongate shaft with first and second ends, a drill head at the first end, and the second end suitable for connection to a
15 drilling apparatus;
- at least one expansion element; and
- a stop

wherein

- the at least one expansion element includes a first engagement portion;
- 20 • the drill head includes a second engagement portion;
- the first and second engagement portions co-operate for retention of the expansion element(s) on the drilling assembly during a drilling operation;

- the first and second engagement portions are configured to co-operate to:
 - permit longitudinal movement of the expansion element(s) relative to a longitudinal axis of the drilling assembly;
 - substantially prevent radial movement of the expansion element(s) relative to the longitudinal axis of the drilling assembly; and
 - substantially prevent circumferential movement of the expansion element(s) relative to the drilling assembly;
- the drill head and the expansion element respectively include co-operating contact surfaces for outward radial displacement of the expansion element(s) on relative longitudinal movement of the drill head;
- the stop is configured to restrict or prevent longitudinal movement of the expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).

According to another aspect of the present invention there is provided a component for an anchoring device including:

a drill head;

at least one expansion element; and

a stop

wherein

- the drill head and expansion element are configured to cooperatively interlock with each other and provide for directed movements of the drill head relative to a longitudinal axis of the shaft;

co-operating contact surfaces between the drill head and the expansion elements are configured such that movement of the drill head with respect to the expansion elements displaces the expansion element outwardly so the expansion element can provide frictional contact with a borehole once inserted therein; and

5 characterised in that

the stop is configured to restrict or prevent longitudinal movement of the expansion elements upon relative longitudinal movement of the drill head with respect to the expansion elements.

According to another aspect of the present invention there is provided a component
10 for an anchoring device including:

a drill head;

at least one expansion element; and

a stop

wherein

15 the at least one expansion element comprises a first engagement portion;

the drill head includes a second engagement portion;

- the first and second engagement portions co-operate for retention of the expansion element(s) on the drill head during a drilling operation;
- the first and second engagement portions are configured to co-operate to:

- 20 ○ permit longitudinal movement of the expansion element(s) relative to a longitudinal axis of the drill head;
- substantially prevent radial movement of the expansion element(s)

relative to the longitudinal axis of the drill head; and

- substantially prevent circumferential movement of the expansion element(s) relative to the drill head;

the drill head and the expansion element(s) respectively include co-operating contact
5 surfaces for outward radial displacement of the expansion element(s) on relative longitudinal movement of the drill head; and

the stop is configured to restrict or prevent longitudinal movement of the expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion elements.

10 According to another aspect of the present invention there is provided a method of using the anchoring device including the steps of:

a) attaching the anchoring device to a drilling apparatus via a drive coupler;

b) positioning the drill head of the anchoring device against a surface;

c) rotating the anchoring device in a first direction of rotation via the drilling
15 apparatus so that the rock bolt is drilled into the surface creating a borehole to a required depth;

d) rotating the shaft and drill head via the drilling apparatus in a second reverse direction of rotation to:

- activate a stop restricting or preventing longitudinal movement of
20 expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s); and
- partially withdraw the shaft and drill head from the borehole thereby causing at least one expansion element located about the drill head to

displace and provide frictional contact of the expansion element(s)
within an internal surface of the borehole.

According to another aspect of the present invention there is provided a method of
using the anchoring device including the steps of:

- 5 a) attaching the anchoring device to a drilling apparatus via a drive coupler;
- b) engaging the drive coupler with a nut positioned on an elongate shaft of the anchoring device;
- c) if required, winding the nut in a first direction of rotation on the shaft until it abuts against a stop;
- 10 d) positioning a drill head of the anchoring device against a surface;
- e) rotating the drill head in a first direction of rotation via the drilling rig so that the anchoring device is drilled into the surface such that the surface abuts a plate attached to the shaft;
- f) rotating the nut on the shaft in a second reverse direction of rotation via the
15 drilling apparatus until the nut abuts the plate and activates a stop restricting or preventing longitudinal movement of expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s);
- g) further rotating the nut in the second reverse direction to partially withdraw the
20 shaft and drill head from the borehole thereby causing at least one expansion element located about the drill head to displace and provide frictional contact of the expansion element(s) within an internal surface of the borehole.

According to another aspect of the present invention there is provided a method of
installing an anchoring device including the step of utilising the anchoring device

substantially as described herein.

According to another aspect of the present invention there is provided a method of connecting a drill head to at least one expansion element in an anchor characterised by the step of positioning the connecting portions which hold the expansion elements
5 to the drill head so that they are shielded from the edges of the borehole during a drilling operation.

It should be appreciated that the term 'rock' as used in the specification is to be given a broad meaning to cover applications in the mining and tunnelling industry and any other industry that requires sub-terranean roof and wall support. The invention is
10 suitable for use in hard rock applications as well as in softer strata, such as that found in coal mines. Other materials and other applications may include concrete, dams, retaining walls, civil engineering, building construction and the like.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following
15 description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a preferred embodiment of the present invention in the form of an anchoring device;

Figure 2 is a perspective view of the wedge of Figure 1;

20 Figure 3 is a top sectional view of the wedge of Figure 1;

Figure 4 is a perspective view of the drill head of Figure 1;

Figure 5 is a perspective view of the anchoring device of Figure 1 in assembled form;

- Figure 6 is a side view of the assembled anchoring device of Figure 5;
- Figure 7 is a cross section taken along the line E-E in Figure 6;
- Figure 8 is a side view of the assembled anchoring device of Figures 6 and 7 attached to a drilling apparatus and drive coupler;
- 5 Figure 9 is a side cross sectional view of Figure 8 with components attached to the drive coupler; and
- Figure 10 is a perspective view of the nut and bearing plate of Figure 9;
- Figure 11 is a side view of the second end of the anchoring device with a double coil spring component;
- 10 Figure 12A is a side view of an assembled rock bolt showing a stop in the form of elongate rods attached on the outside of a series of annular rings;
- Figure 12B is an enlarged sectional view of the anchoring device of Figure 12A;
- Figure 13A is a side view of an assembled anchoring device showing a stop in the form of elongate rods attached on the inside surface of a series of
- 15 Figure 13B is an enlarged sectional view of the anchoring device of Figure 13A;
- Figure 14A is side view of an assembled anchoring device showing a stop in the form of elongate rods joined via an internal helical connection member;
- Figure 14B is an enlarged sectional view of the anchoring device of Figure 14A;
- 20 Figure 15A is side view of an assembled anchoring device showing a stop in the form of elongate rods joined via an external helical connection member;
- Figure 15B is an enlarged sectional view of the anchoring device of Figure 15A;

Figure 16A is a side view of an assembled anchoring device with shortened rods attached on the outside surface of an annular ring;

Figure 16B is an enlarged sectional view of the anchoring device of Figure 16A; and

- 5 Figure 17 is a side view of an alternative anchoring device embodiment showing a stop in the form of a tube.

DETAILED DESCRIPTION INCLUDING BEST MODES

Figure 1 shows a preferred embodiment of the anchoring device in the form of a rock bolt (1) in its unassembled form.

- 10 Rock bolt (1) incorporates a drilling assembly (2) which includes an elongate shaft (3) with a first (drilling) end (4) and a second (drive) end (5), a drill head (6) at the first end (4), and the second end (5) being configured for connection to a drilling apparatus (not shown) in known fashion.

- 15 The shaft (3), which is typically manufactured from steel, is a hollow tube and incorporates a left hand thread (7) along the length of the tube. For clarity, part of the shaft (3) in Figure 1 is shown without the thread.

The rock bolt (1) includes expansion elements or wedges (8A, 8B). For ease of reference the expansion elements (8A, 8B) will now simply be referred to as "wedges" throughout this specification.

20 Wedges

With reference to Figures 1, 2 and 3, the wedges (8A, 8B) include ridges (13A, 13B) on the upper surface which provide additional bonding to the inner surface of a borehole for the first mechanical set. Figure 3 is a top view of the wedges (8A, 8B) depicted in Figures 1 and 2. However, for illustrative purposes, detail which would not

ordinarily be seen in such a view (such as the engagement portion (11) and taper (12A, 12B)) is depicted in dotted lines.

The inner surface of the wedges (8A, 8B) includes a first engagement portion (11) which in this preferred embodiment is a protrusion with a dove tail cross-section (11A) (best seen in Figure 3). The first engagement portion is configured to co-operatively slide and engage with a second engagement portion (10) of the drilling head (6). The second engagement portion (10) is in the form of dovetail shaped groove or channel and the combination of engagement channels to form a dovetail connection in a manner described later in this specification.

The profile of the leading portion (11A) when viewed from the above (best seen in Figure 3) is 'T-Shaped' and is dimensioned so that it does not extend the full length of the second engagement portion (10) of the drill head (6). This is to prevent jamming of the wedges (8A, 8B) during sliding engagement which could otherwise occur from the changing diameter of drill head (6) to wedge(s) (8A, 8B) interface.

The inner surface of the wedges (8A, 8B) is also tapered (12A, 12B) to cooperate with the tapered surface (25) of the drill head (6) in a manner described later in this specification.

The wedges (8A, 8B) also include a recess (14) or notch located at the distal end of the wedges (8A, 8B) dimensioned to receive a stop in the form of an elongate rod (not shown) and is described later in the specification.

The profile surface detail of the wedges (8A, 8B) is best seen in Figure 2. It should be appreciated by those skilled in the art that the configuration of the profile surface and/or recess (14) should not be seen as limiting. For example, alternative recess embodiments may include a v-shaped cut out, a circular cut out or the like. Similarly, the upper surface of wedges (8A, 8B) may be profiled in configurations other than the series of repeating ridges depicted in the Figures.

Drill Head

Drill head (6) is depicted in more detail in Figure 4. With reference to that Figure, drill head (6) incorporates two drill tips or cutters (9A, 9B) at a distal end thereof and aperture (15) to allow drilling fluid and/or cementitious material to pass through in a manner described later in this specification. It should be appreciated that other drill tips could conceivably be used with this invention. For example, a single cutter with a tungsten tip for use in hard rock mining applications.

A further aperture (16) is shown which is located on both sides of the drill head (6) (although only one aperture is shown for illustrative purposes). This aperture (16) is a sight and welding hole used to check that the drill head (6) has been correctly screwed on to the shaft (not shown) and provides a further welding fixture for permanent attachment of the drill head (6) to the shaft.

It should be appreciated that in alternative embodiments, further apertures may be incorporated in to the drill head (6). For example, further apertures on each side of the drill head (6) might be incorporated to allow further drilling fluid, cementitious material etc to pass through the drill head (6).

Drill head (6) includes a tapered surface (25) to co-operate with reverse tapers (12A, 12B) located on the inner surface of expansion elements (8A, 8B). The corresponding tapered surface of drill head (6) and expansion elements (8A, 8B) allows for displacement of the expansion elements (8A, 8B) during the mechanical set operation described later in this specification.

Drill head (6) includes a second engagement portion (10) configured so that it partially extends along the length of the drill head (6). The second engagement portion (10) is in the form of a trapezoid (or "dovetail") shaped groove positioned and formed on the leading front edge of the drill head (6) of the drilling assembly (2). This groove is configured to receive complementary first engagement portion (11) (in the form of a

trapezoid (or “dovetail”) shaped projection on wedges (8A or 8B).

It should be appreciated that the longitudinal position of the first engagement portion (11) on the wedges (8A, 8B) defines where the wedges (8A, 8B) are located and the range of movement permitted relative to the second engagement portion (10) of the drill head (6). The length of the first engagement portion (11) is dimensioned to allow the required range of longitudinal movement before the first engagement portion (11) abuts the distal end of the second engagement portion (10) (discussed in more detail below).

Assembled Rock bolt (drill head end)

Figures 5 and 6 shows the rock bolt (1) of Figure 1 in assembled form. During assembly, the drill head (6), which includes an internal screw thread (not shown), is screwed onto the shaft (3) at the first (drilling) end (4) and permanently fixed by welding onto the shaft (3). The wedges (8A, 8B) are attached to each side of the drill head (6) by the second engagement portion or groove (10) of the drill head (6) capturing first engagement portion or projection (11). The taper (25) of the drill head (6) co-operates with corresponding reverse tapers (12A, 12B) located on the inner surface of wedges (8A, 8B) such that the wedges (8A, 8B) lay flat against the drill head (6) and shaft (3) such that they are disposed generally co-extensively with, or within, the lateral extent or circumference of the drill head.

Engagement (Dovetail Connection)

The manner in which the first engagement portion (11) is captured and retained in the second engagement portion (10) is best seen in Figure 7. Figure 7 shows a cross section of the assembled drill head (6) and wedges (8A, 8B) taken along the line E-E in Figure 6.

The inner surface of the wedges (8A, 8B) includes first engagement portion (11) in

the form of an elongate projection of which the leading section (11A) (Figure 3) is formed in a trapezoid (or “dovetail”) shape.

Drill head (6) includes a second engagement portion (10) in the form of a trapezoid shaped groove extending from the leading edge to approximately half way along the
5 drill head (6) (best seen in Figure 4). The first and second engagement portions (11, 10) are complementary such that the groove slidably receives the projection to form a dovetail connection as depicted in Figure 7.

It will be appreciated by those skilled in the art that the close contact of the walls of projection (11) with the walls of groove (10) will restrict radial and/or circumferential
10 movement of the wedges (8A, 8B) during a drilling operation. This is important as displacement of the wedges (8A, 8B) during the drilling operation may cause them to be damaged and compromise (or even prevent) the mechanical set which they provide. As will be readily apparent, other complementary shapes might be used to achieve the same purpose (for example a T-shape projection and corresponding
15 shaped groove).

It will also be appreciated that a range of longitudinal movement of the wedges (8A, 8B) relative to the longitudinal axis of the drilling assembly (2) is permitted by this configuration. The configuration restricts longitudinal movement of the wedges (8A, 8B) towards the second (drive) end (5) of the rock bolt (1) by abutment of the
20 projection (11) against the closed end of the groove (10). An advantage of this configuration is that the wedges (8A, 8B) are prevented from sliding the entire length of the drilling assembly (2) during a drilling operation and thus dislodging from the drilling assembly (2). However the configuration will permit a large range of longitudinal movement of the wedges towards the first (drilling) end (4) of the drilling
25 assembly (2). This is important as longitudinal movement of the wedges (8A, 8B) in that direction with respect to the drill head will be required during the mechanical set operation (discussed in more detail below).

Rock Bolt Attachment to Drilling Apparatus

Figure 8 illustrates the second (drive) end (5) of the assembled rock bolt (1) attached to a drive coupler (16). The drive coupler (16) is arranged to engage with a drilling apparatus (17) on the shaft (3) so as to allow rotation and thrust to be imparted to the shaft (3). Also shown is a stop (described later in the specification) in the form of elongate rods (27A, B) fixedly connected to a rear portion of the wedges and connected to each other by annular rings (28) extending around the circumference of the elongate shaft (3).

Rock Bolt Modes of Operation

The rock bolt (1) has three modes of operation: setting-up, drilling and mechanical set which are described with reference to Figures 8, 9, 10 and 11 as follows:

Setting-up Mode

Once the rock bolt (1) has been assembled as previously described and with reference to Figures 9 and 10, a bearing plate (18) with corresponding concave and convex faces is inserted onto the shaft (3) with the concave face directed towards the first (drilling) end (4) of the rock bolt (1). Prior to the bearing plate (18) being inserted onto the shaft a mesh or "W" plate (not shown) may also be inserted onto the shaft (3) to abut against the bearing plate (18) as is known in the industry.

As is known in the industry, the bearing plate (18) by convention includes a convex/concave face to assist with abutment to the rock face (for example, in situations where the borehole has not been drilled substantially perpendicular to the rock face). The concave face provides an additional tolerance (usually an angle between 15 – 20°) when abutted to the rock face.

Aperture (19) (shown in Figure 10) of bearing plate (18) is dimensioned so that it can be disposed on the shaft (3) of the second (drive) end (5). The assembled

configuration is best seen in Figure 9.

A spherical nut (20) with corresponding left hand thread is then wound onto the second (drive) end (5) of the shaft (3) and is dimensioned such that the spherical end of the nut (20) partially extends through the aperture (19) of the bearing plate (18).

5 Thus the bearing plate (18) is captured by the spherical nut (20) and the spherical nut (20) is arranged to bear against the stop comprising ring (28) and rods (27A, B) during a mechanical set operation in a manner described below. As is known in the industry, the use of a spherical shaped nut (20) complements the convex/concave bearing plate (18) to provide maximum contact and permit a range of movement
10 against the bearing plate.

As aforesaid, the thread on the shaft (3) and spherical nut (20) are left handed. Accordingly, during the drilling operation, the torque applied to the spherical nut (20) tends to cause it to wind off the second (drive) end (5) of the shaft (3). To prevent this, a stop assembly in the form of a ring (21) is welded to the shaft (3) to prohibit
15 axial movement of the spherical nut (20) beyond a pre-determined location along the shaft (3). The welded ring (21) is secured to a terminal end portion of the shaft (3). This prevents the spherical nut (20) from unwinding during the drilling mode as described below. In alternative embodiments, the welded ring (21) may be replaced by a bayonet fitting, pin fitting and/or equivalent embodiment and should not be seen
20 as limiting.

In practice, the applicant has found that under some conditions the spherical nut (20) which abuts the bearing plate (18) can bind the ring (21) and prevent the spherical nut (20) from releasing when the rotation is reversed in the mechanical set operation (as described further below). If the hole has been over drilled and there is not enough
25 friction in the system to overcome the binding, the shaft (3) may spin in the bore hole of the rock face and the rock bolt may not set as desired. To alleviate this problem, a spring washer in the form of a double coil spring (26) (best seen in Figure 11) may be

utilised at the second end (5) of the shaft (3) between the ring (21) and spherical nut (20). This spring (26) assists in the release of the spherical nut (20) during the mechanical set operation. It should be appreciated that other means of preventing binding of the nut could conceivably be used with this invention. The applicant has
5 also found that it may be beneficial to grease the thread in front of the ring (21). Test results conducted show that the torque to release the spherical nut (20) can be reduced from 100 ft lbs to 40 ft lbs with the double coil spring (26) in combination with grease.

Setting-up Mode with Assembled Rock Bolt and Stop

10 Figures 12A and B illustrates a preferred form of the assembled rock bolt (100) showing a stop in the form of two elongate rods (27A, B). Figure 12B is an enlarged sectional view of the rock bolt of Figure 12A and for illustrative purposes also depicts wedge (8A) in an unattached form to show engagement portions prior to attachment to the drill head. Also, as this preferred form rock bolt (100) with the stop includes the
15 same features of the rock bolt (1) previously described and shown in Figures 1 to 11, like features have been given the same reference numbers.

The rock bolt (100) has two rods (27A, B) which are fixedly connected on the outside surface of a series of annular rings (28) via welding thereto. As with the rock bolt (1) previously shown in Figure 1, the rock bolt (100) has a shaft (3) which is
20 manufactured from hollow tube and contains a left hand thread (7) along the length of the shaft (3). During the manufacture and assembly of the rock bolt (100), the shaft (3) is inserted through the series of annular rings (28) so the rings (28) extend around the circumference of the shaft (3). Also the other shared components are assembled in the same manner as the assembled rock bolt (1) previously described and shown
25 in Figures 1 to 11.

One end of rods (27A, B) is fixedly connected to the wedges (8A, B) by welding to a

rear portion of the wedges (8A, B) as shown by arrow A on Figure 12B. The end of the rod (27A and 27B) which is welded also fits into a notch (14) (shown in Figures 2 and 3) in wedges (8A, B) as shown in Figures 2 and 3. The rods (27A, B) extend along the shaft (3) from the wedges (8A, B) and terminate at the annular ring (28) positioned proximate the second end of the drilling assembly (herein called the “terminal annular ring”. It should be appreciated that the internal diameter of the annular rings (28) are dimensioned, such that they can slide over the shaft (3). The annular rings (28) are configured so the nut (20) can bear against the terminal annular ring (28) of the rods (27A, B) when the nut (20) partially extends through the aperture (not shown) of the bearing plate (18) in a mechanical set operation (described later in the specification).

One purpose of the rods (27A, B) is to provide a stop which restricts or prevents backward longitudinal movement of the wedges (8A, B) as a consequence of backward longitudinal movement of the drill head (6) during rotation of shaft (3) as part of the mechanical set operation. The rods (27A, B) also help control and stabilise the rear portion of the wedges (8A, B) during the drilling operation.

It should be appreciated by those skilled in the art that other design variations could be used without departing from the scope of the present invention. For example, Figures 13A and B show the same rock bolt (100) embodiment shown in Figures 12A and B, but with the two rods (27A, B) connected to the inside surface of the annular ring (28). This variant performs the same function as previously described in relation to Figures 12A and B.

Figures 14A and B show an alternative embodiment for connecting the rods (27A, B) relative to each other. Instead of an annular ring, a helical connection member (29) fixedly connects the rods relative to each other along the length of the elongate shaft (3). In this embodiment the rods (27A, B) are connected via welding to the outside of an internal helical connection member (29). Again, this should not be seen as a

limitation of the present invention. For example, Figures 15A and B show the rods (27A, B) fixedly connected via welding to the inside of an external helical connection member. Further variations may include the use of a plurality of non-continuous helical connection members. Again, these variants perform the same function as previously described in relation to Figures 12A, B and 13 A, B. However, an advantage of the use of helical connection members compared to annular rings is that the weight and amount of material can be reduced during manufacture.

Figures 16A and B show a stop in the form of two shortened rods (27A, B) fixedly connected by welding to the outside surface of one annular ring (28). In this embodiment, the rods (27A, B) are attached to the rear portion of the wedges (8A, B) as previously described, but only partially extend along the elongate shaft (3). This also assists to control and stabilise the rear portion of the wedges (8A, B) during the drilling operation. An advantage of this configuration is that there is less use of material during manufacture.

Drilling Operation Mode

Referring back to Figures 8 and 9, a drive coupler (16) attached to the drilling rig (17) is engaged with the spherical nut (20) (shown in Figure 9). The drilling rig (17) is then operated in a clockwise direction which unwinds the spherical nut (20) until it locks against the welded ring (21) which forms part of the drilling assembly (4). Further rotation of the spherical nut (20) drives the shaft (3) in a clockwise direction which in turn rotates the drill head (6) (welded to the shaft (3)) in a clockwise direction so that the rock bolt (1) is driven or bores into the rock face.

During the above drilling operation, wedges (8A, 8B) are prevented from sliding longitudinally toward the second (drive) end (5) of the rock bolt by abutment of the projection (11) against the end of groove (10) (as previously described). This means that wedges (8A, 8B) cannot dislodge from the drilling assembly (2) during drilling.

Also, as previously described, the taper (25) of the drill head (6) co-operates with corresponding reverse tapers (12A, 12B) located on the inner surface of wedges (8A, 8B) such that the wedges (8A, 8B) are disposed generally co-extensively with, or within, the lateral extent or circumference of the drill head and will not catch against the sides of the bore hole during drilling. In addition, the stop in the form of rods (27A, B) also helps prevent dislodgement of the wedges (8A, B) during drilling, as previously described and as shown in Figures 12 to 16.

In preferred embodiments during the drilling operation, drilling fluid may be pumped through the hollow shaft (3) and drill head apertures (15, 16) of the rock bolt (1) to flush the cutting surface of the rock bolt (1).

Once the rock bolt (1) has been driven or bored into the rock face at the required depth (normally determined by a mesh or "W" plate (not shown) contacting the bearing plate (19) which in turn bears against the rock face with minimum shaft (3) exposed), the mechanical set operation is engaged as described below.

Mechanical Set Operation

On completion of the drilling operation phase, the drilling apparatus (17) is then used to rotate the spherical nut (20) in the reverse i.e. anti-clockwise direction. The spherical nut (20) freely rotates on the shaft (3) until the spherical end of the nut (20) partially extends through the aperture (19) of the bearing plate (18). Thus the bearing plate (18) is captured by the spherical nut (20) and the spherical nut (20) is arranged to bear against the stop at the second drilling assembly end. As the bearing plate (18) is captured by the spherical nut (20), the bearing plate (18) bears hard against the outer face of the rock.

During this operation, the spherical nut (20) abuts the stop in the form of rods (27A, B) and via attachment of the stop to the rear portion of the wedges (8A, B) prevents or restricts backward longitudinal movement of the wedges (8A, B) as a consequence

of counter rotation of nut (20) resulting in withdrawal of the shaft (3) and drill head (6) from the borehole.

This longitudinal movement the shaft (3) and drill head (6) relative to the wedges (8A, 8B) enables the drill head (6) to slide back through the wedges (8A, 8B). The only
5 components capable of longitudinal movement are the shaft (3) and drill head (6) as a primary function of the stop in the form of rods (27A, B) is that via attachment to the wedges (8A, B) it restricts or prevents backward longitudinal movement of the wedges (8A, B) on backward longitudinal movement of the shaft (3) and drill head (6) during this mechanical set operation.

10 Also, the taper of drill head (6) acts against the co-operating reverse taper of wedges (8A, 8B), such that the longitudinal movement of the drill head (6) toward the second (drive) end (5) of the rock bolt (1) displaces the wedges (8A, 8B) to an extent sufficient to allow frictional contact of the wedges (8A, B) against the rock face providing sufficient initial frictional resistance to prevent the rock bolt (1) from sliding
15 out of the borehole.

Further rotation of the spherical nut (20) in the anti-clockwise direction enables the drill head (6) to slide back further through the wedges (8A, 8B), where the tapered drill head (6) again acts against the co-operating reverse taper of wedges (8A, 8B), such that the sliding longitudinal movement displaces the wedges (8A, 8B) further to
20 provide additional frictional contact of the wedges (8A, 8B) with an internal surface of the borehole to mechanically set the rock bolt (1) into the rock face.

To ensure the rock bolt (1) is mechanically set, it can be placed in tension by continuing to apply torque in the reverse direction to the spherical nut (20) resulting in the nut (20) locking up against the bearing plate (18). At that particular point, the
25 wedges (8A, 8B) will pull hard against the rock bore surface so that the wedges (8A, 8B) cannot be moved further. This then effectively binds the rock bolt (1) and inhibits

it from rotating any further. Once the rock bolt (1) is under sufficient tension, the drilling apparatus (17) can be removed.

If required, once the drilling apparatus (17) is detached cementitious material such as High Early Strength (HES) Grout, resin or equivalent bonding material can be injected
5 into the borehole directly and/or through the hollow shaft (3) and aperture (15) of the rock bolt (1) for additional bonding in known fashion. It should be appreciated that channels may be located between the wedges (8A, 8B) and either side of the drill head (6) to clear drilled material and allow cementitious material to be injected into and flow through the channels.

10 **Alternative Rock Bolt Embodiment**

Figure 17 illustrates a cross-sectional view of an alternative embodiment of a self drilling rock bolt (1A). As the rock bolt (1A) includes many of the features of the rock bolt (1) of Figures 1 to 11, like features have been given like reference numbers.

As with the rock bolt (1) shown in Figure 1, the rock bolt (1A) includes a shaft (3)
15 which is manufactured from hollow tube and contains a left hand thread (7) along the length of the shaft (3). In this rock bolt (1A) embodiment the stop is in the form of a distance expansion tube (22). It also includes a third engagement portion (24) positioned on drill head (6) (in addition to the first and second engagement portions as previously described for rock bolt (1)).

20 The distance expansion tube (22) is a hollow sleeve which includes two elongate slots (23). Drill head (6) includes a further two engagement portions (herein referred to as third engagement portions (24)) which are elongate tongues positioned on the distal end and dimensioned so that they partially extend to the front of the drill head. The slots (23) and third engagement portions (24) (elongate tongues) are complementary
25 such that the slots receive the tongues to slidingly engage with each other during the three modes of operation.

In the set-up mode of operation the distance expansion tube (22) is slid over the shaft (3) towards the drill head (6) where the slots (23) are aligned with the third engagement portion (24). It should be appreciated that the internal diameter of distance expansion tube (22) is dimensioned, such that it slides over the shaft (3) and drill head (6), until it comes to bear against the taper (25) of the drill head (6) to prevent the distance expansion tube (22) from dislodging from the drilling assembly (4). The length of the distance expansion tube (22) is also dimensioned to allow for limited longitudinal movement between the first (drilling) end (4) and second (drive) end (5) on the shaft (3). The engagement of the slots (22) with the engagement portion (24) allows for conjoined rotation of the distance expansion tube (22) with the drill head (6) during a drilling operation as previously described. Also, the other shared components are assembled in the same manner as the first preferred embodiment.

A purpose of the distance expansion tube (22) of rock bolt (1A) is to provide a stop as it acts against a shoulder formed in the underside of the wedges (8A, B) thereby restricting or preventing backward longitudinal movement of the wedges (8A, B) on backward longitudinal movement of the drill rod or shaft (3) and drill head (6) during a mechanical set operation. The distance expansion tube (22) also serves to maintain a frictional contact against the inner surface of the wedges (8A,B) and initiate the initial fixing of the wedges during the mechanical set operation without the requirement of barbs as per other rock bolts known the art.

As previously described, the drilling apparatus (not shown) is operated in the reverse direction i.e. anti-clockwise direction. The spherical nut (not shown) freely rotates on the shaft (3) until the bearing plate (not shown) is captured by the spherical nut and the bearing plate bears hard against the outer face of the rock wherein the bearing plate contacts the distance expansion tube (22). As continued rotation of the nut cases the drill rod to withdraw from the borehole (discussed below), distance

expansion tube (22) moves in a longitudinal direction towards the drill head (6) until it comes to bear against the taper (25) of the drill head (6) while contacting the inner surfaces of wedges (8A, 8B). This contact acts against the wedges to hold them in a fixed position relative to further longitudinal movement of the drill head. It also
5 initiates expansion of the wedges (8A, 8B) which are slidingly engaged to the drill head (6) by the dovetail connection to provide sufficient initial frictional resistance to prevent the rock bolt (1) from sliding out of the borehole.

Further rotation of the spherical nut results in further counter rotation of the shaft (3) as the drilling apparatus is operated in the reverse direction. The drill head (6)
10 welded to the shaft (3) also counter rotates within the borehole to allow the drill head (6) to partially withdraw from the borehole relative to longitudinal movement of the wedges (8A, 8B) which are slidingly engaged to the drill head (6) by the dovetail connection as aforesaid.

This relative longitudinal movement between the wedges (8A, 8B) and the drill head
15 (6) enables the drill head (6) to slide back further through the wedges (8A, 8B) on continued rotation of the spherical nut, where the tapered drill head (6) acts against the co-operating reverse taper of wedges (8A, 8B), such that the sliding longitudinal movement displaces the wedges (8A, 8B) further to provide additional frictional contact of the wedges (8A, 8B) with an internal surface of the borehole to
20 mechanically set the rock bolt (1) into the rock face.

Again, once the rock bolt is mechanically set into the rock face, a cementitious material may be utilised for additional bonding. In preferred embodiments, the distance expansion tube (22) may be perforated to allow subsequent material to bond on to the shaft (3).

25 There are many advantages associated with this invention.

For example, the rock bolt includes engagement portions which are integrated into the

componentry.

A stop provides an advantage of restricting or preventing backward longitudinal movement of the expansion elements as a consequence of backward longitudinal movement of the drill head during rotation of the shaft as part of the mechanical set
5 operation to ensure a mechanical set of the rock bolt.

Also, the engagement portions provide a robust means for connection between the drilling assembly and the expansion elements in order to retain the expansion elements during a self drilling operation.

Furthermore, a connection system comprising engagement portions in a 'key and
10 lock' configuration e.g. a pin/tongue configured to co-operatively slide and engage with a corresponding socket/groove simplifies the mechanism of operation as there are less moving parts.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without
15 departing from the scope of the appended claims.

WHAT WE CLAIM IS:

1. An anchoring device including:

a drilling assembly including an elongate shaft with a drill head at one end, and another end configured to connect to a drilling apparatus;

5 at least one expansion element; and

a stop

wherein

the drill head and expansion element(s) are configured to cooperatively interlock with each other to provide for directed movements of the drill head relative to a longitudinal axis of the shaft;

10

co-operating contact surfaces between the drill head and the expansion element(s) are configured such that relative longitudinal movement of the drill head with respect to the expansion element(s) displace(s) the expansion element(s) outwardly so the expansion element(s) can provide frictional contact with a borehole once inserted therein; and

15

characterised in that

the stop is configured to restrict or prevent longitudinal movement of the expansion element(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).

20 2. An anchoring device as claimed in claim 1, wherein the stop is configured to restrict or prevent backward longitudinal movement of the expansion element(s) upon backward longitudinal movement of the elongate shaft and drill head.

3. An anchoring device as claimed in claim 1 or claim 2, wherein the drill head and expansion element engage with each other via a first engagement portion on the drill head cooperatively fitting with a second engagement portion on the expansion element.
- 5 4. An anchoring device as claimed in any one of claims 1 to 3 having two expansion elements located on opposite sides of the drill head to each other.
5. An anchoring device as claimed in claim 3 or claim 4, wherein the first engagement portion is a protrusion configured to co-operatively engage with a second engagement portion in the form of a corresponding channel.
- 10 6. An anchoring device as claimed in any one of claims 3 to 5, wherein the combination of first and second engagement portions forms a dovetail arrangement.
7. An anchoring device as claimed in any one of claims 3 to 6, wherein the first engagement portion is positioned on the inner surface of the expansion
15 element(s) and the second engagement portion is positioned on the outer surface of the drilling assembly.
8. An anchoring device as claimed in claim 7, wherein the second engagement portion is positioned at or about the leading edge of the drill head of the drilling assembly.
- 20 9. An anchoring device as claimed in any one of claims 1 to 8, wherein a second end of the elongate shaft includes a nut and a stop ring with a spring washer located therebetween.
10. An anchoring device as claimed in any one of claims 1 to 9, wherein the expansion element(s) include ridges on an upper surface.

11. An anchoring device as claimed in any one of claims 7 to 10, wherein the inner surfaces of the expansion elements are tapered to cooperate with a tapered surface of the drill head.
12. An anchoring device as claimed in claim 11, wherein the tapered surface of the expansion element(s) is a reverse taper with respect to the corresponding tapered surface of the drill head.
13. An anchoring device as claimed in any one of claims 1 to 12, wherein the elongate shaft is hollow to allow drilling fluid or other material to pass through the shaft.
14. An anchoring device as claimed in claim 13, wherein the drill head includes apertures to allow drilling fluid or other material to pass from the elongate shaft through the drill head.
15. An anchoring device including:
- a drilling assembly including an elongate shaft with first and second ends, a drill head at the first end, and the second end suitable for connection to a drilling apparatus;
 - at least one expansion element; and
 - a stop
- wherein
- the at least one expansion element includes a first engagement portion;
 - the drill head includes a second engagement portion;
 - the first and second engagement portions co-operate for retention of

the expansion element(s) on the drilling assembly during a drilling operation;

- the first and second engagement portions are configured to co-operate to:

- 5
 - permit longitudinal movement of the expansion element(s) relative to a longitudinal axis of the drilling assembly;
 - substantially prevent radial movement of the expansion element(s) relative to the longitudinal axis of the drilling assembly; and

- 10
 - substantially prevent circumferential movement of the expansion element(s) relative to the drilling assembly;

- the drill head and the expansion element respectively include co-operating contact surfaces for outward radial displacement of the expansion element(s) on relative longitudinal movement of the drill head;

15

- the stop is configured to restrict or prevent longitudinal movement of the expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).

- 16. An anchoring device as claimed in claim 15, wherein the stop is configured to restrict or prevent backward longitudinal movement of the expansion element(s) on back ward longitudinal movement of the elongate shaft and drill head.

20

- 17. A component for an anchoring device including:
a drill head;

at least one expansion element; and

a stop

wherein

5 the drill head and expansion element are configured to cooperatively interlock with each other and provide for directed movements of the drill head relative to a longitudinal axis of the shaft;

co-operating contact surfaces between the drill head and the expansion elements are configured such that movement of the drill head with respect to the expansion elements displaces the expansion element outwardly so the expansion element can provide frictional contact with a borehole once inserted therein; and

characterised in that

15 the stop is configured to restrict or prevent longitudinal movement of the expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).

18. A component for an anchoring device including:

a drill head;

at least one expansion element; and

a stop

20 wherein

the at least one expansion element comprises a first engagement portion;

the drill head includes a second engagement portion;

- the first and second engagement portions co-operate for retention of the expansion element(s) on the drill head during a drilling operation;
 - the first and second engagement portions are configured to co-operate to:
 - 5 ○ permit longitudinal movement of the expansion element(s) relative to a longitudinal axis of the drill head;
 - substantially prevent radial movement of the expansion element(s) relative to the longitudinal axis of the drill head; and
 - substantially prevent circumferential movement of the
 - 10 expansion element(s) relative to the drill head;
- the drill head and the expansion element respectively include co-operating contact surfaces for outward radial displacement of the expansion element(s) on relative longitudinal movement of the drill head; and
- the stop is configured to restrict or prevent longitudinal movement of the
- 15 expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s).
19. An anchoring device as claimed in any one of claims 1 to 18, wherein the stop comprises at least one elongate rod fixedly connected to the expansion element(s).
- 20 20. An anchoring device as claimed in claim 19, wherein the elongate rod is fixedly connected to a rear portion of the expansion element(s).
21. An anchoring device as claimed in claims 19 or 20, wherein the rod extends along the elongate shaft from the expansion element(s) to the second end of the drilling assembly.

22. An anchoring device as claimed in any one of claims 19 to 21, wherein the rod is connected to another rod via at least one annular ring extending around the circumference of the elongate shaft.
23. An anchoring device as claimed in claim 22, wherein the rods are connected to an outside surface of the at least one annular ring.
24. An anchoring device as claimed in claim 22, wherein the rods are connected to an inside surface of the at least one annular ring.
25. An anchoring device as claimed in any one of claims 19 to 21, wherein the rod is connected to another rod via a helical connection member.
26. An anchoring device as claimed in claim 25, wherein the helical connection member is a continuous length of material.
27. An anchoring device as claimed in any one of claim 25 or claim 26, wherein the rods are connected via an external helical connection member.
28. An anchoring device as claimed in any one of claim 25 or claim 26, wherein the rods are connected via an internal helical connection member.
29. An anchoring device as claimed in any one of claims 1 to 16, wherein the stop is in the form of a tube.
30. An anchoring device as claimed in claim 29, wherein the tube is perforated to allow material to bond to the elongate shaft.
31. An anchoring device as claimed in claim 29 or claim 30, wherein the tube comprises a connection member which cooperates with an engagement portion on the drill head to allow for conjoined rotation of the tube with a drill head.

32. An anchoring device as claimed in claim 31, wherein the connection member is an elongate slot.
33. An anchoring device as claimed in claim 31, wherein the engagement portion is a tongue.
- 5 34. A method of using the anchoring device as claimed in any one of claims 1 to 16 the method including the steps of:
- a) attaching the anchoring device to a drilling apparatus via a drive coupler;
 - b) positioning the drill head of the anchoring device against a surface;
 - 10 c) rotating the anchoring device in a first direction of rotation via the drilling apparatus so that the rock bolt is drilled into the surface creating a borehole to a required depth;
 - d) rotating the shaft and drill head via the drilling apparatus in a second reverse direction of rotation to:
- 15 • activate a stop restricting or preventing longitudinal movement of expansion elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s); and
 - partially withdraw the shaft and drill head from the borehole thereby causing at least one expansion element located about the drill head to
 - 20 displace and provide frictional contact of the expansion element(s) within an internal surface of the borehole.
35. A method of using the anchoring device as claimed in any of claims 1 to 16, the method including the steps of:

- a) attaching the anchoring device to a drilling apparatus via a drive coupler;
- b) engaging the drive coupler with a nut positioned on an elongate shaft of the anchoring device;
- 5 c) if required, winding the nut in a first direction of rotation on the shaft until it abuts against a stop;
- d) positioning a drill head of the anchoring device against a surface;
- e) rotating the drill head in a first direction of rotation via the drilling rig so that the anchoring device is drilled into the surface such that the
10 surface abuts a plate attached to the shaft;
- f) rotating the nut on the shaft in a second reverse direction of rotation via the drilling apparatus until the nut abuts the plate and activates a stop restricting or preventing longitudinal movement of expansion
15 elements(s) upon relative longitudinal movement of the drill head with respect to the expansion element(s);
- g) further rotating the nut in the second reverse direction to partially withdraw the shaft and drill head from the borehole thereby causing at least one expansion element located about the drill head to displace and provide frictional contact of the expansion element(s) within an
20 internal surface of the borehole.

36. A method of using an anchoring device as claimed in either claim 34 or claim 35, wherein the first direction of rotation is a clockwise direction of rotation and the second direction of rotation is counter-clockwise;

37. A method of connecting a drill head to at least one expansion element in an

anchor as claimed in any one of claims 1 to 16 characterised by the step of positioning the connecting portions which hold the expansion elements to the drill head so that they are shielded from the edges of the borehole during a drilling operation.

- 5 38. An anchoring device substantially as herein described with reference to the Best Modes Section and as illustrated by the accompanying drawings.
39. A component for an anchoring device substantially as herein described with reference to the Best Modes Section and as illustrated by the accompanying drawings.
- 10 40. A method of using an anchoring device substantially as herein described with reference to the Best Modes Section and as illustrated by the accompanying drawings.

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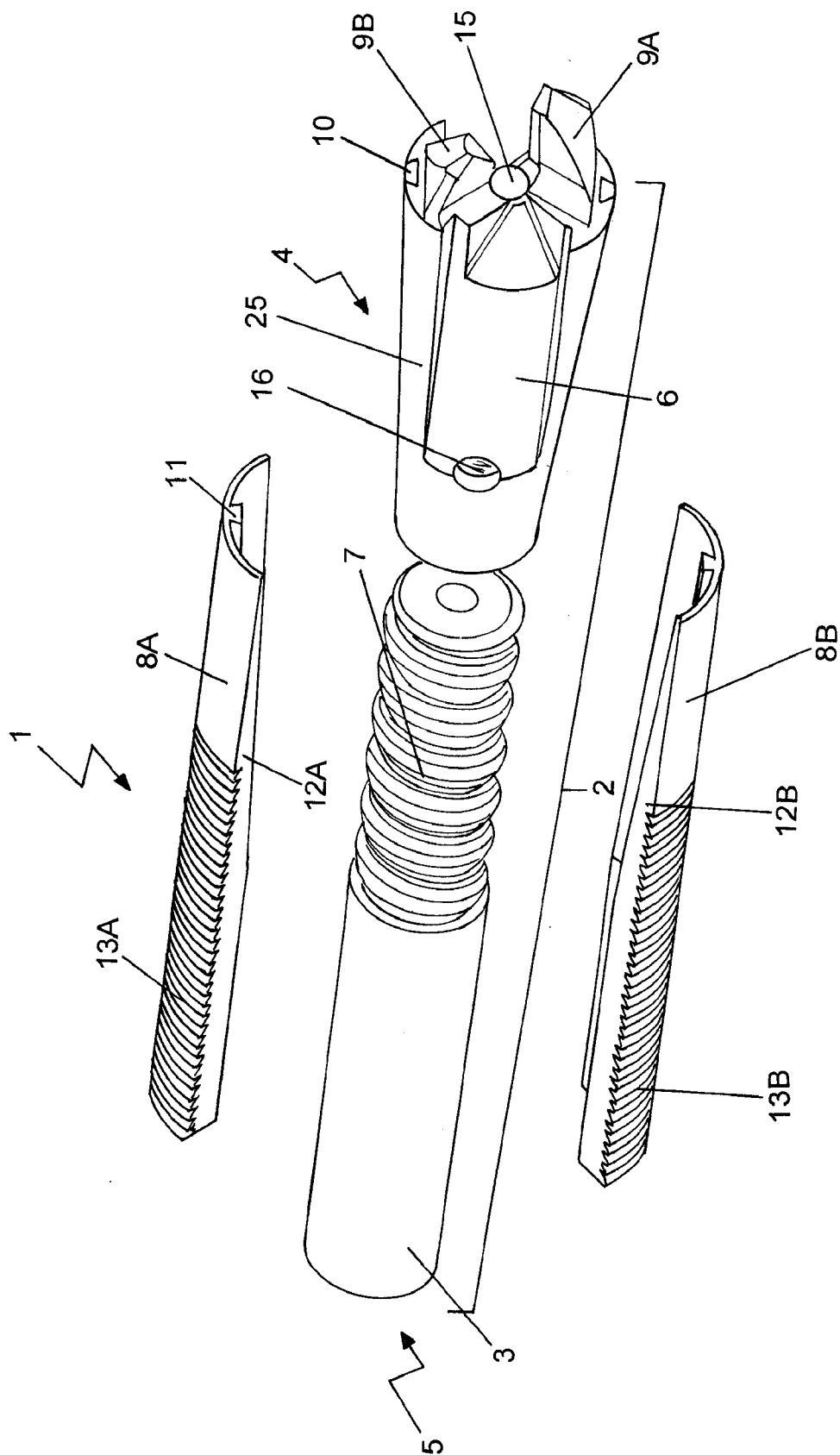


Figure 1

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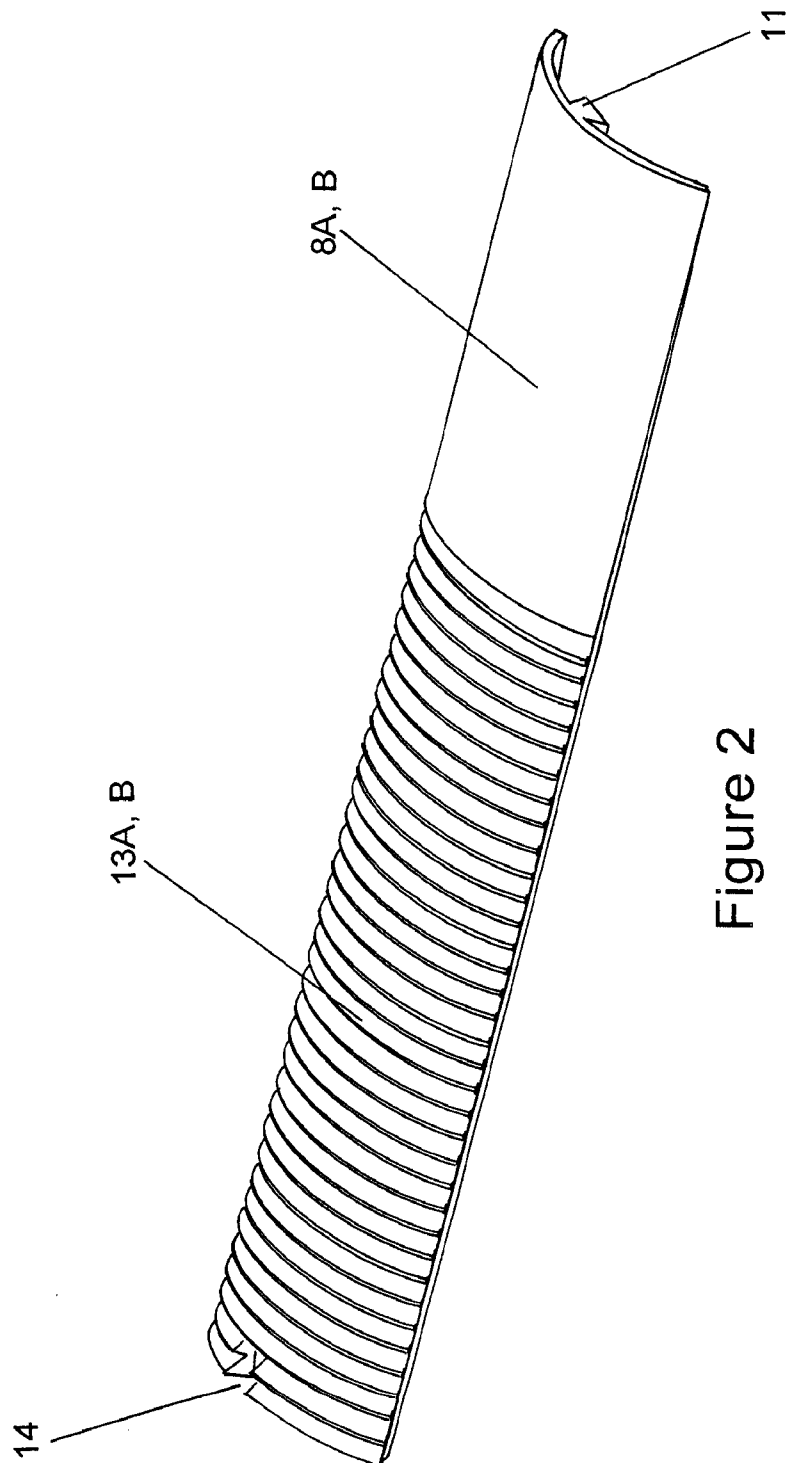


Figure 2

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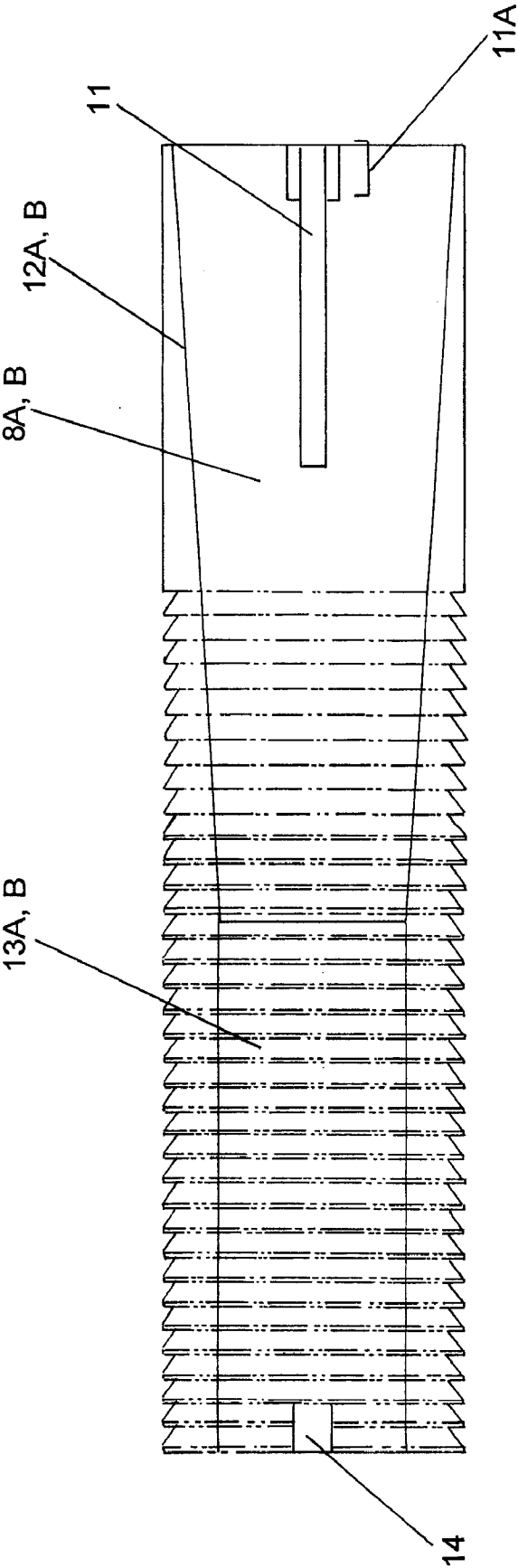


Figure 3

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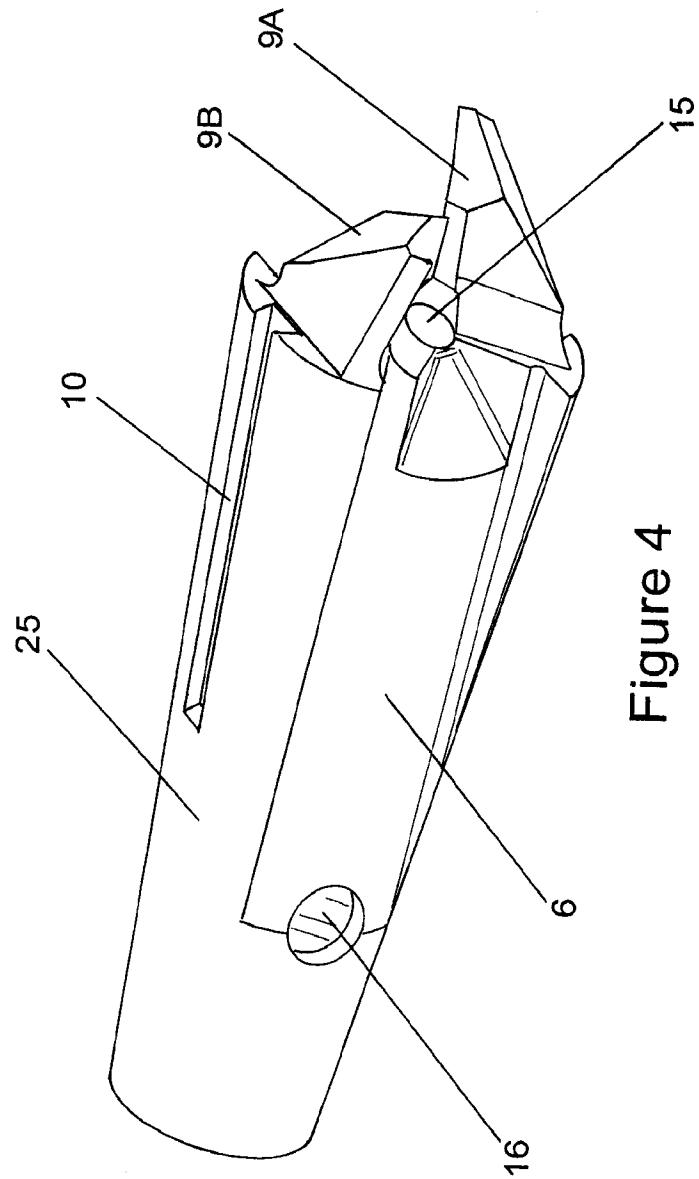


Figure 4

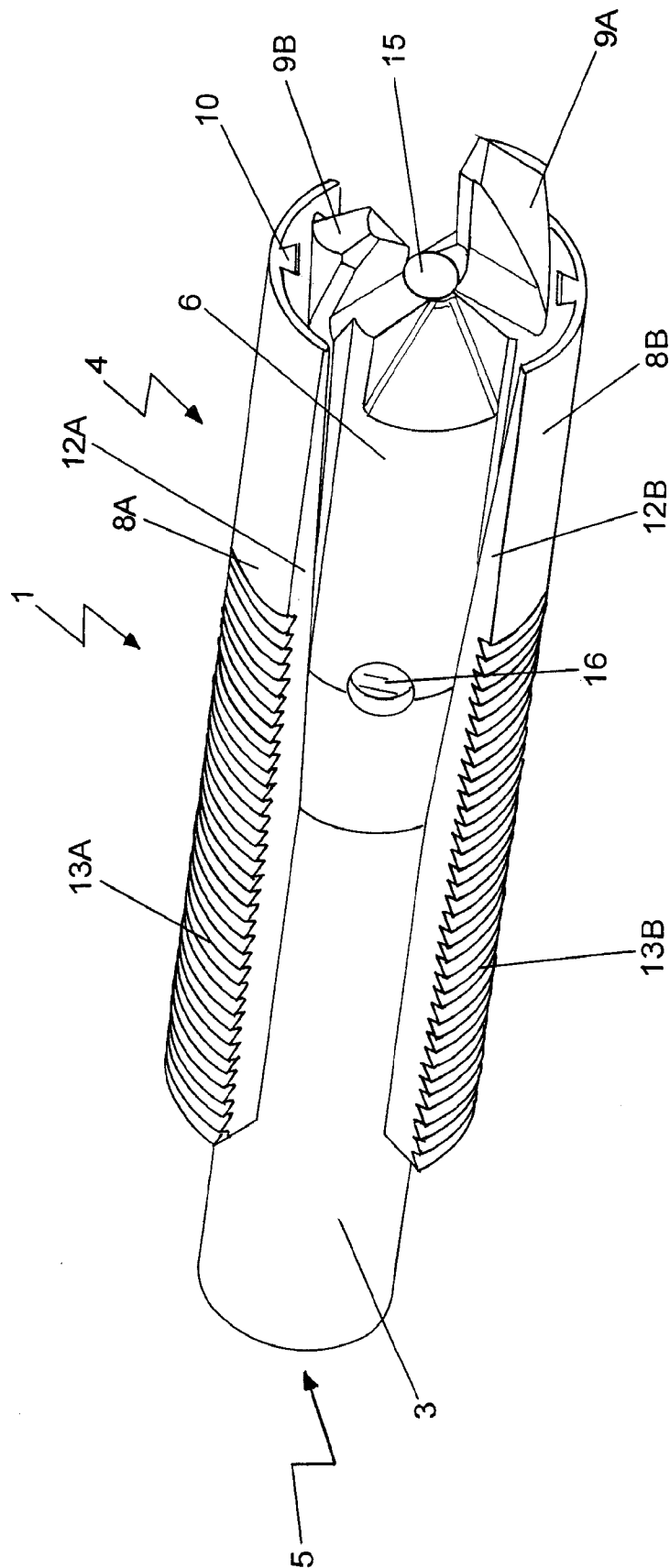


Figure 5

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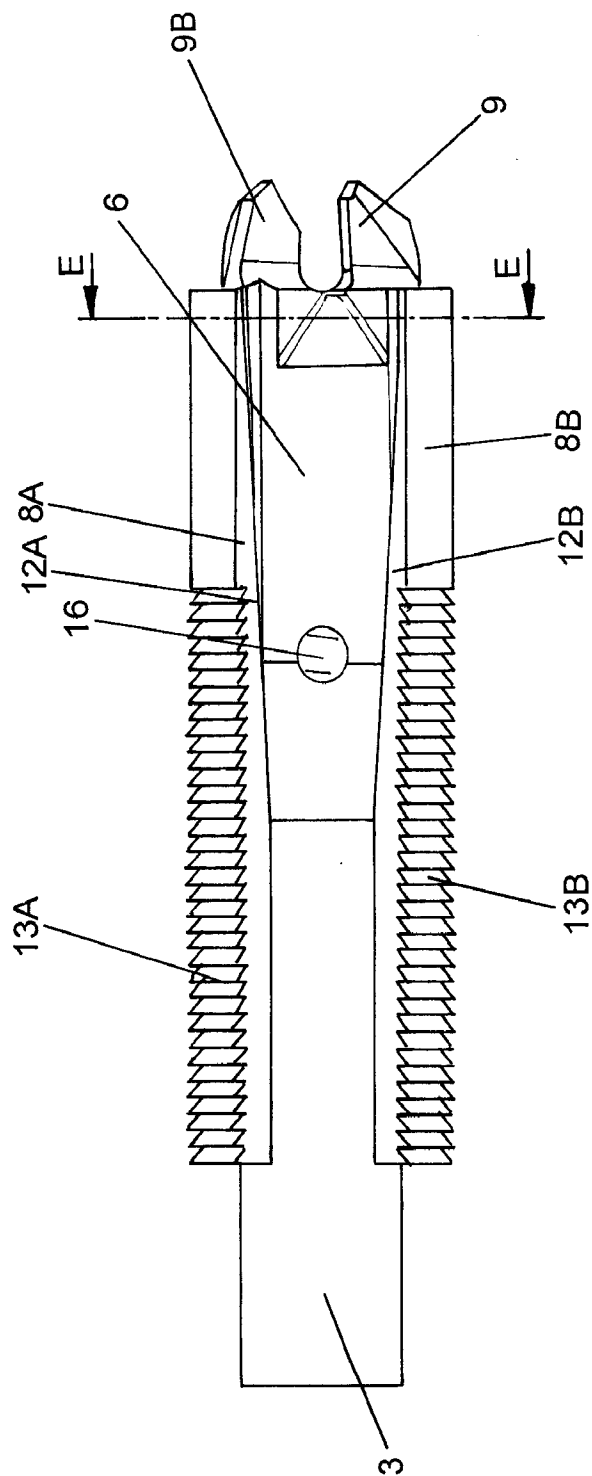


Figure 6

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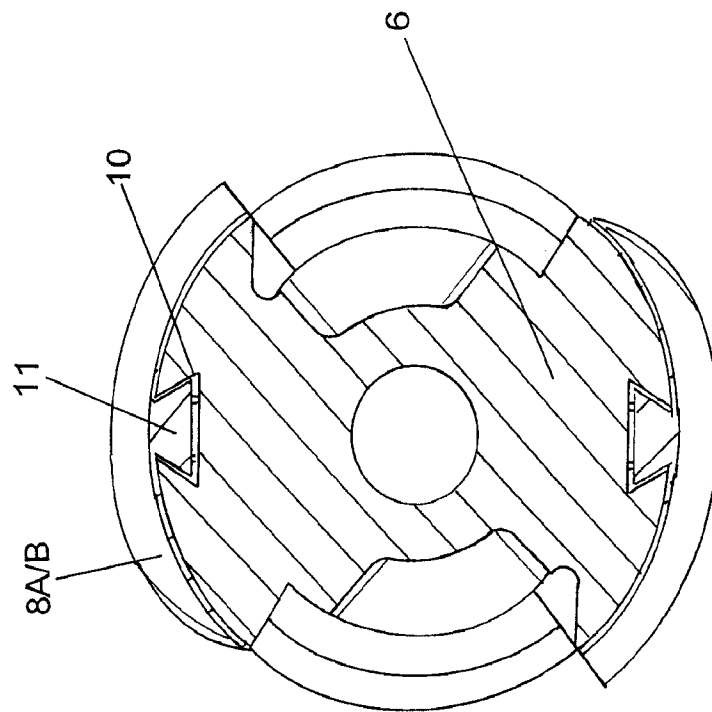


Figure 7

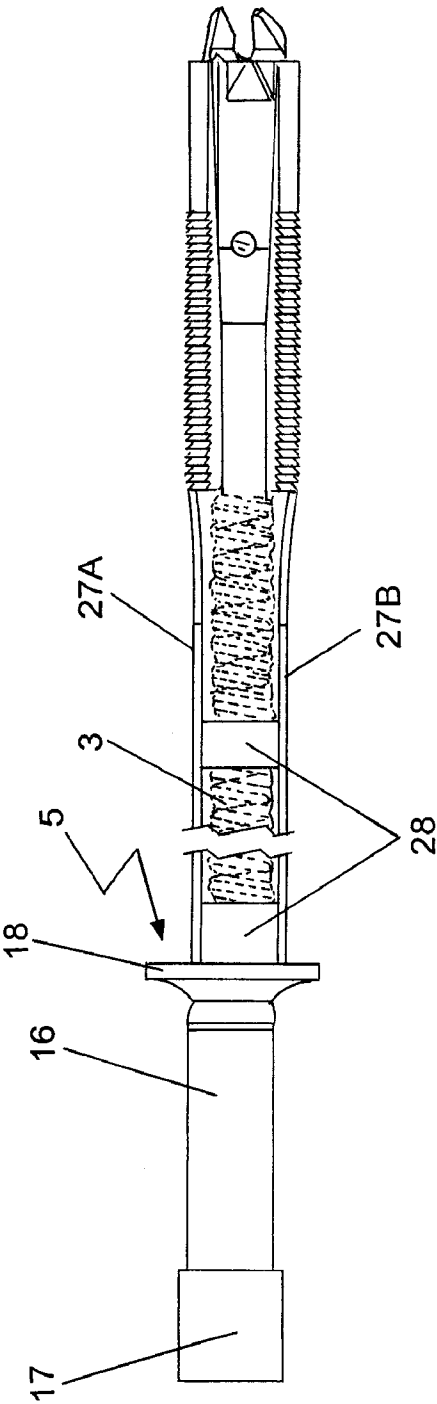


Figure 8

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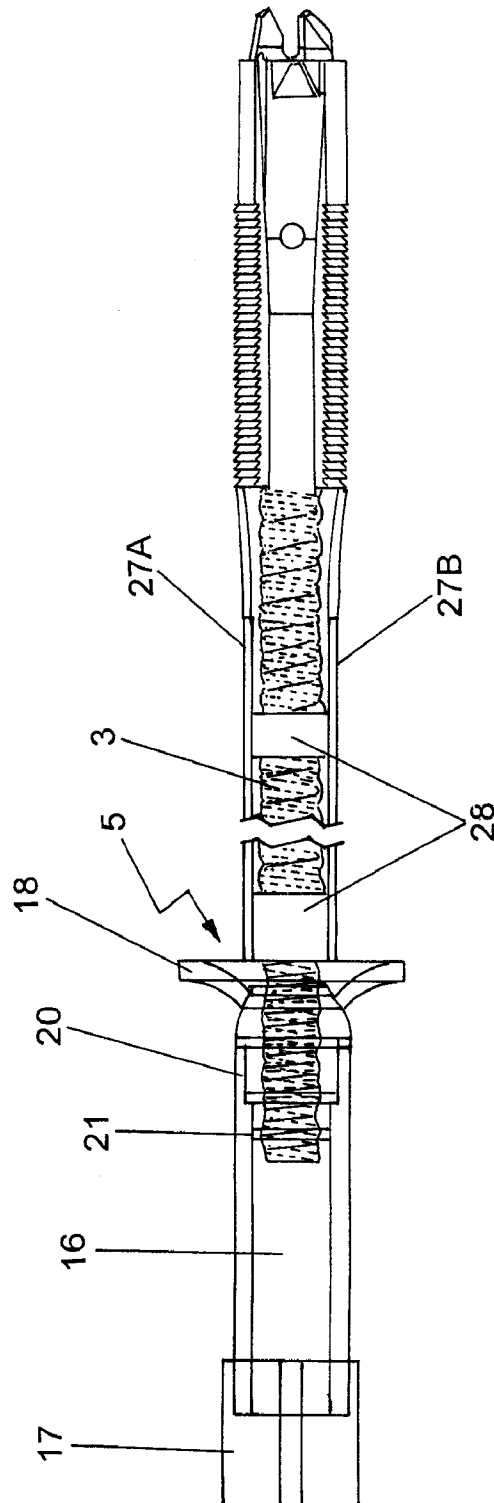


Figure 9

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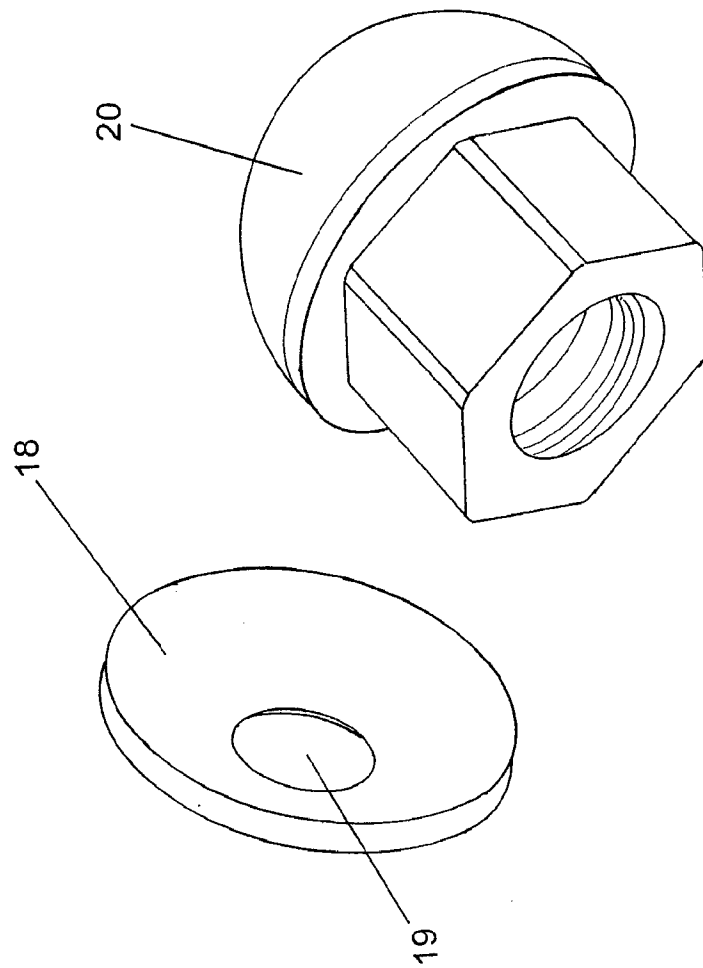


Figure 10

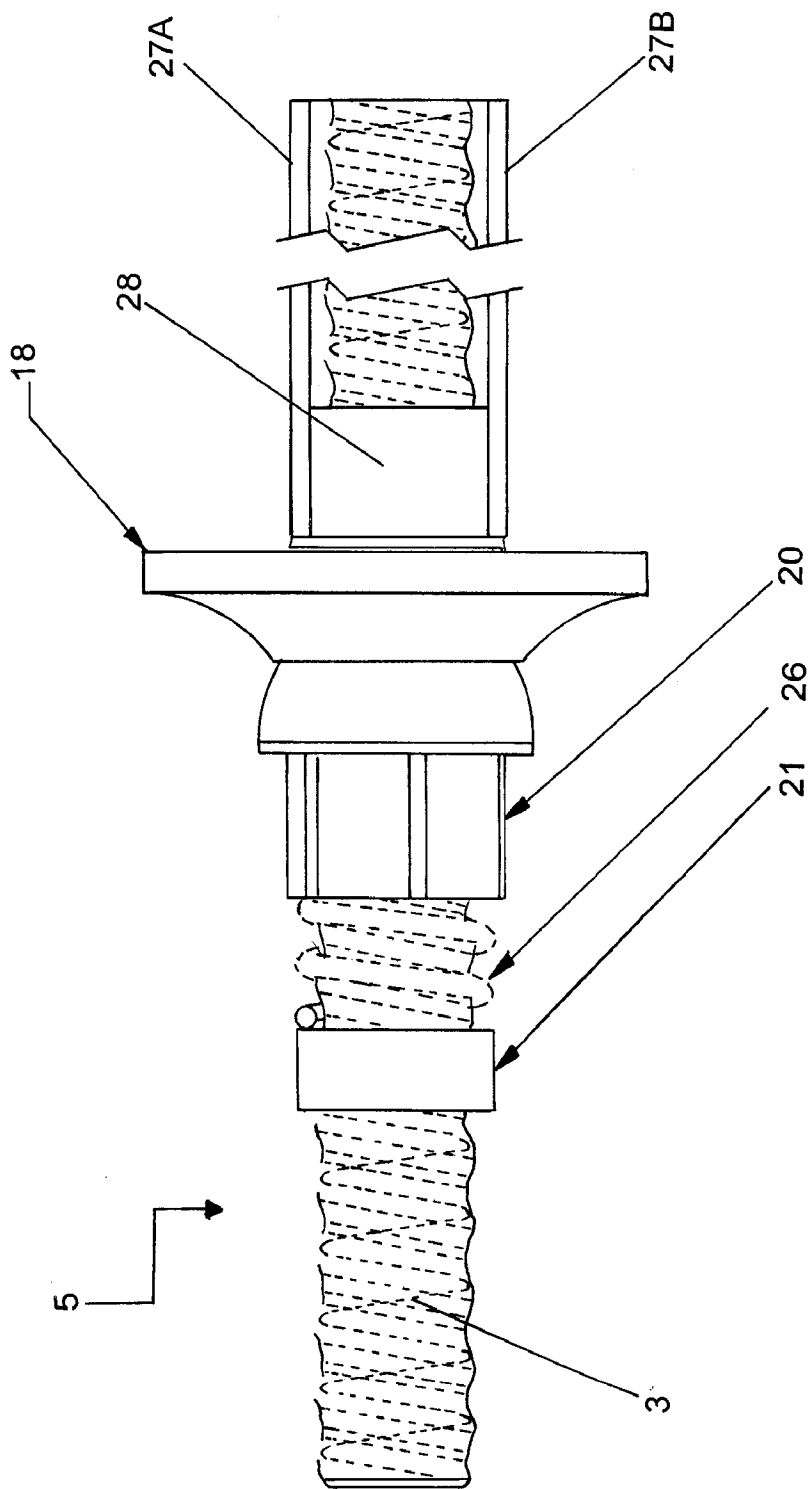


Figure 11

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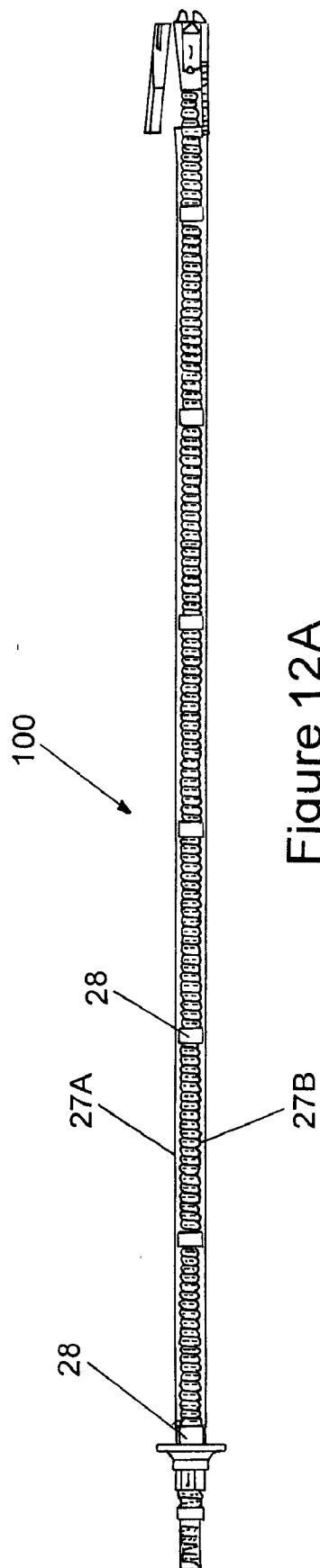


Figure 12A

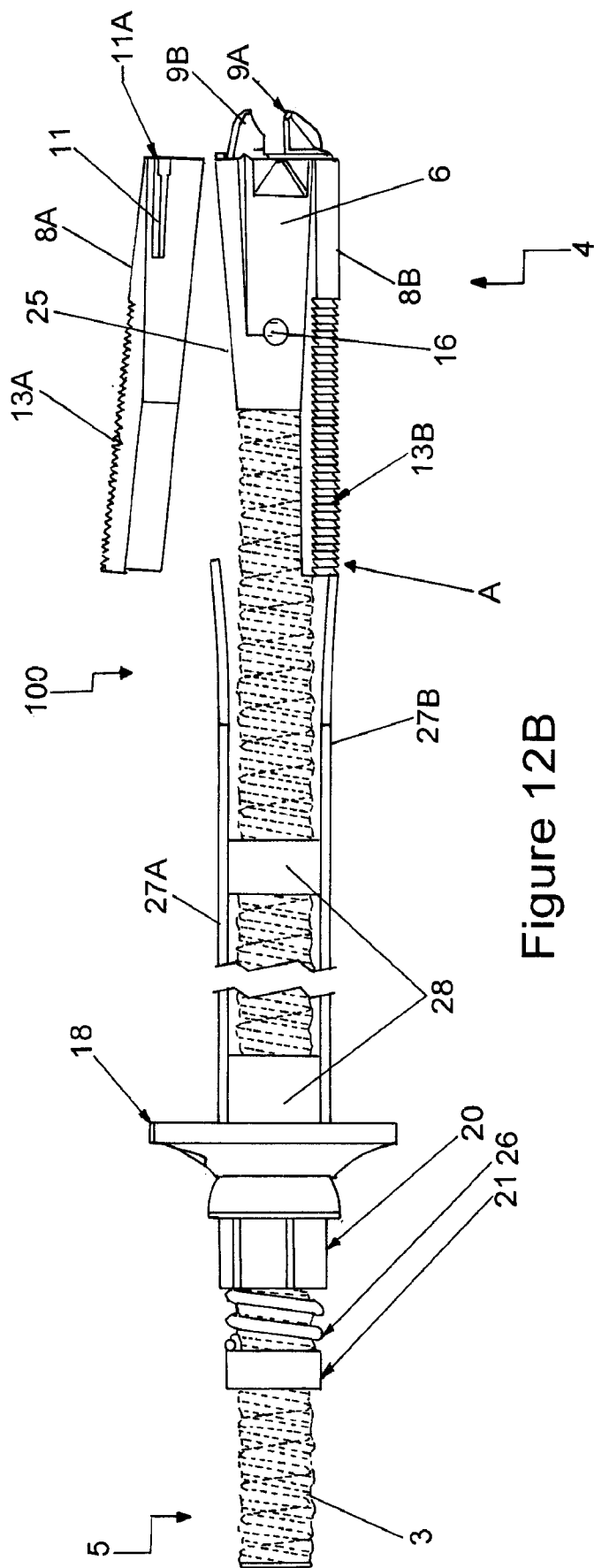


Figure 12B

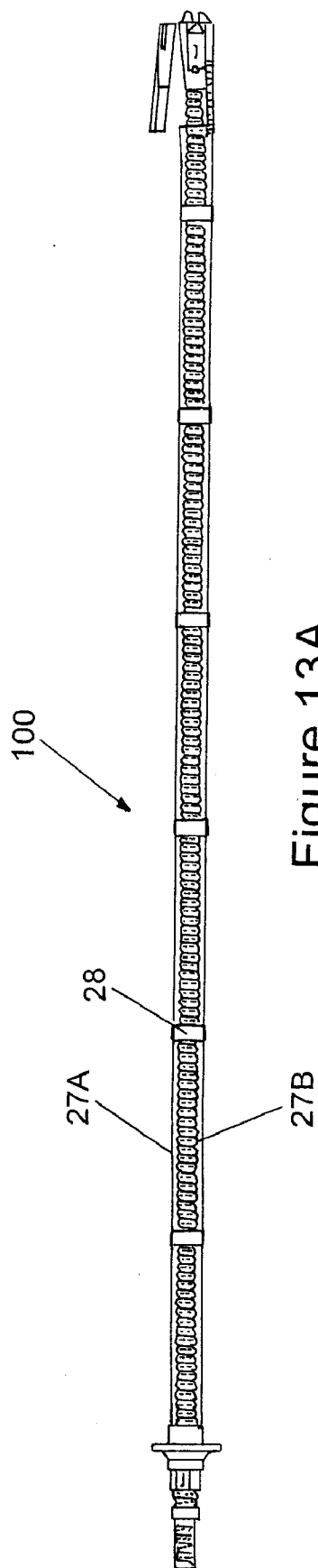


Figure 13A

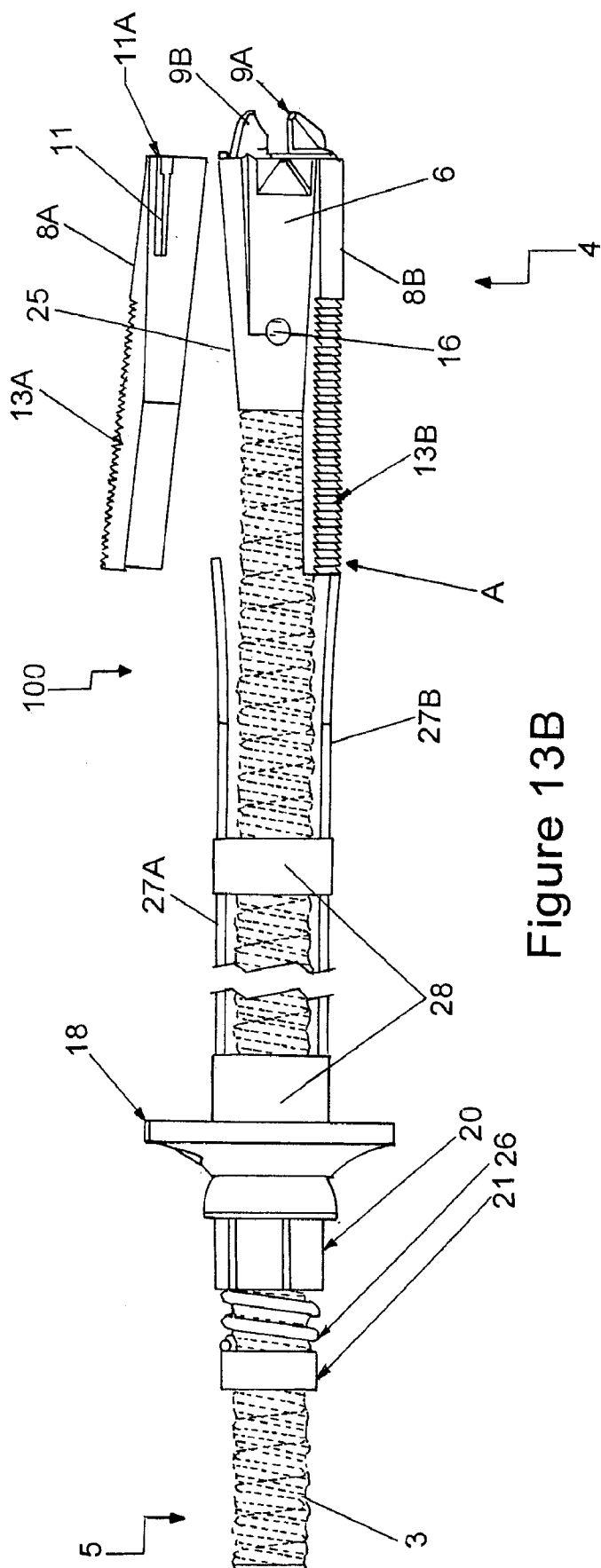


Figure 13B

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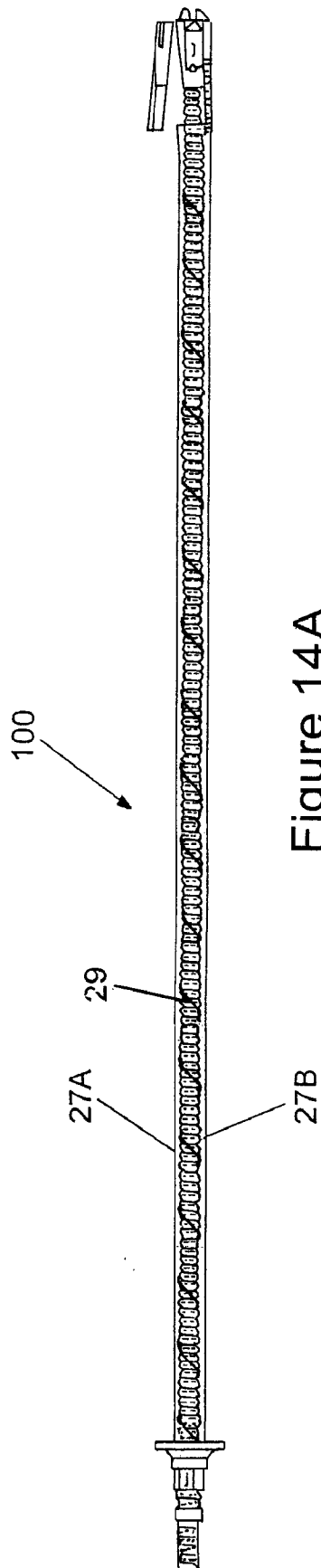


Figure 14A

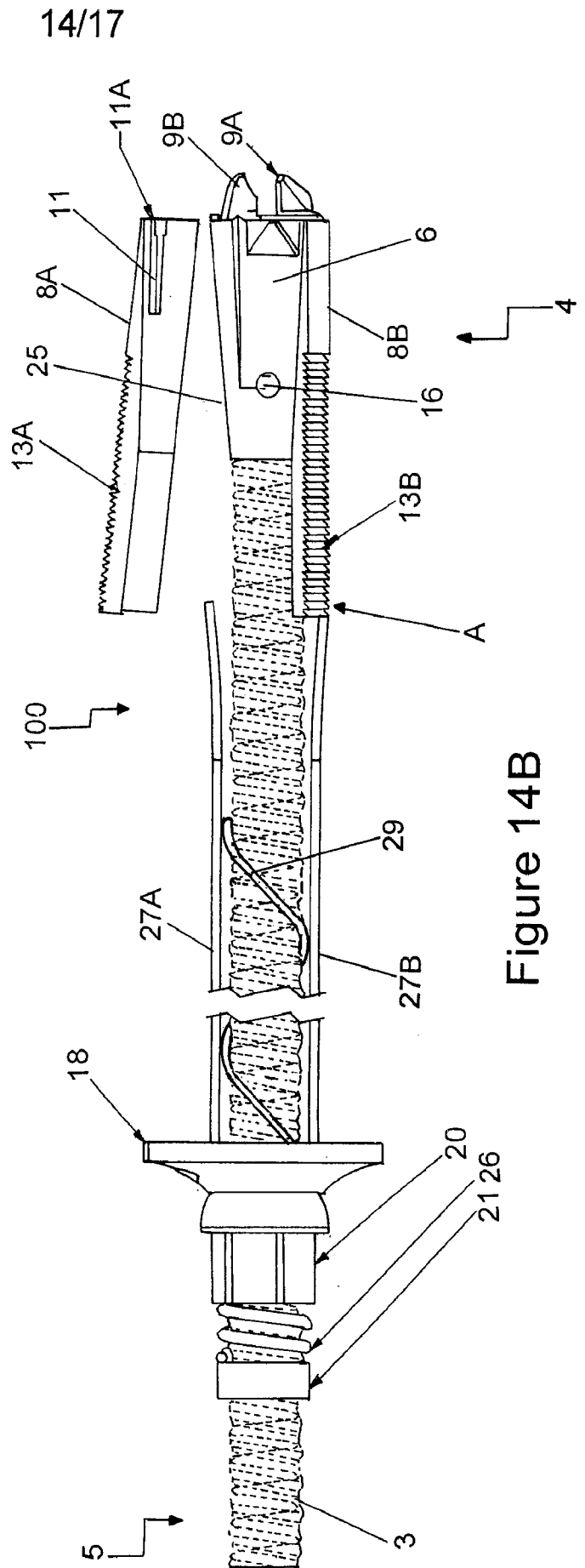


Figure 14B

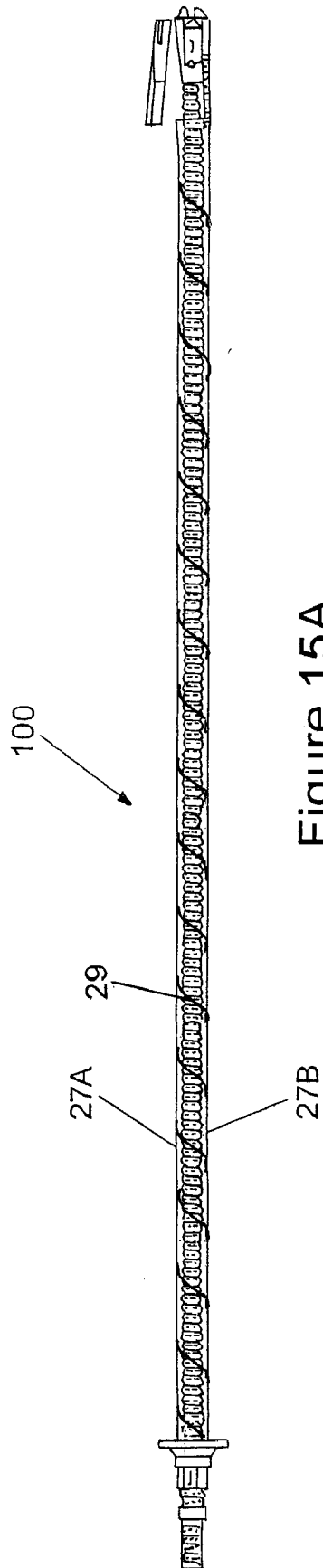


Figure 15A

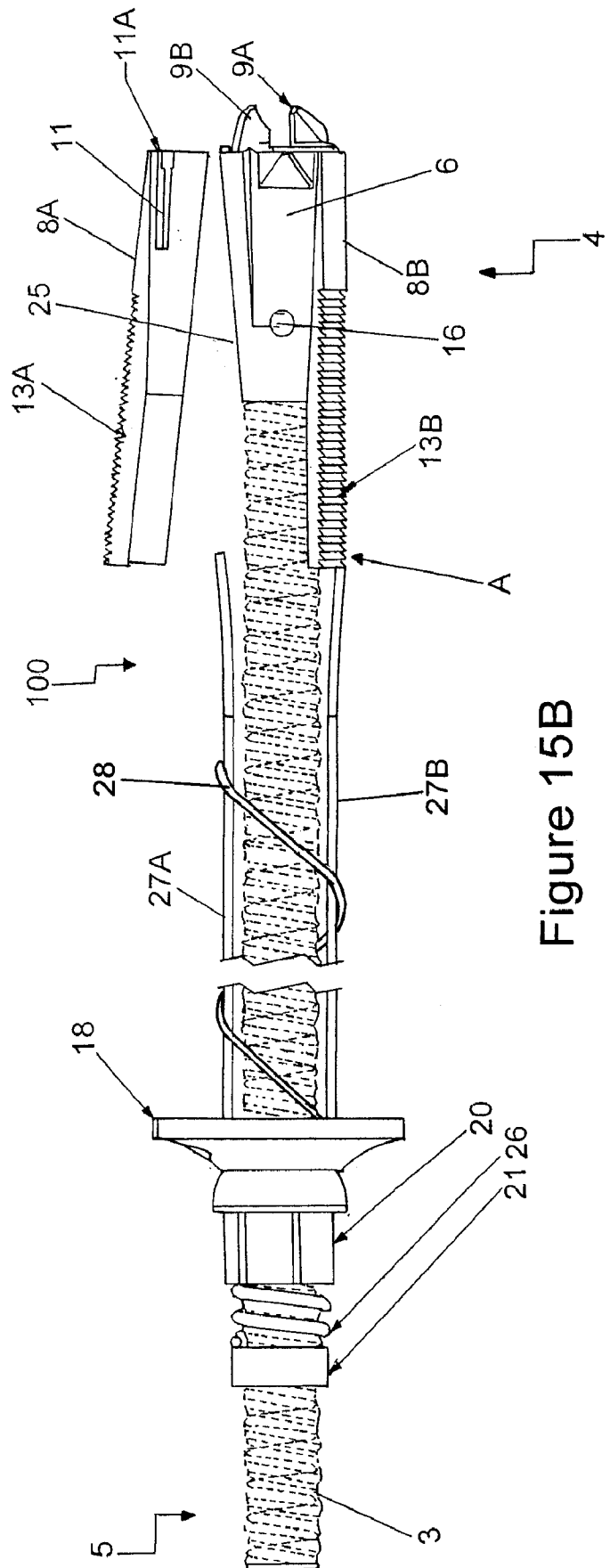


Figure 15B

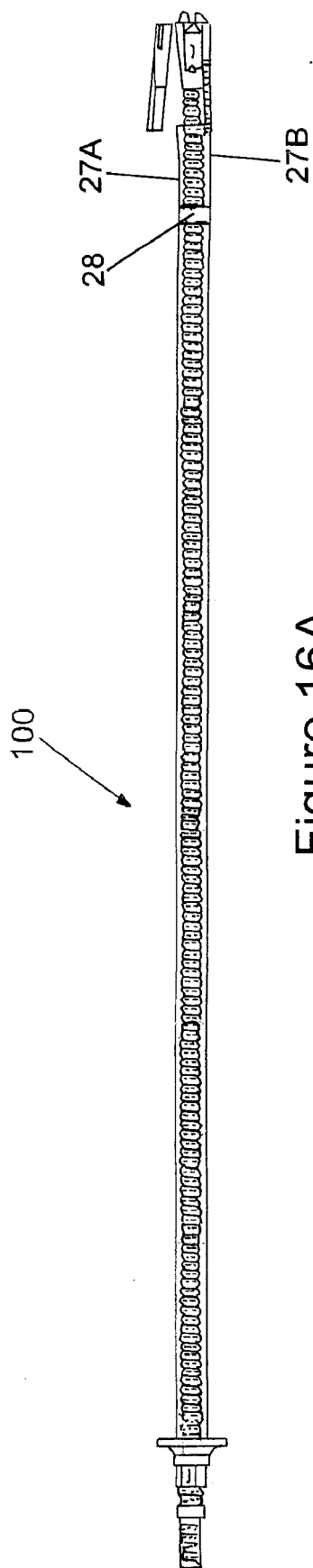


Figure 16A

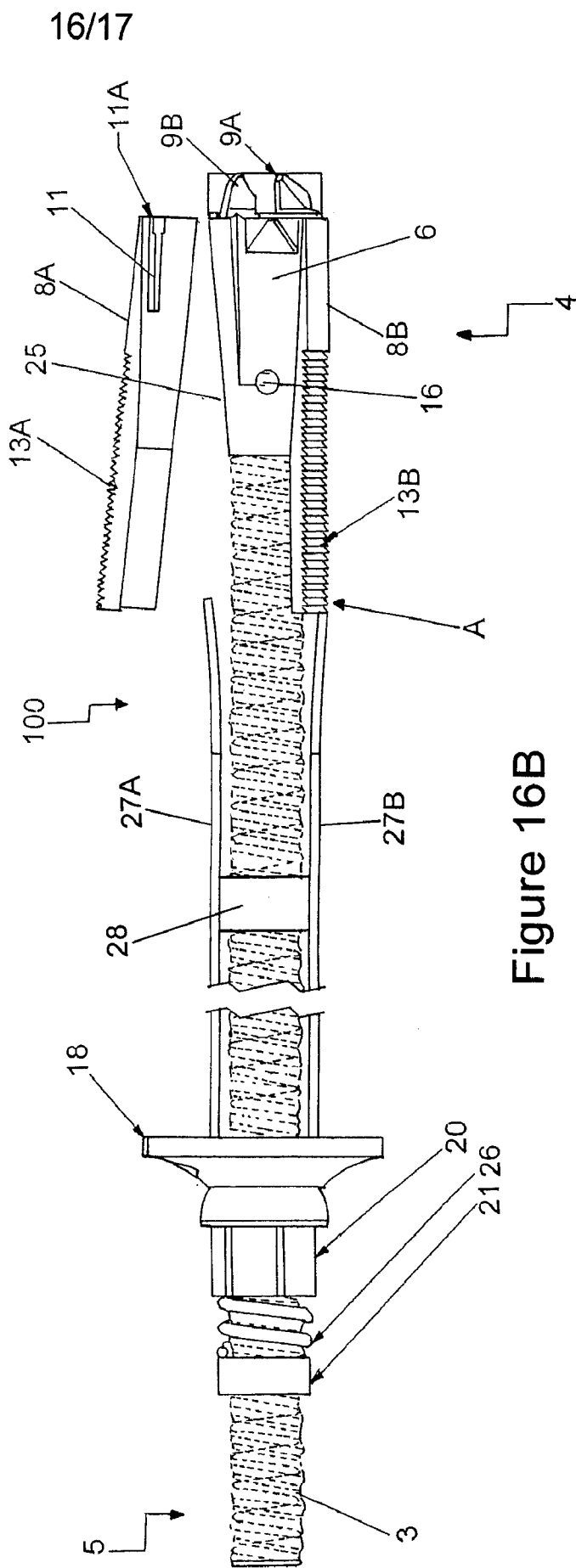


Figure 16B

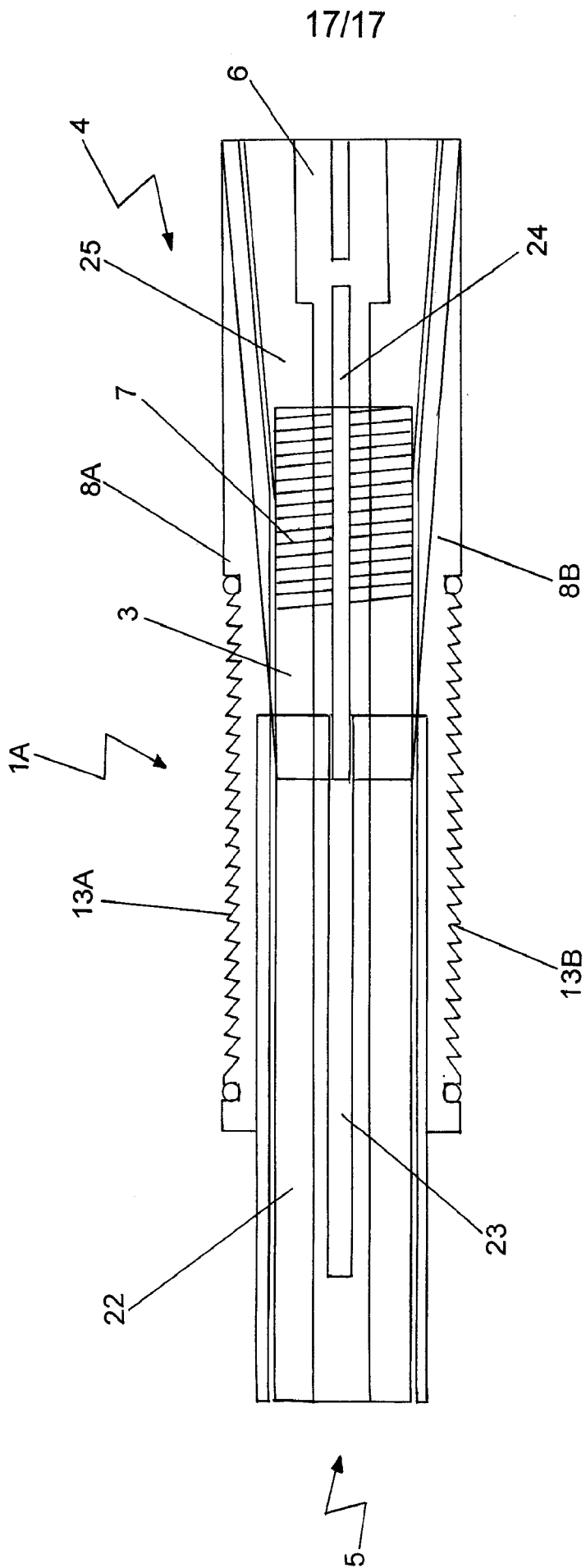


Figure 17