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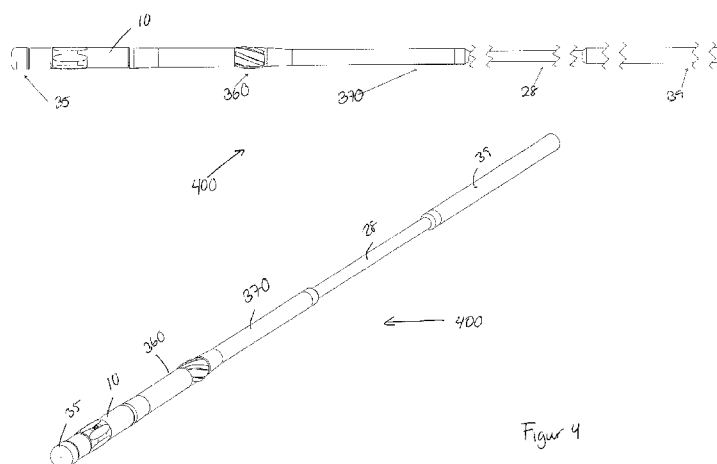


Figure 4

(57) Abstract: A drill string section for directional drilling is described, comprising an outer casing which encases an adjustment mechanism for adjusting drilling direction and angular deflection during drilling. The adjustment mechanism comprises an outer shaft that is rotatably arranged relative to the outer casing and is configured with an axial eccentric first bore having a first bore axis that is parallel to the centre axis. The adjustment mechanism further comprises an inner shaft that is rotatably arranged in the first bore and is configured with an axial, eccentric second bore for passage of a drive shaft for a drill bit. The adjustment mechanism further comprises an outer rotational mechanism for reciprocal rotation of the outer casing and the outer shaft, and for locking against the reciprocal rotary motion between the outer casing and the outer shaft, and an inner rotational mechanism for reciprocal rotation of the outer shaft and the inner shaft, and for locking against reciprocal rotary motion between the outer shaft and the inner shaft.

DEVICE AND METHOD FOR DIRECTIONAL DRILLING

The present invention relates to a drill string section for use in directional drilling.

When drilling oil and/or gas wells, it will often be necessary to guide the drilling tool in a desired direction out of the tool's drilling direction. This is the case, for example, in connection with directional wells which may have a substantial deviation from a vertical direction.

During drilling it is common to use a drill bit connected to a drill string, which drill string and drill bit are rotated about their longitudinal, axial axes by a drive unit which may be located at the surface.

Directional control of the drilling tool can be effected by applying to the drill bit a radial force which is designed to drive the bit to drill at a certain deviation in a desired direction in relation to the centre axis of the bit. The drilling tool may also have provided therein a gyroscope, one or more accelerometers or one or more magnetometers which give feedback on the position of the drill bit in the ground being drilled in.

With regard to directional drilling, it is common general knowledge that it can be done in two ways: either by so-called "point-the-bit", where the drill bit is "tilted" about a point in a desired drilling direction and at a desired angle relative to the centre axis of the drill bit, or by so-called "push-the-bit", where the drill bit is pushed sideways.

An example of a "point-the-bit" solution is described in US 6,092,610. The disadvantage of this solution is that it requires continuous rotation of the bearings for the drill bit shaft at the same speed as, and in the opposite direction to, the drill string. Another example of a "point-the-bit" solution is described in US 6,581,699 B1. The drawback of this solution is that it requires a great deal of force in order to bend the drill string, in addition to the possibility of problems of fatigue arising due to rotation whilst the shaft is bent.

A known "push-the-bit" device is described in WO 2008/156375, where three steering bodies are used that are arranged around the drilling tool in the circumferential direction and are movable in a radial direction in order to push the drill bit in the desired direction. The three steering bodies, which are individually movable, may, however, be subject to problems during operation, for example, leakages at the seals around the movable steering bodies.

Furthermore, WO 96/31679 teaches the use of two eccentric shafts for adjustment of drilling deviation. With this solution it is not possible to achieve a good adjustment in the opposite direction of the pregnant or weighted side 20. This means that the tool taught in this document is rather inflexible in use.

A tool is also known from GB 2334601 where eccentric shafts are used for adjustment of deviation and direction of the drilling tool. This is a “point-the-bit” solution which bends the drill string by means of eccentric rings between two stabilising units.

- 5 WO 2005/099424 describes a rotary gear mechanism that is used to control deviation and direction of the drilling tool. This document teaches that eccentric shafts are used to determine the magnitude of the deviation and the direction. However, this apparatus is constructed such that it is not possible to adjust direction and deviation separately; if direction is adjusted, deflection must also be adjusted or
10 vice versa.

The object of the present invention is thus to provide a new and efficient device for controlling angle and deflection in directional drilling when using a “push-the-bit” device, which is arranged such that direction and deflection can be adjusted continuously, even whilst the drilling string rotates.

- 15 This object is achieved by means of a drill string section according to the independent claim. Additional embodiments of the invention are disclosed in the dependent claims.

- In accordance with the invention a drill string section for receiving a drill bit is provided. The drill string section being adapted for use in directional drilling in a
20 borehole, wherein the centre axis of the drill bit is held parallel to the centre axis of the borehole and wherein the directional drilling is carried out in that the drill bit is parallel displaced by an adjustment mechanism that determines the drilling direction and angular deflection of the drill bit.

- 25 The drill string section comprises an outer casing which encases an adjustment mechanism for adjusting drilling direction and angular deflection during drilling. The adjustment mechanism comprises an outer shaft having a first axial centre axis, which outer shaft is rotatably arranged in relation to the outer casing. The outer shaft is further configured with an axial, eccentric first bore having a first bore axis
30 that is parallel to the first centre axis. The drill string section further comprises an inner shaft having a second axial centre axis, which inner shaft is rotatably arranged in the first bore, and is configured with an axial, eccentric second bore for passage of a drive shaft for a drill bit. The second bore has a second bore axis that is parallel to the second centre axis.

- 35 Further the centre axis of the drill bit is capable of parallel displacement relative to the outer casing and that the outer casing lies in abutment with the borehole or borehole casing when the drill string section is in use. Thus the outer casing is adapted for abutment with a borehole or borecasing.

The outer casing may be configured with return channels for return flow of drilling fluids. The outer casing may have a sleeve-like design with an axial extent in the axial direction of the drill string section to adapt for abutment with a bore hole or bore casing.

- 5 With this device for directional drilling there is no need for external moving parts, with the attendant possibilities of leakage in seals. This solution also with the outer casing gives a greater contact face against the formation, which may be advantageous when drilling in soft formations. Furthermore, since the new solution has the steering integrated in a stabiliser, the drill bit vibrations will be smaller,
10 with the result that a better quality borehole is obtained.

- The drill string section comprises, according to an embodiment of the invention, an outer rotational mechanism for reciprocal rotation of the outer casing and the outer shaft, and for locking the reciprocal rotary motion between the outer casing and the outer shaft, and an inner rotational mechanism for reciprocal rotation of the outer
15 shaft and the inner shaft, and for locking the reciprocal rotary motion between the outer shaft and the inner shaft. The locking may be carried out by suitable means known to the skilled person.

- The outer rotational mechanism comprises a second motor which rotates the outer shaft or the outer casing, in order to cause reciprocal rotation between the outer
20 casing and the outer shaft.

The inner rotational mechanism is, in principle, like the outer rotational mechanism, and comprises a first motor that rotates the outer shaft or the inner shaft, and causes reciprocal rotation between the outer shaft and the inner shaft.

- Each shaft, the inner and the outer shaft, may also be rotated by using more than
25 one motor for rotation of the shaft.

- The first and the second motor may be electric or hydraulic actuators/motors which are supplied with electrical energy through a cable or the like from the surface. Alternatively, the energy may be supplied from a local accumulator/battery or a local generator which, for example, is driven by drilling fluids. The motors can be
30 controlled from the surface in a way that is known to a person of skill in the art. Alternatively, the motors can be controlled in that they follow a pre-programmed path in the tool's processor. The pre-programmed path can be updated underway if so required by direct communication via cable, acoustics or alternatively via mud pulse.

- 35 The eccentricity of the first bore may be identical to that of the second bore. In the second bore, a drive shaft may be provided which is rotatably arranged in relation to the inner shaft. Mounted to the drive shaft is a drill bit. The drive shaft is

preferably mounted to a rotor for rotation of the drill bit, the rotor being rotatably arranged in relation to the outer casing and the adjustment mechanism.

5 In order to help the drill string section to follow the well path when entering or exiting without it being necessary to carry out any active steering, the drill string section for instance the drive shaft, may be provided with a flexible element which permits a radial movement of the drive shaft and ensures that deviation in the well path can be absorbed by the drill string section. Advantageously, the flexible element can be constituted of a spring such as a radial spring, that is to say, a spring which compresses in the radial direction of the drill string section. In an
10 embodiment of the invention, a first radial spring may be arranged around a lower portion of the drive shaft and a second radial spring may be arranged around an upper portion of the drive shaft.

To ensure that rotary motion between the outer casing and the outer shaft, and rotary motion between the outer shaft and the inner shaft are possible, there may,
15 for example, be provided bushings between the surfaces that rotate in relation to each other.

The drill string section may be provided with an anti-rotational mechanism. The anti-rotational mechanism is preferably arranged in the outer casing and may comprise at least one anti-rotational element that is movably arranged in the radial
20 direction and projects from the radially outer surface of the outer casing. The anti-rotational element may be configured with a T-shaped cross-section and be arranged in a cavity in the outer casing such that the upright of the T projects from a slit which extends from the cavity and through the radially outer surface of the outer casing. Below the anti-rotational element is preferably arranged a spring element
25 which so adapted that it presses the anti-rotational element outwards in a radial direction. The spring element may, for example, be wave-shaped. Alternatively, the anti-rotational element may be configured as an arcuate or curved spring element. Furthermore, it may be advantageous to arrange a plurality of such anti-rotational mechanisms in the outer casing in order to prevent or at least reduce rotation of the
30 outer casing relative to the surroundings.

The invention will be described in more detail below with reference to the attached figures, wherein

Figure 1a shows a drill string section in the neutral position according to a first embodiment of the invention.

35 Figure 1b shows the drill string section in Figure 1a, from behind looking towards the drill bit.

Figure 1c shows the section A-A as indicated in Figure 1b.

Figure 1d shows the section B-B as indicated in Figure 1c.

Figure 1e shows the section C-C as indicated in Figure 1c.

Figures 2a-e show the same embodiment of the drill string section as that shown in Figures 1a-e, but with deflection from the neutral position.

- 5 Figure 3a shows a front view of a drill string section in the neutral position, according to a second embodiment of the invention.

Figure 3b shows an axial view of the drill string section in Figure 3a.

Figure 3c shows the section B-B as indicated in Figure 3b.

Figure 3d shows the section C-C as indicated in Figure 3b.

- 10 Figure 3e shows the section D-D as indicated in Figure 3b.

Figure 4 shows an example of a BHA (Bottom Hole Assembly) with the drill string section included.

- Figure 1a shows a drill string having a drill string section 10 comprising a drill bit 35, a drill string section 10 with a rotational mechanism encased by an outer casing 37 in a neutral position, i.e., that the drill string section 10 is not set with any deviation from the centre axis of the drill string (drilling "straight ahead"). The drill string section 10 rests against the surroundings to give counterforce during directional drilling and to stabilise the drill bit, and is equipped with return channels 79 in the surface of the outer casing 37 to allow for return flow of drilling fluids.
- 15 The outer casing 37 of the drill string section 10 is also provided with one or more anti-rotational mechanisms 72 to prevent or at least reduce rotation of the outer casing in relation to the surroundings. It is not essential that the outer casing should be equipped with anti-rotational mechanisms 72 in order for it to have sufficient grip in relation to the surroundings, but their use may be desirable in some cases.
- 20 The surroundings here may, for example, be a pipe in which the drill string section is arranged, or the ground in which drilling is taking place.

- Figure 1c shows an axial section through the drill string shown in Figure 1a. The drill bit 35 is attached to a drive shaft 40 which is configured with a bore 80 for supply of necessary drilling fluids during drilling, and attached to a drill string connector 36 at the opposite end which connects the drill string section 10 to drill string. Disposed between the drill bit 35 and the drill string connector 36 is an adjustment mechanism comprising an inner shaft 39, an outer shaft 38 lying external thereto and a surrounding casing 37. The inner shaft 39 and the outer shaft 38 may comprise the shape of sleeves. The drive shaft 40 is received in a bore that
- 30

is eccentrically arranged in the inner shaft 39. The inner shaft 39 is rotatably arranged in relation to the drive shaft 40 on bearings 41. External to the inner shaft 39 there is further provided in the outer shaft 38 a bore that is eccentrically arranged in the outer shaft 38. Outermost, the outer casing 37 is arranged surrounding the outer shaft 38. The outer casing 37, the outer shaft 38, and the inner shaft 39 have at all times parallel centre axes independent of how the adjustment mechanism is set for direction and angular deviation from the centre axis of the drill bit during drilling.

Figure 1c also indicates an inner rotational mechanism 43 that causes reciprocal rotation of the inner shaft 39 and the outer shaft 38 when angular deflection of the directional drilling is to be adjusted. Similarly, an outer rotational mechanism 44 will cause reciprocal rotation between the outer shaft 38 and the outer casing 37 when the drilling direction is to be adjusted. The inner rotational mechanism 43 is located between the inner shaft 39 and the outer shaft 38 and the outer rotational mechanism 44 is located between the outer shaft 38 and the outer casing 37. The inner rotational mechanism 43 and the outer rotational mechanism 44 are also constructed such that they can lock against reciprocal rotation between the inner shaft 39 and the outer shaft 38, and the outer shaft 38 and the outer casing 37, respectively.

Figure 1d shows the cross-section B-B that is indicated in Figure 1c. Here it can be seen clearly that the drive shaft 40 lies innermost. External to the drive shaft 40 lies the inner shaft 39. External to the inner shaft 39 there is shown in this sectional view a gear rim 49 that is in engagement with a gearwheel 29a which is driven by the first motor 46. Externally lies the outer shaft 38 in which the first motor 46 is arranged.

Figure 1e shows the cross-section C-C as indicated in Figure 1c. The drive shaft lies innermost as in Figure 1d, with the inner shaft 39 located radially external thereto. Radially external to the inner shaft 39 lies the outer shaft 38. A gearwheel 29b, which is driven by the second motor 47, arranged in the outer shaft 38, is in engagement with the gear rim 49. Figures 1a-e show a situation in which the inner shaft 39 and the outer shaft 38 have a position relative to one another such that their eccentricities cancel each other out, and during a drilling operation drilling will take place straight ahead.

Figures 2a-e are the same device and the same sectional views as in Figures 1a-e, and therefore all the details will not be described again here. The difference between Figures 1a-e and Figures 2a-e is that in Figures 2a-e the inner shaft 39 and the outer shaft 38 have been rotated in such a way relative to each other that their eccentricities are added up and give a vertical displacement relative to the neutral position in which drilling takes place straight ahead. In Figures 2d-e, this is

- indicated in that the centre axis of the drive shaft 40 has been lowered slightly to a horizontal level which is indicated by the reference numeral 86, as compared to the neutral position without deflection that is indicated by a horizontal level 85 which is also shown in Figures 1d-e. The centre axis 52 of the drill bit and the drive shaft in
5 displaced state, as shown in Figures 2b-c, has been lowered slightly relative to the corresponding centre axis 51 in the neutral position in which no directional drilling takes place, i.e., drilling is carried out straight ahead. It should be noted that sideways displacement of the centre axis of the drive shaft can go in all directions, not only vertically as indicated in the attached figures.
- 10 Desired direction for the drilling and desired angular deflection can thus be obtained by adjusting the relative position between the inner shaft 39 and the outer shaft 38, and between the outer shaft 38 and the outer casing 37, such that the eccentricity of the inner shaft and that of the outer shaft allow a desired combination of drilling direction and deflection to be obtained.
- 15 Figures 1d and 2d also show the anti-rotational mechanism 72. The anti-rotational mechanism 72 is included to prevent or at least reduce rotation of the outer casing 37 in relation to the surroundings. The anti-rotational mechanism 72 comprises an anti-rotational element 71 which has a T-shape seen in a cross-section perpendicular to the axial direction of the drill string. The anti-rotational element 71 is arranged
20 in a suitable cavity 75 in the outer casing 37 such that the upright of the T projects from a slit in the outer casing 37, which slit extends from the cavity 75 to the outside of the outer casing 37. The cross-bar of the T is movably arranged in a radial direction in the cavity 75. Below the anti-rotation element 71 is arranged a spring element, preferably in the form of a wave spring 74. The wave spring 74
25 presses the anti-rotational element 71 radially outwards and the anti-rotational element 71 will thus at least help to reduce rotation of the outer casing 37 in relation to the surroundings. A plurality of such anti-rotational mechanisms 72 are preferably arranged around the circumference of the outer casing 37.
- 30 Figure 3b shows an axial section of the second embodiment of the invention corresponding to Figure 1c, but without the drill bit. The drill bit is to be attached to a drive shaft 40a that is configured with a bore 80a for supply of necessary drilling fluids during drilling, and attached to a drill string connector 36a at the opposite end which connects the drill string section 10 to the drill string. Disposed
35 between the drill bit 35 and the drill string connector 36 is an adjustment mechanism comprising an inner shaft 39a, an outer shaft 38a lying external thereto and a surrounding outer casing 37a. The inner shaft 39a, as shown in Figure 3b, works in the same way as the inner shaft according to the first embodiment of the invention, but is in this second embodiment shown comprising the following shaft parts, an inner shaft part 39a' and a first and second shaft part 39a'' and 39a'''

external thereto. The inner shaft 39a is configured with an eccentrically arranged bore for receiving the drive shaft 40a. The inner shaft 39a is rotatably arranged relative to the drive shaft 40a on bearings 41a. The outer shaft 38a is further arranged external to the inner shaft 39a. The outer shaft 3a is segmented but otherwise functions in the same way as the outer shaft 3 according to the first embodiment. In the embodiment shown in Figure 3b, the outer shaft 3 is shown comprising the following shaft parts: first, second, third and fourth shaft part 38a', 38a'', 38a''' and 38a''''. The outer shaft 38a is configured with an eccentrically arranged bore for receiving the inner shaft 39a. Outermost, the outer casing 37a is arranged surrounding the outer shaft 38a. The outer casing 37a, the outer shaft 38a, the inner shaft 39a and the drill bit shaft have at all times parallel centre axes independent of how the adjustment mechanism is set for direction and angular deviation from a centre axis of the drill bit during drilling.

Figure 3b also indicates an inner rotational mechanism 43a which causes reciprocal rotation of the inner shaft 39a and the outer shaft 38a when the angular deflection of the directional drilling is to be adjusted. Similarly, an outer rotational mechanism 44a will cause reciprocal rotation between the outer shaft 38 and the outer casing 37a when the drilling direction is to be adjusted. The inner rotational mechanism 43a and the outer rotational mechanism 44a are also constructed such that they can lock against reciprocal rotation between the inner shaft 39a and the outer shaft 38a, and the outer shaft 38a and the outer casing 37a, respectively

There are no sectional views showing how rotation takes place with the aid of motors, gearwheels etc. as shown for the first embodiment in, inter alia, Figures 1d, 1e. A principle corresponding to that shown in Figures 1e and 1d will also be used in the second embodiment of the invention.

Radial springs 50 and 51 are arranged surrounding the drive shaft 40. The springs 50, 51 ensure that the drill string section has a radial flexibility such that the drill string section can follow the possible bends and deviations of the well path without it being necessary to carry out active steering on entering and exiting the well. Each of the springs has a radial inside face which is secured to the drive shaft 40 and a radial outside face that is secured to its respective spring casing 52, 53. It can be seen from the sectional views in Figures 3c and 3d that the spring casings 52 and 53 have a matching configuration that fits cooperatively with projections and grooves in the drive shaft 40a and the drill string connector 36a. Furthermore, a gap is formed between the spring casing 52 and the drive shaft 41a at one end of the drill string section, and between the drill string connector 36a and the spring casing 53 at the other end of the drill string section. The gaps allow the drive shaft to be moved relative to its centre axis by compression of the radial springs, whilst the matching fit between the spring casing 52 and the drive shaft 40a and between the drill string

connector 36a and the spring casing 53 ensures that the parts are prevented from twisting about the centre axis 60.

5 The drill string section according to the second embodiment as shown in Figure 3e is provided with an anti-rotational mechanism 72a having a different embodiment than that shown in Figures 1a-1e. The anti-rotational mechanism 72a in this case is an arcuate or curved body that is secured to the casing 37a in that the opposing side edges of the arcuate or curved body are received in recesses 61, 62 made in the casing 37a. On abutment with a well wall, the curved body will be compressed and expand into recesses 61, 62 in the axial direction of the drill string section, such that
10 the curve becomes flattened and a clamping effect outwards against the well wall is achieved.

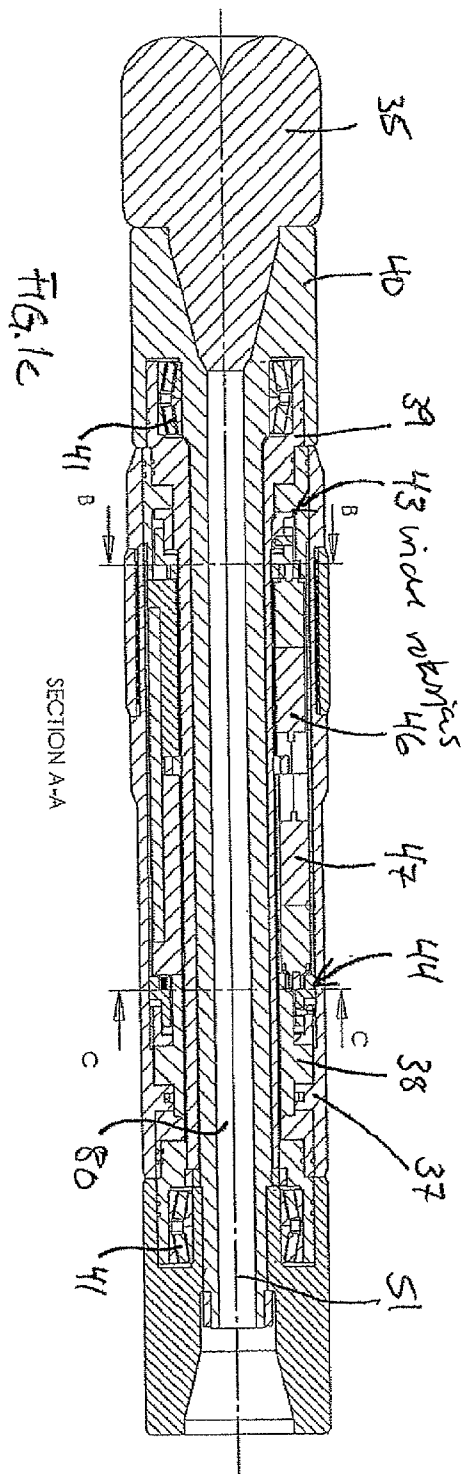
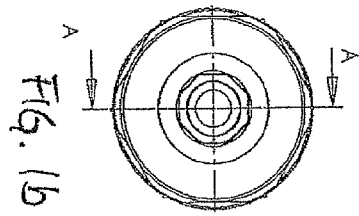
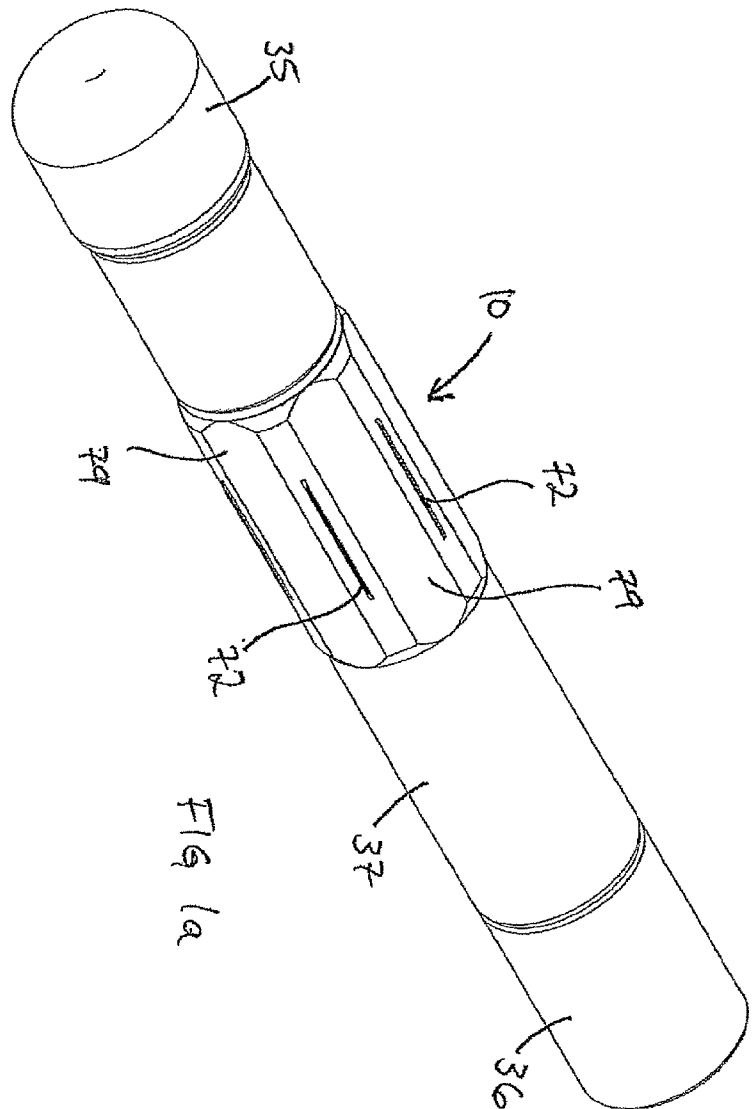
Fig. 4 shows an example of a BHA (Bottom Hole Assembly) 400 comprising drill string section 10 with drill bit 35 mounted on one end thereof. At the other end of the drill string section there is mounted a rotating stabilising unit 360 and arranged
15 thereafter is a mud motor 370. The mud motor 370 increases the speed of the drill bit 35. The BHA /directional drilling tool 400 further includes a flexible connector 28 and a MWD (Measurement While Drilling)/LWD(Logging While Drilling) assembly 390 for measuring and logging drilling and formation data (pressure, temperature, density, gamma radiation etc) .

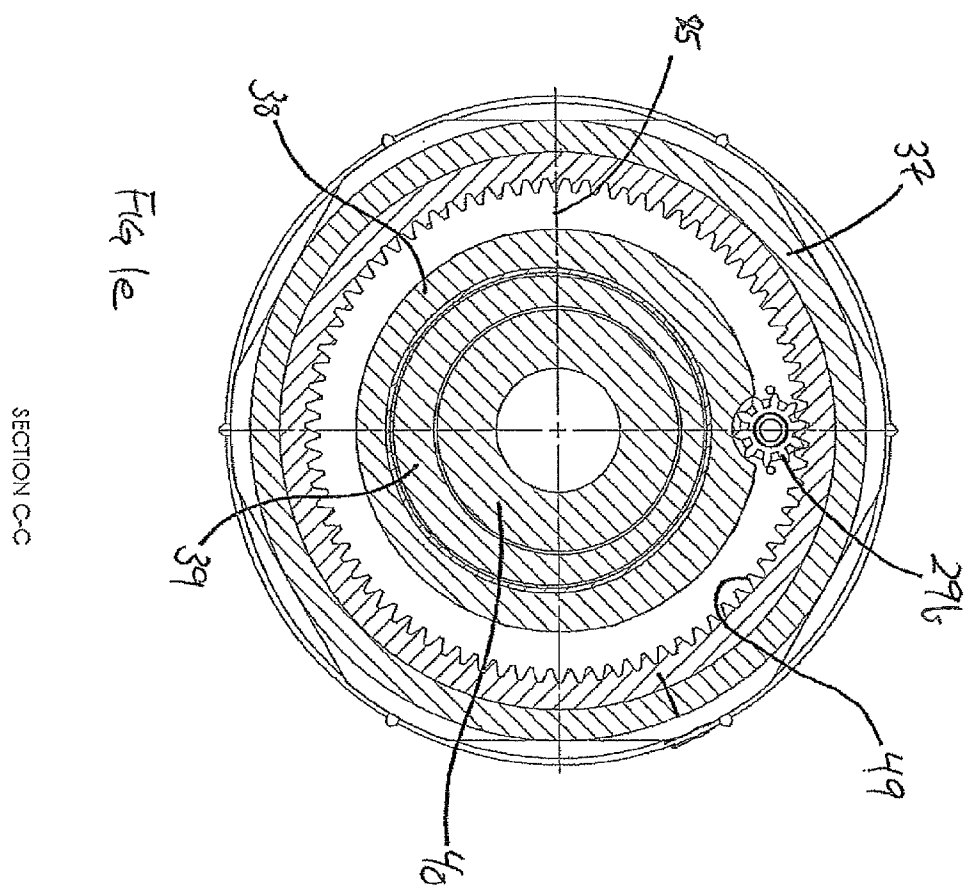
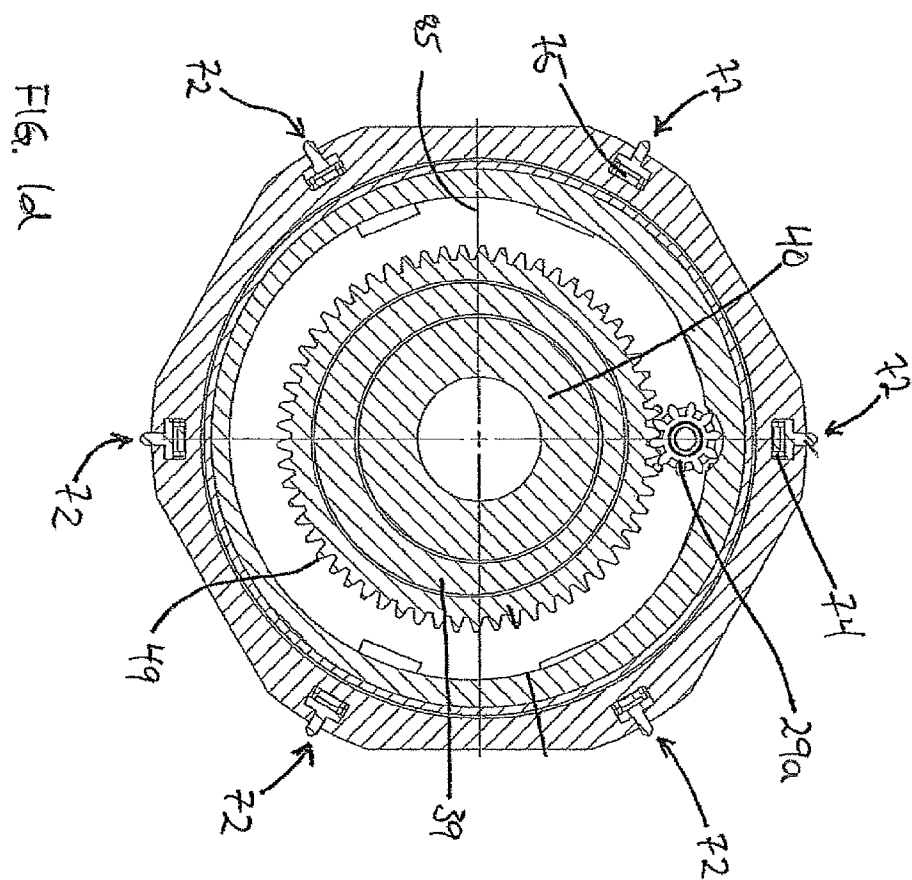
20 The invention has been described here with reference to two embodiments thereof. It should be pointed out that several interpretations of the invention are possible within the scope of the patent claims.

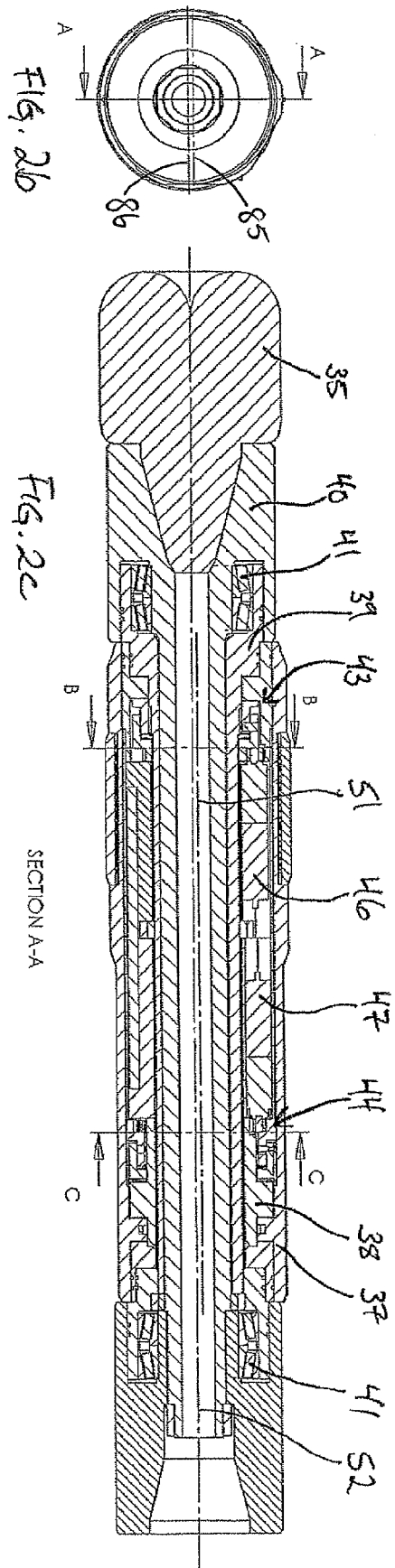
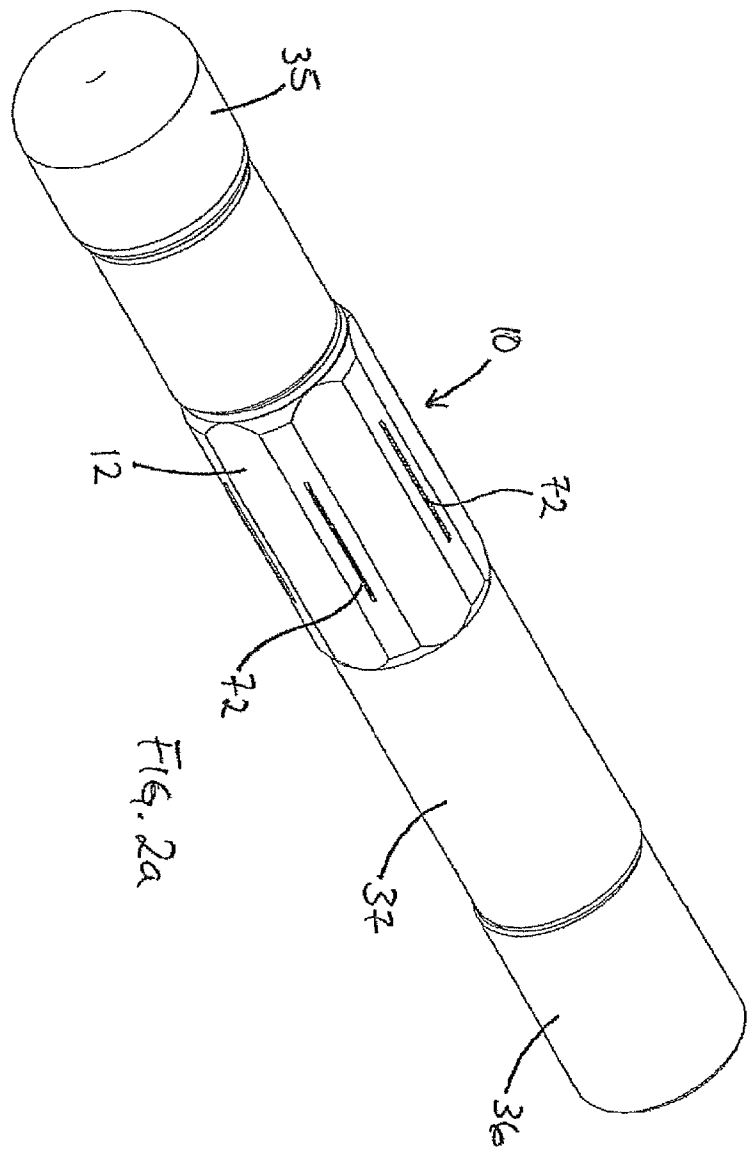
PATENT CLAIMS

1. A drill string section for receiving a drill bit, the drill string section being adapted for use in directional drilling in a borehole, wherein the centre axis of the drill bit is held parallel to the centre axis of the borehole and wherein the directional drilling is carried out in that the drill bit is parallel displaced by an adjustment mechanism that determines the drilling direction and angular deflection of the drill bit,
 characterised in that the adjustment mechanism is encased by an outer casing, the adjustment mechanism comprising
 - an outer shaft having a first axial centre axis, which outer shaft is arranged to be rotated relative to the outer casing, and which outer shaft is configured with an axial eccentric first bore having a first bore axis that is parallel to the first centre axis;
 - an inner shaft having a second axial centre axis, which inner shaft is positioned in the first bore and arranged to be rotated relative to the outer shaft, and which inner shaft is configured with an axial eccentric second bore for passage of a drive shaft for driving the drill bit, which second bore has a second bore axis that is parallel to the second centre axis;
 - further that the centre axis of the drill bit is capable of parallel displacement relative to the outer casing and that the outer casing lies in abutment with the borehole or borehole casing when the drill string section is in use.
2. A drill string section according to claim 1,
 characterised in that the outer casing is configured with return channels for return flow of drilling fluids.
3. A drill string section according to one of claims 1-2,
 characterised in that the eccentricity of the first bore is identical to the eccentricity of the second bore.
4. A drill string section according to one of claims 1-3,
 characterised in that the drive shaft is arranged in the second bore rotatable relative to the inner shaft.
5. A drill string section according to one of claims 1-4,
 characterised in that the drive shaft is provided with a flexible element, preferably a spring, which permits a radial motion of the drive shaft.

6. A drill string section according to claim 4,
c h a r a c t e r i s e d i n that a first radial spring is arranged around a lower
portion of the drive shaft and that a second radial spring is arranged around an
upper portion of the drive shaft.
- 5 7. A drill string section according to one of claims 1-5,
c h a r a c t e r i s e d i n that the outer casing has a sleeve-like design with
an axial extent in the axial direction of the drill string section.
8. A drill string section according to one of claims 1-7,
c h a r a c t e r i s e d i n that the adjustment mechanism comprises
- 10 -an outer rotational mechanism for reciprocal rotation of the outer casing and the
outer shaft, and which is adapted for locking against reciprocal rotary motion
between the outer casing and the outer shaft;
-an inner rotational mechanism for reciprocal rotation of the outer shaft and the
inner shaft, and which is adapted for reciprocal rotary motion between the outer
- 15 shaft and the inner shaft.
9. A drill string section according to one of claims 1-8,
c h a r a c t e r i s e d i n that the outer casing comprises an anti-rotational
mechanism.

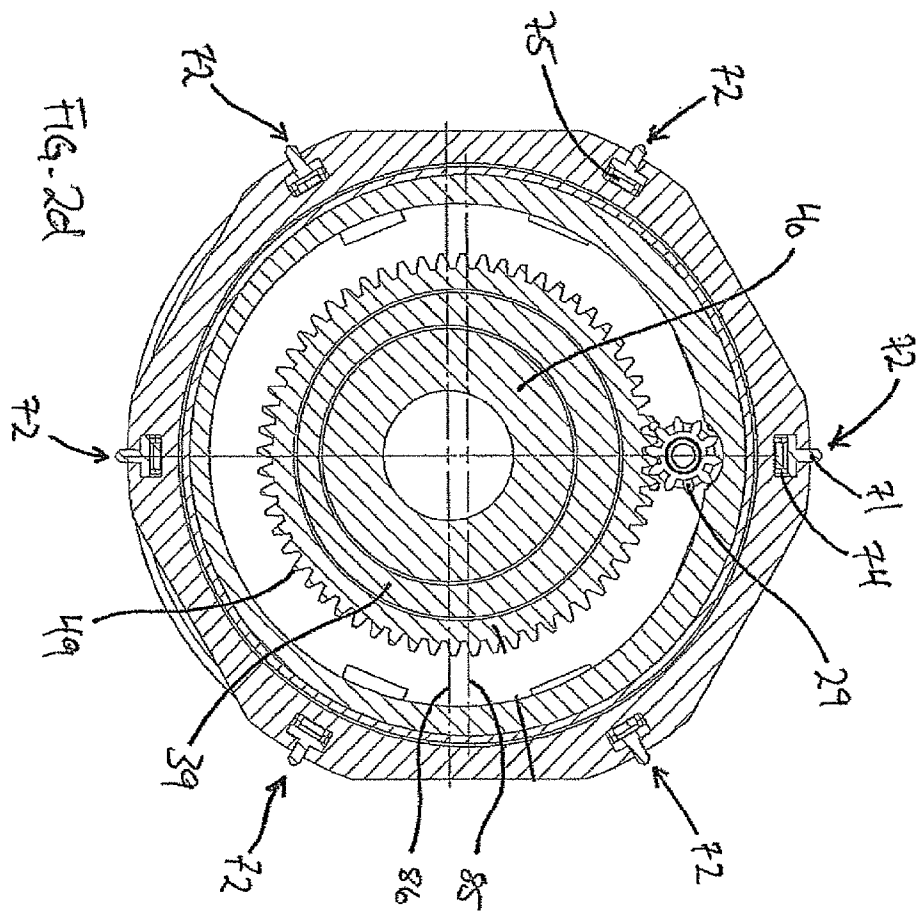




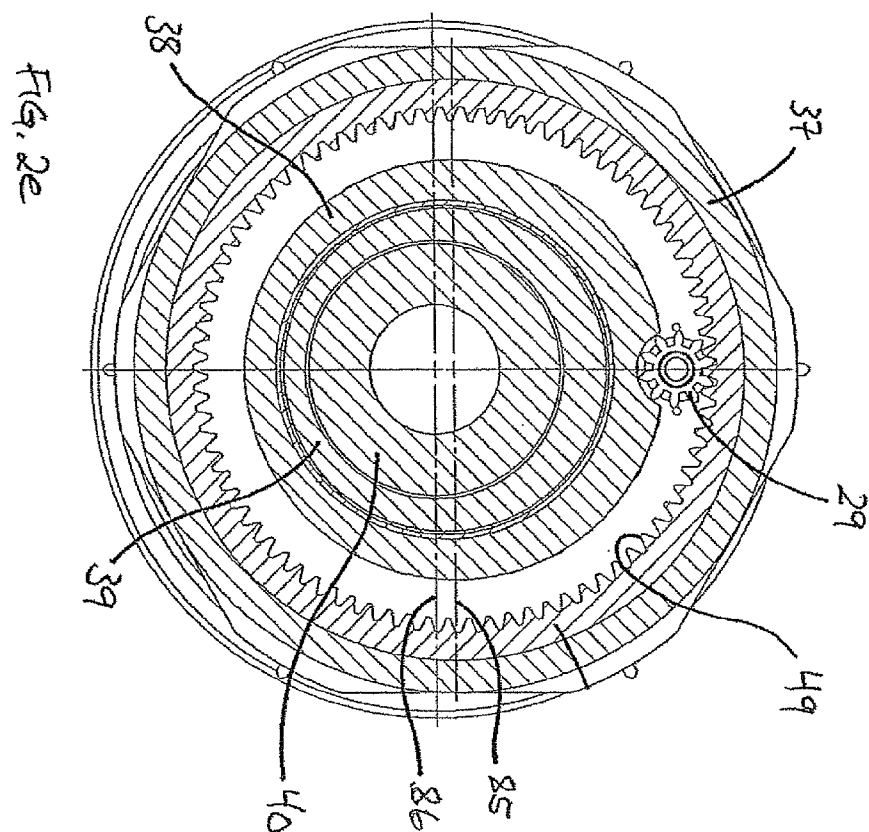


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SECTION B-B

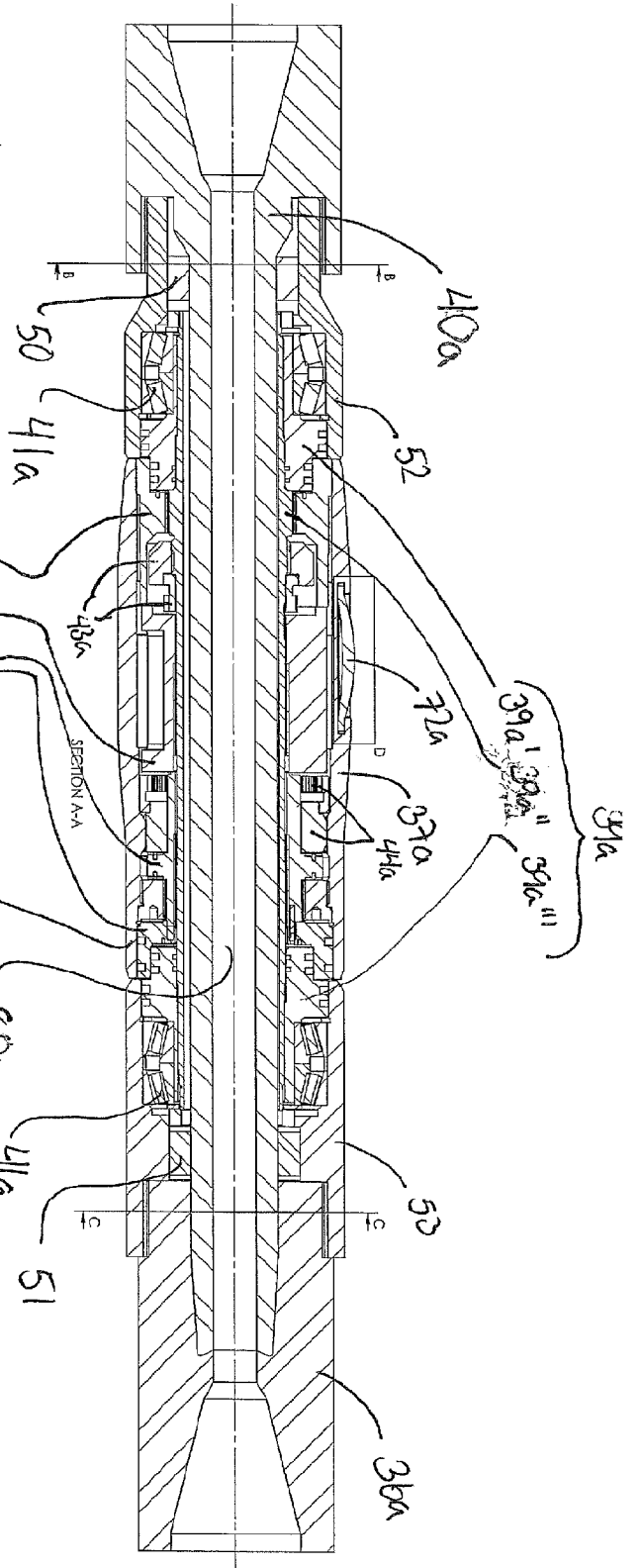


SECTION C-C



5/6

Fig 3v



80a

41a

51

Fig 3a

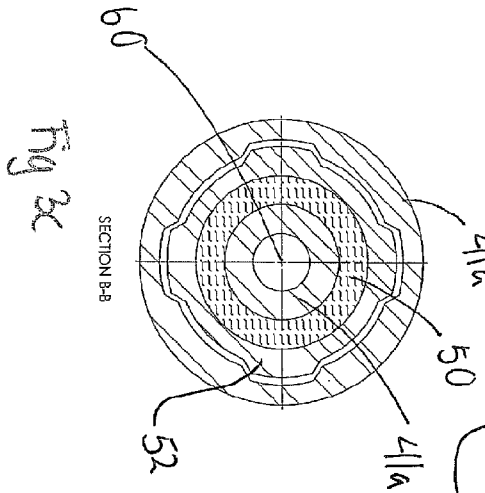
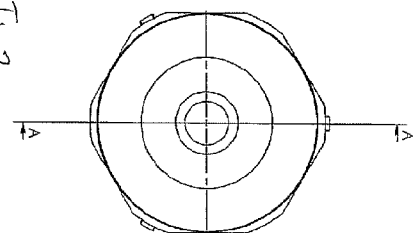


Fig 3c

SECTION B-B

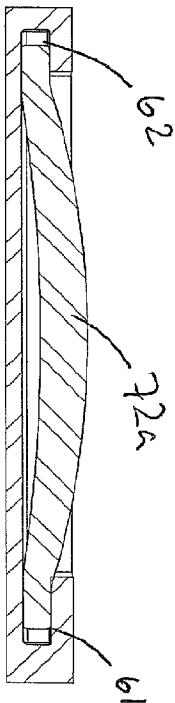


Fig 3

DETAIL D

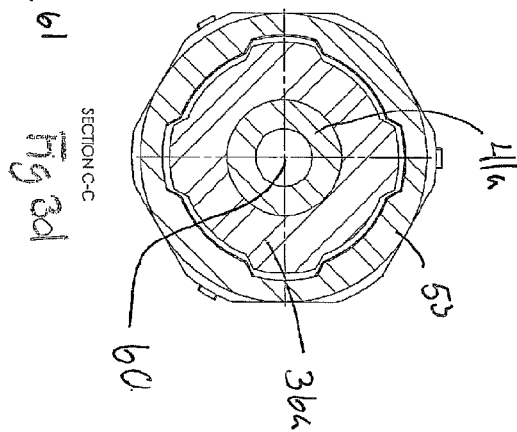


Fig 3d

SECTION C-C

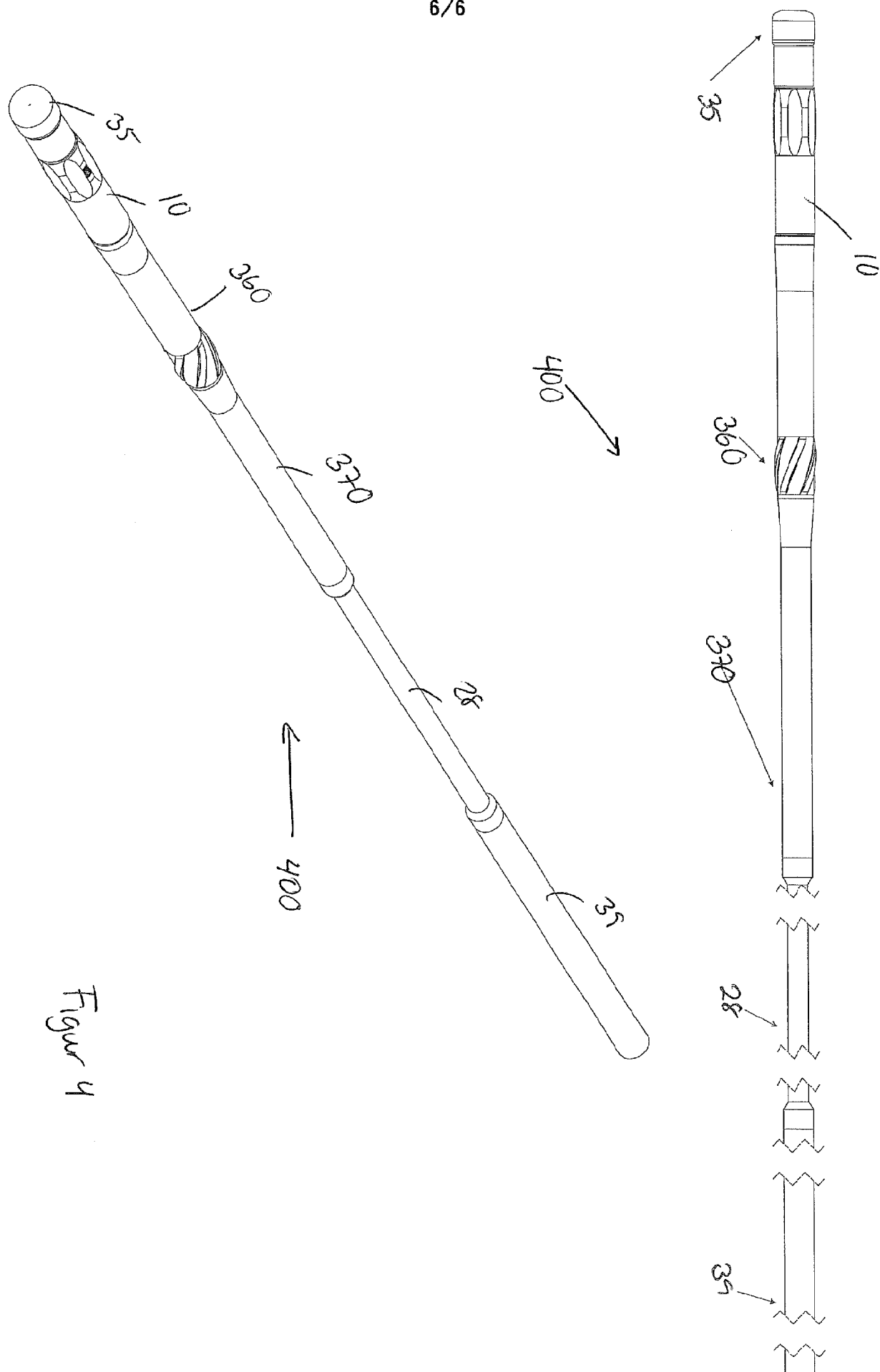


Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/058758

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B7/06
ADD.

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)
E21B

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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2002/185315 A1 (MCLOUGHLIN STEPHEN JOHN [GB] ET AL) 12 December 2002 (2002-12-12) page 8, paragraph 116 - paragraph 122; figures 1,7A,7B -----	1-9
A	US 2002/053470 A1 (NOE PAUL [US] ET AL) 9 May 2002 (2002-05-09) page 2, paragraph 34 - page 3, paragraph 40; figures 4-7 -----	1-9
A	WO 2008/156375 A1 (TUTEEDDEE AS [NO]; HAUGHOM PER OLAV [NO]) 24 December 2008 (2008-12-24) cited in the application figures 3,4 ----- -/--	1-9

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

3 September 2013

Date of mailing of the international search report

18/09/2013

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/058758

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2005/099424 A2 (EARLES RONALD B [US]; LASATER JEFFREY B [US] HALLIBURTON ENERGY SERV I) 27 October 2005 (2005-10-27) cited in the application the whole document	1-9
A	----- US 6 092 610 A (KOSMALA ALEXANDRE G E [US] ET AL) 25 July 2000 (2000-07-25) cited in the application the whole document -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/058758

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