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(54) **ACTUATION DEVICES, TOOLS AND APPARATUS**

BETÄTIGUNGSVORRICHTUNGEN, WERKZEUGE UND VORRICHTUNG

DISPOSITIFS, OUTILS ET APPAREIL D'ACTIONNEMENT

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(73) Proprietor: **The Engineering Business Limited**
Riding Mill,
Northumberland NE44 6EG (GB)

(72) Inventors:
- **GRINSTED, Timothy William**
  Northumberland NE43 7TN (GB)
- **BINGHAM, Martin**
  Hexam NE46 3EY (GB)

(74) Representative: **Harrison Goddard Foote**
Belgrave Hall
Belgrave Street
Leeds LS2 8DD (GB)

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Description

[0001] The present invention relates to actuation devices and to apparatus for positioning such actuation devices in their location of use, primarily at the end of a drill string, and for operating the actuation devices in that location. More specifically, the invention relates the positioning, operation and use of actuation devices located for use in a drill string such as valve actuation devices and devices for the setting of packers or plugs. In one form the invention relates to actuation devices in the form of investigation tools, and to their actuation, and in particular to investigation tools for carrying out geotechnical investigations. More especially, the invention relates to the positioning, operation and use sampling, measuring or testing tools for within drilling equipment to test soils and the like at the bottom of a drilled hole. The apparatus of the invention is well adapted for offshore use.

[0002] It is well known to operate devices such as valve actuators, devices for setting packers or plugs and geotechnical investigation tools - for example, cone penetrometers, vanes, corers and samplers - from inside the drill string of a drilling rig. The invention will be described hereinafter with reference only to geotechnical investigation tools but is also applicable to other actuation devices as noted above. The tools and associated equipment are lowered down the centre hole of the drilling string to the bottom where the tool is latched to prevent return (upward) movement. The tool is then operated as required to take the necessary samples or measurements and, subsequently, the tool and equipment are recovered by releasing the latches and withdrawing through the drill string. Further drilling can then take place before further sampling and testing at another depth.

[0003] The requirement to pass the tool and the associated equipment for its actuation through the drill string imposes severe constraints. For offshore applications, the drill string may be several thousand metres long. Typical drills have a diameter of about 125mm with an internal hole diameter of only 100mm so there is very limited space for the tool and its actuation equipment. The actuation of the tool can typically be by mechanical or hydraulic means, but the restricted operating space commonly results in complexity and unreliability. An example of such complexity is the need for reels and electrical slip rings to allow signals to pass to and from the geotechnical tool during extension and retraction of the actuation equipment.

[0004] WO02/079604 describes an expandable downhole tool. The tool includes a piston and cylinder actuation arrangement. The piston includes a through bore of restricted diameter through which pressured drive fluid passes. A compression spring acts on a lower end of the piston. An increase in pressure of the drive fluid causes the piston to move against the action of the spring. Movement of the piston causes movement of tool elements from a stored position to a deployed position.

[0005] Accordingly, the present invention seeks to provide an actuation system for an actuation device, (such as a geotechnical tool, valve actuation devices or devices for the setting of packers or plugs) which at least partially overcomes these disadvantages.

[0006] According to a first aspect of the invention there is provided apparatus for operation of an actuation device in a drill string, the apparatus comprising:

(i) a hydraulic cylinder having first and second ends including a piston moveable between the respective ends of the cylinder and dividing the cylinder into first and second chambers;
(ii) a hydraulic control unit;
(iii) a first rod depending from a first side of the piston and attachable to an actuation device; characterised in that the apparatus further comprises
(iv) retaining means operative to co-operate with an internal surface of the drill string to restrain the apparatus from withdrawal from the drill string; and
(v) a second rod depending from a second side of the piston opposite the first side and connected to the hydraulic control unit,

and in that the hydraulic control unit is operable to:

(a) supply hydraulic fluid to the first chamber to urge the piston away from the first end thereby to extend the first rod from the cylinder and to draw the hydraulic control unit towards the cylinder,

[0007] Preferably the hydraulic control unit is further operable to:

(b) supply hydraulic fluid to the second chamber to urge the piston towards the first end thereby to extend the second rod from the cylinder and to move the first rod towards the first end.

[0008] With the above-described arrangement, displacement of the actuation device on its extension and retraction can be measured by measuring the oil flow from the hydraulic control unit, or by means of a transducer within the appropriate rod.

[0009] Preferably, the actuation device is selected from the group comprising geotechnical investigation tools, valve actuators, and actuators for the setting of packers and plugs.

[0010] The retaining means may comprise a friction device operable to generate enough force on the inside of the drill string to resist the thrust of the hydraulic piston and cylinder arrangement. However, most preferably the retaining means comprise latching means operative to co-operate with an abutment surface provided on an inner surface of the drill string.

[0011] In order to allow removal of the apparatus and its associated actuation device, preferably the apparatus further comprises shoulder means mountable on the distal end (with respect to the cylinder) of the first rod and

operative to urge the latching means from a latching condition to a release condition during movement of the first rod towards the first end.

[0012] In a preferred construction, the second rod includes discrete passageways therein for the transmission of hydraulic fluid to the respective first and second chambers. Preferably the second rod includes first and second internal tube structures defining a first annular passageway between an inner surface of the second rod and an outer surface of the first internal tube and a second annular passageway between an inner surface of the first internal tube and an outer surface of the second internal tube

[0013] In a preferred variation of this construction the interior of the second internal tube provides a further passageway for control wires or cabling for the actuation device.

[0014] Preferably the apparatus further comprises a casing mountable on the first rod for retaining the actuation device. The said casing desirably includes shock-absorbing means suitable to absorb energy of impact when the apparatus reaches an end stop towards the end of the drill string.

[0015] According to a second aspect of the invention there is provided a method of positioning an actuation device comprising:

i). providing an apparatus as defined in the first aspect of the invention;
ii). positioning the apparatus in a desired location in a drill string;
iii). retaining the apparatus in said desired location; and
iv). supplying hydraulic fluid to said first chamber to extend the first rod from the cylinder and to draw the hydraulic control unit towards the cylinder.

[0016] Preferably the method further comprises the step of:
Supplying hydraulic fluid to said second chamber thereby to urge the piston towards the first end to extend the second rod from the cylinder and to move the first rod towards the first end.

[0017] For a better understanding of the invention and to show how the same may be carried into effect, reference will be made to the following drawings, in which:

Figures 1a and 1 b show schematic drawings of an apparatus according to the present invention;

Figures 1c, 1d and 1e are similar to Figures 1a and 1b and show schematically the operation of the apparatus of the invention within a drill string;

Figure 2 is a schematic sectional view of the apparatus according to the invention with a geotechnical tool mounted thereon;

Figure 3 is similar to Figure 2 showing the tool in an extended configuration;

Figure 4 is a schematic section view illustrating a hydraulic control means of the invention;

Figure 5 is an enlarged view showing the piston and cylinder arrangement of the apparatus of Figures 1 and 2 in which the tool is in a retracted configuration;

Figure 6 is an enlarged view showing the piston and cylinder arrangement of the apparatus of Figures 1 and 2 in which the tool is in an extended configuration;

Figure 7 shows a cross-sectional view along the line 207-207 of Figure 6;

Figures 8 and 9 illustrate a latching means according to the invention in respective latching and non-latching configurations; and

Figure 10 illustrates in more detail a shock-absorbing device useable with the apparatus of the invention.

[0018] As can be seen from Figure 1a, the principal components of the apparatus 100 of the invention, and its associated equipment, comprise a section 100B incorporating a hydraulic control arrangement and a casing 100A in which is disposed an actuating device (which, in this example, is a geotechnical tool) and a hydraulic piston and cylinder arrangement for retraction and withdrawal of the tool. For the purposes of illustration only, the Figures show a cone penetrometer as the geotechnical tool. The apparatus of the invention is equally applicable to other known geotechnical tools and other actuation devices as noted above. The section 100B is connected to a cable 101 which can support the apparatus and will normally include wires or cabling for signal transmission to the tool and the like. As such, the cable 101 is commonly known as an "umbilical". The umbilical 101 passes around a winch 102 for raising and lowering of the apparatus of the invention. The winch 102 is controlled by a control and monitoring system 103 which also controls the operation of the apparatus, tool and associated equipment. In Figure 1b, the apparatus of the invention is in an extended condition, so that the tool 104 projects outwardly from the casing 100A.

[0019] Figures 1c to 1e illustrate the principal stages of operation of the apparatus according to the invention. In a first stage, the section 100B and casing 100A including the tool 104 are lowered by means of cable 101 and winch 102 into the interior of the drilling string 105. The leading end of the drilling string 105 includes an end stop (106) against which a leading end of the casing 100A normally rests when it has been lowered to its position of use (Figure 1d). When the use position is reached and it is desired to deploy the tool 104, the hydraulic piston

and cylinder arrangement in casing 100A causes the section 100B to be drawn towards the casing 100A. At the same time, the tool 104 is extended from the casing 100A (Figure 1e).

[0020] As can be seen from Figure 2, the section 100B is suspended from the umbilical 101 at an umbilical termination 150, and contains a hydraulic control arrangement 151. As shown in Figure 4, the hydraulic control arrangement includes an electrical termination 201 for control and power supply wires, an electric motor 202, a hydraulic pump 203, a fluid volume compensator 204 and hydraulic valves 205. The casing 100A includes a cylinder 152 in which is disposed a piston 157. The piston 157 is moveable within the cylinder 152 and sealingly divides the chamber into first (upper) and second (lower) chambers 152A and 152B. The chambers 152A and 152B are of variable size depending on the location of the piston 157 within the cylinder 152. A tool 104 is disposed within the casing 100A (in the configuration shown in Figure 2) and an upper end of the tool 104 is connected to a distal end (with respect to the cylinder) of a first or lower rod 158. The other end of the first rod 158 is attached to one side of piston 157 so that the first rod 158 and the tool 104 move in unison with the piston 157. A second or upper rod 156 is attached at one end to an opposite side of the piston 157 with respect to the first rod 158. The other (upper) end of the second rod 156 is attached to the section 100B containing the hydraulic control arrangement 151 so that the section 100B also moves in unison with the piston 157.

[0021] In use, the apparatus 100A, 100B incorporating the tool 104 is lowered through the drilling string 105 with the tool 104 in the retracted position shown in Figures 1c and 2. After the casing 100A has reached its use position with the leading end of the casing 100A in juxtaposition with the end stop 106, the tool 104 can be extended. Referring now also to Figures 5 and 6 extension of the tool 104 is initiated by causing the hydraulic control arrangement 151 to pump hydraulic fluid into the first chamber 152A. This causes displacement of the piston 157 downwardly, i.e. towards the leading end of the drilling string and the end stop 106. As will be described in more detail below, the latching means 301 are thereby caused to engage the inner surface of the drilling string 105 (if not already so engaged) to prevent upward movement of the casing 100A with respect to the drilling string 105. Downward displacement of the piston causes a corresponding movement of those components which are attached to it, that is, the first rod 158 and the tool 104, so that the tool 104 is extended from the casing 100A. Likewise, the second rod 156 which is attached to the other side of the piston 157 is also moved downwardly and consequently draws the section 100B downwardly, towards the casing 100A. Movement of the piston 157 in the cylinder 152 can continue, under the control of the hydraulic control arrangement 151, until a desired extension of the tool 104 is achieved, or until the piston 157 reaches the limit of its movement at the lower end of the cylinder 152.

[0022] During operation, especially in an offshore environment, the umbilical 101 is required to accommodate upward and downward movement, such as caused by movement of the vessel on the surface of sea from which the apparatus of the invention is deployed. This upward and downward movement requires changes in the length of the umbilical and may be accommodated by controlling the winch to maintain a desired tension in the umbilical. The desired tension may also be achieved through elasticity of the umbilical.

[0023] After use of the tool 104 in its extended position, the tool 104 can be retracted, under the control of the hydraulic control arrangement 151, by supplying hydraulic fluid to the lower (second) chamber 152B and releasing hydraulic fluid from the first (upper) chamber 152A. This urges the piston 157 and the various components connected thereto to move upwardly so that the tool 104 is retracted within the casing 100A. As will also be described in more detail below, the retraction of the tool 104 into the casing 100A also provides for the release of the latching means 301 so that the apparatus 100 may be withdrawn from the drilling string 105 by means of the umbilical 101 and the winch 102. The hydraulic control arrangement 151 and the piston 157 and cylinder 152 are advantageously designed to provide a low resistance to the flow of hydraulic fluid. This enables recovery of the apparatus in the event of failure of the hydraulic control arrangement 151 by simply lifting the apparatus by means of the umbilical 101. Lifting by the umbilical 101 will cause the piston and rod to be displaced upwardly, so releasing the latching means 301.

[0024] A particular feature of the apparatus of the present invention is the means of transmission of the hydraulic fluid. This is achieved by providing the upper (second) rod 156 with two internal cylindrical tubes passing therethrough, as can be seen most clearly in Figure 7. Figure 7 shows in cross section the drilling string 105 with the casing 100A disposed therein. Within the casing 100A is the upper rod 156, a first internal tube 271 and a second internal tube 270. Preferably the internal tubes 270, 271 and the upper rod 156 are arranged concentrically. The internal tubes 270 and 271 are sized with respect to each other and to the upper rod 156 to define first and second passageways 275 and 276 for the transmission of hydraulic fluid to the respective first and second chambers 152A, 152B of the cylinder 152, the passageways preferably being annular. The inner internal tube 270 also provides within it a conduit for the passage of signal and/or control wires and cables and the like to the tool 104 by means of which the tool 104 is connected to control and monitoring equipment at the surface.

[0025] In an alternative arrangement, the passageways for transmission of hydraulic fluid may be constructed as discrete tubes within which the hydraulic fluid flows, the tubes not then being arranged concentrically. The signal and/or control wires may or may not then be provided with their own internal tube. This alternative ar-

rangement may have the advantage of lower cost and ease of construction.

[0026] In another variation, the hydraulic compensator 204 may take the form of a long flexible tube mounted within the rods 156,158 with the other tubes. This reduces the overall length of the apparatus 100 and so facilitates its handling.

[0027] In another preferred arrangement, some of the required hydraulic valving can be mounted on the piston 157. This is advantageous in saving space and reducing the number of connections in the hydraulic control arrangement 151.

[0028] Figures 8 and 9 illustrate the operation of the latching means 301 of the apparatus according to the invention. The latching means 301 co-operate with a latching ring 300 provided in a suitable location towards the leading end of the drilling string 105. At least a pair of latching arms 301A, 301B is provided which are moveable between a latching condition as shown in Figure 8 in which the arms 301A,B will abut the latching ring 300 and a release condition in which the latching arms 301A, B can freely pass the latching ring 300. The latching arms 301A,B are biased by means such as a spring mechanism 302 towards the latching condition. Before use of the tool 104, as it and the apparatus 100 are lowered on the umbilical 101 through the drilling string 105, the latching means are retained in the release condition by means of a shoulder part 320 of increased width relative to the lower rod 158, which shoulder part 320 counteracts the bias of the biasing means 302. The latching arms 301A, B are retained in the release condition until the shoulder part 320 is moved to release them. As noted above, when the apparatus 100 including the tool 104 reaches its position of use, the tool 104 is extended from the casing 100A. Extension of the tool 104 is caused by extension of lower rod 158 in turn caused by movement of piston 157. Downward movement of lower rod 158 causes the shoulder part 320 to move downwardly with respect to the latching arms 301A,B so that the latching arms are released and can engage the latching ring 300. After use of the tool 104, upward movement of the shoulder part 320 on retraction of the tool 104 and lower rod 158 causes the shoulder part 320 to deflect the latching arms 301A, B to the release condition so that the apparatus 100 and tool 104 can be withdrawn from the drilling string 105.

[0029] Other ways of releasing the latching means 301 can be envisaged, such as means employing the hydraulic pressure in the cylinder 152.

[0030] Figure 10 illustrates the operation of the shock absorbing means preferably provided at the leading end of the casing 100A. As noted above, towards the leading end of the drill string an end stop 106 is provided. The leading end 354 of the casing 100A includes a landing ring 350 which co-operates with the end stop 106 to prevent further downward movement of the casing 100A. The casing 100A includes an annular cavity 358 in which a cylinder 357 is disposed. The landing ring 350 is mounted on the leading end of the cylinder 357. A spring 352, or other suitable damping means such as resilient rubber components, is connected to the upper end of the cylinder 357. Preferably the damping means is disposed within the cavity 358 above the cylinder 357. Thus the damping means acts, by compression, to absorb energy of impact of the apparatus 100 when the apparatus reaches the end stop on initial lowering. In an advantageous modification, a hydraulic damping system may be provided in which a second spring or similar damping means 355 acts on an annular valve 353. A piston 356 forces hydraulic fluid through the valve 353 when urged upwardly (relative to the casing 100A on impact of the landing ring 350 with the end stop 106. The valve 353 and springs 352, 355 can be tuned to provide desired damping characteristics. In alternative, but analogous arrangements; the damping means may be disposed externally of the casing 100A.

[0031] In another alternative, the hydraulic system may provide at least some of the required shock absorption, in that some motion of the rods 156, 158 and the hydraulic control arrangement 151 may be allowed against the hydraulic pressure. This arrangement acts to protect from impact shock the more sensitive components such as the geotechnical tool, motor, hydraulic system and electronic components and a separate mechanical shock absorber may not be needed.

Claims

1. Apparatus (100) for operation of an actuation device (104) in a drill string (105), the apparatus (100) comprising:

   (i) a hydraulic cylinder (152) having first and second ends including a piston (157) moveable between the respective ends of the cylinder (152) and dividing the cylinder (152) into first and second chambers (152A, 152B);
   (ii) a hydraulic control unit (151); and
   (iii) a first rod (158) depending from a first side of the piston (157) and attachable to an actuation device (104);
   characterised in that the apparatus further comprises
   (iv) retaining means (301) operative to co-operate with an internal surface of the drill string (105) to restrain the apparatus (100) from withdrawal from the drill string (105); and
   (v) a second rod (156) depending from a second side of the piston (157) opposite the first side and connected to the hydraulic control unit (151),
   and **in that** the hydraulic control (151) unit is operable to:

      (a) supply hydraulic fluid to the first chamber (152A) to urge the piston (157) away from

the first end thereby to extend the first rod (158) from the cylinder (157) and to draw the hydraulic control unit (151) towards the cylinder (157).

2. Apparatus as claimed in claim wherein me hydraulic control unit (151) is further operable to:

(b) supply hydraulic fluid to the second chamber (152B) to urge the piston (157) towards the first end thereby to extend the second rod (156) from the cylinder (157) and to move the first rod (158) towards the first end.

3. Apparatus as claimed in claim 1 or 2 wherein the actuation device (104) is selected from the group comprising geotechnical investigation tools, valve actuators, and actuators for the setting of packers and plugs.

4. Apparatus as claimed in claim 1, 2 or 3 wherein the retaining means (301) comprise latching means operative to co-operate with an abutment surface (300) provided on an inner surface of the drill string (105).

5. Apparatus as claimed in claim 4 further comprising shoulder means (320) mountable on the distal end of the first rod (158) and operative to urge the latching means (301) from a latching condition to a release condition during movement of the first rod (158) towards the first end.

6. Apparatus as claimed in any preceding claim wherein the second rod (156) includes discrete passageways therein for the transmission of hydraulic fluid to the respective first and second chambers (152A, 152B).

7. Apparatus as claimed in claim 6 wherein the second rod (156) includes first and second internal tube structures (271, 270) defining a first annular passageway (275) between the second rod (156) and the first internal tube (271) and a second annular passageway (276) between the first and second internal tubes (271, 270).

8. Apparatus as claimed in claim 7 wherein the interior of the second internal tube (270) provides a passageway for control wires and cabling for the actuation device.

9. Apparatus as claimed in any preceding claim further comprising a casing mountable on the first rod (158) for retaining the actuation device.

10. Apparatus as claimed in claim 9 wherein said casing includes shock absorbing means suitable to absorb energy of impact when the apparatus reaches an end stop (106) towards the end of the drill string (105).

11. A method of positioning an actuation device comprising:

i). providing an apparatus (100) as claimed in any of claims 1 to 10;
ii). positioning the apparatus (100) in a desired location in a drill string (105);
iii). retaining the apparatus (100) in said desired location; and
iv). supplying hydraulic fluid to said first chamber (152A) to extend the first rod (158) from the cylinder (152) and to draw the hydraulic control unit (151) towards the cylinder (152).

12. A method as claimed in claim 11 further comprising the step of:

v). supplying hydraulic fluid to said second chamber (152B) thereby to urge the piston (157) towards the first end to extend the second rod (156) from the cylinder (152) and to move the first rod (158) towards the first end.

Patentansprüche

1. Vorrichtung (100) zum Betreiben einer Betätigungsvorrichtung (104) in einem Bohrstrang (105), wobei die Vorrichtung (100) umfasst:

(i) einen Hydraulikzylinder (152) mit einem ersten und einem zweiten Ende, einen Kolben (157) einschließend, der zwischen den jeweiligen Enden des Zylinders (152) bewegbar ist und den Zylinder (152) in eine erste und eine zweite Kammer (152A, 152B) unterteilt
(ii) eine Hydrauliksteuerung (151) und
(iii) eine erste Stange (158), die sich von einer ersten Seite des Kolbens (157) erstreckt und an einer Betätigungsvorrichtung (104) anbringbar ist,
dadurch gekennzeichnet, dass die Vorrichtung ferner umfasst:
(iv) Haltemittel (301) die imstande sind, mit einer Innenfläche des Bohrstrangs (105) zusammenzuwirken, um die Vorrichtung (100) daran zu hindern, aus dem Bohrstrang (105) herausgezogen zu werden und
(v) eine zweite Stange (156), die sich von einer zweiten, der ersten Seite gegenüberliegenden Seite des Kolbens (157) erstreckt und mit der Hydrauliksteuerung (151) verbunden ist
und **dadurch**, dass die Hydrauliksteuerung (151) dazu betrieben werden kann:

(a) der ersten Kammer (152A) Hydraulikfluid zuzuführen, um den Kolben (157) von dem ersten Ende wegzudrängen und **dadurch** die erste Stange (158) aus dem Zylinder auszufahren und die Hydrauliksteuerung (151) zu dem Zylinder (157) hinzuziehen.

2. Vorrichtung nach Anspruch 1, bei der die Hydrauliksteuerung (151) ferner dazu betrieben werden kann:

(b) der zweiten Kammer (152B) Hydraulikfluid zuzuführen, um den Kolben (157) zu dem ersten Ende hinzuziehen und **dadurch** die zweite Stange (156) aus dem Zylinder (157) auszufahren und die erste Stange (158) zu dem ersten Ende hinzubewegen.

3. Vorrichtung nach Anspruch 1 oder 2, bei der die Betätigungsvorrichtung (104) aus der Gruppe gewählt wird, die geotechnische Erkundungswerkzeuge, Ventilsteller und Stellglieder zur Einstellung von Packern und Dichtkörpern umfaßt.

4. Vorrichtung nach Anspruch 1, 2 oder 3, bei der die Haltemittel (301) Verriegelungsmittel umfassen, die imstande sind, mit einer Anlagefläche (300) zusammenzuwirken, die auf einer Innenfläche des Bohrstrangs (105) vorgesehen ist.

5. Vorrichtung nach Anspruch 4, ferner Schultermittel (320) umfassend, die an dem distalen Ende der ersten Stange (158) anbringbar sind und imstande sind, die Verriegelungsmittel (301) bei Bewegung der ersten Stange (158) zu dem ersten Ende hin von einem verriegelten Zustand in einen gelösten Zustand zu drängen.

6. Vorrichtung nach einem der vorangehenden Ansprüche, bei der die zweite Stange (156) getrennte Durchgänge für die Übertragung von Hydraulikfluid zu der jeweiligen ersten und zweiten Kammer (152A, 152B) einschließt

7. Vorrichtung nach Anspruch 6, bei der die zweite Stange (156) erste und zweite Innenrohrstrukturen (271, 270) einschließt, die einen ersten ringförmigen Durchgang (275) zwischen der zweiten Stange (156) und dem ersten Innenrohr (271) und einen zweiten ringförmigen Durchgang (276) zwischen dem ersten und dem zweiten Innenrohr (271, 270) definieren.

8. Vorrichtung nach Anspruch 7, bei der das Innere des zweiten Innenrohrs (270) einen Durchgang für Steuerkabel und Verkabelung der Betätigungsvorrichtung bereitstellt.

9. Vorrichtung nach einem der vorangehenden Ansprüche, ferner ein an der ersten Stange (158) montierbares Gehäuse zur Halterung der Betätigungsvorrichtung umfassend.

10. Vorrichtung nach Anspruch 9, bei der das Gehäuse Stoßdämpfungsmittel umfasst, die geeignet sind, Stoßenergie aufzunehmen, wenn die Vorrichtung einen Endanschlag (106) im Endbereich des Bohrstrangs (105) erreicht.

11. Verfahren zum Positionieren einer Betätigungsvorrichtung, umfassend:

i). Bereitstellen einer Vorrichtung (100) nach einem der Ansprüche 1 bis 10
ii). Positionieren der Vorrichtung (100) an einem gewünschten Ort in einem Bohrstrang (105)
iii). Halten der Vorrichtung (100) an dem gewünschten Ort und
iv). Zuführen von Hydraulikflüssigkeit zu der ersten Kammer (152A), um die erste Stange (158) aus dem Zylinder (152) auszufahren und die Hydrauliksteuerung (151) zu dem Zylinder (152) hinzuziehen.

12. Verfahren nach Anspruch 11, ferner den Schritt umfassend:

v). Zuführen von Hydraulikfluid zu der zweiten Kammer (152B), um **dadurch** den Kolben (157) zu dem ersten Ende hinzudrängen, um die zweite Stange (156) aus dem Zylinder (152) auszufahren und die erste Stange (158) zu dem ersten Ende hinzubewegen.

Revendications

1. Appareil (100) pour le fonctionnement d'un dispositif d'actionnement (104) dans un train de forage (105), l'appareil (100) comprenant:

(i) un cylindre hydraulique (152) ayant des première et seconde extrémités comportant un piston (157) mobile entre les extrémités respectives du cylindre (152) et divisant le cylindre (152) en une première et une seconde chambres (152A, 152B) ;
(ii) une unité de commande hydraulique(151) ; et
(iii) une première tige (158) solidaire d'un premier côté du piston (157) et pouvant être reliée à un dispositif d'actionnement (104) ;
caractérisé en ce que l'appareil comprend en plus
(iv) des moyens de retenue (301) agencés pour coopérer avec une surface intérieure du train de forage (105) pour empêcher un retrait de l'ap-

pareil (100) hors du train de forage (105) ; et
(v) une seconde tige (156) solidaire d'un second côté du piston (157) opposé au premier côté et reliée à l'unité de commande hydraulique (151), et **en ce que** l'unité de commande hydraulique (151) est commandable pour

(a) alimenter la première chambre (152A) en fluide hydraulique pour obliger le piston (157) à s'éloigner de la première extrémité de façon à faire sortir la première tige (158) du cylindre (157) et à tirer l'unité de commande hydraulique (151) vers le cylindre (157).

2. Appareil selon la revendication 1 dans lequel l'unité de commande hydraulique (151) est en outre commandable pour :

(b) alimenter la seconde chambre (152B) en fluide hydraulique pour obliger le piston (157) à se déplacer vers la première extrémité de façon à faire sortir la seconde tige (156) du cylindre (157) et à déplacer la première tige (158) vers la première extrémité.

3. Appareil selon l'une des revendications 1 et 2 dans lequel le dispositif d'actionnement (104) est choisi parmi le groupe comprenant des outils d'investigation géotechnique, des valves électropneumatiques, et des servo-moteurs pour l'installation d'obturateurs annulaires et de bouchons.

4. Appareil selon l'une des revendications 1 à 3, dans lequel les moyens de retenue (301) comportent des moyens de verrouillage agencés pour coopérer avec une surface de butée (300) prévue sur une surface intérieure du train de forage (105).

5. Appareil selon la revendication 4 comportant en outre des moyens d'épaulement (320) aptes à être montés sur l'extrémité distale de la première tige (158) et agencés pour obliger les moyens de verrouillage (301) à passer d'un état de verrouillage à un état de déblocage pendant le mouvement de la première tige (158) vers la première extrémité.

6. Appareil selon l'une quelconque des revendications précédentes dans lequel la seconde tige (156) comporte des passages discrets pour la transmission du fluide hydraulique vers les première et seconde chambres respectives (152A, 152B).

7. Appareil selon la revendication 6 dans lequel la seconde tige (156) comporte des première et seconde structures de tubes internes (271, 270) définissant un premier passage annulaire (275) entre la seconde tige (156) et le premier tube interne (271) et un second passage annulaire (276) entre les premier et second tubes internes (271, 270).

8. Appareil selon la revendication 7 dans lequel l'intérieur du second tube interne (270) fournit un passage pour des fils de commande et le câblage pour le dispositif d'actionnement.

9. Appareil selon l'une quelconque des revendications précédentes comportant en outre un tubage apte à être monté sur la première tige (158) pour retenir le dispositif d'actionnement.

10. Appareil selon la revendication 9 dans lequel ledit boîtier comporte des moyens amortisseurs de chocs aptes à absorber l'énergie de l'impact quand l'appareil atteint un arrêt d'extrémité (106) vers l'extrémité du train de forage (105).

11. Un procédé pour le positionnement d'un dispositif d'actionnement consistant à :

(i) réaliser un appareil (100) selon l'une quelconque des revendications 1 à 10;
(ii) positionner l'appareil (100) dans un endroit souhaité dans ledit train de forage (105);
(iii) maintenir l'appareil (100) au dit endroit souhaité; et
(iv) alimenter ladite première chambre (152A) en fluide hydraulique pour faire sortir la première tige (158) du cylindre (152) et tirer l'unité de commande hydraulique (151) vers le cylindre (152).

12. Un procédé selon la revendication 11 consistant en outre à :

(v) alimenter ladite seconde chambre (152B) en fluide hydraulique de façon à obliger le piston (157) à se déplacer vers la première extrémité pour faire sortir la seconde tige (156) du cylindre (152) et à déplacer la première tige (158) vers la première extrémité.

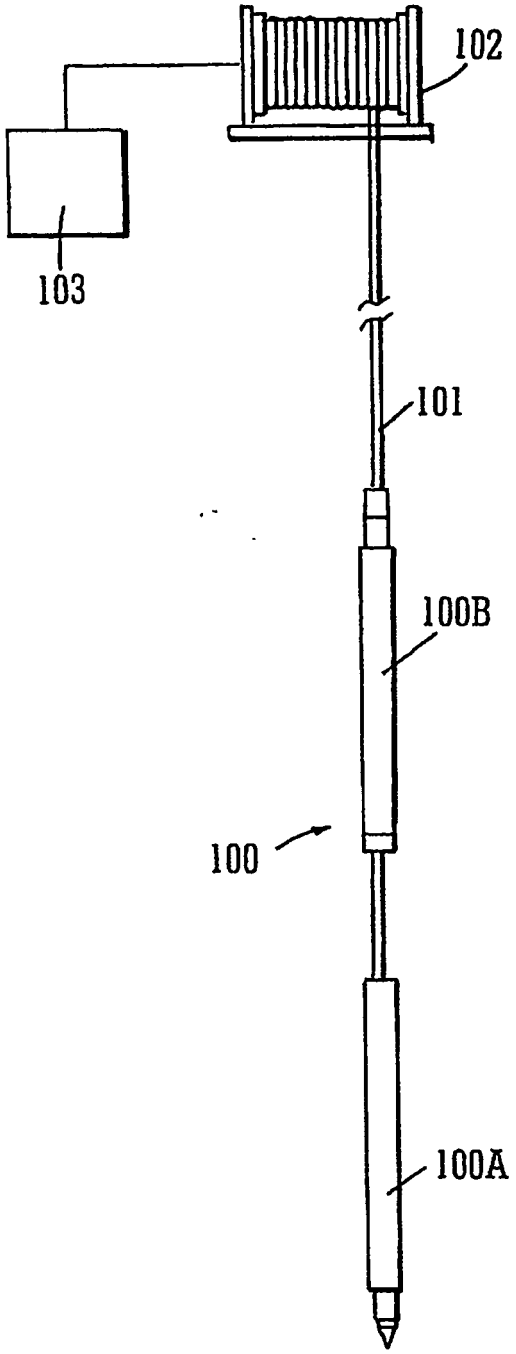

FIG. 1A

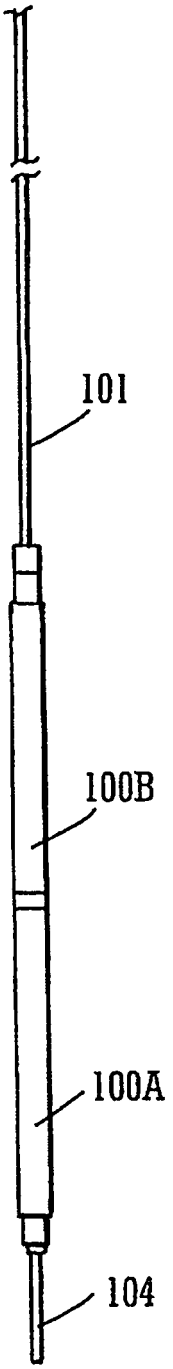

FIG.1B

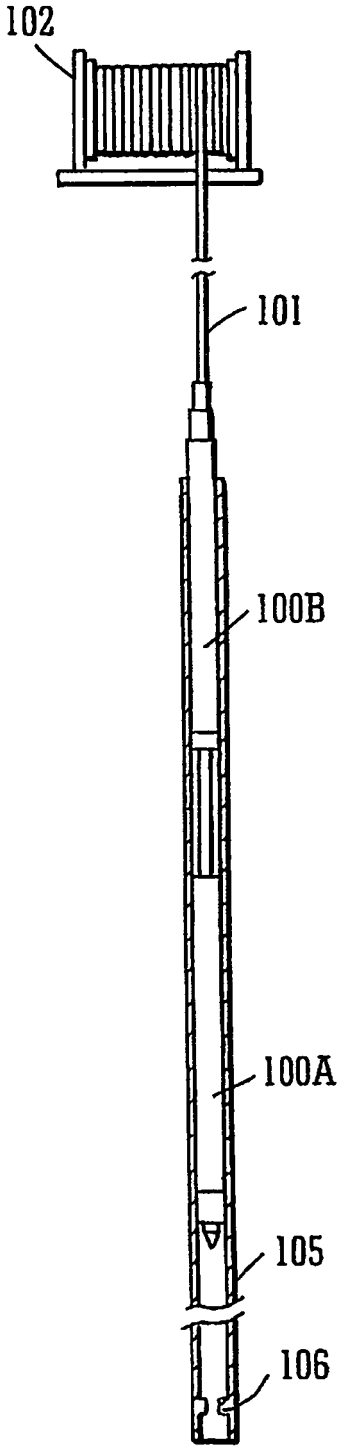

FIG. 1C

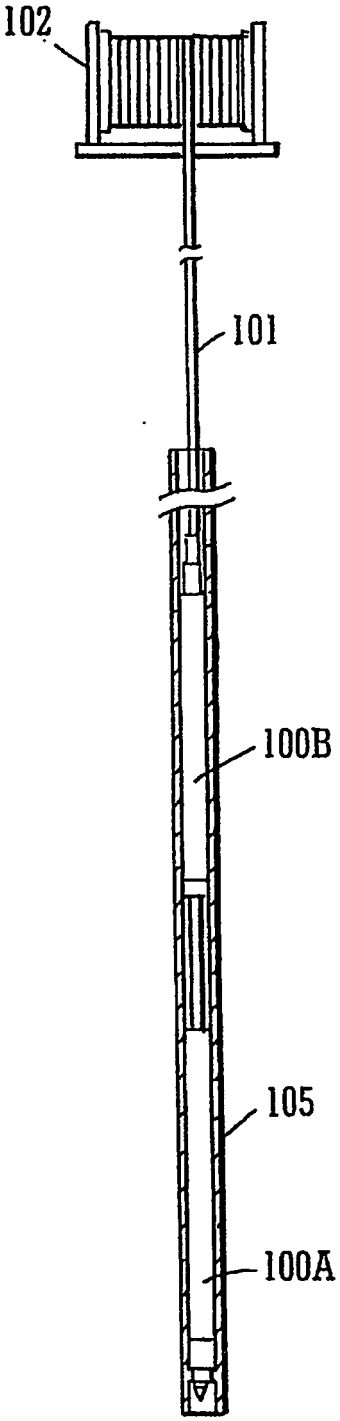

FIG. 1D

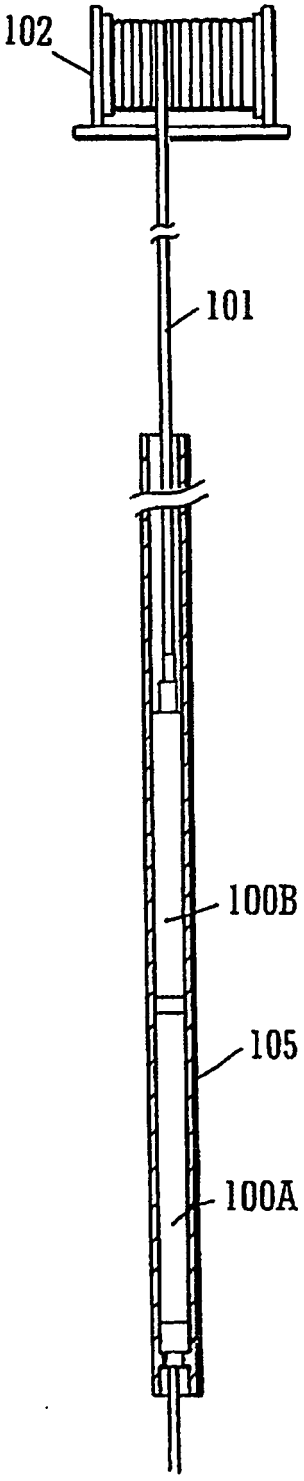

FIG. 1E

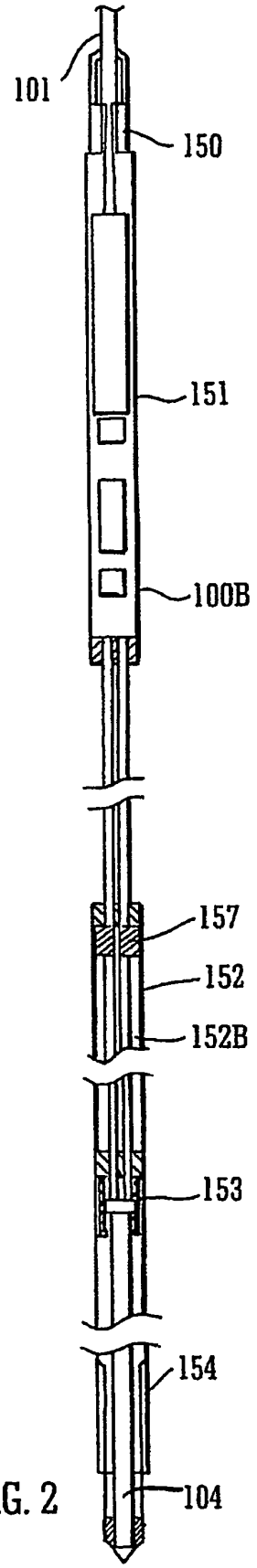
101
150
151
100B
157
152
152B
153
154
104

FIG. 2

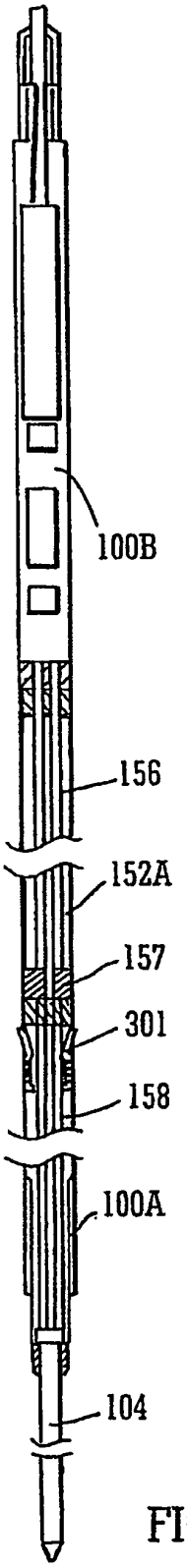
100B
156
152A
157
301
158
100A
104

FIG. 3

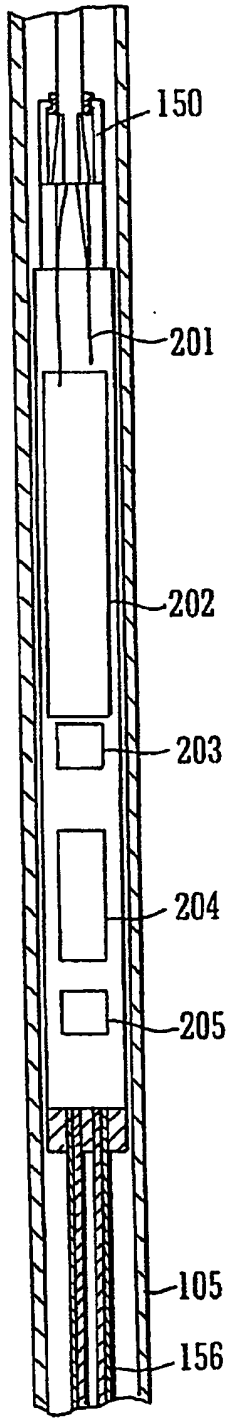

FIG. 4

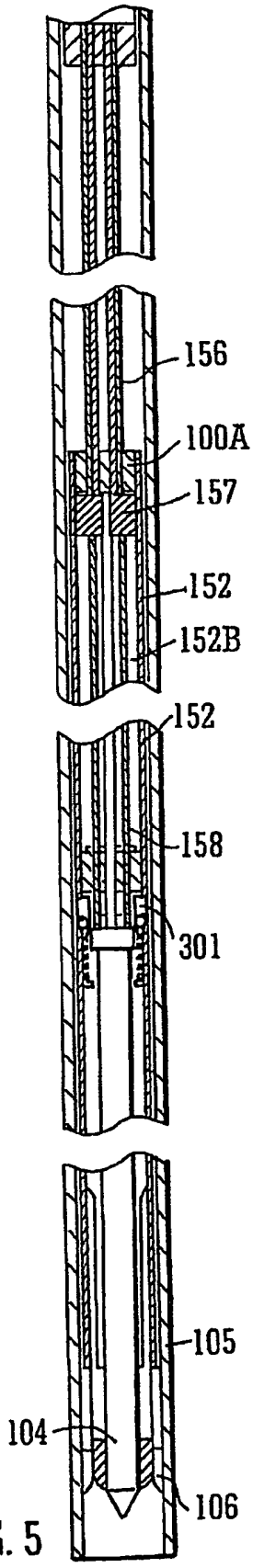

FIG. 5

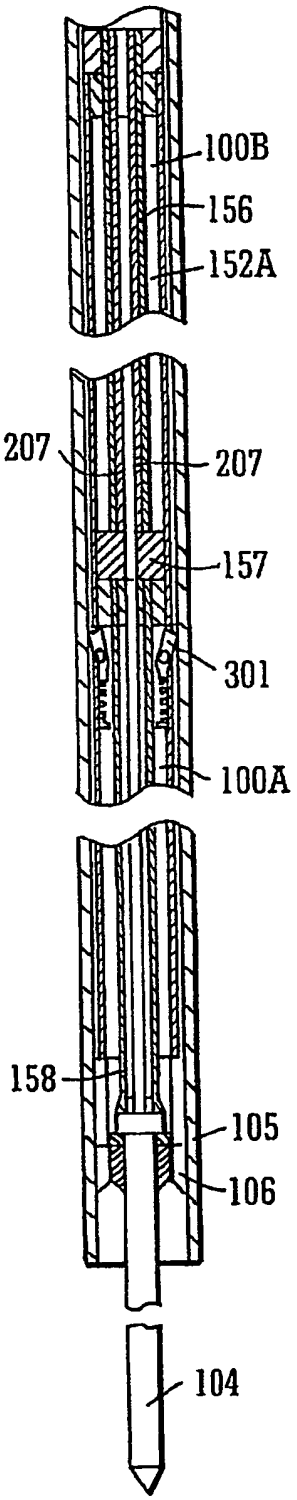

FIG. 6

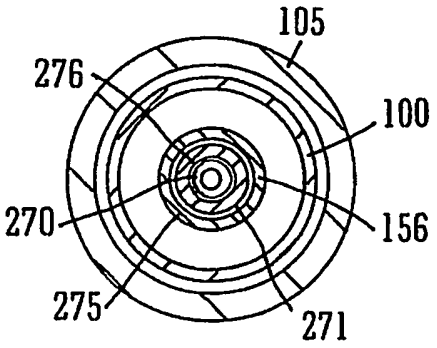

FIG. 7

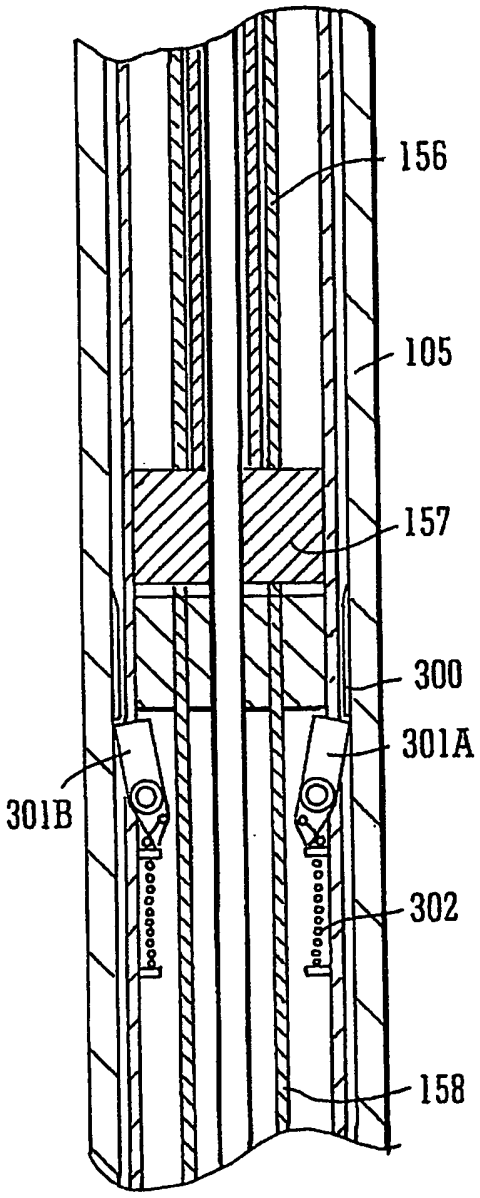

FIG. 8

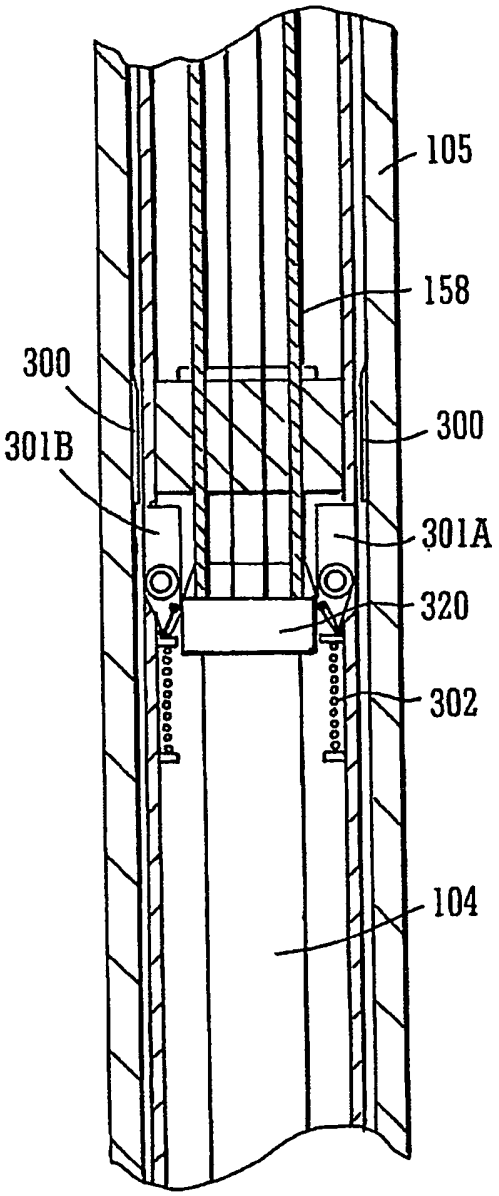

FIG. 9

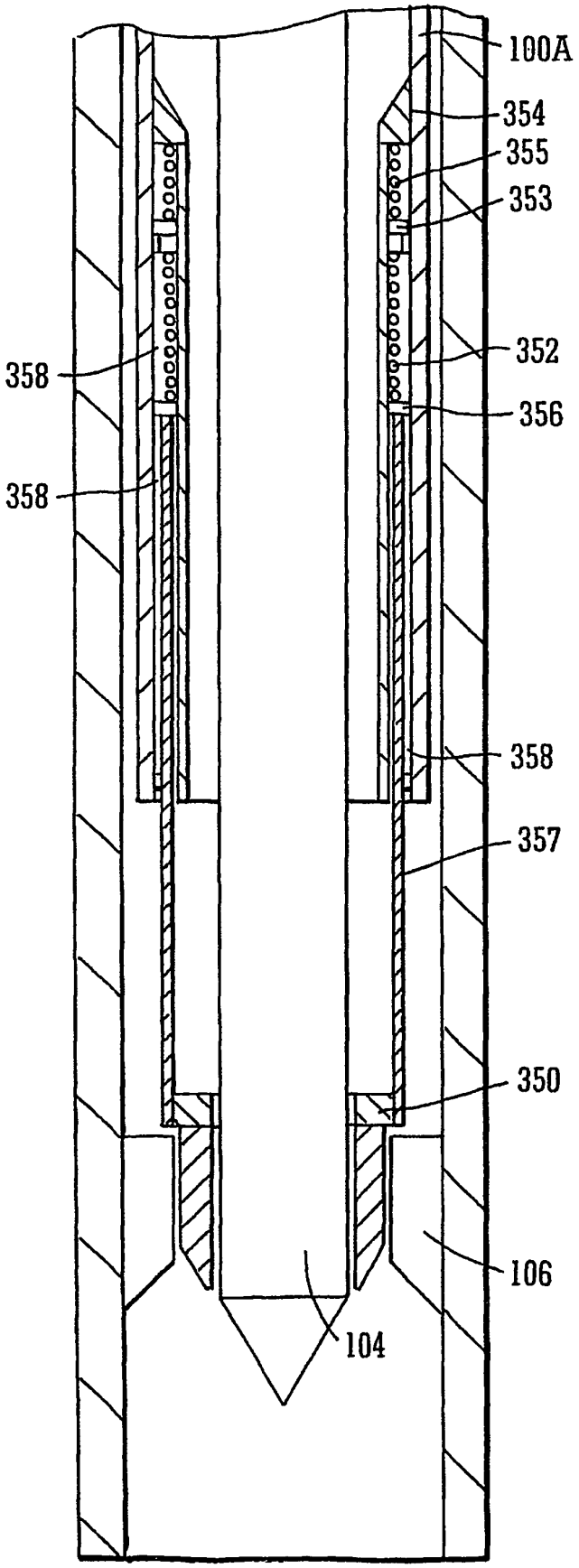

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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