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CONVEYING PARTY DATA

Name	Execution Date
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PROPERTY NUMBERS Total: 1

Property Type	Number
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OWEN SCHICKER

FLEXIDRILL LIMITED

DEED OF ASSIGNMENT OF INTELLECTUAL PROPERTY RIGHTS

PARTIES

OWEN SCHICKER, a New Zealand citizen of 91 Kent Street, Marchwell, Timaru 7910, New Zealand (**Assignor**)

FLEXIRILL LIMITED, a New Zealand company whose registered office is located at 216 Lake Road, Hauraki, Auckland 0622, New Zealand (**Assignee**)

INTRODUCTION

A. The Assignor has devised or contributed to the Invention either during the course of employment with the Assignee or under a commission from the Assignee.

B. The Assignor acknowledges that the Assignee is or should be the legal and beneficial owner of the Invention and the Intellectual Property Rights.

C. To the extent that the Assignor owns the Invention or any Intellectual Property Rights, the Assignor has agreed to assign, and the Assignee has agreed to accept, the Invention and such Intellectual Property Rights subject to the terms and conditions of this deed.

COVENANTS

1. DEFINITIONS

1.1 In this deed, including the Introduction, the following words will have the following meanings:

Copyright means all:

(a) copyrights in any original artistic, literary and other works; and

(b) database rights,

relating to the Invention as may exist anywhere in the world;

Design Rights means all rights in and to the designs to be applied to articles of or relating to the Invention as may exist anywhere in the world including, but not limited to:

(a) the right to apply for and obtain protection for such designs in relation to such articles and the rights conferred by such protection when granted;

(b) the right to claim priority under any international convention or agreement including the Paris Convention (as amended) from any such application or applications referred to in paragraph (a) above;

(c) any unregistered design rights; and

(d) any semi-conductor topography or integrated circuit layout rights;

Improvements has the meaning given to it in clause 4.1;

Improvements IP has the meaning given to it in clause 4.2(a);

Intellectual Property Rights means all industrial and intellectual property rights (whether protectable by statute, at common law or in equity) in and to the Invention as may exist anywhere in the world and whether or not registered or registrable including, but not limited to, the Patent Rights, Copyright and Design Rights;

Invention means any and all inventions described in the Schedule as improved, modified, developed or amended at any time up to the date of signing of this deed;

Know-How means any information, knowledge, experience, data and designs in the possession of the Assignor of a confidential nature and not in the public domain relating to the Invention or the process for making or using it; and

Patent Rights means all patent rights in and to the Invention as may exist or come into existence anywhere in the world including, but not limited to:

(a) the right to apply for and the right to be granted patents or other similar forms of protection in respect of the Invention in any country;

(b) the right to claim priority under any international convention or agreement including the Paris Convention (as amended) from any patent application or applications referred to in paragraph (a) above; and

(c) all rights conferred by any such patent(s) or similar forms of protection when granted.

2. ASSIGNMENT

2.1 **Assignment:** In consideration of the sum of NZ$1.00 paid by the Assignee to the Assignor and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged by the Assignor, the Assignor hereby assigns to the Assignee absolutely all of the Assignor's rights, title and interest in and to:

(a) the Invention; and

(b) the Intellectual Property Rights,

to the extent that the Assignors hold any such rights, title and interest as at the date of this deed.

2.2 **Rights of action:** The assignments effected by clause 2.1 include, without limitation, the assignment and transfer of:

(a) all rights of action, powers and benefits arising from the ownership of the Intellectual Property Rights including, without limitation, the right to sue for damages and other legal and

equitable remedies in respect of all causes of action arising before, on or after the date of this deed; and

(b) all rights of ownership of any materials that form part of the Know-How.

2.3 **Moral rights:** The Assignor waives all of the Assignor's moral rights relating to Copyright works throughout the world, to the extent that the Assignor may lawfully do so.

3. KNOW-HOW

3.1 **Provision of Know-How:** The Assignor will, at the request of the Assignee and to the extent outstanding:

(a) disclose to the Assignee in writing all Know-How known to the Assignor;

(b) provide all other reasonable assistance and information as may be reasonably necessary in order to assist the Assignee, or its nominee, to develop and make or use the Invention; and

(c) where possible, provide all original embodiments of the Invention and any materials that form part of the Know-How.

3.2 **Confidentiality:**

(a) The Assignor agrees to treat all information relating to the Invention, the Know-How and the Intellectual Property Rights as secret and confidential.

(b) Following the execution of this deed, the Assignor will not use, disclose or publish the information referred to in paragraph (a) above without the Assignee's prior written consent.

(c) These obligations of confidentiality will not extend to any information that is or becomes generally available to the public through no act or default of the Assignor. However, the Assignor will promptly advise the Assignee where the Assignor becomes aware of any actual or potential loss of secrecy or confidentiality in respect of such information.

4. IMPROVEMENTS

4.1 **Disclosure:** Following the date of this deed, the Assignor, while employed by the Assignee or under any commission from the Assignee, will immediately disclose to the Assignee all improvements in, modifications of or additions to:

(a) the Invention;

(b) any original artistic, literary or other works relating to the Invention; and

(c) any designs to be applied to the articles of or relating to the Invention,

devised, created, designed, contributed to or acquired by the Assignor (**Improvements**).

4.2 **Ownership of Improvements:**

(a) The Assignee will exclusively, own and the Assignors hereby assign to the Assignee, all Improvements and all intellectual property rights in such Improvements (**Improvements IP**). To the extent that any Improvements and Improvements IP do not on their creation vest in the Assignee but vest in the Assignor, the Assignor will hold such Improvements and Improvements IP on trust for the Assignee.

(b) The Assignor will at any time, upon the Assignee's reasonable request and at the Assignee's expense, appropriately execute all documents necessary to:

(i) confirm the Assignee's ownership of the Improvements and Improvements IP; or

(ii) file a protective application for such Improvements and Improvements IP and/or defend such protective application.

5. EXECUTION OF DOCUMENTS AND FURTHER ACTIONS

5.1 **Further actions:** If requested by the Assignee the Assignor will, at the Assignee's expense, execute all documents, give such assistance and do all other acts and things as may be necessary or desirable to:

(a) apply for and be granted or (if the Assignee thinks fit) join with the Assignee in applying for and being granted protection of the Intellectual Property Rights and the Improvements IP, with the understanding and the intention that all rights, title and interest in and to such applications and any granted protection is to vest in the Assignee;

(b) vest any such protection referred to in paragraph (a) in the Assignee;

(c) amend, maintain or renew any such protection referred to in paragraph (a);

(d) assist the Assignee to:

(i) enable enforcement of any of the Intellectual Property Rights or the Improvements IP (including obtaining all remedies as may be available for infringement of the Intellectual Property Rights and all Improvements IP);

(ii) defeat any challenge to the validity of any of the Intellectual Property Rights and the Improvements IP;

(iii) defend any opposition proceedings brought by a third party in respect of the Intellectual Property Rights and the Improvements IP; or

(iv) conduct opposition proceedings in respect of any application for intellectual property protection by a third party where such application may adversely affect the Assignee's ability to exploit the Intellectual Property Rights and the Improvements IP; and

(e) otherwise implement and carry out the Assignor's obligations under this deed.

5.2 **Power of attorney:** The Assignor hereby irrevocably appoints the Assignee as the Assignor's attorney with full power to act in the Assignor's name and on the Assignor's behalf in fulfilling any of the matters set out in clause 5.1:

(a) to the extent that the Assignor fails to do any of such matters after being called upon to do so by the Assignee; or

(b) if the Assignee is unable, after making reasonable and proper inquiries, to locate the Assignor to request the fulfilment of such matters.

6. GENERAL

6.1 **Waiver:** No failure or delay by any party in exercising any right, power or privilege under this deed will operate as a waiver of such right, power or privilege, nor will any single or partial exercise preclude any other or further exercise of any right, power or privilege under this deed.

6.2 **Counterparts:**

(a) This deed may be executed in any number of counterparts (including facsimile and electronically scanned copies) all of which, when taken together, will constitute one and the same instrument.

(b) A party may enter into this deed by executing any counterpart. The parties acknowledge that this deed may be executed on the basis of an exchange of facsimile or electronically scanned copies and confirm that their respective execution of this deed by such means will be a valid and sufficient execution.

6.3 **Governing law:** The formation, validity, construction and performance of this deed will be governed by and construed in accordance with the laws of New Zealand. The parties irrevocably agree that the Courts of New Zealand will have non-exclusive jurisdiction to hear and determine all disputes under or in connection with this deed. The parties irrevocably waive any objections to New Zealand as the forum for proceedings on the grounds of forum non-conveniens or any similar grounds.

SIGNED AS A DEED

SIGNED by **OWEN SCHICKER** in the presence of:

Signature of Assignor

16-02-2018

Date

WITNESS

Signature:

Name: MICHAEL FRANSEN

Address: 91 POPLAR ST. TIMARU

Occupation: ENGINEER.

SIGNED by **FLEXIDRILL LIMITED** by:

Signature of Director

Bruce Craig MUNRO

Name of Director

16.02.2018

Date

Signature of Director

Name of Director

16-02-2018

Date

SCHEDULE

INVENTION

FIELD OF THE INVENTION

The present invention relates to a coupling for or incorporated into a wireline retrieval assembly and/or downhole tool to assist with drilling and coring in the mineral industry.

BACKGROUND OF INVENTION

Wireline retrieval assemblies assist with the installation (deployment) of and retrieval of downhole apparatus for drilling and/or coring in the mineral industry (mineral exploration and mining). Reference to drilling and/or coring in the mineral industry, refers to, without limitation, to any exploration, mining, logging and/or survey of mineral deposits in the ground.

A wireline retrieval assembly comprises a plurality of members interacting to install/deploy downhole and retrieve tools from downhole. Referring to Figure 1, a wireline retrieval assembly can comprise but is not limited to, a head assembly, an overshot and a wireline. The wireline retrieval assembly is adapted to couple to a downhole tool. The head assembly has a spear head, and the overshot has a complementary engagement portion to attach and detach from the spear head of the head assembly. The overshot of the wire line retrieval assembly is connected to a wireline that can lower the wire line retrieval assembly and connected downhole tool downhole to install (deploy) the tool, and likewise hoist up and retract the wire line retrieval assembly and tool to retrieve the tool from the downhole.

A typical installation ("deployment" is an equivalent term that can be used interchangeably with "installation")/retrieval procedure is as follows. A borehole is drilled using a drill bit coupled to rotating drill rods. When drilling such holes in the ground a core sample can be taken. This is done by leaving the drill rods in place and using a wireline retrievable diamond coring system to take a core sample. A coring tool is lowered downhole into the drill rods and once the core sample is taken, the coring tool is retrieved to surface on a wire line (winch) controlled by a drill rig. To retrieve the coring tool, the wireline and overshot is lowered downhole and when it reaches the top of the head assembly it engages to connect with the head assembly. The head assembly is attached to the coring tool. As the coring tool, head assembly and overshot are removed from the ground they are lifted clear of the drill rods (that line the borehole) by the wireline, then a helper (off sider or operating personnel) supports/guides the unsupported bottom end of the inner tube of the coring

tool as the wireline winch is slowly lowered, then the helper will guide the assembly onto trestles (table or other) whereby the inner core tube assembly containing the core sample is then disconnected from the wireline and overshot by unwinding a threaded connection, leaving the full core barrel on the trestles. The wireline and overshot are then reconnected, again using a threaded connection, to another empty inner core tube assembly. The assembly is again lifted off the trestles by the wireline – with an offsider guiding the assembly back into the drill rods, where it is lowered back downhole so drilling can recommence. Once the coring tool is in place, the overshot is disengaged and the head assembly and coring tool remain downhole. Whilst the empty inner core tube assembly is being lowered down hole, the offsider empties the full inner core tube that has been bought back to surface for analyses. The core sample is emptied form the inner tube by first undoing a threaded connection at the inner tube head assembly, the sample is then emptied from the open tube and the head assembly when it returns from being downhole is then threadably reconnected to the empty inner core tube, ready for the next run. This process is repeated many times throughout a day.

Use of existing wireline retrieval assemblies present health and safety dangers to operators. The inner core tube assembly and overshot assembly are long, slender and heavy, so handling the overshot and inner core tube assembly as it is removed from the drill rig for analyses (and redeploying the assembly back down the hole) without damaging the equipment or causing injuries can be challenging.

Complicating this, the bore holes are often drilled at an angle and the offsider must handle and empty the inner tube assembly within a confined space of a drill stack or in underground cavern, or with a small drill rig. Thus the weight of the assembly that the offsider needs to support adds considerable risk of injury or damage while the assembly is moved to and from the trestles. Even on automated drill rigs, where the assembly is handled by a robotic arm, the offsider is still required to threadably remove the heavy head assembly from the core barrel, and re attach the head assembly to an empty core barrel – so that drilling can resume efficiently.

Additionally, this repeated connecting and disconnecting of heavy threaded components is time consuming, dangerous where the components can easily be damaged. For example, by cross threading.

SUMMARY OF INVENTION

BRIEF DESCRIPTION OF DRAWINGS

Embodiments will be described with reference to the following figures, of which:

Figure 1 prior art wireline retrieval assembly.

Figure 2, 2A, 2B shows in diagrammatic form an overview of a wireline retrieval assembly with pivot couplings.

Figure 3 shows various views of a wire line retrieval assembly with a hook pivot coupling in accordance with a first embodiment

Figure 4 shows the hook pivot coupling in further detail.

Figure 5 shows the hook pivot coupling with a retention pin to retain the hook in place.

Figure 6 shows a clevis of the hook pivot coupling in further detail.

Figure 7 shows the articulating assembly.

Figure 8 shows alternative variations of the first embodiment.

Figure 9, 10 shows an alternative embodiment.

Figure 11 shows an alternative embodiment of a pivot coupling using a rod.

DETAILED DESCRIPTION OF EMBODIMENTS

Overview

In addition to the existing problems posed by wireline retrieval assemblies, the present applicants use wireline retrieval assemblies in a manner that extends the length of the head assembly. For example, the present applicants incorporate a hammering tool or other tool into the head assembly, which extends the length of the head assembly. Such extra long wireline retrieval assemblies cannot be manoeuvred or used in confined spaces or small drill

rigs where the rig is smaller than the wireline retrieval assembly, further exacerbating the problems describe in the background.

Figure 2 shows in diagrammatic form a wireline retrievable assembly 11, comprising an overshot 13 with attached wireline 21, a head assembly 14, and a downhole tool 12 (such as a coring tool, logging tool, surveying tool, drilling tool, hammering tool) according to embodiments described herein. The overshot 13 and head assembly 14 are shown connected, but are detachable/engageable as describe previously. The head assembly 14 might have a further tool incorporated (in addition to the downhole tool mentioned above), such as a hammering tool. The overshot once downhole can now be disengaged to deploy the head assembly and connected downhole tool 12.

The downhole tool ("tool") 12 is coupled with a pivot coupling 15 to the head assembly 14 of the wireline retrieval assembly 11. The pivot coupling 15 is described in the embodiments below. The head assembly 14 (with or without an incorporated tool) and the downhole tool 12 when coupled are termed a "downhole assembly" 9.

Referring to diagrammatic inset Figure 2A, the pivot coupling 15 has two complementary coupling members; a link coupling member ("link" or "latch") 16 which removably engages to a retention coupling member ("retention member" or "keeper") 17. The retention member can take various configurations, but comprises a pivot member 18 on which the link 16 can removably engage, and lateral portions/extensions 19A, 19B that extend to the pivot member 18 and provide for lateral retention of the link – that is, when coupled the lateral portions prevent the link 16 sliding off the pivot member 18. The lateral extensions also allow rotational movement in the head assembly to be transferred to the tool 12, as the hook will abut against and be restrained by a respective lateral extension that is rotated. As an example, but not limiting, the retention member 17 can comprise a forked or U-shaped member providing lateral retention with a pivot pin or other pivot member extending between the forks or ends of the U-shape. The diagrammatic indication of the retention member in concept form in Figure 2A can take various forms, such as a clevis as will be described later, but should not be limited by particular embodiments. Other examples not described, might include a metal hoop or loop or anything else that provides a pivot member and lateral extension that retains the link on the pivot member from sliding off. The retention member can be integrated with or removably couplable to one of the members of the assembly and/or downhole assembly that are being connected together. The link 16 can take various configurations

as will be described, but in general form has an opening 20 to engage with the pivot member 18 of the retention member 17, and also to be received within the lateral retention members 19A, 19B of the retention member. Preferably a camming surface or member 5 helps keep the link vertically retained. Preferably, a retention pin (described with respect to relevant embodiment(s) below) can also be provided in some embodiments to prevent the link from being uncoupled from the retention member unintentionally.

Having a pivot coupling 15 between the head assembly 14 and the downhole tool 12 provides for safer installation and extraction of the downhole tool. As the wireline retrieval assembly and/or downhole tool can articulate/pivot at the pivot coupling(s) 15, and because the pivot coupling(s) 15 can be decoupled, this provides for a much more manoeuvrable assembly.

For example, installation of a downhole apparatus (tool and head assembly) with a pivot coupling 15 can occur as follows. The wireline retrieval assembly 11 is laid flat on the ground or support and connected to a wireline 21 – see Figure 2. The downhole tool 12 is then connected to the wireline retrieval assembly 11 (in this case the head assembly part 14) via a pivot coupling 15 as described herein (which might comprise inserting a retention pin as described herein). The wireline 21 can then be hoisted to hoist the wireline retrieval assembly 11. As the wireline is hoisted, the wireline retrieval assembly can articulate at the pivot coupling 15 between the head assembly 14 and the downhole tool 12, allowing for controlled hoisting – see Figure 2B. Finally, with further hoisting of the wireline the entire wireline retrieval assembly and downhole tool can be lifted into a vertical configuration but in a controlled manner with minimal swinging. This enables deployment within a smaller/confined space (e.g. underground or small coring drill rigs with a short mast) with less concern of the wire line retrieval assembly swinging around uncontrollably. The operators can then guide the wire line retrieval assembly and downhole tool into the downhole position. The overshot 13 can be disengaged from the head assembly and retracted above ground using the wireline 21, leaving the head assembly 14 and tool 12 deployed downhole.

Similarly, with retrieval, a wireline 21 can be attached to the overshot 13 and the overshot lowered and attached to the head assembly downhole. The wireline retrieval assembly 11 and attached tool 12 are lifted out of the drill rods from downhole. The operator can then insert the retention pin, then carefully move the vertical wireline retrieval assembly and downhole tool to the support or the ground and then slowly lower the wireline 21. The entire

assembly will articulate at the pivot coupling 15 between the wire line retrieval head assembly 14 and the tool 12 (see Figure 2B). This allows for a much more controlled lying down of the overall assembly to minimise swinging and other dangers. The downhole tool can then be decoupled at the pivot coupling and another downhole tool attached for installation. This also allows for the various components (overshot, head assembly and tool) to be decoupled and handled separately, which assists operations.

The above is just one general example where there is a coupling 15 between the wireline and retrieval assembly. In an alternative, a second pivot coupling 15 can be placed between the wireline 21 and overshot 13 to provide additional articulation. This arrangement can be used when the drill rig is short. Two methods of deployment and retrieval are provided in more detail below, after embodiments of the apparatus have been described in more detail.

Pivot coupling with a clevis and hook

One possible embodiment of a pivot coupling and its incorporation into a wireline retrieval assembly will be described with reference to Figures 2, 3 and 4. In this embodiment, the retention member takes the form of a clevis 40 with an optional removable pivot pin (pivot member) 41, and the link member takes the form of a hook 42.

Referring to Figure 3, the wire line retrieval assembly 11 comprises an overshot 13 coupled to a head assembly 14. The head assembly has a latch 7 for coupling to drill rods to retain it in place. In this version of the embodiment, for simplicity, there is no pivot coupling at the top of the overshot. However, such a pivot coupling could be incorporated if required. A downhole tool 12 is coupled to the head assembly 14 of the wireline retrieval assembly 11 via a pivot coupling 15. This embodiment is described with reference to a coring too, but the tool 12 could be any of a core catching barrel, a coring tool, hammering tool, drilling tool, surveying tool, logging tool or any other type of tool used in the mineral industry. Optionally, in addition the head assembly might have a coring tool, hammering tool, drilling tool, surveying tool, logging tool or any other type of tool used in the mineral industry incorporated into it (in addition to the tool attached to the head assembly). Where the head assembly has such a tool incorporated into it, reference to the head assembly is considered to cover the tool also. The head assembly has a latch 7 to retain the head assembly (with or without additional tool) 14 and downhole tool 12 in place downhole. Figure 2 shows the tool 12

partially inserted downhole in drill rods 8 that line the borehole previous drilled.

Figure 4 shows the pivot coupling 15 in more detail. The clevis 40 comprises two lateral extensions 43A, 43B with apertures therethrough (not shown as they are filled with a pivot pin). The pivot pin 41 extends through the openings of each lateral extension 43A, 43B and across the gap between the lateral extensions. The pivot pin 41 could be fixed in place or removable. In this case, the pivot pin takes the form of a bolt that can be threaded into one of the lateral extension openings. The lateral extensions 43A, 43B extend from a base 44 that can be coupled to a wire line retrieval assembly member (head assembly 14 in this embodiment). For example, the base could be threaded and screwed onto a complementary thread on the wire line retrieval assembly member (head assembly) 14. (In a variation, the clevis 40 can be integrated with the wire line retrieval assembly member, such that the lateral extensions are integrated with an extent from the wire line retrieval member.) The lateral extensions are spaced apart at least as wide as the width of the hook 42 and are chamfered/radiused 46 to assist insertion of the hook between the two lateral extension members 43A, 43B. These radiused lead in edges, mean that when the operator is trying to engage or guide the hook into place, then if the hook is slightly off line the radiused lead in edges allow the hook to self-align into place. If there was no radiused lead in edges – then it would require the operator to align the hook exactly into place to allow the hook and clevis to engage. This would be fiddly and time consuming. The end of each lateral extension is rounded 45 to provide a camming surface for a retention pin to be described later. The lateral extensions 43A, 43B retain the hook in place when coupled and also restrain the hook to allow rotational movement in the head assembly to be transferred to the tool 12, as the hook will abut against a respective lateral extension that is rotated. Also, the base 44 of the clevis has a camming surface 5 to retain the hook vertically in place when installed. This reduces vertical movement of the hook relative to the clevis.

The hook 42 is configured with a width that allows the hook to be inserted between the lateral extensions 43A, 43B of the clevis 40, and it has an opening 47 to engage around the pivot pin 41. The hook extends from a base 48 that can be coupled to a wire line retrieval assembly or downhole tool 12. For example, the base 48 could be threaded and screwed onto a complementary thread on the downhole tool. (In a variation, the hook can be integrated with the wire line retrieval assembly or downhole tool, such that the hook is integrated with and extends from the wire line retrieval assembly

or tool.) In coring operations, the base 48 is cylindrical with an interior region comprising a channel 50 for flow of drilling or coring fluid during operation, particularly when the assembly is going back down hole. The channel is formed as a cylindrical pipe 50A extending in the base 48 and flow channel apertures 50B, 50C extending horizontally through the base 48 to the exterior. The top portion of the base channel is a rounded seat to receive a bearing 51 that forms a check valve. This valve allows the fluid or mud to flow back uphole and through the inner tube of a coring tool barrel as the assembly is going back down hole. This prevents drilling fluid or mud clogging up the barrel and slowing the process going back downhole.

The static fluid downhole is expelled through the channel 50 and past the check valve 51 when the downhole tool 12 is inserted downhole. In the absence of such fluid, the bearing 51 will under gravity fall to block flow of fluid through the channel 50. The check valve may be considered to comprise the *seat,* a round ball and then directly above the inlet/outlet fluid ports. The front view shows the ball seated in the valve where no fluid is flowing. In use as the assembly is moving downhole, fluid is moving back uphole. This fluid pushes the ball away from its currently seated position and then flows out through the inlet/outlet ports.

Referring to Figure 5, when hook 42 has been coupled to the clevis 40. The hook coupling comprises an aperture 52 therethrough for a retention pin 53, which may be spring loaded. The hook 42 is dimensioned and the retention pin opening 52 is positioned such that when the hook 42 is coupled to the clevis 40 and the retention pin 53 is inserted, the retention pin abuts against the curved camming surface 45 of the lateral extensions 43A, 43B (see Figure 6). This keeps the hook securely in place so that the hook cannot be inadvertently decoupled from the clevis, while still allowing the hook to articulate around the lateral extensions as the retention pin follows camming surface 45. The hook 42 also abuts the base camming surface 5, which keeps the hook retained to reduce vertical movement.
The hook 42 can be coupled to the clevis 40 by engaging the hook opening over the pivot pin 41. The hook in the clevis once engaged form the pivot coupling 15. The spring loaded retention pin is positioned in the opening 52– so that then in position the hook and clevis cannot be separated. The camming surface 45 on the clevis allows the angular movement (articulation) of the retention pin, while reducing the possibility of the hook and clevis from accidentally separating. Additionally the inside walls of the clevis are radiused 46 to provide a guide path for the hook. The safety pin is inserted between

the hook and clevis, once the assembly is out of the drill rods or is immediately uphole. It is removed again before the assembly is lowered back down hole (the hook and clevis can only be separated by moving one at an angle greater than e.g. 45° to the other.) Figure 5 shows a ball locking pin as a possible option but any type of retention pin such as a lynch pin, wire clasp pine, R clip or the like could be used.

The hook assembly is in this embodiment positioned between the head assembly and tool (inner core tube of a coring tool in this embodiment). The hook can be removed by first removing the retention pin, and then rotating the hook around to a flattened portion 42A that allows it to be pushed towards the base of the clevis and then removed away from the pivot pin and disengaged.

In this embodiment, the clevis and the hook member are shown attached to the head assembly 13 and downhole tool 12 respectively. It will be appreciated that this is not essential and the clevis 40 and hook 42 could be swapped around and attached in an opposite configuration to the head assembly and downhole tool. In other variations, the clevis and hook (together pivot coupling 15) could alternatively or additionally be situated between the overshot and wireline in any configuration, or between any other members of the wireline retrieval assembly, and/or between multiple linked downhole tools. In another embodiment to be described later, a pivot coupling 15 as described herein is placed between the wireline 21 and overshot 13 and another between the head assembly 14 and tool 12.

Referring to Figure 7, once coupled the wireline assembly 11 can articulate relative to the downhole tool 12 about the pivot coupling 15 . This allows for much easier installation and retrieval as previously described in the overview, and as will be described in further detail below.

The pivot coupling can be used with any downhole tools that are wireline deployed or retrieved – with or without a check valve. Using the hook as shown in a coring application is one of a number of applications that this pivot coupling could be used for and this would have a check valve. If this pivot coupling is used to attach/release survey tools – then a check may not be needed.

A method of deploying and retrieving a tool using a wireline retrieval assembly with a pivot coupling will be described later.

In general terms, the pivot coupling optionally does one or more of the following when used in a wireline retrieval assembly as described.

- Provide some degree of angular movement between the head assembly and the downhole tool, or between other members where the pivot coupling is used. For example, with an inner core tube of a coring tool, it allows the inner core tube to be handled within a smaller space effectively allowing the assembly to angularly moved as two pieces (articulate) – while being connected as one.
- Allow rotation of the head assembly to be transferred to the tool.
- Eliminate or reduce the use of heavy threads that connects the components - these are easily damaged, and can cause cuts and strain injuries. The preferably small light weight hook component can be threadably disconnected and reattached to an inner core tube when removing a core sample.
- An offsider no longer has to handle such a heavy and cumbersome downhole tool as it can be decoupled from the head assembly during deployment and retrieval procedures.
- Has a built in safety mechanism that cannot unintentionally come apart.
- Requires no tools to separate or put back together (make / break)
- Is fast and simple to use.
- Puts a connector between the head assembly and the tool that is able to be connected - disconnected, without the use of tools.
- Puts a connector placed between the head assembly and the inner core tube, that is able to be connected - disconnected, without the use of threads
- A connector placed between the inner tube head assembly and the tool that is able to be connected and disconnected that allows for +/- 80 or more degrees of angular rotation.
- Puts a connector placed between the head assembly and the tool, that is able to be connected - disconnected whereby there is a clevis and a hook
- Puts a connector placed between the head assembly and the tool, that is able to be connected - disconnected whereby a spring loaded pin or similar pin prevents the clevis and hook from separating and whereby the spring loaded spring or similar pin bears against the curved edge of the clevis - so the clevis acts as a cam. The cam and pin allow the angular movement of the tool relative to the head assembly.
- Puts a connector placed between the head assembly and the downhole tool, where the head assembly contains an optional check valve,

- Enables a hook and clevis to be attached/separated without any degrees of rotation.
- Provides a quick release coupling that preferably allows up to about or equal to 90 degrees of angular movement without any risk of slipping, or prematurely uncoupling and or causing damage or injury.
-

Alternative embodiments

Figure 8 show alternative embodiments, with different positions for the retention pin.

Figures 9 and 10 show another embodiment where there is an additional pivot coupling 15 between the wireline and overshot. This is the same pivot coupling as described above. There is also a pivot coupling between the head assembly and tool as described in the previous embodiment, but for simplicity, this is not shown. This provides an alternative mode of deployment/retrieval that will be described below.

Figures 10, 11 shows another embodiment of a pivot coupling 15. In this one, there is a clevis 40, but instead of the line being a hook 42, the link is a rod 110 with an aperture 112. The rod can extend from a base or be incorporated into a member of the apparatus as previously described. The rod is inserted into the clevis, and a removable pivot pin 111 is Inserted through the clevis hole 52 and the rod hole 112 to couple the rod to the clevis. The pivot coupling can be used as an alternative to the hook pivot coupling in any configuration previously described for the hook pivot coupling.

Methods of installation/deployment and retrieval

Based on the embodiments described above, two methods of installation/deployment and retrieval of a tool are described.

In one option, just a single pivot coupling 15 is used between the head assembly 14 and tool 12. This relates to the embodiment shown in Figures 3 and 7. The embodiment will be described with reference to coring, but that is exemplary only and the same or similar method could be used for other tools. First, a bore is drilled using a drill bit rotated by drill rods. The drill rods are left in place. Starting with the wireline retrieval assembly tophole , where the tool is not yet connected to the head assembly and overshot, the process comprises the following.

1. Both the head assembly and overshot are connected and are laid on the ground or similar. The wireline is connected to the uphole end of the overshot.
2. Using the wireline, the head assembly and overshot are hoisted while the operator is guiding one part of the pivot coupling 15 on the head assembly (e.g. clevis 40) to engage with the other complementary part (e.g. hook 42) of the pivot coupling 15 on the tool (such as a coring tool, surveying tool, drilling tool, logging tool or the like). The tool can be lying on the ground. See Figure 7, "A" and "B". For example, as described above, one part of the pivot comprises a hook or rod and the other a keeper.
3. If the pivot coupling parts are a hook and keeper, then a retention pin 53 is inserted to retain the pivot coupling 15 together. If the pivot coupling parts are a keeper and rod with a hole, when the pivot member is inserted through the keeper, the rod acts as both the retention pin and pivot member. See Figure 7, "C"
4. As hoistng continues, the assembly is vertical (see Figure 3, "A") to position the wireline retrieval assembly over the drill rods. The tool 12 is lowered into the drill rods. Before it is completely deployed, the retention pin is removed (if it is the hook and keeper configuration – see Figure 3, "B", "C"), then the entire wireline retrieval assembly and tool are deployed downhole. If a short retention pin is used that is flush with the clevis lateral extensions, it does not need to be removed.
5. Once the required depth is reached, the overshot is detached from the head assembly. Latches 7 on the head assembly engage with the drill rods, the overshot is retracted back uphole using the wireline, and then coring, drilling, surveying, logging or other activity happens
6. Once operations downhole are complete (e.g. coring, logging, drilling or surveying has taken place), the rotational drive is decoupled and the overshot is deployed downhole and reattached to the latch spear head on the head assembly. The wireline then hoists the overshot bringing the head assembly and tool back up hole.
7. Once the pivot coupling 15A reaches surface the operator can insert the retention pin (if a hook and keeper configuration is used see Figure 3, "B", "C") and then steps 4-1/Figure 7, "A", "B", "C" are repeated in reverse order where a new tool is attached (such as an empty coring tool is re-connected.)

In another method, two pivot couplings 15 are used, such as shown in Figures 9, 10. One between the wireline 21 and overshot 13, and one between the

head assembly 14 and tool 12. This configuration is used where the head assembly 14 is longer than the drill rig. For example, this method and configuration can be particularly useful where an additional tool forms part of the head assembly, thus increasing the length. Generally, the drill rig is small or the space being worked in is small. Again the drill casings are in the borehole. There are now additional steps to take as the wire retrieval assembly is bigger than the rig. To get around this problem, an additional pivot coupling 15 couples the wireline to the wireline end of the overshot to enable the operating personnel to remove the overshot and head assembly from the tool 12 when the wire retrieval assembly is either lowered back down hole or bought back uphole. The additional steps are as follows.

1. The head assembly and overshot are laid on the ground separate from the tool 12.
2. The wireline is connected to the tool via a pivot coupling (part of pivot coupling e.g. clevis on the wireline to to part of pivot coupling e.g. hook on the tool). Both the wireline and tool are hoisted up and the tool lowered into the drill rods and dropped down so that it is level with the drill rod tophole. A claw or similar then holds the uphole end of the tool in place in the drill rods and the wireline is then disengaged from the tool by decoupling the pivot coupling.
3. The wireline is then coupled to the overshot that is attached to the head assembly. This is then hoisted up and guided over to the tool retained in the drill rods.
4. The head assembly is now connected to the tool via the pivot coupling 15. If required, the retention pin is then inserted.
5. The claw is then removed from the tool along with the retention pin if used.
6. The wireline retrieval assembly 11 and the tool 12 are now lowered downhole to deploy the tool downhole. This process occurs by the overshot disengaging the head assembly once the necessary depth is reached, the wireline is then hoisted out of the drill rods.
7. Once operations downhole are complete (e.g. coring, logging, drilling or surveying has taken place), the overshot is lowered back downhole using the wireline to engage to the head assembly. This is then pulled back up hole so that the bottom of the head assembly or top of the tool is level with the top of the cased hole. The retention pin is inserted (if configuration requires it) and/or the claw is engaged with the tool to then hold the tool in place in the borehole.

8. The tool and head assembly pivot coupling 15 is disengaged so that the head assembly and overshot can then be hoisted up and laid on the ground, whilst the tool is still being held in the hole.
9. The wireline is connected to the tool via a pivot coupling (part of pivot coupling 15 on the wireline to part of pivot coupling 15 on the tool). Both the wireline and tool are hoisted up and the tool raised out of the drill rods.

Both methods provide advantages over the prior art. First, the wireline, overshot, head assembly and tool can be decoupled and coupled as required during deployment/retrieval so the operator can work with smaller and lighter components. This is compared to prior art systems, where the entire assembly needs to be handled, which is larger and heavier. Furthermore the coupling and decoupling can occur easily using the couplings. Also, the wireline, head assembly and tool can articulate, which makes for easier handling and maneuver of the assembly, even when it is one piece. All this leads to safer and easier operation.

The pivot coupling itself is lighter and more easily handled. The portion on the tool can be decoupled from the tool (e.g. unthreaded) thus allowing access to the tool, for eg. accessing a core sample.

The prior art requires that there is always at least TWO wireline retrievable and downhole apparatus at the surface (e.g. system assembly and assembly two) for efficient operation. Once assemblyone is bought back uphole man handled and laid on the ground, the wireline is then disengaged from the overshot and reconnected to the overshot of assembly two. Process repeated with assembly two – again manhandled. While assembly two is downhole, the off sider must threadably disconnect the downhole apparatus from the head assembly. Typically the head assembly weighs around 10-20kg – so must untwist this from the downhole tool so that the contents of the downhole tool can be emptied out. The arrangement described herein allows the use of just one overshot and head assembly unit while still remaining time efficient (this means less outlay for equipment, quicker, increased efficiency). Thus when our the tool comes back uphole, only the tool is removed and the overshot and head assembly can then reattach to a different tool. Thus the off sider is not having to untwist the wireline retrieval assembly from the downhole tool. This is quicker, prevents cross threading risk , lessens having to man handle the 10-20kg head assembly etc. This becomes an even more important advantage when the head assembly incorporates additional length and weight by the introduction of additional apparatus into the head assembly. Thus the overall length of the head assembly may increase from say 1m to 3m and the weight increases from 10-20kg to say 50-70kg. Alternatively, if the additional apparatus is incorporated into the downhole tool – then again these similar advantages apply.

Another advantage is that the off sider, if they decide to empty out the contents of the downhole tool from the uphole end of the tool where the pivot coupling is provided – then the off sider can simply unscrew off the hook or

clevis of the pivot coupling. This pivot coupling is light weight and readily removable. This can be seen in Figure 4.

If using two pivot couplings – in addition to the above points, major advantages include the ability to break the unit into manageable sizes and weights for the off sider to handle whilst at surface.

Claims

1. A wireline retrieval head assembly and downhole tool, the wireline retrieval head assembly for coupling to the downhole tool for installation in and retrieval from downhole in a mineral industry field of use, wherein a first of the wireline retrieval head assembly and downhole tool has a retention member that has or is configured to receive a pivot member and a second of the wireline retrieval head assembly and downhole tool has a complementary link with an opening for receiving the pivot member, such that the link can be coupled to the retention member to create a pivot coupling to allow for articulation between the wireline retrieval head assembly and the downhole tool during installation and retrieval of the downhole tool, and the link can be removed from the retention member to remove the downhole tool from the wireline retrieval head assembly.

2. A wireline retrieval head assembly and downhole tool according to claim 1 wherein the retention member has lateral extensions to laterally retain and/or rotationally restrain the link when coupled.

3. A wireline retrieval head assembly and downhole tool according to claim 1 or 2 wherein the link is a hook with an opening and the retention member is a clevis with a pivot pin as the pivot member.

4. A wireline retrieval head assembly and downhole tool according to claim 1, 2 or 3 further comprising a retention pin and an aperture through the hook such that the retention pin can be installed in the aperture to secure the hook to the clevis.

5. A wireline retrieval head assembly and downhole tool according to claim 1 or 2 wherein the link is a rod with an opening and the retention member is a clevis with a removable pivot pin as the pivot member.

6. A wireline retrieval head assembly and downhole tool according to any preceding claim further comprising a further tool coupled to and forming part of the head assembly.

7. A wireline retrieval head assembly and downhole tool according to any preceding claim wherein the downhole tool is anyone of:

- coring tool
- drilling tool
- hammering tool
- surveying tool
- logging tool

8. A wireline retrieval head assembly and downhole tool according to any preceding claim, wherein the wireline retrieval head assembly is adapted to be detachably coupled to an overshot, the overshot for coupling to a wireline, wherein a first of the overshot and wireline has a retention member that has or is configured to receive a pivot member and a second of the overshot and wireline has a complementary link with an opening for receiving the pivot member, such that the link can be coupled to the retention member to create a pivot coupling to allow for articulation between the overshot and wireline to enable installation and retrieval of the downhole tool, and the link can be removed from the retention member to remove the wireline retrieval from the overshot.

9. A wireline retrieval head assembly and downhole tool according to claim 8, wherein a first of the wireline and downhole tool has a retention member that has or is configured to receive a pivot member and a second of the wireline and downhole tool has a complementary link with an opening for receiving the pivot member, such that the link can be coupled to the retention member to create a pivot coupling to allow for articulation between the wireline and downhole tool to enable installation and retrieval of the downhole tool, and the link can be removed from the retention member to remove the wireline from downhole tool.

10. A pivot coupling to removably and pivotably couple a wireline retrieval head assembly and a downhole tool for installation in and retrieval from a dowhole in a mineral industry field of use, wherein the pivot coupling comprises a retention member that has or is configured to receive a pivot member, the retention member integrated in or configured to connect to a first of the wireline retrieval assembly and downhole tool; and a

complementary link with an opening for receiving the pivot member, the link integrated in or configured to connect to a second of the wireline retrieval head assembly and downhole tool, such that in use the link can be coupled to the retention member and pivot member to create the pivot coupling between the wireline retrieval head assembly and the downhole tool during installation and retrieval of the downhole tool, and the link can be removed from the retention member and pivot member to remove the downhole tool from the wireline retrieval system.

11. A pivot coupling according to claim 10 wherein the retention member has lateral extensions to laterally retain and/or rotationally restrain the link when coupled.

12. A pivot coupling according to claim 10 or 11 wherein the link is a hook with and opening and the retention member is a clevis with a pivot pin as the pivot member.

13. A pivot coupling according to claim 10, 11 or 12 further comprising a retention pin and an aperture through the hook such that the retention pin can be installed in the aperture to secure the hook to the clevis.

14. A pivot coupling according to claim 10 or 11 wherein the link is a rod with an opening and the retention member is a clevis with a removable pivot pin as the pivot member.

15. A pivot coupling according to any one of claims 10 to 15 wherein the downhole tool is anyone of:

- coring tool
- drilling tool
- hammering tool
- surveying tool
- logging tool

16. A method of installing a tool downhole in a mineral industry field of use using a wireline retrieval assembly comprising an overshot coupled to a wireline retrieval head assembly, the method comprising the steps of: coupling at least the wireline retrieval assembly to a downhole tool with a pivot coupling of any one of claims 10 to 15

hoisting the wireline retrieval assembly from a surface or support using a wireline, in doing so at least the wireline retrieval assembly and downhole tool pivot at the pivot coupling, and
lowering the wireline retrieval assembly and tool downhole.

17. A method according to claim 16 further comprising detaching the overshot from the wireline retrieval head assembly.

18. A method of retrieving a tool from downhole installed according to claim 16 or 17 comprising the steps of:
retrieving the wireline head assembly and downhole tool using a wireline and overshot to hoist the downhole from downhole,
lowering the wireline retrieval assembly and tool to lay the assembly on a support or surface, in doing so the wireline retrieval assembly and/or tool pivot at the pivot coupling,
removing the link from the retention member to disassemble the wireline retrieval assembly from the tool to retrieve the tool.

19. A method of installing a tool in a downhole in a mineral industry field of use using a wireline and wireline retrieval assembly comprising an overshot coupled to a wireline retrieval head assembly, the method comprising the steps of:
coupling a wireline to a tool with a pivot coupling of any one of claims 10 to 15
lowering and retaining the tool downhole,
coupling the wireline to a wireline retrieval assembly
hoisting the wireline retrieval assembly and coupling it to the tool with a pivot coupling of any one of claims 10 to 15
lowering the wireline retrieval assembly and tool downhole to deploy the tool.

20. A method according to claim 19 further comprising detaching the overshot from the wireline retrieval head assembly.

21. A method of retrieving a tool from downhole installed according to claim 19 or 20 comprising the steps of:
retrieving the wireline head assembly using a wireline and overshot to hoist the wireline head assembly from downhole,
decoupling the tool from the wireline head assembly and retaining the tool in the downhole,

coupling the wireline to the tool and retrieving the tool from downhole using the wireline.

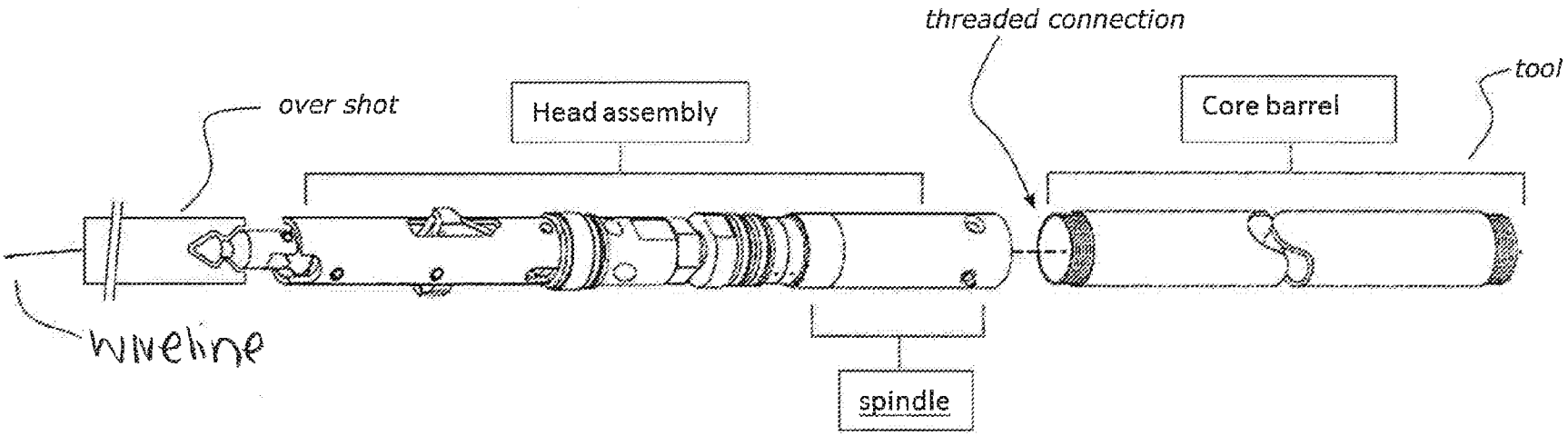


FIGURE 1
(Prior Art)

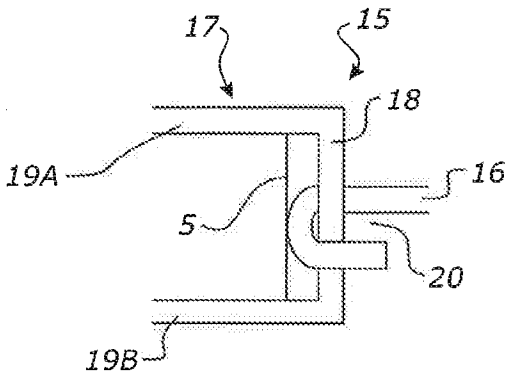


FIGURE 2A

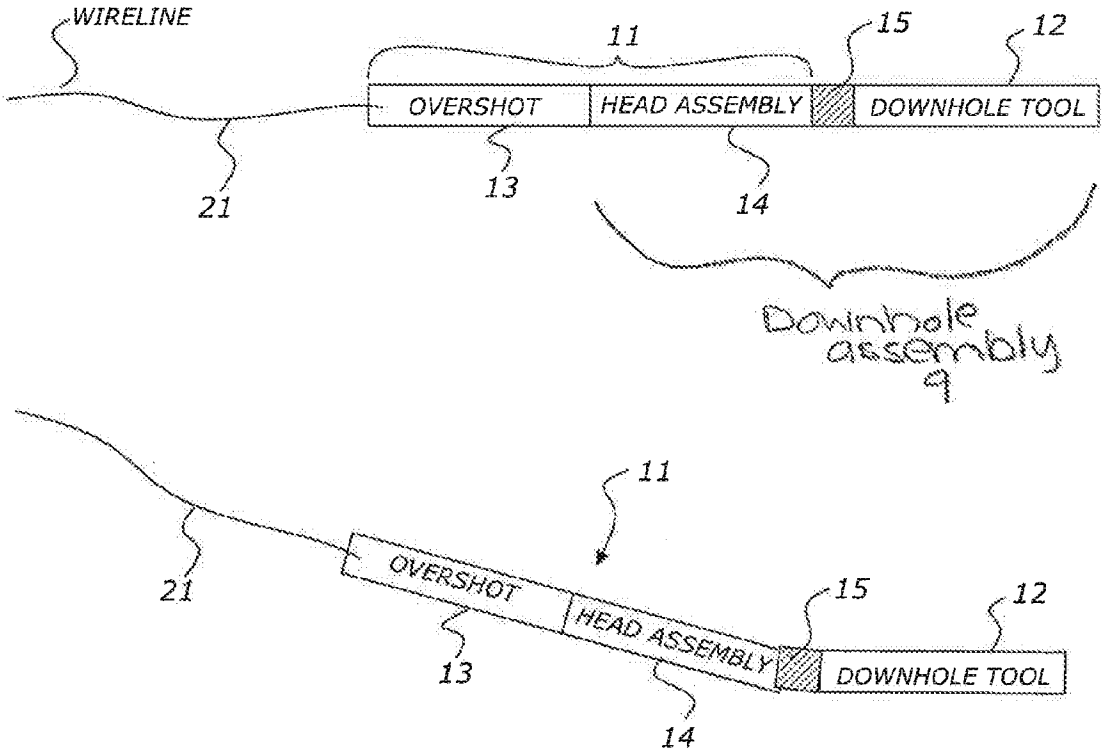


FIGURE 2B

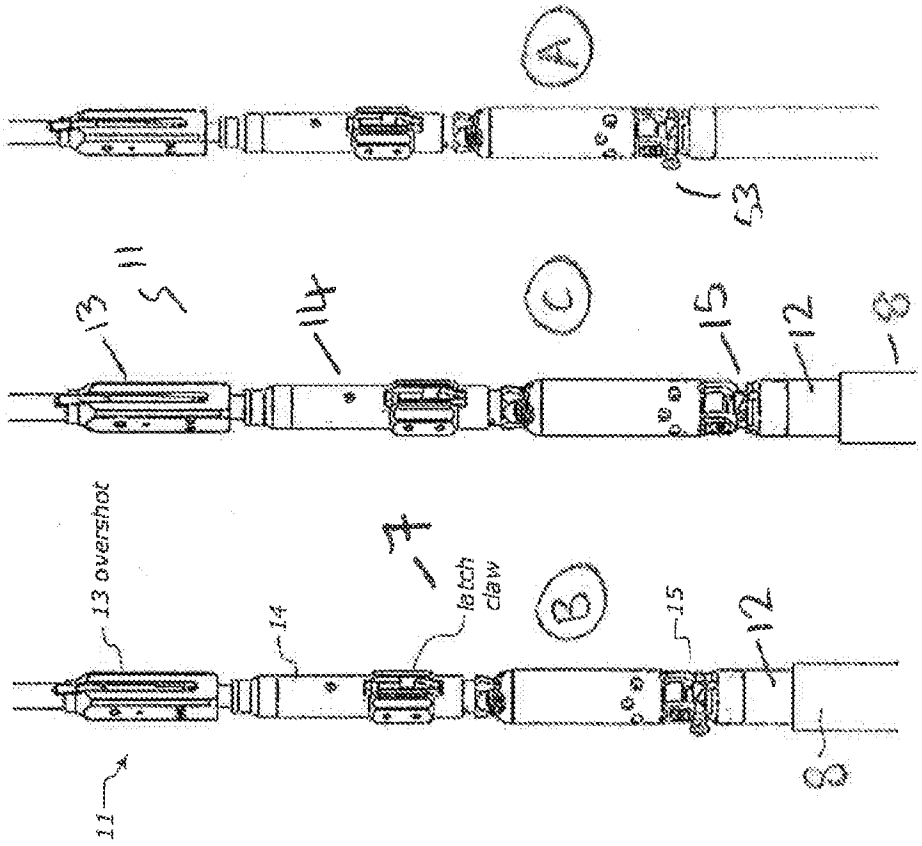
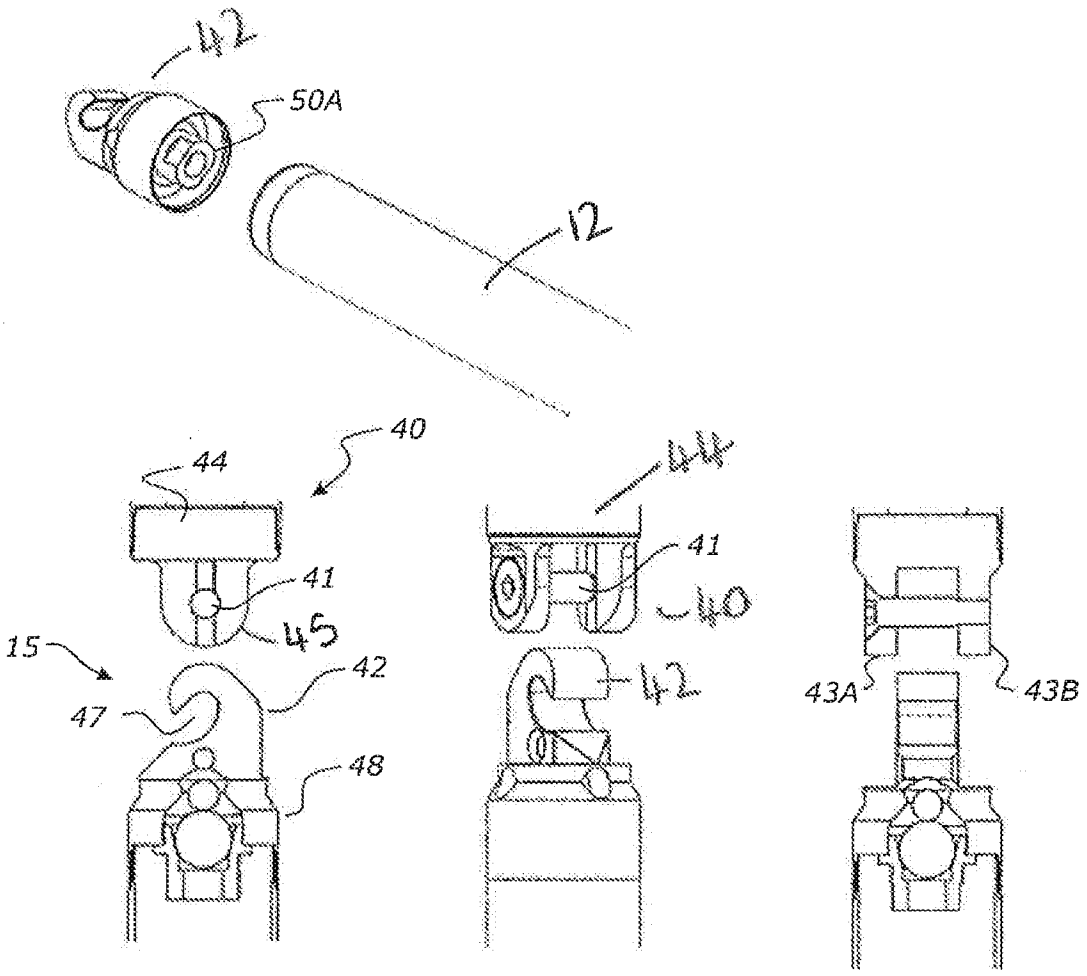


FIGURE 3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48
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43A
43B

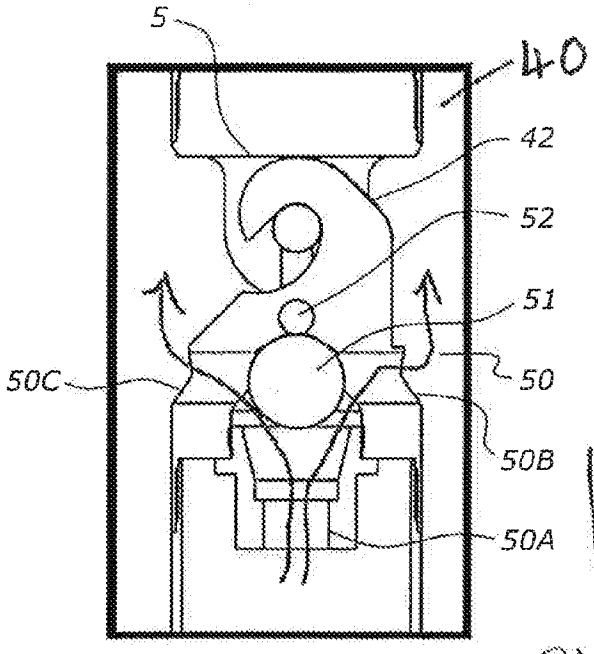
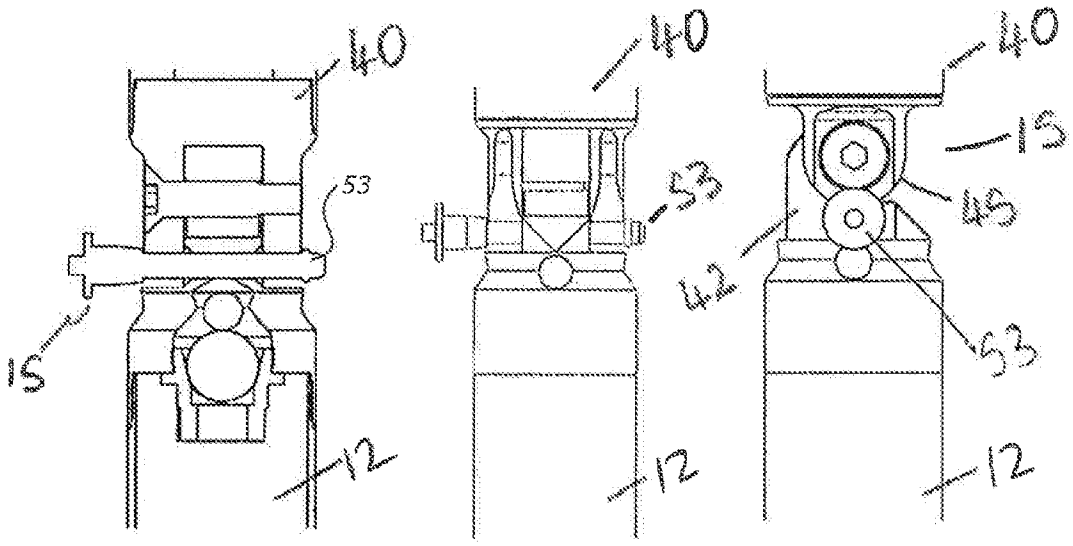

5
40
42
52
51
50C
50
50B
50A

FIGURE 4



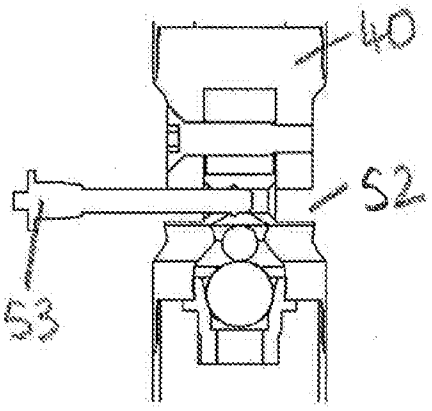


FIGURE 5

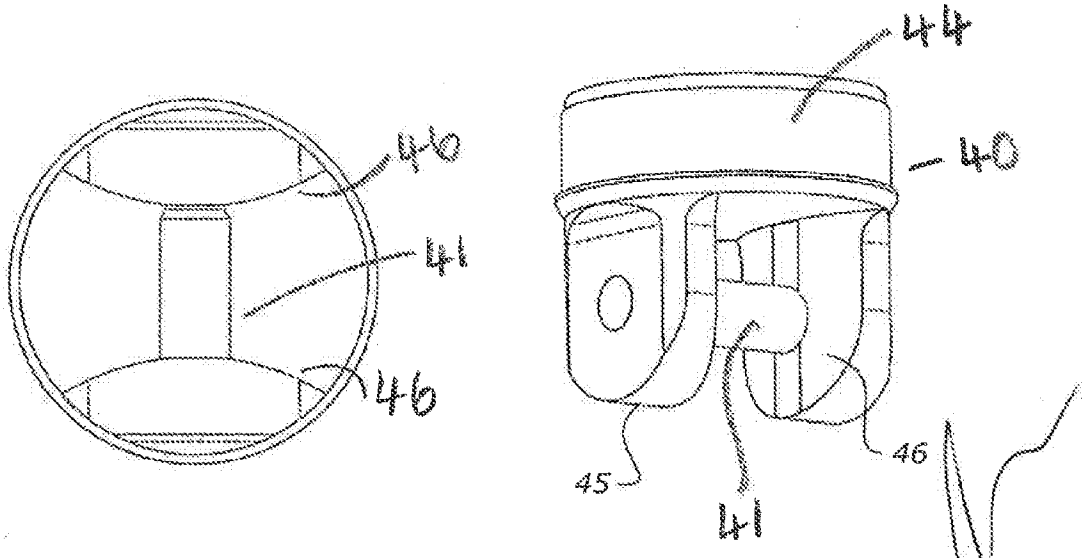


FIGURE 6

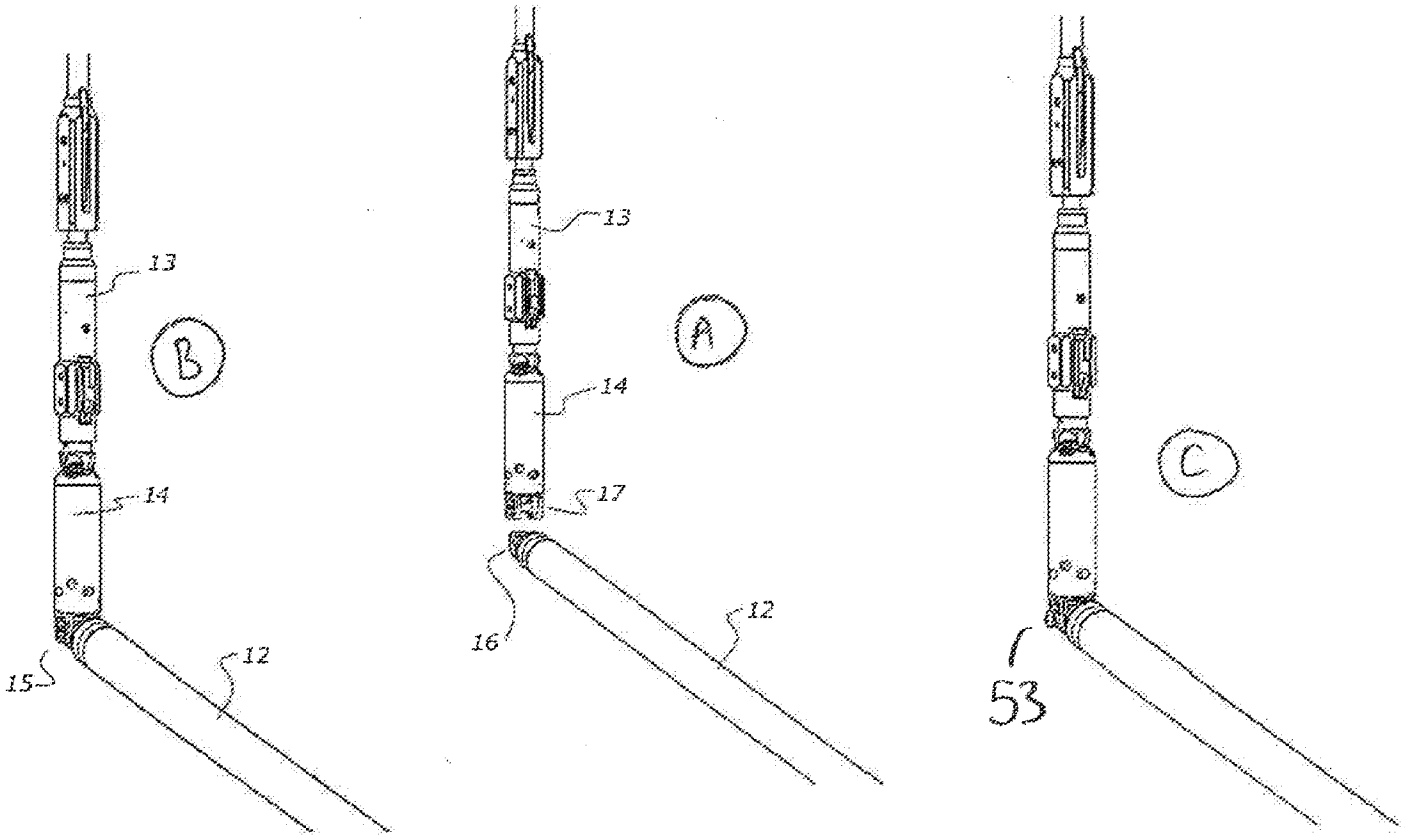


FIGURE 7

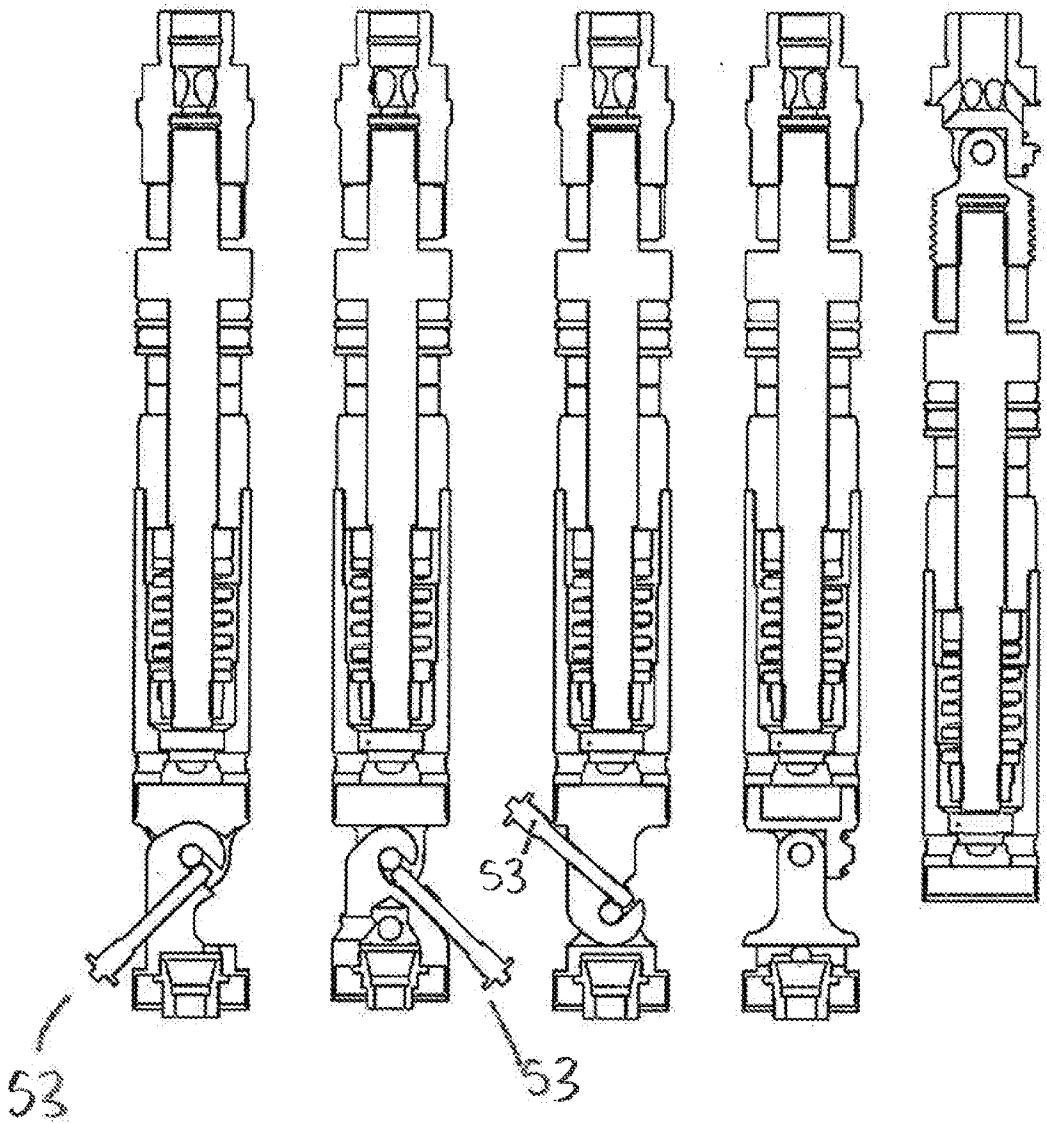


FIGURE 8

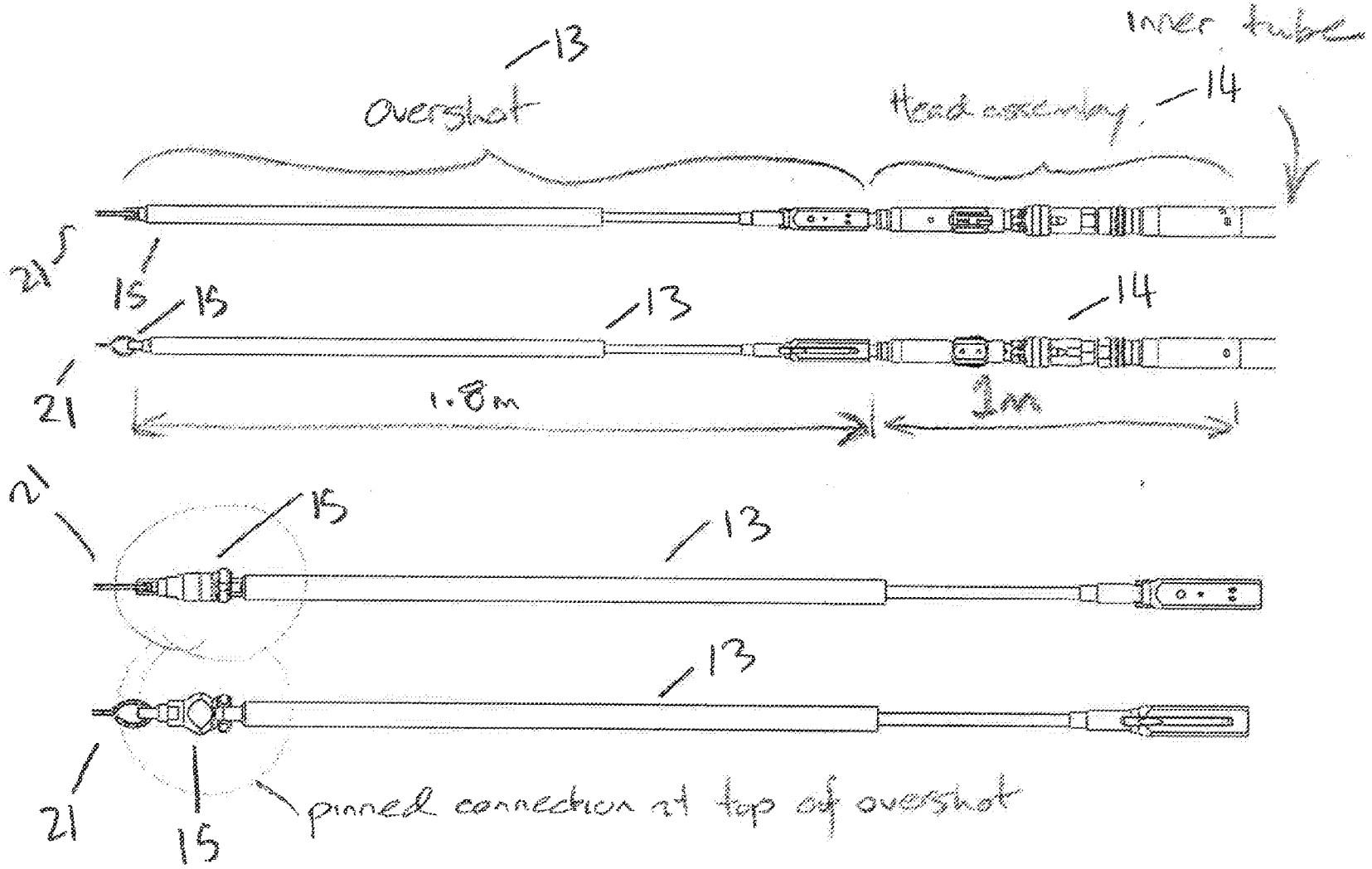


FIGURE 9

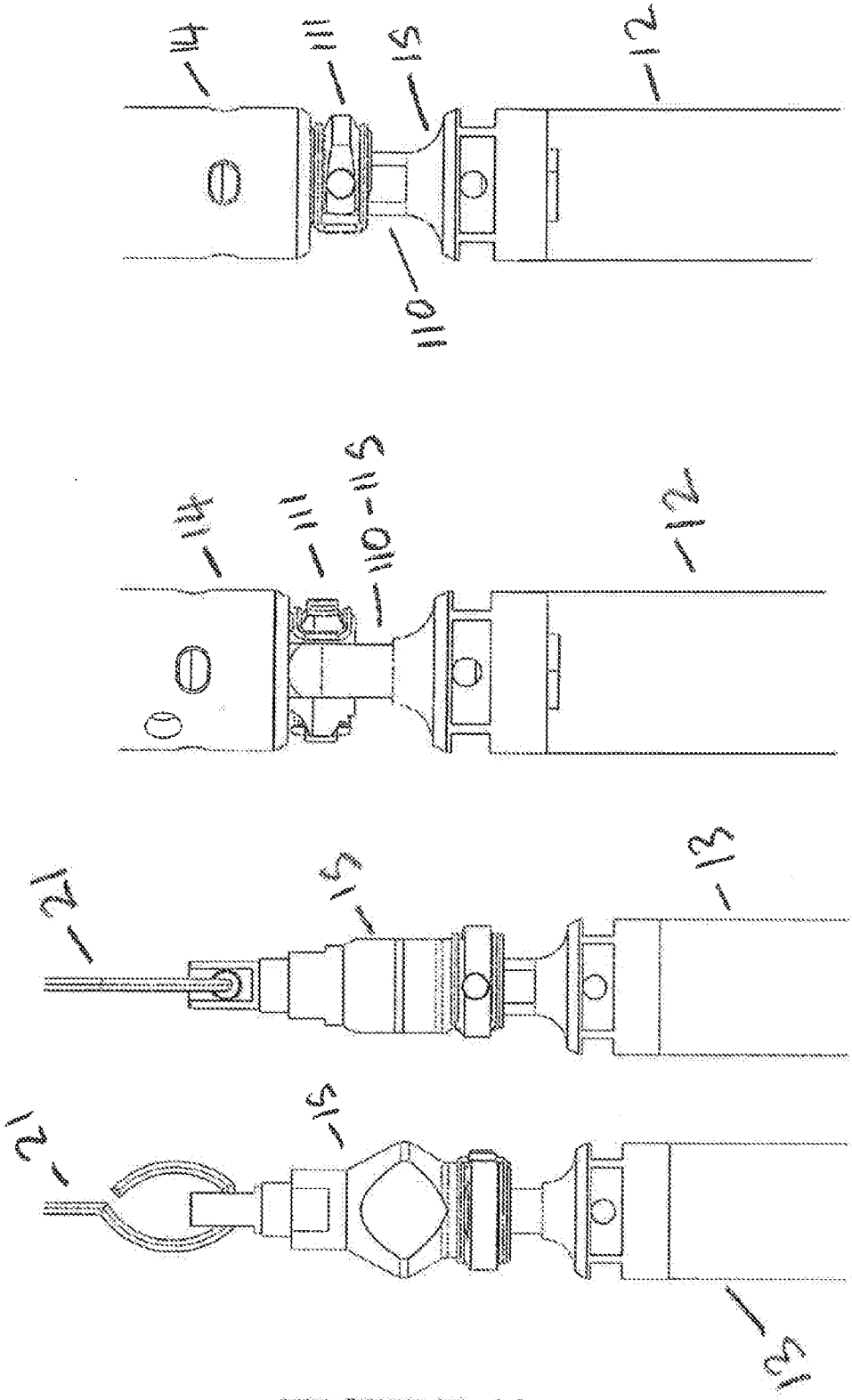


FIGURE 10

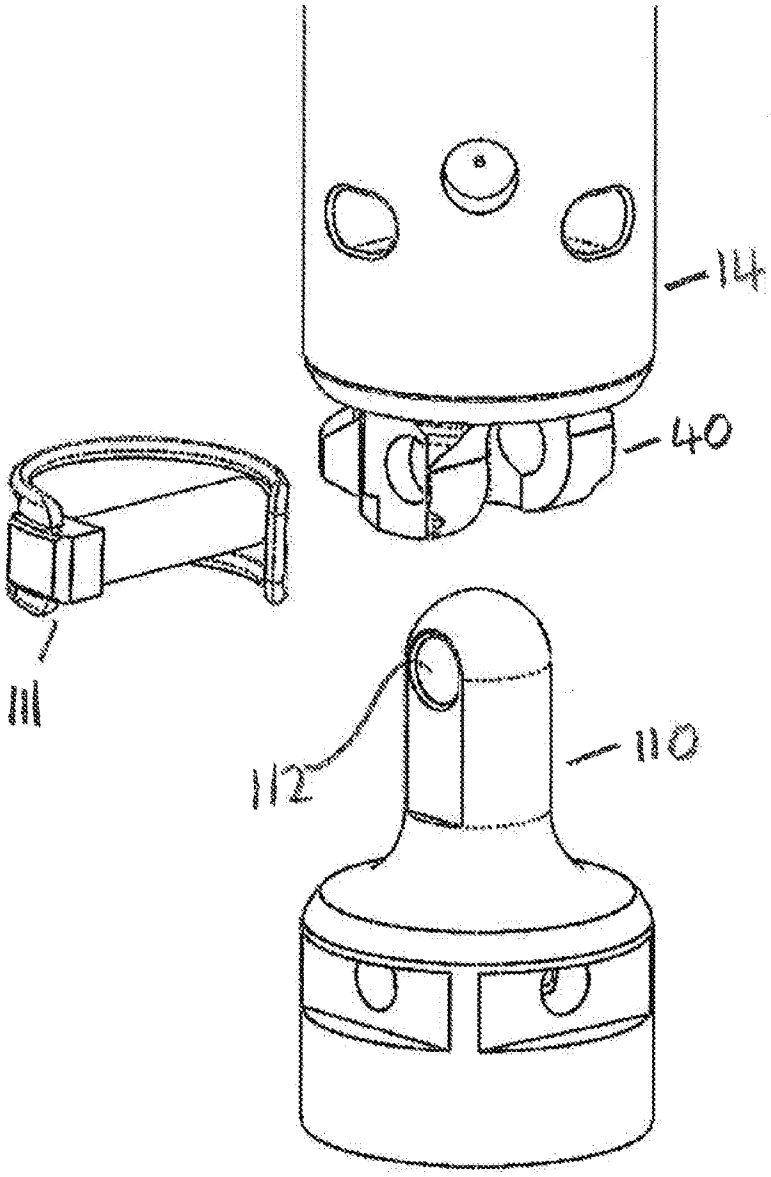


FIGURE 11