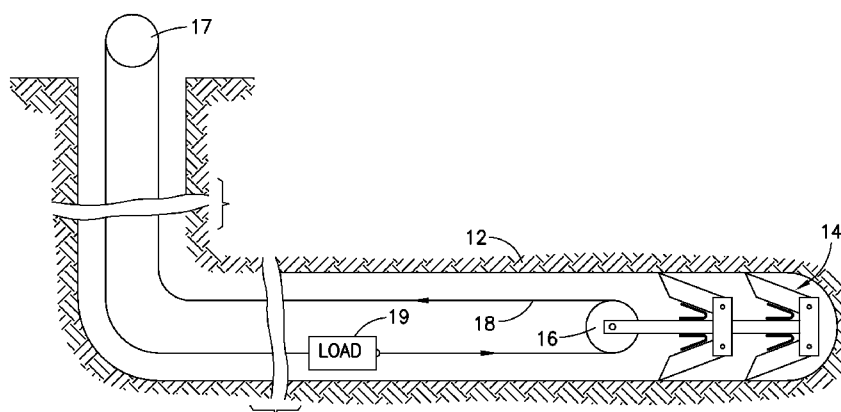




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[Continued on next page]

(54) **Title:** ANCHOR-BASED CONVEYANCE IN A WELL**FIG. 1**

(57) **Abstract:** An anchor is placed in a wellbore to convey loads into a wellbore. The anchor is placed at some desired location in a wellbore and installed at that location using, for example, arms that penetrate into the formation surrounding the anchor. A line extends from the surface, wraps around a pulley in the anchor and attaches to the downhole end of the load. Tension is applied at the surface to the line to pull the load to a desired location in the wellbore. Optionally, the same or a second line can be attached to the uphole end of the load to reposition or retrieve the load. Alternatively, a powered anchor has a line drive device and a spool. A portion of a line extends from the anchor to the load. The line is spooled onto the spool by the line drive device, thereby pulling the load into the wellbore.



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ANCHOR-BASED CONVEYANCE IN A WELL**RELATED APPLICATION**

[0001] This application claims priority to and the benefit of a U.S. Non Provisional Patent Application having Serial No. 14/196887, filed 04 March 2014, which is incorporated by reference in its entirety.

Background

[0002] In the petroleum industry, before a downhole measurement or operation can be performed in a well, a logging tool is deployed to a depth of interest. Current modes of deployment generally include wireline, drill string, coil tubing (CT), slick line, and downhole tractors. Drill string is generally considered the strongest mode and is capable of exerting a force sufficient to deploy relatively large loads into vertical, horizontal, and deviated wells. It can be used to deploy a logging tool even into horizontal, vertical or deviated wells having dog legs. In contrast, a wireline deployment does not provide its own force, but instead relies on gravity to deploy. It therefore works well in vertical wells and in deviated wells with small deviations from vertical, but cannot deploy in horizontal wells or vertical wells with severe dog legs. Traditionally, wireline conveyance has relied on having a rig in place, though recently there is a trend to perform some of the operations in a rig-less environment. Like wireline, a slick line is not driven and as a result works reliably in vertical (or slightly deviated) wells.

[0003] Coil tubing is a driven deployment mode. It can work in horizontal, vertical, and deviated wells, but it is not as strong or rigid as drill string, and therefore not as forceful. In a horizontal well, CT often works for a few thousand feet, but, as it extends farther into the horizontal well, its contact with the wellbore wall increases, and with it, friction. In long horizontal sections, the borehole wall friction becomes comparable to the applied force, causing the CT to buckle and become ineffective.

[0004] A downhole tractor is self-powered and provides its own conveyance mechanism. Tractors are typically used in cased wells and can carry a heavy load to a desired location.

Tractors are designed to make short strides while pulling the load at the same time. This is not a particularly efficient means of deployment.

[0005] There are many operations performed in or on a well after drilling and completion operations are finished and the rig is removed. Currently many of those operations are not closely monitored because it is not practical to convey a logging tool into the well while performing the particular operation. This is especially true in highly deviated and horizontal wells.

Summary

[0006] An anchor is placed in a wellbore to convey loads into a wellbore. The anchor is placed at some desired location in a wellbore and installed at that location using, for example, arms that penetrate into the formation surrounding the anchor. A line extends from the surface, wraps around a pulley in the anchor and attaches to the downhole end of the load. Tension is applied at the surface to the line to pull the load to a desired location in the wellbore. Optionally, the same or a second line can be attached to the uphole end of the load to reposition or retrieve the load. Alternatively, a powered anchor has a line drive device and a spool. A portion of a line extends from the anchor to the load. The line is spooled onto the spool by the line drive device, thereby pulling the load into the wellbore.

[0007] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

Brief Description of the Drawings

[0008] The present disclosure is best understood from the following detailed description when read with the accompanying figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion. Embodiments are described with reference to the following figures. The same numbers are generally used throughout the figures to reference like features and components.

[0009] Figure 1 is a schematic drawing showing an embodiment of an anchor in a wellbore, in accordance with the present disclosure.

[0010] Figure 2 is a schematic drawing showing the anchor of Figure 1 in a retracted configuration, in accordance with the present disclosure.

[0011] Figure 3 is a schematic drawing showing the anchor of Figure 1 in an extended configuration, in accordance with the present disclosure.

[0012] Figure 4 is a schematic drawing showing an embodiment of an anchor with a locomotion mechanism, in accordance with the present disclosure.

[0013] Figure 5 is a schematic drawing showing an embodiment of an anchor on a loading dock and with a locomotion mechanism, in accordance with the present disclosure.

[0014] Figure 6 is a schematic drawing showing wellbore pulleys used in conjunction with two lines and surface tensioning devices, in accordance with the present disclosure.

[0015] Figure 7 is a flowchart for at least one workflow embodiment, in accordance with the present disclosure.

[0016] Figure 8 is a schematic drawing showing a powered anchor in a wellbore, in accordance with the present disclosure.

[0017] Figure 9 is a schematic drawing showing a powered anchor in a wellbore used in conjunction with a power and data cable, in accordance with the present disclosure.

[0018] Figure 10A is a schematic drawing showing, in cross-sectional view, an insert having wellbore pulleys used in conjunction with two lines and surface tensioning devices, in accordance with the present disclosure.

[0019] Figure 10B is a schematic drawing showing, in end view, the insert of Figure 10A, in accordance with the present disclosure.

Detailed Description

[0020] It is to be understood that the following disclosure provides many different embodiments, or examples, for implementing different features of various embodiments. Specific examples of components and arrangements are described below to simplify the present disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the present disclosure may repeat reference numerals and/or letters in the various examples. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various embodiments and/or configurations discussed. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact.

[0021] Some embodiments will now be described with reference to the figures. Like elements in the various figures may be referenced with like numbers for consistency. In the following description, numerous details are set forth to provide an understanding of various embodiments and/or features. However, it will be understood by those skilled in the art that some embodiments may be practiced without many of these details and that numerous variations or modifications from the described embodiments are possible. As used here, the terms “above” and “below,” “up” and “down,” “upper” and “lower,” “upwardly” and “downwardly,” and other like terms indicating relative positions above or below a given point or element are used in this description to more clearly describe certain embodiments. However, when applied to equipment and methods for use in wells that are deviated or horizontal, such terms may refer to a left to right, right to left or diagonal relationship, as appropriate. It will also be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are used to distinguish one element from another.

[0022] The terminology used in the description herein is for the purpose of describing particular embodiments only and is not intended to be limiting. As used in the description and

the appended claims, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will also be understood that the term “and/or” as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. It will be further understood that the terms “includes,” “including,” “comprises,” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0023] As used herein, the term “if” may be construed to mean “when” or “upon” or “in response to determining” or “in response to detecting,” depending on the context. Similarly, the phrase “if it is determined” or “if [a stated condition or event] is detected” may be construed to mean “upon determining” or “in response to determining” or “upon detecting [the stated condition or event]” or “in response to detecting [the stated condition or event],” depending on the context.

[0024] A system and method to provide an anchor that, once deployed and installed in a wellbore, is capable of deploying loads into and out of the well is disclosed. The conveyance of the anchor and the pulling of the load are decoupled into separate steps. The anchor may be positioned and installed, for example, at the far end of the well (toe) and used to pull a load (e.g., a logging tool) into some desired location in the well. The anchor may use a line connected to the load to exert a pulling force on the load. This is in contrast with wireline and slick line deployments which do not provide any driving force and rely solely on the force of earth’s gravity to deploy the load into the well. The pulling force of the anchor is also different from the forces applied by drill string or coil tubing since their forces are pushing (compressive) rather than pulling (tensile). The anchor may be deployed and installed using an independent conveyance mechanism or it may be self-propelled.

[0025] As alluded to above, an anchor is a mechanical unit that goes to or is placed at a desired location in a generally non-vertical section of a wellbore and attaches itself to the borehole wall. The attachment to the wall is sufficiently strong so that when pulling forces are applied to the anchor during operations, the anchor itself does not move. In one

embodiment, the anchor has a pulley and line that can be used to drag a tool, for example, along the length of the wellbore to a desired position, including up to the anchor. For example, the anchor may have a passive pulley that a line (e.g., slickline or wireline) can wrap around and return to the upper end of the well. At the upper end, in operation, a pulling force is applied to the returning or incoming portion of the line. The line passing over the pulley has its other (outgoing) end attached to a load (e.g., a logging tool or any other unit to be conveyed into the borehole). The force exerted by the incoming or returning line to the load is a pulling force since the pulley changes the direction of the force being applied to the incoming end.

[0026] Figure 1 schematically shows a section of a horizontal well 12 with an anchor 14 positioned at the end (toe) of the wellbore. Anchor 14 does not have to be installed at the end of the wellbore. It may be deployed to any desired location in the wellbore so long as the surrounding wellbore wall permits the anchor 14 to securely attach at that location. The anchor 14 has a pulley 16, around which a line 18 wraps. One end of the line, the incoming end, extends to the upper end of well 12 and engages a drive mechanism 17, such as a motor, capable of exerting a tensile force on line 18. The other (outgoing) end of line 18 is attached to a load 19. The arrow shown in Figure 1 on the inbound end of line 18 (i.e., towards motor 17) indicates a pulling action to the left. This force is re-directed to become a pulling force on the load 19 (to the right), as shown by the oppositely directed arrow on line 18. Note line 18 can form a closed loop, around or through drive mechanism 17 and attaching to the opposite (upward) end of load 19. Mechanism 17 can apply a tensile force to line 18 in either direction, thereby allowing load 19 to be pulled into the wellbore or out of the wellbore.

[0027] The embodiment of anchor 14 shown in Figure 1 is shown in more detail in Figure 2. Anchor 14 comprises a support member 21. Arms 22 are rotatably attached to support member 21 and can pivot around pivot points 23. Pivot points 23 allow the free ends of arms 22 to extend toward or away from the wellbore wall. In this embodiment, two arm sections 25 are shown, but the number of arm sections 25 can be one or more, depending on the maximum pulling force anchor 14 is expected to handle. Also, each arm section 25 shows two arms 22, but the number of arms 22 can be more or fewer. Pulley 24 is attached to support member 21 and can rotate around axle 26. In the drawing of Figure 2, the arms 22 are

shown in a closed or retracted position which is their normal configuration during the deployment phase (i.e., when anchor 14 is being delivered to a desired location).

[0028] Upon reaching the desired location, arms 22 are allowed to extend and engage the borehole wall. The extension can be effected, for example, by a spring force on arms 22, as shown in Figure 3. The spring force may be triggered to apply once anchor 14 is in place, or arms 22 may be continuously pushed radially outward by springs 32, causing the free ends or tips of arms 22 to brush against the borehole wall while the anchor is moved towards the installation location in the direction indicated by arrow 27. Arms 22 will consequently rub against the borehole wall but will not attachingly engage with the wall while the force is in the direction of arrow 27. That is, arms 22 will not attachingly engage with the wall unless there is a force on anchor 14 in the direction indicated by arrow 28. The length of arms 22 is chosen to be longer than the radius of the borehole. That ensures that any particular arm 22, when engaged with the borehole wall, will make an angle 34 with support 21 that is less than 90 degrees. The springs 32 shown can be of many different designs and strengths (i.e., spring constants). Note that once a force in the direction 28 is applied to anchor 14, the tips of arms 22 will penetrate into the formation around the borehole wall and prevent anchor 14 from moving in the direction 28. As larger forces are applied to anchor 14, the arms 22 will further outwardly extend and penetrate even deeper into the formation, ensuring that anchor 14 does not move. The arm tips may be sharpened to enhance their ability to penetrate the formation. Other tip or arm designs may be used.

[0029] The embodiment of anchor 14 shown in Figures 2 and 3 is passive in that it is delivered to the desired location by a force acting in direction 27. Once the direction of force is switched to direction 28, arms 22 penetratingly engage the formation to fix anchor 14 in the wellbore. Such an anchor 14 does not need its own source of power for its installation or operation. However, it requires a deploying or conveyance mechanism to deploy and install it. The deploying mechanism may be, for example, a drill string, a tractor or CT. While those conveyance mechanisms are needed to deploy anchor 14, they are used in the deployment/installation phase. After that, anchor 14 can assist future deployments.

[0030] In an alternate embodiment, anchor 14 can be made more self-contained. This may entail many different levels of sophistication. For example, as alluded to above, in the installation phase, the arm extension mechanism can be made to be activated on command rather than having an active spring 32. In this case, the arm tips are not rubbing against the formation wall while anchor 14 is moved to the desired location. As a result, there is less friction between anchor 14 and the borehole wall, which makes it easier to deploy anchor 14 to the desired location. The arm extension mechanism may be powered by a battery, for example, or anchor 14 may be attached to a power cable at the time of installation and extension. Unless it is desired to have power available on anchor 14 for other purposes, once anchor 14 is in place and operational, the power cable can be disconnected and removed (i.e., pulled back to the surface).

[0031] Unlike tractors that carry a load with them while they move in the borehole, anchor 14 carries a minimum load while being deployed. During deployment, the forces involved include the weight of anchor 14 and the weight of line 18 (and their corresponding frictional forces). To ease the deployment further, a lightweight temporary line or leader 45 can be used in the deployment phase (see Figure 4). Once installation is complete, the temporary line or leader 45 can be used to convey the operational line 18 in place.

[0032] Anchor 14 may additionally be equipped with a locomotion mechanism. An example is shown in Figure 4, wherein an electric motor (not shown) is used to drive a belt 43 (via wheels 42), enabling anchor 14 to traverse well 12. More specifically, in the embodiment of Figure 4, a carrier 41 is used to carry anchor 14 to some desired location in the wellbore. Carrier 41 is equipped with wheels 42 which are rotated by a motor (not shown) which in turn is powered by an electrical line (not shown) or battery. The rotation of wheels 42 causes rotation of a belt 43 (similar to what is used in a bulldozer or snow mobile, for example), which then causes the carrier to move along the length of the borehole. Thus, anchor 14 may be self-propelled. As stated above, leader 45 represents a temporary line in this particular embodiment, but may also represent operational line 18 in an alternate embodiment that does not use a leader 45.

[0033] In an alternate embodiment, leader 45 is not attached to anchor 14 while anchor 14 is carried to its desired location. Rather, temporary line 45 (or line 18) is conveyed to anchor 14 by a second trip of carrier 41 and installed. Carrier 41 may be an integral part of anchor 14. In this unitary embodiment, anchor 14 can be retrieved, if desired, by driving carrier 41 in the reverse direction.

[0034] In yet another alternate embodiment, carrier 41 is independent from anchor 14 and may be pulled out of the well once anchor 14 is installed in the desired location. That is, in the embodiment shown in Figure 5, carrier 41 has a loading dock 46 on which to place anchor 14 while deploying anchor 14 to its desired location. Once at that location, anchor 14 is released and carrier 41 is pulled back. In the embodiments of Figures 4 and 5, arms 22 remain in the closed position while anchor 14 is delivered to the desired location. Also, loading dock 46 has, in the embodiment shown, non-driven wheels 47 on which it rolls.

[0035] In addition to pulley 16 (or 24), which is joined to support member 21 of anchor 14, there may optionally be other, additional pulleys to facilitate the movement of line 18 along the length of the well 12. Figure 6 shows an example wherein multiple additional pulleys (e.g., 61, 62) are placed in the well. Since horizontal wells generally are drilled by starting with a vertical section of the well before sidetracking into a deviated section of the well and eventually transitioning to a horizontal section, additional pulleys 61, 62 may be placed at the transition zones, such as the end of vertical section or the beginning of the horizontal section.

[0036] In one implementation of this embodiment, a first line 74 is wrapped around a first winch 65 at an uphole location. First line 74 is passed over a surface pulley 63 which is located over the borehole opening. First line 74 passes through vertical section 66 of the well before reaching additional pulley 62, which is located (in this embodiment) at the transition between the vertical section 66 and the deviated section 67 of the well. First line 74 is placed over additional pulley 62. Having first line 74 ride on additional pulley 62 helps reduce the contact between first line 74 and the borehole wall. Such contact is avoided since it may lead to erosion of the borehole wall and first line 74, in addition to producing undesirable frictional drag. First line 74 extends through the deviated section 67 of the well until it reaches the

transition between the deviated section 67 and the horizontal section 68 of the well. Here additional pulley 61 is installed to guide first line 74. The additional pulleys 61, 62 are small enough so as not to restrict the movement of a load 69 through the well.

[0037] First line 74 extends to and wraps around pulley 16 of anchor 14, before extending back uphole and reaching the downhole end 72 of load 69. First line 74 may be used to pull load 69 toward or to the end of the well. There may also be a second line 76 that may be used to pull load 69 out of the well. Second line 76 is attached to the uphole end 71 of load 69 and extends to an uphole location. Similar to that described above, further additional pulleys 78, 79 may be positioned more or less diametrically opposite additional pulleys 61, 62, respectively, to guide second line 76. Second line 76 engages and travels on additional pulleys 78, 79 and ultimately passes over another surface pulley 63 and wraps around a second winch 64. Additional pulleys 78, 79 serve in a capacity similar to additional pulleys 61, 62 (i.e., reduce friction and erosion). While in the embodiment shown additional pulleys 61, 62, 78, 79 are installed more or less pairwise (i.e., 61/78, 62/79) diametrically across the wellbore, other configurations are possible.

[0038] Figures 10A and 10B show, in cross-section and end view, respectively, an embodiment in which an insert 1010 may be delivered to and disposed in a specific location in the well, such as where pulley 61 of Figure 6 is located. In the embodiment shown in Figures 10A and 10B, insert 1010 has a cylindrical shell frame 1020 that has substantially the same outer diameter as the diameter of the well and can be anchored to the borehole wall (not shown). Insert 1010 comprises at least one pulley (e.g., the one labeled 61 since it serves the equivalent role in this embodiment as pulley 61 of Figure 6) that can be used to guide and support line 74, which is located at or near the ceiling of the well. Line 74 may be caged and supported by a cover 1030 to prevent line 74 from becoming misaligned with pulley 61 when line 74 is not in tension. When line 74 is pulled, tension in the line causes it to engage the groove of pulley 61. Insert 1010 may contain an additional pulley 78 on or near the floor of the well that guides and supports line 76. In this case, line 76 runs between pulley 78 and cylindrical frame 1020. A cover 1030 may be used with pulley 78, but the pulley structure tends to keep line 76 reasonably aligned with pulley 78 and a tensile load in line 76 tends to pull it into engagement with pulley 78. Multiple inserts 1010 may be disposed in the well.

[0039] Operationally, for the embodiment of Figure 6, before load 69 is introduced into the well, first line 74 is run from the winch 65, through the pulleys (e.g., 63, 62, 61), and back to the uphole location. Note, at this point, all of second line 76 is wrapped around second winch 64. The free end of first line 74 is attached to what will be the downhole end 72 of load 69 and the free end of second line 76 is attached to what will be the uphole end 71 of load 69. Load 69 is introduced into the well while it is being supported (via tension) by second line 76. The earth's gravity helps load 69 slide to, or at least close to, the lower end of deviated section 67. While that is happening, first line 74 is not providing any pulling force unless there is a restraining force (such as that arising from traversing a dogleg, for example) that necessitates more force than that already provided by gravity. Once load 69 gets to a position where it cannot go any farther without assistance, second line 76 is made loose (slack) so that it does not impede any further downward motion of load 69. At the same time, first line 74 is tightened, causing a pulling force on load 69. This is continued until load 69 reaches its desired location in the well. The process of removing load 69 out of the well is the reverse. First line 74 is made loose while second line 76 is tightened and pulled. This moves load 69 in the uphole direction. This is continued until load 69 reaches the uphole location.

[0040] In another embodiment, the drive mechanism 17 located uphole in the above-described embodiment may be moved downhole. For example, drive mechanism 17 may be lowered into the well and allowed to descend until it reaches a certain depth (e.g., the bottom of the vertical section - this may be at or near the same location as additional pulley 62). With this arrangement, the number of additional pulleys may be reduced and the rubbing contact of the line (18 or 76) against the borehole wall further minimized. This would reduce the friction between the line and the wall and also minimize any erosion or sticking of the line to the borehole wall.

[0041] Lines 74 and 76 (both or only one) may be purely mechanical and used to pull load 69 in or out of the well. In this case, the line (74 and/or 76) is generally lighter and easier to move through the well compared to heavier electro-mechanical cables. If solely mechanical lines are used, the tools or instruments that are part of load 69 that require electrical power may be operable using batteries. Further, the data measured by those devices is not available

in real-time. The data can be downloaded after the operation is complete and the load 69 is brought to the surface.

[0042] In an alternate embodiment, at least one of the lines (74, 76) is a wireline that can be used to provide power and telemeter (i.e., electronically transfer) data. A wireline is generally heavy and somewhat inflexible and is therefore generally more appropriate to be the second line 76.

[0043] Anchor 14 may have centralizers to center itself within the wellbore while or before the arms are released. That helps ensure that the pulling load is evenly distributed over the different arms 22 for best pulling resistance.

[0044] In yet another embodiment, shown in Figure 8, a powered anchor 80 comprises a mechanism to generate a pulling force. In this embodiment, powered anchor 80 contains a line drive device 82 having, for example, an electric motor and gear system. Line drive device 82 can be used to pull a load (downhole) and store a line 86 within powered anchor 80. Powered anchor 80 does not require a separate driving mechanism located uphole, such as a surface winch, and as a result there is no need for a pulley or a dedicated line going from powered anchor 80 directly to the surface location. That is, powered anchor 80, shown at the end of a horizontal well in Figure 8, is self-contained. The electric motor in line drive device 82 may be powered from uphole. Power may be delivered to powered anchor 80 through line 86, for example. Line 86 is used to pull the load in the downhole direction and, as such, is strong enough to handle the corresponding forces. A power line (not shown) may be placed in a space in the interior region of line 86 for power transfer to powered anchor 80. The technique of making line 86 with electrical wire and logic wires is well known in the wireline art. A first end of line 86 attaches to powered anchor 80. Electrical power and/or commands can be extracted and used to operate powered anchor 80. A second part of line 86 is attached to (or near) the downhole end of a load. Line 86 may extend through or around the load, be secured to (or near) the uphole end of the load, and continue uphole to the surface. Line 86 may be joined to an uphole drive mechanism such that line 86 may be used to withdraw the load (with line drive device 82 in neutral or reverse).

[0045] As stated above, the electric motor and other mechanical and electrical components needed to operate powered anchor 80 are housed in line drive device 82 of powered anchor 80. While a load is pulled toward powered anchor 80, line 86 wraps around a spool 84 for storage. The wrapping can be done in multiple layers to save space. The maximum length of line available depends on the storage capacity of powered anchor 80. Storage capacity factors include, but are not limited to, the length of spool 84, the diameter of spool 84, and the number of layers of line 86 wrapped around spool 84. The last factor depends on, among other things, the diameter of line 86 and the space between spool 84 and the borehole wall. These parameters may be adjusted to produce a desired line length.

[0046] Like the passive embodiments described above, powered anchor 80 may have multiple arms 81 that are longer than the radius of the well and serve to secure powered anchor 80 in the well.

[0047] Figure 9 shows an alternate embodiment in which powered anchor 80 may be connected both mechanically to a load 69 and electrically to an uphole device (not shown). Load 69 may be pulled in two directions using two lines (86, 88). Line 86 may be used by powered anchor 80 to pull load 69 deeper into the well. Line 88 may be used to pull load 69 in the uphole direction. In the embodiment shown, both lines are equipped to provide electrical power and command lines. Provisions may be made in the structure of load 69 to connect the power and command lines of lines 88 and 86. When the load 69 is a logging tool, for example, the connectivity is generally already built into the tool since those tools are commonly designed to accept and transfer electrical power and data from and to other apparatuses above and below the tool. For other loads, such as a container of acid for matrix acidization, for example, wiring 89 from one side of load 69 to the other, along with connectors on each side of load 69, can provide the desired connectivity.

[0048] In a typical deployment scenario, line 86 is connected to the downhole side of load 69. The upper portion of line 88 is spooled on a surface winch 64, and the free (downhole) end is connected to the uphole end of load 69. Load 69 is allowed to enter the well and make a controlled fall under earth's gravity, during which time line 88 is extended and line 86 is spooled. When load 69 reaches a dogleg or the end of its controlled fall, line drive device 82

in powered anchor 80 provides the force to pull load 69 towards powered anchor 80 via line 86. Pulling load 69 out of the well is performed by reversing the forces on lines 88 and 86. Here line 86 is made slack while line 88 is pulled with sufficient force to move load 69 in the uphole direction.

[0049] Attention is now directed to processing procedures, methods, techniques, and workflows that are in accordance with some embodiments. Some operations in the processing procedures, methods, techniques, and workflows disclosed herein may be combined and/or the order of some operations may be changed. It is important to recognize that geologic interpretations, sets of assumptions, and/or domain models may be refined in an iterative fashion. This concept is applicable to the processing procedures, methods, techniques, and workflows discussed herein. This iterative refinement can include use of feedback loops executed on an algorithmic basis, such as at a computing device and/or through manual control by a user who may make determinations regarding whether a given step, action, template, or model has become sufficiently accurate.

[0050] Figure 7 shows a flowchart illustrating an embodiment in accordance with this disclosure. In this embodiment, the workflow comprises disposing an anchor in a first desired location in a wellbore (702); installing the anchor into a formation surrounding the anchor (704); using a line moveably constrained by the anchor to pull a load to a second desired location in the wellbore (706); and optionally, using the line to reposition or retrieve the load (708).

[0051] The foregoing outlines features of several embodiments so that those skilled in the art may better understand the aspects of the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the scope of the present disclosure, and that they may make various changes, substitutions, and alterations herein without departing from the scope of the present disclosure.

[0052] The Abstract at the end of this disclosure is provided to comply with 37 C.F.R. §1.72(b) to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.

[0053] While only certain embodiments have been set forth, alternatives and modifications will be apparent from the above description to those skilled in the art. These and other alternatives are considered equivalents and within the scope of this disclosure and the appended claims. Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from this invention. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words ‘means for’ together with an associated function.

Claims

What is claimed is:

1. A method, comprising:
 - disposing an anchor in a first desired location in a wellbore;
 - installing the anchor into a formation surrounding the anchor; and
 - using a line moveably constrained by the anchor to pull a load to a second desired location in the wellbore.
2. The method of claim 1, further comprising using the line to reposition or retrieve the load.
3. The method of claim 1, wherein the disposing an anchor comprises using a self-propelled anchor.
4. The method of claim 1, wherein the installing the anchor comprises causing anchor arms to penetratingly engage the formation.
5. The method of claim 1, wherein the installing the anchor comprises releasing anchor arms from a retracted position and causing the anchor arms to penetratingly engage the formation.
6. The method of claim 1, wherein the using a line moveably constrained by the anchor to pull a load comprises using a drive mechanism to produce a tensile force in the line.
7. The method of claim 1, wherein the line and the load form a closed loop.
8. The method of claim 1, further comprising using a leader in conjunction with the line.
9. An apparatus, comprising:
 - an anchor having one or more anchor arms, wherein the anchor is disposed and installed in a wellbore;
 - a first line moveably constrained by the anchor; and
 - a drive mechanism capable of producing a tensile force in the first line.

10. The apparatus of claim 9, further comprising a locomotion device.
11. The apparatus of claim 9, wherein the first line is moveably constrained by an anchor pulley.
12. The apparatus of claim 9, wherein the first line is further moveably constrained by one or more wellbore pulleys disposed in various locations in the wellbore.
13. The apparatus of claim 9, further comprising a biasing force mechanism capable of applying a bias force to the one or more anchor arms.
14. The apparatus of claim 13, wherein the one or more anchor arms have a retracted configuration and an extended configuration, and the biasing force mechanism can release the one or more anchor arms from the retracted configuration and drive them to the extended configuration and/or release the one or more anchor arms from the extended configuration and drive them to the retracted configuration.
15. The apparatus of claim 9, further comprising a leader in lieu of the first line.
16. The apparatus of claim 9, wherein the first line comprises electrical and/or logic wires.
17. The apparatus of claim 9, further comprising a second line attached to a load disposed in the wellbore.
18. The apparatus of claim 9, wherein the drive mechanism is disposed on the anchor, elsewhere in the wellbore, or at the earth surface.
19. An apparatus, comprising:
 - an anchor comprising one or more anchor arms, a line drive device, and a spool, wherein the anchor is disposed and installed in a wellbore; and
 - a line that extends from the anchor into the wellbore and is capable of being spooled onto the spool by the line drive device;
 - wherein the line drive device is capable of producing a tensile force in at least the portion of the line that extends into the wellbore.

20. The apparatus of claim 19, wherein the portion of the line that extends into the wellbore is attached to or near a downhole end of a load.
21. The apparatus of claim 20, wherein the line extends through or around the load, is attached to or near an uphole end of the load, and further extends to a drive mechanism capable of producing a tensile force in the line.
22. The apparatus of claim 19, wherein the line comprises electrical and/or logic wires.

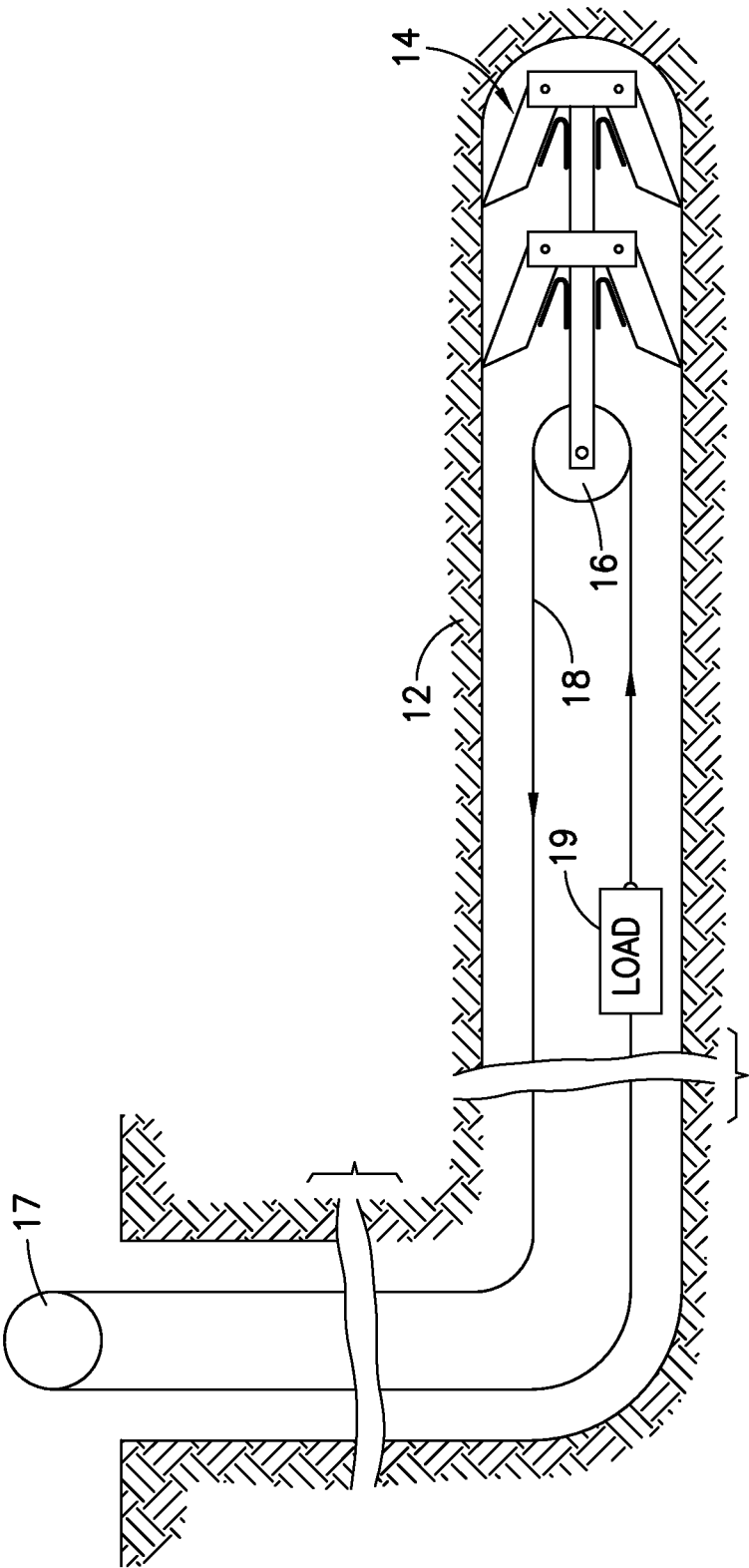


FIG.1

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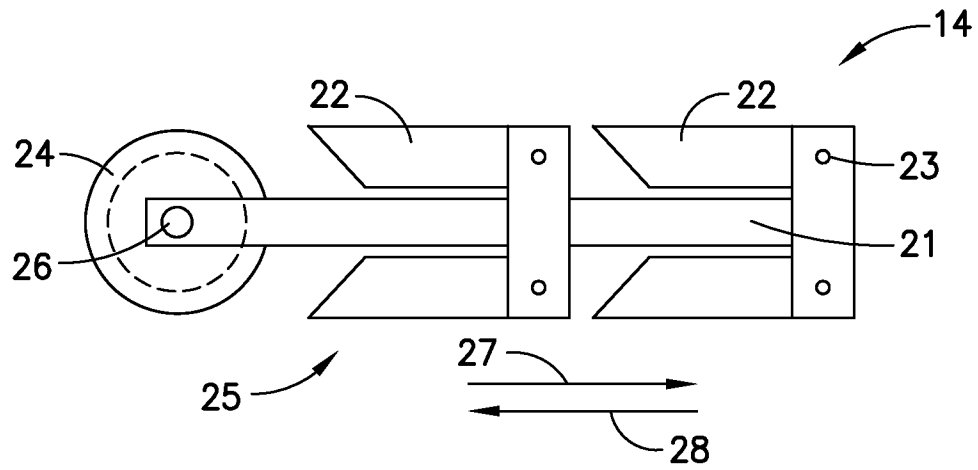


FIG.2

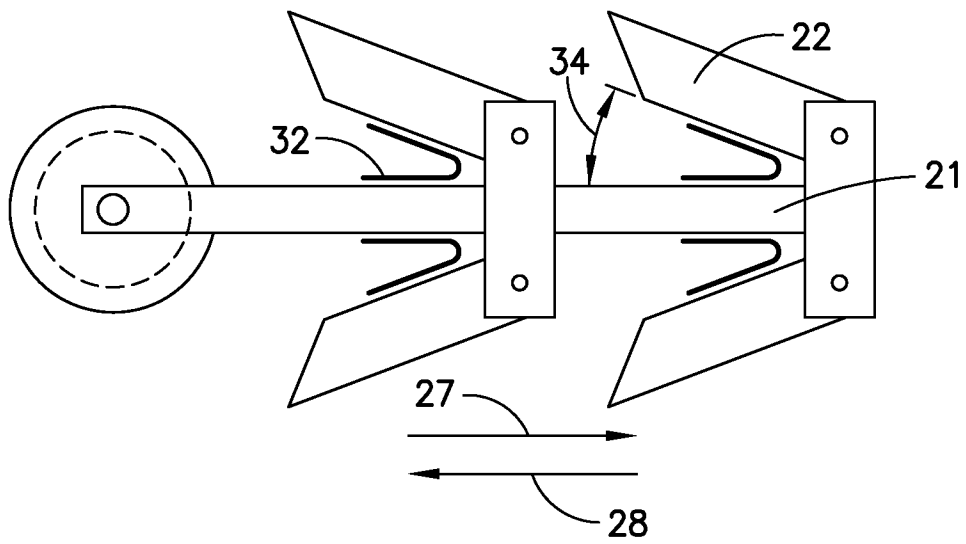


FIG.3

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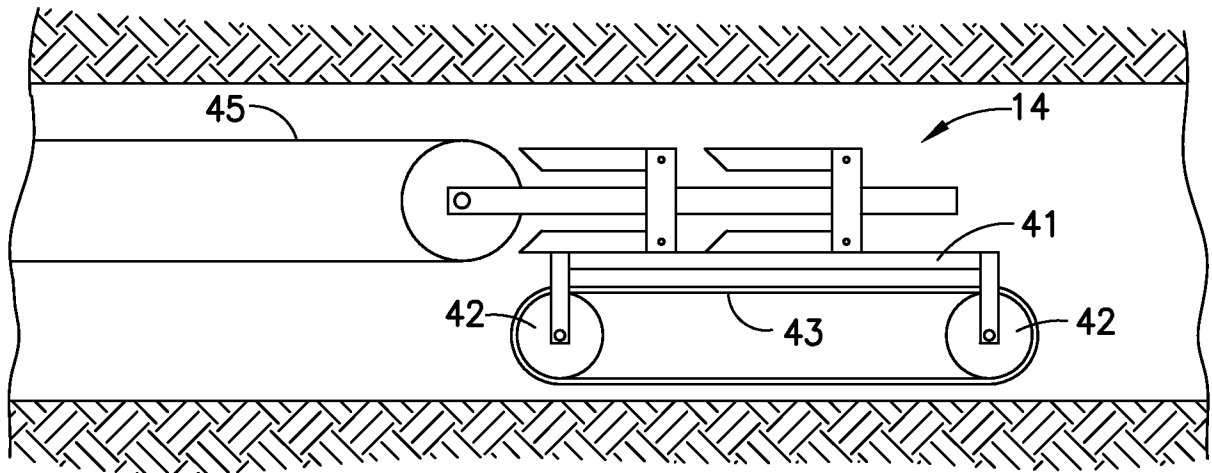


FIG. 4

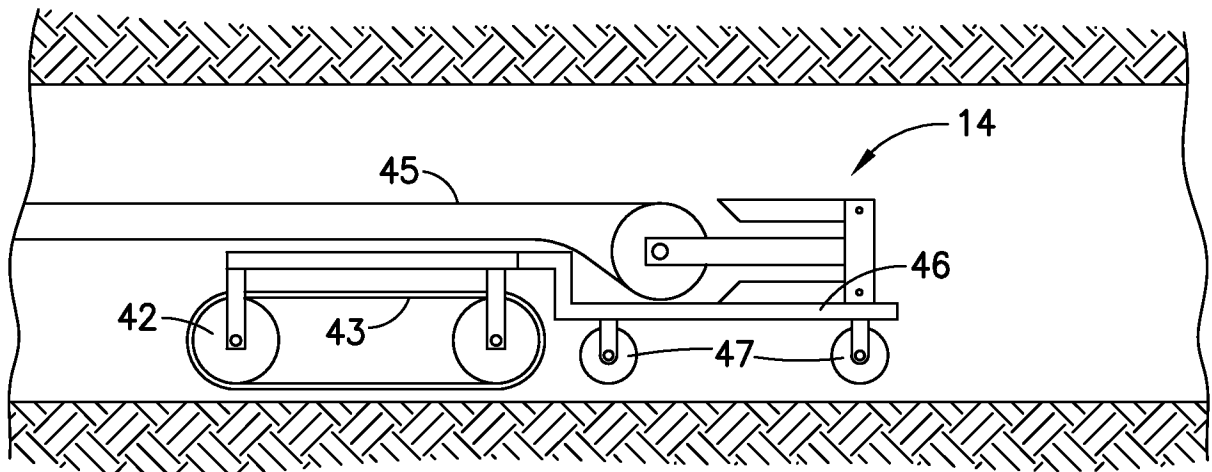
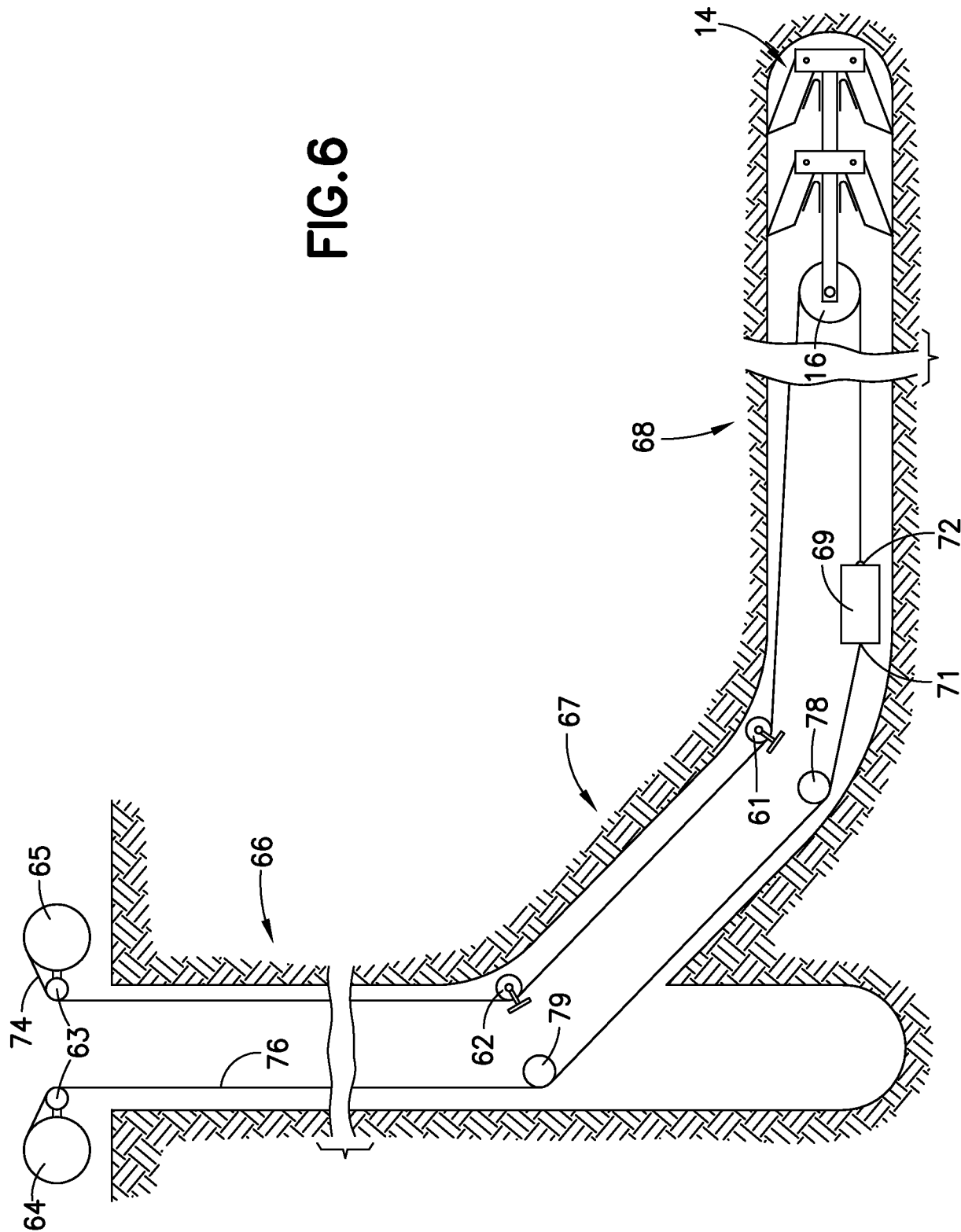


FIG. 5

FIG. 6



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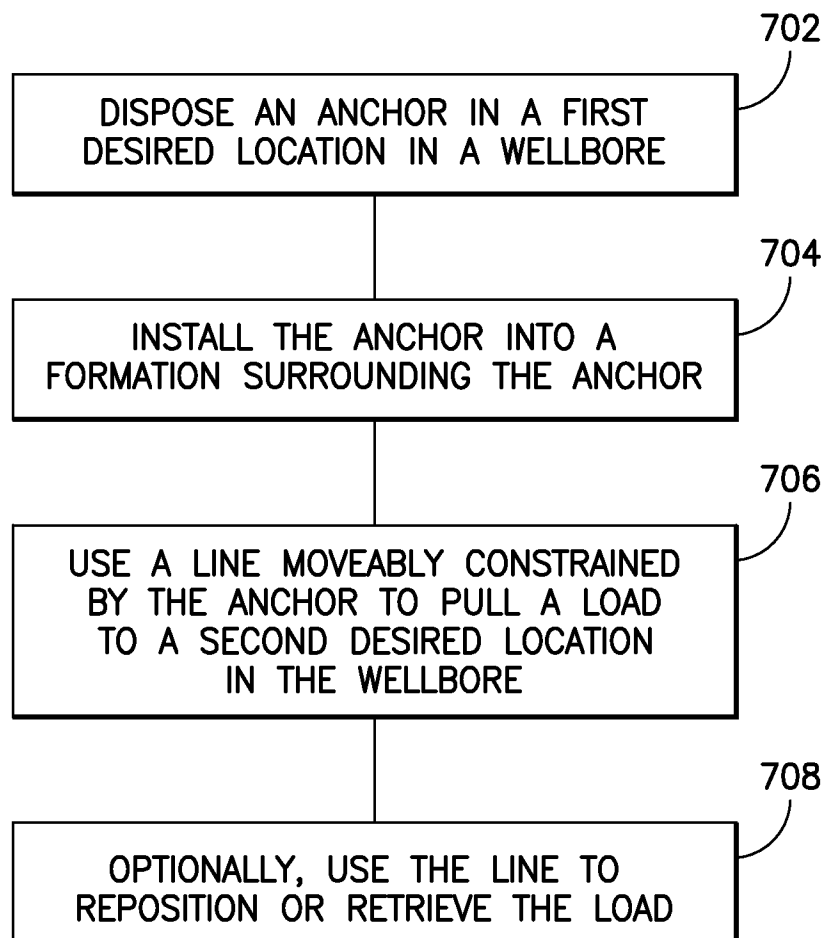


FIG.7

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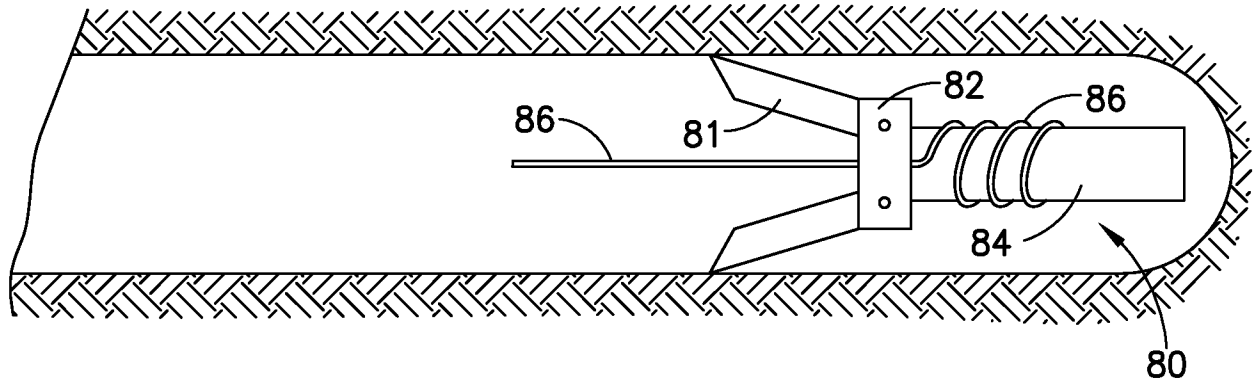


FIG. 8

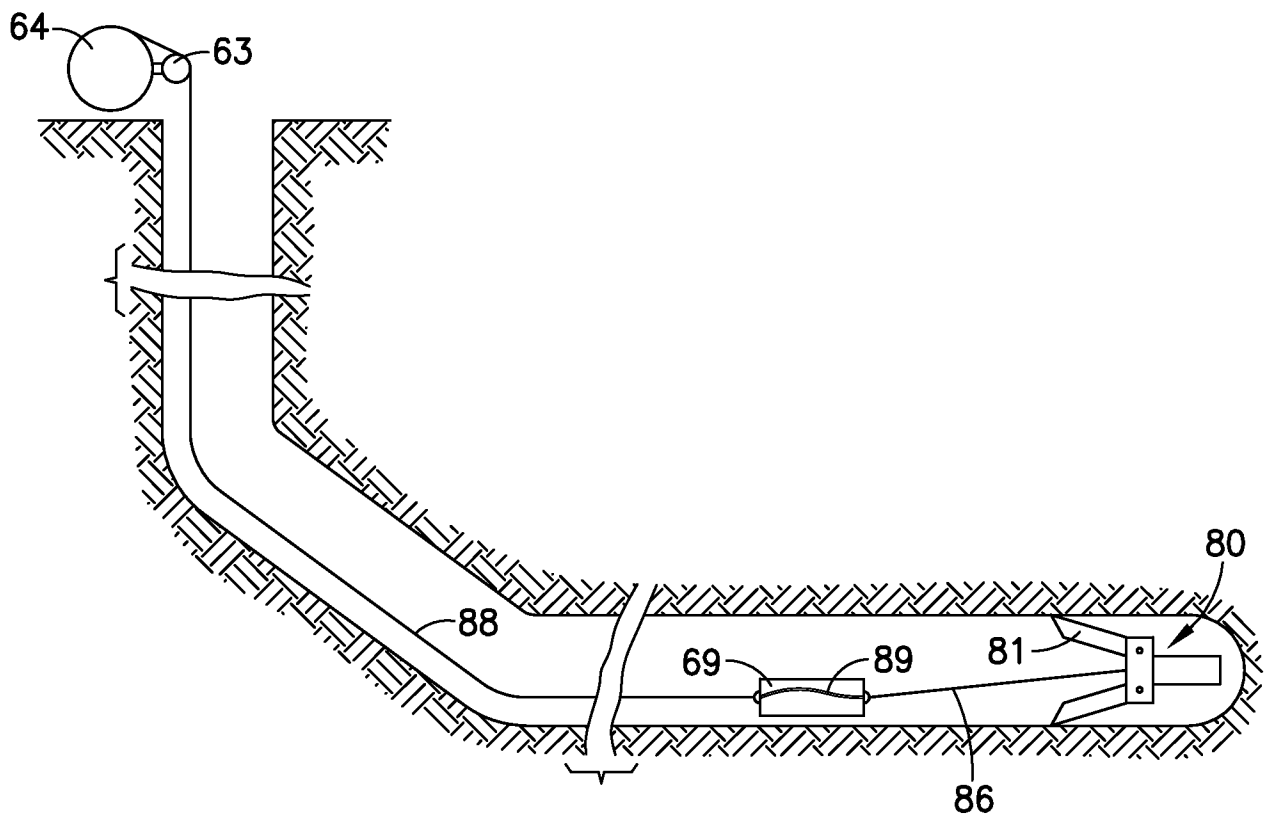


FIG. 9

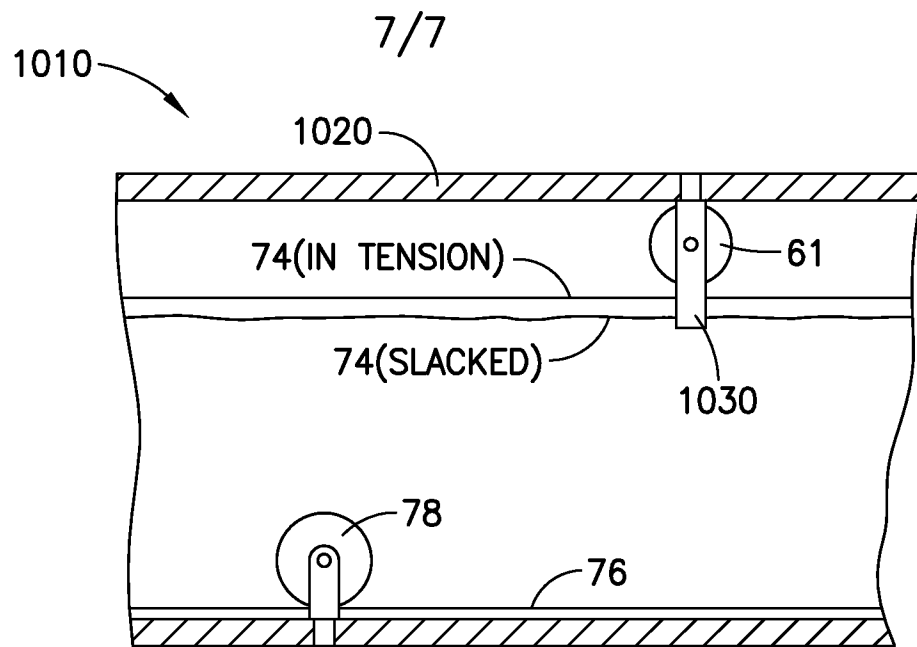


FIG. 10A

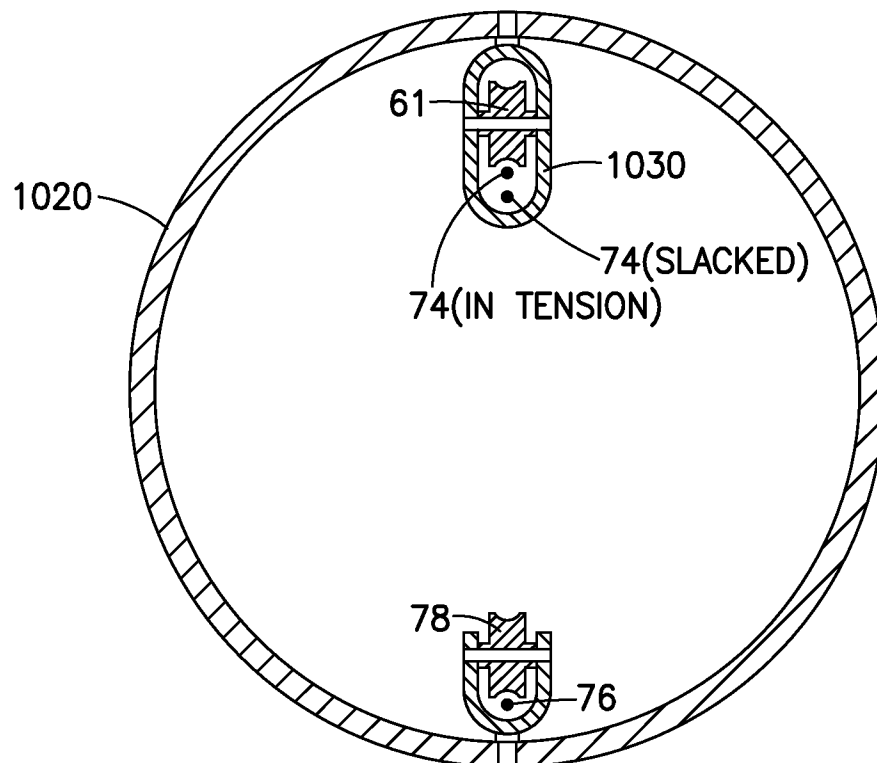


FIG. 10B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/018221**A. CLASSIFICATION OF SUBJECT MATTER****E21B 23/01(2006.01)i, E21B 23/14(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B 23/01; E21B 23/14; E21B 47/12; E21B 23/00; E21B 19/02; H01B 3/00; G02B 6/44; E21B 17/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: wellbore, anchor, pulley, line, arm, drive mechanism, load, spool, and tension

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3550684 A1 (CUBBERLY, WALTER E. JR.) 29 December 1970 See column 1, line 65 - column 3, line 68 and figures 1-4.	1-15, 17-18
Y		16, 19-22
Y	US 2011-0284244 A1 (FLAMANT et al.) 24 November 2011 See paragraph [0033] and figure 1.	16, 22
Y	WO 2013-011130 A1 (SERVICES PETROLIERS SCHLUMBERGER et al.) 24 January 2013 See paragraph [0030] and figure 1.	19-22
A	US 2010-0258293 A1 (LYNDE et al.) 14 October 2010 See paragraphs [0028]-[0030] and figures 5-7.	1-22
A	US 4271908 A (ROBINSON, JR. et al.) 09 June 1981 See column 4, line 57 - column 5, line 45 and figures 1-2.	1-22

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

08 June 2015 (08.06.2015)

Date of mailing of the international search report

10 June 2015 (10.06.2015)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/018221

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 4271908 A	09/06/1981	WO 81-02181 A1	06/08/1981