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(54) Title: METHOD AND SYSTEMS FOR STICK MITIGATION OF CABLE

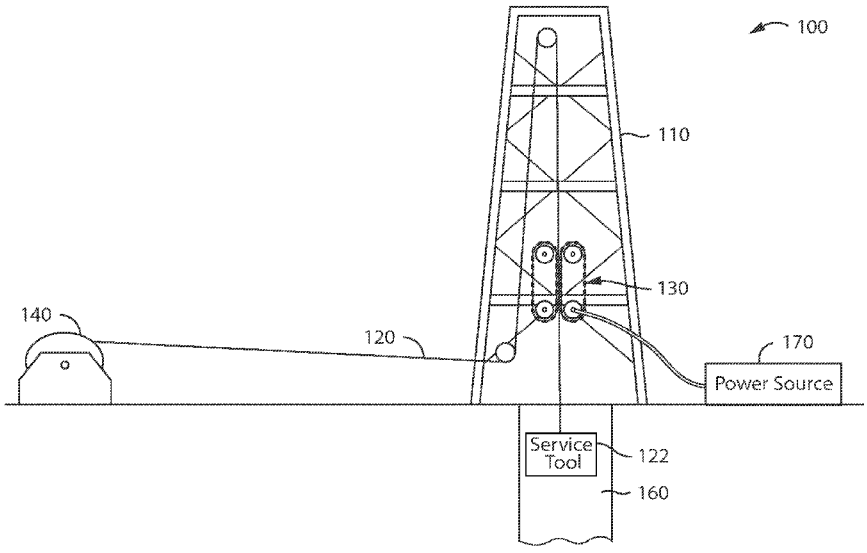

FIG. 1

(57) Abstract: A system for stick mitigation of a cable in a well includes a derrick operatively aligned with a well. The derrick supports a cable and a cable injector. The cable injector is operatively aligned with the well and the cable, and the cable injector is disengaged during normal operations.

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METHOD AND SYSTEMS FOR STICK MITIGATION OF CABLE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This Application claims benefit and priority to Unites States Patent Application No. 14/033313, entitled "Method and Systems for Stick Mitigation of Cable", which was filed on September 20, 2013, the entirety of which is incorporated herein by reference.

FIELD OF THE DISCLOSURE

[0002] The disclosure generally relates to methods and systems for stick mitigation on cable.

BACKGROUND

[0003] Cable is used in many well services. For example, cable is used to deploy tools into the well. The tension on cable during well service has increased as wells are drilled to greater depths.

[0004] Capstans are used to reduce tension on cable. The capstan, however, requires cable to bend about sheaves, and bending the cables about the sheaves can reduce the cable's working ends-fixed break strength (EFBS) to about from 60 percent to about 65 percent of the cable's rated EFBS.

[0005] A need exists, therefore, for systems and methods for stick mitigation of cable that allows cable to have a larger working EFBS, allowing greater forces to be applied to the cable if the cable, a tool string connected with the cable, or both get stuck in the well.

SUMMARY

[0006] An embodiment of a system for stick mitigation of cable in a well can include a derrick operatively aligned with the well. The derrick can support a cable, and a cable injector can be connected with the derrick. The cable injector can be operatively aligned with the well and the cable, and the cable injector can be disengaged as the cable is run into the well. In an embodiment, a drum can be used

to move the cable relative to the well, and a capstan can be located between the derrick and the drum.

[0007] An embodiment of a method for stick mitigation of cable in a well can include performing a well service using cable supported by a derrick. The method can further include moving the cable relative to the well with a drum during normal operations. The method can also include engaging a cable injector to pull on the cable if the cable is stuck in the well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 depicts an example embodiment of a system.

[0009] FIG. 2 depicts another example embodiment of a system.

[0010] FIG. 3 depicts an example of cable injector blocks.

[0011] FIG. 4 depicts an example cable.

[0012] FIG. 5 depicts an example method.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Certain examples are shown in the above-identified figures and described in detail below. In describing these examples, like or identical reference numbers are used to identify common or similar elements. The figures are not necessarily to scale and certain features and certain views of the figures may be shown exaggerated in scale or in schematic for clarity and/or conciseness.

[0014] A system for stick mitigation of cable in a well can include a derrick operatively aligned with the well. The derrick can support the cable as the cable is used to perform well services. The cable can be any cable used in well services; however, in an embodiment the cable is a wireline cable. The wireline cable can be a polymer-locked, crush-free wireline cable or any other wireline cable.

[0015] A cable injector can be connected with the derrick. The cable injector can be connected with the derrick in any manner. For example, the cable injector can be hung on the derrick and aligned with the well. The cable injector can be operatively aligned with the well and the cable. For example, the cable injector can be aligned with the cable and well allowing the cable injector to provide force to the cable that is perpendicular to the well. The cable injector can be disengaged during normal

operations. Normal operations, as used herein, means that neither the cable, a tool string connected with the cable, or both are stuck in the well.

[0016] During normal operations, a drum connected with the cable can be used to move the cable relative to the well. For example, the drum can run the cable into the well and pull the cable out of the well. In an embodiment of the system, a capstan can be located between the derrick and the drum.

[0017] An example method for stick mitigation of cable in a well includes performing a well service using a cable supported by a derrick, and moving the cable relative to the well with a drum. During normal operation of the system the well service can be performed with the cable injector disengaged; however, the cable injector can be engaged to pull on the cable if the cable is stuck in the well during the well service, deployment of the cable, retrieval of the cable, or combinations thereof. The cable injector can pull on the cable with a force that is up to about 85 percent of the cables designed ends-fixed break strength.

[0018] Turning now to the FIGS. FIG. 1 depicts an example embodiment of a system.

[0019] The system **100** includes a derrick **110** operatively supporting a cable **120**. For example, a plurality of sheaves can be connected with the derrick **110**, and the sheaves can guide and support the cable **120**. The cable **120** at one end can be connected with a service tool **122**. The service tool **122** can be measurement equipment, telemetry equipment, pumping equipment, perforating equipment, other downhole equipment, or combinations thereof. For example, a combination of sensors and other downhole equipment can be assembled to form a toolstring, and the toolstring can be connected with the cable. The cable **120** at another end can be connected with a drum **140**.

[0020] The drum **140** can be used to run the cable **120** into the well **160**. The drum **140** can move the cable **120** relative to the well **160**. The cable **120** can be used to deploy the attached service tool **122** to a desired depth so a service operation can be performed. After the service operation is performed, the drum **140** can be used to retrieve the cable **120** and the attached service tool **122**.

[0021] A cable injector **130** is operatively connected with the derrick **110**. The cable injector **130** can be any cable injector. A power source **170** can be in communication with the cable injector **130**. The power source **170** can be an electric power source, a hydraulic power source, a pneumatic power source, or combinations thereof.

[0022] During normal operation of the system **100**, the cable injector **130** is disengaged, and the drum **140** provides the force on the cable **120** that is necessary to run the cable **120** into the well **160** and pull the cable **120** out of the well **160**. The cable **120**, the connected service tool **122**, or both may get stuck in the well **160**. For example, the service tool **122** may catch on an obstruction in the well **160**. Additional force may need to be applied to the cable **120** to free the cable **120**, the service tool **122**, or both when the cable **120**, the service tool **122**, or both are stuck, and normal operation of the system is no longer possible.

[0023] To provide the additional force, the cable injector **130** is engaged and the power source **170** provides power to a drive assembly of the cable injector **130**. Engaging the cable injector **130** can include providing power, using the power source **170** to one or more actuators (not shown), such as linear actuators, to move a pair of cable blocks (shown in detail below) into engagement with one another. The engaged cable injector **130** can provide force to the cable **120**, and the force applied to the cable **120** can be perpendicular to or substantially in line with the well **160**. Accordingly, the cable **120** is pulled in a straight line by the cable injector **130**. The cable injector **130** provides force until the cable **120** and the service tool **122** are free to move relative to the well, allowing normal operations to resume. Once normal operations resume, the cable injector **130** is disengaged.

[0024] FIG. 2 depicts another example embodiment of a system. The system **200** includes the derrick **110**, the cable injector **130**, the cable **120**, and the drum **140**. The power source **170** can be in communication with the cable injector **130**, and the service tool **122** can be connected with the cable **120**.

[0025] The system **200** can also include a capstan **150**. The capstan **150** can be located between the derrick **110** and the drum **140**. The capstan **150** can reduce tension on the cable **120** during normal operations. For example, as the drum **140** runs the cable **120** into the well **160** to deploy the service tool **122**, the capstan **150** can reduce the tension on the cable **120** to the drum **140**.

[0026] FIG. 3 depicts an example of cable injector blocks. A first cable injector block **310** and a second cable injector block **320** can cooperate to provide force to the cable **120**, when the cable injector is engaged.

[0027] The first cable injector block **310** can include a first belt **314**. The first belt **314** can be located on a first drive assembly (not shown). The first drive assembly can be any drive system. Illustrative drive assemblies include hydraulic systems, electric

systems, and pneumatic systems. A first channel **312** can be located on the first belt **314.** The first channel **312** is configured to fit about the cable **120**.

[0028] The second cable injector block **320** can include a second belt **324**. The second belt **324** can be disposed about a second drive assembly (not shown). The second drive assembly can be any drive system. The second belt **324** can have a second channel **322**. The first channel **312** is aligned with the second channel **322** when the injector block is operatively installed on the derrick. Accordingly, the first belt **314** and the second belt **324** can engage one another when the injector block is engaged, and the first channel **312** and the second channel **322** can secure about the cable **120**. The belts **314** and **324** can move and provide force to the cable **120.**

[0029] The belts **314** and **324** can be made of any material that allows the belts **314** and **324** to tightly grip the cable **120** without damaging the cable **120**. The material can be softer than the cable **120**. Illustrative materials include wood, polymers, or metal.

[0030] FIG. 4 depicts an example cable. The example cable **120** includes a core **410**, inner armor **420**, and outer armor **430**.

[0031] The core **410** can have any number of conductors **412**. The conductors **412** can have a jacket **414** disposed thereabout. A polymer **422** can fill the core **410** and interstitial spaces between the inner armor **420** and the outer armor **430**. The polymer **422** can be crush-resistant polymer. The polymer **422** locks the armor layers **420** and **430** with the jacket **414**. Accordingly, the armor layers **420** and **430** are locked with the core **410**. The design of the cable **120** provides a mechanically rigid, torque-balanced and crush-free wireline cable that reduces issues with core coldflow, cable rotation, plastic stretch, armor stranding, and bird-caging.

[0032] The cable **120** can be spooled under high-tension. For example the cable **120** can be spooled at a tension of about 13,000 lbf, handle instantaneous pulls of about 18,000 lbf, and with a safety margin of about 9,000 lbf.

[0033] FIG. 5 depicts an example method. The method **500** is depicted as a plurality of blocks or operations.

[0034] The method **500** includes performing a well service using a cable supported by a derrick (Block **510**). The method **500** continues by moving the cable relative to the well with a drum during normal operations (Block **512**). In an embodiment of the method a capstan located between the derrick and drum is used to reduce cable tension during normal operations.

[0035] The method also includes engaging a cable injector to pull on the cable if the cable is stuck in the well (Block **514**). The cable can be stuck in the well when a service tool connected with the cable is stuck or the cable is otherwise stuck. The cable injector can be engaged by providing power to actuators and moving injector blocks into engagement about the cable. Power can then be delivered to a drive system connected with the cable injector, and the cable injector pulls on the cable with a force that is up to about 80 percent of the cables ends-fixed break strength. During normal operations, the cable injector is disengaged.

[0036] Although example assemblies, methods, systems have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers every method, apparatus, and article of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

What is claimed is:

1. A system for stick mitigation of cable in a well, wherein the system comprises:

a derrick operatively aligned with a well;

a cable supported by the derrick; and

a cable injector connected with the derrick, wherein the cable injector is operatively aligned with the well and the cable, and wherein the cable injector is disengaged during normal operations.

2. The system of claim 1, wherein the cable injector is hung on the derrick.

3. The system of claim 1, wherein the cable is a polymer-locked, crush-free wireline cable.

4. The system of claim 1, further comprising:

a drum connected with the cable, wherein the drum runs the cable in the well, and wherein the drum pulls the cable out of the well.

5. A system for stick mitigation of cable in a well, wherein the system comprises:

a derrick operatively aligned with a well;

a cable supported by the derrick;

a drum for running the cable into and pulling the cable out of the well;

a capstan located between the derrick and the drum; and

a cable injector connected with the derrick, wherein the cable injector is operatively aligned with the well and the cable, and wherein the cable injector is disengaged as the cable is run into the well.

6. A method for stick mitigation of cable in a well, wherein the method comprises:

performing a well service using a cable supported by a derrick;

moving the cable relative to the well with a drum during normal operations; and

engaging a cable injector to pull on the cable if the cable is stuck in the well.

7. The method of claim 6, wherein the cable injector pulls on the cable with a force that is up to 85 percent of the cables ends-fixed break strength.

8. The method of claim 6, wherein the cable injector is disengaged during normal operations.

9. The method of claim 6, wherein engaging the cable injector comprises providing hydraulic power thereto.

10. The method of claim 6, further comprising using a capstan located between the derrick and drum to reduce cable tension during normal operations.

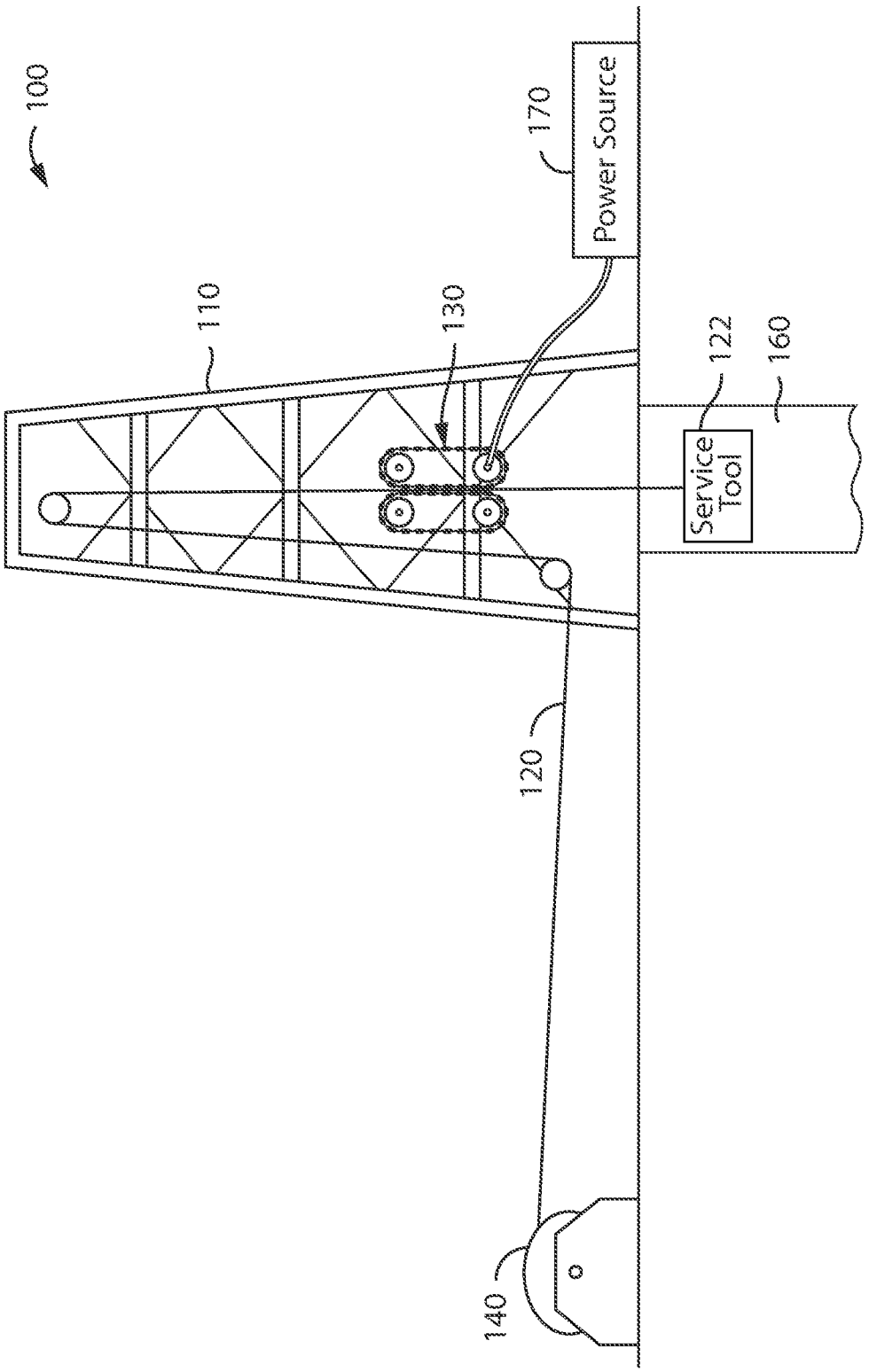

FIG. 1

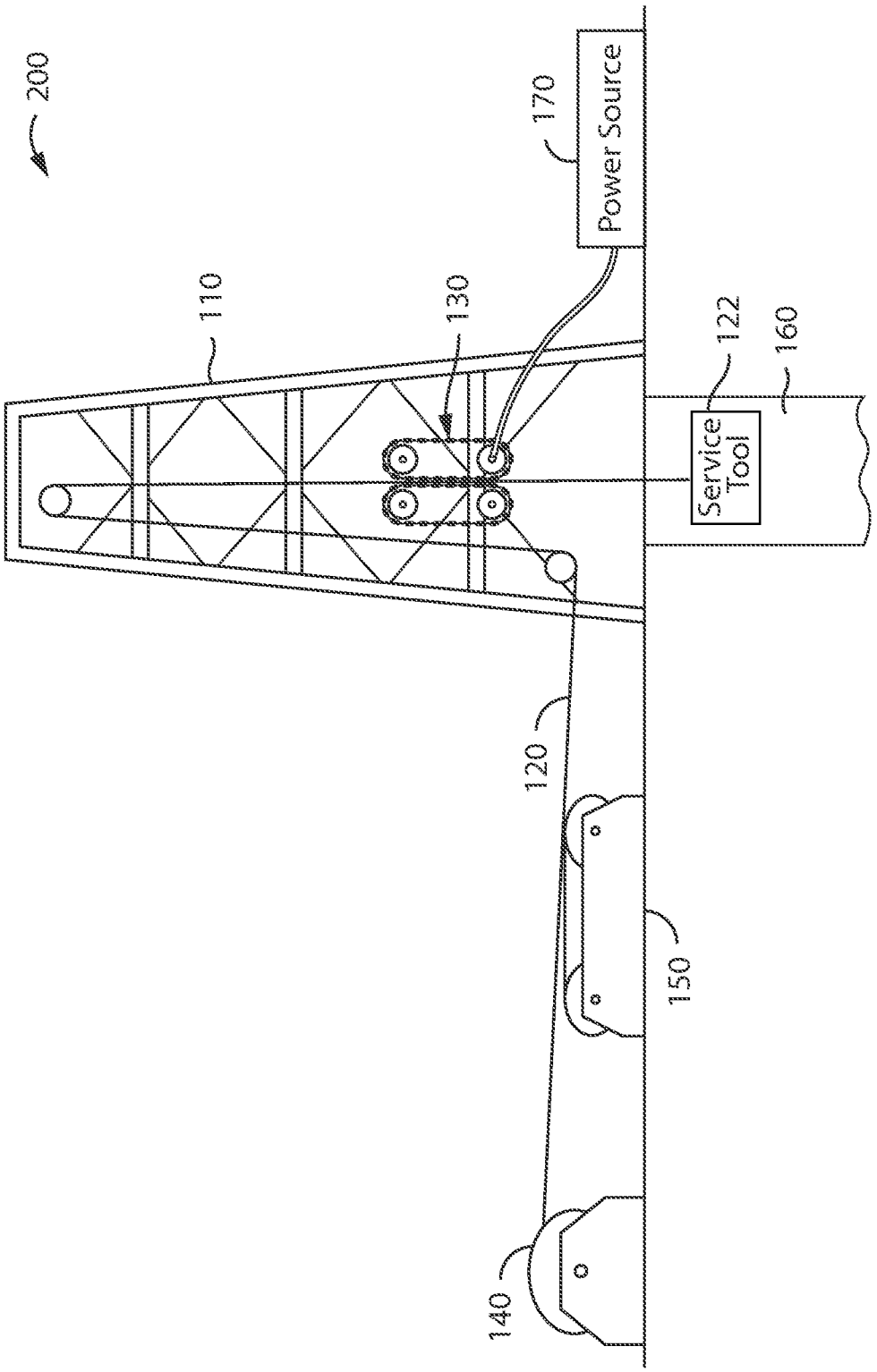

FIG. 2

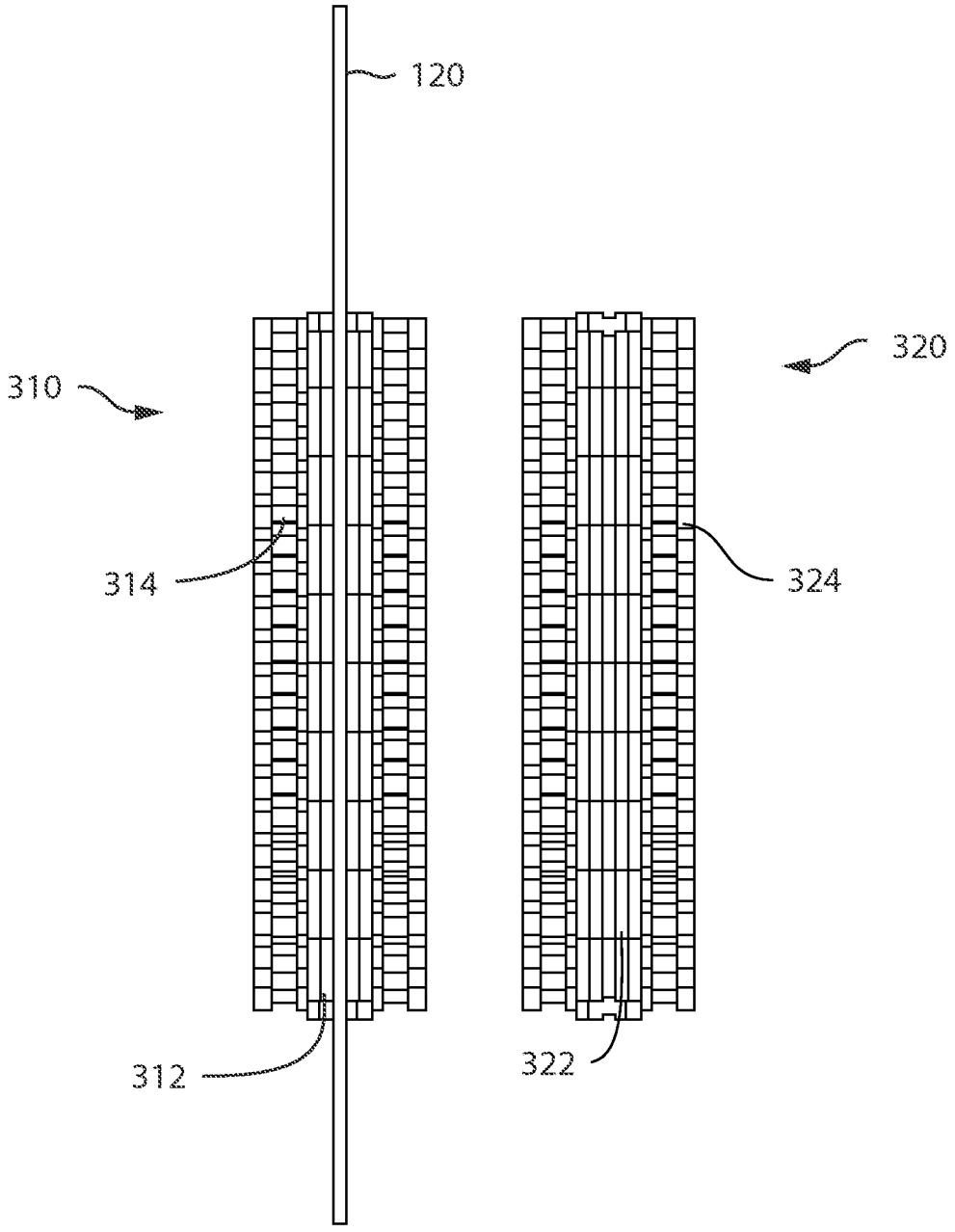

FIG. 3

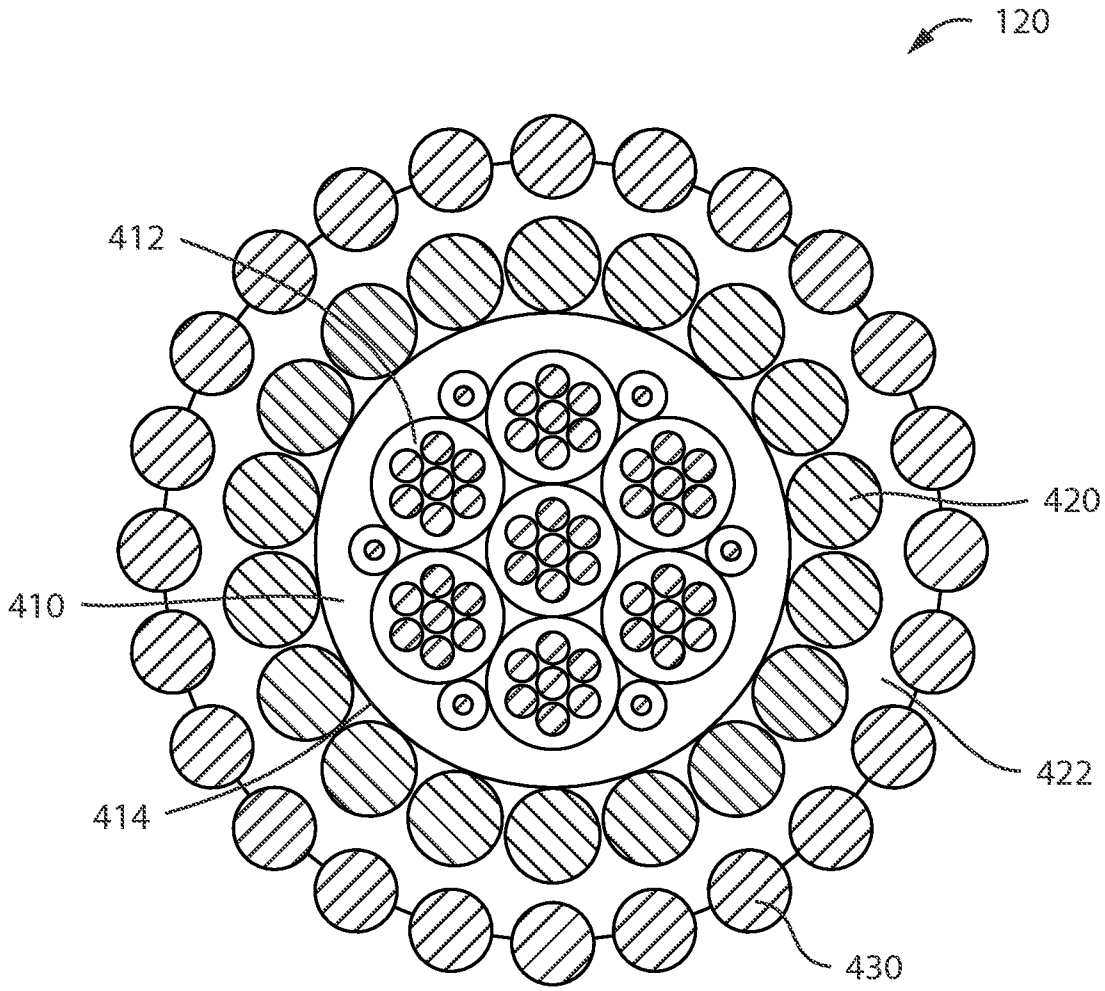

FIG. 4

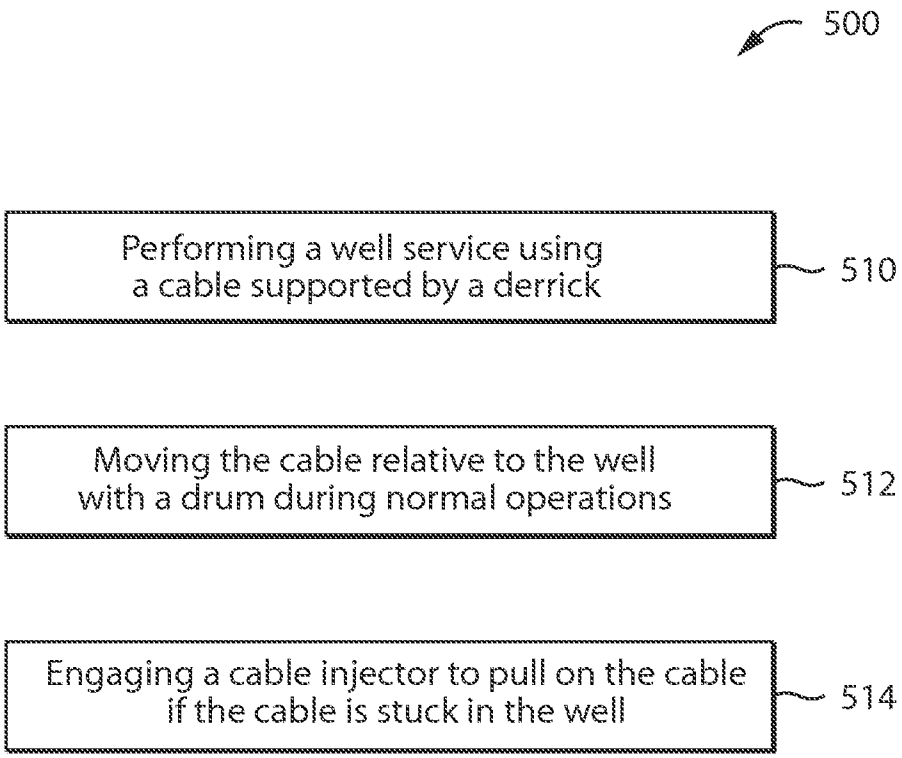
500
Performing a well service using a cable supported by a derrick
510
Moving the cable relative to the well with a drum during normal operations
512
Engaging a cable injector to pull on the cable if the cable is stuck in the well
514

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/056297

A. CLASSIFICATION OF SUBJECT MATTER

E21B 19/00(2006.01)i, E21B 19/02(2006.01)i, E21B 23/14(2006.01)i, E21B 15/00(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 19/00; H02G 1/08; E21B 41/06; E21B 19/08; E21B 19/16; E21B 19/02; E21B 23/14; E21B 15/00

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, rig, derrick, cable, cable injector, belt, and pulley

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6276454 B1 (FONTANA et al.) 21 August 2001 See column 4, line 46 - column 7, line 53; column 15, lines 34-36 and figures 1,5A.	1-4,6-9
Y		5,10
Y	US 2009-0020294 A1 (VARKEY et al.) 22 January 2009 See abstract and paragraph [0044] and figure 5.	5,10
A	US 4899823 A (COBB et al.) 13 February 1990 See abstract, column 4, line 42 - column 5, line 55 and figure 5.	1-10
A	US 2005-0247454 A1 (DOMANN et al.) 10 November 2005 See paragraphs [0012]-[0021] and figures 1-3.	1-10
A	US 6179269 B1 (KOBYLINSKI, LEE S.) 30 January 2001 See column 7, lines 5-65 and figure 7.	1-10

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"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	Date of mailing of the international search report
29 December 2014 (29.12.2014)	**29 December 2014 (29.12.2014)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/056297

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