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(54) Title: WIRELINE RETRIEVABLE PROGRESSING CAVITY PUMP

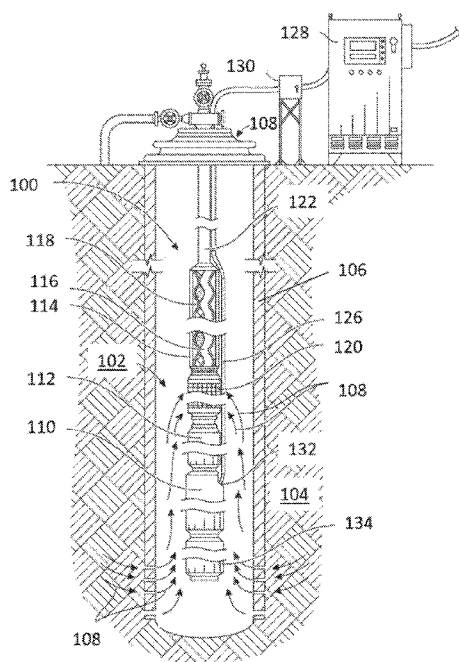


FIG. 1

(57) Abstract: A progressive cavity pump system may comprise a progressive cavity pump (PCP) configured to be deployed in a wellbore, an electric motor, wherein the PCP is configured to rotate at the same speed as the electric motor, and a first portion of the pumping system is configured to be replaced, via a tensile element, without replacing a second portion of the pumping system. The first portion may comprise the PCP and the second portion may comprise the motor.

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WIRELINE RETRIEVABLE PROGRESSING CAVITY PUMP**CROSS REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims priority benefit of U.S. Provisional Application No. 63/513,585 filed July 14, 2023, the entire contents of which are herein incorporated by reference in their entirety.

BACKGROUND

[0002] In many well applications, electric submersible pumps (ESPs) are deployed downhole to provide artificial lift for lifting oil to a collection location. An ESP has a series of centrifugal pump stages contained within a protective housing and mated to a submersible electric motor. The ESP may be installed at the end of a production string and is powered and controlled via an armor protected cable. Electric submersible pumps may be used in a variety of moderate-to-high-production rate wells, however each ESP is designed for a specific well and for a relatively tight range of pumping rates.

[0003] In many well applications, electric submersible pumps (ESPs) are deployed downhole to provide artificial lift for lifting oil to a collection location. An ESP has a series of centrifugal pump stages contained within a protective housing and mated to a submersible electric motor. The ESP may be installed at the end of a production string and is powered and controlled via an armor protected cable. Electric submersible pumps may be used in a variety of moderate-to-high-production rate wells, however each ESP is designed for a specific well and for a relatively tight range of pumping rates.

SUMMARY

[0004] A progressive cavity pump system may comprise a progressive cavity pump (PCP) configured to be deployed in a wellbore; an electric motor, wherein the PCP is configured to rotate at the same speed as the electric motor; and a first portion of the pumping system is configured to be replaced, via a tensile element, without replacing a second portion of the pumping system. The first portion may comprise the PCP and the second portion may comprise the motor. The first portion may comprise the PCP, a mandrel, a support unit, a motor protector, a flexible unit, a motor, a motor stator, a motor rotor, a pump stator, a pump rotor, a stator, a gauge, or a motor lead extension (MLE). The second portion may comprise the PCP, a mandrel, a support unit, a motor

protector, a flexible unit, a motor, a motor stator, a motor rotor, a pump stator, a pump rotor, a stator, a gauge, or a motor lead extension (MLE). An operating speed of the motor may be equal or less than 500 revolutions per minute (RPM). The operating speed of the motor may be greater than 500 and less than 1000 revolutions per minute (RPM). The operating speed of the motor may be greater or equal to 1000 and less than or equal to 2000 revolutions per minute (RPM). The progressive cavity pump system may comprise an anchoring system configured to prevent a rotation of the progressive cavity pump system in the wellbore. The progressive cavity pump system may comprise an anchoring system to prevent an axial movement of the PCP system in the wellbore. The motor may comprise a permanent magnet motor (PMM). The motor may comprise an induction motor. The progressive cavity pump system may comprise an anchoring system coupled to the motor. The progressive cavity pump system may comprise a tubing drain that is configured to be hydraulically actuated. 14. The tensile element may comprise a wireline, a slickline, a coil tubing, one or more ropes, one or more cables, or a sucker rod. A method for retrieving a progressive cavity pump (PCP) may comprise retrieving a first portion of the PCP, wherein the PCP was deployed in a wellbore, using a tensile element to retrieve the first portion of the PCP without replacing a second portion of the pumping system, and retracting an anchoring system. A method comprising: disposing an anchoring system of a progressive cavity pump within a wellbore; and operatively coupling a stator assembly to the anchoring system via a non-conduit element.

BRIEF DESCRIPTION OF DRAWINGS

[0001] FIG. 1 shows an electric submersible progressive cavity pump system.

[0002] FIG. 2 shows a wireline retrievable stator assembly for a progressive cavity pump.

[0003] FIG. 3 shows another view of a wireline retrievable stator assembly for a progressive cavity pump.

[0004] FIG. 4 shows yet another electric submersible progressive cavity pump system.

DETAILED DESCRIPTION OF DRAWINGS

[0005] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. 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 disclosure. These are, of course, merely examples and are not intended to be limiting. In addition, the 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. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments are possible. This description is not to be taken in a limiting sense, but rather made merely for the purpose of describing general principles of the implementations. The scope of the described implementations should be ascertained with reference to the issued claims.

[0006] As used herein, the terms “connect”, “connection”, “connected”, “in connection with”, and “connecting” are used to mean “in direct connection with” or “in connection with via one or more elements”; and the term “set” is used to mean “one element” or “more than one element”. Further, the terms “couple”, “coupling”, “coupled”, “coupled together”, and “coupled with” are used to mean “directly coupled together” or “coupled together via one or more elements”. As used herein, the terms “up” and “down”; “upper” and “lower”; “top” and “bottom”; and other like terms indicating relative positions to a given point or element are utilized to more clearly describe some elements. Commonly, these terms relate to a reference point at the surface from which drilling operations are initiated as being the top point and the total depth being the lowest point, wherein the well (e.g., wellbore, borehole) is vertical, horizontal or slanted relative to the surface.

[0007] According to an embodiment, the electric submersible progressive cavity pump system combines a progressive cavity pump with a motor and a gearbox which are all submersible and may be fully submersed downhole. This allows the electric submersible progressive cavity pump system to be constructed as a drop-in replacement for an ESP and to utilize the same surface equipment. As a result, continued production can be maintained on a cost effective basis. Additionally, use of a progressive cavity pump enables use of the overall electric submersible progressive cavity pump system in a wide variety of wells including unconventional deviated wells, e.g. horizontal wells.

[0008] Referring generally to Figure 1, an example of an electric submersible progressive cavity pump system 100 is illustrated as deployed in a borehole 102, e.g. a wellbore. In this

embodiment, the wellbore 102 is drilled into a subterranean formation 104 and, in some applications, may be lined with casing 106. Perforations are formed through the casing 106 and out into the surrounding formation 104 to enable the inflow of oil 108 and/or other fluids which may then be pumped to a collection location via the electric submersible progressive cavity pump system 100.

[0009] According to the example illustrated, the electric submersible progressive cavity pump system 100 may comprise a submersible motor 110, e.g. an induction motor or a PMM (permanent magnet motor), a submersible gearbox 112 driven by the motor 110, and a progressive cavity pump 114 driven via the gearbox 112. The progressive cavity pump 114 may comprise a rotor 116 rotatably positioned within a surrounding composite stator 118. The motor 110 and gearbox 112 may be used to drive/rotate the rotor 116 within the composite stator 118 to pump fluid, e.g. oil 108. For example, the oil 108 entering wellbore 102 may be drawn in through a pump intake 120 and pumped via progressive cavity pump 114 up through a tubing 122, e.g. a production tubing. From tubing 122, the pumped fluid may be directed through a wellhead 124 to an appropriate surface collection location.

[0010] Electric power may be provided downhole to the submersible motor 110 via a power cable 126. In the example illustrated, the power cable 126 is routed along the tubing 122 and connected with a power source 128, e.g. a variable speed drive or switchboard, via a cable junction box 130. However, appropriate electrical power may be provided to the downhole motor 110 via various types of power supply systems. The power cable 126 is connected to the motor 110 by a sealed motor electrical connector 132.

[0011] Depending on the parameters of a given application, the electric submersible progressive cavity pump system 20 may comprise a variety of other components and/or may be coupled with a variety of other components and systems. By way of example, various shaft seals, motor protectors, and other components may be connected with, or integrated into, the motor 110 and/or gearbox 112. In the illustrated example, a lower component 134 is coupled with motor 110 on a downhole side of the motor 110. By way of example, the lower component 134 may be an oil compensator or a base gauge. However, many other types of components and systems may be connected with or used in combination with the electric submersible progressive cavity pump system 20.

[0012] Turning now to FIG. 2, FIG. 2 is a wireline retrievable stator assembly for a progressive cavity pump, such as the progressive cavity pump 114 described above with reference to FIG. 1. The wireline retrievable stator assembly for a progressive cavity pump of FIG. 2 may comprise a fishing neck 202, PC-Pump Stator 204, bi-directional torque anchor 206, and seating cups 208. As shown in FIG. 2, the stator assembly includes a rotor extending through a stator. The stator assembly further includes a fishing neck on an uphole end portion of the stator assembly and a sealing assembly including a torque anchor and seating cups on a downhole end portion of the stator assembly.

[0013] FIG. 3 discloses another view of a wireline retrievable stator assembly for a progressive cavity pump comprising a flexible shaft 302, pump intake 304, rotor flexible shaft connector 306, and a pump seating nipple 308. The fishing neck allows the stator to be installed or removed from an anchoring system positioned within the borehole, shown in FIG. 3.

[0014] The anchoring system includes a pump intake coupled to a seating nipple and surrounding a flexible shaft having a rotor connector. In operation, a wireline is used to run the stator assembly downhole and mate the stator assembly with the anchoring system. As the stator assembly is mated to the anchoring system, as shown in FIG. 4, the rotor of the stator assembly engages with the rotor connector of the anchoring system to transmit torque from a motor coupled to the anchoring system to the rotor. Further, the seating cups and torque anchor engage with the seating nipple to prevent relative axial and rotational movement between the stator assembly and the anchoring system.

[0015] Language of degree used herein, such as the terms “approximately,” “about,” “generally,” and “substantially” as used herein represent a value, amount, or characteristic close to the stated value, amount, or characteristic that still performs a desired function or achieves a desired result. For example, the terms “approximately,” “about,” “generally,” and “substantially” may refer to an amount that is within less than 10% of, within less than 5% of, within less than 1% of, within less than 0.1% of, and/or within less than 0.01% of the stated amount. As another example, in certain embodiments, the terms “generally parallel” and “substantially parallel” or “generally perpendicular” and “substantially perpendicular” refer to a value, amount, or characteristic that departs from exactly parallel or perpendicular, respectively, by less than or equal to 15 degrees, 10 degrees, 5 degrees, 3 degrees, 1 degree, or 0.1 degree.

[0016] Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims. It is also contemplated that various combinations or sub-combinations of the specific features and aspects of the embodiments described may be made and still fall within the scope of the disclosure. It should be understood that various features and aspects of the disclosed embodiments can be combined with, or substituted for, one another in order to form varying modes of the embodiments of the disclosure. Thus, it is intended that the scope of the disclosure herein should not be limited by the particular embodiments described above.

CLAIMS

What is claimed is:

1. A progressive cavity pump system comprising:
 - a progressive cavity pump (PCP) configured to be deployed in a wellbore;
 - an electric motor, wherein the PCP is configured to rotate at the same speed as the electric motor; and
 - a first portion of the pumping system is configured to be replaced, via a tensile element, without replacing a second portion of the pumping system.
2. The progressive cavity pump system of claim 1, wherein the first portion comprises the PCP and the second portion comprises the motor.
3. The progressive cavity pump system of claim 1, wherein the first portion comprises the PCP, a mandrel, a support unit, a motor protector, a flexible unit, a motor, a motor stator, a motor rotor, a pump stator, a pump rotor, a stator, a gauge, or a motor lead extension (MLE).
4. The progressive cavity pump system of claim 1, wherein the second portion comprises the PCP, a mandrel, a support unit, a motor protector, a flexible unit, a motor, a motor stator, a motor rotor, a pump stator, a pump rotor, a stator, a gauge, or a motor lead extension (MLE).
5. The progressive cavity pump system of claim 1, wherein an operating speed of the motor is equal or less than 500 revolutions per minute (RPM).
6. The progressive cavity pump system of claim 1, wherein an operating speed of the motor is greater than 500 and less than 1000 revolutions per minute (RPM).
7. The progressive cavity pump system of claim 1, wherein an operating speed of the motor is greater or equal to 1000 and less than or equal to 2000 revolutions per minute (RPM).
8. The progressive cavity pump system of claim 1, further comprising an anchoring system configured to prevent a rotation of the progressive cavity pump system in the wellbore.
9. The progressive cavity pump system of claim 1, further comprising an anchoring system to prevent an axial movement of the PCP system in the wellbore.

10. The progressive cavity pump system of claim 1, wherein the motor is a permanent magnet motor (PMM).
11. The progressive cavity pump system of claim 1, wherein the motor is an induction motor.
12. The progressive cavity pump system of claim 1, further comprising an anchoring system coupled to the motor.
13. The progressive cavity pump system of claim 1, further comprising a tubing drain that is configured to be hydraulically actuated.
14. The progressive cavity pump system of claim 1, wherein the tensile element comprises a wireline, a slickline, a coil tubing, one or more ropes, one or more cables, or a sucker rod.
15. A method for retrieving a progressive cavity pump (PCP) comprising:
 - retrieving a first portion of the PCP, wherein the PCP was deployed in a wellbore;
 - using a tensile element to retrieve the first portion of the PCP without replacing a second portion of the pumping system; and
 - retracting an anchoring system.
16. A method comprising:
 - disposing an anchoring system of a progressive cavity pump within a wellbore; and
 - operatively coupling a stator assembly to the anchoring system via a non-conduit element.

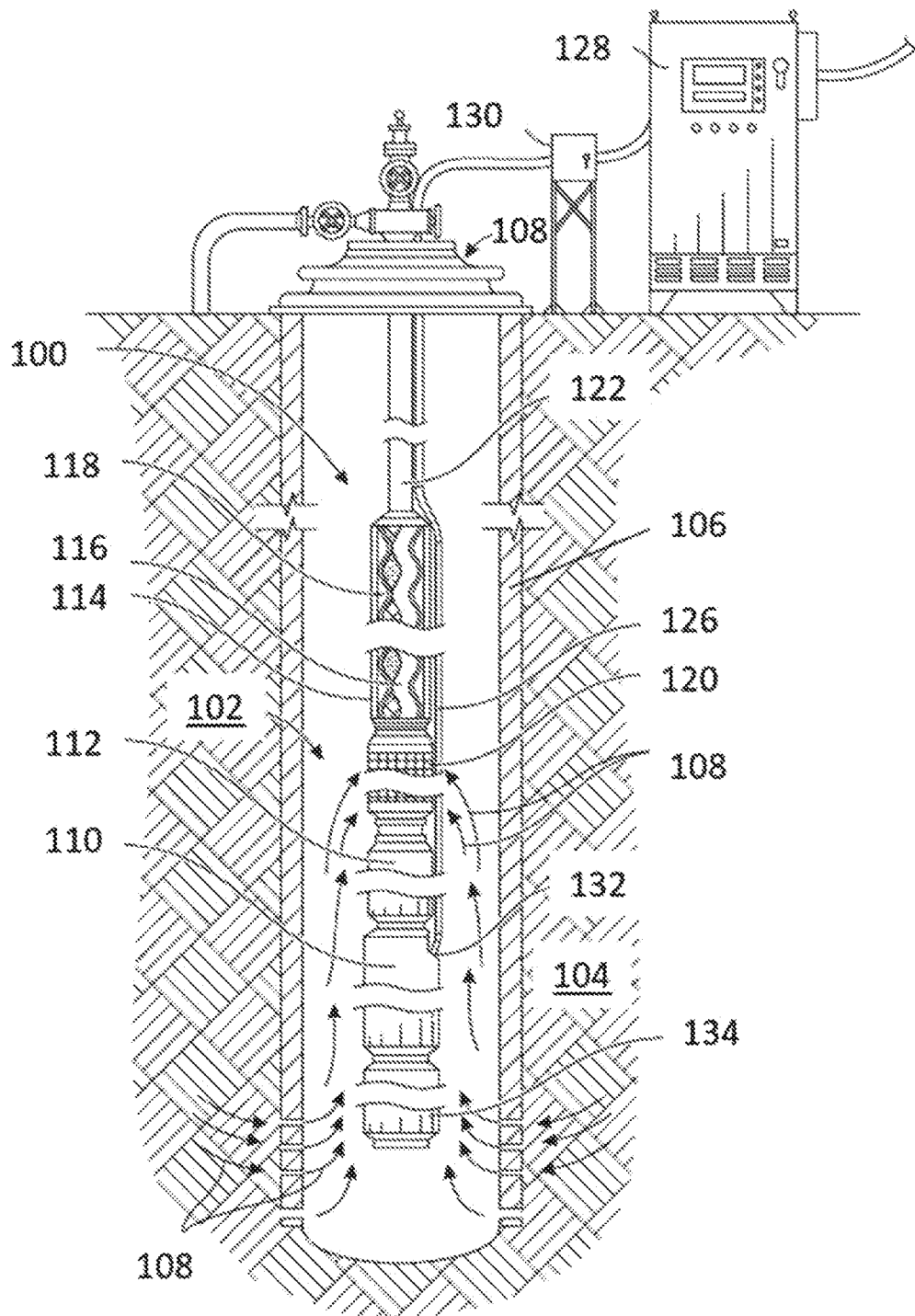


FIG. 1

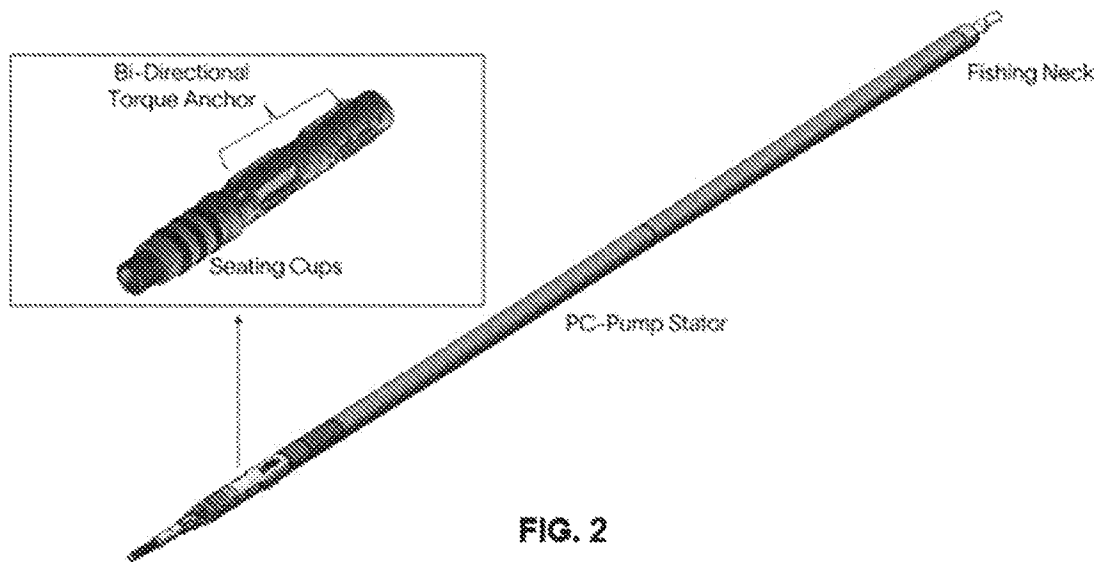


FIG. 2

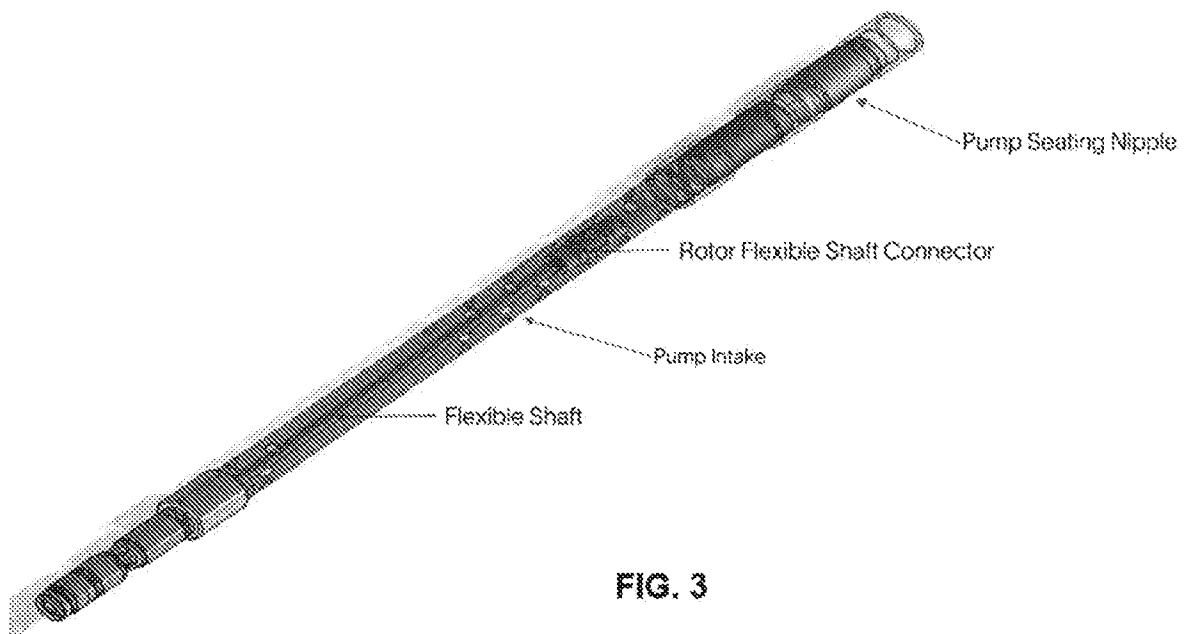


FIG. 3

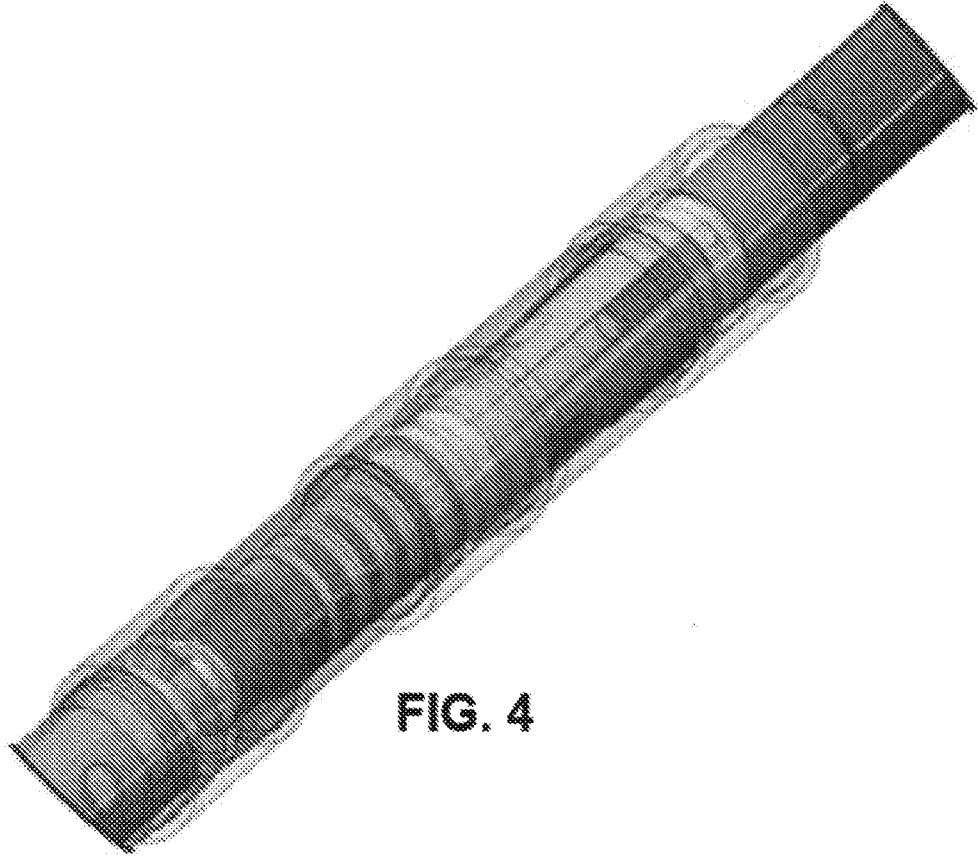


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER**F04D 13/10(2006.01)i; F04D 13/06(2006.01)i; F04D 29/42(2006.01)i; F04D 29/60(2006.01)i; E21B 43/12(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)

F04D 13/10(2006.01); E21B 17/042(2006.01); E21B 23/00(2006.01); E21B 23/01(2006.01); E21B 33/10(2006.01);
E21B 43/12(2006.01); F04B 17/03(2006.01)

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: downhole, wellbore, progressive cavity pump, motor, retrieval, tensile element,
anchoring, tubing darin**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5871051 A (MANN, JAY S.) 16 February 1999 (1999-02-16) abstract, column 3, lines 3-21, claims 1, 36, 44, and figures 1, 2	1-7,14
Y		8-13,15,16
Y	US 2018-0179870 A1 (UPWING ENERGY, LLC) 28 June 2018 (2018-06-28) paragraphs [0105], [0183]-[0196] and figures 1, 7, 17, 23-26, 30	8-12,15,16
Y	US 2015-0259998 A1 (TAZCO HOLDINGS INC.) 17 September 2015 (2015-09-17) paragraph [0067] and figure 15	13
A	US 5746582 A (PATTERSON, JOHN C.) 05 May 1998 (1998-05-05) abstract, claim 1, and figures 2-5	1-16
A	US 6561775 B1 (WEFERS, HANS) 13 May 2003 (2003-05-13) abstract, claim 1, and figures 1-7	1-16



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/US2024/038078

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