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14/968,292 14 December 2015 (14.12.2015) US(71) Applicant: **GENERAL ELECTRIC COMPANY**
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(54) Title: A HYDROCARBON EXTRACTION WELL AND A METHOD OF CONSTRUCTION THEREOF

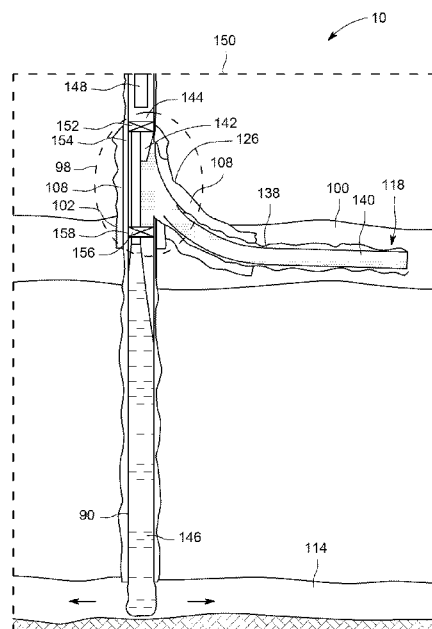


FIG. 1

(57) Abstract: A method for forming a leg junction in a well is provided. The method includes drilling a vertical leg upto a first predetermined depth to form a well bore. The method also includes underreaming the vertical leg at a junction location in the vertical leg to form a first junction section. The method further includes infusing a binding material in the first junction section. The method also includes drilling a lateral leg upto a first predetermined distance through a sidewall of the first junction section. The method further includes underreaming the lateral leg through the sidewall of the first junction section to form a second junction section. The method also includes infusing the binding material in the first junction section and the second junction section to form the leg junction between the vertical leg and the lateral leg.



(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*

A HYDROCARBON EXTRACTION WELL AND A METHOD OF CONSTRUCTION THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority and benefit of U.S. Provisional Application No. 62/195814 entitled “SYSTEM AND METHOD FOR WELL PARTITION AND DOWNHOLE SEPARATION OF WELL FLUIDS” filed on July 23, 2015, which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Embodiments of the present invention relate generally to wells, and more particularly to a hydrocarbon extraction well and a method of construction thereof.

[0003] Non-renewable hydrocarbon fluids such as oil and gas are used widely in various applications for generating energy. Such hydrocarbon fluids are present below the surface of earth. The hydrocarbon fluids are extracted from the hydrocarbon extraction wells which extend below the surface of earth. However, the hydrocarbon fluids in their natural form are not available in a purified form and are available as a mixture of hydrocarbon fluids, water, sand, and other particulate matter together referred to as well fluid. Such well fluids are filtered using different mechanisms to extract hydrocarbon rich stream and a water stream.

[0004] Furthermore, different kinds of wells may be used to extract the hydrocarbon rich stream based on a geographical location of the hydrocarbon extraction well. In one approach, the well fluids are extracted to the surface of the earth and are separated at the surface of the earth, using a surface separator. The water separated from the well fluids is disposed at a certified central water disposal location. However, such an approach increases risk of seismic activity in the geographical location.

[0005] In another approach, the well fluids are separated within the well, using a downhole separator. The water stream separated from the hydrocarbon rich stream, is disposed within the same well. However, in such approaches, well fluids lose flow pressure over a period of time, which reduces life of the hydrocarbon extraction well.

Moreover, in some approaches, the well may include lateral legs which may aid in maintaining the flow pressure of the well fluids. In such configurations, the downhole separator is installed at a junction between the vertical leg and the lateral leg, which may affect structural integrity of the well.

BRIEF DESCRIPTION

[0006] Briefly, in accordance with one embodiment, a method for forming a leg junction in a well is provided. The method includes drilling a vertical leg upto a first predetermined depth to form a well bore. The method also includes underreaming the vertical leg at a junction location in the vertical leg to form a first junction section. The method further includes infusing a binding material in the first junction section. The method also includes drilling a lateral leg upto a first predetermined distance through a sidewall of the first junction section. The method further includes underreaming the lateral leg through the sidewall of the first junction section to form a second junction section. The method also includes infusing the binding material in the first junction section and the second junction section to form the leg junction between the vertical leg and the lateral leg.

[0007] In another embodiment, a well is provided. The well includes a vertical leg and one or more lateral legs in fluid communication with the vertical leg. The well also includes one or more leg junctions formed using a binding material, wherein the one or more lateral legs are connected to the vertical leg at one or more leg junctions.

DRAWINGS

[0008] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

[0009] FIG. 1 is a schematic representation of a well in accordance with an embodiment of the invention.

[0010] FIG. 2 is a schematic representation of a well in accordance with another embodiment of the invention.

[0011] FIG.3 is a flow chart representing steps involved in a method for forming a leg junction in a well in accordance with an embodiment of the invention.

[0012] FIG. 4 is a schematic representation of a step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0013] FIG. 5 is a schematic representation of another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0014] FIG. 6 is a schematic representation of yet another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0015] FIG. 7 is a schematic representation of another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0016] FIG. 8 is a schematic representation of yet another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0017] FIG. 9 is a schematic representation of another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0018] FIG. 10 is a schematic representation of yet another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0019] FIG. 11 is a schematic representation of another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

[0020] FIG. 12 is a schematic representation of yet another step performed in a method for constructing the well of FIG. 1 in accordance with an embodiment of the invention.

DETAILED DESCRIPTION

[0021] Embodiments of the present invention disclose a well and a method for constructing the well. The method includes drilling a vertical leg to a predetermined depth to form a well bore. The method also includes underreaming the vertical leg at a junction location in the vertical leg to form a first junction section. The method further includes infusing a binding material in the first junction section. The method also includes drilling a lateral leg upto a predetermined distance through a sidewall of the first junction section. The method further includes underreaming the lateral leg through the sidewall of the first junction section to form a second junction section. The method also includes infusing the binding material in the first junction section and the second junction section to form a leg junction between the vertical leg and the lateral leg.

[0022] FIG. 1 is a schematic representation of a well 10 in accordance with an embodiment of the invention. The well 10 includes a vertical leg 90 and a lateral leg 118 in fluid communication with the vertical leg 90. The lateral leg 118 is connected to the vertical leg 90 via a leg junction 98. The leg junction 98 includes a first junction section 102 and a second junction section 126. The leg junction 98 is formed using a binding material 108 to provide additional structural integrity at a joint portion between the vertical leg 90 and the lateral leg 118.

[0023] In the illustrated embodiment, the lateral leg 118 includes a liner 138 which extends laterally from the second junction section 126. The lateral leg 118 is located in a production zone 100. The lateral leg 118 includes a plurality of perforations (not shown) which are configured to allow well fluids 140 from the production zone 100 to enter the lateral leg 118. In one embodiment, the well fluids 140 include a

mixture of oil, water, and sand. A separator 142, for example, a downhole separator, is located at the leg junction 98 in the vertical leg 90. The separator 142 is configured to separate the well fluids 140 into a hydrocarbon rich stream 144 and water 146. In one embodiment, the separator 142 may include a centrifugal separator or a cyclonic separator. An electrical submersible pump 148 is located above the leg junction 98, in the vertical leg 90. The electrical submersible pump 148 is configured to transfer the hydrocarbon rich stream 144 to a surface 150 of earth.

[0024] Further, the leg junction 98 includes a first isolation packer 152 disposed at a first end 154 and a second isolation packer 156 disposed at a second end 158. As used herein, “isolation packer” may be defined as a sealing device, which is used to isolate different sections of the well. The electrical submersible pump 148 is disposed above the first isolation packer 152 of the leg junction 98. The vertical leg 90 is connected to a centralized subterranean water disposal zone 114. The water 146 which is separated from the well fluids 140, is disposed in the centralized subterranean water disposal zone 114 via the vertical leg 90.

[0025] FIG. 2 is a schematic representation 170 of another embodiment of a well 172 in accordance with an embodiment of the invention. The well 172 includes a vertical leg 174 and a plurality of lateral legs 176 in fluid communication with the vertical leg 174. Each of the plurality of lateral legs 176 is connected to the vertical leg 174 at corresponding leg junctions 178. In such embodiments, at least one of the plurality of lateral legs 176 is a production leg 180 which is configured to receive well fluids from a production zone 182. Furthermore, at least one of remaining lateral legs is a disposal leg 186, which is used for disposing the water separated from the well fluids. In one embodiment, a first lateral leg in the plurality of lateral legs 176 may be a production leg 180 and a second lateral leg in the plurality of lateral legs 176 may be a disposal leg 186. In another example, a first lateral leg may be a production leg and a second lateral leg, a third lateral leg, and a fourth lateral leg may be disposal legs. The second lateral leg, the third lateral leg, and the fourth lateral leg may be distributed at different locations in a disposal zone 188 to provide a distributed disposal of water separated from the well fluids.

[0026] FIG. 3 is a flow chart representing steps involved in a method 200 for forming a leg junction in a well in accordance with an embodiment of the invention. The method 200 includes a step 202 in which a vertical leg is drilled upto a first predetermined depth to form a well bore. At step 204, the vertical leg is under-reamed at a junction location to form a first junction section. At step 206, a binding material is infused in the first junction section. Furthermore, a lateral leg is drilled upto a first predetermined distance through a sidewall of the first junction section in step 208. At step 210, the lateral leg is under-reamed upto a first predetermined distance to form a second junction section. The second junction section is infused with the binding material in step 212.

[0027] FIG. 4 is a diagrammatical representation 201 of steps 202, 204, and 206 of the method 200 in accordance with the embodiment of FIG. 3. The vertical leg 90 is drilled upto the first predetermined depth 92 to form the well bore 94. The first predetermined depth 92 is determined based on a junction location 96 of a leg junction 98. The junction location 96 of the leg junction 98 is within or adjacent to the production zone 100. In other embodiments, the junction location 96 may also be adjacent or within a distributed water disposal zone as shown in FIG. 2. Furthermore, the vertical leg 90 is under-reamed to form a first junction section 102. In the illustrated embodiment, a width 104 of the first junction section 102 is greater than a width 106 of the vertical leg 90. Subsequently, the first junction section 102 is infused with the binding material 108. In one embodiment, the binding material 108 may include cement. The binding material 108 is allowed to settle and dry for a predefined time period prior to initiating further steps in the method 70.

[0028] FIG. 5 is a diagrammatical representation of an intermediate step 213 for the formation of the vertical leg 90 in accordance with an exemplary embodiment. The vertical leg 90 is drilled through the first junction section 102 such that the width 104 of the first junction section 102 is equal to the width 106 of the vertical leg 90. A portion of the binding material 108 forms sidewalls 110 of the first junction section 102.

[0029] FIG. 6 is a diagrammatical representation of another intermediate step 214 performed prior to step 208 of FIG. 3 for the formation of the vertical leg 90 in accordance with an exemplary embodiment. The vertical leg 90 is drilled further upto a second predetermined depth 112. The second predetermined depth 112 of the vertical leg 90 may depend on a type of well to be formed. For example, in the embodiment of FIG. 1, the vertical leg 90 is drilled upto a depth which is adjacent to the centralized subterranean water disposal zone 114. In other embodiments, as shown in FIG. 2, the vertical leg 90 may be drilled upto a depth based on location of a deepest leg junction. Further, a casing 116 is disposed within the vertical leg 90. A cementing process is performed to affix the casing 116 to the vertical leg 90.

[0030] FIG. 7 is a diagrammatical representation of the step 208 in accordance with the embodiment of FIG. 3. The lateral leg 118 having a width 130 is drilled upto a first predetermined distance 120 through the sidewall 110 of the first junction section 102 to the production zone 100, using a directional device 124. In the illustrated embodiment, the directional device 124 is installed at the first junction section 102 in the vertical leg 90. The directional device 124 provides a desired direction during the drilling process. In one embodiment, the directional device 124 may include a whipstock. In the illustrated embodiment, the whipstock includes an inclined plane oriented towards a direction in which the lateral leg 118 is intended to be drilled. Similarly, a lateral leg may also be drilled extending to the distributed water disposal zone 64 as shown in FIG. 2.

[0031] FIG. 8 is a diagrammatical representation of the step 210 in accordance with the embodiment of FIG. 3. The lateral leg 118 is under-reamed upto the first predetermined distance 120 to form the second junction section 126. The width 128 of the second junction section 126 is greater than the width 130 (shown in FIG. 7) of the lateral leg 118.

[0032] FIG. 9 is a diagrammatical representation of the step 212 in accordance with the embodiment of FIG. 3. The second junction section 126 is infused with the binding material 108. The directional device 124 (shown in FIG. 7) is removed from the vertical leg 90 and a retrievable bridge plug 132 is installed at the first junction

section 102 prior to infusing the binding material 108. As used herein, the term “retrievable bridge plug 132” may be defined as removable plugs that serve as downhole barriers and can be set at a predetermined depth anywhere within the wellbore tubing or casing to facilitate a wide range of well support operations. The binding material 108 is allowed to settle and dry for a predefined period of time. The retrievable bridge plug 132 provides a support to the binding material 108 and also prevents a flow of the binding material 108 below the first junction section 102.

[0033] FIG. 10 is a diagrammatical representation of an additional step 216 performed after the step 212 of FIG. 3, in accordance with an exemplary embodiment. The lateral leg 118 is drilled through the second junction section 126 upto a second predetermined distance 134 such that the width 128 of the second junction section 126 is equal to the width 130 of the lateral leg 118. The binding material 108 forms sidewalls 136 of the second junction section 126.

[0034] FIG. 11 is a diagrammatical representation of an additional step 218 performed after step 216 of FIG. 10, in accordance with an exemplary embodiment of the invention. A liner 138 is installed in the lateral leg 118 extending from the second junction section 126 after drilling the lateral leg 118 upto the second predetermined distance 134.

[0035] FIG. 12 is a diagrammatical representation of an additional step 220 performed after step 218 of FIG. 11, in accordance with an exemplary embodiment. The vertical leg 90 is drilled through the first junction section 102 to remove the binding material 108. Later the retrievable bridge plug 132 is removed from the first junction section 102 to form the leg junction 98 (shown in FIG. 4) corresponding to the lateral leg 118. The leg junction 98 provides structural integrity to the connection between the vertical leg 90 and the lateral leg 118. Specifically, the structural integrity is provided by the binding material 108 of the sidewalls 110 and 136 of the first junction section 102 and the second junction section 126 respectively.

[0036] The steps depicted in FIGS. 4-12 may be repeated with additional modifications to form a plurality of lateral legs connected to the vertical leg at a

plurality of corresponding leg junctions as shown in FIG. 2, to provide structural integrity to the connecting locations of the plurality of lateral legs to the vertical leg.

[0037] It is to be understood that a skilled artisan will recognize the interchangeability of various features from different embodiments and that the various features described, as well as other known equivalents for each feature, may be mixed and matched by one of ordinary skill in this art to construct additional systems and techniques in accordance with principles of this specification. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

[0038] While only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

CLAIMS:

1. A method comprising:

drilling a vertical leg upto a first predetermined depth to form a well bore;

underreaming the vertical leg at a junction location in the vertical leg to form a first junction section;

infusing a binding material in the first junction section;

drilling a lateral leg upto a first predetermined distance through a sidewall of the first junction section;

underreaming the lateral leg through the sidewall of the first junction section to form a second junction section; and

infusing the binding material in the first junction section and the second junction section to form a leg junction between the vertical leg and the lateral leg.
2. The method of claim 1, further comprising drilling the vertical leg to a second predetermined depth through the first junction section at the junction location, prior to drilling the lateral leg.
3. The method of claim 1, further comprising installing a directional device in the first junction section at the junction location in the vertical leg prior to drilling the lateral leg.
4. The method of claim 3, further comprising removing the directional device from the first junction section at the junction location and installing a retrievable

bridge plug in the first junction section prior to infusing the binding material in the first junction section and the second junction section.

5. The method of claim 4, further comprising removing the retrievable bridge plug and drilling the vertical leg to a second predetermined depth through the first junction section.

6. The method of claim 1, further comprising drilling the lateral leg upto a second predetermined distance through the second junction section after infusing the binding material in the first junction section and the second junction section.

7. The method of claim 6, further comprising installing a liner from the second junction section in the lateral leg.

8. A well comprising:

a vertical leg;

one or more lateral legs in fluid communication with the vertical leg; and

one or more leg junctions formed using a binding material, wherein the one or more lateral legs are connected to the vertical leg at one or more leg junctions.

9. The well of claim 8, wherein each of the one or more leg junctions comprise a first junction section and a second junction section.

10. The well of claim 9, wherein the first junction section is formed along the vertical leg and the second junction section is formed along the lateral leg.

11. The well of claim 8, wherein at least one of the one or more lateral legs, is a production leg.

12. The well of claim 11, wherein the vertical leg is a disposal leg coupled to a subterranean water disposal zone.

13. The well of claim 8, wherein at least one of the one or more lateral legs is a disposal leg.

14. The well of claim 8, further comprising a liner disposed extending from a second junction section of the leg junction within the lateral leg.

15. The well of claim 8, further comprising a casing installed within the vertical leg.

16. The well of claim 8, further comprising one or more downhole separators disposed in the one or more leg junctions.

17. The well of claim 8, further comprising a first isolation packer disposed at a first end and a second isolation packer disposed at a second end of each of the leg junctions in the vertical leg.

18. The well of claim 17, further comprising an electrical submersible pump provided above the first isolation packer, in the vertical leg.

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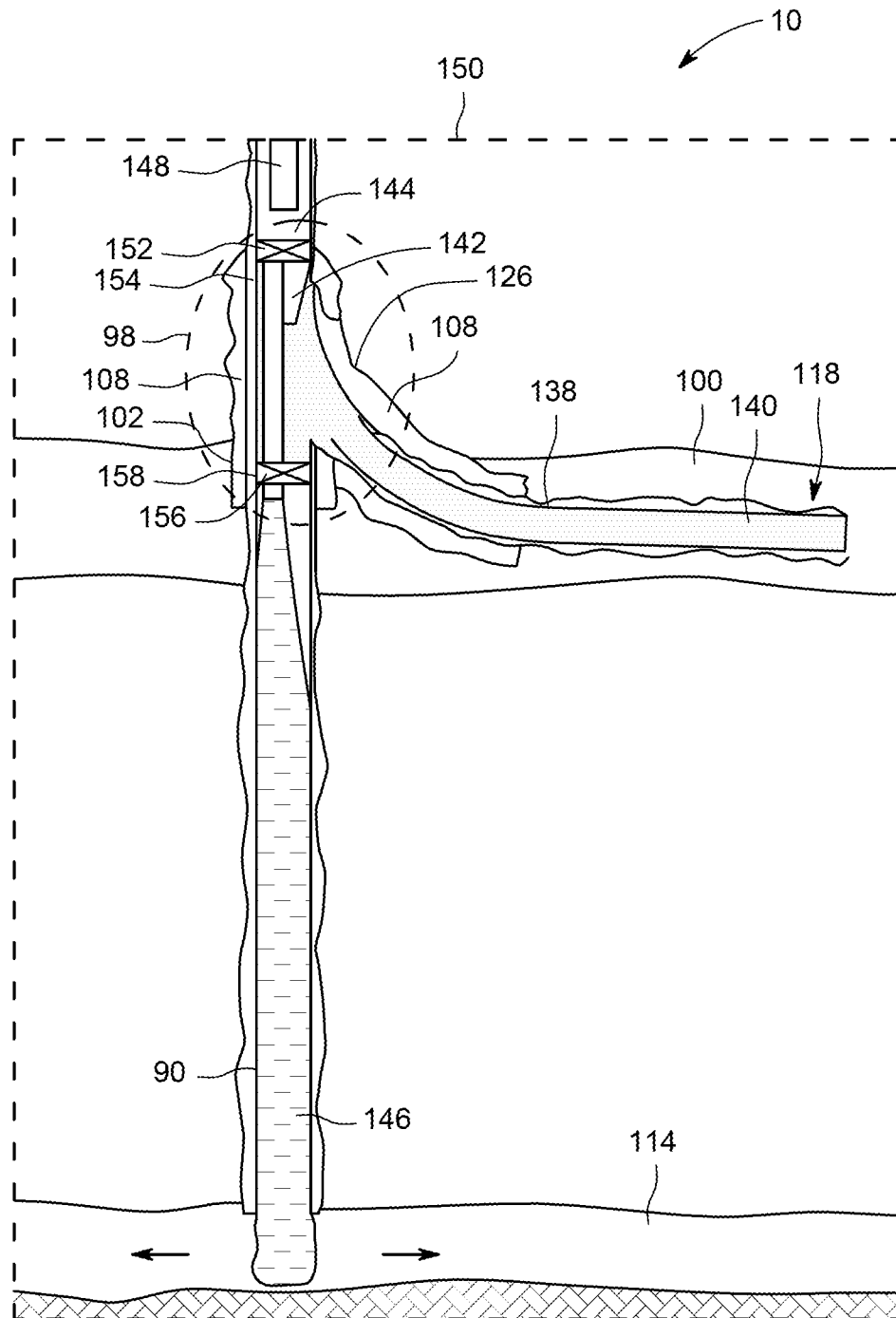


FIG. 1

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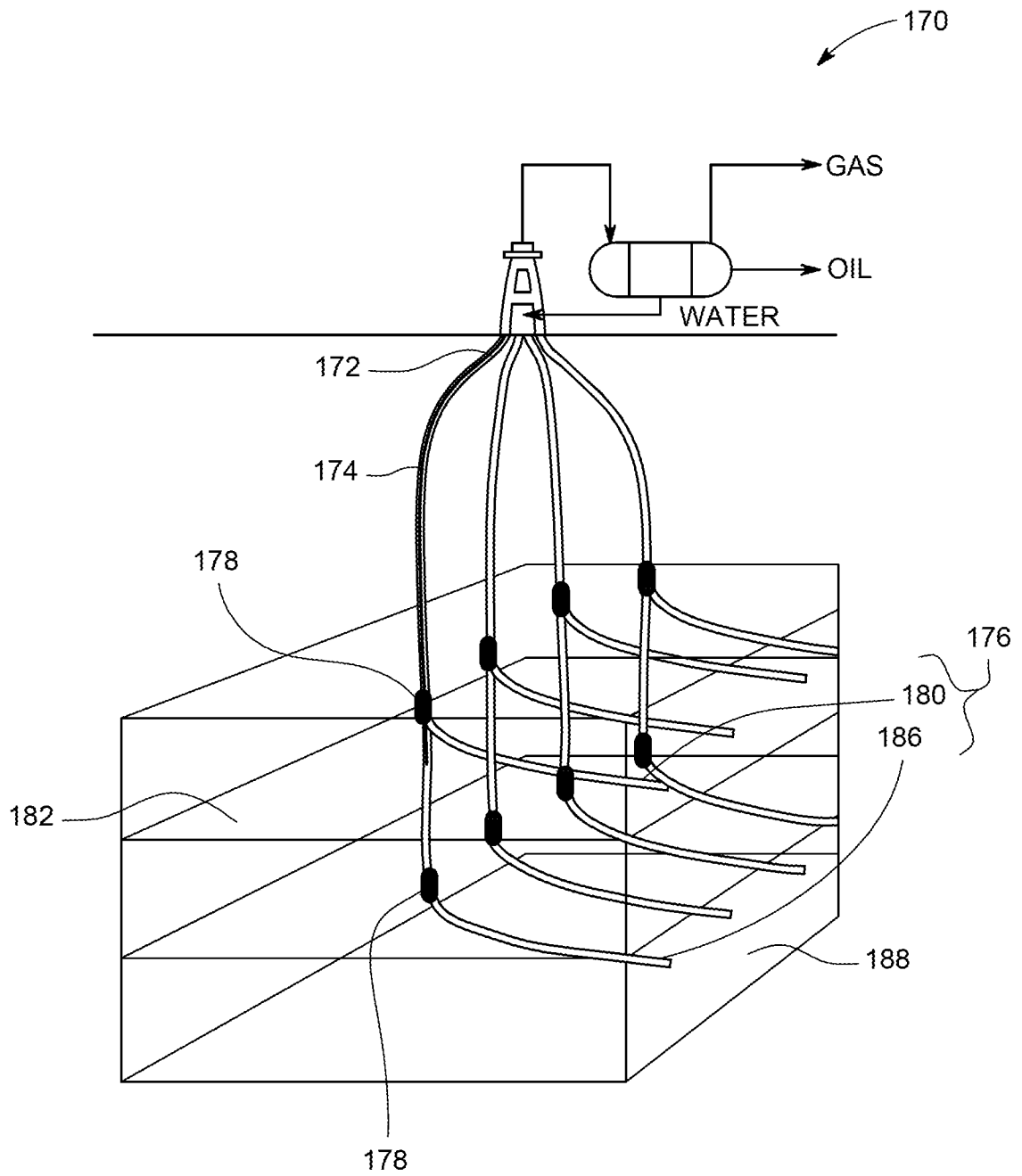


FIG. 2

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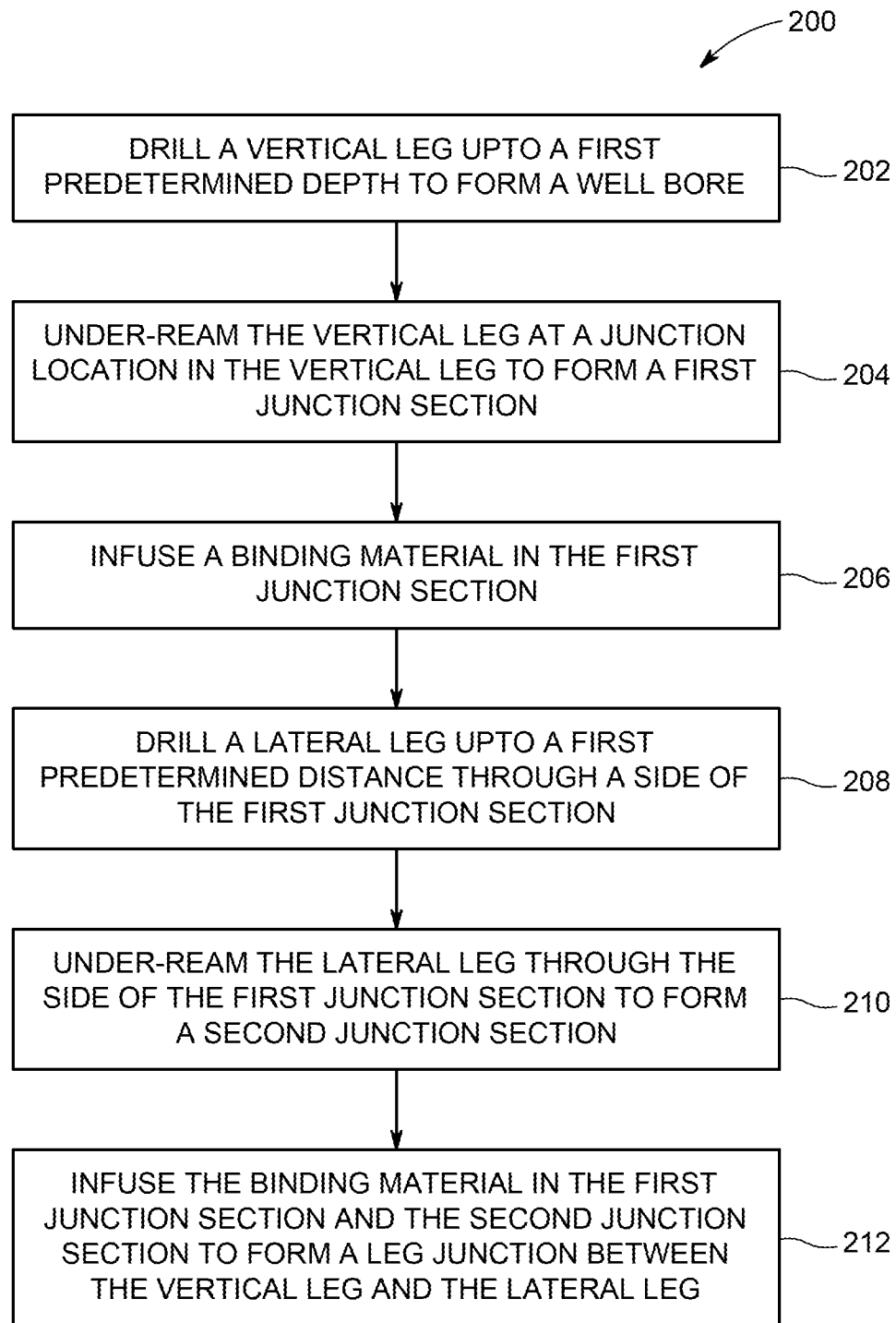


FIG. 3

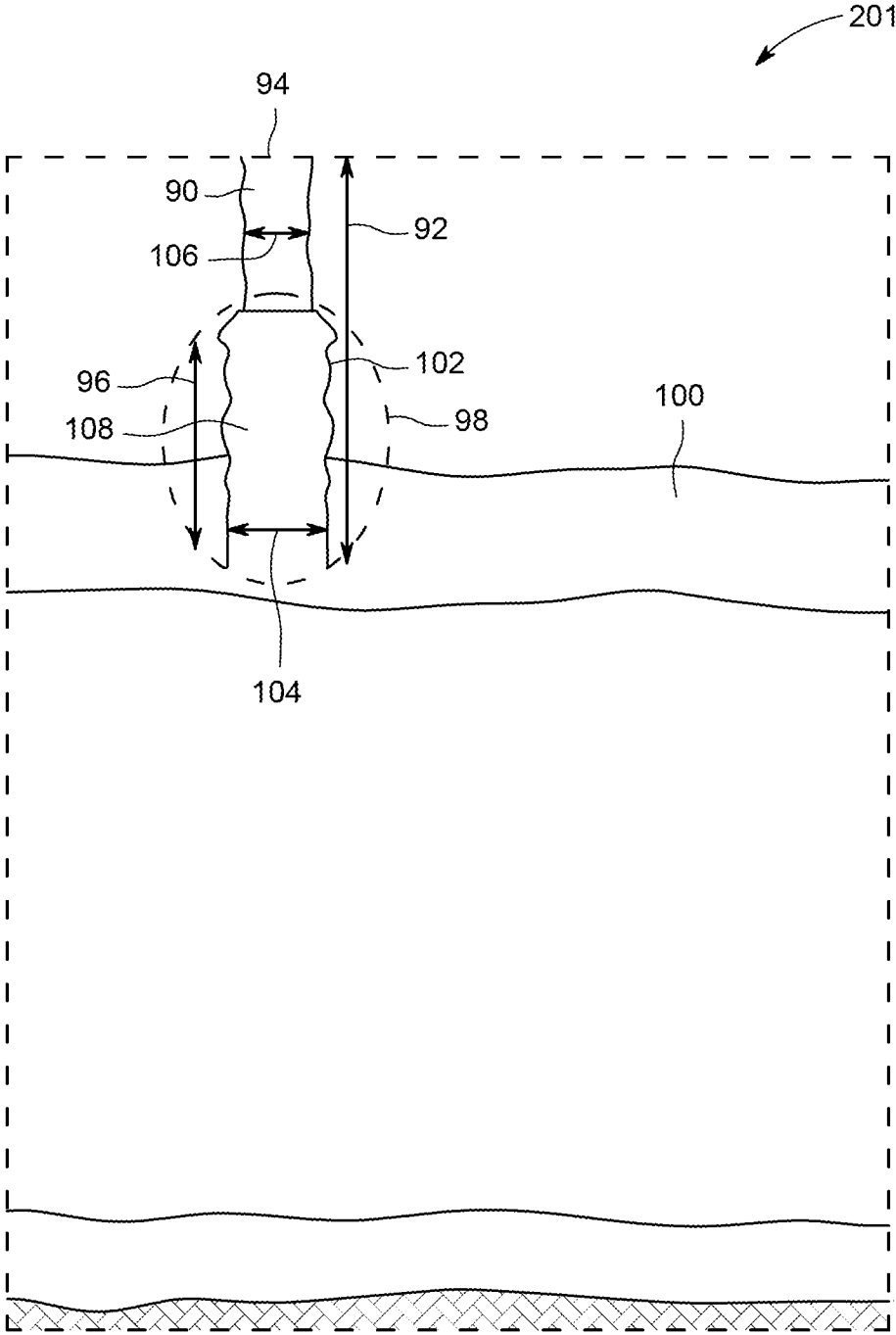


FIG. 4

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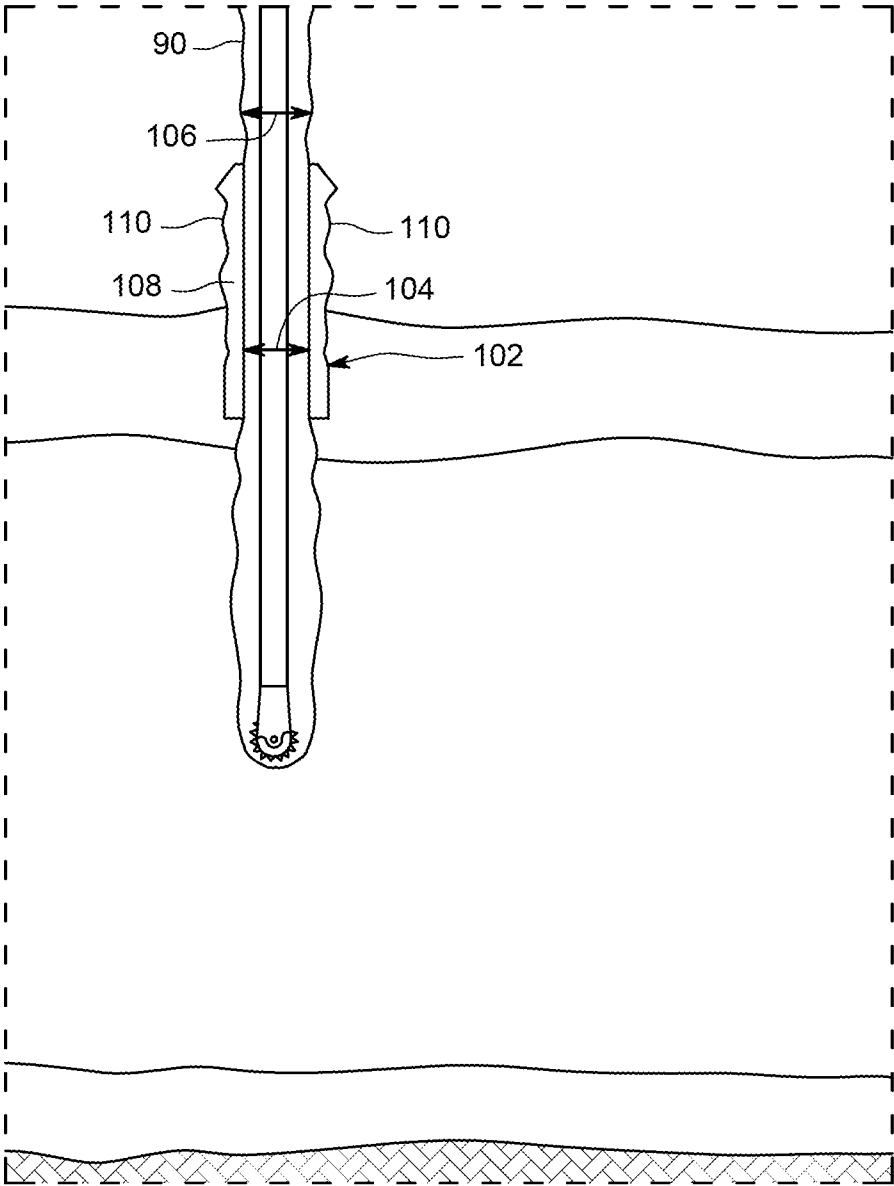


FIG. 5

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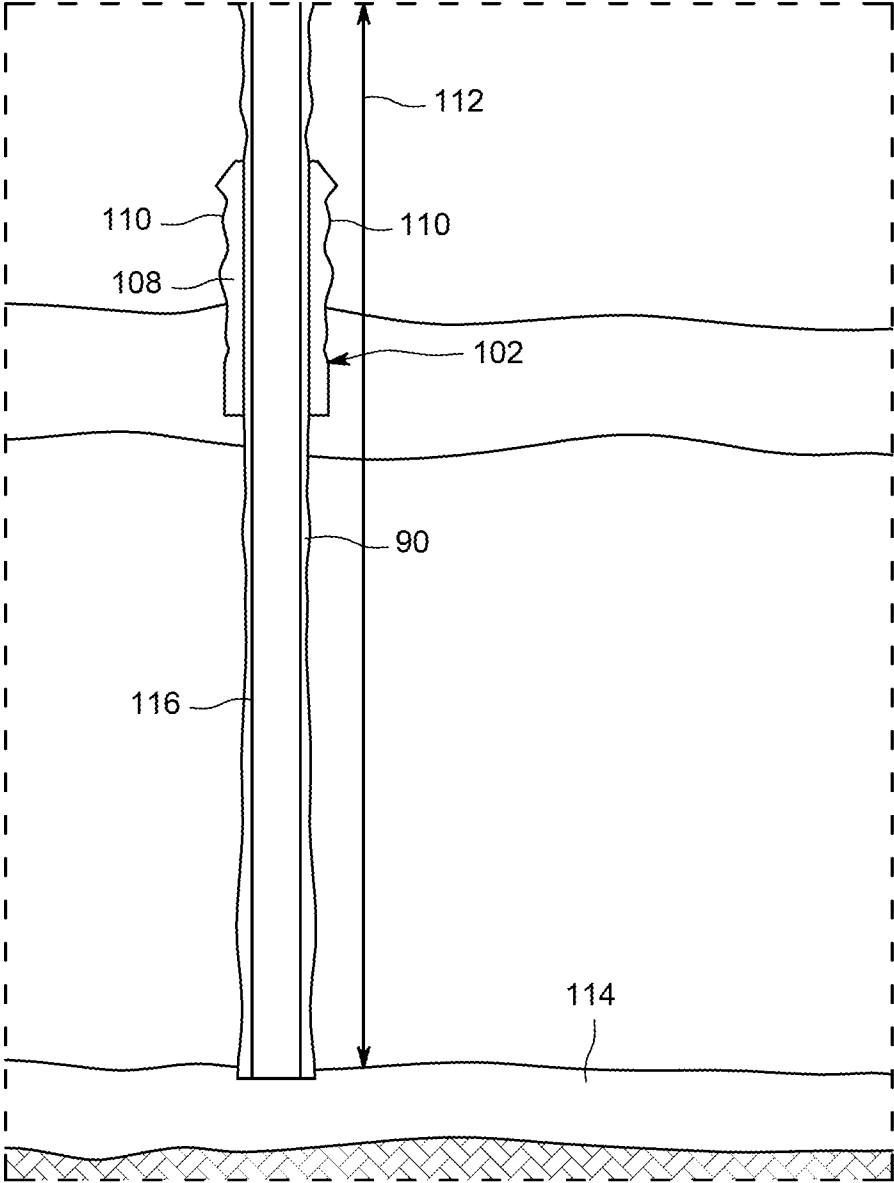


FIG. 6

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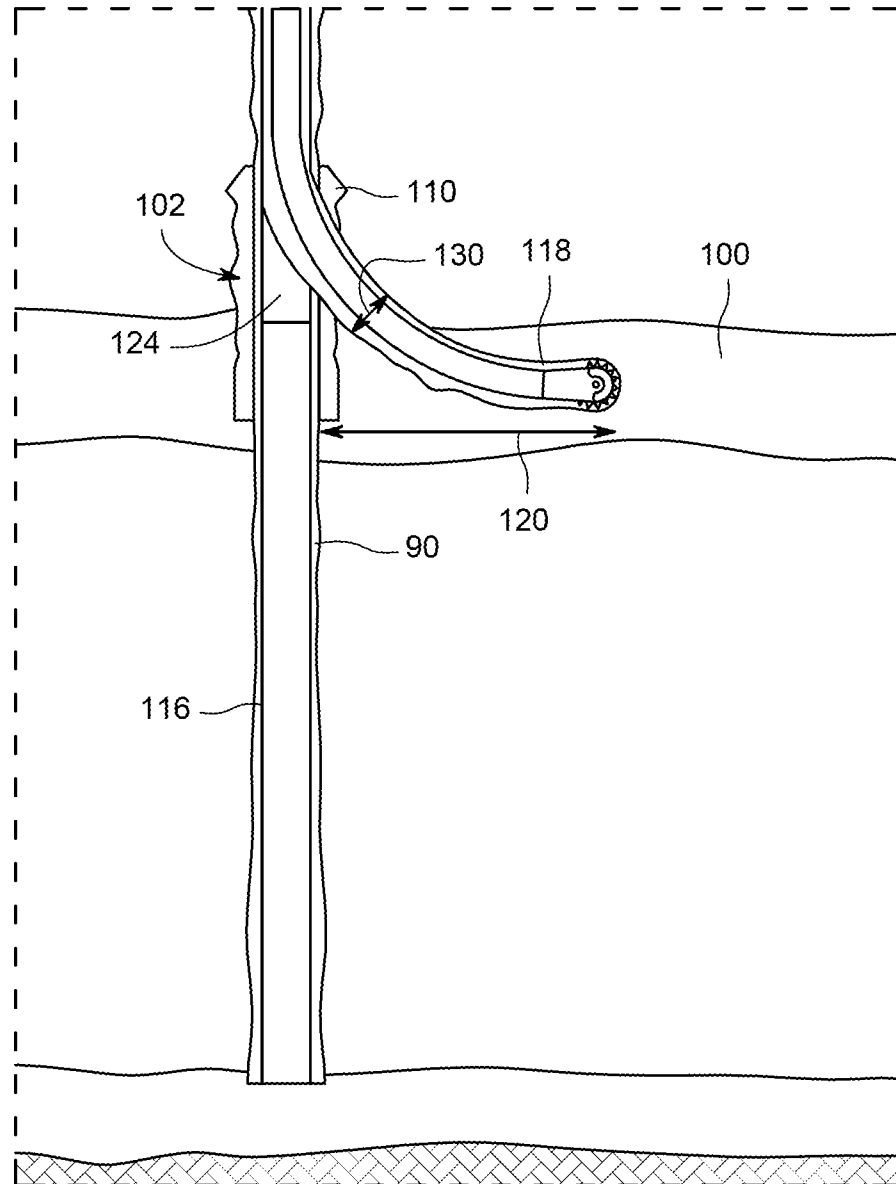


FIG. 7

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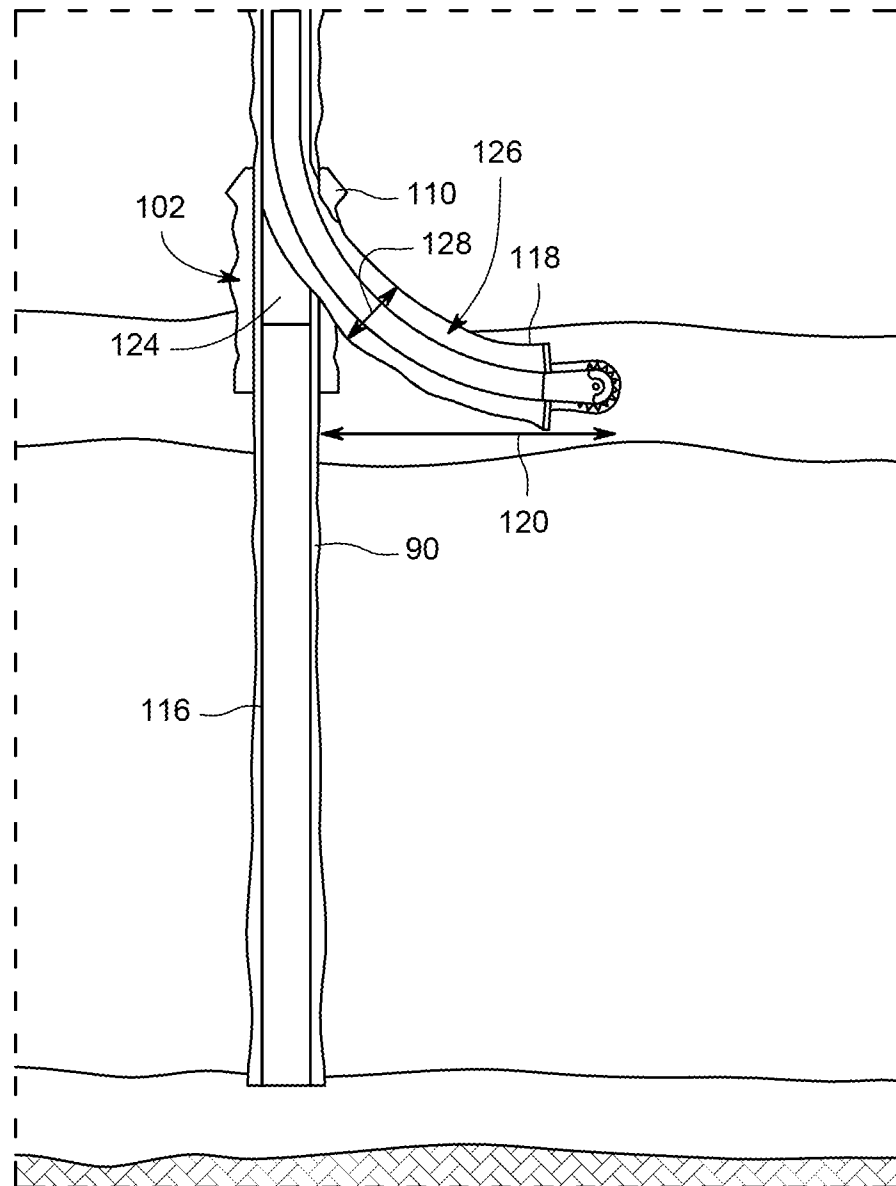


FIG. 8

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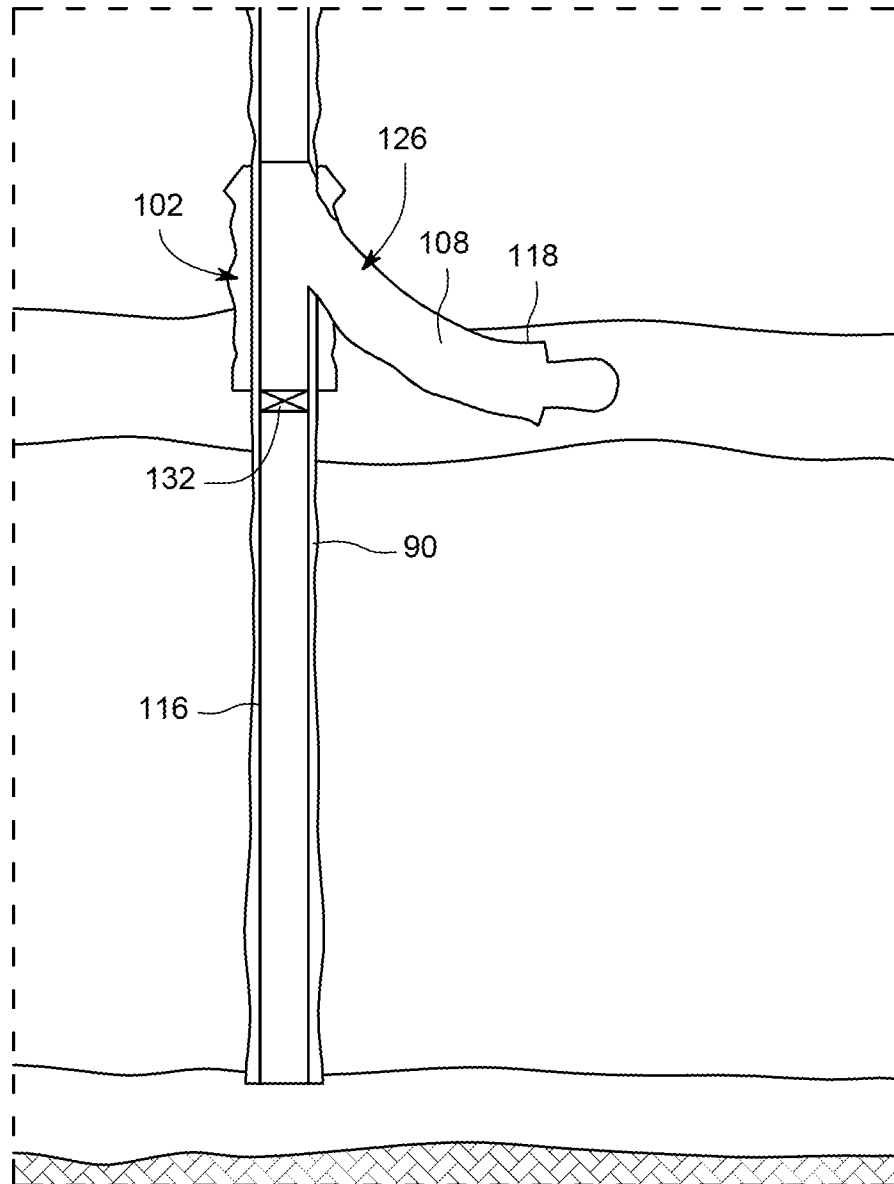


FIG. 9

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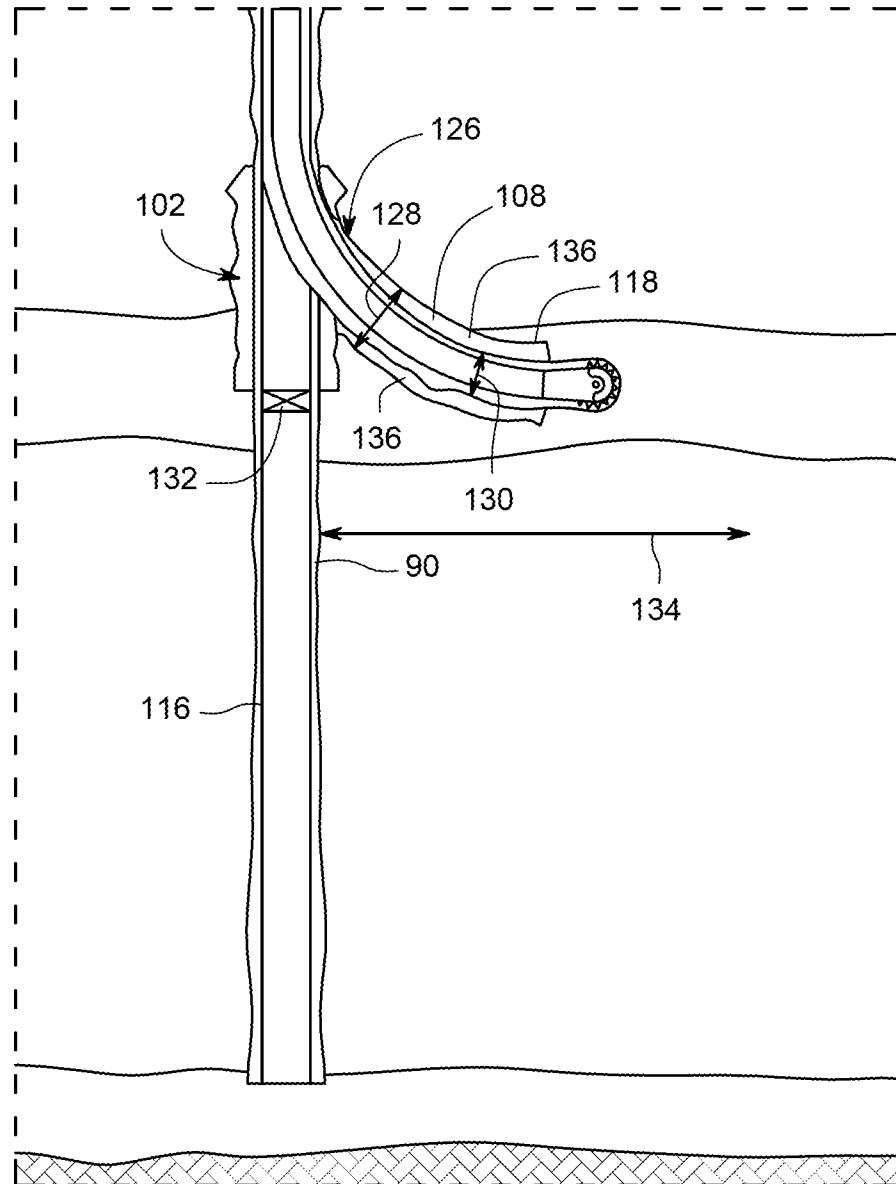


FIG. 10

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218

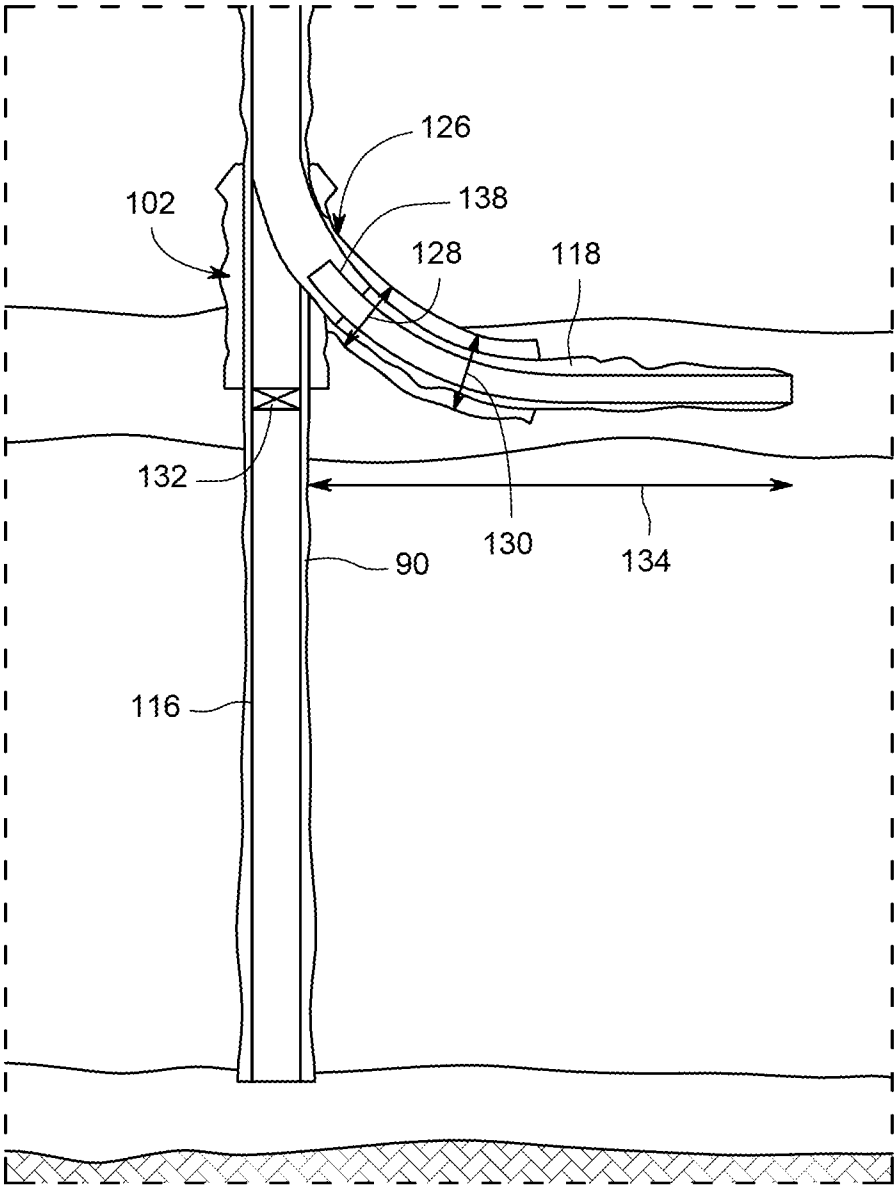


FIG. 11

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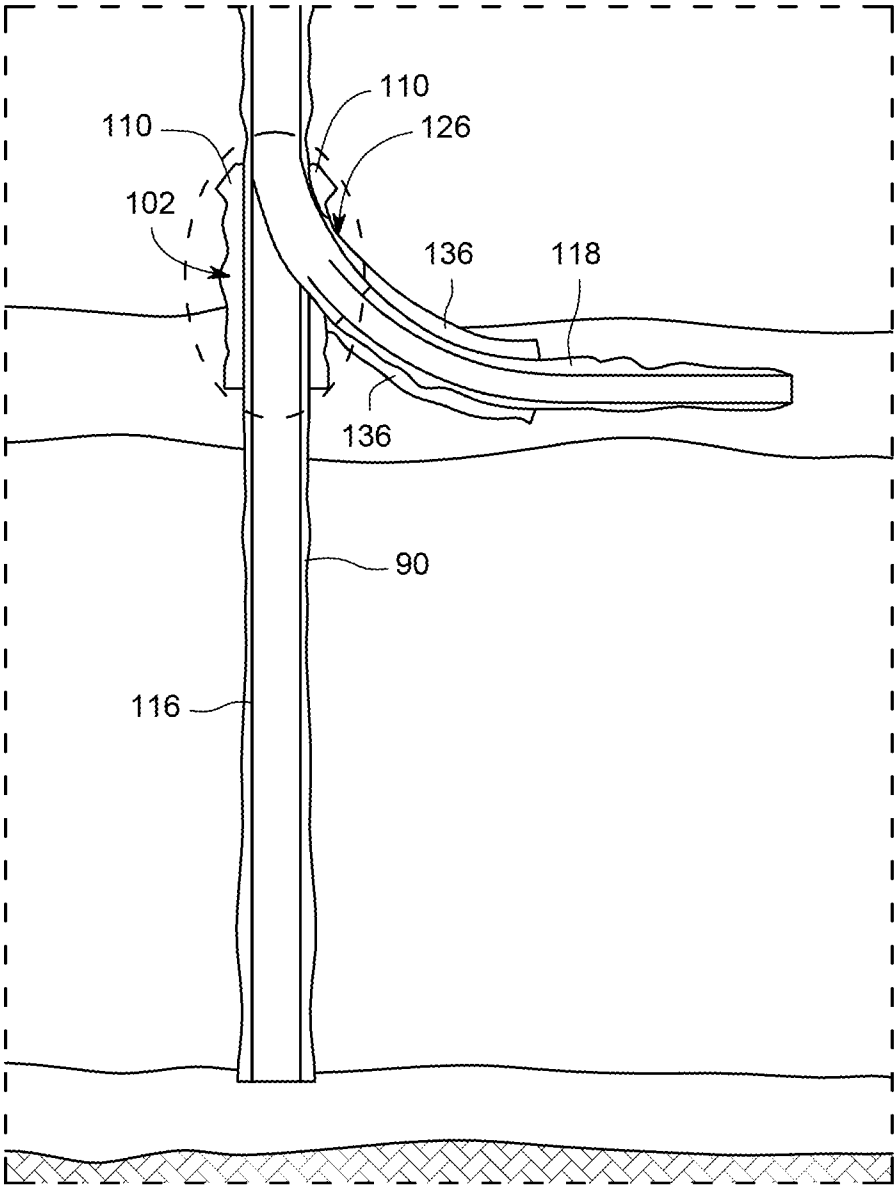


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/042005

A. CLASSIFICATION OF SUBJECT MATTER

INV. E21B7/06

ADD.

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

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

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

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 6 070 667 A (GANO JOHN C [US]) 6 June 2000 (2000-06-06) column 8, line 14 - column 9, line 67; figures 2,3	8,11,15 1-7,9, 10, 12-14, 16-18
X A	----- US 5 992 524 A (GRAHAM STEPHEN A [US]) 30 November 1999 (1999-11-30) column 7, line 36 - line 62; figure 1	8,11,15 1-7,9, 10, 12-14, 16-18
A	----- US 2001/047872 A1 (ROBERTS JOHN D [US] ET AL) 6 December 2001 (2001-12-06) the whole document ----- -/-	1,8



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

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

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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

20 September 2016

Date of mailing of the international search report

05/10/2016

Name and mailing address of the ISA/

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Morrish, Susan

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/042005

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 189 616 B1 (GANO JOHN C [US] ET AL) 20 February 2001 (2001-02-20) the whole document -----	1,8
A	US 5 423 387 A (LYNDE GERALD D [US]) 13 June 1995 (1995-06-13) the whole document -----	1,8
A	US 5 318 122 A (MURRAY DOUGLAS J [US] ET AL) 7 June 1994 (1994-06-07) the whole document -----	1,8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/042005

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6070667	A	06-06-2000	AU 754360 B2	14-11-2002
			AU 1134799 A	26-08-1999
			BR 9900452 A	20-03-2001
			CA 2260624 A1	05-08-1999
			EP 0935049 A2	11-08-1999
			NO 990511 A	06-08-1999
			US 6070667 A	06-06-2000

US 5992524	A	30-11-1999	AU 7372096 A	17-04-1997
			EP 0852653 A1	15-07-1998
			EP 1312750 A2	21-05-2003
			NO 981381 A	27-05-1998
			US 5697445 A	16-12-1997
			US 5992524 A	30-11-1999
			WO 9712113 A1	03-04-1997

US 2001047872	A1	06-12-2001	AU 4767800 A	05-12-2000
			CA 2373152 A1	23-11-2000
			DE 60009483 D1	06-05-2004
			DE 60009483 T2	24-02-2005
			EP 1179115 A1	13-02-2002
			NO 20014111 A	22-10-2001
			US 2001047872 A1	06-12-2001
			WO 0070183 A1	23-11-2000

US 6189616	B1	20-02-2001	CA 2272680 A1	28-11-1999
			EP 0961007 A2	01-12-1999
			EP 1428974 A2	16-06-2004
			EP 1914380 A1	23-04-2008
			US RE41059 E1	29-12-2009
			US 6135208 A	24-10-2000
			US 6189616 B1	20-02-2001

US 5423387	A	13-06-1995	NONE	

US 5318122	A	07-06-1994	AU 663277 B2	28-09-1995
			AU 4997993 A	03-03-1994
			CA 2120368 A1	17-02-1994
			DE 4393849 T1	10-11-1994
			DK 38894 A	06-06-1994
			GB 2275286 A	24-08-1994
			NL 9320007 A	01-11-1994
			NO 941238 A	02-06-1994
			US 5318122 A	07-06-1994
			WO 9403701 A1	17-02-1994
