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(54) Title: BACKUP

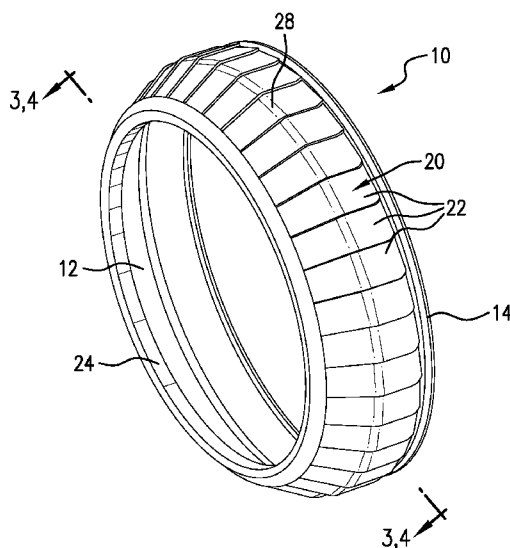


FIG. 1

(57) Abstract: A backup including a radially inwardly disposed circumferentially continuous ring; a radially outwardly disposed circumferentially discontinuous ring, the circumferentially discontinuous ring comprising a plurality of segments arranged to overlap adjacent ones thereof about a circumference of the circumferentially discontinuous ring.



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).

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BACKUP

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Application No. 16/367,341, filed on March 28, 2019 which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Backup configurations have been known in the downhole industry for a long time. They function in various ways to reduce the tendency of rubber or similar sealing materials extruding when exposed to a pressure differential thereacross. Generally backup rings attempt to fulfill their purposes by getting in the way of an extrusion path of the seal material. Some are successful though many are not and most are expensive and difficult to set with marginal pressure holding capacities. The art therefore would be receptive to alternative backups that provide commercial advantages.

SUMMARY

[0003] A backup including a radially inwardly disposed circumferentially continuous ring; a radially outwardly disposed circumferentially discontinuous ring, the circumferentially discontinuous ring comprising a plurality of segments arranged to overlap adjacent ones thereof about a circumference of the circumferentially discontinuous ring.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:

[0005] Figure 1 is an isometric view of a backup as disclosed herein;

[0006] Figure 2 is a larger view of a portion of the backup of Figure 1 illustrating the overlapping segments;

[0007] Figure 3 is a cross sectional view of Figure 1 illustrating the overlapping nature of the segments before setting of a tool using the backup;

[0008] Figure 4 is a cross sectional view of Figure 1 illustrating the overlapping nature of the segments after setting of a tool using the backup;

[0009] Figure 5 is an enlarged illustration of a portion of the backup of Figure 1 illustrating various features of the backup;

[0010] Figure 6 is a cross sectional view of a tool employing the backup disclosed herein in an unset position;

[0011] Figure 7 is a cross sectional view of the tool of Figure 6 in a set position; and

[0012] Figure 8 is a schematic representation of a downhole system employing a backup as described herein.

DETAILED DESCRIPTION

[0013] A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.

[0014] Referring to Figure 1, an isometric view of a backup 10 is illustrated. The backup 10 is of a type that is used in the downhole industry to prevent extrusion of a sealing material when subjected to a pressure differential across the sealing material. Configurations of this type are known to the industry as for example packer systems, plugs, etc. The backup 10 is to be placed in use near one end of a sealing element (discussed further in relation to Figures 6 and 7 below). The backup 10 itself is unique in that it provides for an unusually low setting force, ultra-expansion; super conformability settability in out of round conditions such as ovaled tubulars or open hole that is not cylindrical, etc. By “unusually low setting force” it is meant that setting force required is in a range of about 15kips to about 30kips and that where common systems would require multiple or large area pistons to achieve the setting of the tool, the backup as disclosed herein should not. Further, the backup as disclosed herein will reduce tool length and size. The term “ultra-expansion” is intended to mean expansion ratio (Casing ID/Gage ring OD) is more than 115%. The term “super-conformability” is intended to mean the ring can easily conform to not only casing/Borehole ID with defects such as a groove, a cut, etc., but also an oval borehole/ casing ID with less setting force.

[0015] Benefits of the backup ring 10 are achieved due to its construction. The backup 10 comprises a radially inwardly disposed circumferentially continuous ring 12 that is composed of a thin material. The material may be a metal or a plastic, for example. “Thin” meaning having a thickness of from about 0.015” to about 0.050” thick. The thickness allows for great conformability. The ring 12 exhibits no breaks therein such that it presents a complete barrier to extrusion. Moreover, the ring 12 includes, in at least some embodiments, a flare feature 14 that ensures a complete contact connection with the tubular form (casing, tubular, open hole, etc.) in which the backup 10 is set. The flare feature 14 energizes a

connection with the wall at edge 16 thereby rendering extrusion of the seal material therepast extremely unlikely. In addition, because of the shape of the flare 14 as shown, the seal material itself will tend to further energize the contact of edge 16 with the wall.

[0016] The backup 10 also comprises a radially outwardly disposed circumferentially discontinuous ring 20. The ring 20 comprises a plurality of segments 22 arranged to overlap adjacent ones thereof about a circumference of the circumferentially discontinuous ring. Each of the segments 22 extend from a base ring 24 that both joins each of the segments 22 together but also joins the ring 12 with the ring 20. Beyond the base ring 24, each segment 22 is completely detached from any other segment beyond mere contact therewith. This is to say that the individual segments are essentially free from one another other than for base ring 24. Such construction eliminates hoop stress in the ring 20 during expansion in setting of the tool using this backup 10 thereby reducing the force required to set the tool that uses backup 10. Referring to Figure 2, the overlapping nature of the segments 22 is more easily perceived. In an embodiment, illustrated in Figures 3 and 4 at least one of the segments 22 overlaps the adjacent segment 22 by 10% to 50% of the width of the segment 22 (that dimension being taken in the circumferential direction) in an unset condition. In the subsequent set condition, the overlap, in an embodiment is about 20% of what it was in the unset position. In each case, there will remain overlap among the segments 22 in the set position so that the plurality of segments 22 provide for support of the ring 12 in the expanded set position.

[0017] Also in embodiments, the segments 22 includes a bend 28 therein in the axial direction of the backup 10. As used herein, the term “bend” is meant to encompass a macro curvilinear shape that wholly or partially makes up the ring or ring segment geometry. By macro curvilinear shape it is meant that the deviation in direction of the material of the segments can range from a slight curvature on the order of only a few degrees (up to a much large degree as noted below) of deviation and a curving area of deviation to a more pronounced bend where a line is visible by the human eye and/or can be felt by the human hand is formed at the deviation point (rather than an area where no actual line can be seen or felt). The bend 28 further strengthens the segments 22 and hence the ring 20 without impacting the benefits of reduced setting force, ultra-expansion and super-conformability. Bends 28 in some embodiments employ an angle of from about 100 degrees to about 170 degrees.

[0018] In another embodiment, the bend 28 may not actually be a bend but rather simply a variation in the thickness of the segment at the same location. Variations in

thickness of the material making up the segment 22 will affect its conformability. Lesser thicknesses will allow greater conformability which greater thicknesses will provide relatively more resistance to conformability.

[0019] In particular embodiments the degree of overlap of the segments 22 may be selected to address swab off and or radial support. Specifically, the larger the overlap, the greater the resistance to swab off under higher flow conditions prior to setting of the tool.

[0020] Referring to Figure 5, it should be noted that there is a gap 30 between the ring 12 and the ring 20 that is about 0.005" to about 0.050" thick. The gap 30 provides the benefit of facilitating segment expansion by providing space to avoid contact friction at early stages of expansion. In embodiments, the gap is of uniform thickness around the backup. In other embodiments, the gap is of non-uniform thickness about the backup.

[0021] Turning now to Figure 6 and 7, one embodiment of a tool 40 that employs the backup 10 as disclosed is illustrated. The tool 40 is illustrated in cross section in both an unset and a set position, in Figures 6 and 7, respectively. Referring to Figure 6, the unset tool 40 includes a mandrel 42, upon which is mounted a primary seal 44 and secondary seals 46. The secondary seals 46 are directly backup up by backups 10, one on each longitudinal end of the tool 40. Also present are expandable backups 48. Upon setting of the tool 40, the components noted are forced to move toward one another effectively shortening the overall length of the tool 40 in order to seal the tool 40 against a casing or other tubular structure 50. As will be appreciated from a perusal of Figure 6 and 7, the backups 10 are forced to move radially outwardly into contact with the casing 50 making sealing contact therewith to prevent extrusion of the seals 44 or 46 past the backups 10.

[0022] Finally, in an embodiment, the backup 10 is an additively manufactured component. Additive manufacturing allows for much simpler manufacture of the backup as shown and described than conventional machining and so reduces cost of manufacture.

[0023] Referring to Figure 8, a schematic representation of a downhole system 60 including a tubing or casing string 50 and a backup 10 disposed adjacent a seal 46 therein.

[0024] Set forth below are some embodiments of the foregoing disclosure:

[0025] Embodiment 1: A backup including a radially inwardly disposed circumferentially continuous ring; a radially outwardly disposed circumferentially discontinuous ring, the circumferentially discontinuous ring comprising a plurality of segments arranged to overlap adjacent ones thereof about a circumference of the circumferentially discontinuous ring.

[0026] Embodiment 2: The backup as in any prior embodiment wherein the radially inwardly disposed ring and the radially outwardly disposed ring are joined at an axial end of the backup.

[0027] Embodiment 3: The backup as in any prior embodiment wherein segments of the discontinuous ring or rings overlap the adjacent segments.

[0028] Embodiment 4: The backup as in any prior embodiment wherein in a set position, the segments of the discontinuous ring or rings continue to overlap the adjacent segments.

[0029] Embodiment 5: The backup as in any prior embodiment wherein the plurality of segments are connected to each other only at the axial end of the backup.

[0030] Embodiment 6: The backup as in any prior embodiment wherein one or more of the plurality of segments include a bend.

[0031] Embodiment 7: The backup as in any prior embodiment wherein one or more of the plurality of segments include a variation in thickness of the one or more segments.

[0032] Embodiment 8: The backup as in any prior embodiment wherein the bend is duplicated in each of the plurality of segments.

[0033] Embodiment 9: The backup as in any prior embodiment consisting of no more rings than the radially inwardly disposed ring and the radially outwardly disposed ring.

[0034] Embodiment 10: The backup as in any prior embodiment wherein the radially inwardly disposed ring is of a uniform thickness.

[0035] Embodiment 11: The backup as in any prior embodiment wherein the radially inwardly disposed ring is of a non-uniform thickness.

[0036] Embodiment 12: The backup as in any prior embodiment wherein the radially inwardly disposed ring further includes a flare feature.

[0037] Embodiment 13: The backup as in any prior embodiment wherein the radially inwardly disposed ring and the radially outwardly disposed ring are spaced from each other by a circumferential gap.

[0038] Embodiment 14: The backup as in any prior embodiment wherein the gap is uniform between the rings.

[0039] Embodiment 15: The backup as in any prior embodiment wherein the gap is non-uniform between the rings.

[0040] Embodiment 16: A tool including a seal, a backup as in any prior embodiment adjacent thereto.

[0041] Embodiment 17: A downhole system including a string disposed in a borehole, a backup as in any prior embodiment operably connected to the string.

[0042] Embodiment 18: The downhole system as in any prior embodiment further comprising a seal in operative contact with the backup.

[0043] The use of the terms “a” and “an” and “the” and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. Further, it should be noted that the terms “first,” “second,” and the like herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another.

[0044] The term “about” is intended to include the degree of error associated with measurement of the particular quantity based upon the equipment available at the time of filing the application. For example, “about” can include a range of $\pm 8\%$ or 5% , or 2% of a given value.

[0045] The teachings of the present disclosure may be used in a variety of well operations. These operations may involve using one or more treatment agents to treat a formation, the fluids resident in a formation, a wellbore, and / or equipment in the wellbore, such as production tubing. The treatment agents may be in the form of liquids, gases, solids, semi-solids, and mixtures thereof. Illustrative treatment agents include, but are not limited to, fracturing fluids, acids, steam, water, brine, anti-corrosion agents, cement, permeability modifiers, drilling muds, emulsifiers, demulsifiers, tracers, flow improvers etc. Illustrative well operations include, but are not limited to, hydraulic fracturing, stimulation, tracer injection, cleaning, acidizing, steam injection, water flooding, cementing, etc.

[0046] While the invention has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they

are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited.

What is claimed is:

1. A backup (10) comprising:
a radially inwardly disposed circumferentially continuous ring (12);
a radially outwardly disposed circumferentially discontinuous ring (20), the circumferentially discontinuous ring (20) comprising a plurality of segments (22) arranged to overlap adjacent ones thereof about a circumference of the circumferentially discontinuous ring (20).
2. The backup (10) as claimed in claim 1 wherein the radially inwardly disposed ring (12) and the radially outwardly disposed ring (20) are joined at an axial end of the backup (10).
3. The backup (10) as claimed in claim 1 wherein segments (22) of the discontinuous ring or rings (20) overlap the adjacent segments (22).
4. The backup (10) as claimed in claim 1 wherein in a set position, the segments of the discontinuous ring or rings (20) continue to overlap the adjacent segments (22).
5. The backup (10) as claimed in claim 2 wherein the plurality of segments (22) are connected to each other only at the axial end of the backup (10).
6. The backup (10) as claimed in claim 1 wherein one or more of the plurality of segments (22) include a bend (28).
7. The backup (10) as claimed in claim 1 consisting of no more rings than the radially inwardly disposed ring (12) and the radially outwardly disposed ring (20).
8. The backup (10) as claimed in claim 1 wherein the radially inwardly disposed ring (12) is of a uniform thickness.
9. The backup (10) as claimed in claim 1 wherein the radially inwardly disposed ring (12) is of a non-uniform thickness.
10. The backup (10) as claimed in claim 1 wherein the radially inwardly disposed ring (12) further includes a flare feature (14).
11. The backup (10) as claimed in claim 1 wherein the radially inwardly disposed ring (12) and the radially outwardly disposed ring (20) are spaced from each other by a circumferential gap (30).
12. The backup (10) as claimed in claim 1 wherein the gap (30) is non-uniform between the rings (12, 20).
13. A tool (40) comprising:
a seal (46);
a backup (10) as claimed in claim 1 adjacent thereto.

14. A downhole system (60) comprising:

a string (50) disposed in a borehole;

a backup (10) as claimed in claim 1 operably connected to the string.

15. The downhole system (60) as claimed in claim 14 further comprising a seal (46) in operative contact with the backup (10).

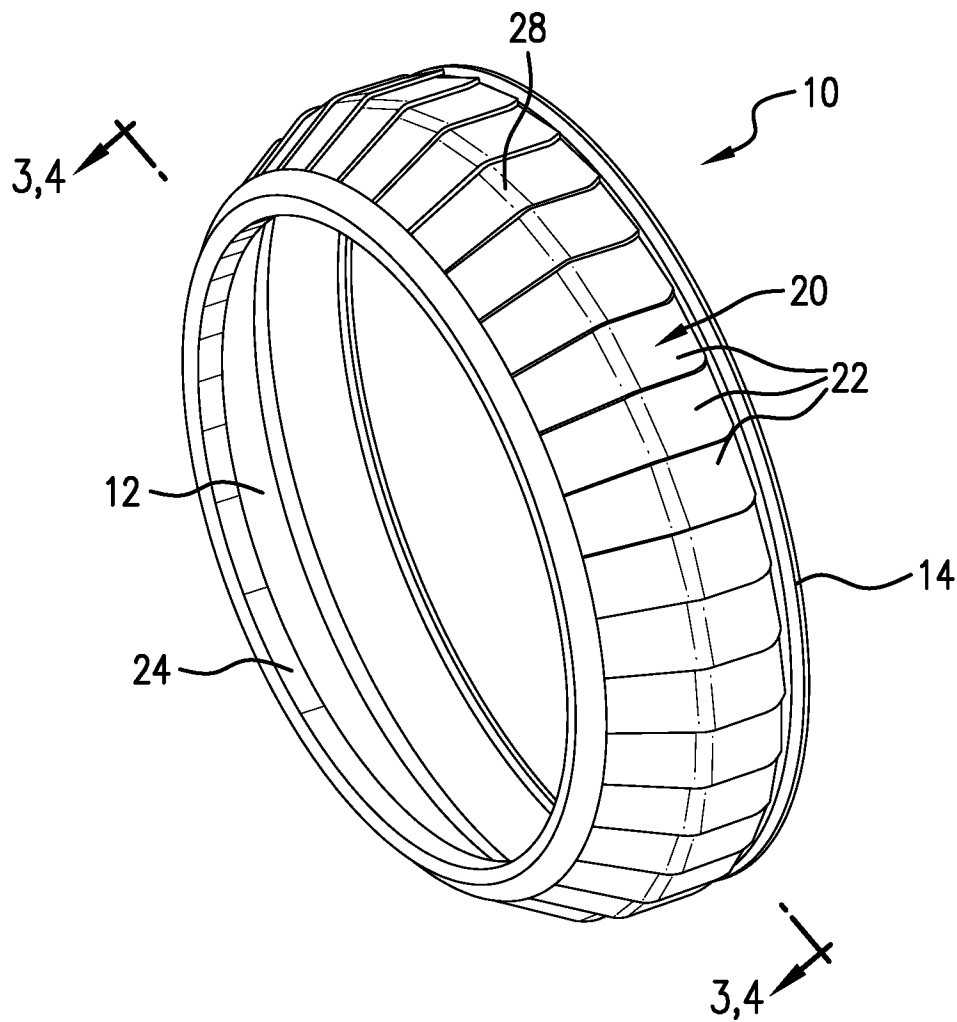


FIG. 1

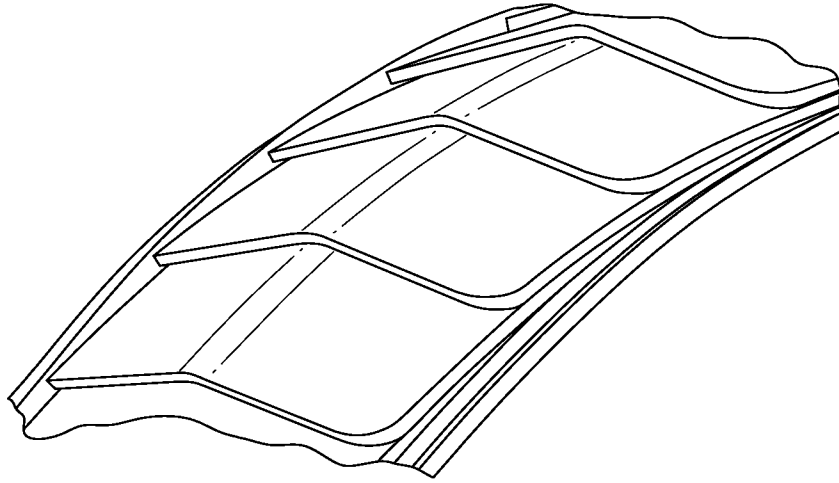


FIG. 2

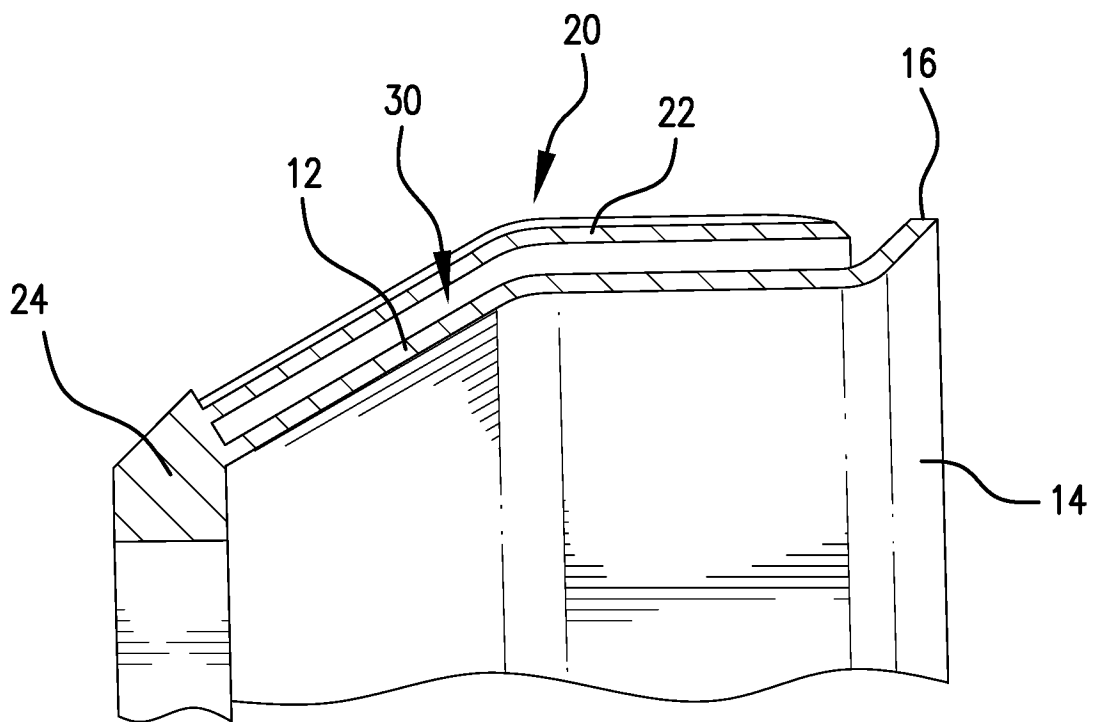


FIG. 5

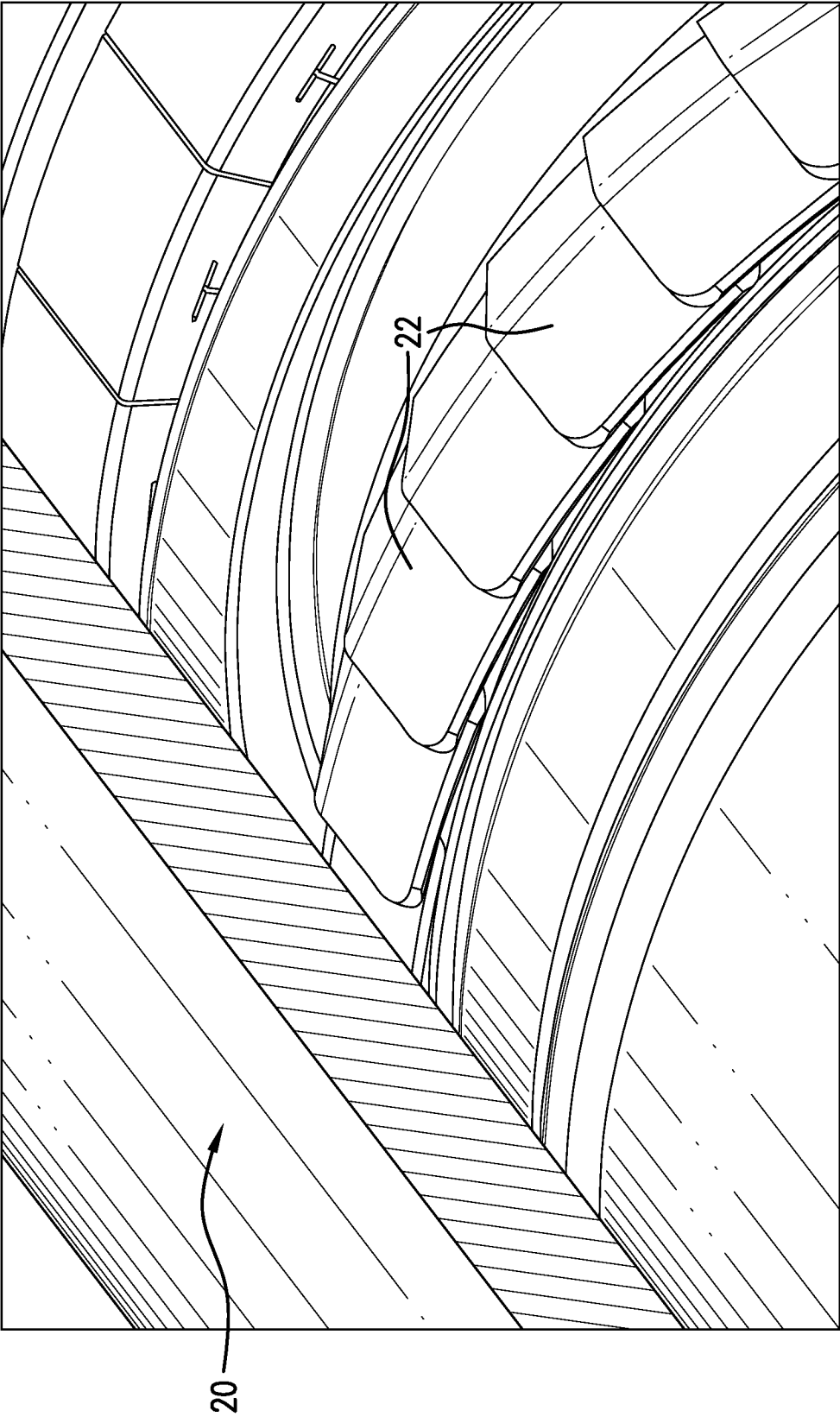


FIG.3



FIG. 4

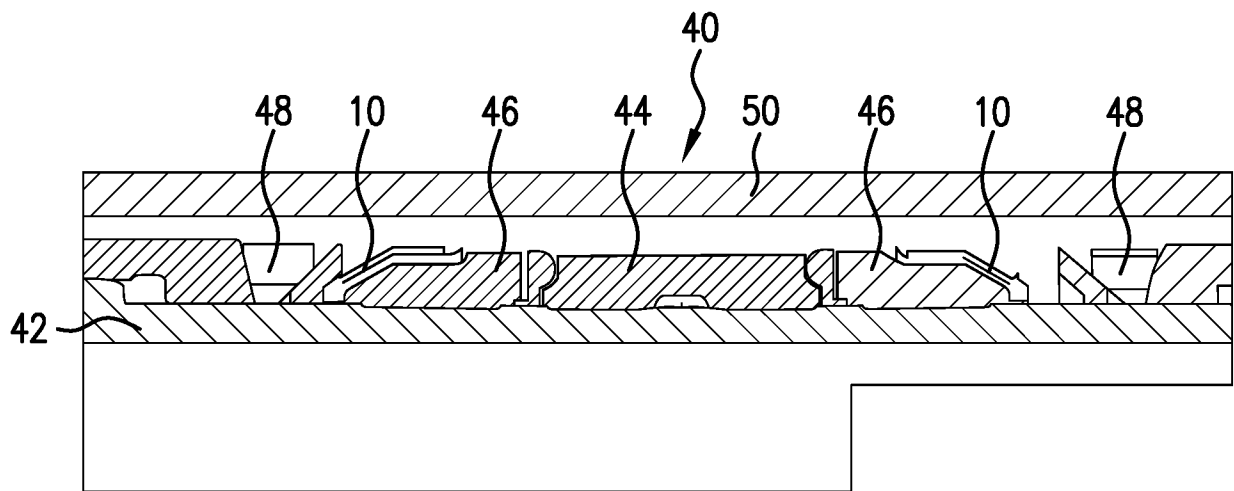


FIG.6

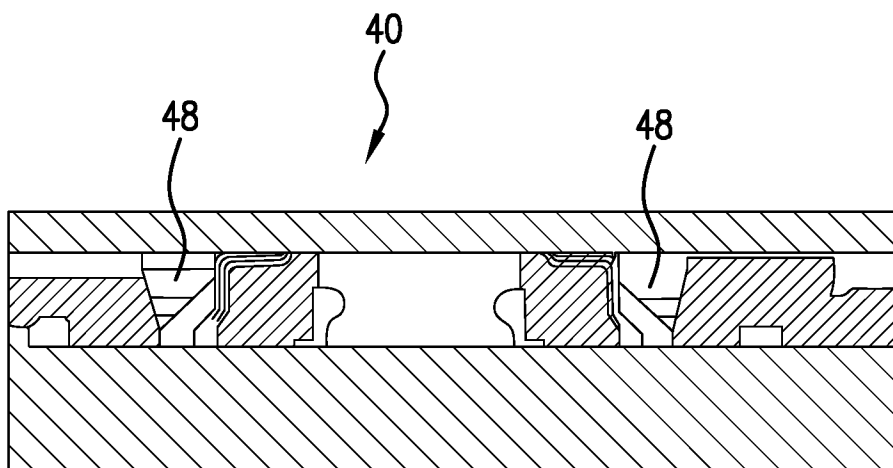


FIG.7

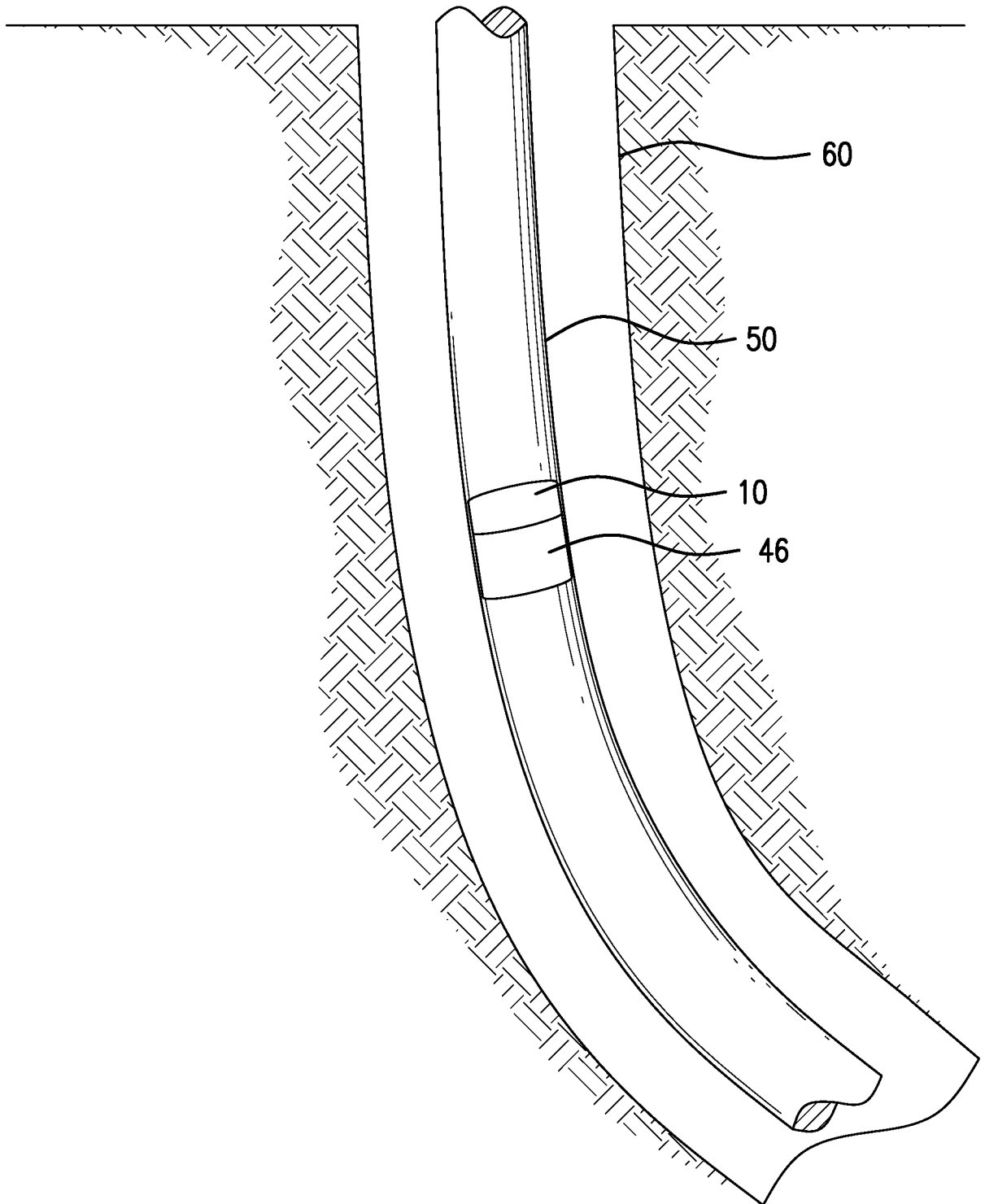


FIG. 8

A. CLASSIFICATION OF SUBJECT MATTER**E21B 33/12(2006.01)i, F16J 15/3272(2016.01)i, F16J 15/16(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 33/12; E21B 23/00; E21B 23/06; E21B 33/126; E21B 33/128; E21B 33/129; E21B 43/10; E21B 47/01; F16J 15/3272; F16J 15/16

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: string, backup, seal, ring, segment, bend, flare

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013-0306331 A1 (BISHOP et al.) 21 November 2013 paragraphs [0016], [0023]-[0024], [0028], [0032]-[0034] and figures 2-6	1-10, 13-15
Y		11-12
Y	US 2018-0298716 A1 (BAKER HUGHES INCORPORATED) 18 October 2018 paragraphs [0029], [0036] and figures 8-11	11-12
A	US 2008-0135240 A1 (BRENNAN et al.) 12 June 2008 paragraphs [0077]-[0080] and figures 5A-5C	1-15
A	US 2009-0277648 A1 (NUTLEY et al.) 12 November 2009 paragraphs [0037]-[0043] and figures 1A-4	1-15
A	US 2015-0330174 A1 (CRAIGON et al.) 19 November 2015 paragraphs [0132]-[0134] and figures 13-16	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"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

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Date of the actual completion of the international search

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Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea



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INTERNATIONAL SEARCH REPORT

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