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Gar et al.

(54) **INTERNAL SLIP DESIGN WITH MINIMUM BACKLASH FOR PACKERS SEAL ENHANCEMENT**

(71) Applicant: **Halliburton Energy Services, Inc.**, Houston, TX (US)

(72) Inventors: **Shobeir Pirayeh Gar**, Carrollton, TX (US); **Xiaoguang Allan Zhong**, Singapore (SG); **Christian Alexander Ramirez**, Carrollton, TX (US); **David Joe Steele**, Carrollton, TX (US)

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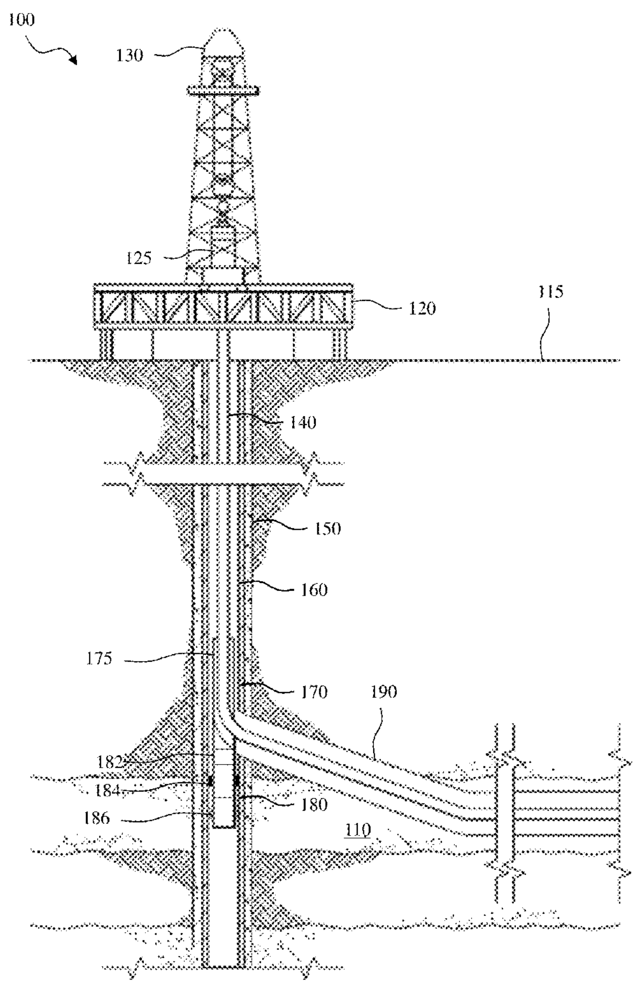
(57) **ABSTRACT**

Provided is a sealing/anchoring subassembly, a well system, and method. The sealing/anchoring subassembly, in one aspect, includes a mandrel, as well as a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state. The sealing/anchoring subassembly, according to this aspect, also includes a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state. The ratch latch body, in one aspect, may include a stroke sleeve having a plurality of stroke sleeve teeth disposed thereon, and a base having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.



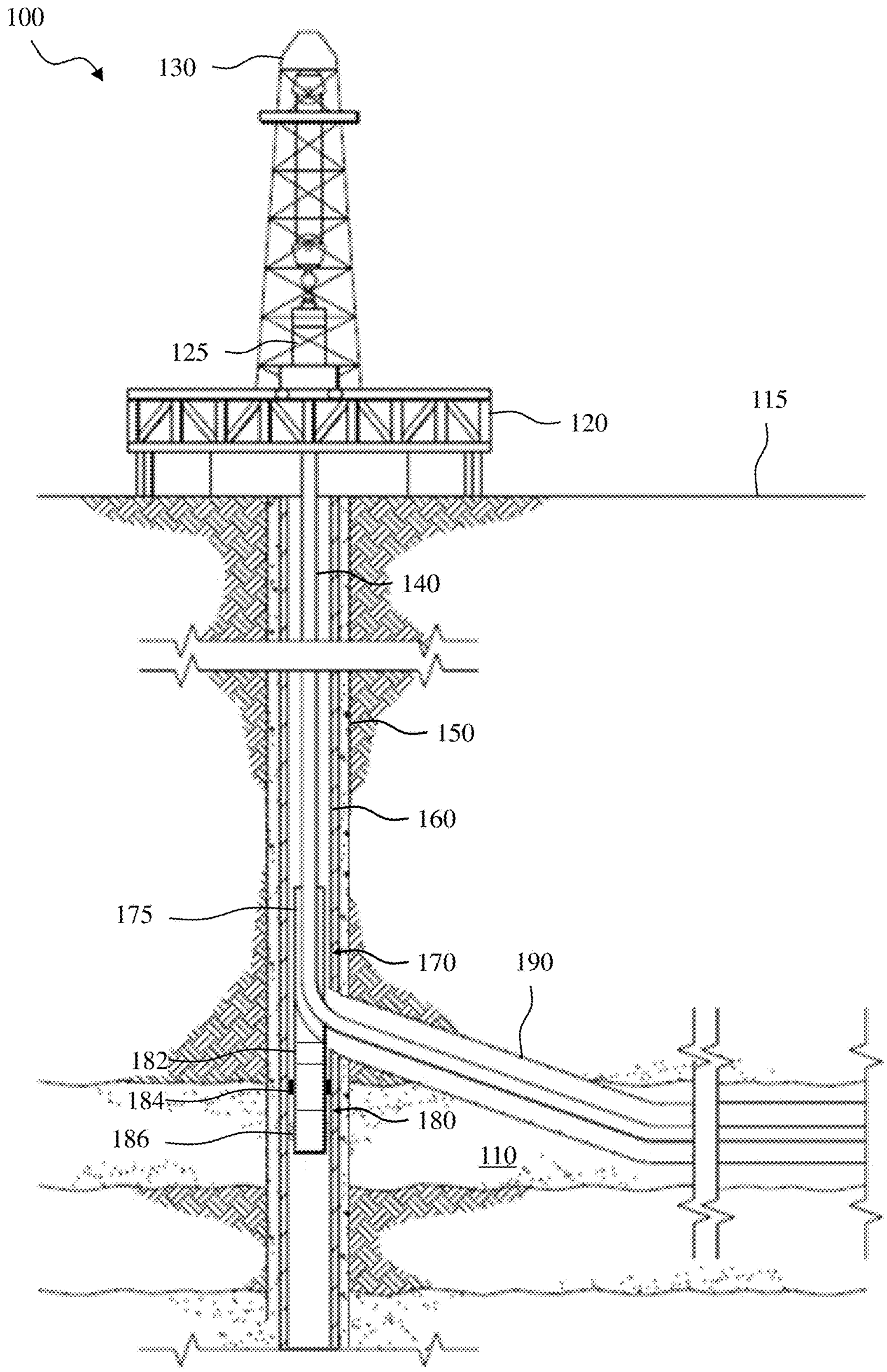


FIG. 1

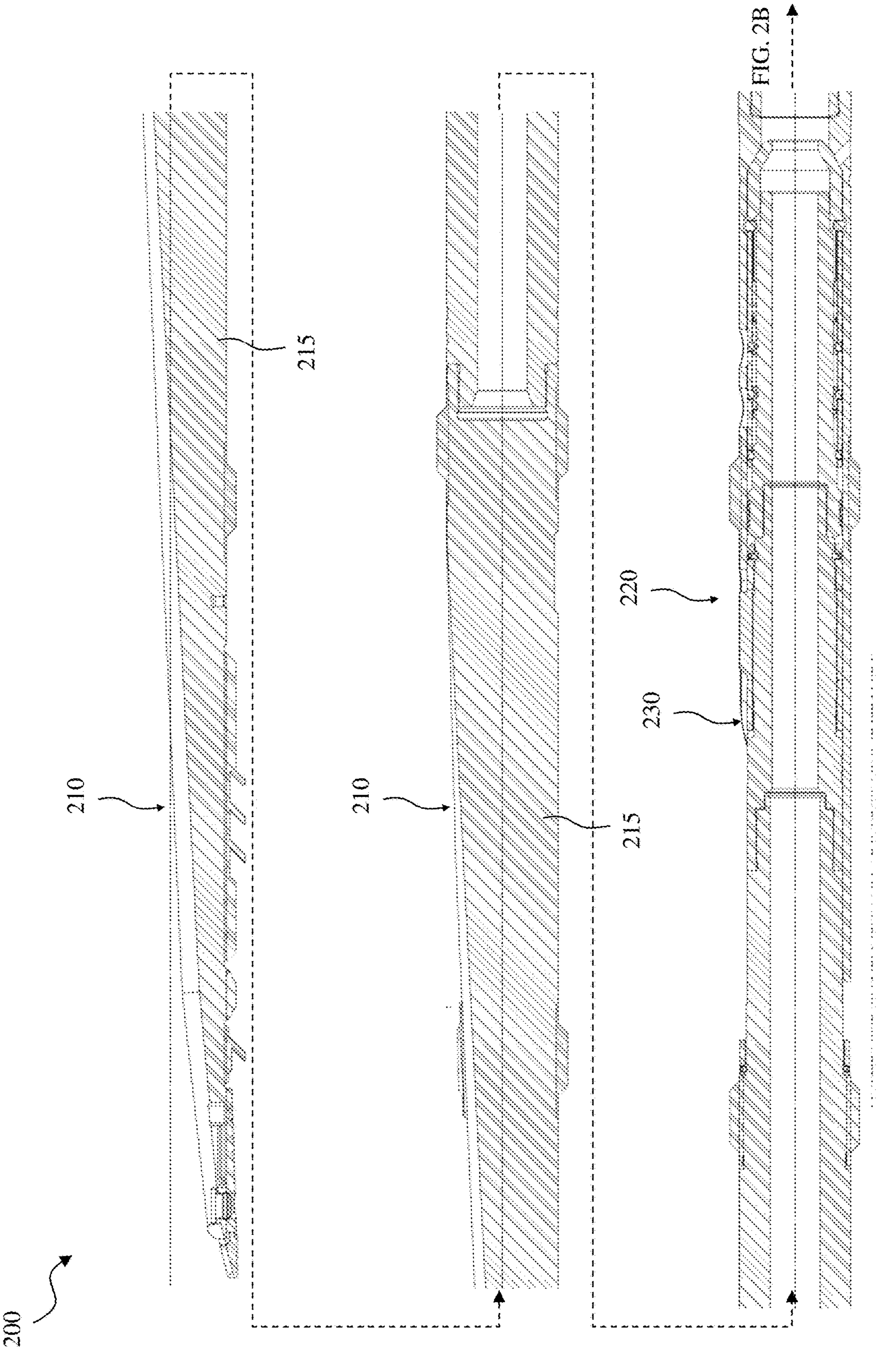


FIG. 2A

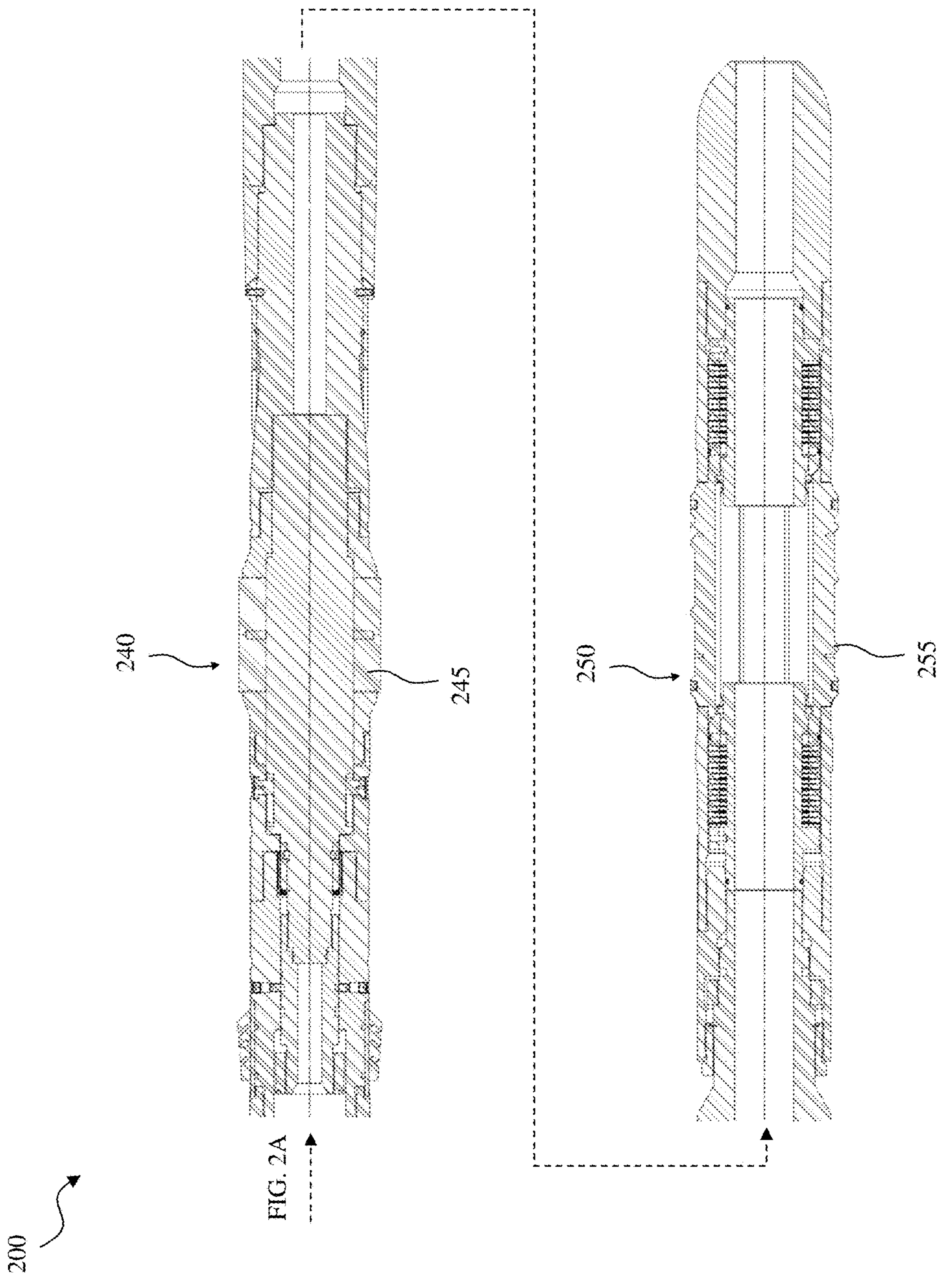


FIG. 2B

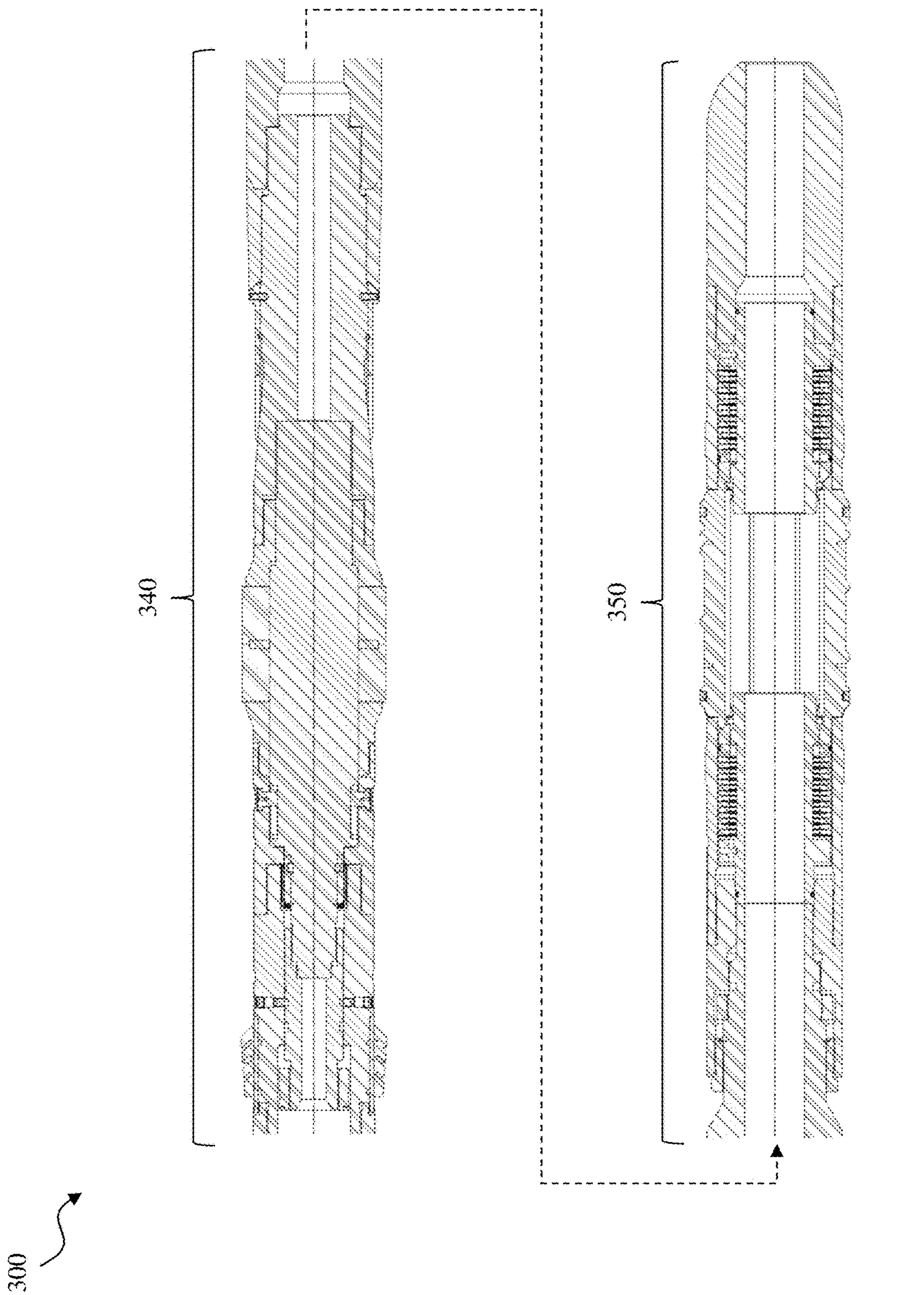


FIG. 3

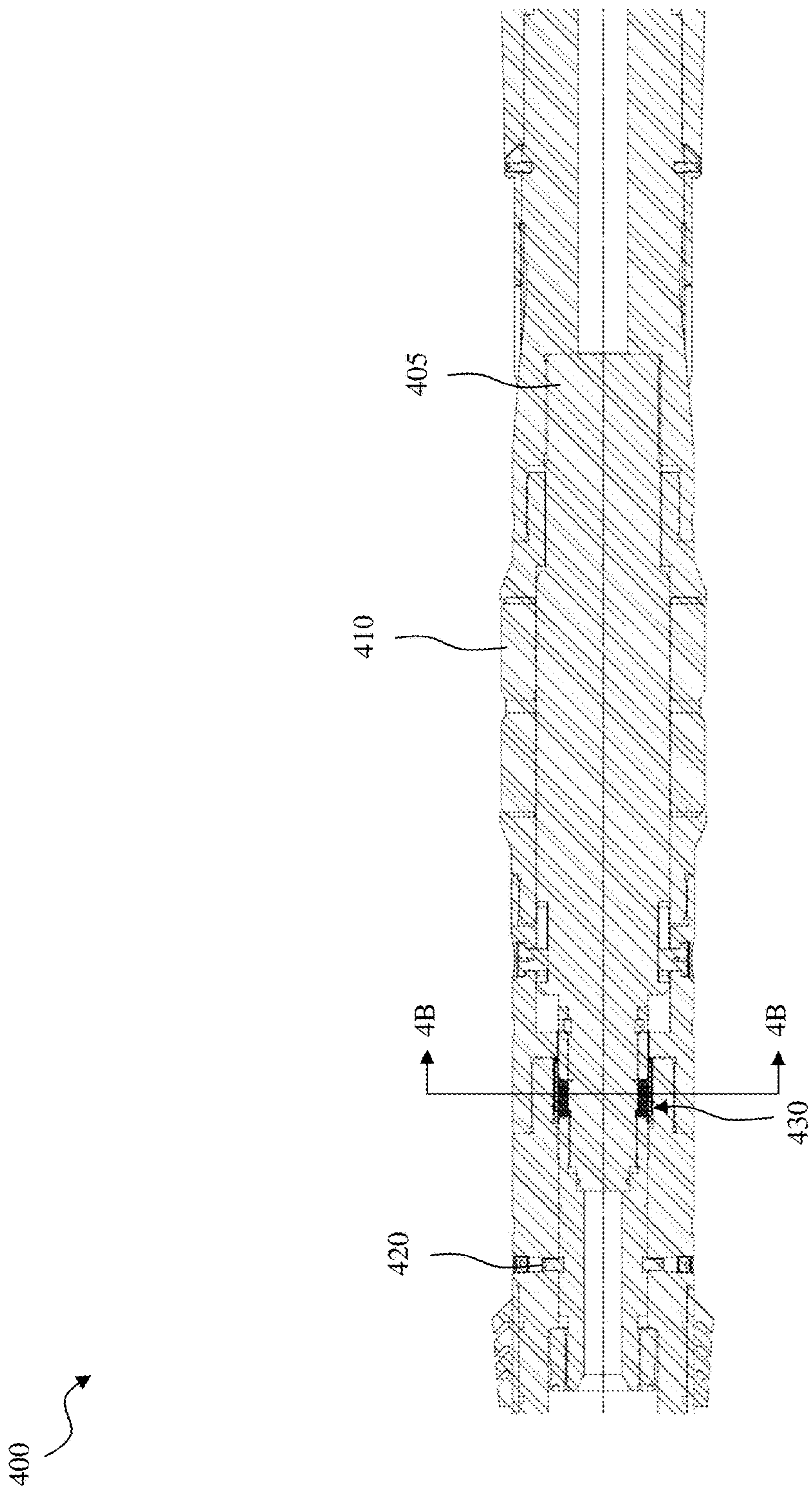


FIG. 4A

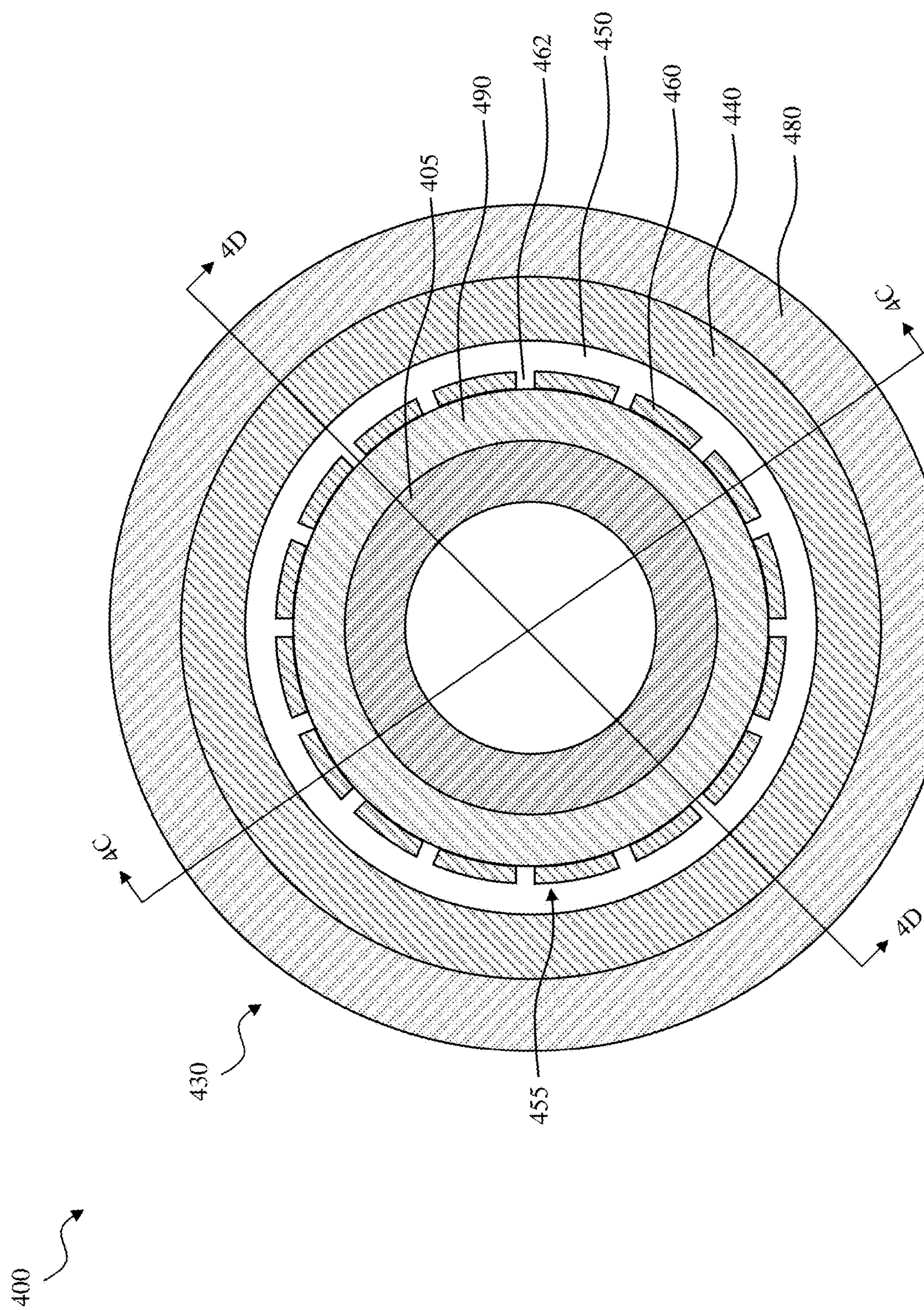
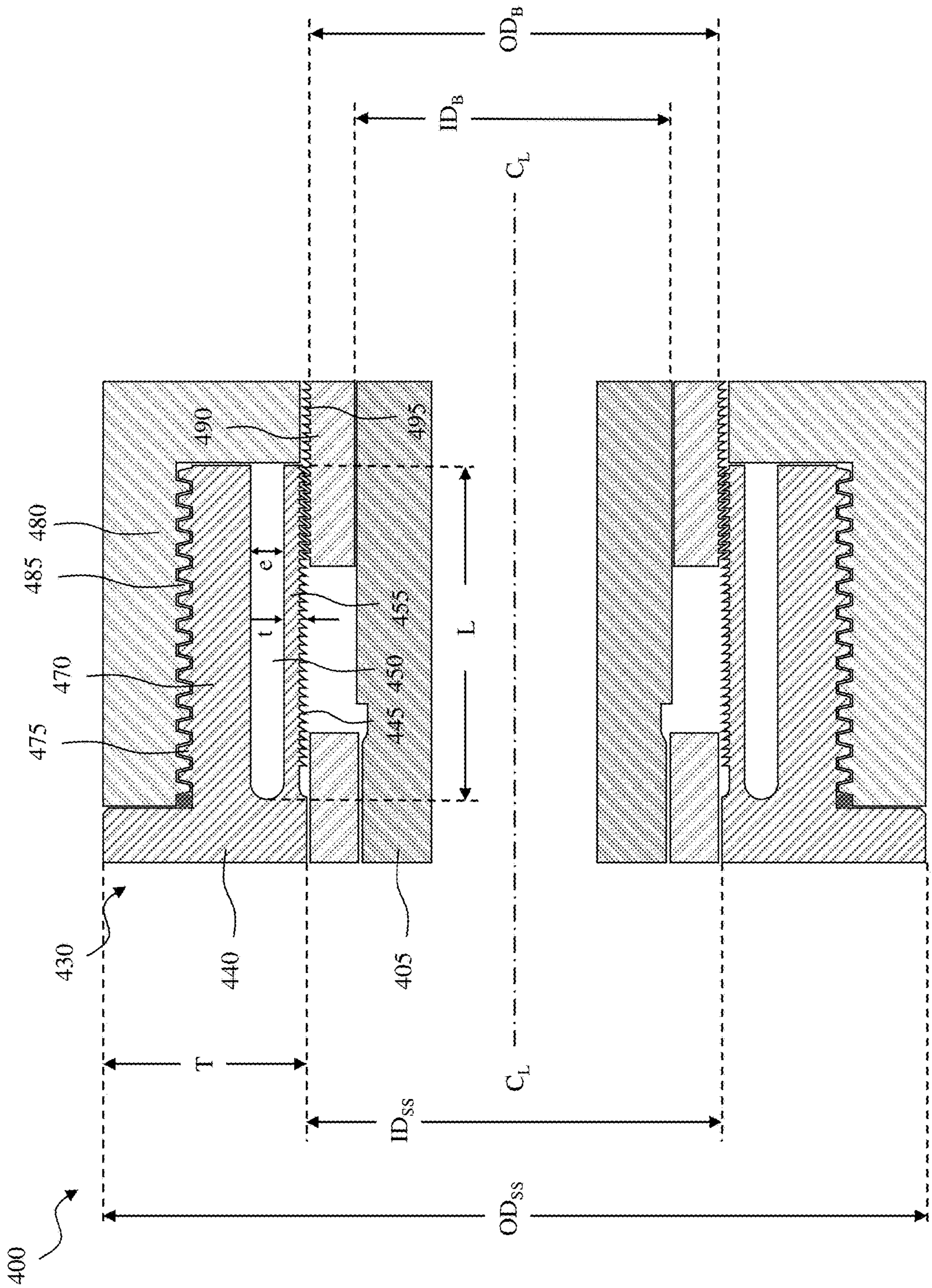


FIG. 4B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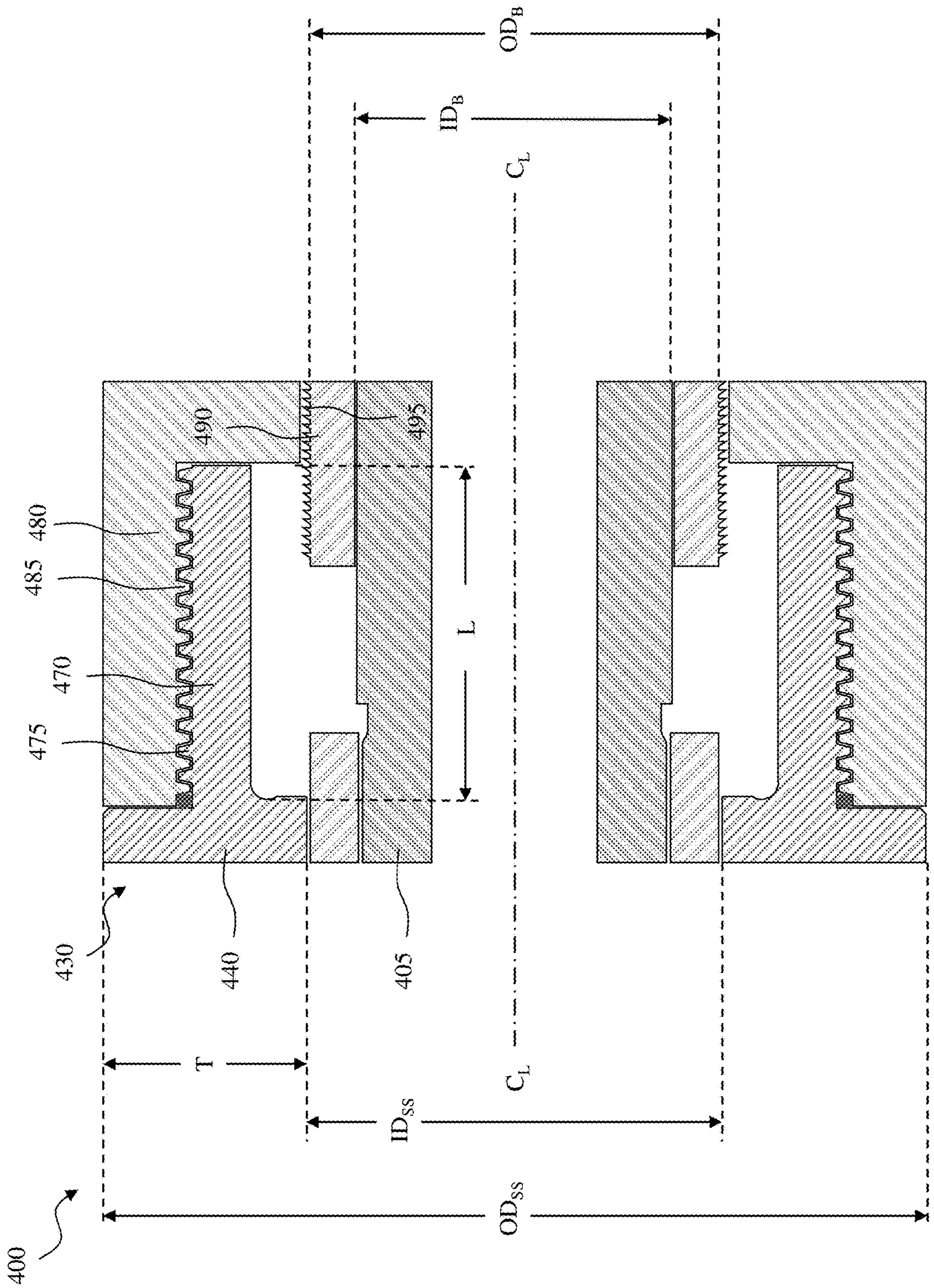
C_L
490
495
480
485
e
455
t
L
470
450
445
475
430
440
405
T
C_L
ID_{SS}
OD_{SS}
400

FIG. 4C



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ID_{SS}
OD_{SS}
400

FIG. 4D

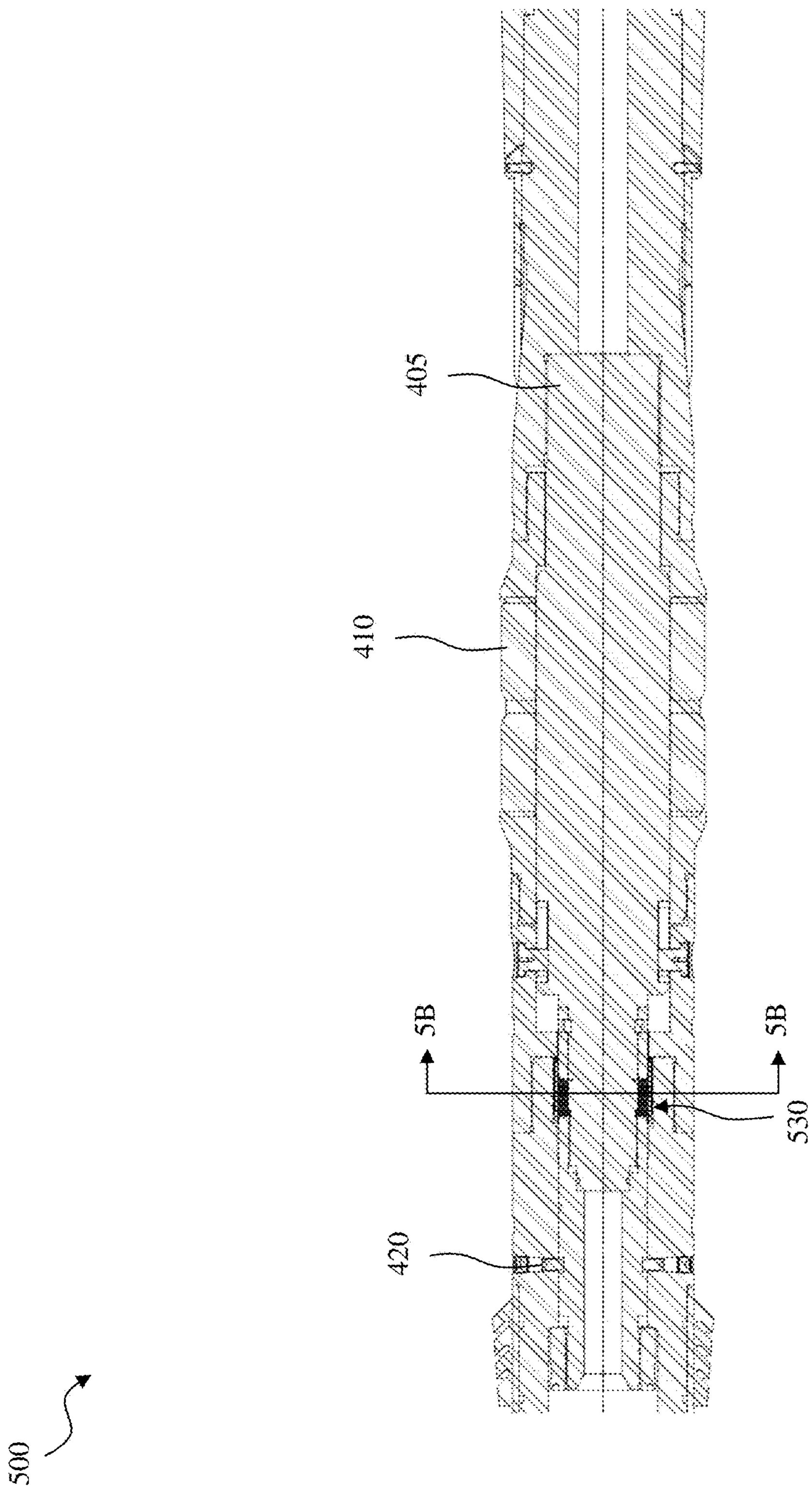


FIG. 5A

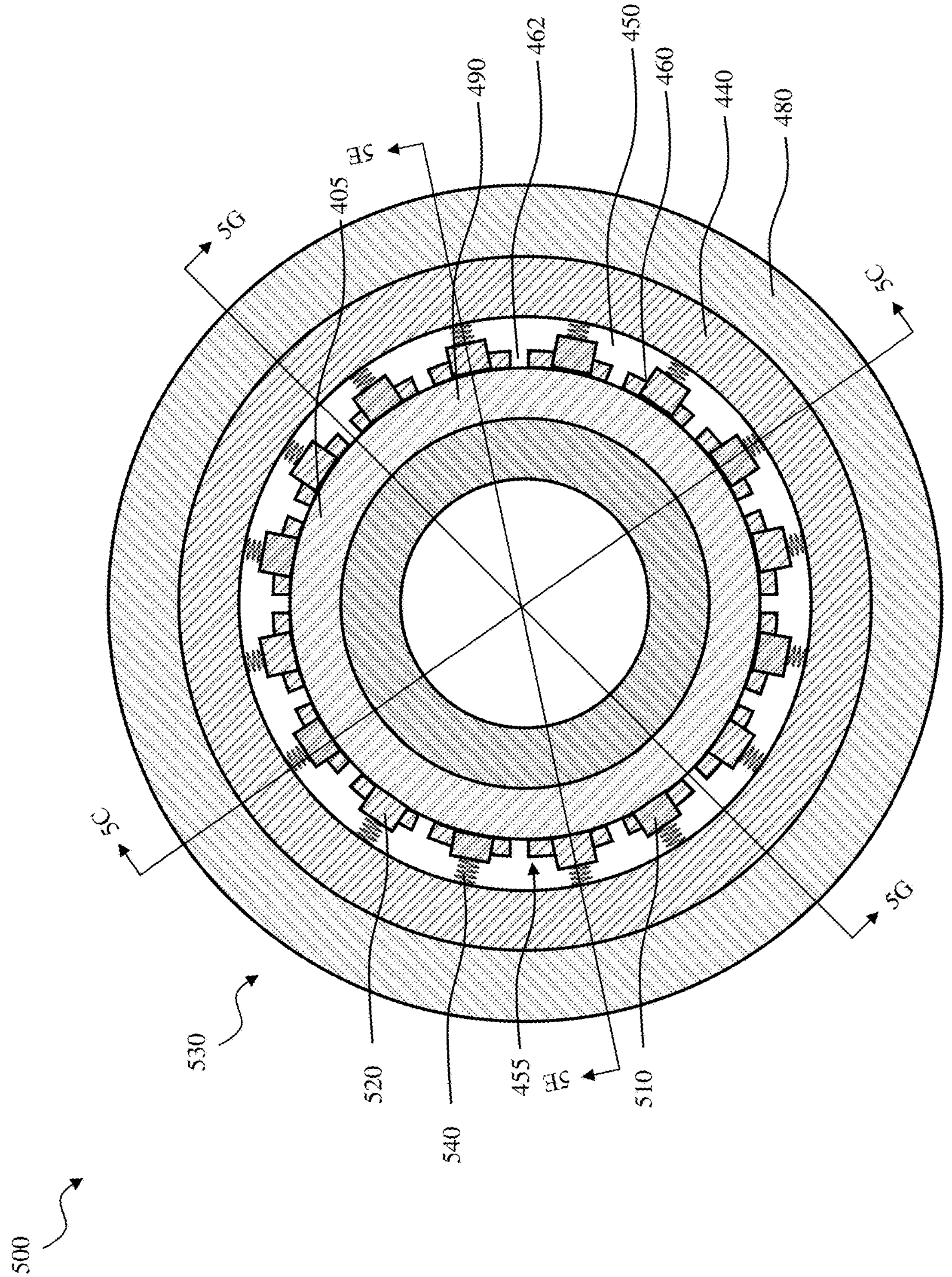
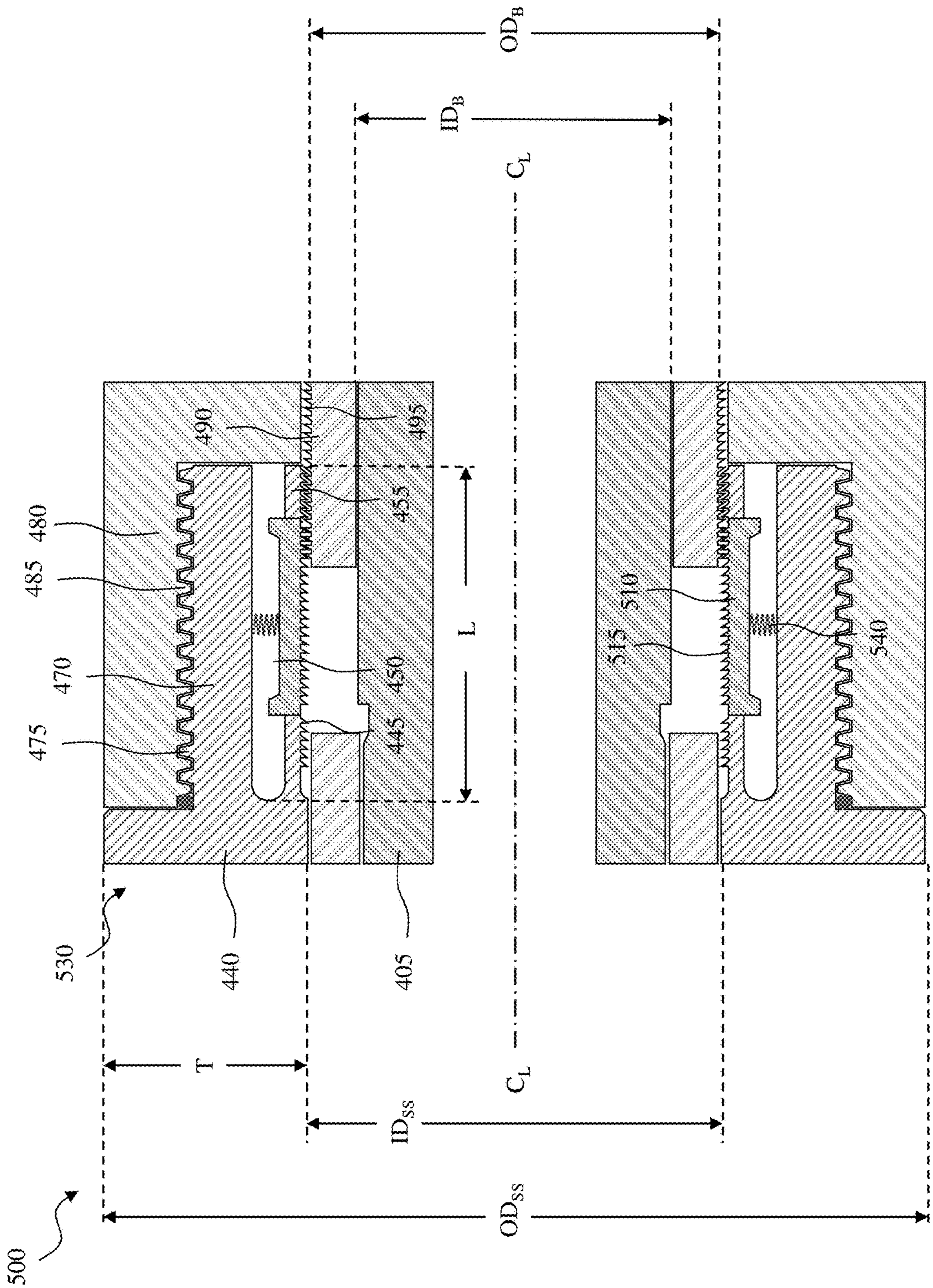

500
530
520
540
455
5E
510
405
5E
5G
5G
5C
5C
490
462
450
460
440
480

FIG. 5B



500
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440
405
OD_{SS}
ID_{SS}
T
C_L
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455
450
445
L
OD_B
ID_B
510
515
540

FIG. 5C

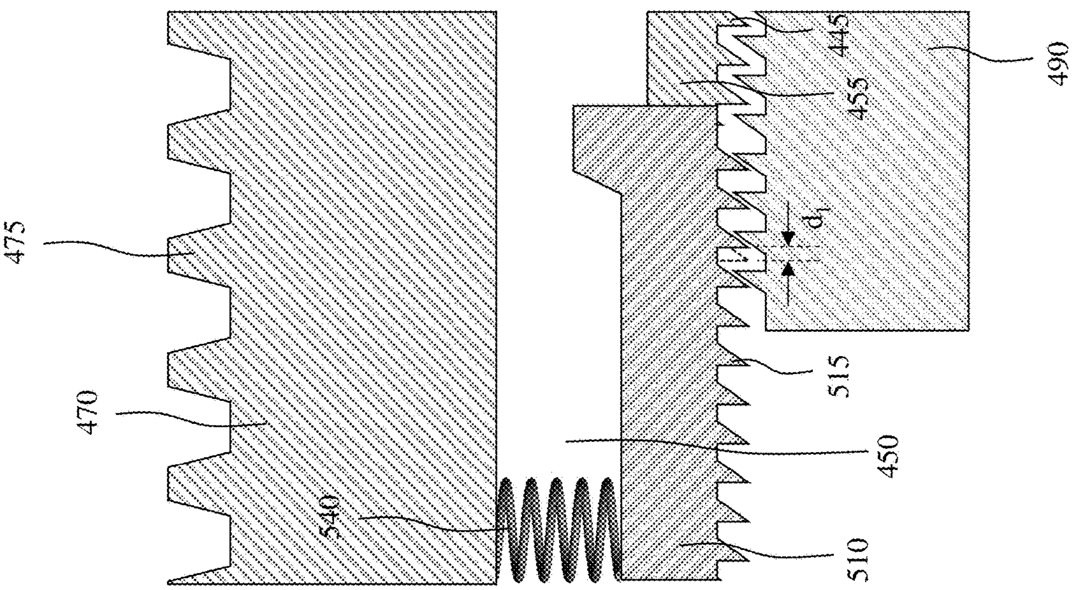
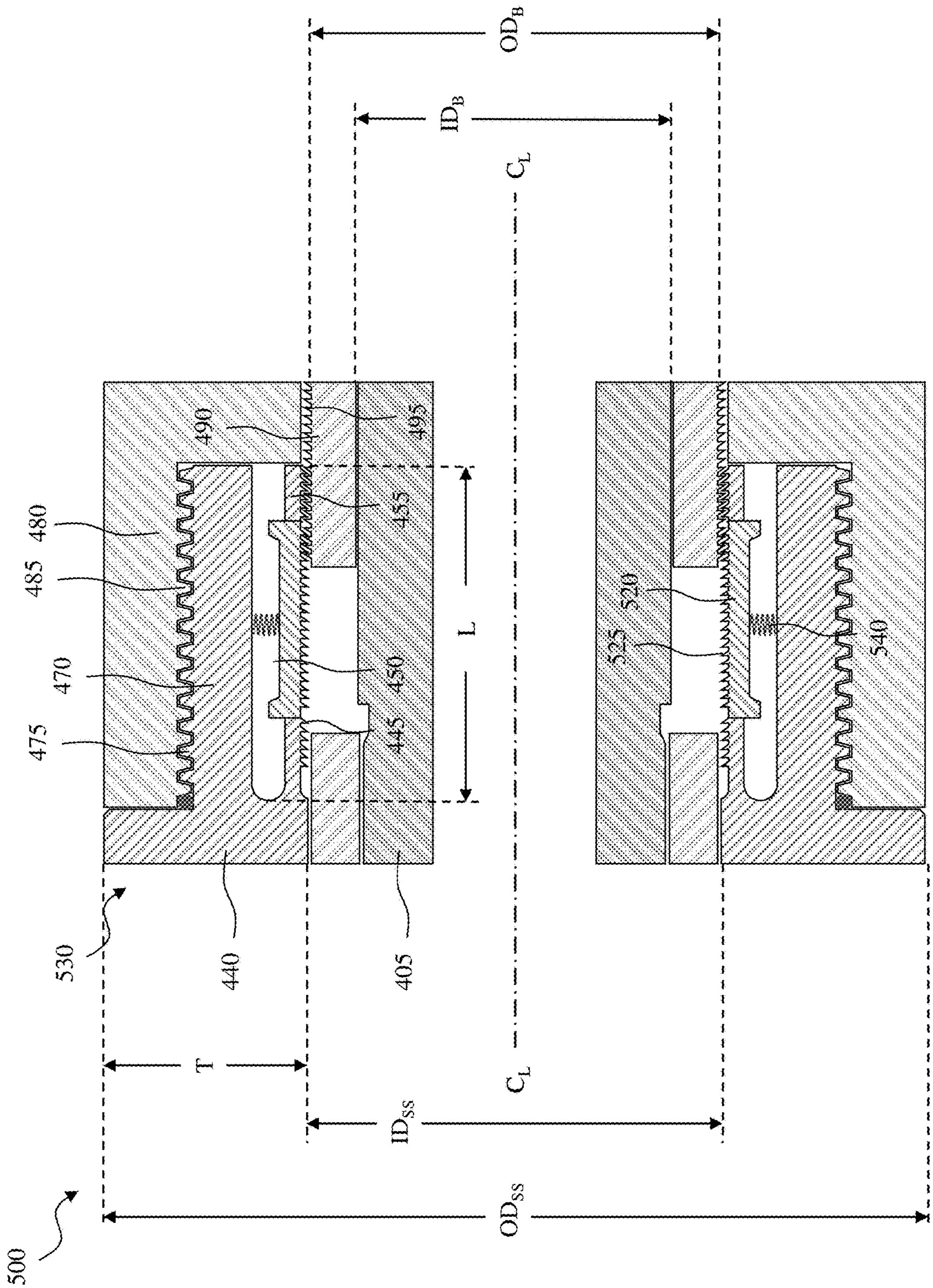


FIG. 5D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490
495
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525
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L
T
OD_B
ID_B
C_L
C_L
ID_{SS}
OD_{SS}

FIG. 5E

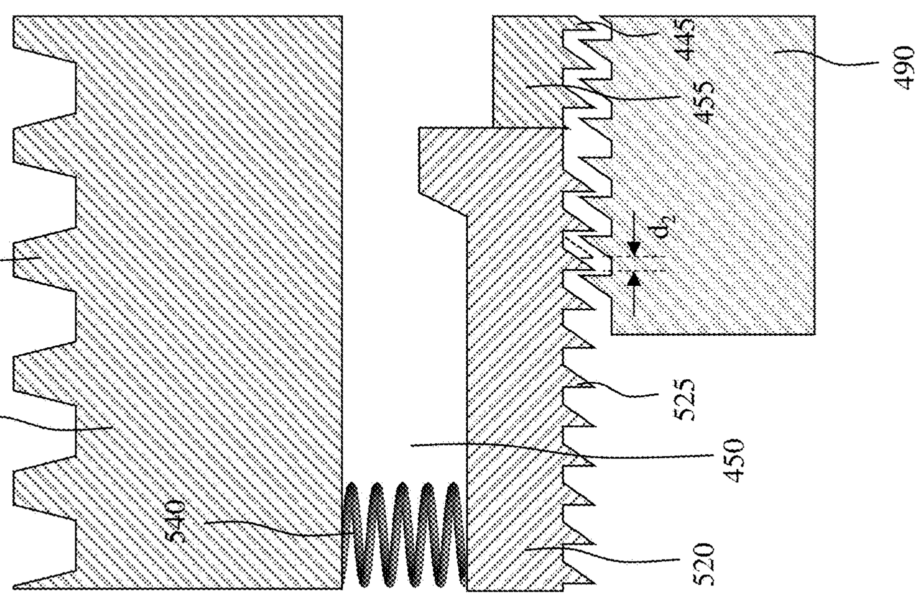
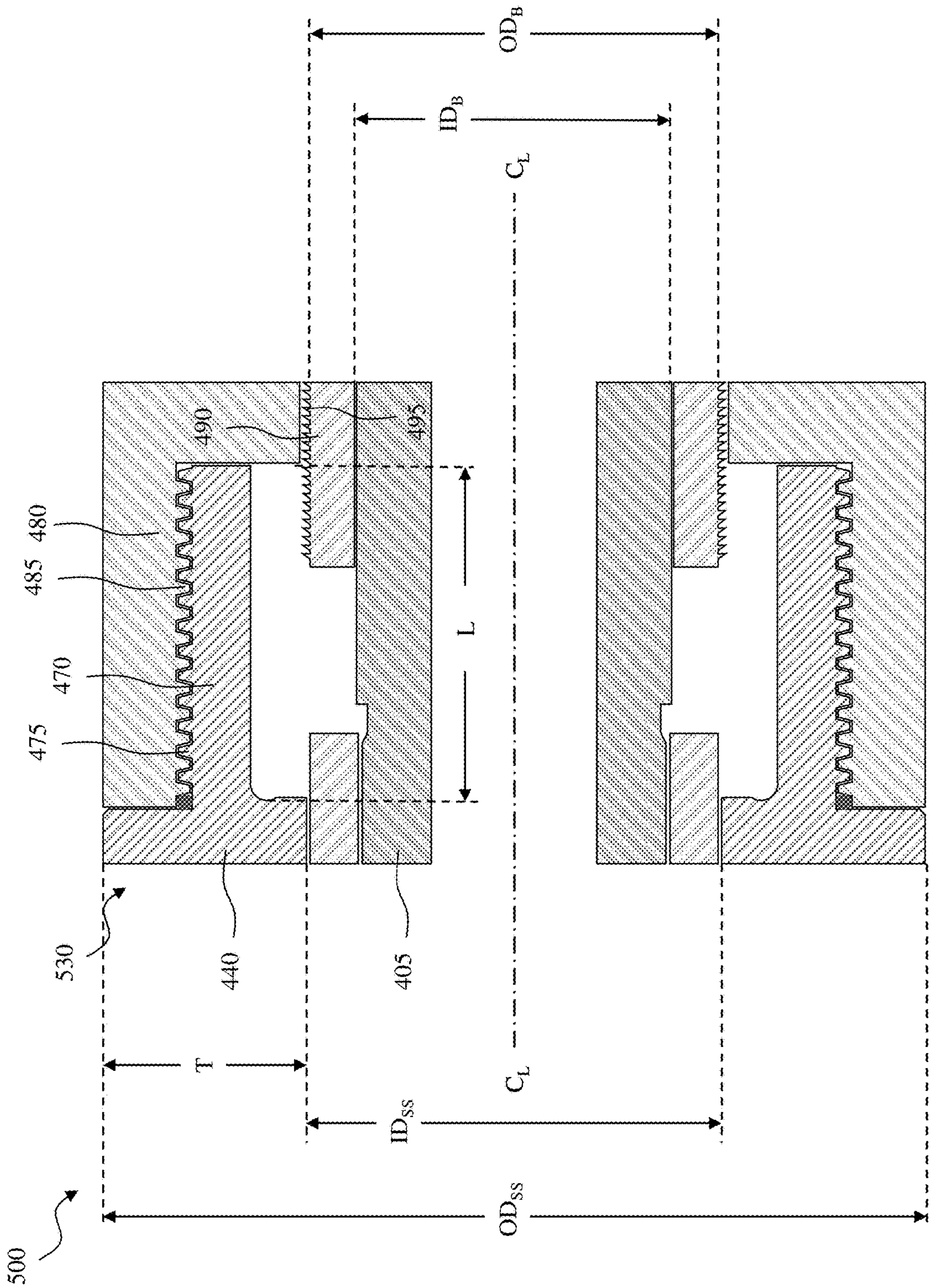


FIG. 5F



OD_B
ID_B
C_L
490
495
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485
470
475
L
530
440
405
T
C_L
ID_SS
OD_SS
500

FIG. 5G

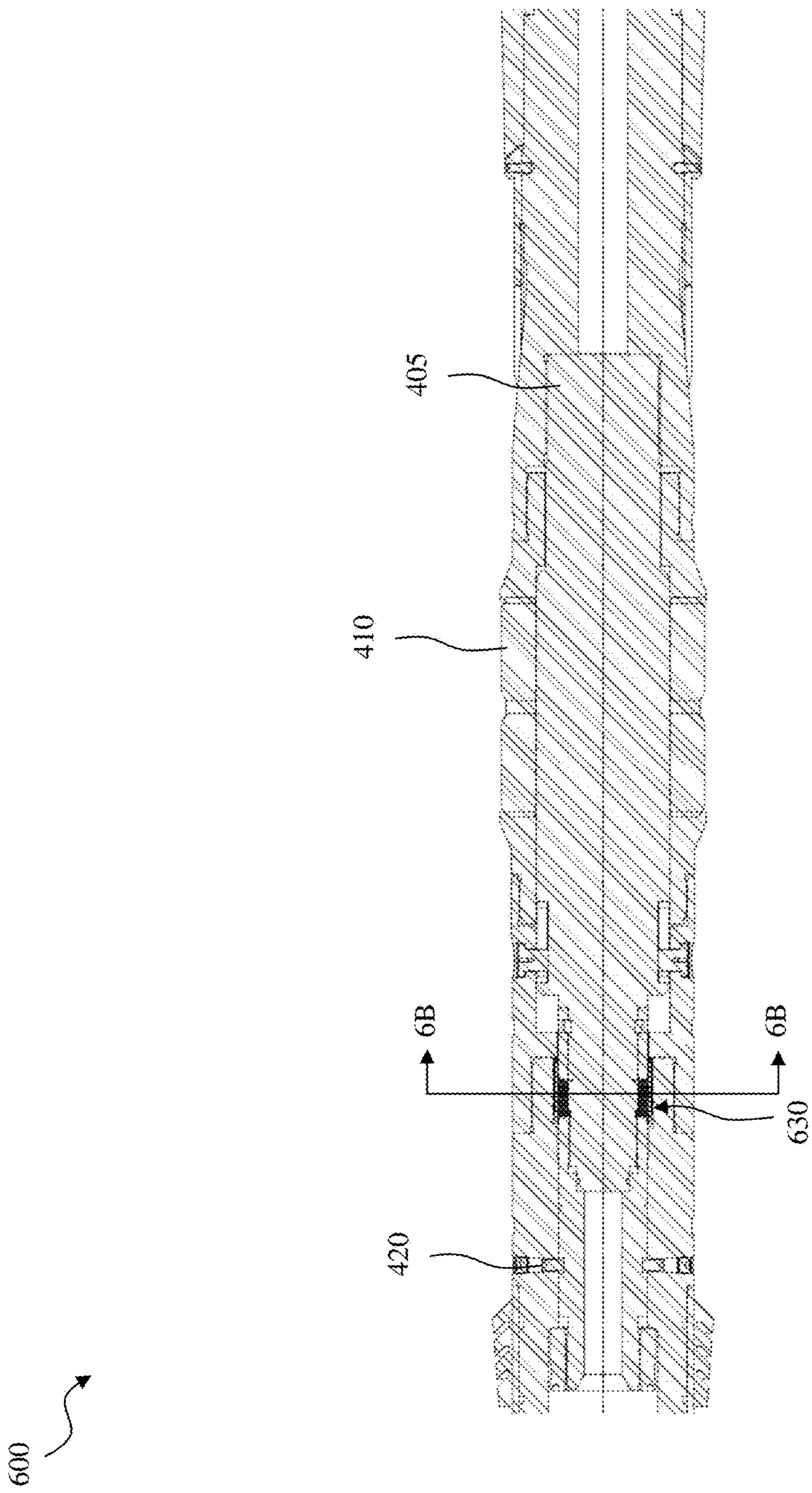


FIG. 6A

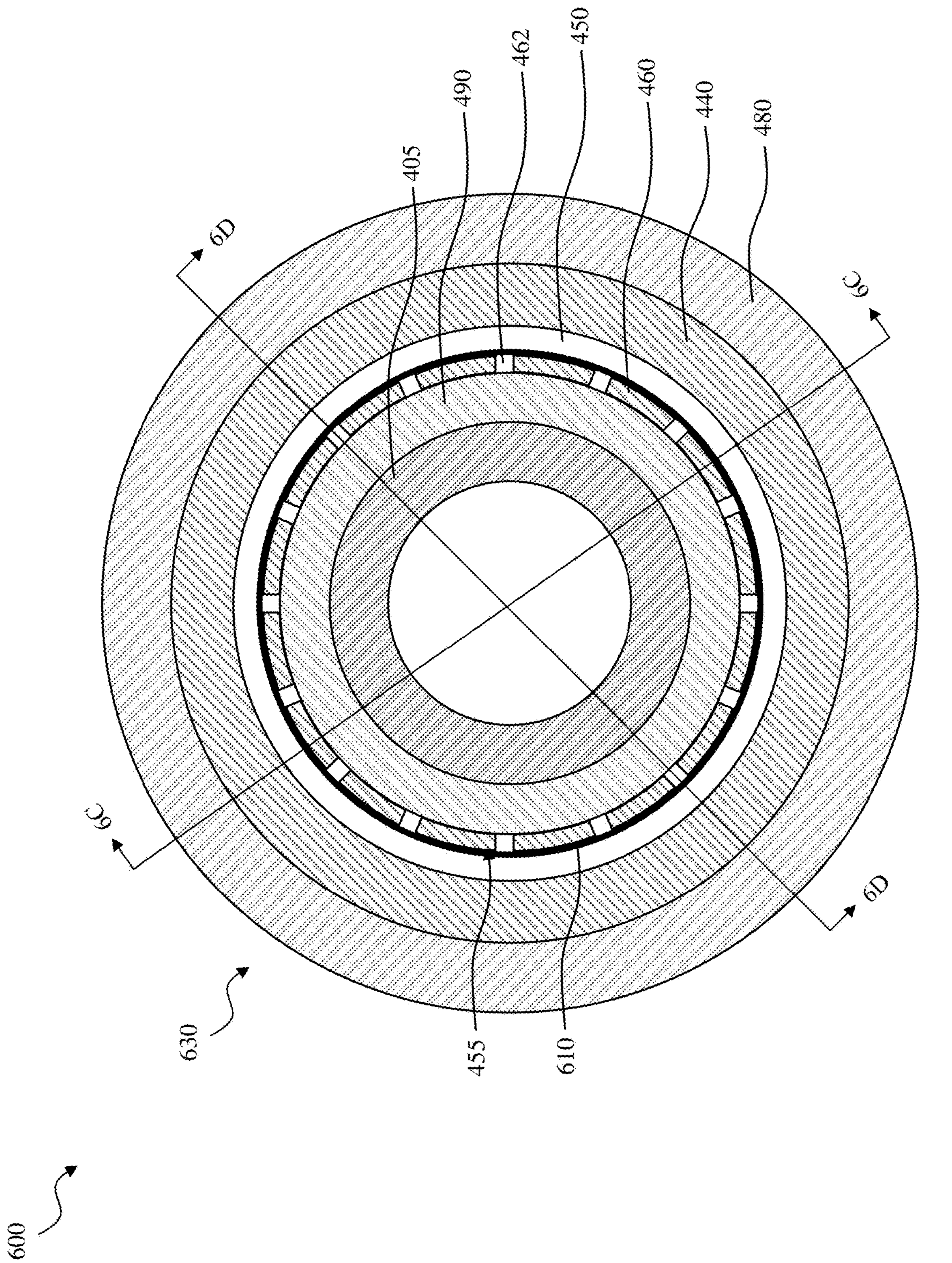
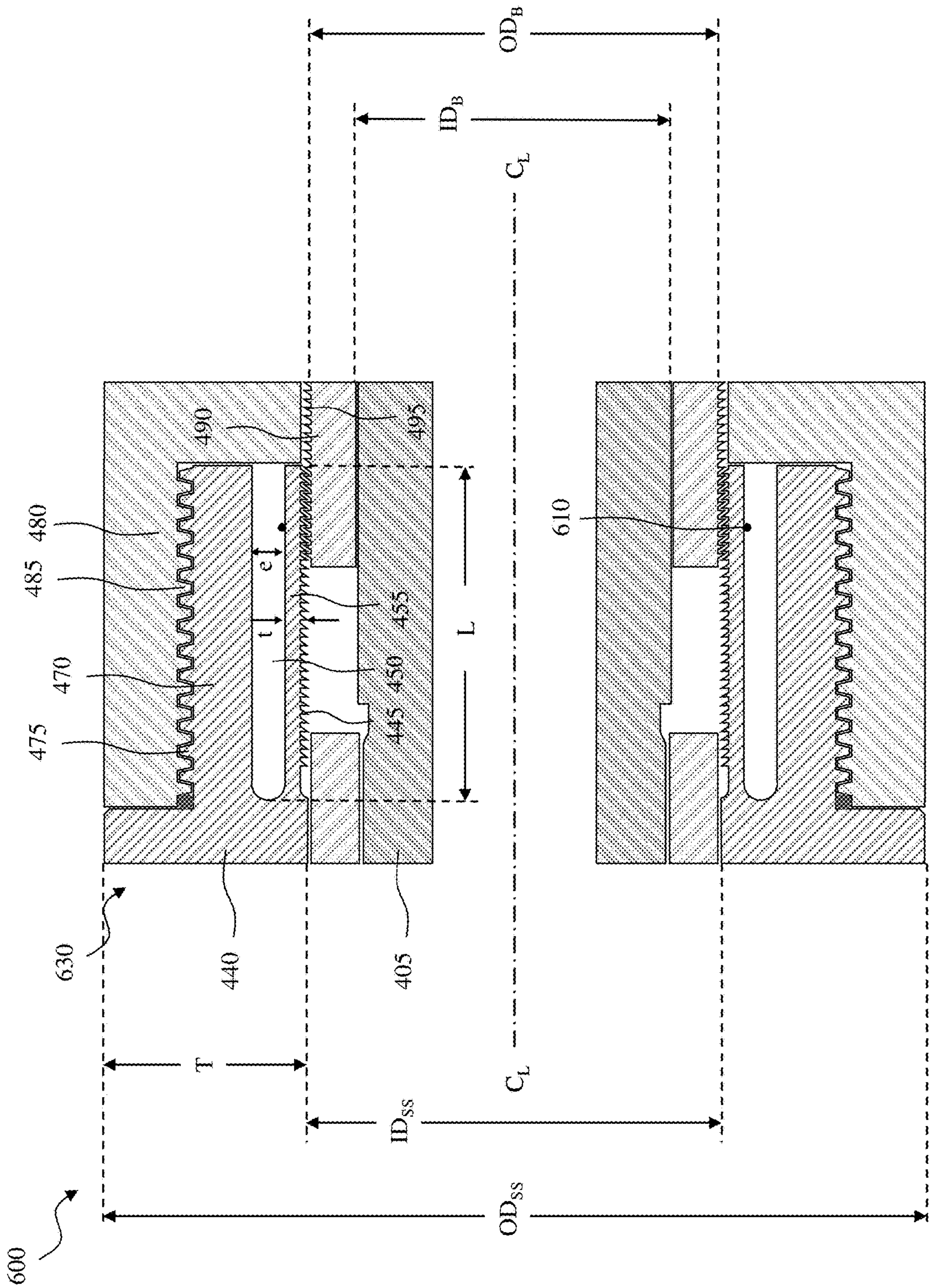


FIG. 6B



OD_B
ID_B
C_L
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470
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445
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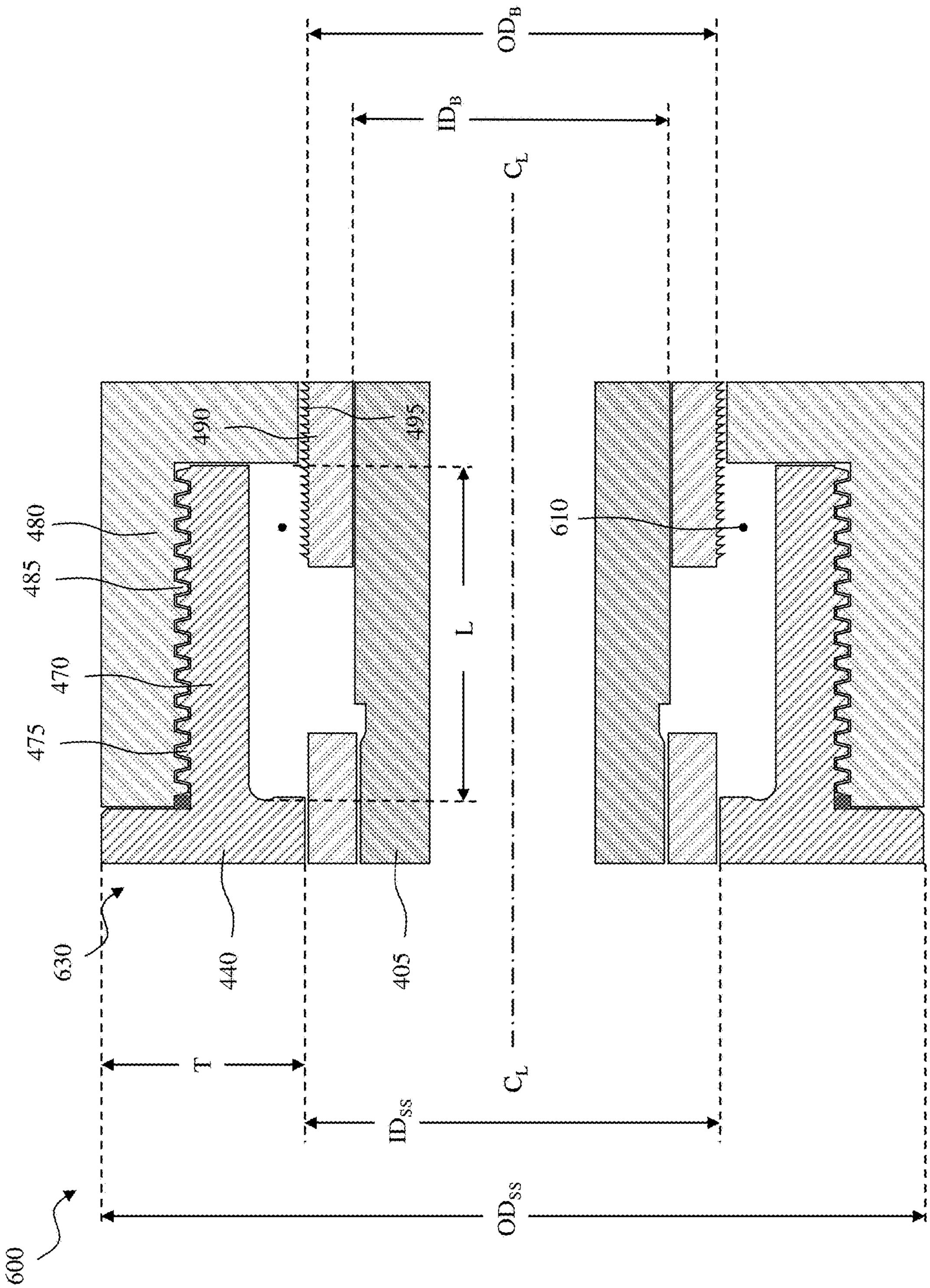
630
440
405
T
C_L
ID_{SS}
OD_{SS}
600

FIG. 6C


OD_B
ID_B
C_L
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470
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630
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405
T
C_L
ID_SS
OD_SS
600

FIG. 6D

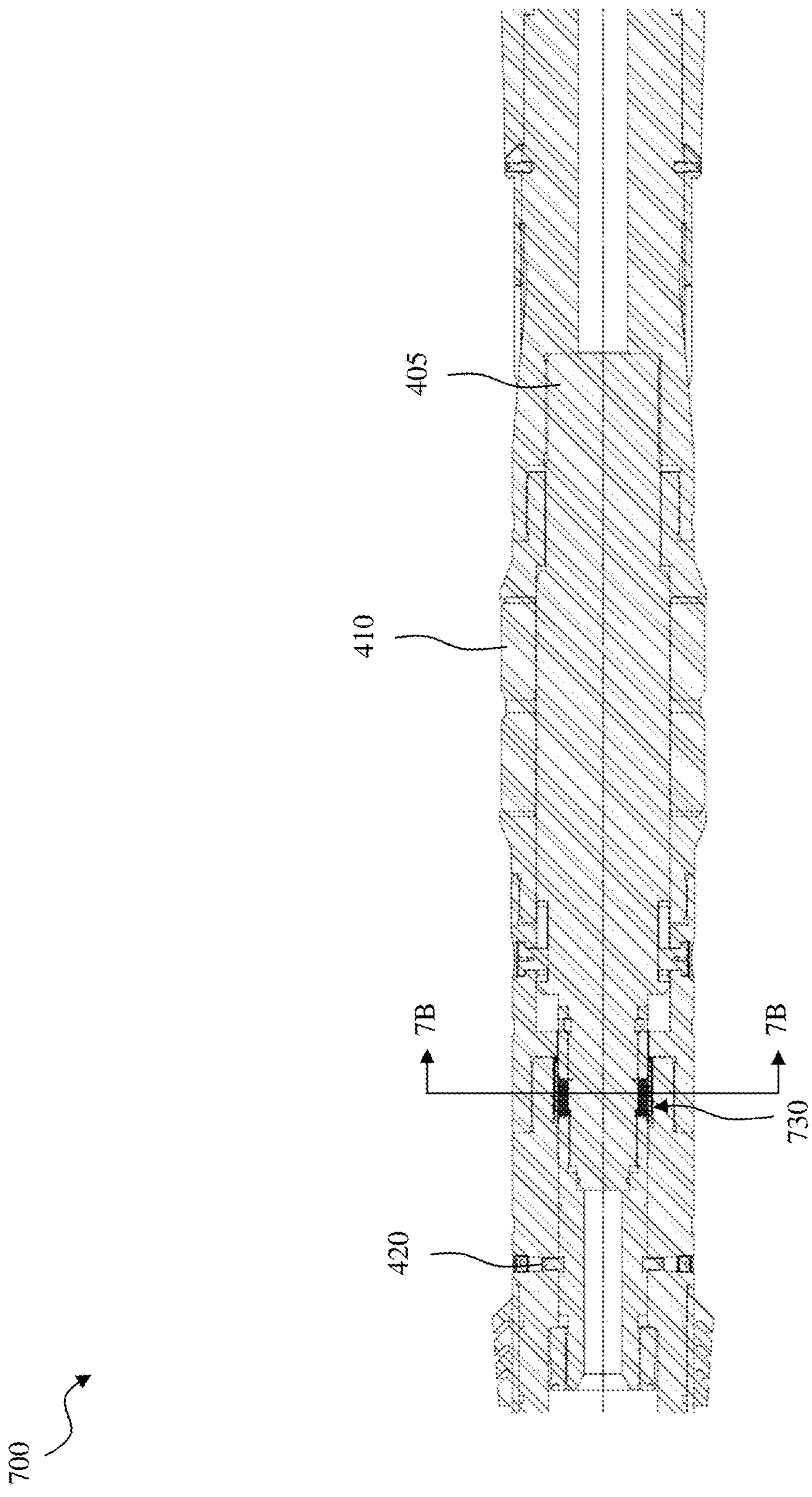


FIG. 7A

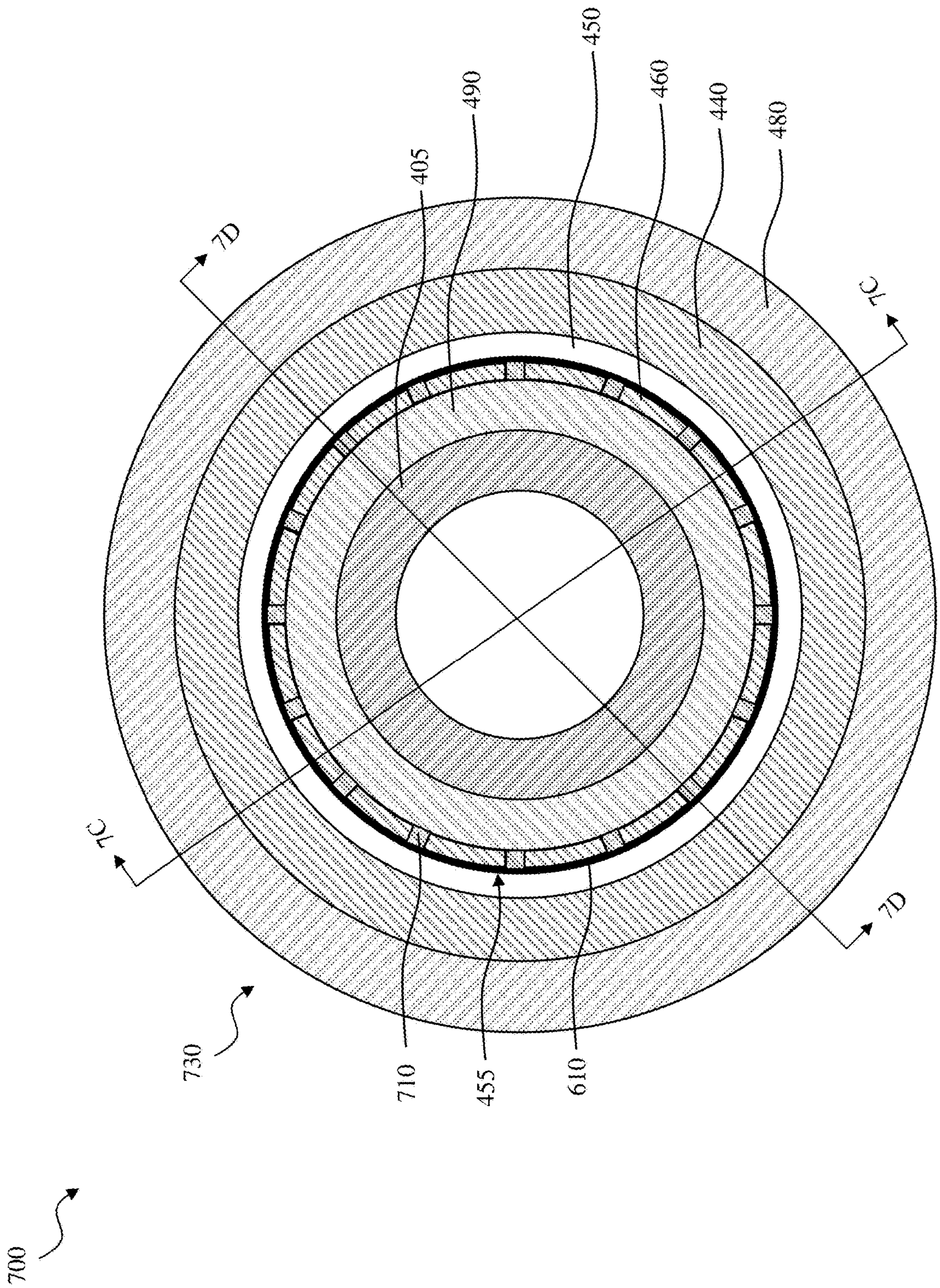
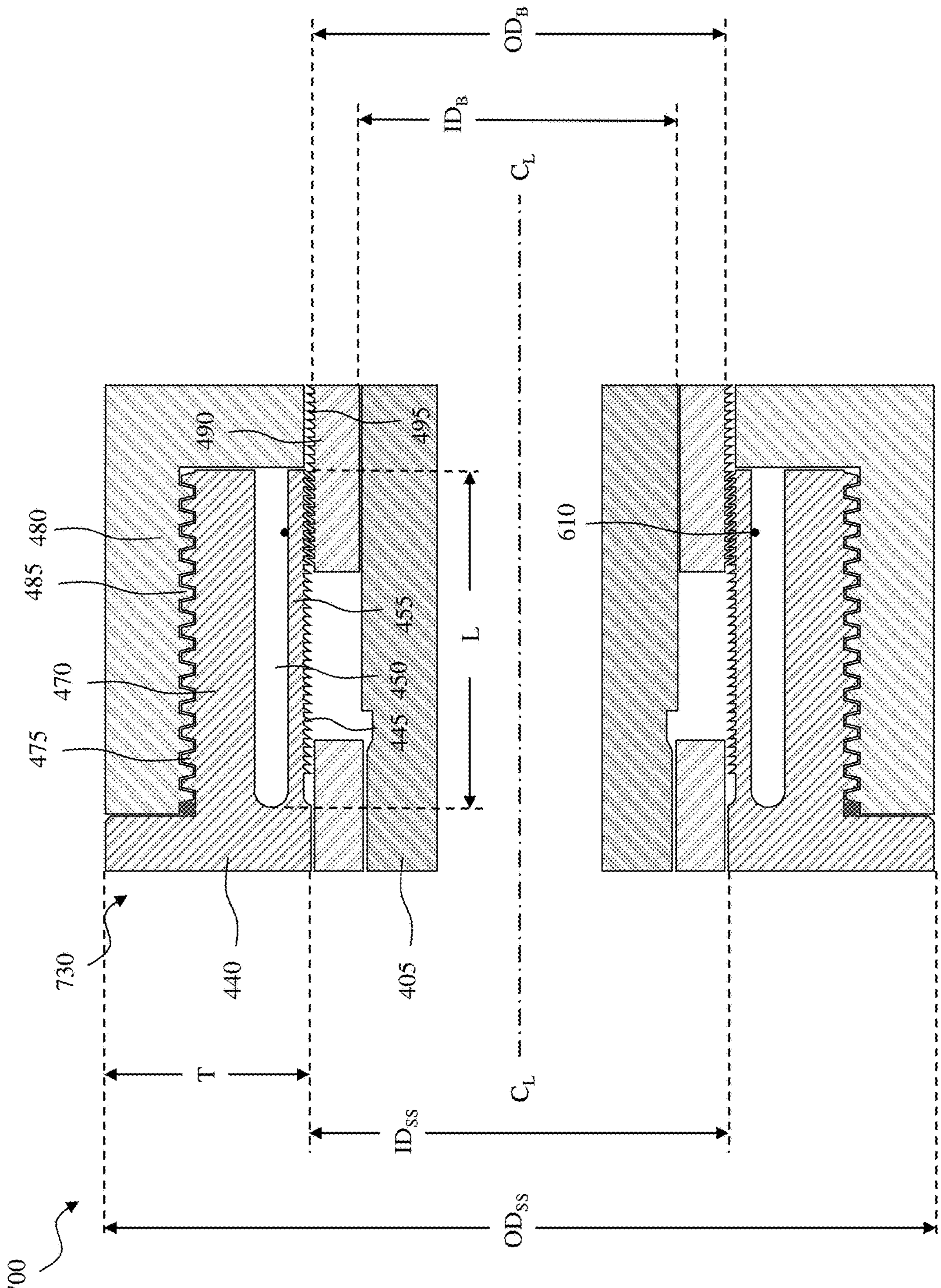
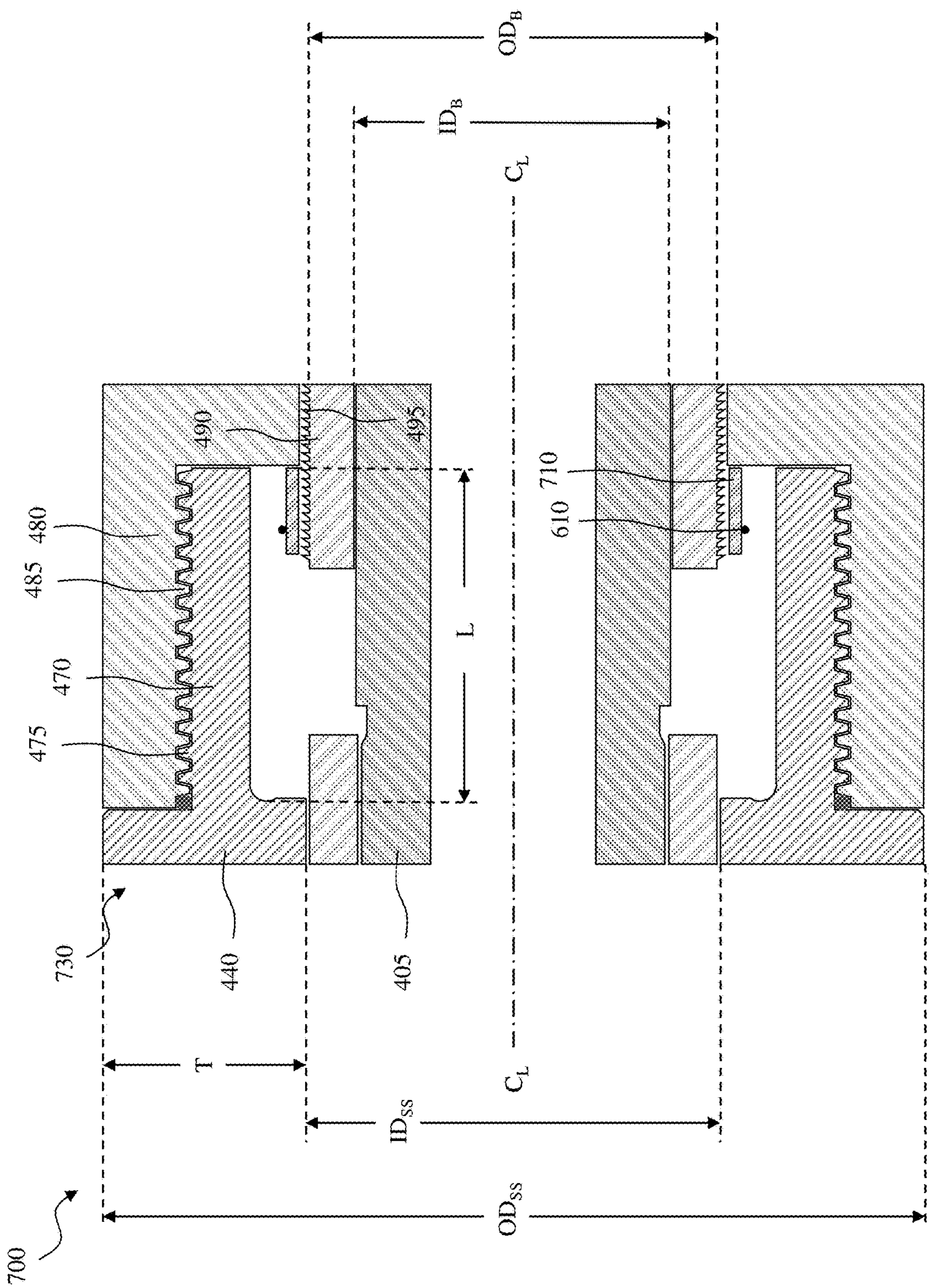


FIG. 7B



OD_B
ID_B
C_L
490
495
480
485
470
475
455
450
445
610
L
730
440
405
T
C_L
ID_{SS}
OD_{SS}
700

FIG. 7C



OD_B
ID_B
C_L
490
495
480
485
470
475
710
610
L
730
440
405
T
C_L
ID_{SS}
OD_{SS}
700

FIG. 7D

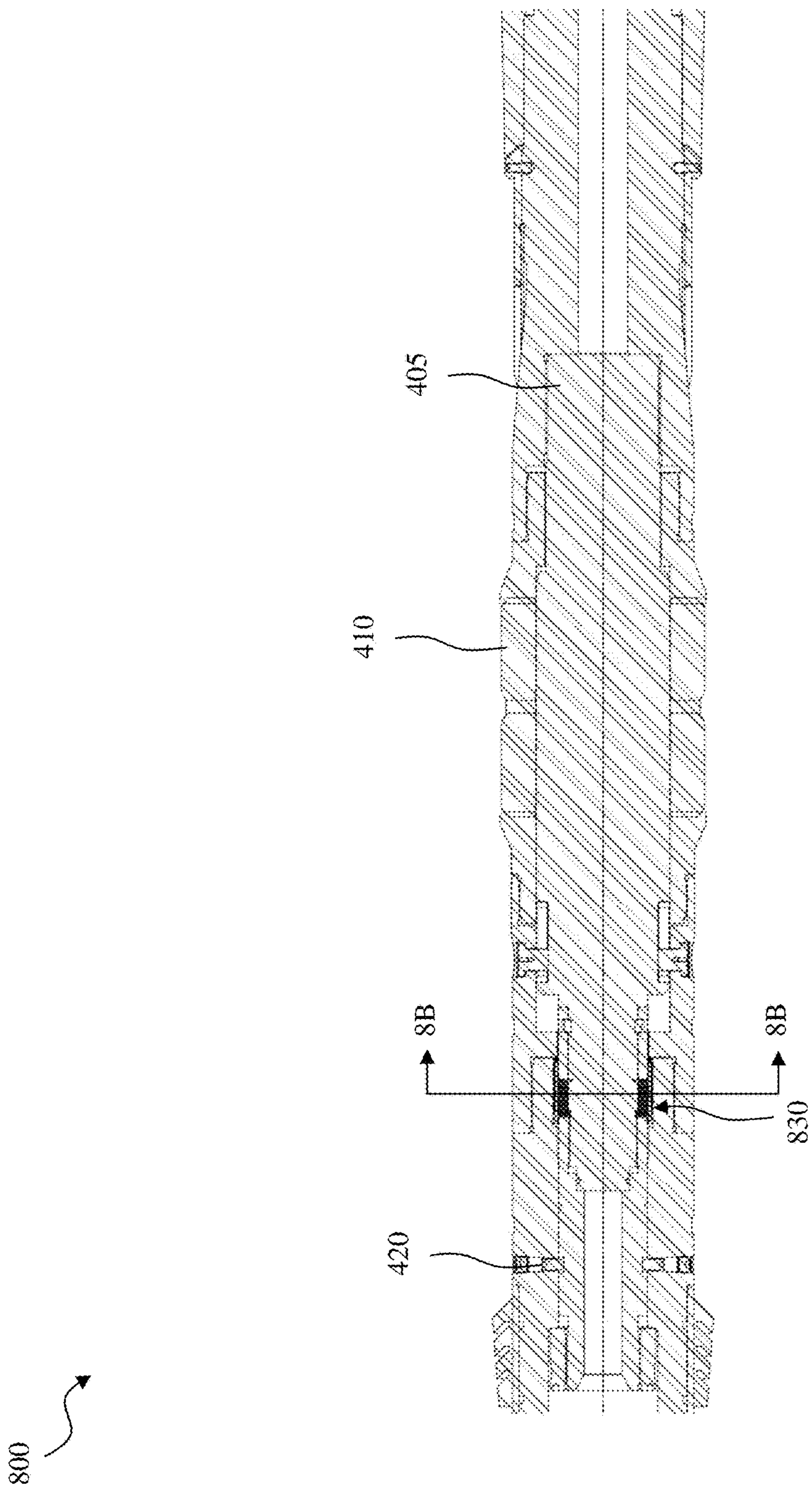


FIG. 8A

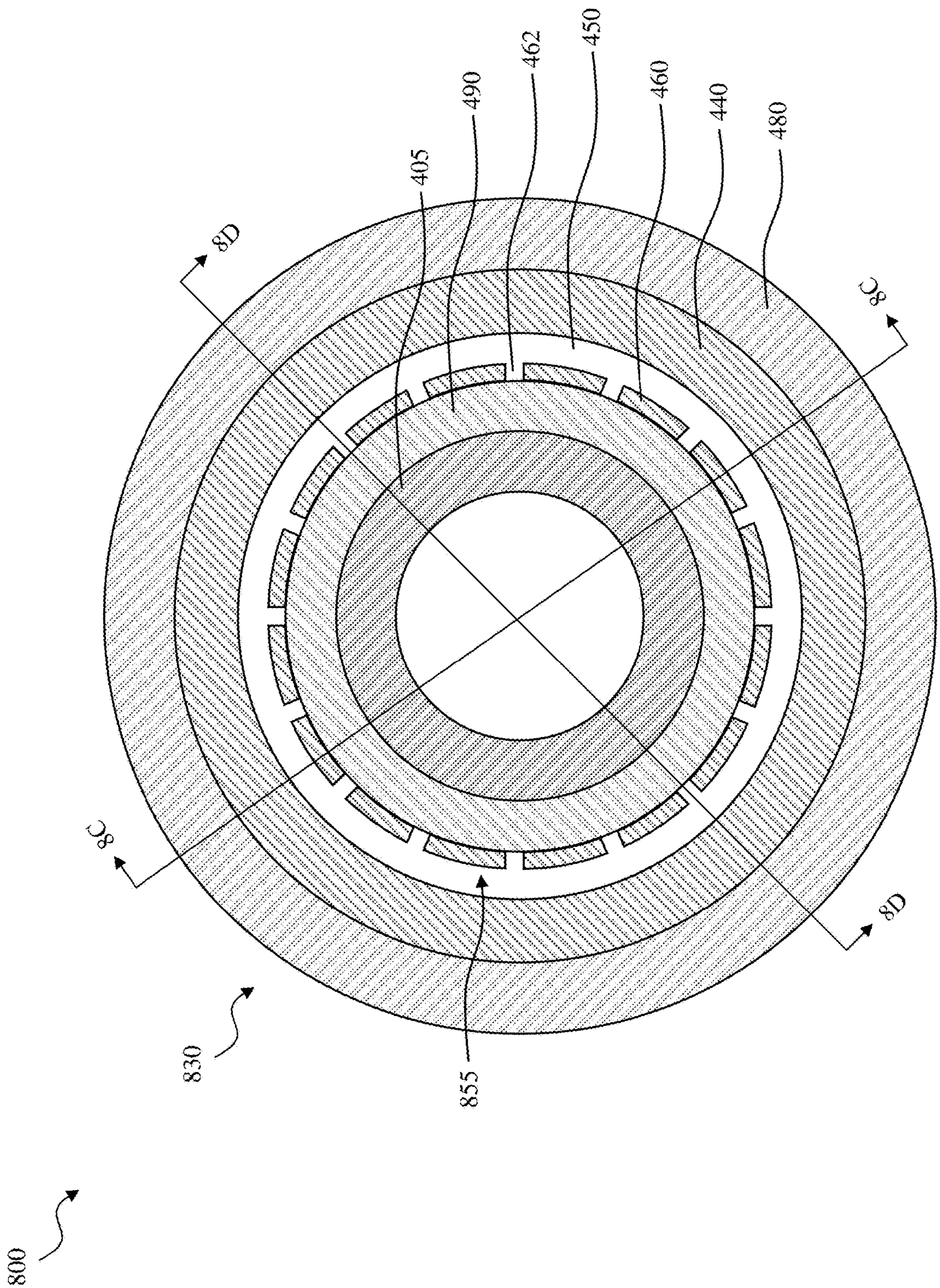
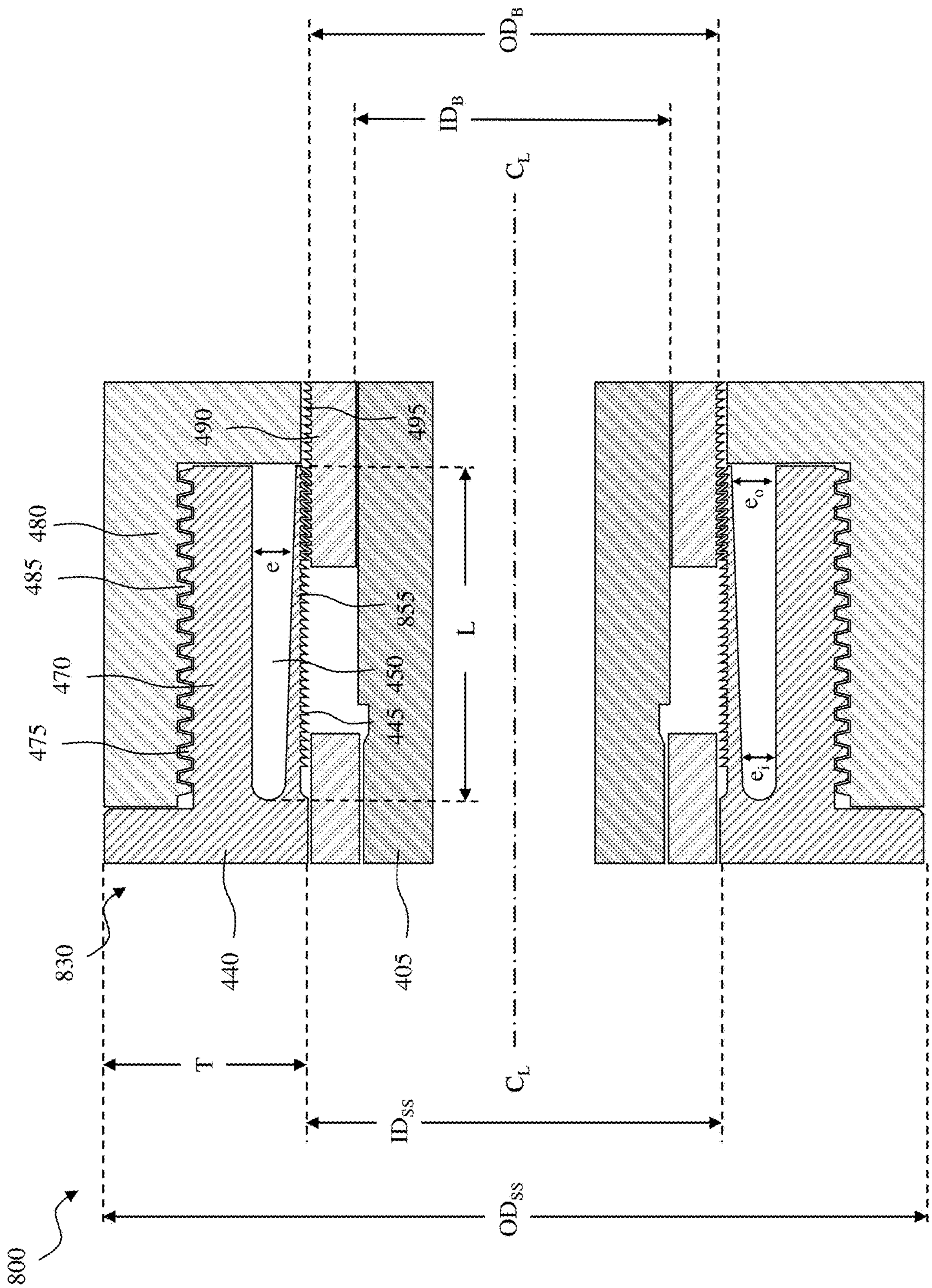
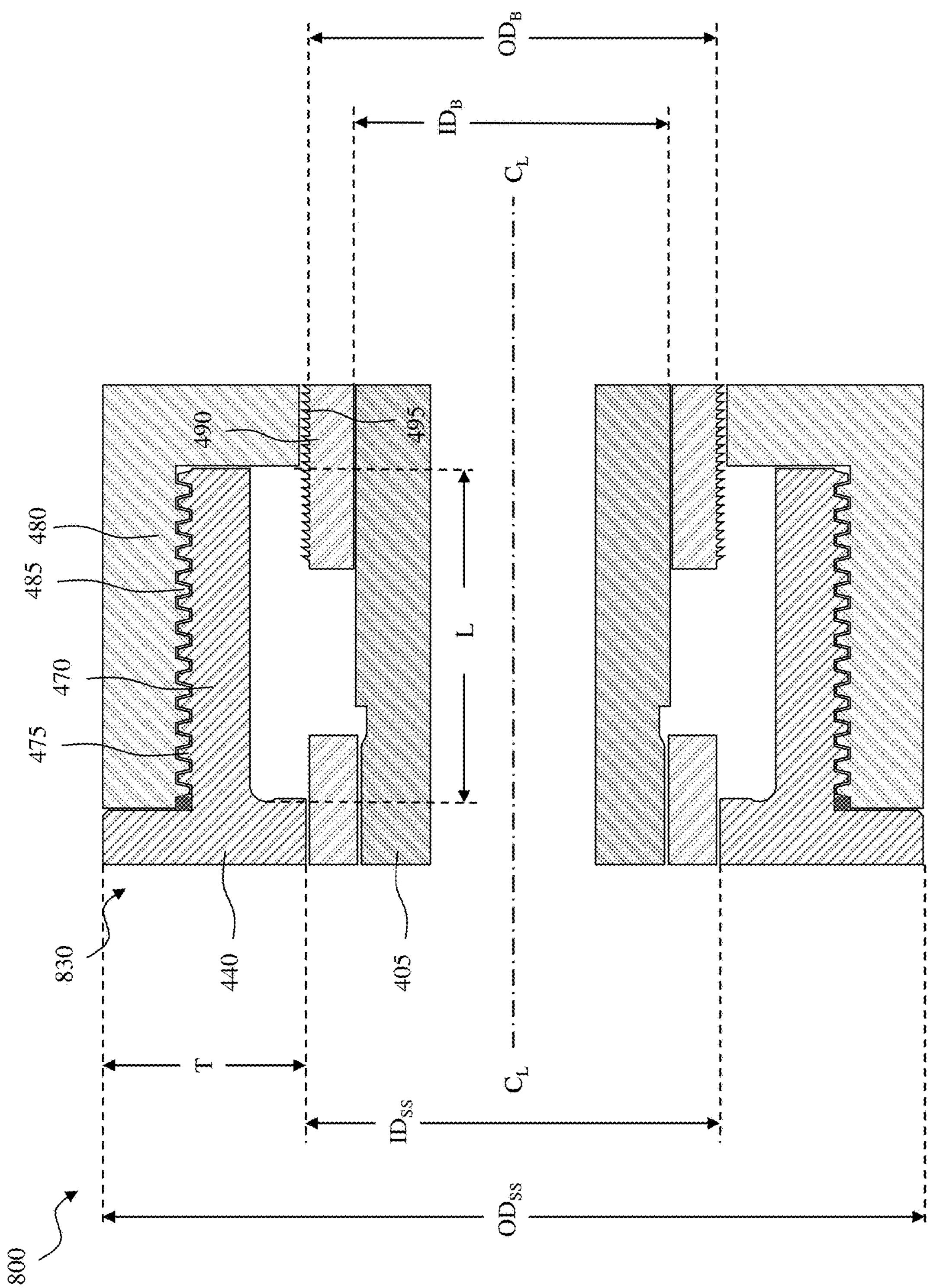


FIG. 8B



OD_B
ID_B
C_L
490
495
480
485
470
475
e
855
450
445
L
e_o
e_i
830
440
405
T
C_L
ID_SS
OD_SS
800

FIG. 8C



800
830
440
405
480
485
470
475
490
495
L
T
OD_B
ID_B
C_L
C_L
ID_{SS}
OD_{SS}

FIG. 8D

INTERNAL SLIP DESIGN WITH MINIMUM BACKLASH FOR PACKERS SEAL ENHANCEMENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a divisional of U.S. patent application Ser. No. 18/073,679, entitled “INTERNAL SLIP DESIGN WITH MINIMUM BACKLASH FOR PACKERS SEAL ENHANCEMENT”, filed on Dec. 2, 2022. The above-listed application is commonly assigned with the present application is incorporated herein by reference as if reproduced herein in its entirety.

BACKGROUND

[0002] The unconventional market is very competitive. The market is trending towards longer horizontal wells to increase reservoir contact. Multilateral wells offer an alternative approach to maximize reservoir contact. Multilateral wells include one or more lateral wellbores extending from a main wellbore. A lateral wellbore is a wellbore that is diverted from the main wellbore or another lateral wellbore.

[0003] The lateral wellbores are typically formed by positioning one or more deflector assemblies at desired locations in the main wellbore (e.g., an open hole section or cased hole section of the main wellbore) with a running tool. The deflector assemblies are often laterally and rotationally fixed within the main wellbore using a wellbore anchor, sealed using a wellbore seal, and then used to create an opening in the casing.

BRIEF DESCRIPTION

[0004] Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0005] FIG. **1** illustrates a schematic view of a well system designed, manufactured and operated according to one or more embodiments disclosed herein;

[0006] FIGS. **2**A and **2**B illustrate one embodiment of a whipstock assembly designed and manufactured according to one or more embodiments of the disclosure;

[0007] FIG. **3** illustrates an alternative embodiment of a sealing/anchoring subassembly, the sealing/anchoring subassembly including a sealing section and a latching element section designed and manufactured according to an alternative embodiment of the disclosure;

[0008] FIGS. **4**A through **4**D illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more embodiments of the disclosure;

[0009] FIGS. **5**A through **5**G illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure;

[0010] FIGS. **6**A through **6**D illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure;

[0011] FIGS. **7**A through **7**D illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure; and

[0012] FIGS. **8**A through **8**D illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure.

DETAILED DESCRIPTION

[0013] In the drawings and descriptions that follow, like parts are typically marked throughout the specification and drawings with the same reference numerals, respectively. The drawn figures are not necessarily to scale. Certain features of the disclosure may be shown exaggerated in scale or in somewhat schematic form and some details of certain elements may not be shown in the interest of clarity and conciseness. The present disclosure may be implemented in embodiments of different forms.

[0014] Specific embodiments are described in detail and are shown in the drawings, with the understanding that the present disclosure is to be considered an exemplification of the principles of the disclosure, and is not intended to limit the disclosure to that illustrated and described herein. It is to be fully recognized that the different teachings of the embodiments discussed herein may be employed separately or in any suitable combination to produce desired results.

[0015] Unless otherwise specified, use of the terms “connect,” “engage,” “couple,” “attach,” or any other like term describing an interaction between elements is not meant to limit the interaction to direct interaction between the elements and may also include indirect interaction between the elements described. Unless otherwise specified, use of the terms “up,” “upper,” “upward,” “uphole,” “upstream,” or other like terms shall be construed as generally away from the bottom, terminal end of a well; likewise, use of the terms “down,” “lower,” “downward,” “downhole,” “downstream,” or other like terms shall be construed as generally toward the bottom, terminal end of a well, regardless of the wellbore orientation. Use of any one or more of the foregoing terms shall not be construed as denoting positions along a perfectly vertical axis. Unless otherwise specified, use of the term “subterranean formation” shall be construed as encompassing both areas below exposed earth and areas below earth covered by water such as ocean or fresh water.

[0016] The present disclosure is based, at least in part, on the acknowledgment that body lock rings are an important part of a sealing/anchoring subassembly such as packer system, for example being used to hold the setting load once the sealing/anchoring subassembly is set and prior to differential pressure application. However, backlash or set back of the body lock ring is an inherent drawback of common locking systems, resulting in some loss in setting force and subsequent relaxation of the packer element, which eventually affects the packer sealing performance (e.g., particularly for large size packers). The present disclosure has recognized that one way to control and limit the backlash is to refine the grooves of the body lock ring. Unfortunately, doing so does not completely eliminate the backlash issues, and moreover makes the design and manufacturing process expensive.

[0017] With the foregoing acknowledgments in mind, the present disclosure has developed a new locking system that removes the independent body lock ring entirely, but in turn reduces the stroke sleeve inner diameter (ID_{SS}) and adds a plurality of teeth to the stroke sleeve ID_{SS}, the plurality of teeth functioning as an integrated locker ring of sorts, such that the stroke sleeve teeth may couple (e.g., directly couple) with the related teeth in the base. In at least one embodiment, a slot is formed within the stroke sleeve thickness between its outer diameter (OD_{SS}) and its ID_{SS}, such that the integrated locker ring can ratchet along the base without yielding the teeth or affecting the pin threads in the OD_{SS} of the stroke sleeve. Thus, in at least one embodiment, the locker ring is effectively decoupled from a radially outer portion of the stroke sleeve (e.g., near the pin threads along the OD_{SS} of the stroke sleeve).

[0018] The present disclosure has also recognized that it may be beneficial to include a plurality of segments in the integrated locker ring, thereby making the locker ring circumferentially discontinuous. In fact, in at least one embodiment, the locker ring includes (n) segments around its circumference, all of which are connected at a root of the stroke sleeve. The present disclosure has additionally recognized that the number (n) of segments around the circumference, the slot opening width (e), the locker ring thickness (t) and length of the slot (L) may all be properly selected to tailor the sealing/anchoring subassembly for a given geometry and/or setting load. For example, the locker ring thickness (t) and length of the slot (L) may specifically be adjusted to control the radial stiffness or flexibility of the segmented locker ring.

[0019] The present disclosure has recognized that by removing the independent body lock ring, any additional backlash introduced by the independent body lock ring goes away, which results in minimal backlash as often seen in common packer designs. What results is improved sealing performance, for example as a result of reducing the backlash, reduced cost due to removing the independent body lock ring, and enhanced reliability due to removing an extra component. Additionally, the sealing/anchoring subassembly according to the present design is simple, for example with no manufacturing design complexities, as well as is a versatile concept that can easily be applied to other packer systems.

[0020] The disclosure, in one embodiment, also describes a new method for deploying, setting, and retrieving one or more features of a whipstock assembly, as might be used to form a lateral wellbore from a main wellbore. In at least one embodiment, the whipstock assembly includes a sealing/anchoring subassembly, the sealing/anchoring subassembly including an orienting receptacle section, a sealing section, and a latching element section. In accordance with one embodiment of the disclosure, the orienting receptacle section, along with a collet and one or more orienting keys, may be used to land and position a guided milling assembly within the casing, the guided milling assembly ultimately being used to generate a pocket in the casing. In accordance with one other embodiment of the disclosure, the orienting receptacle section, along with the collet and one or more orienting keys, may be used to land and position a whipstock element section of the whipstock assembly within the casing (e.g., the whipstock element section ultimately being used to form a lateral wellbore off of the main wellbore), and cement a multilateral junction between the two.

[0021] In at least one embodiment, the sealing section may employ any known or hereafter discovered sealing elements capable of setting and/or sealing the sealing section. For example, in at least one embodiment, the sealing elements are polymer sealing elements set with a mechanical axial load about a mandrel. Ultimately, unless otherwise required, the present disclosure is not limited to any specific sealing elements.

[0022] Notwithstanding the foregoing, in at least one embodiment, the sealing section additionally includes a ratch latch body coupled to the sealing/anchoring element. The ratch latch body, in at least one embodiment, is configured to hold the sealing/anchoring element in the radially expanded state. For example, the ratch latch body according to one embodiment may include a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon. The ratch latch body according to this one embodiment may further include a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon. In at least this one embodiment, the stroke sleeve teeth and the base teeth are configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.

[0023] In one or more other embodiments, a circumferential slot is formed within a thickness (T) of the stroke sleeve between the stroke sleeve outer diameter (OD_{SS}s) and the stroke sleeve inner diameter (ID_{SS}). In this one embodiment, the slot forms an integrated locker ring. Furthermore, in one or more embodiments, the integrated locker ring includes (n) segments around its circumference, the (n) segments configured to allow the integrated locker ring to radially deform via a cantilever action.

[0024] FIG. **1** is a schematic view of a well system **100** designed, manufactured and operated according to one or more embodiments disclosed herein. The well system **100** includes a platform **120** positioned over a subterranean formation **110** located below the earth's surface **115**. The platform **120**, in at least one embodiment, has a hoisting apparatus **125** and a derrick **130** for raising and lowering one or more downhole tools including pipe strings, such as a drill string **140**. Although a land-based oil and gas platform **120** is illustrated in FIG. **1**, the scope of this disclosure is not thereby limited, and thus could potentially apply to offshore applications. The teachings of this disclosure may also be applied to other land-based well systems different from that illustrated.

[0025] As shown, a main wellbore **150** has been drilled through the various earth strata, including the subterranean formation **110**. The term "main" wellbore is used herein to designate a wellbore from which another wellbore is drilled. It is to be noted, however, that a main wellbore **150** does not necessarily extend directly to the earth's surface but could instead be a branch of yet another wellbore. A casing string **160** may be at least partially cemented within the main wellbore **150**. The term "casing" is used herein to designate a tubular string used to line a wellbore. Casing may actually be of the type known to those skilled in the art as a "liner" and may be made of any material, such as steel or composite material and may be segmented or continuous, such as coiled tubing. The term "lateral" wellbore is used herein to designate a wellbore that is drilled outwardly from its intersection with another wellbore, such as a main wellbore. Moreover, a lateral wellbore may have another lateral wellbore drilled outwardly therefrom.

[0026] In the embodiment of FIG. **1**, a whipstock assembly **170** according to one or more embodiments of the present disclosure is positioned at a location in the main wellbore **150**. Specifically, the whipstock assembly **170** could be placed at a location in the main wellbore **150** where it is desirable for a lateral wellbore **190** to exit. Accordingly, the whipstock assembly **170** may be used to support a milling tool used to penetrate a window in the main wellbore **150**, and once the window has been milled and a lateral wellbore **190** formed, in some embodiments, the whipstock assembly **170** may be retrieved and returned uphole by a retrieval tool.

[0027] The whipstock assembly **170**, in at least one embodiment, includes a whipstock element section **175**, as well as a sealing/anchoring subassembly **180** coupled to a downhole end thereof, the sealing/anchoring subassembly **180** designed, manufactured and/or operated according to one or more embodiments of the disclosure. The sealing/anchoring subassembly **180**, in one or more embodiments, includes an orienting receptacle section **182**, a sealing section **184**, and a latching element section **186**. The orienting receptacle section **182**, in one or more embodiments, along with a collet and one or more orienting keys, may be used to land and positioned a guided milling assembly and/or the whipstock element section **175** within the casing string **160**. The sealing section **184**, in at least one embodiment, seals an annulus (e.g., provides a pressure tight seal) between the whipstock assembly **170** and the casing string **160**. In at least one embodiment, the latching element section **186** axially, and optionally rotationally, fixes the whipstock assembly **170** within the casing string **160**.

[0028] The elements of the whipstock assembly **170** may be positioned within the main wellbore **150** in one or more separate steps. For example, in at least one embodiment, the sealing/anchoring subassembly **180**, including the orienting receptacle section **182**, sealing section **184** and the latching element section **186** are run in hole first, and then set within the casing string **160**. Thereafter, the sealing section **184** may be pressure tested. Thereafter, the whipstock element section **175** may be run in hole and coupled to the sealing/anchoring subassembly **180**, for example using the orienting receptacle section **182**. What may result is the whipstock assembly **170** illustrated in FIG. **1**.

[0029] Turning now to FIGS. **2**A and **2**B, illustrated is one embodiment of a whipstock assembly **200** designed and manufactured according to one or more embodiments of the disclosure. The whipstock assembly **200**, in the illustrated embodiment of FIGS. **2**A and **2**B, includes a whipstock element section **210**, and a sealing/anchoring subassembly **220**. The whipstock element section **210**, in the illustrated embodiment, includes a whipstock element **215** (e.g., ramp element). The sealing/anchoring subassembly **220**, in one or more embodiments, includes an orienting receptacle section **230** (e.g., including a muleshoe), a sealing section **240**, and a latching element section **250**. The sealing section **240**, in the illustrated embodiment, among other features disclosed below, includes a sealing/anchoring element **245**, the sealing/anchoring element **245** configured to move between a radially retracted state and a radially expanded state. The latching element section **250**, in the illustrated embodiment, includes one or more latching features **255**, the one or more latching features **255** configured to engage with a profile in a casing string.

[0030] Turning to FIG. **3**, illustrated is an alternative embodiment of a sealing/anchoring subassembly **300**, the sealing/anchoring subassembly including a sealing section **340** and a latching element section **350** designed and manufactured according to an alternative embodiment of the disclosure. The sealing section **340**, latching element section **350** and an orienting element section (not shown in FIG. **3**) may be run in hole within a main wellbore, set, and then pressure tested, prior to a whipstock element section (not shown in FIG. **3**) of the whipstock assembly being run in hole and attached with the sealing section **340** (e.g., engaged with the orienting element section attached to the sealing section **340**). Notwithstanding, FIG. **3** illustrates the latching element section **350** in the engaged state, whereas the sealing section **340** is in the radially retracted state.

[0031] Turning to FIGS. **4**A through **4**D, illustrated are various different cross-sectional views of a portion of a sealing/anchoring subassembly **400** designed, manufactured and/or operated according to one or more embodiments of the disclosure. As is illustrated, in one or more embodiments, the sealing/anchoring subassembly **400** includes a mandrel **405** having a sealing/anchoring element **410** positioned thereabout. In at least one embodiment, the sealing/anchoring element **410** is configured to move between a radially retracted state and a radially expanded state.

[0032] The sealing/anchoring subassembly **400**, in the illustrated embodiment, additionally includes one or more setting shear features **420**. In one or more embodiments, the one or more setting shear features **420** are used to hold the sealing/anchoring element **410** in its radially retracted state while running in hole, and thus allowing a flow path for cleaning the wellbore.

[0033] The sealing/anchoring subassembly **400**, in one or more embodiments, additionally includes a ratch latch body **430** designed, manufactured and/or operated according to one or more embodiments of the disclosure. In the illustrated embodiment, the ratch latch body **430** is configured to move and/or hold the sealing/anchoring element **410** in the radially expanded state. The ratch latch body **430** includes, in one or more embodiments, a stroke sleeve **440** having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}). Further to the embodiment of FIGS. **4**A through **4**D, the stroke sleeve inner diameter (ID_{SS}) has a plurality of stroke sleeve teeth **445** disposed thereon.

[0034] The ratch latch body **430**, in the embodiment shown, further includes a circumferential slot **450** formed within a thickness (T) of the stroke sleeve **440** between the stroke sleeve outer diameter (OD_{SS}) and the stroke sleeve inner diameter (ID_{SS}). In accordance with this embodiment, the slot **450** forms an integrated locker ring **455**, as discussed above. Further to this embodiment, in one or more embodiments the integrated locker ring **455** includes (n) segments **460** separated by spacings **462** around its circumference, the (n) segments **460** configured to allow the integrated locker ring **455** to radially deform via a cantilever action. In at least one embodiment, (n) is at least two. In yet another embodiment, (n) is at least three, at least four, at least six, or twelve or more. In at least one other embodiment, the number (n) of segments **460** around the circumference, the slot opening width (e), the locker ring thickness (t) and the length of the slot (L) may all be properly selected to tailor the sealing/anchoring subassembly **400** for a given geometry and/or setting load.

[0035] In at least one embodiment, the stroke sleeve **440** additionally includes a pin section **470** having a plurality of pin threads **475**, the pin threads **475** configured to engage with related box threads **485** in a box section **480** of the sealing/anchoring subassembly **400**. Further to the embodiment shown in FIGS. **4**A through **4**D, the slot **450** may be in the pin section **470** of the stroke sleeve **440**.

[0036] The ratch latch body **430**, in one or more embodiments, may further include a base **490** having a base outer diameter (OD_B) and a base inner diameter (ID_B). The base outer diameter (OD_B), in the illustrated embodiment, has a plurality of base teeth **495** disposed thereon. Accordingly, in at least one embodiment the stroke sleeve teeth **445** and the base teeth **495** are configured to directly ratchet along one another to hold the sealing/anchoring element **410** in the radially expanded state. For example, in at least one embodiment the stroke sleeve **440** moves while the base **490** remains fixed (e.g., a fixed base). For example, the base **490** could be fixed (e.g., permanently fixed or releasably fixed) to the mandrel **405** in one or more embodiments. In other embodiments, it may be preferable to have the stroke sleeve **440** remain fixed, while the base **490** moves relative to the fixed stroke sleeve **440**. Thus, in accordance with one embodiment of the disclosure, the integrated locker ring **455** is effectively decoupled from a radially outer portion of the stroke sleeve **440** (e.g., near the pin threads **475** along the stroke sleeve outer diameter (OD_{SS})). Moreover, in the embodiment of FIGS. **4**A through **4**D, the sealing/anchoring subassembly **400** does not include an independent body lock ring, as discussed above.

[0037] Turning to FIGS. **5**A through **5**G, illustrated are cross-sectional views of a sealing/anchoring subassembly **500** designed, manufactured and/or operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **500** is similar in many respects to the sealing/anchoring subassembly **400** illustrated in FIGS. **4**A through **4**D above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring subassembly **500** differs, for the most part, from the sealing/anchoring subassembly **400**, in that it includes additional/different features for its ratch latch body **530**. For example, in the embodiment of FIGS. **5**A through **5**G, the ratch latch body **530** further includes first retaining blocks **510** positioned in first openings in the (n) segments **460**, the first retaining blocks **510** having first retaining block teeth **515** that are offset from the stroke sleeve teeth **445** a first direction by a first offset distance (d_1). For example, as shown in FIG. **5**D the base teeth **495** have a fixed pitch, and in this embodiment the stroke sleeve teeth **445** are centered upon the base teeth **495**. However, as shown, the first retaining block teeth **515** are offset from the stroke sleeve teeth **445** (e.g., in relation to the fixed pitch base teeth **495**) by the first offset distance (d_1). Furthermore, the first retaining block teeth **515** are offset in a first direction (e.g., to the right in this embodiment). In at least one embodiment, the first offset distance (d_1) ranges from $\frac{1}{8}^{th}$ of a thread to ½ of a thread.

[0038] In one or more embodiments, the first retaining blocks **510** are located in ones of the (n) segments **460**, and the ratch latch body **530** further includes second retaining blocks **520** positioned in second openings in others of the (n) segments **460**, the second retaining blocks **520** having second retaining block teeth **525** that are offset from the stroke sleeve teeth **445** a second direction by a second offset distance (d_2). For example, as shown in FIG. **5**F the base teeth **495** have the fixed pitch, and in this embodiment the stroke sleeve teeth **445** are centered upon the base teeth **495**. However, as shown, the second retaining block teeth **525** are offset from the stroke sleeve teeth **445** (e.g., in relation to the fixed pitch base teeth **495**) by the second offset distance (d_2). Furthermore, the second retaining block teeth **525** are offset in a second direction (e.g., opposite direction . . . to the left in this embodiment). In at least one embodiment, the second offset distance (d_2) ranges from $\frac{1}{8}^{th}$ of a thread to ½ of a thread.

[0039] In at least one embodiment, the first offset distance (d_1) and the second offset distance (d_2) are similar distances in opposite directions, but in other embodiments may be different distances in opposite directions or even different distances in the same direction. Further to this embodiment, the first retaining blocks **510** and second retaining blocks **520** may circumferentially alternate in ones of the (n) segments **460** in one or more embodiments, and thus act as ratchet blocks.

[0040] In one or more embodiments, spring members **540** engage with the first retaining blocks **510** and second retaining blocks **520** to hold them radially engaged with the base **490**. Any type of spring member **540** currently known or hereafter discovered could be used and remain within the scope of the present disclosure.

[0041] In one or more other embodiments, the first retaining blocks **510** and second retaining blocks **520** are affixed by the base **490**. In accordance with this embodiment, the first retaining blocks **510** and second retaining blocks **520** may move outward to engage the stroke sleeve teeth **445**.

[0042] Turning to FIGS. **6**A through **6**D, illustrated are cross-sectional views of a sealing/anchoring subassembly **600** designed, manufactured and operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **600** is similar in many respects to the sealing/anchoring subassembly **400** illustrated in FIGS. **4**A through **4**D above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring subassembly **600** differs, for the most part, from the sealing/anchoring subassembly **400**, in that it includes additional/different features for its ratch latch body **630**. For example, in the embodiment of FIGS. **6**A through **6**D, the sealing/anchoring subassembly **600** further includes a band **610** disposed in the slot **450** radially about the (n) segments **460**. The term band, as used herein, encompasses traditional bands, retaining rings (e.g., smalley retaining rings), snap rings, traditional springs, garter springs (e.g., compression garter springs), etc. that could in certain embodiments be circumferentially and continuously positioned about the (n) segments **460**. The band **610**, in one or more embodiments, is an elastic band **610**, such as an O-ring or other similar feature. In one or more other embodiments, the band **610** is a plastic or metal band **610**. In at least one embodiment, the band **610** adjusts the radial stiffness of the segments **460** and enhances the engagement of the stroke sleeve teeth **445** with the base teeth **495** while keeping the necessary flexibility for ratcheting.

[0043] Turning to FIGS. **7**A through **7**D, illustrated are cross-sectional views of a sealing/anchoring subassembly **700** designed, manufactured and operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **700** is similar in many respects to the sealing/anchoring subassembly **600** illustrated in FIGS. **6**A through **6**D above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring subassembly **700** differs, for the most part, from the sealing/anchoring subassembly **600**, in that it includes additional/different features for its ratch latch body **730**. For example, in the embodiment of FIGS. **7**A through **7**D, the sealing/anchoring subassembly **700** further includes positioning blocks **710** located within the spacing **462** between each of the (n) segments **460**. The positioning blocks **710**, in one or more embodiments, may be used to resist any potential twist or tangential (hoop) deformation of the segments **460**. Furthermore, in at least one embodiment, the band **610** is engaged with the positioning blocks **710**, for example holding the positioning blocks **710** radially engaged with the base **490**.

[0044] Turning to FIGS. **8**A through **8**D, illustrated are cross-sectional views of a sealing/anchoring subassembly **800** designed, manufactured and operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **800** is similar in many respects to the sealing/anchoring subassembly **400** illustrated in FIGS. **4**A through **4**D above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring subassembly **800** differs, for the most part, from the sealing/anchoring subassembly **400**, in that it includes additional/different features for its ratch latch body **830**. For example, in the embodiment of FIGS. **8**A through **8**D, the sealing/anchoring subassembly **800** includes a tapered integrated locker ring **855**. In at least one embodiment, the tapered integrated locker ring **855** has an opening slot width (e_o) greater than an inside slot width (e_i). In one or more embodiments, the tapered integrated locker ring represents a non-prismatic cantilever beam concept, where the tapered shape is a factor to control the radial stiffness of the integrated locker ring **855**. Alternatively, the base can be made flexible instead having similar circumferential slots.

[0045] Aspects disclosed herein include:

[0046] A. A sealing/anchoring subassembly, the sealing/anchoring subassembly including: 1) a mandrel; 2) a sealing/anchoring element positioned about the mandrel, the isolation element configured to move between a radially retracted state and a radially expanded state; 3) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: a) a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and b) a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.

[0047] B. A well system, the well system including: 1) a wellbore located in a subterranean formation; and 2) a sealing/anchoring assembly positioned in the wellbore, the sealing/anchoring assembly including: a) a mandrel; b) a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and c) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: i) a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and ii) a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.

[0048] C. A method, the method including: 1) positioning a sealing/anchoring assembly within a wellbore located in a subterranean formation, the sealing/anchoring assembly including: a) mandrel; b) a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and c) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: i) a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and ii) a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state; and 2) actuating the stroke sleeve to move the sealing/anchoring element from the radially retracted state to the radially expanded state.

[0049] Aspects A, B and C may have one or more of the following additional elements in combination: Element 1: further including a circumferential slot formed within a thickness (T) of the stroke sleeve between the stroke sleeve outer diameter (OD_{SS}) and the stroke sleeve inner diameter (ID_{SS}), the slot forming an integrated locker ring. Element 2: wherein the integrated locker ring includes (n) segments around its circumference, the (n) segments configured to allow the integrated locker ring to radially deform via a cantilever action. Element 3: wherein (n) is at least four. Element 4: wherein (n) is at least six. Element 5: further including first retaining blocks positioned in first openings in the (n) segments, the first retaining blocks having first retaining block teeth that are offset from the stroke sleeve teeth a first direction by a first offset distance (d_1). Element 6: wherein the first offset distance (d_1) ranges from $1/8^{th}$ of a thread to ½ of a thread. Element 7: wherein the first retaining blocks are located in ones of the (n) segments, and further including second retaining blocks positioned in second openings in others of the (n) segments, the second retaining blocks having second retaining block teeth that are offset from the stroke sleeve teeth a second direction by a second offset distance (d_2). Element 8: wherein the second direction is a second opposite direction to the first direction. Element 9: wherein the second offset distance (d_2) ranges from $1/8^{th}$ of a thread to ½ of a thread. Element 10: wherein the first retaining blocks and second retaining blocks circumferentially alternate. Element 11: further including spring members engaged with the first retaining blocks and second retaining blocks to hold them radially engaged with the base. Element 12: further including a band disposed in the slot radially about the (n) segments. Element 13: wherein the band is engaged with positioning blocks located within a spacing between each of the (n) segments. Element 14: wherein the integrated locker ring is a tapered integrated locker ring, the tapered integrated locker ring having an opening slot width (e_o) greater than an inside slot width (e_i). Those skilled in the art to which this application relates will appreciate that other and further additions, deletions, substitutions and modifications may be made to the described embodiments. Element 15: wherein the wellbore is a main wellbore, and further including a lateral wellbore extending from the main wellbore, the sealing/anchoring assembly positioned proximate an intersection between the main wellbore and the lateral wellbore.

[0050] Those skilled in the art to which this application relates will appreciate that other and further additions, deletions, substitutions and modifications may be made to the described embodiments.

What is claimed is:

1. A sealing/anchoring subassembly, comprising:

a mandrel;

a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and

a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including:

a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and

a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.

2. The sealing/anchoring subassembly as recited in claim **1**, further including a circumferential slot formed within a thickness (T) of the stroke sleeve between the stroke sleeve outer diameter (OD_{SS}) and the stroke sleeve inner diameter (ID_{SS}), the slot forming an integrated locker ring.

3. The sealing/anchoring subassembly as recited in claim **2**, wherein the integrated locker ring includes (n) segments around its circumference, the (n) segments configured to allow the integrated locker ring to radially deform via a cantilever action.

4. The sealing/anchoring subassembly as recited in claim **3**, wherein (n) is at least four.

5. The sealing/anchoring subassembly as recited in claim **3**, wherein (n) is at least six.

6. The sealing/anchoring subassembly as recited in claim **3**, further including first retaining blocks positioned in first openings in the (n) segments, the first retaining blocks having first retaining block teeth that are offset from the stroke sleeve teeth a first direction by a first offset distance (d_1).

7. The sealing/anchoring subassembly as recited in claim **6**, wherein the first offset distance (d_1) ranges from ⅛th of a thread to ½ of a thread.

8. The sealing/anchoring subassembly as recited in claim **6**, wherein the first retaining blocks are located in ones of the (n) segments, and further including second retaining blocks positioned in second openings in others of the (n) segments, the second retaining blocks having second retaining block teeth that are offset from the stroke sleeve teeth a second direction by a second offset distance (d_2).

9. The sealing/anchoring subassembly as recited in claim **8**, wherein the second direction is a second opposite direction to the first direction.

10. The sealing/anchoring subassembly as recited in claim **8**, wherein the second offset distance (d_2) ranges from ⅛th of a thread to ½ of a thread.

11. The sealing/anchoring subassembly as recited in claim **8**, wherein the first retaining blocks and second retaining blocks circumferentially alternate.

12. The sealing/anchoring subassembly as recited in claim **8**, further including spring members engaged with the first retaining blocks and second retaining blocks to hold them radially engaged with the base.

13. The sealing/anchoring subassembly as recited in claim **3**, further including a band disposed in the slot radially about the (n) segments.

14. The sealing/anchoring subassembly as recited in claim **13**, wherein the band is engaged with positioning blocks located within a spacing between each of the (n) segments.

15. The sealing/anchoring subassembly as recited in claim **2**, wherein the integrated locker ring is a tapered integrated locker ring, the tapered integrated locker ring having an opening slot width (e_o) greater than an inside slot width (e_i).

16. A well system, comprising:

a wellbore located in a subterranean formation; and

a sealing/anchoring assembly positioned in the wellbore, the sealing/anchoring assembly including:

a mandrel;

a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and

a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including:

a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and

a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state.

17. The well system as recited in claim **16**, wherein the wellbore is a main wellbore, and further including a lateral wellbore extending from the main wellbore, the sealing/anchoring assembly positioned proximate an intersection between the main wellbore and the lateral wellbore.

18. The well system as recited in claim **16**, further including a circumferential slot formed within a thickness (T) of the stroke sleeve between the stroke sleeve outer diameter (OD_{SS}) and the stroke sleeve inner diameter (ID_{SS}), the slot forming an integrated locker ring.

19. The well system as recited in claim **18**, wherein the integrated locker ring includes (n) segments around its circumference, the (n) segments configured to allow the integrated locker ring to radially deform via a cantilever action.

20. The well system as recited in claim **19**, wherein (n) is at least four.

21. The well system as recited in claim **19**, wherein (n) is at least six.

22. The well system as recited in claim **19**, further including first retaining blocks positioned in first openings in the (n) segments, the first retaining blocks having first retaining block teeth that are offset from the stroke sleeve teeth a first direction by a first offset distance (d_1).

23. The well system as recited in claim **22**, wherein the first offset distance (d_1) ranges from ⅛th of a thread to ½ of a thread.

24. The well system as recited in claim **22**, wherein the first retaining blocks are located in ones of the (n) segments, and further including second retaining blocks positioned in second openings in others of the (n) segments, the second retaining blocks having second retaining block teeth that are offset from the stroke sleeve teeth a second direction by a second offset distance (d_2).

25. The well system as recited in claim **24**, wherein the second direction is a second opposite direction to the first direction.

26. The well system as recited in claim **24**, wherein the second offset distance (d_2) ranges from ⅛th of a thread to ½ of a thread.

27. The well system as recited in claim **24**, wherein the first retaining blocks and second retaining blocks circumferentially alternate.

28. The well system as recited in claim **24**, further including spring members engaged with the first retaining blocks and second retaining blocks to hold them radially engaged with the base.

29. The well system as recited in claim **19**, further including a band disposed in the slot radially about the (n) segments.

30. The well system as recited in claim **29**, wherein the band is engaged with positioning blocks located within a spacing between each of the (n) segments.

31. The well system as recited in claim **18**, wherein the integrated locker ring is a tapered integrated locker ring, the tapered integrated locker ring having an opening slot width (e_o) greater than an inside slot width (e_i).

32. A method, comprising:

positioning a sealing/anchoring assembly within a wellbore located in a subterranean formation, the sealing/anchoring assembly including:
- a mandrel;
- a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and
- a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including:
  - a stroke sleeve having a stroke sleeve outer diameter (OD_{SS}) and a stroke sleeve inner diameter (ID_{SS}), the stroke sleeve inner diameter (ID_{SS}) having a plurality of stroke sleeve teeth disposed thereon; and
  - a base having a base outer diameter (OD_B) and a base inner diameter (ID_B), the base outer diameter (OD_B) having a plurality of base teeth disposed thereon, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state; and

actuating the stroke sleeve or base to move the sealing/anchoring element from the radially retracted state to the radially expanded state.

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