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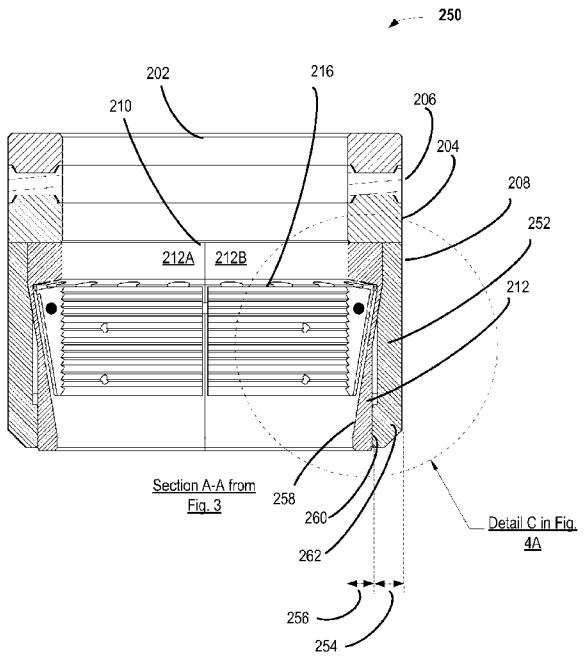


FIG. 2B

(57) Abstract: In at least one embodiment, slip hanger (114) or a packoff (124) to be used with oilfield equipment has a plurality of inner bowl segments (212A, 212 B) that provides support to a plurality of slip segments (216) on an inner side (258) and has a singular outer bowl (252) to support an outer side (260) of the plurality of inner bowl segments, where the plurality of inner bowl segments include a plurality of first retention features (456) to enable association with a plurality of second retention features (454) of the outer bowl.

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COMBINATION SET SLIP HANGER OR PACKOFF

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This is a PCT application of U.S. Non-Provisional application 18/738,791, titled COMBINATION SET SLIP HANGER OR PACKOFF, filed June 10, 2024, which is related to and claims the benefit of priority from U.S. provisional application 63/509,937, titled COMBINATION SET SLIP HANGER OR PACKOFF, filed June 23, 2023, the entire disclosures of both of which are incorporated by reference herein for all intents and purposes.

BACKGROUND

1. Technical Field

[0002] This disclosure relates generally to oilfield equipment and more particularly to systems and methods for a combination set for a slip hanger or a packoff having inner bowl segments to support slip segments on an inner side and having support from a singular outer bowl.

2. Description of the Prior Art

[0003] A slip hanger, such as a manual slip hanger, is a type of wellhead equipment used with oilfield equipment to support the weight of oilfield tubulars strings in a wellbore; these oilfield tubulars may be a casing or tubing strings. The slip hanger may be installed within the wellhead and may include a series of slips that grip a casing string. A housing may be provided to hold the slip hanger in place. Further, a mechanism may be provided within the slip hanger for releasing and setting the slips. The slip hanger may be used in conjunction with a casing or tubing head, which may form part of a wellhead via a flanged, threaded, or other type of mechanical connection. The casing or tubing head may be referred to as a casing head herein, and the tubular may be

referred to as a casing string. The casing head includes a bore that may be slightly larger than the casing string, which allows the casing string to be run through it. The slip hanger may be placed within casing head and the slips may be set to grip the casing string. For removal of the casing string, slips may be released by releasing the casing tension and the casing string can be pulled out of the wellbore. In a similar manner, a packoff is a mechanical seal used in oilfield equipment to prevent fluid leakage between sections of the equipment, such as to isolate the annulus volume from a bore volume in a wellhead. In all such applications, there may be a reduction in an annular envelope required to fit a combination set hanger.

SUMMARY

[0004] In at least one embodiment, a system for a slip hanger or a packoff to be used with oilfield equipment includes a plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side, where the plurality of inner bowl segments include a plurality of first retention features to enable association with a plurality of second retention features of the outer bowl.

[0005] In at least one embodiment, plurality of inner bowl segments support a plurality of slip segments on an inner side and are to be supported by a singular outer bowl on an outer side, where the plurality of inner bowl segments include a plurality of first retention features to enable association with a plurality of second retention features of the outer bowl, and where the plurality of inner bowl segments are part of a slip hanger or a packoff to be used with oilfield equipment.

[0006] In at least one embodiment, a method for using a slip hanger or a packoff in an oilfield equipment includes determining a diameter to be associated with an application of the slip hanger or the packoff. The method includes determining at least a plurality of inner bowl segments

associated with the diameter. The method includes providing the plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side. The plurality of inner bowl segments include a plurality of first retention features to enable association with a plurality of second retention features of the outer bowl.

BRIEF DESCRIPTION OF DRAWINGS

[0007] Some of the features and benefits of the present disclosure having been stated, others will become apparent as the description proceeds when taken in conjunction with the accompanying drawings, in which:

[0008] FIG. 1 is a block diagram of certain oilfield equipment that is subject to a combination set for a slip hanger or a packoff having inner bowl segments, as detailed herein and in accordance with at least one embodiment.

[0009] FIG. 2A is a perspective view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment.

[0010] FIG. 2B is a cross-section side view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment.

[0011] FIG. 2C is another cross-section side view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment.

[0012] FIG. 3 is a top view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment.

[0013] FIG. 4A is a detailed section view of aspects of a combination set for a slip hanger or a

packoff having inner bowl segments, such as from FIG. 3, that can also be used with a packoff, in accordance with at least one embodiment.

[0014] FIG. 4B is a different detailed section view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, such as from FIG. 3, in accordance with at least one embodiment.

[0015] FIG. 5A is a side view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment.

[0016] FIG. 5B is a top section view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, from FIG. 5A, in accordance with at least one embodiment.

[0017] FIG. 5C is a different top section view of aspects of a combination set for a slip hanger or a packoff having inner bowl segments, from FIG. 5A, in accordance with at least one embodiment.

[0018] FIG. 6 is a flow diagram of a method for a system of a combination set for a slip hanger or a packoff having inner bowl segments that is described at least in FIGS. 1-5C herein, in accordance with at least one embodiment.

[0019] While the disclosure will be described in connection with the preferred embodiments, it will be understood that it is not intended to limit the disclosure to that embodiment. On the contrary, it is intended to cover all alternatives, modifications, and equivalents, as may be included within the spirit and scope of the disclosure as defined by the appended claims.

DETAILED DESCRIPTION

[0020] The foregoing aspects, features and advantages of the present technology will be further appreciated when considered with reference to the following description of preferred embodiments and accompanying drawings, wherein like reference numerals represent like elements. In describing the preferred embodiments of the technology illustrated in the appended drawings, specific terminology will be used for the sake of clarity. The present technology, however, is not intended to be limited to the specific terms used, and it is to be understood that each specific term includes equivalents that operate in a similar manner to accomplish a similar purpose.

[0021] In at least one embodiment, to resolve issues, such as described above with respect to reduction of an annular envelope, a system for a slip hanger or a packoff includes multiple inner bowl segments to support multiple slip segments on an inner side and to be supported by a singular outer bowl on an outer side, where a beam structure having an alternating flutes and splines that are milled on an inner side of the outer bowl to provide such support. For example, the alternating flutes and splines provide structural capacity to transfer load from pressure above the slip hanger or packoff to a load shoulder of the outer bowl. The flutes and spines, along with the load shoulder, provide one or more retention features to enable association with matching retention features of the inner bowl segments. The load shoulder is also associated with a nesting in the outer bowl to interface with the inner bowl segments. This supports a nested slip arrangement in which the multiple inner bowl segments have interfacing shoulders that represent first retention features to be associated with the load shoulder, representing second retention features of the outer bowl, and altogether being responsible for the transferred load described herein.

[0022] Slip hangers or packoffs may include a seal that is energized manually, by a casing weight, or by a combination of both. A combination set hanger may include an outer shoulder

housing, nested slip bowl, and slips. However, such a configuration may require adequate annular space, or specific slip bowl and casing size combinations. In at least one embodiment, the system and method herein, by inner bowl segments and an outer bowl having alternating milled flutes and splines in a load shoulder, can address such issues. Further, the combination set slip hanger or packoff herein can address different size requirements by the replaceable one or more of the inner bowl segments or the outer bowl to accommodate even tight annular spaces.

[0023] FIG. 1 is a block diagram of certain oilfield equipment 100 that is subject to a combination set for a slip hanger or a packoff having inner bowl segments, as detailed herein and in accordance with at least one embodiment. The oilfield equipment 100 may include a Christmas tree 130 over a wellhead 120 located at or about a surface layer 140. The Christmas tree 130 may include on one or more branches 102 having valves thereon of the oilfield equipment 100.

[0024] Further, as illustrated in FIG. 1, the oilfield equipment 100 may include a top connector 112 that is connected at a top of a studded cross 104. There may be multiple flow line gate valves and multiple kill line gate valves, generally illustrated as valves 106. These valves 106 may be on opposite sides of a studded cross 104. Further, the oilfield equipment may include one or more master gate valves 108, such as an upper and a lower master gate valve. A tubing head adapter may be connected between a tubing head 110 and at least one of the master gate valves 108.

[0025] In at least one embodiment, a system 114 of a combination set for a slip hanger or a packoff having inner bowl segments may be used to perform operations associated with a tubing string 116 and may be located within a casing hanger spool 118. In at least one embodiment, further, a system 114 of a combination set for a slip hanger or a packoff having inner bowl segments may be used to perform operations associated with a tubing string 116 and may be

located within a tubing head 110 of the oilfield equipment 100.

[0026] In at least one embodiment, a system of a combination set for a slip hanger or a packoff having inner bowl segments may be used with other hangers, including a tubing hanger associated with a tubing, a production casing hanger associated with a production casing, or an intermediate casing hanger associated with an intermediate casing. Therefore, the illustrated tubing string 116 may be a series of concentric oilfield tubulars (casing or tubing), each having an independent hanger that may benefit from the present system of a slip hanger having a compression plate with grooves or slots.

[0027] In at least one embodiment, a casing string may line walls of a wellbore and may be supported by a slip hanger 114 mounted to a wellhead 120, but associations to one or more of a casing hanger spool 118 or another feature. The slip hanger may be referred to also as a casing hanger. In at least one embodiment, wedge-shaped segmented slips may be provided for coupling between the slip hanger 114 and the tubing string 116. Further, compression seal assemblies may be provided for preventing pressure communication and may be provided between the tubing string 116 and wellhead 120.

[0028] In at least one embodiment, a system of a slip hanger 114 or a system of a packoff 124 may include multiple inner bowl segments to support multiple slip segments on an inner side and to be supported by a singular outer bowl on an outer side. Further, the inner bowl segments may include first retention features to enable association with second retention features of the outer bowl. For example, the retention features are shoulders that interface to transfer load to a load shoulder of the wellhead (or housing) to support the outer bowl for the slip hanger or packoff to be used with the oilfield equipment.

[0029] The system 114 may be coupled together with threaded fasteners, including screws, bolts, studs, and nuts. These threaded fasteners may be torqued to an amount that causes the compression plate with grooves or slots to axially compress to provide a compressive preload force to the compression seal, to isolate the annulus between the tubing string 116 and wellhead 120. In at least one embodiment, instead of the threaded fasteners, the top plate and a seal adjacent to the top plate may be associated together by an internal lockdown. The internal lockdown may include other types of screws, such as lock screws without the aligned stud holes. These lock screws may be associated with the wellhead 120, and provide a compressive force to the slip hanger compression plate.

[0030] FIG. 2A is a perspective view of aspects 200 of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment. In at least one embodiment, the system 114 is also referred to as seal assembly and the system 114; 124 is made up of a top plate 202 (also referred to also as a compression plate), a seal or seal element 206, a bottom plate 204, a slip bowl 208, and slips 216 that engage a casing string. At least an inner bowl 212 of the slip bowl 208 includes inner bowl segments 212A, B separated at a joint 210. The inner bowl segments 212A, 212B are illustrated as two semi-circular or 180 degree members, but may include more than two segments.

[0031] The inner bowl segments 212A, 212B are joined at a split 210, and the seal assembly and the system 114; 124 is generally a combination set for a slip hanger or packoff. The seal 206 occupies an annulus seal gland, which is formed by a slip bowl 208 and portions of the tubular 116, the wellhead housing 120, the top plate 202 that are annularly around the slip bowl 208. As a result, a gland volume of the annulus seal gland is in reference to the space formed within the

slip bowl 208 and portions of the tubular 116, the wellhead housing 120, the top plate 202 that are annularly around the slip bowl 208. FIG. 2A also illustrates that side fasteners 218 may be provided that is distinct from the fasteners 214 at the top plate 202. In at least one embodiment, the side fasteners 218 may be provided to associate the inner bowl segments 212A, B with an outer bowl of the slip bowl 208, but may also associate slip segments 216 with the inner bowl segments 212A, B and with an outer bowl of the slip bowl 208.

[0032] In at least one embodiment, the top plate 202 is for a slip hanger or a packoff and forms at least one part of a slip bowl 208 to retain a seal 206 with the slip bowl 208. In at least one embodiment, the top plate 202 restrains the seal 206 in at least one direction. The top plate 202 is associated with the seal 206, a bottom plate 204, which may be optional, and the slip bowl 208 under a fastener preload (such as from the fasteners 214) or under thermal expansion of the seal assembly and the system 114, 124. FIG. 2A illustrates that a tubular 116 is provided through an axis 220 of the system of the slip hanger or packoff.

[0033] In at least one embodiment, example materials for at least the top plate 202 and other plates to be used with the slip bowl 208 include elastic materials, such as carbon steel or stainless steel, whereas the seal 206 may be of an elastomer material. In at least one embodiment, such elastomer may include hydrogenated nitrile butadiene rubber (HNBR) or Polyether ether ketone (PEEK). In at least one embodiment, the top plate 202 can help to achieve a good seal at a low temperature. This is at least because a strain energy stored in the top plate 202, at an ambient temperature, may be released at the low temperature to compensate for thermal contraction of the elastomer material.

[0034] In at least one embodiment, the inner bowl segments 212A, 212B are axially fastened

together from a top side of the top plate 202 using fasteners 214 that are threaded and that thread into a bolt hole, and through the seal 206 before reaching the slip bowl 208. Even though illustrated below the top plate 202, the seal 206 may be above the top plate 202, in at least one embodiment. The fasteners 214 may be hexagonal headed socket but may be any suitable lock screws or studs used to bring together the compression plate 202 and the compression seal 206.

[0035] FIG. 2B is a cross-section side view of aspects 250 of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment. The cross-section side view is from a section A-A as illustrated in FIG. 3, where the section A-A is in an area between the fasteners 214 of a slip bowl 208. In at least one embodiment, like in FIG. 2A, the system 114 (or seal assembly) 114; 124 may be made up of a top plate 202, a seal or seal element 206, a bottom plate 204, a slip bowl 208, and slips 216 that engage a casing string or other tubulars. The slip bowl 208 includes a singular outer bowl 252 and an inner bowl 212 that is made up of at least two segments or semi-circular members 212A, 212B. The inner bowl segments 212A, 212B are joined at a split 210, and the seal assembly and the system 114; 124 is generally a combination set for a slip hanger or packoff.

[0036] Further, FIG. 2B illustrates that the inner bowl segments 212A, B may include a first thickness 256 that is between an inner side 258 and an outer side 260 of the inner bowl segments 212A, B. Further, a profile between the inner side 258 and the outer side 260 may include retention features in FIG. 2C that may be considered in the first thickness 256. In at least one embodiment, it is also possible for the outer bowl 252 to include a second thickness 254 of its outer wall 262. The first thickness 256 and the second thickness 252 may be based at least in part on at least one diameter of a wellhead and a casing or other tubular in an application of the slip hanger or the

packoff.

[0037] FIG. 2C is another cross-section side view of aspects 270 of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment. The cross-section side view is from a section B-B as illustrated in FIG. 3, where the section B-B is across the fasteners 214 of the slip bowl 208. In at least one embodiment, like in FIGS. 2A and 2B, the system 114 (or seal assembly) 114; 124 may be made up of a top plate 202, a seal or seal element 206, a bottom plate 204, a slip bowl 208, and slips 216 that engage a casing string or other tubulars. The slip bowl 208 includes a singular outer bowl 252 and an inner bowl 212 that is made up of at least two segments or semi-circular members. The inner bowl segments are joined at a split, and the seal assembly and the system 114; 124 is generally a combination set for a slip hanger or packoff.

[0038] Further, FIG. 2C illustrates that each of the fasteners 214 threads at least the inner bowl segments 212A, B through provided bolt holes 272. Further, FIG. 2C illustrates that the fasteners 214 may also thread additional provided bolt holes 274 of respective segments of the slips 216. This may be in addition to separate bolt holes 276 provided on the sides of the slips for the side fasteners 218 described at least in FIG. 2A. There are further bolt holes 278 for the top plate 202, the seal 206, and any other plates (such as a plate 204).

[0039] FIG. 3 is a top view of aspects 300 of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment. The top plate 202 may be axially fastened together using fasteners 214 that are threaded and that thread into a bolt hole 278 (and subsequently into a bolt hole 272, 274 of the inner bowl segments 212A, B and of the slips 216) in the slip bowl 208. The fasteners 214 are illustrated as hexagonal headed socket bolts,

studs, or screws, for example purposes. FIG 3 also illustrates that the system 114 includes an area 303 to allow mounting of the system over a tubing string 116 or other tubulars. In at least one embodiment, the system 114 for a slip hanger is mounted on a tubing string 116 lowered into a wellhead 120 to support the weight of tubing string 116 in the wellbore 122.

[0040] FIG. 4A is a detailed section view of aspects 400 of a combination set for a slip hanger or a packoff having inner bowl segments, such as from FIG. 3, that can also be used with a packoff, in accordance with at least one embodiment. Further, FIG. 4B is a different detailed section view of aspects 450 of a combination set for a slip hanger or a packoff having inner bowl segments, such as from FIG. 3, in accordance with at least one embodiment. For example, marked areas 400A, 450A illustrate that the outer bowl 252 includes a beam structure of flutes 402 and splines 452 in an inner side 404 of the outer bowl 252 of the slip hanger or the packoff. The beam structure enables transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of an oilfield equipment, such as a wellhead 120, via an outer shoulder 458 of an outer bowl 252 of the slip bowl 208.

[0041] FIG. 4B also illustrates that the inner bowl segments 212A, B include a first retention features 456 to enable association with second retention features 454 of the outer bowl 252. For example, the first retention features 456 and the plurality of second retention features 454 are interfacing shoulders, as illustrated in at least FIG. 4B, that interface to provide load transfer from within the slip hanger or packoff 114 to the oilfield equipment. In at least one embodiment, the first thickness and the second thickness associated with the inner bowl segments and with the outer bowl include the flutes and spines requirement and represent at least a thickness based on the flutes of the outer bowl.

[0042] In at least one embodiment, FIG. 5A is a side view of aspects 500 of a combination set for a slip hanger or a packoff having inner bowl segments, in accordance with at least one embodiment. The side view illustrates the side bolt holes 278 to receive side fasteners 218 for one or more of the slips 216 or the inner bowl segments 212A, B of the slip bowl 208. Further, top cut-outs E-E and F-F of FIG. 5A are detailed in FIGS. 5B and 5C herein.

[0043] FIG. 5B is a top section view of aspects 550 of a combination set for a slip hanger or a packoff having inner bowl segments, from FIG. 5A, in accordance with at least one embodiment. For example, FIG. 5B illustrates that the outer bowl 252 includes a beam structure of flutes 402 and splines 452, from a top section view E-E (as marked in FIG. 5A). The flutes 402 and splines 452 are in an inner side of the outer bowl 252 of the slip hanger or the packoff. The beam structure enables transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of an oilfield equipment, such as a wellhead 120, via an outer shoulder of an outer bowl 252 of the slip bowl 208. The top section view E-E also illustrates that the slips 216 are in four segments with segment breaks 552 illustrated differently than the inner bowl segments 212A, 212B that are in two segments separated at its own segment break 210.

[0044] FIG. 5C is a different top section view of aspects 570 of a combination set for a slip hanger or a packoff having inner bowl segments, from FIG. 5A, in accordance with at least one embodiment. For example, like in FIG. 5B, FIG. 5C illustrates that the outer bowl 252 includes a beam structure of flutes 402 and splines 452, from a top section view F-F (as marked in FIG. 5A). As the top section view F-F is lower than the top section view E-E, the slip segments 216 are illustrated. The flutes 402 and splines 452 are in an inner side of the outer bowl 252 of the slip hanger or the packoff. This top section view F-F also illustrates that the slips 216 are in four

segments with segment breaks illustrated, but that a skilled artisan would recognize that more or fewer segments may be used.

[0045] FIG. 6 is a flow diagram of a method 600 for a system of a combination set for a slip hanger or a packoff having inner bowl segments that is described at least in FIGS. 1-5C herein, in accordance with at least one embodiment. The method 600 is for a slip hanger or a packoff to be used with an oilfield equipment. The method 600 includes determining (602) a diameter to be associated with an application of the slip hanger or the packoff. A further step in the method 600 includes determining (604) at least multiple inner bowl segments associated with the diameter. A verification (606) may be performed for the inner bowl segments being associated with the diameter.

[0046] The method 600 includes providing (608) the inner bowl segments to support multiple slip segments on an inner side and to be supported by a singular outer bowl on an outer side. As the inner bowl segments include multiple first retention features to enable association with multiple second retention features of the outer bowl, the method 600 may include associating (610) the first retention features of the inner bowl segments with the second retention features of the outer bowl for load transfer, such as from the slip hanger or packoff to the wellhead.

[0047] In at least one embodiment, the method 600 may include a further step or a sub-step for providing a load shoulder of the oilfield equipment to support the singular outer bowl for the slip hanger or packoff to be used with the oilfield equipment. In at least one embodiment, the method 600 may include a further step or a sub-step for providing a top plate and a seal to be associated with the inner bowl segments, the slip segments, and the singular outer bowl. Further, these features may be retained together, as part of the method 600, using multiple fasteners. As such,

the top plate, the seal, and at least the inner bowl segments may be retained together, prior to use in the oilfield equipment.

[0048] In at least one embodiment, in the method 600, the first retention features and the second retention features are part of multiple interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment. Further, in the method 600, the inner bowl segments may include a first thickness between the inner side and the outer side. In addition, the singular outer bowl includes a second thickness of an outer wall. The first thickness and the second thickness may be based at least in part on at least one diameter of an oilfield equipment and a casing in an application of the slip hanger or the packoff.

[0049] In at least one embodiment, in the method 600, the outer bowl may include a beam structure having multiple flutes and splines in an inner side of the slip hanger or the packoff. The beam structure can enable transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of the wellhead or other oilfield equipment, for instance.

[0050] In at least one embodiment, in the method 600, the inner bowl segments may be replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith. Further, multiple ones of the fasteners may be provided to retain together the inner bowl segments by a pulling force on the plurality of inner bowl segments and by a squeezing force on a seal that is between the inner bowl segments and a top plate.

[0051] While techniques herein may be subject to modifications and alternative constructions, these variations are within spirit of present disclosure. As such, certain illustrated embodiments are shown in drawings and have been described above in detail, but these are not limiting

disclosure to specific form or forms disclosed; and instead, cover all modifications, alternative constructions, and equivalents falling within spirit and scope of disclosure, as defined in appended claims.

[0052] When introducing elements of various embodiments of the present invention, the articles "a," "an," "the," and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to "one embodiment", "an embodiment", "certain embodiments," or "other embodiments" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Furthermore, reference to terms such as "above," "below," "upper", "lower", "side", "front," "back," or other terms regarding orientation are made with reference to the illustrated embodiments and are not intended to be limiting or exclude other orientations.

[0053] Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within range, unless otherwise indicated herein and each separate value is incorporated into specification as if it were individually recited herein. In at least one embodiment, use of a term, such as a set (for a set of items) or subset unless otherwise noted or contradicted by context, is understood to be nonempty collection including one or more members. Further, unless otherwise noted or contradicted by context, term subset of a corresponding set does not necessarily denote a proper subset of corresponding set, but subset and

corresponding set may be equal.

[0054] Conjunctive language, such as phrases of form, at least one of A, B, and C, or at least one of A, B and C, unless specifically stated otherwise or otherwise clearly contradicted by context, is otherwise understood with context as used in general to present that an item, term, etc., may be either A or B or C, or any nonempty subset of set of A and B and C. In at least one embodiment of a set having three members, conjunctive phrases, such as at least one of A, B, and C and at least one of A, B and C refer to any of following sets: {A}, {B}, {C}, {A, B}, {A, C}, {B, C}, {A, B, C}. Thus, such conjunctive language is not generally intended to imply that certain embodiments require at least one of A, at least one of B and at least one of C each to be present. In addition, unless otherwise noted or contradicted by context, terms such as plurality, indicates a state of being plural (such as, a plurality of items indicates multiple items). In at least one embodiment, a number of items in a plurality is at least two but can be more when so indicated either explicitly or by context. Further, unless stated otherwise or otherwise clear from context, phrases such as based on means based at least in part on and not based solely on.

[0055] In at least one embodiment, even though the above discussion provides at least one embodiment having implementations of described techniques, other architectures may be used to implement described functionality, and are intended to be within scope of this disclosure. In addition, although specific responsibilities may be distributed to components and processes, they are defined above for purposes of discussion, and various functions and responsibilities might be distributed and divided in different ways, depending on circumstances.

[0056] In at least one embodiment, although subject matter has been described in language specific to structures and/or methods or processes, it is to be understood that subject matter claimed

in appended claims is not limited to specific structures or methods described. Instead, specific structures or methods are disclosed as example forms of how a claim may be implemented.

[0057] From all the above, a person of ordinary skill would readily understand that the tool of the present disclosure provides numerous technical and commercial advantages and can be used in a variety of applications. Various embodiments may be combined or modified based in part on the present disclosure, which is readily understood to support such combination and modifications to achieve the benefits described above.

[0058] It should be appreciated that embodiments herein may utilize one or more values that may be experimentally determined or correlated to certain performance characteristics based on operating conditions under similar or different conditions. The present disclosure described herein, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While a presently preferred embodiment of the disclosure has been given for purposes of disclosure, numerous changes exist in the details of procedures for accomplishing the desired results. These and other similar modifications will readily suggest themselves to those skilled in the art and are intended to be encompassed within the spirit of the present disclosure disclosed herein and the scope of the appended claims.

[0059] At least one embodiment of the disclosure can be described in view of the following clauses. Clause 1 being a system for a slip hanger or a packoff to be used with oilfield equipment, characterized by a plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side, wherein the plurality of inner bowl segments is further characterized by a plurality of first retention features to enable association with a plurality of second retention features of the outer bowl. Clause 2 being the

system of clause 1, further characterized by: a load shoulder of the oilfield equipment to support the outer bowl for the slip hanger or packoff to be used with the oilfield equipment. Clause 3 being the system of clause 1, wherein the plurality of first retention features and the plurality of second retention features are a plurality of interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment. Clause 4 being the system of clause 1, further characterized by: a top plate; a seal; and a plurality of fasteners to retain together the top plate, the seal, and at least the plurality of inner bowl segments prior to use in the oilfield equipment. Clause 5 being the system of clause 1, wherein the plurality of inner bowl segments is further characterized by a first thickness between the inner side and the outer side and wherein the singular outer bowl is further characterized by a second thickness of an outer wall, wherein the first thickness and the second thickness are based at least in part on at least one diameter of the oilfield equipment and a casing in an application of the slip hanger or the packoff. Clause 6 being the system of clause 1, wherein a plurality of fasteners retain together the plurality of inner bowl segments by a pulling force on the plurality of inner bowl segments and by a squeezing force on a seal that is between the plurality of inner bowl segments and a top plate. Clause 7 being the system of clause 1, further characterized by: wherein the outer bowl is further characterized by a beam structure having a plurality of flutes and splines in an inner side of the slip hanger or the packoff to enable transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of the oilfield equipment. Clause 8 being the system of clause 1, wherein the plurality of inner bowl segments is replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith. Clause 9 being a plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side, wherein the plurality of inner bowl segments is further characterized by a plurality of first retention

features to enable association with a plurality of second retention features of the outer bowl, wherein the plurality of inner bowl segments are part of a slip hanger or a packoff to be used with oilfield equipment. Clause 10 being the plurality of inner bowl segments of clause 9, wherein the plurality of first retention features and the plurality of second retention features are a plurality of interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment. Clause 11 being the plurality of inner bowl segments of clause 9, wherein the plurality of inner bowl segments is replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith. Clause 12 being the plurality of inner bowl segments of clause 9, wherein the plurality of inner bowl segments is further characterized by a first thickness between the inner side and the outer side and wherein the outer bowl is further characterized by a second thickness of an outer wall, wherein the first thickness and the second thickness are based at least in part on at least one diameter of an oilfield equipment and a casing in an application of the slip hanger or the packoff. Clause 13 being a method for a slip hanger or a packoff to be used with an oilfield equipment, which is further characterized by: determining a diameter to be associated with an application of the slip hanger or the packoff; determining at least a plurality of inner bowl segments associated with the diameter; and providing the plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side, wherein the plurality of inner bowl segments is further characterized by a plurality of first retention features to enable association with a plurality of second retention features of the outer bowl. Clause 14 being the method of clause 13 is further characterized by providing a load shoulder of the oilfield equipment to support the singular outer bowl for the slip hanger or packoff to be used with the oilfield equipment. Clause 15 being the method of clause 13 is further characterized by providing a top plate and a seal to be associated

with the plurality of inner bowl segments, the plurality of slip segments, and the singular outer bowl; and retaining together, using a plurality of fasteners, the top plate, the seal, and at least the plurality of inner bowl segments prior to use in the oilfield equipment. Clause 16 being the method of clause 13, wherein the plurality of first retention features and the plurality of second retention features are a plurality of interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment. Clause 17 being the method of clause 13, wherein the plurality of inner bowl segments is further characterized by a first thickness between the inner side and the outer side and wherein the singular outer bowl is further characterized by a second thickness of an outer wall, wherein the first thickness and the second thickness are based at least in part on at least one diameter of an oilfield equipment and a casing in an application of the slip hanger or the packoff. Clause 18 being the method of clause 13, wherein the outer bowl is further characterized by a beam structure having a plurality of flutes and splines in an inner side of the slip hanger or the packoff to enable transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of the oilfield equipment. Clause 19 being the method of clause 13, wherein the plurality of inner bowl segments is replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith. Clause 20 being the method of clause 13, wherein a plurality of fasteners retain together the plurality of inner bowl segments by a pulling force on the plurality of inner bowl segments and by a squeezing force on a seal that is between the plurality of inner bowl segments and a top plate.

CLAIMS

What is claimed is:

1. A system for a slip hanger (114) or a packoff (124) to be used with oilfield equipment, the system characterized by:

a plurality of inner bowl segments (212A, 212 B) to support a plurality of slip segments (216) on an inner side (258) and to be supported by a singular outer bowl (252) on an outer side (260), wherein the plurality of inner bowl segments further characterized by a plurality of first retention features (456) to enable association with a plurality of second retention features (454) of the outer bowl.

2. The system of claim 1, further characterized by:

a load shoulder of the oilfield equipment to support the outer bowl for the slip hanger or packoff to be used with the oilfield equipment.

3. The system of claim 1, wherein the plurality of first retention features and the plurality of second retention features are a plurality of interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment.

4. The system of claim 1, further characterized by:

a top plate (202);

a seal (206); and

a plurality of fasteners (214) to retain together the top plate, the seal, and at least the plurality of inner bowl segments prior to use in the oilfield equipment.

5. The system of claim 1, wherein the plurality of inner bowl segments is further

characterized by a first thickness (256) between the inner side and the outer side and wherein the singular outer bowl is further characterized by a second thickness (254) of an outer wall, wherein the first thickness and the second thickness are based at least in part on at least one diameter of the oilfield equipment and a casing in an application of the slip hanger or the packoff.

6. The system of claim 1, wherein a plurality of fasteners (214) retain together the plurality of inner bowl segments by a pulling force on the plurality of inner bowl segments and by a squeezing force on a seal that is between the plurality of inner bowl segments and a top plate.

7. The system of claim 1, wherein the outer bowl is further characterized by a beam structure having a plurality of flutes (402) and splines (452) in an inner side of the slip hanger or the packoff to enable transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of the oilfield equipment.

8. The system of claim 1, wherein the plurality of inner bowl segments is replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith.

9. A method (600) for a slip hanger (114) or a packoff (124) to be used with an oilfield equipment, characterized by:

determining (602) a diameter to be associated with an application of the slip hanger or the packoff;

determining (604) at least a plurality of inner bowl segments associated with the diameter; and

providing (608) the plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side, wherein the plurality of inner bowl segments is further characterized by a plurality of first retention features to enable association (610) with a plurality of second retention features of the outer bowl.

10. The method of claim 9, further characterized by:

providing a load shoulder of the oilfield equipment to support the singular outer bowl for the slip hanger or packoff to be used with the oilfield equipment.

11. The method of claim 9, further characterized by:

providing a top plate and a seal to be associated with the plurality of inner bowl segments, the plurality of slip segments, and the singular outer bowl; and

retaining together, using a plurality of fasteners, the top plate, the seal, and at least the plurality of inner bowl segments prior to use in the oilfield equipment.

12. The method of claim 9, wherein the plurality of first retention features and the plurality of second retention features are a plurality of interfacing shoulders that interface to provide load transfer from within the slip hanger or packoff to the oilfield equipment.

13. The method of claim 9, wherein the plurality of inner bowl segments is further characterized by a first thickness between the inner side and the outer side and wherein the singular outer bowl is further characterized by a second thickness of an outer wall, wherein the first thickness and the second thickness are based at least in part on at least one diameter of an oilfield equipment and a casing in an application of the slip hanger or the packoff.

14. The method of claim 9, wherein the outer bowl is further characterized by a beam structure having a plurality of flutes and splines in an inner side of the slip hanger or the packoff to enable transfer loads from a pressure above the slip hanger or a packoff to a load shoulder of the oilfield equipment.

15. The method of claim 9, wherein the plurality of inner bowl segments is replaceable to adjust the slip hanger or the packoff to an application diameter associated therewith.

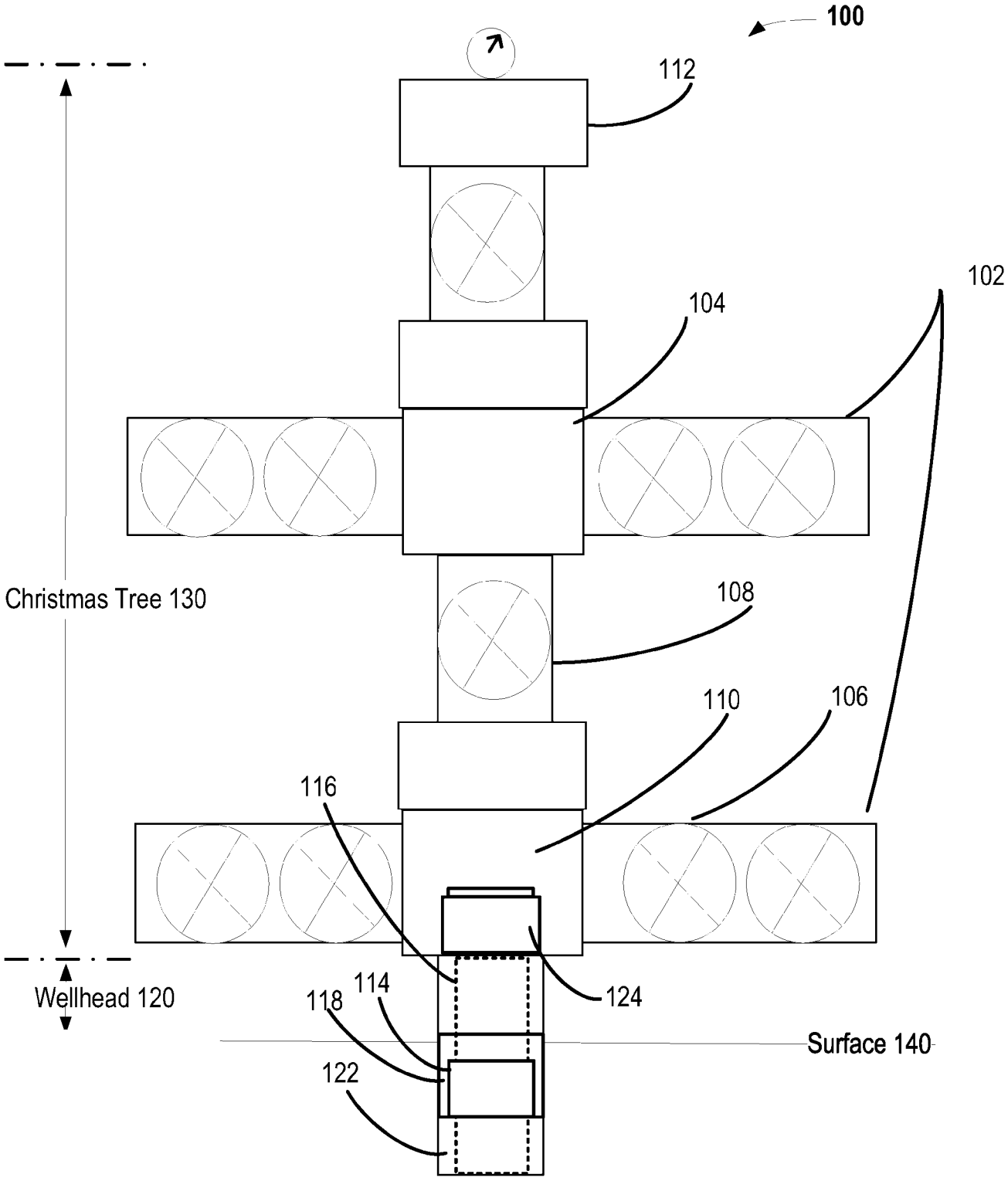

100
112
102
104
Christmas Tree 130
108
110
106
116
Wellhead 120
114
118
124
Surface 140
122

FIG. 1

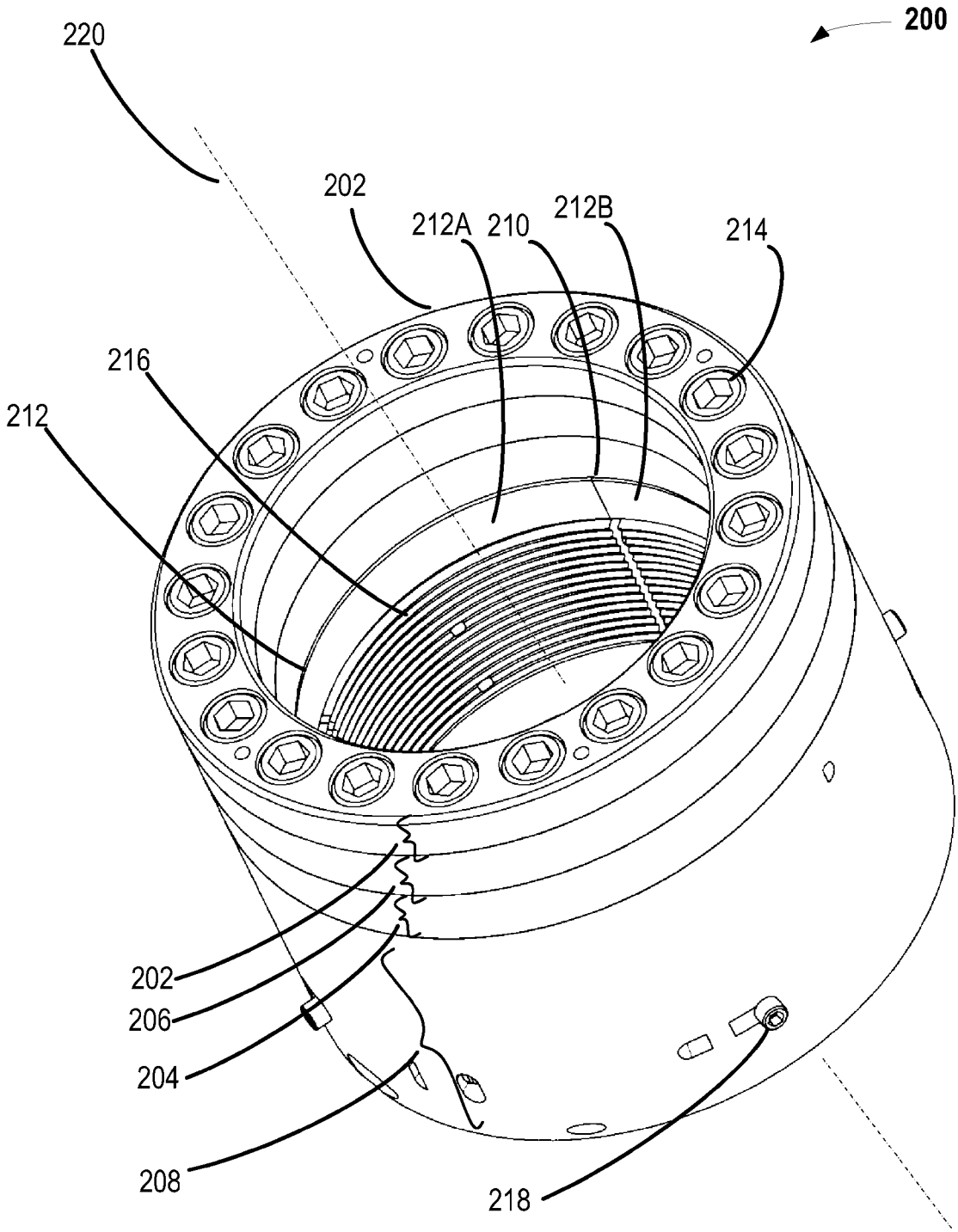


FIG. 2A

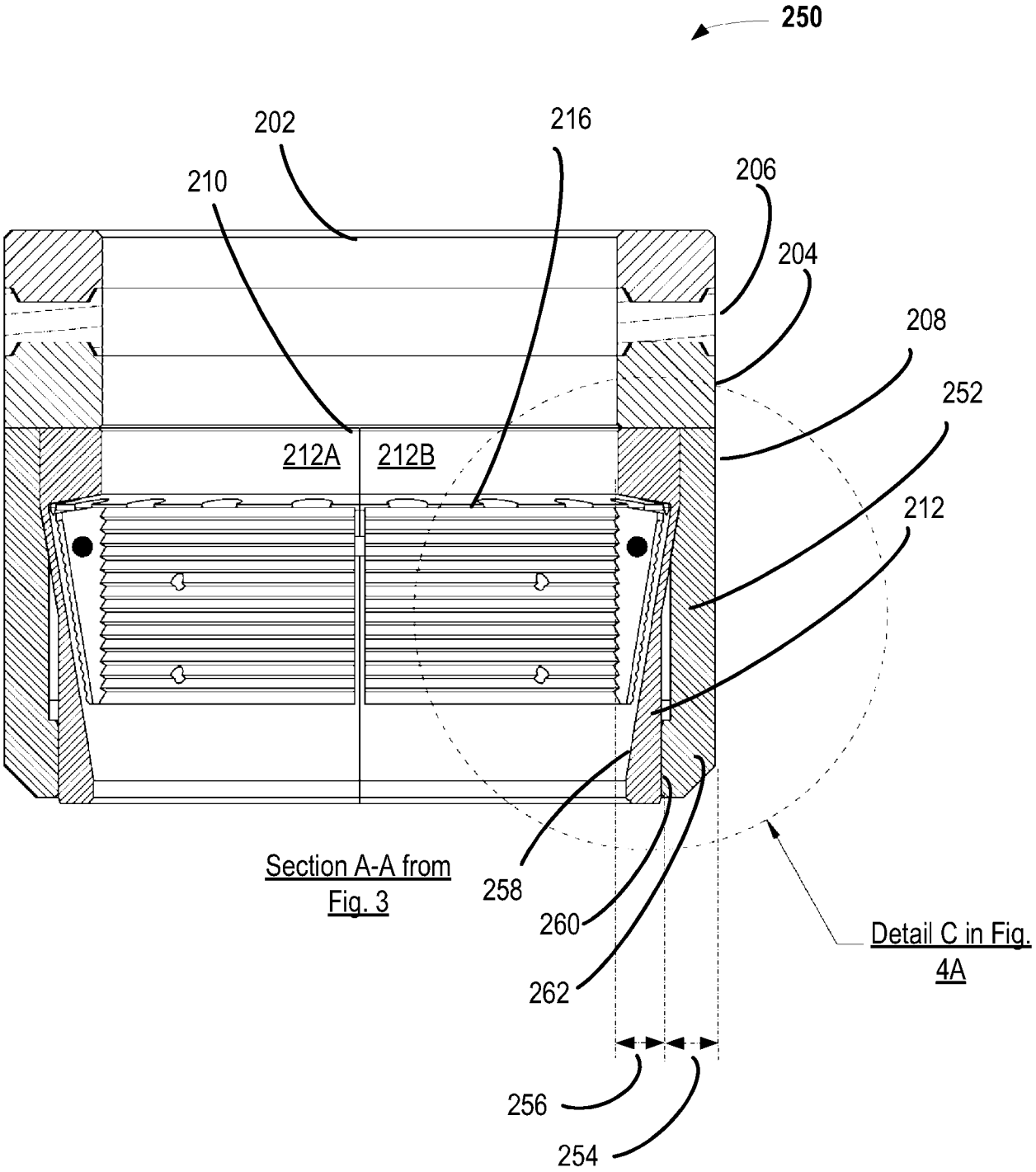

250
202
216
210
206
204
208
252
212A
212B
212
Section A-A from Fig. 3
258
260
262
Detail C in Fig. 4A
256
254

FIG. 2B

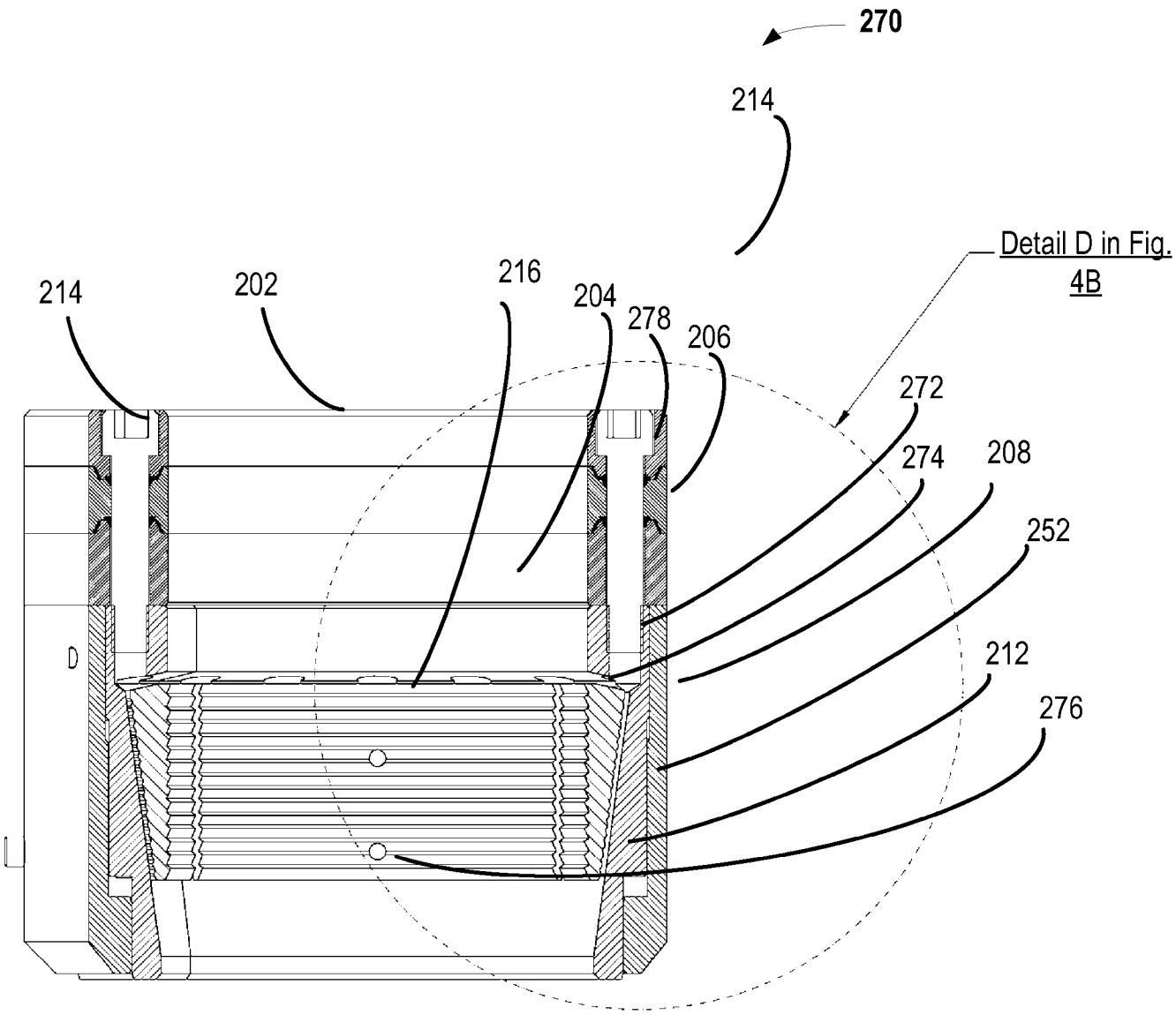

270
214
Detail D in Fig. 4B
214
202
216
204
278
206
272
274
208
252
212
276
D
Section B-B from Fig. 3

FIG. 2C

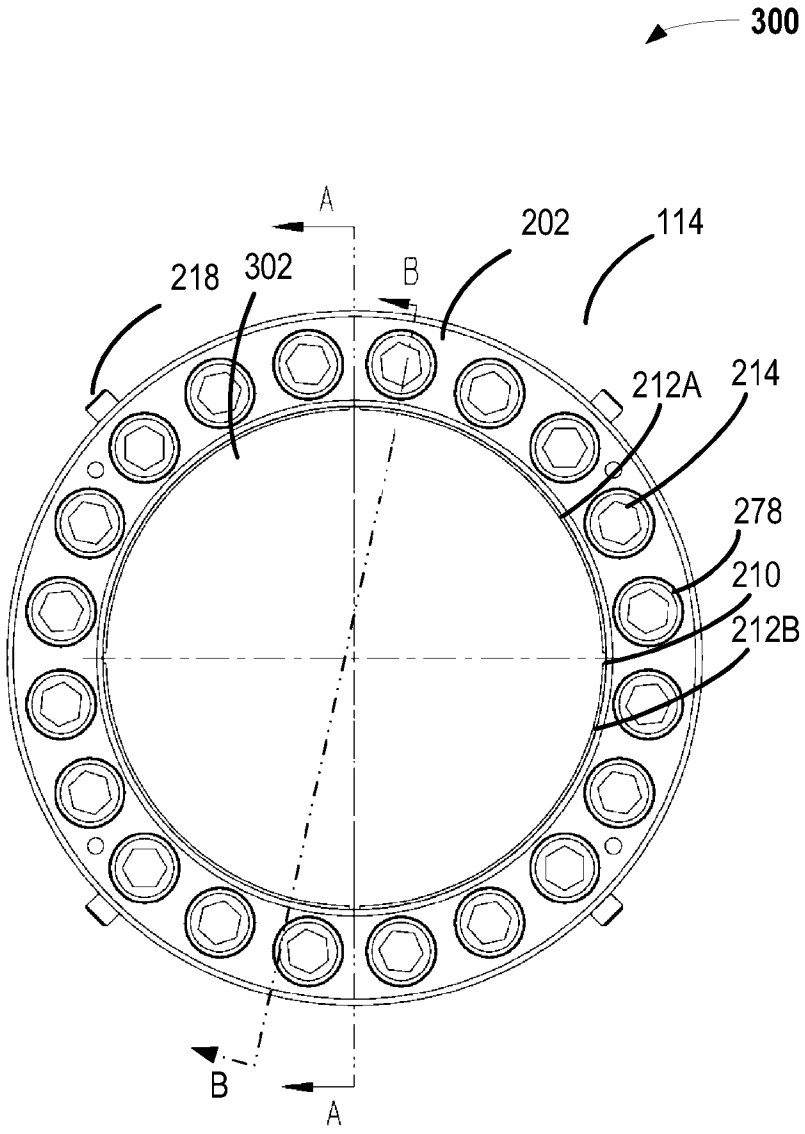


FIG. 3

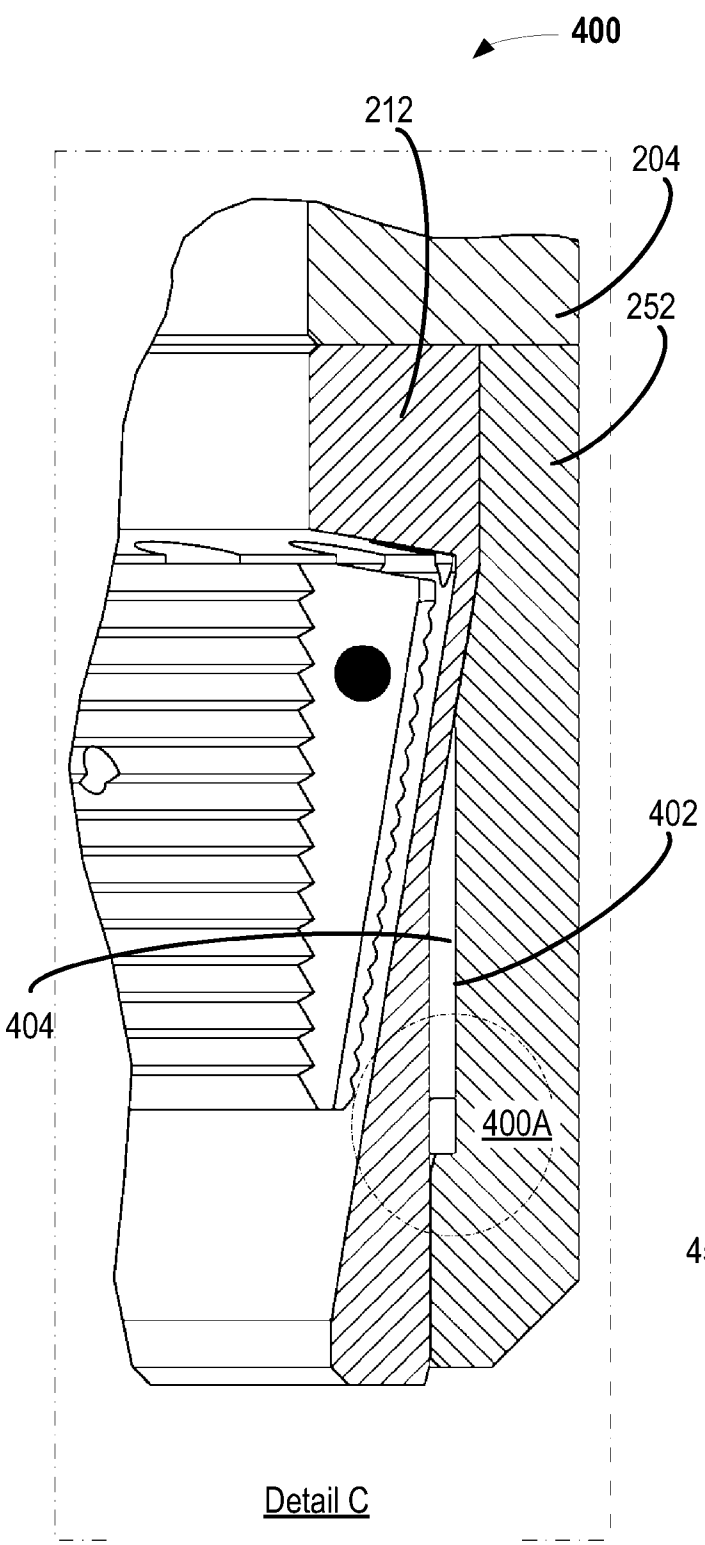

400
212
204
252
402
404
400A
Detail C

FIG. 4A

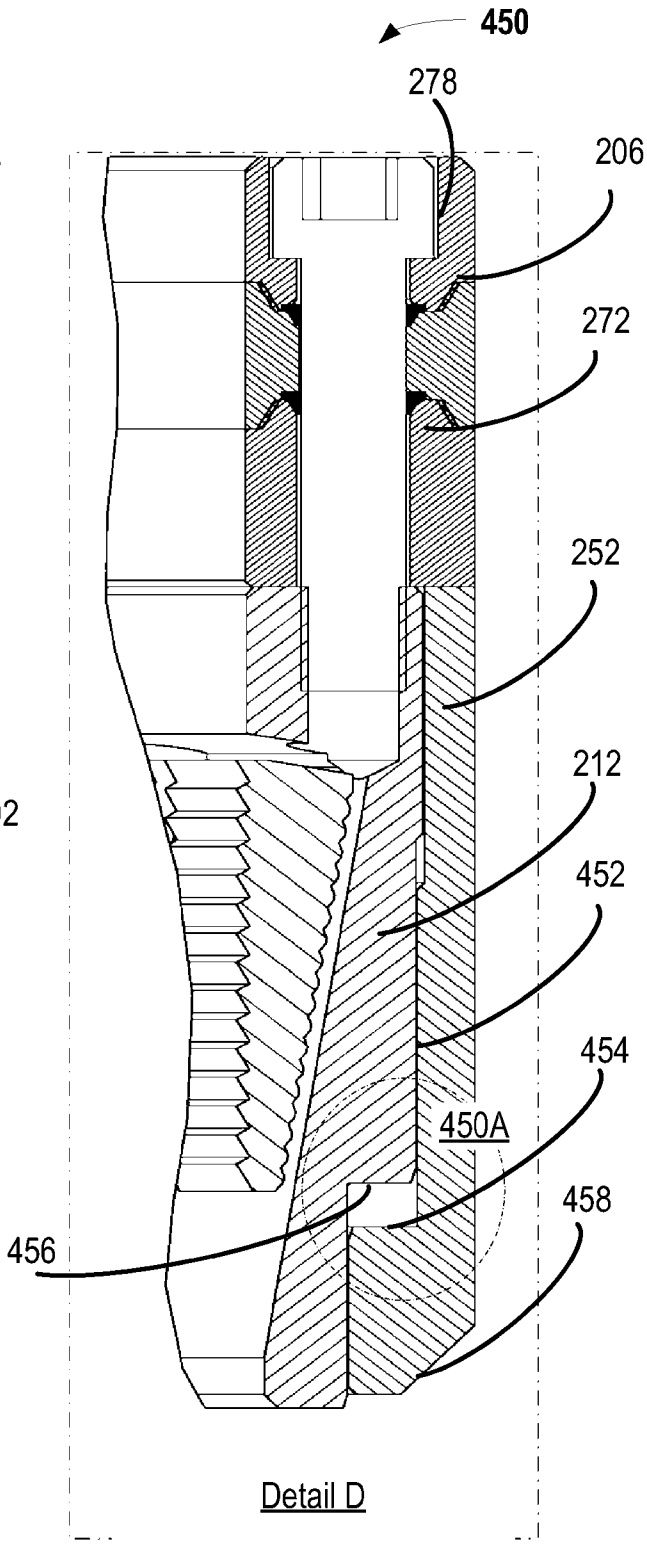

450
278
206
272
252
212
452
454
450A
458
456
Detail D

FIG. 4B

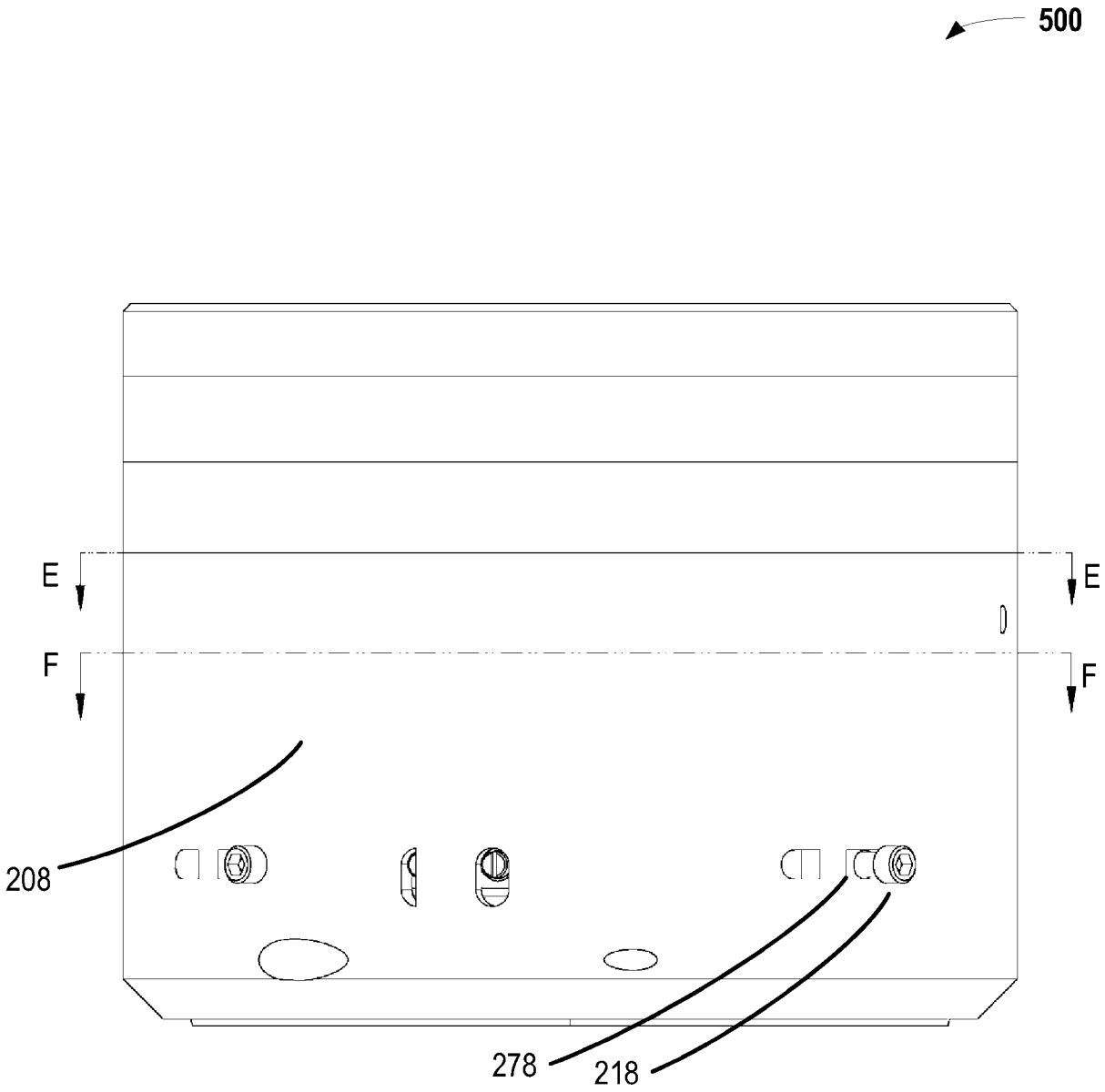


FIG. 5A

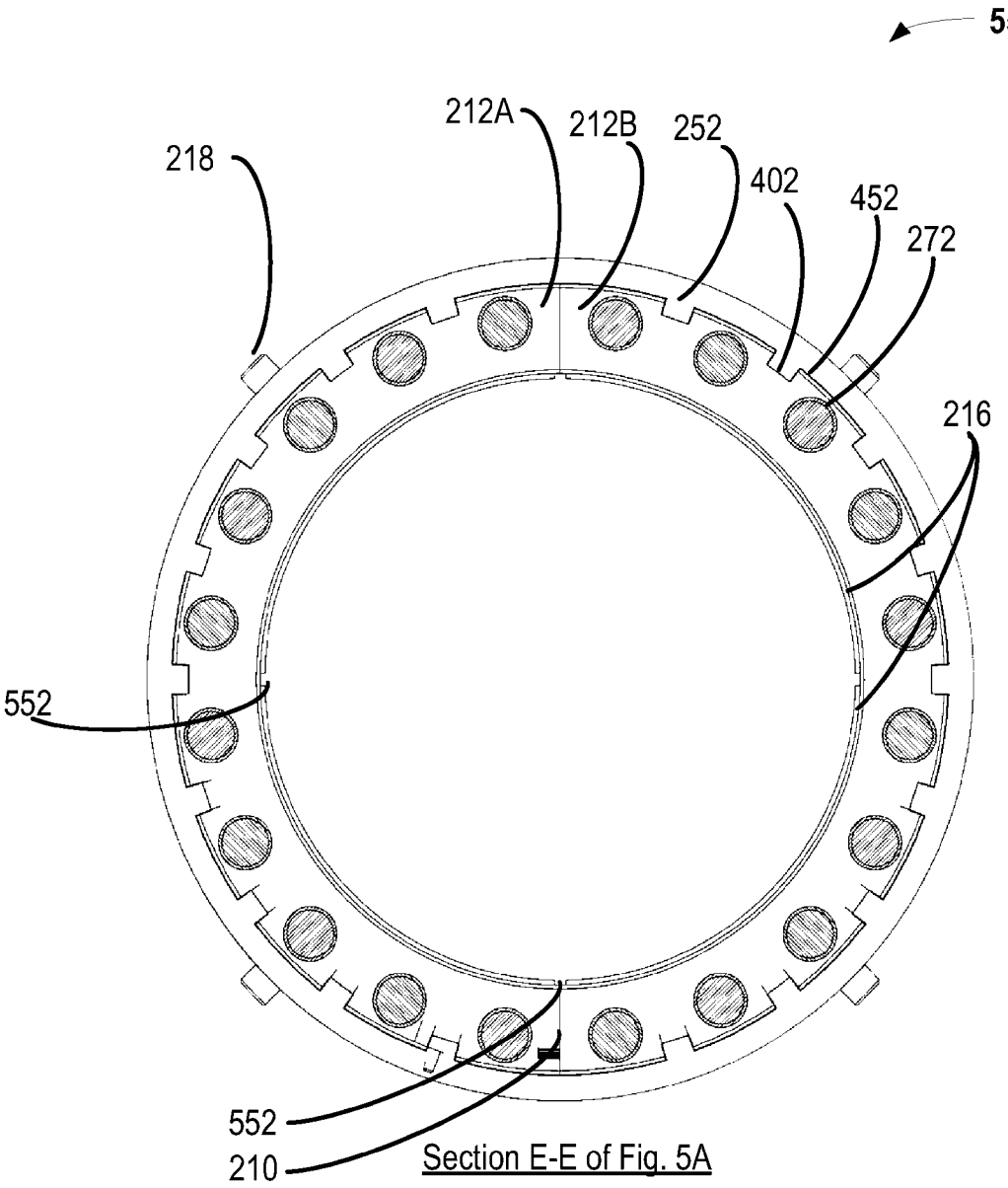
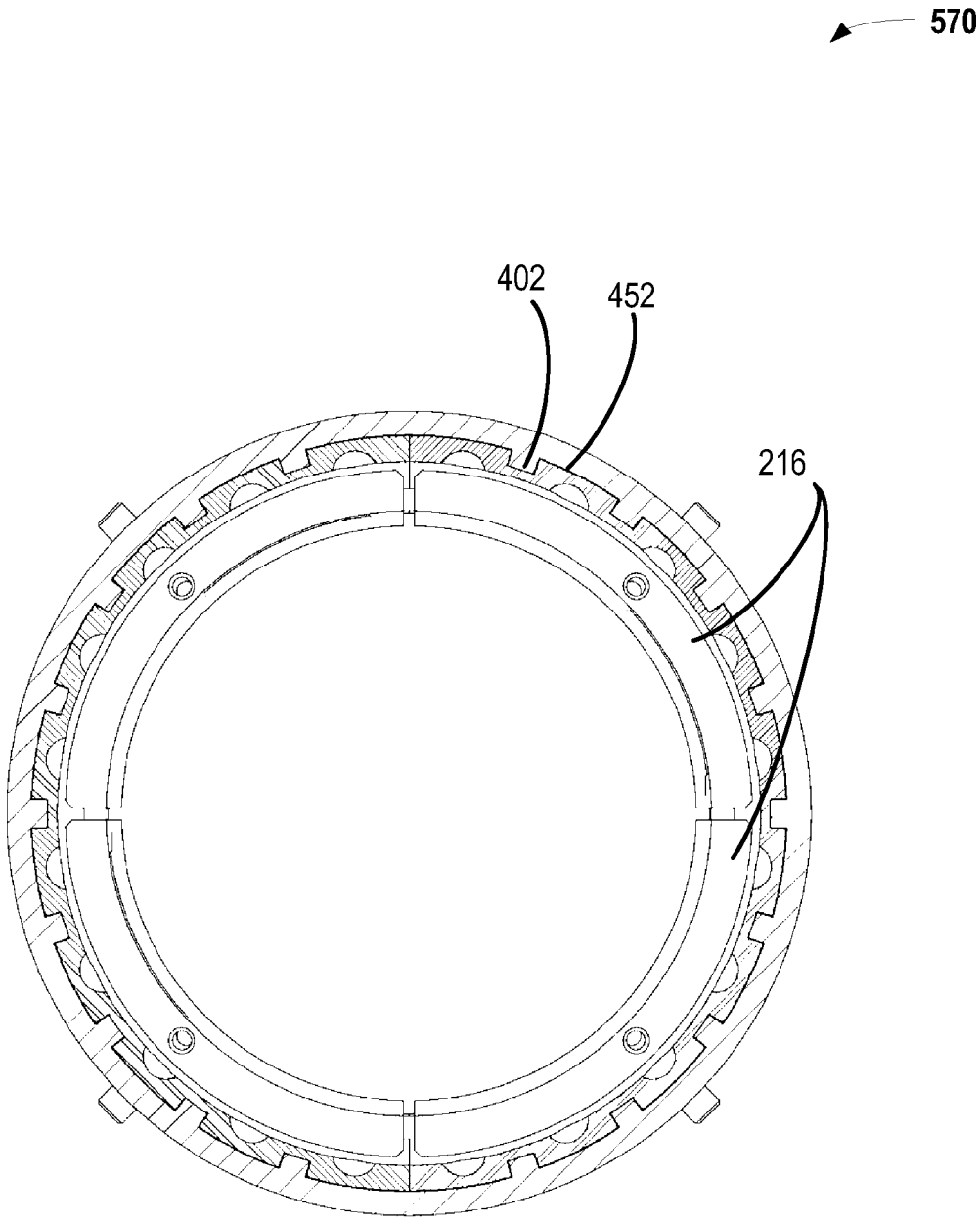

550
212A
212B
252
402
452
272
218
216
552
552
210
Section E-E of Fig. 5A

FIG. 5B



Section F-F of Fig. 5A

FIG. 5C

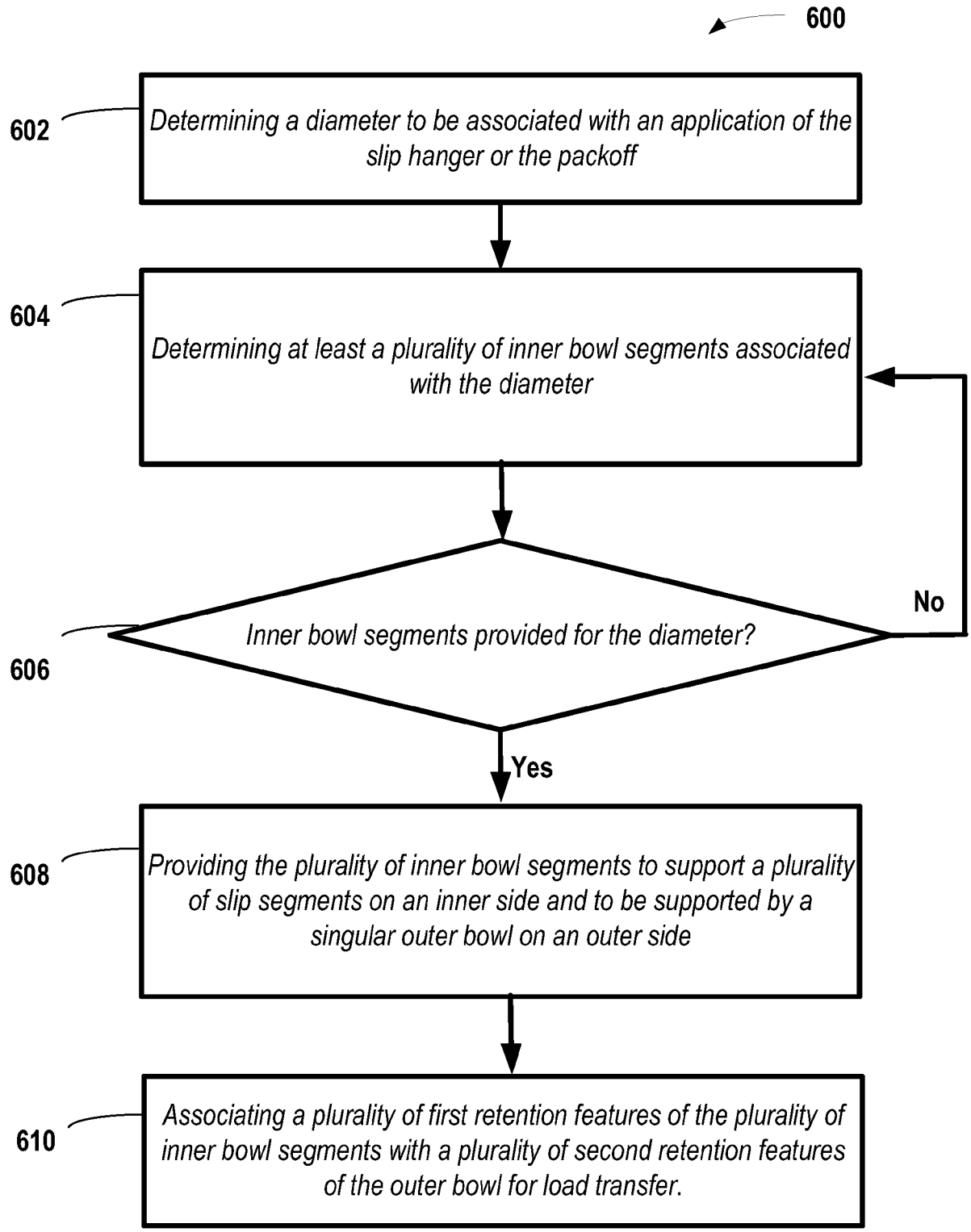

600
602
Determining a diameter to be associated with an application of the slip hanger or the packoff
604
Determining at least a plurality of inner bowl segments associated with the diameter
606
Inner bowl segments provided for the diameter?
No
Yes
608
Providing the plurality of inner bowl segments to support a plurality of slip segments on an inner side and to be supported by a singular outer bowl on an outer side
610
Associating a plurality of first retention features of the plurality of inner bowl segments with a plurality of second retention features of the outer bowl for load transfer.

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2024/033418

A. CLASSIFICATION OF SUBJECT MATTER

E21B 33/04(2006.01)i; **E21B 33/129**(2006.01)i; **E21B 23/01**(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 33/04(2006.01); E21B 19/10(2006.01); E21B 33/12(2006.01); F16L 21/00(2006.01)

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: slip hanger, packoff, inner bowl segments, retention features, load shoulder

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2013-158030 A1 (AKER SOLUTIONS PTE. LTD.) 24 October 2013 (2013-10-24) page 6, line 1 - page 8, line 22 and figures 4-8b, 11d	1-15
Y	US 2021-0285303 A1 (WILSON et al.) 16 September 2021 (2021-09-16) paragraphs [0076], [0234]-[0258] and figures 10-13	1-15
A	US 5031695 A (CAIN et al.) 16 July 1991 (1991-07-16) column 2, line 21 - column 3, line 68 and figures 1-2	1-15
A	US 5222555 A (BRIDGES, CHARLES D.) 29 June 1993 (1993-06-29) column 2, lines 45-56 and figure 3	1-15
A	WO 2017-007817 A1 (GE OIL & GAS PRESSURE CONTROL LP) 12 January 2017 (2017-01-12) figures 2-3B	1-15

☐ 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
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 September 2024	**30 September 2024**

Name and mailing address of the ISA/KR	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US2024/033418

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
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				US	11473390	B2	18 October 2022
				US	12018543	B2	25 June 2024
				US	2023-0287755	A1	14 September 2023
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				GB	2242465	A	02 October 1991
US	5222555	A	29 June 1993	US	5287922	A	22 February 1994
WO	2017-007817	A1	12 January 2017	SA	517390643	B1	02 November 2022
				US	10253589	B2	09 April 2019
				US	2017-0009539	A1	12 January 2017