

HIGH PRESSURE SEAL BACK-UP

BACKGROUND

[0001] The field of the invention relates to seal back-ups for wellbore tools often used in oil and gas well applications. Sealing members engage movable members in wellbore tools. Seal back-ups provide support for the sealing members as well as attempt to reduce an extrusion gap. When under pressure, sealing members can extend through the extrusion gap when making sealing contact. During this time, standard seals can fall through the extrusion gap and limit the amount of the seal surface area engaging an outer surface to form a sealing engagement. Additionally, standard seals can shear and cause fragments of the seal to fall through the extrusion gap (often called the nibbling effect). Over time, prolonged nibbling can cause premature failure of the seal.

SUMMARY

[0002] In an embodiment, a seal mechanism for use with a downhole component comprises a first tubular member and a second tubular member, wherein the first tubular member is disposed within the second tubular member and separated therefrom by an extrusion gap; a circumferential groove disposed on the first tubular member; a seal disposed within the circumferential groove, wherein the seal is selectively positionable into engagement with the second tubular member; and a high pressure seal back-up disposed within the circumferential groove, wherein the distance between an inside diameter of the high pressure seal back-up and an outside diameter of the high pressure seal back-up is configured to remain substantially constant when pressure increases on the high pressure seal back-up, and wherein the high pressure seal back-up is configured to have an increase in its outer diameter in response to a pressure increase.

[0003] In an embodiment, a high pressure seal mechanism for use with a downhole component in a wellbore environment comprises a tubular member and a surface, where the tubular member is disposed adjacent to the surface and separated from the surface by an extrusion gap, a circumferential groove disposed on the tubular member, a seal disposed within the circumferential groove, where the seal is selectively positionable into an engagement with the surface, and a high pressure seal back-up disposed within the circumferential groove, where the distance between an inside diameter of the high pressure seal back-up and an outside diameter of the high pressure seal back-up is configured to remain substantially constant when pressure increases on the high pressure seal back-up.

[0004] In another embodiment, a method comprises increasing pressure on a seal and a high pressure seal back-up, where the seal and high pressure seal back-up are disposed with a circumferential groove, extending the high pressure seal back-up into an extrusion gap, and forming a seal between a tubular member and a surface.

[0005] These and other features will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] For a more complete understanding of the present disclosure and the advantages thereof, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description:

[0007] Figure 1 is a cut-away view of an embodiment of a wellbore servicing system.

[0008] Figure 2A is a side view of an embodiment of a high pressure seal mechanism.

[0009] Figure 2B is a cross-section view of an embodiment of a high pressure seal mechanism.

[0010] Figure 3A is a side view of an embodiment of a high pressure seal back-up.

[0011] Figure 3B is a side view of an embodiment of a standard seal back-up.

[0012] Figure 4A is another cross-section view of an embodiment of a high pressure seal mechanism.

[0013] Figure 4B is cross-section view of an embodiment of a high pressure seal back-up.

[0014] Figure 5A is a cross-section view of an embodiment of a standard seal mechanism.

[0015] Figure 5B is a cross-section view of an embodiment of a seal in a standard seal mechanism.

[0016] Figure 5C is cross-section view of an embodiment of a standard seal back-up and a seal in a standard seal mechanism.

[0017] Figure 6 is another cross-section view of an embodiment of a high pressure seal mechanism.

[0018] Figure 7 is another cross-section view of an embodiment of a high pressure seal mechanism.

[0019] Figure 8 is another cross-section view of an embodiment of a high pressure seal mechanism.

[0020] Figure 9 is another cross-section view of an embodiment of a high pressure seal mechanism.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0021] In the drawings and description that follow, like parts are typically marked throughout the specification and drawings with the same reference numerals, respectively. The drawing figures are not necessarily to scale. Certain features of the invention may be shown exaggerated in scale or in somewhat schematic form and some details of conventional elements may not be shown in the interest of clarity and conciseness. 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 invention, and is not intended to limit the invention to that illustrated and described herein. It is to be fully recognized that the different teachings of the embodiments discussed infra may be employed separately or in any suitable combination to produce desired results.

[0022] Unless otherwise specified, any use of any form of the terms “connect,” “engage,” “couple,” “attach,” or any other 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. In the following discussion and in the claims, the terms “including” and “comprising” are used in an open-ended fashion, and thus should be interpreted to mean “including, but not limited to ...”. Reference to up or down will be made for purposes of description with “up,” “upper,” “upward,” or “upstream” meaning toward the surface of the wellbore and with “down,” “lower,” “downward,” or “downstream” meaning toward the terminal end of the well, regardless of the wellbore orientation. Reference to in or out will be made for purposes of description with “in,” “inner,” or “inward” meaning toward the center or central axis of the wellbore, and with “out,” “outer,” or “outward” meaning toward the wellbore tubular and/or wall of the wellbore. Reference to “longitudinal,” “longitudinally,” or “axially” means a direction substantially aligned with the main axis of the wellbore and/or wellbore tubular. Reference to “radial” or “radially” means a direction substantially aligned with a line between the main axis of the wellbore and/or wellbore tubular and the wellbore wall that is substantially normal to the main axis of the wellbore and/or wellbore tubular, though the radial direction does not have to pass through the central axis of the wellbore and/or wellbore tubular. The various characteristics mentioned above, as well as other features and characteristics described in more detail below, will be readily apparent to those skilled in the art with the aid of this disclosure upon reading the

following detailed description of the embodiments, and by referring to the accompanying drawings.

[0023] Several tools used in a servicing operation may comprise one or more high pressure seal mechanisms configured to engage one or more other components. For example, a completion tool and/or a retrieval tool may comprise a piston having a high pressure seal mechanism. The component may be fixedly attached to the tool. A tool comprising a high pressure seal mechanism may comprise a seal to engage a surface in the wellbore. This seal may be disposed in a circumferential groove, and the circumferential groove may be disposed circumferentially on a surface of a portion of the wellbore tool. Traditional seal back-ups may be used in seals to help maintain the seal under high pressure. However, traditional back-ups do not extend into the extrusion gap, leading to potential leaks and loss of integrity of the seal. In order to address this potential problem, the high pressure seal back-up disclosed herein extends into the extrusion gap under pressure, supporting the seal in the extrusion gap when the seal is under pressure. The high pressure seal mechanism may comprise a high pressure seal back-up disposed with the circumferential groove and configured so that the distance between the inside diameter of the high pressure seal back-up and the outside diameter of the high pressure seal back-up remain substantially constant when pressure increases on the high pressure seal back-up. As used herein, “high pressure” means greater than or equal to about 500 pounds per square inch, greater than or equal to about 1,000 pounds per square inch, greater than or equal to about 5,000 pounds per square inch, or greater or equal to about 10,000 pounds per square inch. One of ordinary skill in the art would understand, with the aid of this disclosure, when a “high pressure” scenario exists based on, for example, the operational conditions, the service environment, the type of seal, or any safety concerns. For example, a “high pressure” scenario may exist, which may require a high pressure seal back-up, when there is a need for a standard seal back-up. While described in terms of a high pressure seal back-up and a high pressure seal system in some embodiments, the systems and methods described herein may also be used at pressures less than those considered high pressure.

[0024] When the high pressure seal mechanism is under high pressure, the seal extends from the groove, into the extrusion gap, and engages an outside surface. The high pressure seal back-up may also extend from the groove and into the extrusion gap. The high pressure seal back-up may engage the seal in the extrusion gap, supporting the seal in the extrusion gap, and preventing the

seal from falling into the extrusion gap. Preventing the seal from falling into the extrusion gap facilitates a better sealing engagement between the tool and outside surface. Additionally, this feature may also relieve pressure between the seal and the edge of, for example, the circumferential groove or a second seal back-up, reducing any shear force on the seal, and potentially extending the life of the seal.

[0025] As further disclose herein, the high pressure sealing mechanism may comprise a plurality of second seal back-ups and a plurality of high pressure seal back-ups. The plurality of second seal back-ups and the plurality of high pressure seal back-ups provide support for the seal in the circumferential groove. In one embodiment, a plurality of second seal back-ups and a plurality of high pressure seal back-ups are configured to make the high pressure seal mechanism a two-way seal. In another embodiment, a plurality of second seal back-ups and a plurality of high pressure seal back-ups are configured to make the high pressure seal mechanism a one-way seal. Additionally, the high pressure seal back-up may have a plurality of locking teeth extending outwardly from the high pressure seal back-up and configured to engage with a plurality of locking teeth extending outwardly from a surface adjacent to the high pressure seal back-up. In some embodiments, a wedge may be fixedly attached to a surface adjacent to the high pressure seal back-up. These features may limit the reduction of the outside diameter of the high pressure seal back-up when pressure decreases on the high pressure seal back-up. Further features may keep the high pressure seal back-up in the extrusion gap when, for example, there is a sudden drop in differential pressure followed quickly by a rise in differential pressure where otherwise the seal might fall into the extrusion gap before the high pressure seal back-up has time to move back into the extrusion gap and prevent the seal from falling through the extrusion gap.

[0026] Turning to Figure 1, an example of a wellbore operating environment in which one or more high pressure seal mechanisms may be used is shown. As depicted, the operating environment comprises a drilling rig 106 that is positioned on the earth's surface 104 and extends over and around a wellbore 114 that penetrates a subterranean formation 102 for the purpose of recovering hydrocarbons. The wellbore 114 may be drilled into the subterranean formation 102 using any suitable drilling technique. The wellbore 114 extends substantially vertically away from the earth's surface 104 over a vertical wellbore portion 116, deviates from vertical relative to the earth's surface 104 over a deviated wellbore portion 136, and transitions to

a horizontal wellbore portion 118. In alternative operating environments, all or portions of a wellbore may be vertical, deviated at any suitable angle, horizontal, and/or curved. The wellbore may be a new wellbore, an existing wellbore, a straight wellbore, an extended reach wellbore, a sidetracked wellbore, a multi-lateral wellbore, and other types of wellbores for drilling and completing one or more production zones. Further the wellbore may be used for both producing wells and injection wells. In an embodiment, the wellbore may be used for purposes other than or in addition to hydrocarbon production, such as uses related to geothermal energy and/or the production of water (e.g., potable water).

[0027] A wellbore tubular string comprises a seal mechanism may be lowered into the subterranean formation 102 for a variety of drilling, completion, workover, and/or treatment procedures throughout the life of the wellbore. The embodiment shown in Figure 1 illustrates the wellbore tubular 120 in the form of a completion string being lowered into the subterranean formation. It should be understood that the wellbore tubular 120 is equally applicable to any type of wellbore tubular being inserted into a wellbore, including as non-limiting examples drill pipe, production tubing, rod strings, and coiled tubing. In the embodiment shown in Figure. 1, the wellbore tubular 120 comprising the high pressure seal mechanism may be conveyed into the subterranean formation 102 in a conventional manner and may subsequently be used to provide a seal within the wellbore as described herein.

[0028] The drilling rig 106 comprises a derrick 108 with a rig floor 110 through which the wellbore tubular 120 extends downward from the drilling rig 106 into the wellbore 114. The drilling rig 106 comprises a motor driven winch and other associated equipment for extending the wellbore tubular 120 into the wellbore 114 to position the wellbore tubular 120 at a selected depth. While the operating environment depicted in Figure 1 refers to a stationary drilling rig 106 for lowering and setting the wellbore tubular 120 comprising the seal mechanism within a land-based wellbore 114, in alternative embodiments, mobile workover rigs, wellbore servicing units (such as coiled tubing units), and the like may be used to lower the wellbore tubular 120 comprising the seal mechanism into a wellbore. It should be understood that a wellbore tubular 120 comprising the seal mechanism may alternatively be used in other operational environments, such as within an offshore wellbore operational environment. In alternative operating environments, a vertical, deviated, or horizontal wellbore portion may be cased and cemented and/or portions of the wellbore may be uncased.

[0029] Regardless of the type of operational environment in which the high pressure seal mechanism 200 is used, it will be appreciated that the high pressure seal mechanism 200 serves to provide a seal between two components. The high pressure seal mechanism 200 may utilize different configurations than a standard seal mechanism. As described in greater detail below with respect to Figures 2A and 2B, the high pressure seal mechanism 200 generally comprises a first tubular member 202 and a second tubular member 204, a circumferential groove 206, a seal 208, and a high pressure seal back-up 210. The circumferential groove 206 is disposed on the first tubular member 202. The first tubular member 202 and second tubular member 204 are separated by an extrusion gap 212. The seal 208 may be disposed within the circumferential groove 206 so that the seal 208 is selectively positionable into engagement with the second tubular member 204. The high pressure seal back-up 210 may be disposed at least partially within the circumferential groove 206 so that when pressure increases on the high pressure seal back-up 210 the outer diameter of the high pressure seal back-up 210 increases while the distance between an inside diameter of the high pressure seal back-up 210 and an outside diameter of the high pressure seal back-up 210 remain substantially constant.

[0030] Figure 2A illustrates a side view of the high pressure seal mechanism 200, and Figure 2B illustrates the same embodiment of the high pressure seal mechanism 200 in cross-section. As shown in Figures 2A and 2B, an embodiment of the high pressure seal mechanism 200 comprises a first tubular member 202 and a second tubular member 204, the first tubular member 202 and the second tubular member 204 are separated by an extrusion gap 212. The second tubular member 204 may also be a flat surface, a surface such as a bore, (e.g., in a wall of a component, within a tubular member, etc.) or any other type of surface as long as an extrusion gap 212 exists between the first tubular member 202 and the second tubular member 204. A circumferential groove 206 is disposed on the first tubular member 202. The circumferential groove 206 may be disposed radially, for example, on the first tubular member 202 such that the circumferential groove 206 extends perpendicular to the longitudinal axis of the first tubular member 202. In an embodiment, the circumferential groove 206 may extend at a non-perpendicular angle to the longitudinal axis of the first tubular member 202. In an embodiment, the circumferential groove 206 may also be disposed elliptically, for example, such that the distance from the center point of the circumferential groove 206 on the longitudinal axis of the first tubular member 202 to the circumferential groove 206 is not constant.

[0031] A seal 208 is disposed with the circumferential groove 206. The seal 208 may be an o-ring, for example, or it may be any other member that could provide a seal between the first tubular member 202 and the second tubular member 204. The seal 208 may rest inside, on, or adjacent to the circumferential groove 206. When pressure is not applied, the seal 208 may sit inside the circumferential groove 206 without extending radially into the extrusion gap 212, the seal 208 may at least partially extend into the extrusion gap 212, or the seal 208 may engage the second tubular member 204.

[0032] A high pressure seal back-up 210 is disposed with the circumferential groove 206. The high pressure seal back-up 210 may rest inside, on, or adjacent to the circumferential groove 206. When pressure is not applied, the high pressure seal back-up 210 may sit inside the circumferential groove 206 without extending radially into the extrusion gap 212, or the high pressure seal back-up 210 may at least partially extend radially into the extrusion gap 212. As shown in Figure 3A and Figure 3B, an embodiment of the high pressure seal back-up 210, depicted in Figure 3A, depicts how the high pressure seal back-up 210 has two main faces that generally face in the direction that a normal force would be applied as shown. The main faces of the high pressure seal back-up 210 are such that they are located on at least two planes which intersect when pressure is not applied to the main faces of the high pressure seal back-up 210. When under pressure, the high pressure seal back-up 210 may partially flatten out and radially expand. In an embodiment, the high pressure seal back-up 210 may at radially expand by at least about 1%, at least about 2%, at least about 3%, at least about 4%, at least about 5%, at least about 6%, at least about 7%, at least about 8%, at least about 9%, or at least about 10% of the outer radius of the high pressure seal back-up 210 in an uncompressed and un-expanded state. In an embodiment, the inside and outside diameters of the high pressure seal back-up 210 may increase when axially compressed. When under pressure, the high pressure seal back-up 210 may flatten out and the inside and outside diameters of the high pressure seal back-up 210 may increase. This feature of the high pressure seal back-up 210 allows the distance between an inside diameter of the high pressure seal back-up 210 and an outside diameter of the high pressure seal back-up 210 to remain substantially constant when the high pressure seal back-up 210 is under high pressure. In an embodiment of the high pressure seal back-up 210, the high pressure seal back-up 210 comprises a wave spring, which can comprise any ring having one or more wave-like features and/or radially expands upon being axially compressed.

[0033] Conversely, Figure 3B depicts how a standard seal back-up has two main faces that generally face in the direction that a normal force would be applied as shown. However, the main faces of the standard seal back-up are such that they are located on parallel planes. In this configuration, the outside and inside diameter of the high pressure seal back-up 210 remain substantially constant even when a load is applied. This configuration relies more heavily on the elastic or inelastic malleable characteristics of its composition under a normal force.

[0034] The various components of the sealing mechanism (e.g., the high pressure seal back-up) may be formed from materials selected to withstand downhole conditions including heat and/or various acidic or basic fluids. Examples of suitable materials may include, but are not limited to, fluoropolymers, polyethylene polymers, silicone polymers, urethane polymers, and any combination thereof. Nonlimiting examples of suitable elastomeric compounds include, ethylene propylene diene monomer (EPDM), fluoroelastomers (FKM) [Viton®], perfluoroelastomers (FFKM) [Kalrez®, Chemraz®, Zalak®], fluoropolymer elastomers [Viton®], polytetrafluoroethylene, copolymer of tetrafluoroethylene and propylene (FEPM) [Aflas®], and polyetheretherketone (PEEK), polyetherketone (PEK), polyamide-imide (PAI), polyimide [Vespel®], polyphenylene sulfide (PPS), and any combination thereof. In addition to these components, various metals suitable for use in forming the high pressure seal back-up may be used (e.g., spring steel and the like). In an embodiment, metals that experience plastic deformation may be used when, for example, the seal back-up does not need to act as a dynamic seal. Various other components may be used in combination with any of the listed materials.

[0035] As shown in Figure 4A, another embodiment of the high pressure seal mechanism 200 depicts the high pressure seal mechanism 200 under a pressure differential. In this embodiment, the seal 208 acting under a normal force created by the differential pressure (e.g., a higher pressure on the right of the seal 208 than on the left of the seal 208 in Figure 4A) extends into the extrusion gap 212 engaging the second tubular member 204. Additionally, the high pressure seal back-up 210 acting under a normal force created by the differential pressure expands and extends into the extrusion gap 212 while keeping the distance between the inside diameter of the high pressure seal back-up 210 and the outside diameter of the high pressure seal back-up 210 substantially constant relative to the distance between the inside diameter of the high pressure seal back-up 210 and the outside diameter of the high pressure seal back-up 210 when pressure is not applied. As a normal force is applied to the high pressure seal back-up 210,

the inside diameter of the high pressure seal back-up 210 begins to move a distance 404 from the base of circumferential groove 206. At the same time, the outside diameter of the high pressure seal back-up 210 begins to move a distance 404 into the extrusion gap. As a normal force is applied to the high pressure seal back-up 210 the distances 402 and 404 are substantially the same. The high pressure seal back-up 210 engages both the wall of the circumferential groove 206 and the seal 208. This feature prevents the seal 208 from falling through the extrusion gap 212 and engages more surface area of the seal 208 with the second tubular member 204 creating a stronger seal, as more closely shown in Figure 4B. This feature also substantially reduces the shearing and nibbling effect on the seal 208 by preventing the seal 208 from falling through the extrusion gap 212 and shearing the seal 208 with an edge. In another embodiment, the high pressure seal back-up 210 may also engage the second tubular member 204.

[0036] As shown in Figure 5A, another embodiment depicts the effect a standard seal mechanism 500 has on a seal 508 under a pressure differential. In this embodiment, the seal 508 is allowed to extend through the extrusion gap 512 reducing the engagement that could take place between the seal 508 and the second tubular member 204, as shown in Figure 5B, and shearing the seal 508 producing a nibbling effect that accelerates the wear on the seal 508, as shown in Figure 5B. Unlike the high pressure seal back-up 210 in Figure 4A, the standard seal back-up 514 depicted in Figure 5A and Figure 5B relies more heavily on the elastic or inelastic malleable characteristics of its composition under a normal force and does not substantially extend into the extrusion gap 512. Thus, the standard back-up seal 514 may not be as effective at preventing the seal 508 from falling through the extrusion gap 512 as the high pressure seal back-up described herein.

[0037] As shown in Figure 6, another embodiment discloses a second seal back-up 614 disposed adjacent to the seal 608 and adjacent to the high pressure seal back-up 610. Although in this embodiment the second seal back-up 614 is disposed between the high pressure seal back-up 610 and the seal 608, the second seal back-up 614 may also be positioned on lower pressure side from the high pressure seal back-up 610, a higher pressure side from the seal 608, or anywhere disposed with the circumferential groove 606. This configuration provides extra support in the circumferential groove 606 for the high pressure seal back-up 610 and the seal 608 and helps to provide a uniform force on the high pressure seal back-up 610 helping to uniformly compress the high pressure seal back-up 610 in the axial direction. In this embodiment, even

though the second seal back-up 614 has a corner that appears to be similar to the corner depicted in Figure 5 and Figure 5B that would result in the nibbling effect, the high pressure seal back-up 610 still prevents the seal 610 from falling through the extrusion gap 612 and thus greatly reduces the shearing between the second seal back-up 614 and the seal 608.

[0038] As shown in Figure 7, another embodiment discloses the use of a plurality of high pressure seal back-ups 710 as well as a plurality of second seal back-ups 714. This configuration provides extra support for the seal 708 in the circumferential groove 706. The positions of the seal 708, the plurality of high pressure seal back-ups 710, and the plurality of second seal back-ups 714 may be disposed in any combination with the circumferential groove 706. Furthermore, in this embodiment and other similar embodiments the high pressure seal mechanism 700 may be a two-way seal. In general, a two-way seal comprises a seal configured to maintain a pressure differential in a first direction that is substantially similar to a pressure differential in a second direction. In other embodiments, the high pressure seal mechanism may be a one-way seal. In general, a one-way seal comprises a seal configured to maintain a first pressure differential in a first direction and a second differential in a second direction, where the first pressure differential and the second pressure differential are different. For example, when a high pressure seal back-up is disposed on only one side of a seal, the seal may maintain a seal at a higher pressure differential when the higher pressure is applied to the seal side than when the higher pressure is applied to the high pressure seal back-up side. When the pressure is applied to the high pressure seal back-up side, the pressure may bias the high pressure seal back-up away from the wall of the groove and not axially compress the high pressure seal back-up.

[0039] As shown in Figure 8, another embodiment discloses a plurality of locking teeth 816 extending outwardly from the high pressure seal back-up 810 and configured to engage with a plurality of locking teeth 816 extending outwardly from a surface adjacent to the high pressure seal back-up 810. Figure 8 depicts the plurality of locking teeth 816 engaging the high pressure seal back-up 810 with the second seal back-up 814. However, the plurality of locking teeth 818 may engage the high pressure seal back-up 810 with any surface disposed with the circumferential groove 806 including the wall of the circumferential groove 806. The plurality of locking teeth 816 are configured to limit the reduction of the outside diameter of the high pressure seal back-up 810 when pressure decreases. This configuration keeps the high pressure seal back-up 810 in the extrusion gap 812 when, for example, there is a sudden drop in

differential pressure followed quickly by a rise in differential pressure where otherwise the seal 808 might fall into the extrusion gap 812 before the high pressure seal back-up 810 has time to move back into the extrusion gap 812 and prevent the seal 808 from falling through the extrusion gap 812. When pressure decreases across the high pressure seal mechanism 800, the plurality of locking teeth 816 prolong the time the high pressure seal back-up 810 remains extended into the extrusion gap 812 before the high pressure seal back-up 810 resets into the low pressure condition. When the high pressure seal back-up 810 axially expands, it may no longer fully engage the locking teeth 816 and may eventually disengage from the locking teeth 816 upon a sufficient amount of axial expansion. Once the plurality of locking teeth 816 are no longer engaged, the high pressure seal back-up 810 contracts into the circumferential groove 806 and into the low pressure condition.

[0040] As shown in Figure 9, another embodiment discloses a wedge 918 fixedly attached to a second surface adjacent to the high pressure seal back-up 910 and configured to limit the reduction on the outside diameter of the high pressure seal back-up 910 when pressure decreases on the high pressure seal back-up 910. Figure 9, depicts the wedge 918 fixedly attached to a second seal back-up 914, however, the wedge 918 can be fixedly attached to any surface disposed with the circumferential groove 906 and adjacent to the high pressure seal back-up 910. The wedge configuration keeps the high pressure seal back-up 910 in the extrusion gap 912 when, for example, there is a sudden drop in differential pressure followed quickly by a rise in differential pressure where otherwise the seal 908 might fall into the extrusion gap 912 before the high pressure seal back-up 910 has time to move back into the extrusion gap 912 and prevent the seal 908 from falling through the extrusion gap 912. When pressure decreases across the high pressure seal mechanism 900, the wedge 918 prolongs the time the high pressure seal back-up 910 remains extended into the extrusion gap 912 before the high pressure seal back-up 910 resets into the low pressure condition. When the high pressure seal back-up 910 axially expands, it may no longer fully engage the wedge 918 and may eventually disengage from the wedge 918 upon a sufficient amount of axial expansion. Once the wedge 918 no longer engages the high pressure seal back-up 910, the high pressure seal back-up 910 contracts into the circumferential groove 906 and into the low pressure condition.

[0041] A seal mechanism may be assembled using any technique known in the art. In an embodiment, the seal mechanism may be assembled by first constructing the seal mechanism on

the first tubular member. A circumferential groove may be disposed on the first tubular member and a seal may be disposed at least partially within the circumferential groove. For example, the seal may comprise an elastomeric material that may be stretched and passed over the first tubular member before contracting into the groove. A high pressure seal back-up may be disposed at least partially within the circumferential groove by compressing the high pressure seal back-up to radially expand both the inner and outer diameters, placing the high pressure seal back-up around the axis of the first tubular member so that the first tubular member fits through the inside diameter of the high pressure seal back-up, moving the high pressure seal back-up along the axis of first tubular member until it is radially positioned with the circumferential groove, and decompressing the high pressure seal back-up allowing the inside diameter of the high pressure seal back-up to contract. The first tubular member may then be disposed within the second tubular member. As an alternative to compressing the high-pressure seal back-up during installation, a cut (e.g., a radial cut) may be made in the high pressure seal back-up to create a gap in the high pressure seal back-up to allow the high pressure seal back-up to expand. The high pressure seal back-up may then be moved over the first tubular member. Once the high pressure seal back-up is radially in position with the circumferential groove, the high pressure seal back-up gap may contract, reducing the diameter of the high pressure seal back-up, and positioning the high pressure seal back-up at least partially within the circumferential groove. The further axial compression of the high pressure seal back-up during use may serve to close the cut.

[0042] In an embodiment, the seal mechanism may be used to form a seal between two surfaces. The pressure on the seal and the high pressure seal back-up may be increased when the seal and the high pressure seal back-up are disposed at least partially within the circumferential groove. The high pressure seal back-up may be extended into the extrusion gap, and the seal may engage a tubular member and a surface to form a sealing engagement between the tubular member and the surface. The high pressure seal back-up may extend into extrusion gap in response to an axial compression, which may result from the application of a pressure differential across the seal mechanism. As the high pressure seal back-up expands, the distance between an inside diameter of the high pressure seal back-up and an outside diameter of the high pressure seal back-up may remain substantially constant. The seal mechanism may then maintain a seal while the pressure differential is maintained across the seal mechanism. In an embodiment, the

high pressure seal back-up may extend into the extrusion gap and contact the surface, thereby forming an engagement between both the tubular member and the surface. In some embodiments, locking teeth may be used. In this configuration, the locking teeth on the high pressure seal back-up may engage the corresponding features on an adjacent surface (which may comprise one-way features), thereby preventing the high pressure seal back-up from radially contracting until the pressure differential has fallen below a threshold. In some embodiments, a wedge disposed on an adjacent surface to the high pressure seal back-up may be used. In this configuration, the wedge on the adjacent surface may engage the high pressure seal back-up, thereby preventing the high pressure seal back-up from radially contracting until the pressure differential has fallen below a threshold.

[0043] When the pressure differential across the seal mechanism decreases, the high pressure seal back-up may radially contract away from the surface while maintaining a substantially constant distance between an outside diameter of the high pressure seal back-up and an inside diameter of the high pressure seal back-up. In an embodiment, the high pressure seal back-up may contract out of the extrusion gap. When a wedge is used on an adjacent surface to the high pressure seal back-up, the wedge may slow the reduction of the outside diameter of the high pressure seal back-up when pressure decreases on the high pressure seal back-up. Similarly when one or more locking features are used on an adjacent surface to the high pressure seal back-up, the locking features may slow the reduction of the outside diameter of the high pressure seal back-up when pressure decreases on the high pressure seal back-up. Once the pressure differential across the seal mechanism has fallen below a threshold, the high pressure seal back-up may axially expand and disengage from any locking features, thereby allowing the high pressure seal back-up to contract into the circumferential groove. The pressurization/depressurization cycle may be repeated any number of times and the seal mechanism may be used to form a seal across the extrusion gap.

[0044] At least one embodiment is disclosed and variations, combinations, and/or modifications of the embodiment(s) and/or features of the embodiment(s) made by a person having ordinary skill in the art are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Where numerical ranges or limitations are expressly stated, such express ranges or limitations should be understood to include iterative ranges or limitations

of like magnitude falling within the expressly stated ranges or limitations (e.g., from about 1 to about 10 includes, 2, 3, 4, etc.; greater than 0.10 includes 0.11, 0.12, 0.13, etc.). For example, whenever a numerical range with a lower limit, R_l , and an upper limit, R_u , is disclosed, any number falling within the range is specifically disclosed. In particular, the following numbers within the range are specifically disclosed: $R = R_l + k * (R_u - R_l)$, wherein k is a variable ranging from 1 percent to 100 percent with a 1 percent increment, i.e., k is 1 percent, 2 percent, 3 percent, 4 percent, 5 percent, ..., 50 percent, 51 percent, 52 percent, ..., 95 percent, 96 percent, 97 percent, 98 percent, 99 percent, or 100 percent. Moreover, any numerical range defined by two R numbers as defined in the above is also specifically disclosed. Use of the term "optionally" with respect to any element of a claim means that the element is required, or alternatively, the element is not required, both alternatives being within the scope of the claim. Use of broader terms such as comprises, includes, and having should be understood to provide support for narrower terms such as consisting of, consisting essentially of, and comprised substantially of. Accordingly, the scope of protection is not limited by the description set out above but is defined by the claims that follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present invention.

CLAIMS

What is claimed is:

1. A seal mechanism for use with a downhole component comprising:
 - a first tubular member and a second tubular member, wherein the first tubular member is disposed within the second tubular member and separated therefrom by an extrusion gap;
 - a circumferential groove disposed on the first tubular member;
 - a seal disposed within the circumferential groove, wherein the seal is selectively positionable into engagement with the second tubular member; and
 - a high pressure seal back-up disposed within the circumferential groove, wherein the distance between an inside diameter of the high pressure seal back-up and an outside diameter of the high pressure seal back-up is configured to remain substantially constant when pressure increases on the high pressure seal back-up, and wherein the high pressure seal back-up is configured to have an increase in its outer diameter in response to a pressure increase;
 - wherein a plurality of locking teeth are disposed on a surface of the high pressure seal back-up and are configured to engage with the plurality of locking teeth disposed on a surface adjacent to the high pressure seal back-up.
2. The seal mechanism of claim 1, wherein a wedge is fixedly attached to a surface adjacent to the high pressure seal back-up.
3. The seal mechanism of claim 1, wherein the high pressure seal back-up comprises at least one material selected from the group consisting of: a fluoropolymer, a polyethylene polymer, a silicon polymer, a urethane polymer, a metal, and any combination thereof.
4. The seal mechanism of claim 1, wherein the high pressure seal back-up is a wave spring.

5. The seal mechanism of claim 1, wherein the high pressure seal mechanism comprises a oneway seal.
6. The seal mechanism of claim 1, wherein the high pressure seal back-up is configured to engage the second tubular member in response to a pressure increase on the high pressure seal back-up.
7. The seal mechanism of claim 1, wherein a plurality of the high pressure seal back-ups are disposed within the circumferential groove, wherein the distance between an inside diameter of each of the high pressure seal back-up and an outside diameter of each of the high pressure seal back-up is configured to remain substantially constant when pressure increases on each of the high pressure seal back-up.
8. The seal mechanism of claim 1, wherein a plurality of second seal back-ups are disposed within the circumferential groove.
9. A seal mechanism configured for a downhole component comprising:
 - a tubular member disposed adjacent to a surface;
 - a circumferential groove disposed on the tubular member;
 - a seal disposed within the circumferential groove, wherein the seal is configured to engage with the surface; and
 - a high pressure seal back-up disposed within the circumferential groove, wherein the high pressure seal back-up is configured to extend into an extrusion gap in response to an axial compression, resulting from the application of a pressure differential across the seal mechanism;
 - wherein the high pressure seal back-up has a plurality of locking teeth disposed thereon which engage with the plurality of locking teeth on an adjacent surface to the high pressure seal back-up to prevent the high pressure seal back-up from radially contracting until the pressure differential falls below a threshold.
10. The seal mechanism of claim 9, wherein the tubular member and the surface are configured so that the tubular member may move axially along the surface.

11. The seal mechanism of claim 9, wherein the high pressure seal back-up is configured to prevent the seal from extruding through the extrusion gap.
12. The seal mechanism of claim 9, wherein the high pressure seal back-up is configured so that the distance between an inside diameter of the high pressure seal back-up and an outside diameter of the high pressure seal back-up remain substantially constant when pressure increases on the high pressure seal back-up.
13. The seal mechanism of claim 9, wherein a second seal back-up disposed within the circumferential groove is configured to engage with the high pressure seal back-up.
14. A method comprising:
- increasing pressure on a seal and a high pressure seal back-up, wherein the seal and the high pressure seal back-up are disposed at least partially within a circumferential groove, wherein the high pressure seal back-up comprises a wave spring;
- radially extending the high pressure seal back-up; and
- engaging the seal with a tubular member and a surface to form a sealing engagement between the tubular member and the surface;
- wherein the method further comprising engaging a plurality of locking teeth disposed on a surface of the high pressure seal back-up with a plurality of locking teeth disposed on a second surface adjacent to the high pressure seal back-up.
15. The method of claim 14, further comprising decreasing pressure on the seal and the high pressure seal back-up, wherein the high pressure seal back-up radially contracts away from the surface while maintaining a substantially constant distance between an outside diameter of the high pressure seal back-up and an inside diameter of the high pressure seal back-up.
16. The method of claim 14, further comprising engaging a wedge fixedly attached to a second surface adjacent to the high pressure seal back-up.

17. The method of claim 16, further comprising decreasing pressure on the seal and the high pressure seal back-up, wherein the wedge slows the reduction of the outside diameter of the high pressure seal back-up when pressure decreases on the high pressure seal back-up.

18. The method of claim 14, further comprising decreasing pressure on the seal and the high pressure seal back-up, wherein the plurality of locking teeth disposed on the high pressure seal back-up and engaged with the plurality of locking teeth disposed on the second surface slows the reduction of the outside diameter of the high pressure seal back-up when pressure decreases on the high pressure seal back-up.