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Internal slip including one or more symmetrical teeth

Abstract

Provided is an internal slip, a sealing/anchoring subassembly, a well system, and method. The internal slip, in one aspect, includes a tubular, the tubular having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t). The internal slip, in this aspect, further includes a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with base teeth disposed on a base outer diameter (OD.sub.B) of a base positioned radially inside of the tubular. The internal slip, in this aspect, further includes a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with stroke sleeve teeth disposed on a stroke sleeve outer diameter (OD.sub.SS) of a stroke sleeve positioned radially outside of the tubular, wherein one or more of the second set of teeth are generally symmetrical about a centerline thereof.

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Background/Summary

BACKGROUND

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

(2) The lateral wellbores are typically formed by positioning one or more deflector assemblies at desired locations in the main wellbore (e.g., an open hole section or cased hole section of the main wellbore) with a running tool. The deflector assemblies are often laterally and rotationally fixed

within the main wellbore using a wellbore anchor, sealed using a wellbore seal, and then used to create an opening in the casing.

Description

BRIEF DESCRIPTION

(1) Reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

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

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

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

(5) FIGS. **4**A through **4**E illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more embodiments of the disclosure;

(6) FIGS. **5**A through **5**E illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure; and

(7) FIGS. **6**A through **6**E illustrate cross-sectional views of a portion of a sealing/anchoring subassembly designed and manufactured according to one or more alternative embodiments of the disclosure.

DETAILED DESCRIPTION

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

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

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

(11) The present disclosure is based, at least in part, on the acknowledgment that internal slips are an important part of a sealing/anchoring subassembly such as packer system, for example being used to hold the setting load once the sealing/anchoring subassembly is set and prior to differential

pressure application. However, backlash or set back of the internal slip is an inherent drawback of common locking systems, resulting in some loss in setting force and subsequent relaxation of the packer element, which eventually affects the packer sealing performance (e.g., particularly for large size packers).

(12) The present disclosure has recognized that one way to control and limit the backlash is to refine the teeth of the internal slip. For example, the present disclosure has developed a new internal slip that includes a set of teeth on an outer diameter (OD) thereof, one or more of the set of teeth being generally symmetrical about a centerline thereof. The phrase “generally symmetrical”, as used herein, means that the one or more of the set of teeth are symmetrical within 20 percent about the centerline thereof. In yet another embodiment, the present disclosure has developed a new internal slip that includes a set of teeth on an outer diameter (OD) thereof, one or more of the set of teeth being substantially symmetrical about the centerline thereof. The phrase “substantially symmetrical”, as used herein, means that the one or more of the set of teeth are symmetrical within 10 percent about the centerline thereof. In yet even another embodiment, the present disclosure has developed a new internal slip that includes a set of teeth on an outer diameter (OD) thereof, one or more of the set of teeth being ideally symmetrical about the centerline thereof. The phrase “ideally symmetrical”, as used herein, means that the one or more of the set of teeth are symmetrical within 3 percent about the centerline thereof.

(13) The present disclosure has determined that a internal slip with the symmetrical teeth provides more geometrical constraint that enhances the ratcheting stiffness, which in turn substantially reduces the aforementioned backlash. What results is improved sealing performance, for example as a result of reducing the backlash. Additionally, the scaling/anchoring subassembly according to the present design is simple, for example with no manufacturing design complexities, as well as is a versatile concept that can easily be applied to other packer systems.

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

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

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

(17) As shown, a main wellbore **150** has been drilled through the various earth strata, including the subterranean formation **110**. The term "main" wellbore is used herein to designate a wellbore from which another wellbore is drilled. It is to be noted, however, that a main wellbore **150** does not necessarily extend directly to the earth's surface but could instead be a branch of yet another wellbore. A casing string **160** may be at least partially cemented within the main wellbore **150**. The term "casing" is used herein to designate a tubular string used to line a wellbore. Casing may actually be of the type known to those skilled in the art as a "liner" and may be made of any material, such as steel or composite material and may be segmented or continuous, such as coiled tubing. The term "lateral" wellbore is used herein to designate a wellbore that is drilled outwardly from its intersection with another wellbore, such as a main wellbore. Moreover, a lateral wellbore may have another lateral wellbore drilled outwardly therefrom.
(18) In the embodiment of FIG. **1**, a whipstock assembly **170** according to one or more embodiments of the present disclosure is positioned at a location in the main wellbore **150**. Specifically, the whipstock assembly **170** could be placed at a location in the main wellbore **150** where it is desirable for a lateral wellbore **190** to exit. Accordingly, the whipstock assembly **170** may be used to support a milling tool used to penetrate a window in the main wellbore **150**, and once the window has been milled and a lateral wellbore **190** formed, in some embodiments, the whipstock assembly **170** may be retrieved and returned uphole by a retrieval tool.
(19) The whipstock assembly **170**, in at least one embodiment, includes a whipstock element section **175**, as well as a sealing/anchoring subassembly **180** coupled to a downhole end thereof, the sealing/anchoring subassembly **180** designed, manufactured and/or operated according to one or more embodiments of the disclosure. The sealing/anchoring subassembly **180**, in one or more embodiments, includes an orienting receptacle section **182**, a sealing section **184**, and a latching element section **186**. The orienting receptacle section **182**, in one or more embodiments, along with a collet and one or more orienting keys, may be used to land and positioned a guided milling assembly and/or the whipstock element section **175** within the casing string **160**. The scaling section **184**, in at least one embodiment, seals an annulus (e.g., provides a pressure tight seal) between the whipstock assembly **170** and the casing string **160**. In at least one embodiment, the latching element section **186** axially, and optionally rotationally, fixes the whipstock assembly **170** within the casing string **160**.
(20) The elements of the whipstock assembly **170** may be positioned within the main wellbore **150** in one or more separate steps. For example, in at least one embodiment, the sealing/anchoring subassembly **180**, including the orienting receptacle section **182**, scaling section **184** and the latching element section **186** are run in hole first, and then set within the casing string **160**. Thereafter, the sealing section **184** may be pressure tested. Thereafter, the whipstock element section **175** may be run in hole and coupled to the sealing/anchoring subassembly **180**, for example using the orienting receptacle section **182**. What may result is the whipstock assembly **170** illustrated in FIG. **1**.
(21) Turning now to FIGS. **2**A and **2**B, illustrated is one embodiment of a whipstock assembly **200** designed and manufactured according to one or more embodiments of the disclosure. The whipstock assembly **200**, in the illustrated embodiment of FIGS. **2**A and **2**B, includes a whipstock element section **210**, and a sealing/anchoring subassembly **220**. The whipstock element section **210**, in the illustrated embodiment, includes a whipstock element **215** (e.g., ramp element). The sealing/anchoring subassembly **220**, in one or more embodiments, includes an orienting receptacle section **230** (e.g., including a muleshoe), a sealing section **240**, and a latching element section **250**. The scaling section **240**, in the illustrated embodiment, among other features disclosed below, includes a sealing/anchoring element **245**, the sealing/anchoring element **245** configured to move between a radially retracted state and a radially expanded state. The latching element section **250**, in the illustrated embodiment, includes one or more latching features **255**, the one or more latching features **255** configured to engage with a profile in a casing string.

(22) Turning to FIG. **3**, illustrated is an alternative embodiment of a sealing/anchoring subassembly **300**, the sealing/anchoring subassembly including a sealing section **340** and a latching element section **350** designed and manufactured according to an alternative embodiment of the disclosure. The sealing section **340**, latching element section **350** and an orienting element section (not shown in FIG. **3**) may be run in hole within a main wellbore, set, and then pressure tested, prior to a whipstock element section (not shown in FIG. **3**) of the whipstock assembly being run in hole and attached with the sealing section **340** (e.g., engaged with the orienting element section attached to the sealing section **340**). Notwithstanding, FIG. **3** illustrates the latching element section **350** in the engaged state, whereas the sealing section **340** is in the radially retracted state.
(23) Turning to FIGS. **4**A through **4**E, illustrated are various different cross-sectional views of a portion of a sealing/anchoring subassembly **400** designed, manufactured and/or operated according to one or more embodiments of the disclosure. As is illustrated, in one or more embodiments, the sealing/anchoring subassembly **400** includes a mandrel **405** having a sealing/anchoring element **410** positioned thereabout. In at least one embodiment, the sealing/anchoring element **410** is configured to move between a radially retracted state and a radially expanded state.
(24) The sealing/anchoring subassembly **400**, in the illustrated embodiment, additionally includes one or more setting shear features **420**. In one or more embodiments, the one or more setting shear features **420** are used to hold the scaling/anchoring element **410** in its radially retracted state while running in hole, and thus allowing a flow path for cleaning the wellbore.
(25) The sealing/anchoring subassembly **400**, in one or more embodiments, additionally includes a ratch latch body **430** designed, manufactured and/or operated according to one or more embodiments of the disclosure. In the illustrated embodiment, the ratch latch body **430** is coupled to the sealing/anchoring element **410**, and is additionally configured to move and/or hold the sealing/anchoring element **410** in the radially expanded state. The ratch latch body **430** includes, in one or more embodiments, a stroke sleeve **440** having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS). Further to the embodiment of FIGS. **4**A through **4**E, the stroke sleeve inner diameter (ID.sub.SS) has a plurality of stroke sleeve teeth **445** disposed thereon. As will be further understood below, in at least one embodiment one or more of the pluralities of stroke sleeve teeth **445** are generally symmetrical about a centerline thereof. In at least one embodiment, the stroke sleeve **440** additionally includes a pin section **450** having a plurality of pin threads **455** (e.g., acme pin threads), the pin threads **455** configured to engage with related box threads **465** (e.g., acme box threads) in a box section **460** of the scaling/anchoring subassembly **400**, or vice versa.
(26) The ratch latch body **430**, in one or more embodiments, may further include a base **490** having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B). The base outer diameter (OD.sub.B), in the illustrated embodiment, has a plurality of base teeth **495** disposed thereon. In one or more embodiments, such as shown, the plurality of base teeth **495** are conventional directionally angled base teeth, and thus are not generally symmetrical about a centerline thereof.
(27) The ratch latch body **430**, in one or more embodiments, additionally includes a internal slip **470** disposed radially between the stroke sleeve **440** and the base **490**. The internal slip **470**, in one or more embodiments, may include a tubular **472**, the tubular **472** having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t). In accordance with at least one embodiment, the internal slip **470** further includes a first set of teeth **475** disposed along the tubular inner diameter (ID.sub.t), the first set of teeth **475** configured to engage with the base teeth **495**. In accordance with at least one other embodiment, the internal slip **470** includes a second set of teeth **480** disposed along the tubular outer diameter (OD.sub.t), the second set of teeth **480** configured to engage with the stroke sleeve teeth **445**.
(28) As discussed above, in at least one embodiment one or more of the second set of teeth **480** are generally symmetrical about a centerline **482** thereof. Furthermore, in at least one embodiment, one or more of the second set of teeth **475** are substantially, if not ideally, symmetrical about the

centerline **482**. In the illustrated embodiment of FIGS. **4**A through **4**E, tips of the one or more of the second set of teeth **475** that are generally symmetrical are in a shape of a polygon. For example, in the embodiment of FIGS. **4**A through **4**E the tips are in the shape of a trapezoid, nevertheless other polygonal shapes are within the scope of the disclosure. Thus, in accordance with at least one embodiment, sidewalls **484** of the tips of the one or more of the second set of teeth **480** are angled relative to the centerline **482**. Additionally, in at least one embodiment, the stroke sleeve teeth **445** (e.g., as they engage with the second set of teether **480**) may also be generally symmetrical, substantially symmetrical, or ideally symmetrical (e.g., as those phrases are defined), such as to engage with the similarly shaped second set of teeth **480**.

(29) Further to the embodiment of FIGS. **4**A through **4**E, in at least one embodiment, the first set of teeth **475** are not generally symmetrical about a centerline **478** thereof. Thus, for example, the first set of teeth **475** could be directionally angled teeth, the directionally angled teeth better suited for ratcheting one direction than an opposite direction. In yet other embodiments, however, one or more of the first set of teeth **475** are generally symmetrical about a centerline **478** thereof.

(30) In one or more embodiments, the tubular **472** has a first end **474***a* and a second end **474***b*. In the illustrated embodiment, the tubular **472** is circumferentially discontinuous proximate the second end **474***b* (e.g., as shown in FIG. **4**B). For example, in one or more embodiments, the tubular **472** could includes two or more slots **486** (e.g., four/six/eight/ten/twelve or more slots **486** in one embodiment) in the second end **474***b* of the tubular **472**, thereby forming the circumferentially discontinuous second end **474***b*. In at least one embodiment, the two or more slots **486** (e.g., four or more slots **486**) may be employed to reduce a radial stiffness of the tubular **472**. In yet another embodiment, the tubular **472** is circumferentially continuous proximate the first end **474***a* (e.g., not shown in the embodiments of FIGS. **4**A through **4**E).

(31) Accordingly, in at least one embodiment, the stroke sleeve teeth **445**, the second set of teeth **480**, the first set of teeth **475**, and the base teeth **495** are configured to ratchet along one another to hold the sealing/anchoring element **410** in the radially expanded state. For example, in at least one embodiment the stroke sleeve **440** moves while the base **490** remains fixed (e.g., a fixed base). For example, the base **490** could be fixed (e.g., permanently fixed or releasably fixed) to the mandrel **405** in one or more embodiments. In other embodiments, it may be preferable to have the stroke sleeve **440** remain fixed, while the base **490** moves relative to the fixed stroke sleeve **440**.

(32) Turning to FIGS. **5**A through **5**E, illustrated are cross-sectional views of a sealing/anchoring subassembly **500** designed, manufactured and/or operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **500** is similar in many respects to the scaling/anchoring subassembly **400** illustrated in FIGS. **4**A through **4**E above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The sealing/anchoring subassembly **500** differs, for the most part, from the scaling/anchoring subassembly **400**, in that it employs a different ratch latch body **530** employing a different internal slip **570**. For example, in the embodiment of FIGS. **5**A through **5**E, one or more of the second set of teeth **580** that are generally symmetrical about the centerline **582** are in a shape of a triangle.

(33) Turning to FIGS. **6**A through **6**E, illustrated are cross-sectional views of a sealing/anchoring subassembly **600** designed, manufactured and/or operated according to an alternative embodiment of the disclosure. The sealing/anchoring subassembly **600** is similar in many respects to the sealing/anchoring subassembly **400** illustrated in FIGS. **4**A through **4**E above. Accordingly, like reference numbers have been used to indicate similar, if not identical, features. The scaling/anchoring subassembly **600** differs, for the most part, from the scaling/anchoring subassembly **400**, in that it employs a different ratch latch body **630** employing a different internal slip **670**. For example, in the embodiment of FIGS. **6**A through **6**E, one or more of the second set of teeth **680** that are generally symmetrical about the centerline **682** are in a shape of an arc (e.g., half circle in one embodiment).

(34) Aspects disclosed herein include: A. A internal slip, the internal slip including: 1) a tubular, the

tubular having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t); 2) a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with base teeth disposed on a base outer diameter (OD.sub.B) of a base positioned radially inside of the tubular; and 3) a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with stroke sleeve teeth disposed on a stroke sleeve outer diameter (OD.sub.SS) of a stroke sleeve positioned radially outside of the tubular, wherein one or more of the second set of teeth are generally symmetrical about a centerline thereof. B. A scaling/anchoring subassembly, the sealing/anchoring subassembly including: 1) a mandrel; 2) a sealing/anchoring element positioned about the mandrel, the isolation element configured to move between a radially retracted state and a radially expanded state; 3) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: a) a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; and b) a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B) having a plurality of base teeth disposed thereon; c) a internal slip disposed radially between the stroke sleeve and the base, the internal slip including: i) a tubular, the tubular having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t); ii) a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and iii) a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein one or more of the second set of teeth are generally symmetrical about a centerline thereof, and further wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state. C. A well system, the well system including: 1) a wellbore located in a subterranean formation; and 2) a sealing/anchoring assembly positioned in the wellbore, the sealing/anchoring assembly including: a) a mandrel; b) a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and c) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: i) a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; and ii) a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B) having a plurality of base teeth disposed thereon; iii) a internal slip disposed radially between the stroke sleeve and the base, the internal slip including: a tubular, the tubular having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t); a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein one or more of the second set of teeth are generally symmetrical about a centerline thereof, and further wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state. D. A method, the method including: 1) positioning a sealing/anchoring assembly within a wellbore located in a subterranean formation, the sealing/anchoring assembly including: a) mandrel; b) a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and c) a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: i) a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; and ii) a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B) having a plurality of base teeth disposed thereon; iii) a internal slip disposed radially between the stroke sleeve and the base, the internal slip including: a tubular, the tubular having a tubular inner diameter (ID.sub.t) and a tubular outer diameter (OD.sub.t); a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein one or more of the second set of teeth are generally symmetrical about a centerline thereof, and further wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state, the stroke sleeve teeth and the base teeth configured to directly ratchet along one another to hold the sealing/anchoring element in the radially expanded state; and 2) actuating the stroke sleeve or base to move the sealing/anchoring element from the radially retracted state to the radially expanded state.

(35) Aspects A, B, C, and D may have one or more of the following additional elements in combination: Element 1: wherein the one or more of the second set of teeth are substantially symmetrical about the centerline thereof. Element 2: wherein the one or more of the second set of teeth are ideally symmetrical about the centerline thereof. Element 3: wherein tips of the one or more of the second set of teeth that are generally symmetrical are in a shape of a polygon. Element 4: wherein sidewalls of the tips of the one or more of the second set of teeth that are generally symmetrical are angled relative to the centerline. Element 5: wherein tips of the one or more of the second set of teeth that are generally symmetrical are in a shape of a triangle. Element 6: wherein tips of the one or more of the second set of teeth that are generally symmetrical are in a shape of an arc. Element 7: wherein the first set of teeth are not generally symmetrical about a different centerline thereof. Element 8: wherein the tubular has a first end and a second end, and further wherein the tubular is circumferentially discontinuous proximate the second end. Element 9: wherein the tubular is circumferentially continuous proximate the first end, and further including four or more slots in the second end of the tubular forming the circumferentially discontinuous second end, the four or more slots configured to reduce a radial stiffness of the tubular. Element 10: wherein the wellbore is a main wellbore, and further including a lateral wellbore extending from the main wellbore, the sealing/anchoring assembly positioned proximate an intersection between the main wellbore and the lateral wellbore.

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

Claims

1. A sealing/anchoring subassembly, comprising: a mandrel; a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B)

having a plurality of base teeth disposed thereon; an internal slip disposed radially between the stroke sleeve and the base, the internal slip including: a tubular, the tubular having a tubular inner diameter (ID.sub.t), a tubular outer diameter (OD.sub.t), a first end and a second end, wherein the tubular is circumferentially continuous proximate the first end and circumferentially discontinuous proximate the second end, the circumferentially discontinuous second end configured to reduce a radial stiffness of the tubular; a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state.
2. The sealing/anchoring subassembly as recited in claim 1, wherein tips of the one or more of the second set of teeth are in a shape of a polygon.
3. The sealing/anchoring subassembly as recited in claim 2, wherein sidewalls of the tips of the one or more of the second set of teeth are angled relative to a centerline.
4. The sealing/anchoring subassembly as recited in claim 1, wherein tips of the one or more of the second set of teeth are in a shape of a triangle.
5. The sealing/anchoring subassembly as recited in claim 1, wherein tips of the one or more of the second set of teeth are in a shape of an arc.
6. The sealing/anchoring subassembly as recited in claim 1, wherein the second set of teeth are not symmetrical about a centerline thereof.
7. The sealing/anchoring subassembly as recited in claim 1, further including four or more slots in the second end of the tubular forming the circumferentially discontinuous second end, the four or more slots configured to reduce a radial stiffness of the tubular.
8. A well system, comprising: a wellbore located in a subterranean formation; and a sealing/anchoring assembly positioned in the wellbore, the sealing/anchoring assembly including: a mandrel; a sealing/anchoring element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B) having a plurality of base teeth disposed thereon; an internal slip disposed radially between the stroke sleeve and the base, the internal slip including: a tubular, the tubular having a tubular inner diameter (ID.sub.t), a tubular outer diameter (OD.sub.t), a first end and a second end, wherein the tubular is circumferentially continuous proximate the first end and circumferentially discontinuous proximate the second end, the circumferentially discontinuous second end configured to reduce a radial stiffness of the tubular; a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state.
9. The well system as recited in claim 8, wherein the wellbore is a main wellbore, and further including a lateral wellbore extending from the main wellbore, the sealing/anchoring assembly positioned proximate an intersection between the main wellbore and the lateral wellbore.
10. A method, comprising: positioning a sealing/anchoring assembly within a wellbore located in a subterranean formation, the sealing/anchoring assembly including: a mandrel; a sealing/anchoring

element positioned about the mandrel, the sealing/anchoring element configured to move between a radially retracted state and a radially expanded state; and a ratch latch body coupled to the sealing/anchoring element, the ratch latch body configured to hold the sealing/anchoring element in the radially expanded state, the ratch latch body including: a stroke sleeve having a stroke sleeve outer diameter (OD.sub.SS) and a stroke sleeve inner diameter (ID.sub.SS), the stroke sleeve inner diameter (ID.sub.SS) having a plurality of stroke sleeve teeth disposed thereon; a base having a base outer diameter (OD.sub.B) and a base inner diameter (ID.sub.B), the base outer diameter (OD.sub.B) having a plurality of base teeth disposed thereon; an internal slip disposed radially between the stroke sleeve and the base, the internal slip including: a tubular, the tubular having a tubular inner diameter (ID.sub.t), a tubular outer diameter (OD.sub.t), a first end and a second end, wherein the tubular is circumferentially continuous proximate the first end and circumferentially discontinuous proximate the second end, the circumferentially discontinuous second end configured to reduce a radial stiffness of the tubular; a first set of teeth disposed along the tubular inner diameter (ID.sub.t), the first set of teeth configured to engage with the base teeth; and a second set of teeth disposed along the tubular outer diameter (OD.sub.t), the second set of teeth configured to engage with the stroke sleeve teeth, wherein the stroke sleeve teeth, the second set of teeth, the first set of teeth, and the base teeth are configured to ratchet along one another to hold the sealing/anchoring element in the radially expanded state; and actuating the stroke sleeve or base to move the sealing/anchoring element from the radially retracted state to the radially expanded state.