ABSTRACT

An insert seal unit includes a frustoconical body. A lower slip assembly is in operable communication with the body as is an upper slip. A seal element is in operable communication with each of the upper slip and the lower slip assembly.
INSERT SEAL UNIT AND METHOD FOR MAKING THE SAME

BACKGROUND OF THE INVENTION

[0001] Insert seal units function to allow cementing accessories such as “landing collars”, “float collars”, “float shoes”, “drillable packoffs” and ball catcher sub to be installed directly into a line casing for installation in a wellbore. The insert seal units are configured to support any one of the identified accessories and to provide such support in a range of liner casing sizes. The seal units’ capability of being seiflably mounted in a range of casing sizes eliminates the need for specifically designed insert seal units for each casing size thereby rendering manufacture of the units more economical.

[0002] While commercially available insert seal units such as Baker Oil Tools part # H079721601 operate well for their intended function, they do suffer from long term degradation due to elastomer breakdown. The units typically rely upon an elastomeric O-ring seal that while providing a very good initial seal, will of course be detrimentally affected by the harsh environment of a wellbore. This is particularly true in a hydrocarbon wellbore due to high temperatures and harsh chemical constitution of environmental fluids. The art would of course appreciate the longevity of an insert seal unit having greater resistance to such environmental factors.

SUMMARY

[0003] An insert seal unit includes a frustoconical body. A lower slip assembly is in operable communication with the body as is an upper slip. A seal element is in operable communication with each of the upper slip and the lower slip assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Referring now to the drawings wherein like elements are numbered alike in the several Figures:

[0005] FIG. 1 is a cross-sectional view of an insert seal unit as described herein in an unactuated position.

[0006] FIG. 2 is a cross-sectional view similar to FIG. 1, but in the actuated position.

[0007] FIG. 3 is an enlarged view of the ratchet teeth of the internal slips.

DETAILED DESCRIPTION OF THE DRAWINGS

[0008] Referring to FIG. 1, an insert seal unit 10 is illustrated in an unactuated position. The unit 10 includes a body 12 that is predominately frustoconically shaped at an outside surface 14 thereof and defines a throughbore 16 having at least one and possibly a number of radial dimensions. Some embodiments include more than one radial dimension along an axial length thereof (as shown). As the precise nature of the bore profile is not germane to the invention, it is noted here only for clarity.

[0009] Upon the outside surface 14, a recess 18 is disposed extending radially inwardly of the outside surface 14 in a roughly triangular cross-section (in the illustrated embodiment; other recess shapes are not precluded and are contemplated). Moreover, the recess may be annular or may be in segments that when viewed together from a transverse cross-section, appear annular in shape. It is to be appreciated that the geometry of the recess 18 is important in two aspects. The first is a frustoconical surface 20 and second is a bearing surface 22. The frustoconical surface 20 is so shaped in a direction opposite to the direction of the outside surface 14 for the purpose of causing a set (at least one) of internal slips 24 at least partially disposed within the recess 18 to be urged radially outwardly upon moving toward a largest diameter portion 26 of the frustoconical surface 20. The bearing surface is to be configured to support a resilient member 28 therein to facilitate the movement of the slips 24 toward portion 26. The resilient member may be an elastomeric spring, metal spring, etc.

[0010] Slips 24 include a set of ratchet teeth 30. The teeth are directional to facilitate movement of complementary teeth in a direction along teeth 30 toward a larger diametrical portion of body 12. The teeth are thus configured with a face 32 substantially transverse to an axis of body 12 and a face 34 substantially angled relative thereto (see FIG. 3).

[0011] Radially outwardly adjacent outside surface 14 are positioned a lower slip assembly 40, an upper slip 50 and a seal element 60. The lower slip assembly comprises a slip body 42, a ratchet thread 44 complementary to thread 30. The thread 44 is illustrated in FIG. 1 as engaged with thread 30 at a narrow end 46 of slip body 42. Radially outwardly of slip body 42 is an anchor member 48 similar to that of the prior commercial device. It will be appreciated that as assembly 40 climbs the thread interface 50/44, the outside dimension of the unit 10 expands ultimately causing the unit 10 to become anchored in a target tubular. Also, to be understood is that assembly 40 is to have dimensions calculated to allow a greater amount of movement axially of body 12 than the upper slip 50 in order to effect actuation of the seal element 60. This will become more clear in the following description.

[0012] Referring to upper slip 50, it will be appreciated that the slip 50 is narrower at one end 52 than it is at its other end 54. The angular surface 56 that creates the difference in ends 50 and 52 is selected to follow outside surface 14 of body 12 in such a way that an anchor surface 58 of slip 50 is maintained substantially in parallel with a longitudinal axis of body 12. This ensures that surface 58 will engage an inside surface 80 of the target tubular 82 (see FIG. 2) squarely and therefore reliably. As noted above, the selected dimensions of upper slip 50 should take into account the angle of the frustocone of body 12 so that the amount of axial movement of upper slip 50 is less than the possible amount of movement of lower slip assembly 40. The reason for this is that it is intended that a space between upper slip 50 and lower slip assembly 40 (occupied by seal element 60) is to be reducible in axial dimension upon actuation of the unit 10. Reduction of the axial dimension of the space noted imparts an axial load on seal element 60 thereby causing the element to grow radially. Radial growth results in radial loading the element between the outside surface 14 and an inside surface 80 of the target tubular 82 (visible in FIG. 2).

[0013] Axial load on the seal element is maintained post actuation by the action of the ratchet threads 30 and 44 against one another. As was noted hereinabove, the threads move along one another in one direction but do not move in the opposite direction. Once the unit is actuated then, the axial compressive load is maintained on the seal element indefinitely.

[0014] While the seal element may be of any deformable material, in one embodiment the element is metallic such that the seal is a metal-to-metal seal, highly resistant to downhole environmental factors. This embodiment is illustrated in FIGS. 1 and 2.
In the illustrated embodiments, the seal element 60 comprises end housings 62 and 64 and an intermediary structure 66 constructed to cause deformation of the element 60 such that the intermediary structure 66 rotates around its own center from a position where a longitudinal extent of the structure 66 is at a relatively more axial orientation to a position where the longitudinal extent is at a relatively more transverse orientation with respect to the axis of the body 12. The rotational movement is effected by the positioning of joining structures 68 and 70 relative to each other. As one will immediately appreciate from FIG. 1, the structures 68 and 70 are offset from each other thereby including the rotational movement of intermediary structure 66 upon compressive axial load. It will be appreciated from the illustrations that the length of structure 66 is of a dimension greater than the dimension between surface 14 and surface 80 when the unit 10 is in the actuated position.

Optionally, and illustrated in FIGS. 1 and 2, elastomeric seals 84, 86 and 88 may be employed as shown in the figures. These are backup seals that help to ensure positive sealing in the event of a surface abnormality that might otherwise precipitate a small leak. As the metal-to-metal seal illustrated is quite effective, however, the elastomeric seals 84, 86 and 88 are not necessary.

It is to be understood that while the term "upper" and "lower" have been used in describing components of the insert seal unit disclosed herein, these are simply names to provide distinction between the two. They are not intended to connote that one is necessarily vertically "higher" than the other. In fact, the unit may be employed "upside down" equally well.

While preferred embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

1. An insert seal unit comprising:
   a. a frustoconical body;
   a lower slip assembly in operable communication with the body;
   an upper slip in operable communication with the body;
   a seal element in operable communication with each of the upper slip and the lower slip assembly.

2. The insert seal unit as claimed in claim 1 wherein the body further includes a recess therein.

3. The insert seal unit as claimed in claim 2 wherein the recess is annular.

4. The insert seal unit as claimed in claim 2 wherein the recess includes a frustoconical surface.

5. The insert seal unit as claimed in claim 4 wherein the frustoconical surface defines a frustocone oriented in opposition to an orientation of the frustoconical body.

6. The insert seal unit as claimed in claim 2 wherein the recess includes a stop surface supportive of a resilient member.

7. The insert seal unit as claimed in claim 6 wherein the resilient member is interposed between the stop surface and an internal slip to bias the internal slip outwardsly of the body.

8. The insert seal unit as claimed in claim 2 wherein the unit further comprises at least one internal slip disposed at least partially within the recess.

9. The insert seal unit as claimed in claim 8 wherein the at least one internal slip includes a ratchet thread.

10. The insert seal unit as claimed in claim 9 wherein the thread is configured for one-way ratcheting movement.

11. The insert seal unit as claimed in claim 1 wherein the lower slip assembly includes a slip body having a ratchet thread and an anchor surface.

12. The insert seal unit as claimed in claim 1 wherein the upper slip and the lower slip assembly are aligned axially with the seal element.

13. The insert seal unit as claimed in claim 12 wherein a spacing between the upper slip and lower slip assembly is changeable.

14. The insert seal unit as claimed in claim 13 wherein the seal is axially loadable by a change in the spacing.

15. The insert seal unit as claimed in claim 14 wherein the seal increases in radial dimension upon application of axial load thereon.

16. The insert seal unit as claimed in claim 1 wherein the seal is metal.

17. The insert seal unit as claimed in claim 1 wherein the seal element includes two end housings and an intermediary structure, the intermediary structure being connected to the end housings by offset joining structures.

18. A method for installing an insert seal unit comprising:
   placing an insert seal unit as claimed in claim 1 in a target tubular;
   urging the lower slip assembly toward an actuated position on the body;
   axially loading the seal element between the upper slip and the lower slip assembly.

19. The method for installing an insert seal unit as claimed in claim 18 further comprising radially deforming the seal element into sealing contact with the body and an inside surface of the target tubular.

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