Claims

What is claimed is:

1. A wellhead assembly comprising:

an outer tubular member;

an inner tubular member coaxial within the outer tubular member relative to an axis of the outer tubular member;

a seal pocket between the inner and outer tubular members;

an annular seal assembly in the seal pocket; and

a spring element in the seal pocket and axially compressed against one end of the seal assembly.

2. The wellhead assembly of claim 1, wherein the seal assembly comprises an annular elastomeric sealing ring, an annular base ring attached to an end of the sealing ring, an annular upper ring on an end of the sealing ring opposite the base ring, wherein the spring element engages the base ring.

3. The wellhead assembly of claim 1, wherein the spring element comprises a series of accordion shaped folds.

4. The wellhead assembly of claim 1, wherein the spring element comprises a corrugated member.

5. The wellhead assembly of claim 1, wherein the spring element comprises Belleville washers.

6. The wellhead assembly of claim 1, wherein one of the inner and outer tubular members has a shoulder, defining a lower end of the seal pocket, and the spring element is compressed between the shoulder and the seal assembly.

7. The wellhead assembly of claim 6, further comprising a lockdown member that engages an upper end of the seal assembly and defines an upper end of the seal pocket.

8. The wellhead assembly of claim 1, wherein the outer tubular member is selected from the list consisting of wellhead housing and a casing hanger and wherein the inner tubular is selected from the list consisting of a casing hanger and a tubing hanger.

9. A method of sealing an annulus between an inner and outer tubular member of a wellhead assembly, the method comprising:

providing a seal assembly with a spring member on an end of the seal assembly;

coaxially disposing the seal assembly within the annulus and radially deforming the seal assembly between the inner and outer tubular member; and

axially compressing the spring member against the seal assembly.

10. The method of claim 9, wherein axially compressing comprises: with a lockdown member, applying a downward force on the seal assembly, the downward force passing through the seal assembly to the spring element.

11. The method of claim 9, wherein one of the inner and outer tubular members has a shoulder extending across the annulus and the spring member is compressed between the shoulder and the seal assembly.

12. The method of claim 9, wherein the step of axially compressing comprises, with a lockdown member, applying a downward force on the seal assembly, the downward force passing through the seal assembly to the spring element, wherein one of the inner and outer tubular members has a shoulder extending across the annulus and the spring member is compressed between the shoulder and the seal assembly, and wherein the tubulars comprise an inner tubular and an outer tubular and wherein the seal assembly is coupled with the outer tubular.

13. The method of claim 10, wherein the inner tubular member is selected from the list consisting of a tubing hanger and a casing hanger and the outer tubular that is selected from the list consisting of a wellhead housing and casing.

14. The method of claim 9, wherein the spring member is selected from the list consisting of accordion shaped folds, a corrugated member, and Belleville washers.

15. The method of claim 9, wherein the seal assembly comprises an elastomeric sealing ring.

16. A seal assembly comprising:

an annular elastomeric sealing ring and inner and outer sides and opposing ends extending between the inner and outer sides;

an annular upper ring on an end of the sealing ring

an annular base ring attached to an end of the sealing ring on an end of the sealing ring opposite the base ring; and

a spring element provided on an end of the base ring opposite the sealing ring, so that when an axial force is applied to the upper ring and directed towards the sealing ring, the sides of the sealing

ring deform outwardly away from one another and the spring element compresses to retain stored energy therein.

17. The seal assembly of claim 16, wherein the upper member is configured for engagement with a lockdown member for applying the axial force to the upper ring.

18. The seal assembly of claim 16, wherein the end of spring element opposite the lower ring is configured for engagement with a shoulder attached to a tubular member.

19. The seal assembly of claim 16, wherein the sides of the sealing ring are configured for sealing engagement with a wall of a tubular.

20. The seal assembly of claim 16, wherein the spring element is selected from the list consisting of accordion shaped folds, rows of slots, a corrugated member, and Belleville washers.

CLAIMS

What is claimed is:

1. A wellhead assembly comprising:

a wellhead housing;

a tubular inner wellhead member coaxial within the wellhead housing relative to an axis of the wellhead housing and stationarily landed within the wellhead housing;

an external upward facing shoulder on the inner wellhead member, defining is seal pocket between the inner wellhead member and the wellhead housing, the shoulder being in a plane perpendicular to the axis, an outer surface of the inner wellhead member within the seal pocket being cylindrical, and inner surface of the outer wellhead member within the seal pocket being cylindrical;

an annular seal assembly in the seal pocket and comprising,

an annular elastomeric sealing ring, an annular metallic upper ring on an upper end of the sealing ring, an annular metallic base ring attached to a lower end of the sealing ring, the base ring having a lower portion that abuts the upward facing shoulder and is integrally formed with the base ring and configured into a resilient member;

a lockdown member in engagement with the inner wellhead member and the wellhead housing and having a lower end in abutment with the upper ring to deform the sealing ring into static sealing engagement with the inner wellhead member and the wellhead housing when an axial force is applied to the lockdown member, and wherein the axial force on the lockdown member exerts a compressive force to axially deform the lower portion of the base ring; and

wherein the axially deformed lower portion of the base ring exerts an upward force on the sealing ring to maintain the static scaling engagement in the event that cooling causes the sealing ring to shrink.

2. The wellhead assembly of claim 1, wherein elongated, circumferentially extending slots are formed radially through the lower portion of the base ring at spaced apart locations along a circumference of the base ring to define the resilient member in the base ring.

3. The wellhead assembly of claim 1, wherein the lower portion of the base ring comprises a series of accordion shaped folds.

4. The wellhead assembly of claim 1, wherein the base ring has an upper inner leg located radially inward from a lower portion of the sealing ring that is in metal-to-metal contact with the wellhead housing and an upper outer leg located radially outward from a lower portion of the sealing ring that is in metal-to-metal contact with the inner wellhead member.

5. A method of sealing an annulus between a tubular inner wellhead member and a wellhead housing of a wellhead assembly, the inner tubular member being stationarily landed within the wellhead housing, the method comprising:

providing an upward facing shoulder on an exterior of the inner wellhead member to define a lower end of the annulus, the upward facing shoulder being in a plane perpendicular to an axis of the wellhead housing, an outer surface of the inner wellhead member extending upward from the upward facing shoulder being cylindrical, and an inner surface of the outer wellhead member adjacent said outer surface being cylindrical;

providing an annular seal assembly that comprises an annular sealing ring, a metallic upper ring mourned to an upper end of the sealing ring, and a metallic resilient base member attached to a lower end of the sealing ring, the base member having a spring element integrally formed with the base member;

coaxially disposing the seal assembly within the annulus and abutting the base member on the upward facing shoulder;

exerting a downward axial force with a lockdown member on the upper ring, thereby axially compressing the seal assembly so that the sealing ring is radially enlarged into static sealing engagement against the inner wellhead member and the wellhead housing and the spring element of the base member is axially deformed to store potential energy in the base member; and

with the spring element of the axially deformed base member, maintaining an axial force against the sealing ring to retain static sealing engagement with the inner wellhead member and the wellhead housing in the event cooling of the sealing ring causes shrinkage of the sealing ring.

6. The method of claim 5, wherein the spring element of the base member comprises accordion shaped folds.

7. The method of claim 5, wherein the sealing ring is elastomeric.

8. A wellhead assembly comprising:

a wellhead housing having a bore;

a tubular inner wellhead member stationarily landed in the bore and having an external upward facing shoulder that is in a plane perpendicular to an axis of the bore;

a seal assembly sealing between an inner surface of the wellhead housing and an outer surface of the inner wellhead member, the inner and outer surfaces being cylindrical and concentric, the seal assembly landing on the upward facing shoulder and comprising:

a single annular elastomeric sealing ring having inner and outer sides, the outer side statically sealing against the inner surface of the wellhead housing, the inner side statically sealing against the outer surface of the inner wellhead member;

an annular metallic upper ring attached to an upper end of the sealing ring;

an annular metallic base ring attached to lower end of the sealing ring;

a spring element extending downward from the base ring into contact with the upward facing shoulder, the spring element comprising a series of accordion-shaped folds, the spring element and the base ring being an integrally formed single-piece member;

a lockdown member in abutment with the seal assembly and in engagement with the wellhead housing and the inner wellhead member to apply an axial force to the upper ring of the seal assembly, causing the sides of the elastomeric sealing ring to deform away from one another into static sealing engagement with the wellhead housing and the inner wellhead member, and causing the spring element to compress against the upward facing shoulder to retain stored energy therein; and

wherein the stored energy causes the spring element to exert an upward three on the sealing ring to maintain the static sealing engagement in the event the sealing ring shrinks due to cooling.

9. The seal assembly of claim 8, wherein the base ring has an upper inner leg located radially inward from a lower portion of the sealing ring that is in metal-to-metal contact with the wellhead housing and an upper outer leg located radially outward from a lower portion of the sealing ring that is in metal-to-metal contact with the inner wellhead member.