

Claims

1. A wellhead assembly, comprising:

a wellhead housing having a bore with a wellhead housing sidewall and a longitudinal axis;

a hanger landed in the bore, the hanger having a hanger sidewall;

a plurality of parallel circumferentially extending ridges located on at least one of the sidewalls, each of the ridges having upper and lower flanks that join a crest;

a plurality of sealing bands, each of the bands being located between adjacent ones of the ridges;

a metal seal ring having inward facing and outward facing seal surfaces in metal-to-metal sealing engagement with the hanger and wellhead housing sidewalls, respectively;

at least one of the seal surfaces being in metal-to-metal sealing engagement with the bands;

the crests of the ridges being embedded into said at least one of the seal surfaces; and

a recess extending through each of the ridges from the upper flank to the lower flank to allow any fluid trapped between the ridges to flow out.

2. The assembly according to claim 1, wherein an axial dimension of each of the bands is greater than a distance from a base of the upper flank to a base of the lower flank of each of the ridges.

3. The assembly according to claim 1, wherein an axial dimension of each of the bands is greater than a radial protrusion dimension of each of the ridges.

4. The assembly according to claim 1, wherein each of the bands is cylindrical.

5. The assembly according to claim 1, wherein an axial distance from a center of the crest of one of the ridges to a center of the crest of an adjacent one of the ridges is greater than a radial protrusion of each of the ridges past the bands.

6. The assembly according to claim 1, wherein each of the recesses has a base that is recessed from adjacent ones of the bands.

7. The assembly according to claim 6, wherein after setting, a gap exists between the base of each of the recesses and said one of the seal surfaces.

8. The assembly according to claim 1, further comprising:

an upper junction between each of the recesses and a next upper one of the bands;

a lower junction between each of the recesses and a next lower one of the bands; and

wherein

each of the junctions comprises a chamfer.

9. The assembly according to claim 1, wherein each of the recesses is circular.

10. The assembly according to claim 1, wherein an axial cross section of each of the ridges defines an equilateral triangular configuration.

11. A wellhead assembly, comprising:

a wellhead housing having a bore with a wellhead housing sidewall and a longitudinal axis;

a hanger landed in the bore, the hanger having a hanger sidewall;

a plurality of parallel circumferentially extending hanger sidewall ridges located on the hanger sidewall, each of the hanger sidewall ridges having upper and lower flanks that converge to a crest;

a plurality of hanger sidewall bands, each of the hanger sidewall bands being located between adjacent ones of the hanger sidewall ridges;

a metal seal ring having an outward facing seal surface in metal-to-metal sealing engagement with the wellhead housing sidewall and an inward facing seal surface in metal-to-metal sealing engagement with the hanger sidewall bands;

the crests of the hanger sidewall ridges being embedded into the inward facing seal surface to restrict relative movement between the hanger and the seal ring; and

a recess extending through each of the hanger sidewall ridges from the upper flank to the lower flank to allow any fluid trapped between the hanger sidewall ridges to flow out.

12. The assembly according to claim 11, further comprising:

a plurality of parallel circumferentially extending wellhead housing sidewall ridges located on the wellhead housing sidewall, each of the wellhead housing sidewall ridges having upper and lower flanks that converge to a crest;

a plurality of wellhead housing sidewall bands, each of the wellhead housing sidewall bands being located between adjacent ones of the wellhead housing sidewall ridges;

the crests of the wellhead housing sidewall ridges being embedded into the outward facing seal surface to restrict relative movement between the seal ring and the wellhead housing; and

a recess extending through each of the wellhead housing sidewall ridges from the upper flank to the lower flank of each of the wellhead sidewall ridges to allow any fluid trapped between the wellhead sidewall ridges to flow out.

13. The assembly according to claim 11, wherein a radial dimension from the axis to each of the recesses is less than a radial dimension from the axis to each of the bands.

14. The assembly according to claim 11, wherein an axial distance from a center of the crest of one of the ridges to a center of the crest of an adjacent one of the ridges is greater than an axial dimension of each of the ridges, measured from a junction of the upper flank with an upper one of the bands to a junction of the lower flank with a lower one of the bands.

15. The assembly according to claim 11, wherein each of the bands is cylindrical.

16. The assembly according to claim 11, wherein each of the recesses has upper and lower edges that are parallel with each other and perpendicular to the axis.

17. A method for sealing between a hanger sidewall of a hanger and a wellhead housing sidewall of a bore of a wellhead assembly, comprising:

(a) providing a plurality of parallel circumferentially extending ridges on at least one of the sidewalls, each of the ridges having upper and lower flanks that converge to a crest, with a sealing band located between adjacent ones of the ridges and a recess extending through each of the ridges from the upper flank to the lower flank;

(b) placing a metal seal ring having outward facing and inward facing seal surfaces between the wellhead housing sidewall and the hanger sidewall, respectively, and deforming the seal

ring such that at least one of the seal surfaces is in metal-to-metal sealing engagement with the band, and the crests of the ridges are embedded into said at least one of the seal surfaces; and

(c) forcing liquid trapped between each of the ridges through the recesses while performing step (b).

18. The method according to claim 16, wherein step (a) comprises providing the band with a cylindrical configuration.

19. The method according to claim 16, wherein:

step (a) comprises providing each of the recesses with a base that is recessed from adjacent ones of the bands; and

step (b) results in a gap being located between the band and said one of the seal surfaces after deforming the seal ring.

20. The method according to claim 16, wherein step (a) comprises providing the ridges and the band on both the wellhead housing sidewall and the hanger sidewall.