CLAIMS

What is claims is:

1. A sealing apparatus adapted to be positioned in an annular space between concentrically disposed members, the sealing apparatus comprising:

a sealing ring defining oppositely inclined interior and exterior surfaces each having a generally frusto-conical shape and defining opposing first and second edges, a nose adjoining the respective first edges of the interior and exterior surfaces, and a first convex surface adjoining the respective second edges of the interior and exterior surfaces opposite the nose, wherein the oppositely inclined interior and exterior surfaces are radially spaced apart along a radius of the sealing ring;

wherein the sealing ring has a first width measured between the respective first edges of the interior and exterior surfaces and a second width measured between the respective second edges of the interior and exterior surfaces, the first width being smaller than the second width;

wherein the nose of the sealing ring defines oppositely inclined first and second surfaces each having a generally frusto-conical shape and defining opposing third and fourth edges, and a second convex surface adjoining the respective third edges of the first and second surfaces;

wherein the sealing ring has a third width measured between the respective third edges of the first and second surfaces, the third width being smaller than the first and second widths; and

wherein, when the sealing apparatus is positioned in the annular space and in an energized configuration, the first convex surface of the sealing ring is adapted to be depressed so that the interior and exterior surfaces thereof expand radially to exert contact stress on each of the concentrically disposed members.

2. The sealing apparatus of claim 1, wherein, when the first convex surface of the sealing ring is depressed, the contact stress exerted on each of the concentrically disposed members by the sealing ring exceeds a fluid pressure within the annular space, causing the sealing ring to form a seal against the fluid pressure in the annular space.

3. The sealing apparatus of claim 2, further comprising a compression ring adapted to be disposed adjacent the sealing ring within the annular space, the compression ring defining a planar surface adapted to engage the first convex surface of the sealing ring,

wherein, when the sealing apparatus is positioned in the annular space and in the energized configuration, the fluid pressure within the annular space urges the planar surface of the compression ring to depress the first convex surface of the sealing ring.

4. The sealing apparatus of claim 2, further comprising a first back-up ring adapted to be disposed adjacent the sealing ring within the annular space, the first back-up ring defining a first concave surface that is adapted to be engaged by the nose of the sealing ring,

wherein, when the sealing apparatus is positioned in the annular space and in the energized configuration, the fluid pressure within the annular space urges the nose of the sealing ring to conform with the first concave surface of the first back-up ring, causing the first back-up ring to flare outwardly and engage the concentrically disposed members.

5. The sealing apparatus of claim 4, further comprising a second back-up ring adapted to be disposed adjacent the first back-up ring within the annular space, the second back-up ring defining a second concave surface that is adapted to be engaged by the first back-up ring,

wherein, when the sealing apparatus is positioned in the annular space and in the energized configuration, the fluid pressure within the annular space

urges the first back-up ring to conform with the second concave surface of the second back-up ring, causing the second back-up ring to flare outwardly and engage the concentrically disposed members.

6. The sealing apparatus of claim 5,

wherein, when the first back-up ring flares outwardly to engage the concentrically disposed members, extrusion of the sealing ring is restricted within a first temperature range; and

wherein, when the second back-up ring flares outwardly to engage the concentrically disposed members, extrusion of the first back-up ring and, consequently, the sealing ring is restricted within a second temperature range, the second temperature range being generally higher than the first temperature range.

7. The sealing apparatus of claim 1, wherein the interior and exterior surfaces of the sealing ring define first and second inclination angles, respectively, measured from a longitudinal center axis of the sealing ring, the first and second inclination angles being substantially equal to one another.

8. The sealing apparatus of claim 7, wherein the first and second surfaces of the sealing ring define third and fourth inclination angles, respectively, measured from the longitudinal center axis of the sealing ring, the third and fourth inclination angles being substantially equal to one another and greater than the first and second inclination angles.

9. A method of sealing an annular space between concentrically disposed members, the method comprising:

providing a sealing ring within the annular space, the sealing ring defining oppositely inclined interior and exterior surfaces each having a generally frusto-conical shape and defining opposing first and second edges, a nose adjoining the respective first edges of the interior and exterior surfaces,

and a first convex surface adjoining the respective second edges of the interior and exterior surfaces opposite the nose,

wherein the oppositely inclined interior and exterior surfaces are radially spaced apart along a radius of the sealing ring,

wherein the sealing ring has a first width measured between the respective first edges of the interior and exterior surfaces and a second width measured between the respective second edges of the interior and exterior surfaces, the first width being smaller than the second width,

wherein the nose of the sealing ring defines oppositely inclined first and second surfaces each having a generally frusto-conical shape and defining opposing third and fourth edges, and a second convex surface adjoining the respective third edges of the first and second surfaces, and

wherein the sealing ring has a third width measured between the respective third edges of the first and second surfaces, the third width being smaller than the first and second widths; and

forming a seal against a fluid pressure in the annular space, comprising

depressing the first convex surface of the sealing ring so that the interior and exterior surfaces thereof expand radially to exert contact stress on each of the concentrically disposed members.

10. The method of claim 9, wherein, when the first convex surface of the sealing ring is depressed, the contact stress exerted on each of the concentrically disposed members by the sealing ring exceeds the fluid pressure within the annular space, causing the sealing ring to form the seal against the fluid pressure in the annular space.

11. The method of claim 9,

wherein the method further comprises providing a compression ring adjacent the sealing ring within the annular space, the compression ring defining a planar surface that engages the first convex surface of the sealing ring; and

wherein depressing the first convex surface of the sealing ring comprises urging the planar surface of the compression ring against the first convex surface of the sealing ring.

12. The method of claim 9,

wherein the method further comprises providing a first back-up ring adjacent the sealing ring within the annular space, the first back-up ring defining a first concave surface that is engaged by the nose of the sealing ring; and

wherein depressing the first convex surface of the sealing ring causes the nose of the sealing ring to conform with the first concave surface of the first back-up ring, forcing the first back-up ring to flare outwardly to engage the concentrically disposed members.

13. The method of claim 12,

wherein the method further comprises providing a second back-up ring adjacent the first back-up ring within the annular space, the second back-up ring defining a second concave surface that is engaged by the first back-up ring; and

wherein depressing the first convex surface of the sealing ring causes the first back-up ring to conform with the second concave surface of the second back-up ring, forcing the second back-up ring to flare outwardly to engage the concentrically disposed members.

14. The method of claim 13,

wherein, when the first back-up ring flares outwardly to engage the concentrically disposed members, extrusion of the sealing ring is restricted within a first temperature range; and

wherein, when the second back-up ring flares outwardly to engage the concentrically disposed members, extrusion of the first back-up ring and, consequently, the sealing ring is restricted within a second temperature range, the second temperature range being generally higher than the first temperature range.

15. The method of claim 11, wherein the interior and exterior surfaces of the sealing ring define first and second inclination angles, respectively, measured from a longitudinal center axis of the sealing ring, the first and second inclination angles being substantially equal to one another.

16. The method of claim 15, wherein the first and second surfaces of the sealing ring define third and fourth inclination angles, respectively, measured from the longitudinal center axis of the sealing ring, the third and fourth inclination angles being substantially equal to one another and greater than the first and second inclination angles.