CLAIMS

We claim:

1. A tolerance ring assembly, comprising:
an outer component having a bore with an axis therein;
an inner component mounted in the bore of the outer component, such that the inner component mates with the outer component and is movable relative thereto;
a tolerance ring located in the bore between the inner and outer components, the tolerance ring comprising:
an annular band formed from a metallic material;
an elastomeric layer on the annular band; and
a low friction layer on at least one of the annular band and the elastomeric layer.

2. A tolerance ring assembly according to Claim 1, wherein the annular band is formed from spring steel and the low friction layer is laminated to at least one side of the annular band.

3. A tolerance ring assembly according to Claim 1, wherein the low friction layer is on the annular band opposite the elastomeric layer.

4. A tolerance ring assembly according to Claim 1, wherein the low friction layer comprises PTFE and is bonded to one of the annular band and the elastomeric layer, and the elastomeric layer comprises one of nitrile rubber, olefinic elastomeric, polyether-/polyester-elastomeric, ethylene-propylene-elastomeric, ethylene-acrylic rubber and fluoro elastomeric materials.

5. A tolerance ring assembly according to Claim 1, further comprising an adhesive or primer layer between the annular band and the elastomeric layer, and between the low friction layer and said at least one of the annular band and the elastomeric layer.

6. An assembly, comprising:
an outer component;
an inner component located in the outer component and movable relative thereto;
a tolerance ring mounted between the inner and outer components, the tolerance ring comprising:
an annular band formed from a metallic material and having radial inner and outer surfaces; and
a low friction material encapsulating the annular band, such that both the radial inner and outer surfaces are substantially located within the low friction material.

7. An assembly according to Claim 6, wherein the annular band is located completely within the low friction material such that no portion of the annular band is exposed from and external to the low friction material.

8. An assembly according to Claim 6, wherein at least a portion of the annular band is exposed from and extends externally relative to the low friction material.

9. An assembly according to Claim 6, wherein the annular band is spring steel and is perforated or stamped.

10. An assembly according to Claim 6, wherein the annular band comprises geometrical formations that are formed therein by coining or deep drawing, and the geometrical formations comprise waves, cones or ball-shaped formations.

11. An assembly according to Claim 6, wherein the annular band is encapsulated within the low friction material by calendaring or laminating, and the low friction material comprises a PTFE compound tape.

12. An assembly according to Claim 6, wherein the low friction material forms a smooth cylindrical profile, and the annular band undulates in a non-cylindrical profile within the smooth cylindrical profile.

13. An assembly according to Claim 6, wherein the low friction material and the annular band each have non-cylindrical profiles and are complementary in shape to each other.

14. An assembly according to Claim 6, further comprising a backing layer joined to the tolerance ring, the backing layer is formed from one of steel, Al, Cu and Ti, and is radially external to the low friction layer, and the low friction layer is laminated on the backing layer.

15. An assembly according to Claim 6, wherein the low friction layer has a thickness of approximately 0.1 to 0.05 mm on each of the radial inner and outer surfaces of the annular band, and the low friction layer is bonded or welded to the annular band.

16. A method of forming a tolerance ring, comprising:

(a) providing a sheet formed from a metallic material;

(b) forming apertures in the sheet;

(c) fabricating geometrical formations into the sheet to form a sheet profile;

(d) encapsulating the sheet profile in a low friction material;

(e) forming the encapsulated sheet profile into an annular shape to form a tolerance ring.

17. A method according to Claim 16, wherein step (b) comprises forming shaped holes in the sheet by perforating or stamping.

18. A method according to Claim 16, wherein step (c) comprises fabricating the geometrical formations into the sheet by coining, forming or deep drawing waves, balls or cones to form the sheet profile.

19. A method according to Claim 16, wherein step (d) comprises encapsulating the sheet profile in the low friction material by calendaring or laminating through the apertures in the sheet.

20. A method according to Claim 16, wherein the sheet is formed into an annular band having radial inner and outer surfaces, and the low friction material encapsulates the annular band such that both the radial inner and outer surfaces are located within the low friction material.

21. A method according to Claim 16 further comprising, after step (d), forming shapes in the low friction material that are complementary in shape to the geometrical formations in the sheet profile, and the forming shapes step comprises at least one of coining, calendaring and sintering the low friction material.

22. A method according to Claim 16, wherein step (c) occurs before step (d).

23. A method according to Claim 16, wherein step (d) comprises lamination and occurs before step (c).

24. A method according to Claim 16, further comprising the step of installing a backing layer to the tolerance ring, and the backing layer is installed on a radial exterior of the low friction layer.

CLAIMS

1. An assembly, comprising:

an outer component;

an inner component located in the outer component and movable relative thereto;

a tolerance ring mounted between the inner and outer components, the tolerance ring comprising:

an annular band formed from a metallic material and having radial inner and outer surfaces , wherein the metallic material consist of a sheet comprising apertures and shaped to include a sheet profile, the sheet profile including waves, cones, or ball shapes; and

a low friction material encapsulating the annular band, such that both the radial inner and outer surfaces are substantially located within the low friction material.

2. An assembly according to Claim 1, wherein the annular band is located within the low friction material such that no portion of the annular band is exposed from and external to the low friction material.

3. An assembly according to Claim 1, wherein at least a portion of the annular band is exposed from and extends externally relative to the low friction material.

4. An assembly according to Claim 1, wherein the annular band is encapsulated within the low friction material by calendaring or laminating, and the low friction material comprises a PTFE compound tape.

5. An assembly according to Claim 1, wherein the low friction material forms a smooth cylindrical profile, and the annular band undulates in a non-cylindrical profile within the smooth cylindrical profile.

6. An assembly according to Claim 1, wherein the low friction material and the annular band each have non-cylindrical profiles and are complementary in shape to each other.

7. An assembly according to Claim 1, further comprising a backing layer joined to the tolerance ring, the backing layer is formed from one of steel, Al, Cu and Ti, and is radially external to the low friction layer, and the low friction layer is laminated on the backing layer.

8. An assembly according to Claim 1, wherein the low friction layer has a thickness of approximately 0.1 to 0.05 mm on each of the radial inner and outer surfaces of the annular band, and

the low friction layer is bonded or welded to the annular band.

9. A method of forming a tolerance ring, comprising:

(a) providing a sheet formed from a metallic material;

(b) forming apertures in the sheet;

(c) fabricating geometrical formations into the sheet to form a sheet profile;

(d) encapsulating the sheet profile in a low friction material;

(e) forming the encapsulated sheet profile into an annular shape to form a tolerance ring.

10. A method according to Claim 9, wherein step (b) comprises forming shaped holes in the sheet by perforating or stamping.

11. A method according to Claim 9, wherein step (c) comprises fabricating the geometrical formations into the sheet by coining, forming or deep drawing waves, balls or cones to form the sheet profile.

12. A method according to Claim 9, wherein step (d) comprises encapsulating the sheet profile in the low friction material by calendaring or laminating through the apertures in the sheet.

13. A method according to Claim 9, wherein the sheet is formed into an annular band having radial inner and outer surfaces, and the low friction material encapsulates the annular band such that both the radial inner and outer surfaces are located within the low friction material.

14. A method according to Claim 9 further comprising, after step (d), forming shapes in the low friction material that are complementary in shape to the geometrical formations in the sheet profile, and the forming shapes step comprises at least one of coining, calendaring and sintering the low friction material.

15. A method according to Claim 9, wherein step (c) occurs before step (d).

16. A method according to Claim 9, wherein step (d) comprises lamination and occurs before step (c).

17. A method according to Claim 9, further comprising the step of installing a backing layer to the tolerance ring, and the backing layer is installed on a radial exterior of the low friction layer.