flow component on the other side of the ring seal is a W-type. Some have attempted to solve this problem by creating a ring seal having one end surface designed to interface with a C-type port and the opposite end designed to interface with a W-type port. A shortcoming of such a ring seal is that one must be conscious of the orientation of the ring seal when positioning it between the flow components of different port types. Positioning the ring seal in an inverted orientation may cause damage to the flow components or ports thereof. Another shortcoming is that this ring seal cannot be used between flow components with the same port type, thus requiring a user to have a variety of ring seals on hand based on the port types of the flow components being joined together.

[0006] Some attempts to create port neutral ring seals have been attempted, for example, having identical sealing surface designs suitable for both C-type and W-type ports. One such ring seal with axial protrusions, however, may create scratches on the fluid port surface of C-type ports. Other problems have arisen including potential misalignment problems with W-type ports leading to seal failure.

SUMMARY

[0006a] According to an aspect of the present disclosure, there is provided a metallic ring seal comprising: an annular body defining an axial hole therethrough for fluid passage in an axial direction, the annular body having a radial plane perpendicular to the axial direction and having: a radial outer face with a generally C-shaped cross section groove, a plurality of bores disposed therein, or both the generally C-shaped cross section groove and the plurality of bores; a first sealing side on a first axial end of the annular body, the first sealing side including: a first deformable annular protrusion extending from the annular body in the axial direction to a first apex, the first deformable annular protrusion configured to deform upon engagement with a first planar sealing surface, a second deformable annular protrusion extending from the annular body in the axial direction to a second apex, the second deformable annular protrusion configured to deform upon engagement with the first planar sealing surface, a first trough defined between the first deformable annular protrusion and the second deformable annular protrusion, the first trough extending annularly around the first sealing side, the first trough including an annular trough base, a first outer rising surface, and a first inner rising surface, the first outer rising surface extending radially outward from the trough base to one of the first apex and the second

apex, the first inner rising surface extending radially inward from the trough base to the other of the first apex and the second apex, and the first trough configured to engage with a first annular rounded sealing protrusion; wherein the first inner rising surface and the first outer rising surface are curved in cross section; wherein a distance between the first apex and the second apex is between 0.06 cm (0.023 inches) and 0.11 cm (0.043 inches), and wherein the first trough has a maximum depth below the first deformable annular protrusion of between 0.008 cm (0.003 inches) and 0.02 cm (0.008 inches).

[0006b] According to another aspect of the present disclosure, there is provided a metallic ring seal comprising: an annular body defining an axial hole therethrough for fluid passage in an axial direction, the annular body having a radial plane perpendicular to the axial direction and having: a radial outer face with a generally C-shaped cross section groove, a plurality of bores disposed therein, or both the generally C-shaped cross section groove and the plurality of bores; a first sealing side on a first axial end of the annular body, the first sealing side including: a first deformable annular protrusion extending from the annular body in the axial direction to a first apex, the first deformable annular protrusion configured to deform upon engagement with a first planar sealing surface, a second deformable annular protrusion extending from the annular body in the axial direction to a second apex, the second deformable annular protrusion configured to deform upon engagement with the first planar sealing surface, a first trough defined between the first deformable annular protrusion and the second deformable annular protrusion, the first trough extending around the first sealing side and configured to engage with a first annular rounded sealing protrusion, the first trough including an annular trough base, a first outer rising surface, and a first inner rising surface, the first outer rising surface extending radially outward from the trough base to one of the first apex and the second apex, the first inner rising surface extending radially inward from the trough base to the other of the first apex and the second apex, wherein the first inner rising surface and the first outer rising surface are curved in cross section, wherein a distance between the first apex and the second apex is substantially larger than a maximum depth of the first trough below the first deformable annular protrusion, the distance between the first apex and the second apex and the depth of the first trough permitting the first annular rounded sealing protrusion to be received between the first apex and the second apex and against the trough to deform the trough against the first annular rounded sealing protrusion to form a fluid tight seal with the first annular rounded sealing protrusion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a top perspective view of a ring seal according to various embodiments.

[0008] FIG. 2 is a top plan view of the ring seal of FIG. 1.

[0009] FIG. 3 is a cross-sectional view of the ring seal of FIG. 1 taken along lines 3-3 of FIG. 2.

[0010] FIG. 4 is a closeup view of a portion of the cross-sectional view of the ring seal of FIG. 3.

[0011] FIG. 5 is a cross-sectional view of the ring seal of FIG. 1 set between a C-type fluid flow component and a W-type fluid flow component prior to compression.

[0012] FIG. 6 is a cross-sectional view of the ring seal of FIG. 1 set between the fluid flow components of FIG. 5 after compression.

[0013] Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions and/or relative positioning of some of the elements in the figures may be exaggerated relative to