

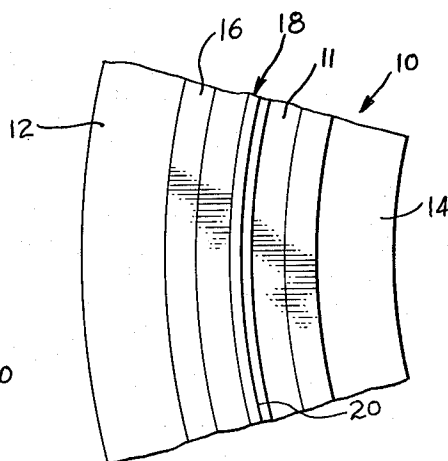
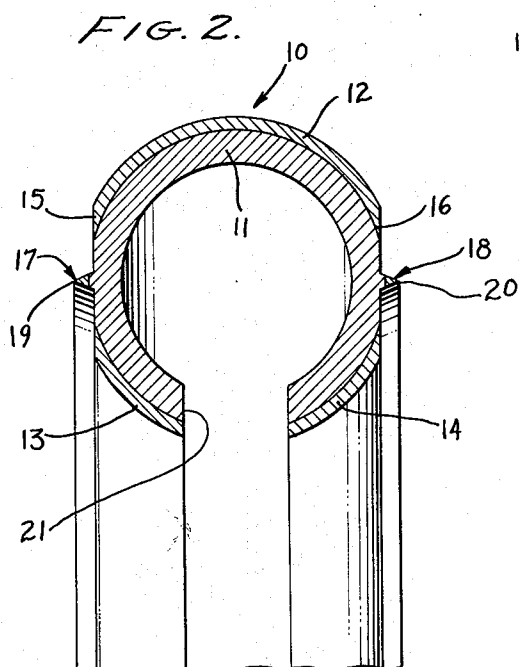
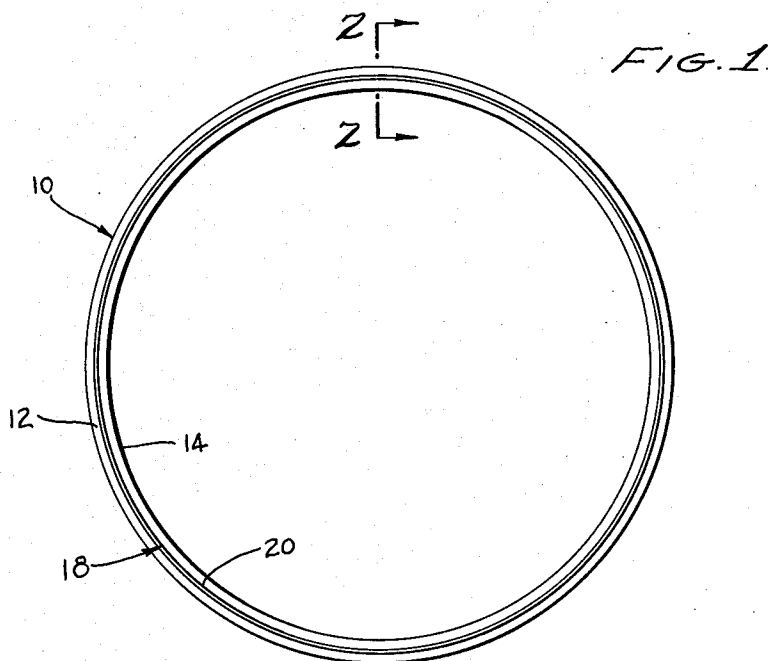
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3,188,100

SEAL PROVIDED WITH RIBS

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SEAL PROVIDED WITH RIBS

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This invention relates to the art of providing gas-tight metal seals which may be used at extremely high temperatures, and more particularly to an effective metal seal.

Although the present invention may have a much larger scope of application and should not be limited to those uses specifically disclosed herein for that reason, the seal of the present invention has been found to be especially useful between annular metal flanges by which it is axially compressed. Metal seal material is used which performs its function effectively over a temperature range much larger than that of conventional organic sealants.

In the past, it has been the practice to use a harder plated metal body ribbed on both sides for a high temperature gas-tight seal. The plated metal is softer, but the material used therefor must be selected, at least in part, for its desirable electroplating property. The same is true of the harder metal body. Unfortunately, the functions of both metals in forming a gas-tight seal is completely unaffected by the electroplating property of each. It is in fact the malleability of the soft metal that is the property of principal concern when it functions as a seal. In particular, hopefully the plated metal at the tips of the seal ribs is mechanically driven or compressed into extremely small grooves or scratches or tool marks in the contacting surfaces of a pair of annular flanges between which the metal seal body is compressed.

Due to the fact that it has not been possible to use extremely malleable plating metals because of their poor electroplating properties, plated metal seals have performed poorly. They have also suffered in their performance because it is not possible to electroplate a small, very sharp edge. Note will be taken that a small, sharp malleable metal edge may be deformed and driven or compressed into the small annular flange grooves much farther and with a substantially improved sealing effect over that which may be produced with a large, dull malleable metal edge.

It is known in the art that a metal plated metal O-ring may be employed for a high-temperature gas-tight seal. However, it is not possible with such a seal to use a ribbed metal body because of figure-eight deflection that the O-ring takes under a compression load.

The present invention overcomes the above-described and other disadvantages of the prior art by providing a seal including a relatively hard metal body clad with a relatively soft metal.

The word "clad" as used herein is a technical word of art. A hard metal sheet is conventionally "clad" with a sheet of soft metal by preparing the surfaces of each of the sheets meticulously, so that the same are absolutely smooth to within extremely small tolerances, carefully cleaning the surfaces of the sheets, and pressing the two sheets together with an extremely high force, i.e., at pressures of millions of pounds per square inch to cause the sheets to adhere to one another by a molecular bond therebetween.

As stated previously, the cladding process described in the immediately preceding paragraph is conventional. Hence, no claim is, of course, made to that process or the product thereof, i.e. clad metal sheet per se. However, it is an outstanding feature of the present invention that a hard metal sheet clad with a softer metal is employed as a seal in accordance with the present invention, because in this case, the material of the cladding sheet may be selected for its malleable property rather than for its electro-

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plating property. This makes it an extremely valuable metal sealing material. Note will be taken that such was not possible in the case of prior art electroplated malleable materials.

In accordance with the present invention, the metal sheet thereof may include a toroidal shaped hard metal body having an annular slot through the internal surface thereof to provide a sealing ring of a C-shaped cross section. As stated previously, metal seals are in general clamped between annular flanges. Hence, the hard metal ring may be clad, on its external surface with a soft metal. The hard metal is preferably made of a material having a high resilience. Due to the fact that the soft metal is clad rather than electroplated in accordance with the prior art, it is in fact possible to select a hard metal of properties more suitable for a metal seal than was heretofore possible in accordance with prior art practices, because prior art practice required the use of a hard resilient metal suitable for electroplating.

In accordance with another outstanding feature of the present invention, the clad metal thereof may be located in a rib on the harder metal. It also may be provided with an extremely small width and may be machined to have an extremely sharp edge. This construction likewise is substantially improved over the rather large dull edge of prior art electroplated ribs in that the small, sharp, clad malleable metal of the present invention may be driven or compressed into the small grooves of the annular compressing flanges employed in high-temperature gas-tight seals.

It is also a feature of the present invention that a ring of a C-shaped cross section be employed in lieu of the conventional metal O-ring of the prior art in that the C-shaped section of the ring of the present invention does not take a figure-eight deflection that the O-ring of the prior art does. Thus, the compression load may be provided directly on the small sharp edge of the malleable clad metal of the present invention.

A method of fabricating a clad metal seal having a clad sealing malleable metal rib thereon of an extremely small width and an extremely sharp edge will be described. This method includes the step of removing spaced portions of a softer metal clad onto a harder metal to leave a rib of the softer metal on the harder metal between the said portions of the softer metal. It is also an outstanding feature that this step may be performed in a manner such that the rib is left with a relatively sharp edge. The softer metal may be removed by machining. This is not possible with electroplated malleable metal because the same flakes off of the harder metal onto which the same is plated. It was, in fact, an outstanding discovery of the present invention that clad metal might be so machined.

The above described and other advantages of the present invention will be better understood from the following description when considered in connection with the accompanying drawings.

In the drawings which are to be regarded as merely illustrative:

FIG. 1 is a top plan view of a ring seal made in accordance with the present invention;

FIG. 2 is a sectional view of the ring taken on the line 2—2 shown in FIG. 1; and

FIG. 3 is a broken away side elevational view of the portion of the ring shown in FIG. 2.

In the drawing in FIG. 1, a ring 10 is shown which may be constructed in accordance with the present invention. The detail of the structure of ring 10 is better illustrated in FIG. 2. It will be noted that a hard metal tube 11 is provided which is clad at 12, 13 and 14 with a softer metal. Opposite sides of ring 10 at 15 and 16 are machined flat and the softer metal on the exterior of tube

11 at 15 and 16 is removed except for ribs at 17 and 18 respectively, which are provided with sharp edges at 19 and 20 respectively. Tube 11 is provided with an annular slot extending through the internal surface thereof around the complete interior of ring 10.

Ring 10 is made as follows. The metal of tube 11 is made in sheet stock and this sheet stock is clad with the sheet stock out of which soft metal at 12, 13 and 14 is made. The same is true of the soft metal at ribs 17 and 18. The hard metal of tube 11 may be stainless steel. This metal may have a relatively high resilience. The metal at 12, 13, 14, 17 and 18 may be copper.

The copper clad stainless steel sheet is then formed into a copper clad tube 11 with the copper on the external surface of the stainless steel. The seam of the tube may be at the inner portion of ring 10 and need not be welded together in that the seam is eventually slotted at 21 anyway. The slot 21 may be machined in tube 11. The ends of the tubing 11 may be butt welded together and the weld ground flush with the external surface of the ring 10. If desired, the slot 21 may be milled after the ring 10 has been formed by butt welding and grinding the weld. Opposite sides of ring 10 are then machined flat as at 15 and 16 leaving copper ribs 17 and 18 having relatively sharp edges at 19 and 20 respectively.

From the foregoing, it will be appreciated that by cladding tube 11 instead of electroplating the same, it is possible to select a material for tube 11 for maximum strength, chemical resistance and/or temperature resistance suitable to the specific application. Still further, the soft metal at 12, 13, 14, 17 and 18 may be chosen for maximum malleability, ductility, chemical resistance and/or temperature resistance suitable to the specific application. Note will be taken that the present invention therefore is substantially improved over that of the prior art in that the prior art hard and soft metals of the metal seals thereof have, in the past, had to be selected on the basis of their suitable electroplating property. The seal of the present invention also is substantially improved over that of the prior art. That is, edges 19 and 20 of ribs 17 and 18 can be made extremely sharp. This is true notwithstanding the fact that, as stated previously, it was impossible to produce such sharp edges with prior art electroplated soft metals in that such metals flake off of a hard base metal and cannot therefore be machined. This also explains the outstanding feature of the present invention in providing ribs 17 and 18 by machining the soft metal cladded onto tube 11.

The C-shaped cross section of ring 10, as shown in FIG. 2, also makes it possible to locate the compressive force of the annular compressive flanges of the prior art on the very sharp edges 19 and 20 of ribs 17 and 18 respectively and at no other point as would normally be required with metal O-ring seals of the prior art.

Although only one specific embodiment of the present

invention has been described and illustrated herein, many changes and modifications will of course suggest themselves to those skilled in the art. This single embodiment has been selected for this disclosure for the purpose of illustration only. The present invention should therefore not be limited to the embodiment so selected, the true scope of the invention being defined only in the appended claims.

What is claimed is:

1. A seal comprising: an approximately toroidal shaped hollow body made of a spring material, said body having an annular slot therein internally thereof; and a circular rib on each of the opposite sides of said body clad thereto, said ribs being made of a relatively malleable material.

2. The invention as defined in claim 1, wherein said ribs have relatively sharp axial edges.

3. A seal comprising: a tube-like body made of a spring metal and having a shape similar to that of a torus; and an axially extending annular rib clad upon opposite sides of said body, said ribs being made of a metal more malleable than that of said body.

4. The invention as defined in claim 3, wherein said ribs have relatively sharp axial edges.

5. A seal comprising: a hollow tube-like body made of a spring metal and having a shape similar to that of a torus; and an axially extending annular rib clad to one side of said body, said rib being made of a metal more malleable than that of said body.

6. A seal comprising: a metal ring; and an annular rib clad to said ring, said rib being made of a metal more malleable than that of said ring.

7. A seal comprising: a hollow tube-like body made of a spring metal and having a shape similar to that of a torus, said body having an annular slot therein internally thereof; and an axially extending annular rib clad to one side of said body, said rib being made of a metal more malleable than that of said body.

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