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(54) IMPROVEMENTS IN SEALING RING ASSEMBLIES

(71) We, BESTOBELL SEALS LIMITED, a British Company, of 202-208 Bath Road, Slough, Berkshire, SL1 4DP, do hereby declare the invention, for which we pray
 5 that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to sealing ring
 10 assemblies for forming a sliding seal between two relatively reciprocable members one of which has a cylindrical surface. The two members may, for example, be a
 15 piston and a surrounding cylinder in which case the assembly moves with the piston and the outer periphery of the assembly forms a sliding seal against the cylinder, or
 20 the members may be a piston rod and a surrounding housing. In this case the sealing assembly is mounted in the surrounding
 housing and the inner periphery of the assembly forms a sliding seal against the rod.

One assembly for this purpose comprises
 25 a sealing ring, an anti-extrusion ring and a bearing ring arranged side by side coaxially but not bonded to each other. The sealing ring is made of synthetic rubber. The anti-extrusion ring is made of thermo-
 30 plastic plastics material which is harder than the sealing ring and the bearing ring is made of thermoplastic plastics material which is harder than the anti-extrusion ring. To enable it to perform its function
 35 of preventing extrusion of the softer sealing ring when subjected to axial pressure, the anti-extrusion ring lies next to the sealing ring and is thus in between the sealing ring and the bearing ring.

40 In the case of a single-acting sealing ring assembly, which is only intended to resist pressure applied to it in an axial direction from one side, the assembly consists only of these three rings. The ring
 45 assembly may, however, be double-acting,

that is to say it may be intended to resist pressure applied to it in both axial directions from either side, and in this case there are two anti-extrusion rings, arranged
 one on each side of the sealing ring, and
 50 two bearing rings, one beside each of the anti-extrusion rings and on the sides of the anti-extrusion rings remote from the sealing ring. It is mainly when the assembly is
 intended for forming a seal between a
 55 piston and a surrounding cylinder that a double-acting assembly is required.

In the case of assemblies fitted to pistons in particular, the assembly fits in a radially
 outwardly open annular groove in the
 60 piston and if the piston is made in two parts which separate from each other at the groove, all of the rings may be continuous. With one-piece pistons, however, the sealing ring is continuous as it is
 65 sufficiently soft and resilient to be stretched to enable it to be fitted into the groove, but both the anti-extrusion and the bearing rings are split.

Such sealing ring assemblies, whether
 70 single-acting or double-acting, have proved very effective but it has been found that there is a tendency for the bearing ring, or bearing rings in the case of a double-acting
 assembly, which are most commonly split
 75 to enable them to be mounted in position, to rotate about the common axis of the rings relative to the anti-extrusion and sealing rings.

The tendency for this rotation to take
 80 place is particularly marked in the case of ring assemblies mounted on the pistons of hydraulic cylinders where the sealing ring slides on and forms a seal against the
 internal surface of the cylinder. We have
 85 found that the relative rotation can lead to premature failure of the seal due to wear and abrasion between the adjacent rings which rotate relative to each other.

The aim of the present invention is to 90

overcome this tendency for relative rotation between the bearing ring, or bearing rings, and the other rings in such sealing ring assemblies.

5 To this end, according to this invention a sealing ring assembly for forming a seal between two relatively reciprocable members, one of which has a cylindrical surface, the assembly comprising a sealing ring, an
10 anti-extrusion ring and a bearing ring arranged side by side co-axially, but not bonded to each other, the sealing ring being made of synthetic rubber, the anti-extrusion ring of thermoplastic plastics material which is harder than the sealing
15 ring and the bearing ring of thermoplastic plastics material which is harder than the anti-extrusion ring, is characterised in that the bearing ring is provided around a circumferentially extending surface, which is in contact with a surface of the anti-extrusion ring, with a series of angularly
20 spaced projections or depressions which, when the assembly is subjected to pressure in an axial direction, mate with the contacting surface of the anti-extrusion ring to key the bearing ring and the anti-extrusion ring together in such a way that relative movement between these two rings
25 in a circumferential direction is prevented.

In the case of a double-acting assembly in which there are two anti-extrusion rings, one on each side of the sealing ring, and two bearing rings, one adjacent each of the
30 anti-extrusion rings, both the bearing rings are provided with a series of the angularly spaced projections or depressions.

The, or each, anti-extrusion ring may be provided with depressions or projections
40 which receive, or fit in, respectively the projections or depressions of the bearing ring, but when the anti-extrusion ring is made of a comparatively deformable and resilient material, for instance thermo-
45 plastic rubber which is preferred, this material will flow under pressure to allow projections on the bearing ring to penetrate into it, or to cause it to flow into depressions in the bearing ring of its own
50 accord.

Preferably the, or each, anti-extrusion ring has a concave face on one side and the adjacent part of the sealing ring fits into the concavity. The other side of the,
55 or each, anti-extrusion ring preferably has a part-conical face which engages with a corresponding face on the adjacent bearing ring. The angle of conicity of these part-conical faces is preferably from 150 degrees
60 to 166 degrees. That is to say as seen in radial section of the two rings, the line of contact between the two conical surfaces lies at an angle of between 7 degrees and 15 degrees to a plane normal to the common axis of the ring assembly with the

part-conical face of the anti-extrusion ring facing away from the sealing ring with a radially outward component and the conical face of the bearing ring being undercut.

70 The bearing ring, or each bearing ring when there are two, is preferably of L-shaped radial section with one arm of the L extending axially away from the sealing ring and the other arm of the L extending
75 radially inwards in the case of an assembly which is intended for fitting to a piston and to seal around its outer periphery. To perform its function, the bearing ring necessarily has a cylindrical surface which,
80 in use, bears against the cylindrical surface of the one of the two reciprocable members and, when the bearing ring is of L-shaped cross-section, this cylindrical peripheral surface is on the axially extending arm of the
85 L and its axial extent is thus greater than it would be for a ring of, say, rectangular cross-section of the same cross-sectional area.

Preferably the anti-extrusion ring, or 90 each anti-extrusion ring has a circumferentially extending and axially projecting portion which extends within the adjacent bearing ring and has a radially outwardly directed circumferentially extending surface
95 in contact with a radially inwardly directed circumferentially extending surface of the adjacent bearing ring. That is to say when the bearing ring is of L-shaped cross-section, the axial extension of the anti-extrusion ring may extend either around the inside of the free end of the radially extending arm of the L, or, alternatively, the axial extension of the anti-extrusion ring may extend within an annular rebate
105 formed in the radially inwardly extending arm of the L.

When the bearing ring has a radially inwardly directed circumferentially extending surface in contact with an axially projecting portion of the anti-extrusion ring in this way, the projections or depressions may be provided on the radially inwardly directed surface of the bearing ring. In this case the bearing ring may be provided
115 with depressions which are of rounded circumferential profile and these depressions form humps between them.

When the anti-extrusion ring and the bearing ring are provided with contacting
120 part-conical surfaces, the bearing ring, or each of the bearing rings when there are two, may be provided with projections and these projections may then be in the form of ribs projecting axially from the part-conical face of the bearing ring. These
125 ribs are preferably of triangular shape as seen in section radial to the ring assembly with the angle of the apex of the triangle at the external periphery of the bearing
130

ring such that the edges of the ribs which are directed towards the anti-extrusion ring lie in a plane substantially normal to the axis of the assembly.

- 5 Two examples of sealing ring assemblies, together with two modifications, in accordance with the invention are illustrated in the accompanying drawings, in which:—

Figure 1 is a radial section through one example;

Figure 2 is an elevation to a much smaller scale as seen in an axial direction of one of the faces of the bearing rings in the example shown in Figure 1 illustrating the arrangement of ribs provided on the bearing rings;

Figure 3 is a radial section through a second example;

Figure 4 is a detail showing the profile of depressions in the bearing rings of the second example;

Figure 5 is a radial section showing a modification of the bearing rings in the first example; and,

Figure 6 is a radial section showing a modification of the bearing rings in the second example.

Both of the examples of the sealing ring assemblies shown in the drawings are double-acting piston seals forming a seal between a reciprocating piston 1 and a cylindrical surface 2 of a surrounding cylinder. The piston is formed in one piece and has an annular groove 3 with an annular rebate 4 at each side.

In both the illustrated examples, the sealing ring assembly comprises a sealing ring 5 made of nitrile rubber and of eight-sided radial section. The sealing ring 5 is continuous and is of sufficient elasticity to enable it to be stretched over the piston and then allowed to contract again to fit in the groove 3.

At each side of the sealing ring 5 is an anti-extrusion ring 6 having on one side a concave face 7 in which the adjacent part of the sealing ring 5 fits and, on the other side, a part-conical face 8 and an axial extension 9. The anti-extrusion rings 6 are made of thermoplastic rubber and each has a single slit. The rings are of sufficient resilience to enable them to be sprung apart at their slits and thus be fitted over the piston and into the groove 3.

A bearing ring 10 is disposed adjacent each of the anti-extrusion rings 6 on the sides of these rings remote from the sealing ring 5. Each bearing ring 10 is made of polyacetal resin and is split in the same way as the anti-extrusion ring 6 to enable it to be snapped into position on the piston. Each bearing ring 10 is of L-shaped radial section having an axially extending arm 11 and a radially inwardly extending arm 12. The arm 11 has an external cylindrical

peripheral surface which bears against the internal face 2 of the cylinder and the arm 12 has a part-conical face which fits against the face 8 of the anti-extrusion ring 6. In both the illustrated examples, the angle of conicity of the faces 8 and the faces of the rings 10 which fit against the faces 8 is 166 degrees so that as shown in Figure 1 and 3, these faces, as seen in radial section, are inclined at an angle of 7 degrees to a plane normal to the common axis of the ring assembly. As shown in Figures 1 and 3, however, this angle may be varied preferably between 7 degrees and 15 degrees.

In the example shown in Figures 1 and 2, each of the bearing rings 10 has a series of six ribs 13 projecting axially from the part-conical face of the arm 12. These ribs are equi-angularly spaced as shown in Figure 2 and are triangular in radial section as seen in Figure 1. The angle of the apex of the triangle at the external periphery of the bearing ring is such that the edges of the ribs which are directed towards the sealing ring 5 lie in a plane normal to the common axis of the ring assembly.

The anti-extrusion rings 6 may be moulded with recesses within which the ribs 13 fit, but in the example illustrated in Figures 1 and 2, there are no recesses in the faces 8, but when the ring assembly is subjected to fluid pressure, the material of the anti-extrusion rings 6 flows into the spaces between the ribs 13. That is to say the ribs 13 penetrate into the anti-extrusion rings 6 and in consequence the bearing rings 10 are keyed to their adjacent anti-extrusion rings 6 and the adjacent rings 6 and 10 are prevented from rotating relative to each other.

When the sealing ring assembly is subjected to pressure, the sealing ring 5, which is of relatively soft and resilient material, is compressed axially and is accordingly forced radially outwards against the surface 2 and radially inwards against the bottom surface of the groove 3 in the piston 1. It is also pressed firmly into the concave surfaces 7. Owing to the pressure upon it, the sealing ring 5 is unable to rotate on the piston 1 and the very intimate contact between the ring 5 and each of the rings 6 prevents the ring 6 from rotating or at least very greatly restricts any rotation. Thus owing to the ribs 13, which form a key between the rings 10 and the rings 6, the bearing rings 10 are prevented from rotating relative to the rings 6 and are prevented or at least very severely restricted in rotating on the piston 1. In consequence wear of the surfaces of contact between the rings 10 and the piston 1 and between the rings 10 and the rings 6 is very greatly reduced and the life of the rings is prolonged. The

outermost lips of the anti-extrusion rings 6 at the outer periphery of the sealing ring 5 prevent the ring 5 from being extruded into the annular clearance between the piston 1 and the surface 2 and thus perform the normal function of anti-extrusion rings.

The second example shown in Figures 3 and 4 of the drawings is generally similar to the example shown in Figures 1 and 2 except that the ribs 13 of the first example are replaced by a series of arcuate depressions 14 in the radially inwardly facing circumferentially extending surface of the arm 12 of each of the rings 10. The radially outwardly facing surface of the extension 9 of each of the anti-extrusion rings 6 penetrates under pressure into the depressions 14. This prevents the bearing rings 10 from rotating in the same way as the bearing rings 10 in the first example are prevented from rotating by the ribs 13.

In place of the ribs 13 or the depressions 14, the bearing ring 10 may be provided with recesses or humps respectively of the same or similar shape. The material of the anti-extrusion ring will flow under pressure into these recesses or between the humps and key the two rings together to resist relative circumferential movement in the same way as the ribs 13 or the depressions 14.

In the modification illustrated in Figure 5, the bearing ring 10' is generally similar to the bearing ring 10 except that its inwardly directed arm 12' is of somewhat greater axial thickness than the arm 12. Further, the arm 12' is provided at its radially inner end with a radially inwardly extending annular tongue 15. This form of bearing ring is used in a piston in which the groove is of somewhat greater axial extent than the groove 3 shown in Figure 1 of the drawings. The provision of the tongues 15 on the bearing rings enables an assembly with the same sealing ring 5 and the same anti-extrusion rings 6 to be used on a piston with a groove 3 of the greater width.

Figure 6 shows a bearing ring 10'' and is provided with an annular tongue 15' and bears just the same relationship to the bearing ring 10 of the example of Figure 3 as the bearing ring 10' does to the bearing ring 10 in the example of Figure 1.

Whilst in both of the examples shown in Figures 1 and 3, the sealing ring 5 is shown as being of eight-sided radial section with cylindrical external and internal peripheral faces, sealing rings of other radial sections may be used. For example, the sealing ring 5 may be a conventional O-ring of circular radial section or alternatively either the external peripheral face, or the internal peripheral face, or both these faces

may be provided with one or more circumferentially extending grooves or ribs.

WHAT WE CLAIM IS:—

1. A sealing ring assembly for forming a seal between two relatively reciprocable members, one of which has a cylindrical surface, the assembly comprising a sealing ring, an anti-extrusion ring and a bearing ring arranged side by side co-axially, but not bonded to each other, the sealing ring being made of synthetic rubber, the anti-extrusion ring of thermoplastic plastics material which is harder than the sealing ring and the bearing ring of thermoplastic plastics material which is harder than the anti-extrusion ring, wherein the bearing ring is provided around a circumferentially extending surface, which is in contact with a surface of the anti-extrusion ring, with a series of angularly spaced projections or depressions which, when the assembly is subjected to pressure in an axial direction, mate with the contacting surface of the anti-extrusion ring to key the bearing ring and the anti-extrusion ring together in such a way that relative movement between these two rings in a circumferential direction is prevented.

2. A sealing ring assembly according to claim 1, which is double-acting and in which there are two anti-extrusion rings, one on each side of the sealing ring, and two bearing rings, one adjacent each of the anti-extrusion rings and both the bearing rings being provided with a series of the angularly spaced projections or depressions.

3. A sealing ring assembly according to claim 1 or claim 2, in which the or each anti-extrusion ring is provided with depressions or projections which receive, or fit in, respectively the projections or depressions of the bearing ring.

4. A sealing ring assembly according to claim 1 or claim 2, in which the or each anti-extrusion ring is made of deformable and resilient thermoplastic plastics material, which flows under pressure to allow projections on the bearing ring to penetrate into it or to cause it to flow into depressions in the bearing ring.

5. A sealing ring assembly according to any one of the preceding claims, in which the or each anti-extrusion ring has a concave face on one side and the adjacent part of the sealing ring fits into the concavity.

6. A sealing ring assembly according to claim 5, in which the other side of the or each anti-extrusion ring has a part-conical face which engages with a corresponding face on the adjacent bearing ring.

7. A sealing ring assembly according to claim 6, in which the angle of conicity of the part-conical faces is from 150° to 166°.

8. A sealing ring assembly according to 130

any one of the preceding claims, in which the or each bearing ring is of L-shaped radial section with one arm of the L extending axially away from the sealing ring and the other arm of the L extending radially inwards.

9. A sealing ring assembly according to any one of the preceding claims, in which the or each anti-extrusion ring has a circumferentially extending and axially projecting portion which extends within the adjacent bearing ring and has a radially outwardly directed circumferentially extending surface in contact with a radially inwardly directed circumferentially extending surface of the adjacent bearing ring.

10. A sealing ring assembly according to claim 9, in which the projections or depressions are provided on the radially inwardly directed circumferentially extending surface of the or each bearing ring.

11. A sealing ring assembly according to claim 10, in which there are depressions in the radially inwardly directed surface, the depressions being of rounded circumferential profile.

12. A sealing ring assembly according to claim 6, claim 7 or any one of claims 8 to 11 when dependent upon claim 6 or claim 7, in which the or each bearing ring is provided with projections and these projections are in the form of ribs projecting axially from the part-conical face of the bearing ring.

13. A sealing ring assembly according to claim 12, in which the ribs are of triangular shape as seen in section radial to the ring assembly, with the angle of the apex of the

triangle at the external periphery of the bearing ring such that the edges of the ribs which are directed towards the anti-extrusion ring lie in a plane substantially normal to the axis of the assembly.

14. A sealing ring assembly according to claim 4 or any one of claims 5 to 13 when dependent upon claim 4, in which the or each anti-extrusion ring is of a thermoplastic rubber.

15. A sealing ring assembly according to any one of the preceding claims, in which the sealing ring is of nitrile rubber.

16. A sealing ring assembly according to any one of the preceding claims, in which the or each bearing ring is of polyacetal resin.

17. A sealing ring assembly according to claim 1, substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

18. A sealing ring assembly according to claim 1, substantially as described with reference to Figures 3 and 4 of the accompanying drawings.

19. A sealing ring assembly according to claim 17, but modified substantially as described with reference to Figure 5 of the accompanying drawings.

20. A sealing ring assembly according to claim 18, but modified substantially as described with reference to Figure 6 of the accompanying drawings.

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COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of
the Original on a reduced scale

Sheet 1

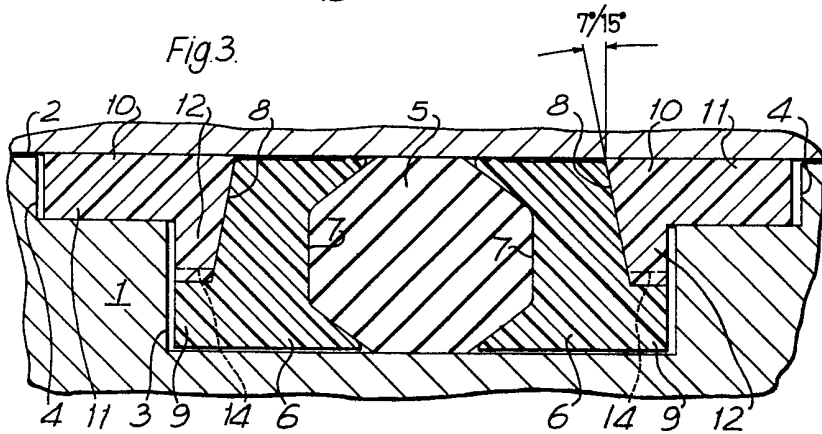
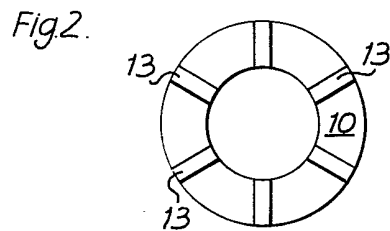
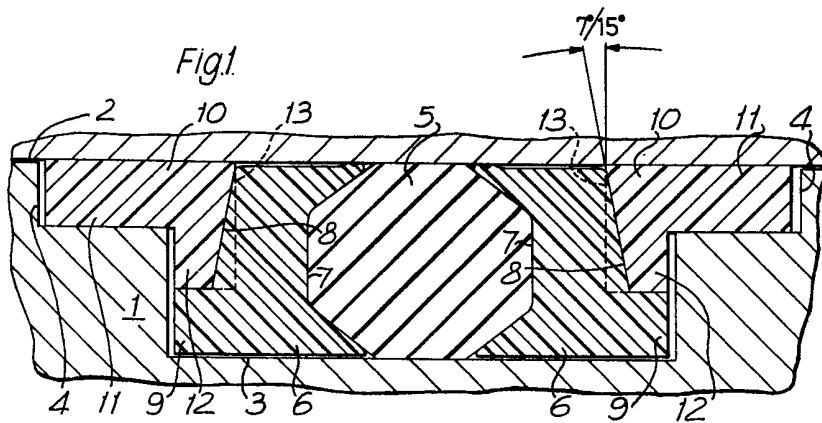


Fig.4.

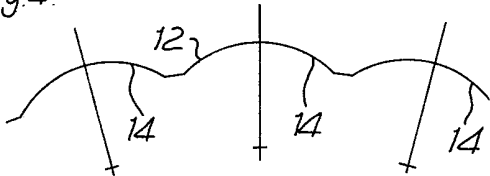


Fig.5.

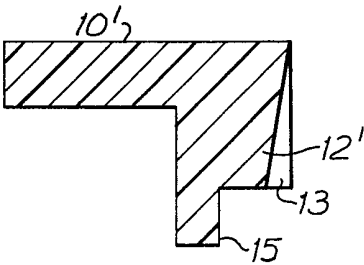


Fig.6.

