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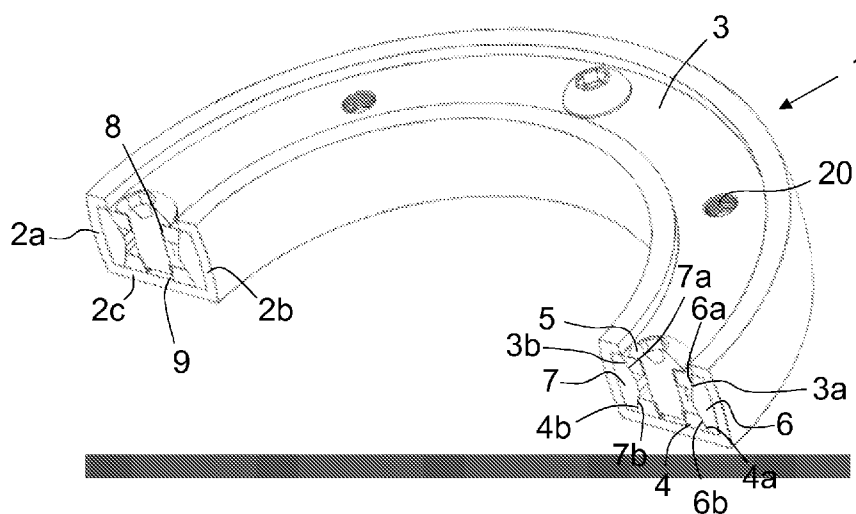


FIG. 3

(57) Abstract: The adjustable sealing device (1) comprises an annular outer sealing portion (2a), an annular inner sealing portion (2b) arranged coaxially with the outer sealing device portion (2a), first and second actuation rings (3, 4) arranged between the outer sealing portion (2a) and the inner sealing portion (2b), adjusting elements (5) for adjusting axial distance between the actuation rings (3, 4), outer pressing elements (6) arranged between the outer sealing portion (2a) and the actuation rings (3, 4), and inner pressing elements (7) arranged between the inner sealing portion (2b) and the actuation rings (3, 4). The actuation rings (3, 4) and the pressing elements (6, 7) are provided with contact surfaces (3a, 4a) for mutual cooperation and the contact surfaces (3a, 3b, 4a, 4b, 6a, 6b, 7a, 7b) are configured to cooperate so that a change in the axial distance between the actuation rings (3, 4) moves the outer pressing elements (6) radially outwards and the inner pressing elements (7) radially inwards, and an opposite change in the axial distance moves the pressing elements (6, 7) to opposite directions.

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Adjustable sealing device and use of such sealing device

Technical field of the invention

The present invention relates to an adjustable sealing device for sealing an annular gap between a cylindrical inner surface of a first part and a cylindrical outer surface of a second part in accordance with claim 1. The invention also concerns a use of such a sealing device as defined in the other independent claim.

Background of the invention

In many different applications there is a need to seal a clearance between a stud or shaft and a surrounding part. Typically, different rubber seals are used for sealing the clearance. Different rubber seals are known, such as O-rings, V-rings or square-rings. The seal is forced into the clearance between the stud and the surrounding part. The sealing capacity of a rubber seal depends on the geometry of the seal and the properties of the material. The compression force of the seal depends on the dimensions of the stud and the surrounding part. For effective sealing, different seals are usually needed for different applications if there are even small differences in dimensions. If a seal is removed, it usually needs to be replaced by a new seal.

An example of an application where rubber seals are used is cylinder head stud bolts of large piston engines. In large piston engines, each cylinder head is attached to the engine block by means of pretensioned stud bolts. The stud bolts are screwed to the engine block. The space above the threads of the engine block and a stud bolt is filled with oil for preventing corrosion. The space is then closed by installing a rubber seal into the clearance between the stud bolt and the engine block. The seal cannot be removed without cutting it. Therefore, inspection of the oil space is difficult. Condensation in the oil space can lead to corrosion of the stud bolt. This can lead even to breaking of the stud bolt.

Summary of the invention

An object of the present invention is to provide an adjustable sealing device for sealing an annular gap between a cylindrical inner surface of a first part and a cylindrical outer surface of a second part. The characterizing features of the
5 sealing device according to the invention are given in claim 1. Another object is to provide a use of such a sealing device.

The sealing device according to the invention comprises an annular outer sealing portion configured to be engaged with a cylindrical inner surface of a first part, an annular inner sealing portion arranged coaxially with the outer sealing
10 portion, having a smaller diameter than the outer sealing portion and configured to be engaged with a cylindrical outer surface of a second part, a first actuation ring arranged between the outer sealing portion and the inner sealing portion coaxially with the sealing portions, a second actuation ring arranged between the outer sealing portion and the inner sealing portion in parallel with the first
15 actuation ring and coaxially with the sealing portions, at least two adjusting elements for adjusting the distance between the first actuation ring and the second actuation ring in the axial direction of actuation rings, at least two outer pressing elements arranged between the outer sealing portion and the first and second actuation rings, and at least two inner pressing elements arranged between the
20 inner sealing portion and the first and second actuation rings. The first actuation ring and the second actuation ring are provided with outer contact surfaces for cooperation with the outer pressing elements and with inner contact surfaces for cooperation with the inner pressing elements, and the outer pressing elements and the inner pressing elements are provided with respective contact surfaces.

25 The contact surfaces of the actuation rings and the pressing elements are configured to cooperate so that a change in the axial distance between the actuation rings moves the outer pressing elements radially outwards with respect to a center axis of the sealing device and the inner pressing elements radially inwards with respect to the center axis, and an opposite change in the axial distance
30 between the actuation rings moves the outer pressing elements radially inwards and the inner pressing elements radially outwards.

With the sealing device according to an invention, a gap between two parts that do not substantially move in relation to each other can be reliably sealed. The two parts can be, for instance, a stud or a shaft and a surrounding part. The

inner and outer diameters of the sealing device can be adjusted, which allows removing of the sealing device for example for inspection without breaking the sealing device. The sealing force can be adjusted, and the sealing device can be used for gaps with slightly different dimensions.

- 5 According to an embodiment of the invention, the contact surfaces of the actuation rings and the pressing elements are configured so that movement of the actuation rings towards each other moves the outer pressing elements radially outwards and the inner pressing elements radially inwards.

- 10 According to an embodiment of the invention, each contact surface of the first actuation ring and the second actuation ring is inclined relative to the axial and radial directions of the actuation rings and each contact surface of the outer pressing elements and the inner pressing elements is inclined correspondingly for cooperation with one of the contact surfaces of the actuation rings.

- 15 According to an embodiment of the invention, the inclined contact surfaces of the first actuation ring and/or the second actuation ring extend over the whole perimeter of the actuation ring in circumferential direction. This simplifies the assembly of the sealing device and ensures that the contact surfaces remain aligned.

- 20 According to an embodiment of the invention, the inclined contact surfaces of the outer pressing elements and/or the inner pressing elements extend in circumferential direction over the whole pressing element.

According to an embodiment of the invention, each of the first actuation ring and the second actuation ring tapers towards a radial center plane of the sealing device.

- 25 According to an embodiment of the invention, the outer sealing portion is connected to the inner sealing portion via a middle sealing portion. The middle sealing portion prevents leakage through the sealing device.

According to an embodiment of the invention, the sealing device comprises at least four outer pressing elements and at least four inner pressing elements.

- 30 With a greater number of pressing element, more uniform sealing force can be achieved.

According to an embodiment of the invention, the sealing device comprises at least four adjusting elements. With a greater number of adjusting elements, the actuation rings can be kept better aligned.

According to an embodiment of the invention, the adjusting elements are bolts.

- 5 According to an embodiment of the invention, the sealing portions are made of a material comprising plastic and/or rubber.

According to an embodiment of the invention, the actuation rings and the pressing elements are made of a metal or an alloy.

- 10 According to an embodiment of the invention, the actuation rings and the pressing elements are made of plastic.

The sealing device defined above can be used for sealing a gap between an engine block and a stud bolt used for attaching a cylinder head to the engine block.

15 **Brief description of the drawings**

Embodiments of the invention are described below in more detail with reference to the accompanying drawings, in which

Fig. 1 shows a prior art solution for sealing a gap between an engine block and a stud bolt used for attaching a cylinder head to the engine block,

- 20 Fig. 2 shows sealing device according to an embodiment of the invention,

Fig. 3 shows a cross-sectional view of the sealing device of figure 2,

Fig. 4 shows an exploded view of the sealing device of figure 2,

- 25 Fig. 5 shows a cross-sectional view of part of the sealing device of figure 2 arranged in a gap between two parts, the sealing device being in a shrunk state, and

Fig. 6 shows a similar view as figure 5 but the sealing device being in an expanded state.

Description of embodiments of the invention

Figure 1 shows a cross-sectional view of part of an engine block 11 and a stud bolt 12. The engine is a large internal combustion engine, such as a main or an auxiliary engine of a ship or an engine that is used at a power plant for producing electricity. The stud bolt 12 is used for attaching a cylinder head (not shown) to the engine block 11. The lower end of the stud bolt 12, i.e. the end that is inserted into a hole 19 of the engine block 11, is provided with a thread 15. The hole 19 is a blind hole. The hole 19 is provided with a thread 16 with which the thread 15 of the stud bolt 12 can be engaged. An annular cavity 18 is formed around the stud bolt 12 above the threads 15, 16 of the stud bolt 12 and the hole 19. The cavity 18 is filled with oil to prevent corrosion of the stud bolt 12.

A gap 10 is formed between the outer surface 14 of the stud bolt 12 and the inner surface 13 of the hole 19. In the prior art solution of figure 1, the gap 10 between the stud bolt 12 and the engine block 11 is sealed by means of a seal 17. The seal 17 is a one-piece rubber seal. The seal 17 can have a complex and customized shape to ensure proper shrink force. The seal 17 is forced into the gap for example by pressing or hammering. A problem of the solution is that despite the seal 17, water and dirt may enter into the cavity 18 and cause corrosion problems. In the worst case, this may lead to breaking of the stud bolt 12. Regular checks of the conditions in the cavity 18 are thus desirable. However, the conventional seals 17 are in practice destroyed when removed and need to be replaced by new seals.

Figures 2 to 6 show different views of an adjustable sealing device 1 according to an embodiment of the invention. The sealing device 1 is configured to seal a gap between two stationary parts. The sealing device 1 according to the invention could be used instead of the seal 17 of figure 1 to seal the gap 10 between the engine block 11 and the cylinder head stud bolt 12. However, the sealing device 1 could also be used in other applications, where an annular gap between a cylindrical inner surface of a first part and a cylindrical outer surface of a second part needs to be sealed. The sealing device 1 according to the invention can be used between parts that do not move in relation to each other.

The sealing device 1 according to the invention comprises an annular outer sealing portion 2a that is configured to be engaged with a cylindrical inner surface

13, such as a hole, of a first part 11, such as an engine block or other stationary part, and an annular inner sealing portion 2b that is arranged coaxially with the outer sealing portion 2a and has a smaller diameter than the outer sealing portion 2a. The inner sealing portion 2b is configured to be engaged with a cylindrical outer surface 14 of a second part 12, such as a stud bolt or other stationary part protruding into the first part 11. In the example of figure 1, the outer sealing portion 2a would thus be against the wall of the hole 19 in the engine block 11 and the inner sealing portion 2b would be against the outer surface of the stud bolt 12. The outer sealing portion 2a and the inner sealing portion 2b are made of an elastic material. The material can comprise for example rubber or plastic. The sealing device has a center axis 21.

The sealing device 1 comprises a first actuation ring 3 that is arranged between the outer sealing portion 2a and the inner sealing portion 2b. The first actuation ring 3 is coaxial with the sealing portions 2a, 2b. The sealing device 1 further comprises a second actuation ring 4 arranged between the outer sealing portion 2a and the inner sealing portion 2b in parallel with the first actuation ring 3 and coaxially with the sealing portions 2a, 2b. The distance between the first actuation ring 3 and the second actuation ring 4 is adjustable in the axial direction of the actuation rings 3, 4. For adjusting the distance, the sealing device 1 comprises at least two adjusting elements 5.

The sealing device 1 further comprises at least two outer pressing elements 6 arranged between the outer sealing portion 2a and the first and second actuation rings 3, 4, and at least two inner pressing elements 7 arranged between the inner sealing portion 2b and the first and second actuation rings 3, 4.

The first actuation ring 3 and the second actuation ring 4 are provided with outer contact surfaces 3a, 4a for cooperation with the outer pressing elements 6 and with inner contact surfaces 3b, 4b for cooperation with the inner pressing elements 7. The outer pressing elements 6 and the inner pressing elements 7 are provided with respective contact surfaces 6a, 6b, 7a, 7b for cooperation with the contact surfaces 3a, 3b, 4a, 4b of the actuation rings 3, 4.

The contact surfaces 3a, 3b, 4a, 4b, 6a, 6b, 7a, 7b of the actuation rings 3, 4 and the pressing elements 6, 7 are configured to cooperate so that a change in the axial distance between the actuation rings 3, 4 moves the outer pressing elements 6 radially outwards with respect to the center axis 21 of the sealing

device 1 and the inner pressing elements 7 radially inwards with respect to the center axis 21, and an opposite change in the axial distance between the actuation rings 3, 4 moves the outer pressing elements 6 radially inwards and the inner pressing elements 7 radially outwards. The pressing elements 6, 7 can thus be moved in the radial direction of the actuation rings 3, 4.

The movement of the outer pressing elements 6 causes radial movement and stretching of the outer sealing portion 2a and the movement of the inner pressing elements 7 causes radial movement and compression of the inner sealing portion 2b. Both the inner diameter and the outer diameter of the sealing device 1 can thus be adjusted. The effect of the movements of the pressing elements 6, 7 can be seen in figures 5 and 6. In the embodiment of the figures, the inner pressing elements 7 move inwards in the radial direction of the sealing device 1 as the actuation rings 3, 4 move towards each other. At the same time, the outer pressing elements 6 move outwards. The distance between the outer pressing elements 6 and the inner pressing elements 7 thus increases. In the situation of figure 5, the actuation rings 3, 4 are at a maximum distance from each other. The inner diameter of the sealing device 1 is thus at its greatest and the outer diameter of the sealing device 1 is at its smallest. This can be referred to as a shrunk state. The sealing device 1 is inserted into a gap 10 in the shrunk state.

In the situation of figure 6, which shows an expanded state of the sealing device 1, the actuation rings 3, 4 have been moved by means of the adjusting elements 5 towards each other. The inner pressing elements 7 have thus been moved farther from the outer pressing elements 6. The outer diameter of the sealing device 1 has increased and the inner diameter has decreased. Consequently, the sealing device 1 is tightly pressed both against an inner surface 13 of a first part 11 and an outer surface 14 of a second part 12. The sealing device 1 thus effectively seals a gap 10 between the two parts 11, 12. The transition from the state of figure 4 to the state of figure 5 can be reversed. The sealing device 1 can thus be easily removed from the gap 10 for example for inspection. The sealing device 1 can also be reused.

The embodiment of the figures is now described in more detail. Each of the outer sealing portion 2a and the inner sealing portion 2b is a continuous annular or sleeve-like sealing member. The sealing device 1 further comprises a middle sealing portion 2c. The middle sealing portion 2c connects the inner sealing portion 2b to the outer sealing portion 2a. The middle sealing portion 2c is parallel

with the actuation rings 3, 4. The middle sealing portion 2c prevents leaks through the sealing device 1. Together the sealing portions 2a, 2b, 2c form a sealing element 2. The sealing element 2 is an annular trough. The sealing element 2 is a one-piece part. The sealing element 2 is configured to accommodate the actuation rings 3, 4 and the pressing elements 6, 7. The free edges of the outer sealing portion 2a and the inner sealing portion 2b extend in the axial direction of the actuation rings 3, 4 over both actuation rings 3, 4 when the actuation rings 3, 4 are in the outermost positions, i.e. when the distance between the actuation rings 3, 4 is at its greatest. Also the outer pressing elements 6 and the inner pressing elements 7 are accommodated within the space defined by the outer sealing portion 2a, the inner sealing portion 2b and the middle sealing portion 2c. In the embodiment of the figures, the outer sealing portion 2a is provided with a flange 2d protruding inwards from the free edge of the outer sealing portion 2a. The inner sealing portion 2b is provided with a similar flange 2e protruding outwards from the free edge of the inner sealing portion 2b.

In the embodiment of the figures, the sealing device 1 comprises four outer pressing elements 6. The outer pressing elements 6 extend substantially over the whole outer perimeter of the actuation rings 3, 4. The number of the outer pressing elements 6 does not need to be four, but the sealing device 1 could comprise fewer or more outer pressing elements 6. In the figures, the outer pressing elements 6 are identical with each other, but that is not necessary. For instance, the outer pressing elements 6 could have different lengths. However, in order to achieve a uniform sealing force, it is beneficial to have identical outer pressing elements 6. Each outer pressing element 6 has a shape of a segment of a ring. When the sealing device 1 is in a shrunk state as shown in figure 5, the outer pressing elements 6 extend almost continuously over the whole outer perimeters of the actuation rings 3, 4. There are only small gaps between the outer pressing elements 6. The gaps allow expansion of the sealing device 1. In the expanded state shown in figure 6, the gaps between the outer pressing elements 6 are larger. The outer surface 6c of each outer pressing element 6 in the radial direction is in direct contact with the outer sealing portion 2a. It would also be possible to arrange additional parts between the outer sealing portion 2a and the outer pressing elements 6, but that would make the construction more complicated. Each outer pressing element 6 has a first contact surface 6a for cooperation with an outer contact surface 3a of the first actuation ring 3 and a second

contact surface 6b for cooperation with an outer contact surface 4a of the second actuation ring 4.

The inner pressing elements 7 are similar to the outer pressing elements 6. Therefore, the considerations presented above with respect to the outer pressing elements 6 can also be applied to the inner pressing elements 7 *mutatis mutandis*. In the embodiment of the figures, there are four inner pressing elements 7, but also a different number of inner pressing elements 7 could be used. The inner surface 7c of each inner pressing element 7 is in direct contact with the inner sealing portion 2b. However, it is not necessary that the inner pressing elements 7 are in direct contact with the inner sealing portion 2b. Each inner pressing element 7 has a first contact surface 7a for cooperation with an inner contact surface 3b of the first actuation ring 3 and a second contact surface 7b for cooperation with an inner contact surface 4b of the second actuation ring 4. In the shrunk state of the sealing device 1, as shown in figure 5, there are gaps between the inner pressing elements 7. In the expanded state shown in figure 6, the gaps between the inner pressing elements 7 are smaller.

The outer and inner pressing elements 6, 7 are made of a material that is stiffer than the material of the sealing element 2. The pressing elements 6, 7 are substantially rigid parts. The pressing elements 6, 7 can be made for example of a metal or an alloy, plastic or a composite material. Also the actuation rings 3, 4 are made of a material that is stiffer than the material of the sealing element 2. The material can be the same or similar than the material of the pressing elements 6, 7. Also the actuation rings 3, 4 are substantially rigid parts.

In the embodiment of the figures, the adjusting elements 5 are bolts. In the embodiment of the figures, the sealing device 1 is provided with four bolts 5, but also a different number of bolts 5 could be used. The first actuation ring 3 is provided with a through-hole 8 for each bolt 5. The second actuation ring 4 is provided with a threaded hole 9 for each bolt 5. Each bolt 5 is engaged with the thread of the corresponding hole 9 of the second actuation ring 4. As the bolts 5 are tightened, the second actuation ring 4 moves towards the first actuation ring 3. By having four bolts 5, the actuation rings 3, 4 can be kept in correct alignment with respect to each other but the sealing device 1 is still convenient to use. If there were only two bolts, the actuation rings 3, 4 could more easily tilt in respect of each other. On the other hand, with more than four bolts 5, the sealing device 1 would be slower to use. The bolts 5 could be replaced for example by a lever

system or other kinds of adjusting elements, but that would make the construction more complicated.

The first actuation ring 3 is additionally provided with at least one extraction hole 20. In the embodiment of the figures, there are four extraction holes 20. The
5 extraction holes 20 are provided with threads, which allow bolts or a special extraction tool to be engaged with the holes 20 for pulling the sealing device 1 away from a gap 10.

In the embodiment of the figures, the contact surfaces 3a, 3b, 4a, 4b of the actuation rings 3, 4 extend over the whole perimeters of the actuation rings 3, 4.
10 This makes the manufacturing of the actuation rings 3, 4 simpler and also facilitates assembly of the sealing device 1, as the contact surfaces 3a, 3b, 4a, 4b become automatically aligned with the contact surfaces 6a, 6b, 7a, 7b of the pressing elements 6, 7. Except for the holes 8, 9, 20, the actuation rings 3, 4 are rotationally symmetrical.

15 In the embodiment of the figures, all the contact surfaces 3a, 3b, 4a, 4b, 6a, 6b, 7a, 7b of the actuation rings 3, 4 and the pressing elements 6, 7 are inclined relative to the axial and radial directions of the actuation rings 3, 4. The angle between the contact surface and the axial direction, i.e. the direction of the center axis 21, can be for example in the range of 15–75 degrees. The mating contact
20 surfaces are parallel with each other. Preferably, all the contact surfaces have the same inclination angle. The contact surfaces 3a, 3b, 4a, 4b of the actuation rings 3, 4 are inclined so that the actuation rings 3, 4 taper towards each other. The contact surfaces 6a, 6b, 7a, 7b of the pressing elements 6, 7 are inclined so that the pressing elements 6, 7 become thinner from a radial center
25 plane 22 towards axial edges of the pressing elements 6, 7.

The contact surfaces of the actuation rings 3, 4 and the pressing elements 6, 7 could also be implemented in other ways. For instance, the actuation rings 3, 4 could taper in opposite directions compared to the embodiment of the figures. The pressing elements 6, 7 would become thinner towards the radial center
30 plane 22. The sealing element 1 would function so that the pressing elements 6, 7 are moved farther from each other as the actuation rings are moved away from each other.

It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims.

Claims

1. An adjustable sealing device (1) for sealing an annular gap (10) between a cylindrical inner surface (13) of a first part (11) and a cylindrical outer surface (14) of a second part (12), the sealing device (1) comprising
 - 5 - an annular outer sealing portion (2a) configured to be engaged with the cylindrical inner surface (13) of the first part (11),
 - an annular inner sealing portion (2b) arranged coaxially with the outer sealing portion (2a), having a smaller diameter than the outer sealing portion (2a) and configured to be engaged with the cylindrical outer surface (14) of the second part (12),
 - 10 - a first actuation ring (3) arranged between the outer sealing portion (2a) and the inner sealing portion (2b) coaxially with the sealing portions (2a, 2b),
 - a second actuation ring (4) arranged between the outer sealing portion (2a) and the inner sealing portion (2b) in parallel with the first actuation ring (3) and coaxially with the sealing portions (2a, 2b),
 - 15 - at least two adjusting elements (5) for adjusting the distance between the first actuation ring (3) and the second actuation ring (4) in the axial direction of actuation rings (3, 4),
 - 20 - at least two outer pressing elements (6) arranged between the outer sealing portion (2a) and the first and second actuation rings (3, 4), and
 - at least two inner pressing elements (7) arranged between the inner sealing portion (2b) and the first and second actuation rings (3, 4),
 wherein
 - 25 - the first actuation ring (3) and the second actuation ring (4) are provided with outer contact surfaces (3a, 4a) for cooperation with the outer pressing elements (6) and with inner contact surfaces (3b, 4b) for cooperation with the inner pressing elements (7),
 - the outer pressing elements (6) and the inner pressing elements (7) are provided with respective contact surfaces (6a, 6b, 7a, 7b), and
 - 30 - the contact surfaces (3a, 3b, 4a, 4b, 6a, 6b, 7a, 7b) of the actuation rings (3, 4) and the pressing elements (6, 7) are configured to cooperate so that a change in the axial distance between the actuation rings (3, 4) moves the outer pressing elements (6) radially outwards with respect to a center axis (21) of the sealing device (1) and the inner pressing elements (7) radially inwards with respect to the center axis (21), and an
 - 35

opposite change in the axial distance between the actuation rings (3, 4) moves the outer pressing elements (6) radially inwards and the inner pressing elements (7) radially outwards.

2. A sealing device (1) according to claim 1, wherein the contact surfaces (3a, 3b, 4a, 4b, 6a, 6b, 7a, 7b) of the actuation rings (3, 4) and the pressing elements (6, 7) are configured so that movement of the actuation rings (3, 4) towards each other moves the outer pressing elements (6) radially outwards and the inner pressing elements (7) radially inwards.
3. A sealing device (1) according to claim 1 or 2, wherein each contact surface (3a, 3b, 4a, 4b) of the first actuation ring (3) and the second actuation ring (4) is inclined relative to the axial and radial directions of the actuation rings (3, 4) and each contact surface (6a, 6b, 7a, 7b) of the outer pressing elements (6) and the inner pressing elements (7) is inclined correspondingly for cooperation with one of the contact surfaces (3a, 3b, 4a, 4b) of the actuation rings (3, 4).
4. A sealing device (1) according to claim 3, wherein the inclined contact surfaces (3a, 3b, 4a, 4b) of the first actuation ring (3) and/or the second actuation ring (4) extend over the whole perimeter of the actuation ring (3, 4) in circumferential direction.
5. A sealing device (1) according to claim 3 or 4, wherein the inclined contact surfaces (6a, 6b, 7a, 7b) of the outer pressing elements (6) and/or the inner pressing elements (7) extend in circumferential direction over the whole pressing element (6, 7).
6. A sealing device (1) according to any of the preceding claims, wherein each of the first actuation ring (3) and the second actuation ring (4) tapers towards a radial center plane of the sealing device (1).
7. A sealing device (1) according to any of the preceding claims, wherein the outer sealing portion (2a) is connected to the inner sealing portion (2b) via a middle sealing portion (2c).
8. A sealing device (1) according to any of the preceding claims, wherein the sealing device (1) comprises at least four outer pressing elements (6) and at least four inner pressing elements (7).

9. A sealing device (1) according to any of the preceding claims, wherein the sealing device (1) comprises at least four adjusting elements (5).
10. A sealing device (1) according to any of the preceding claims, wherein the adjusting elements (5) are bolts.
- 5 11. A sealing device (1) according to any of the preceding claims, wherein the sealing portions (2a, 2b, 2c) are made of a material comprising plastic and/or rubber.
12. A sealing device (1) according to any of the preceding claims, wherein the actuation rings (3, 4) and the pressing elements (6, 7) are made of a metal or
10 an alloy.
13. A sealing device (1) according to any of claim 1–11, wherein the actuation rings (3, 4) and the pressing elements (6, 7) are made of plastic.
14. Use of an adjustable sealing device (1) according to any of the preceding claims for sealing a gap (10) between an engine block (11) and a stud bolt (12)
15 used for attaching a cylinder head to the engine block (11).

1/4

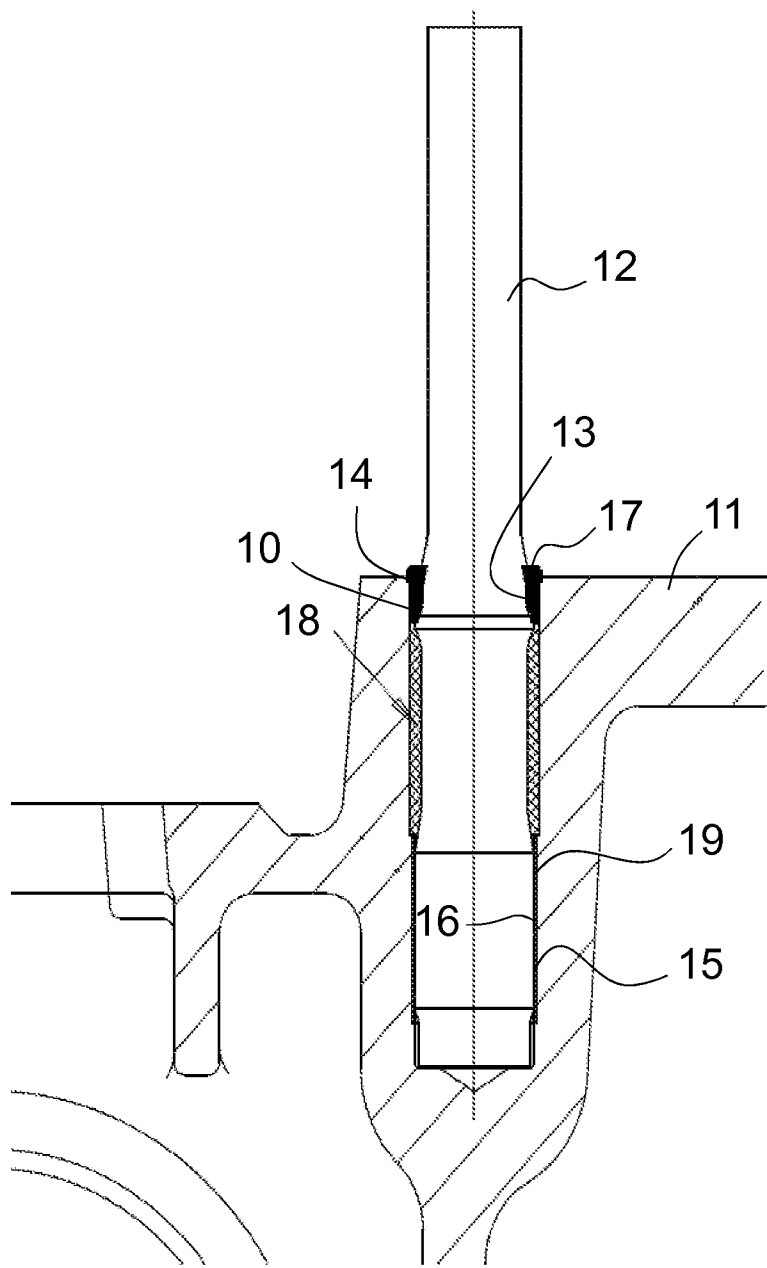


FIG. 1

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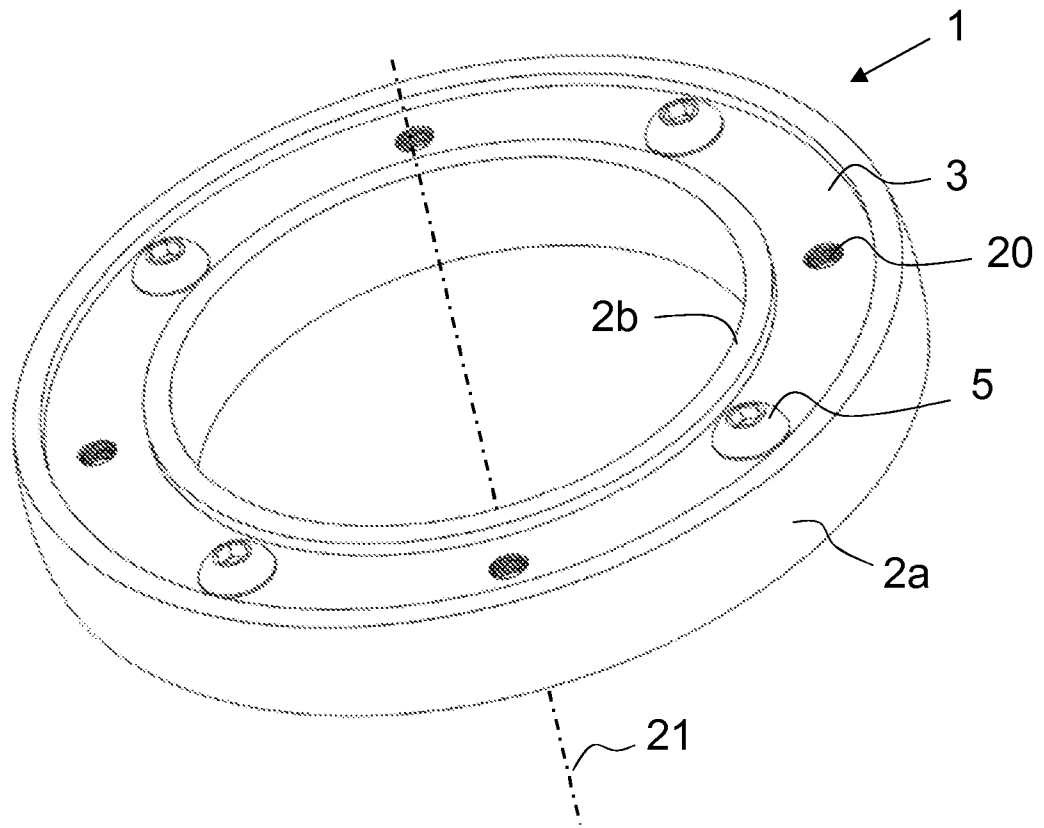


FIG. 2

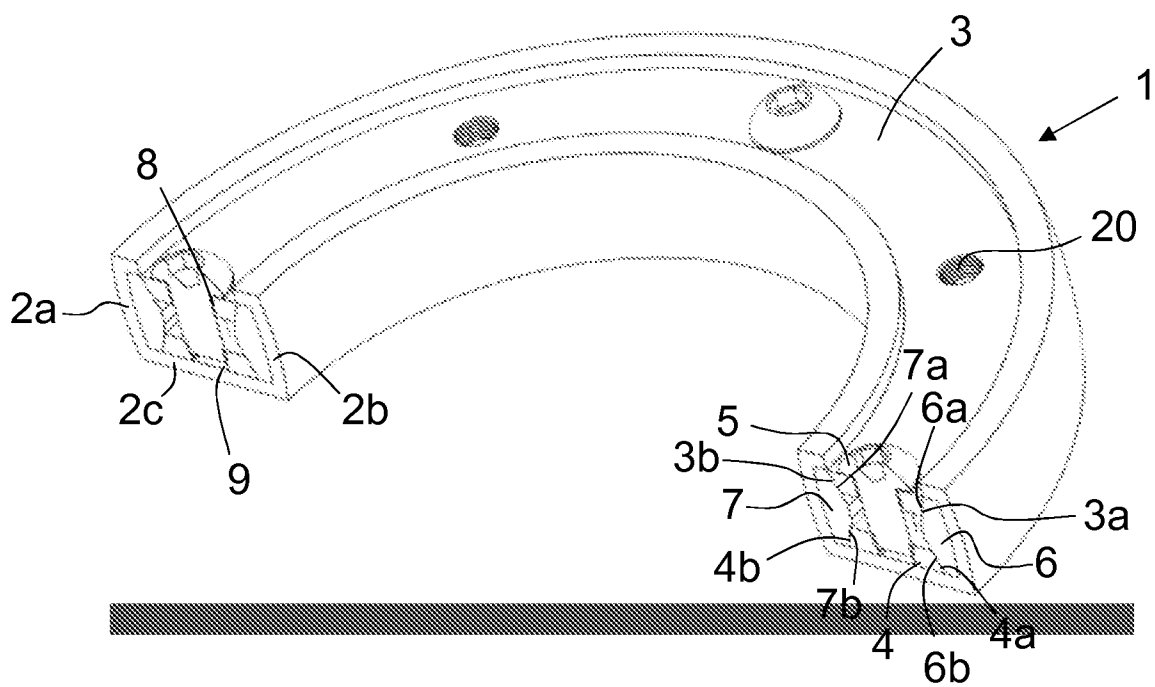


FIG. 3

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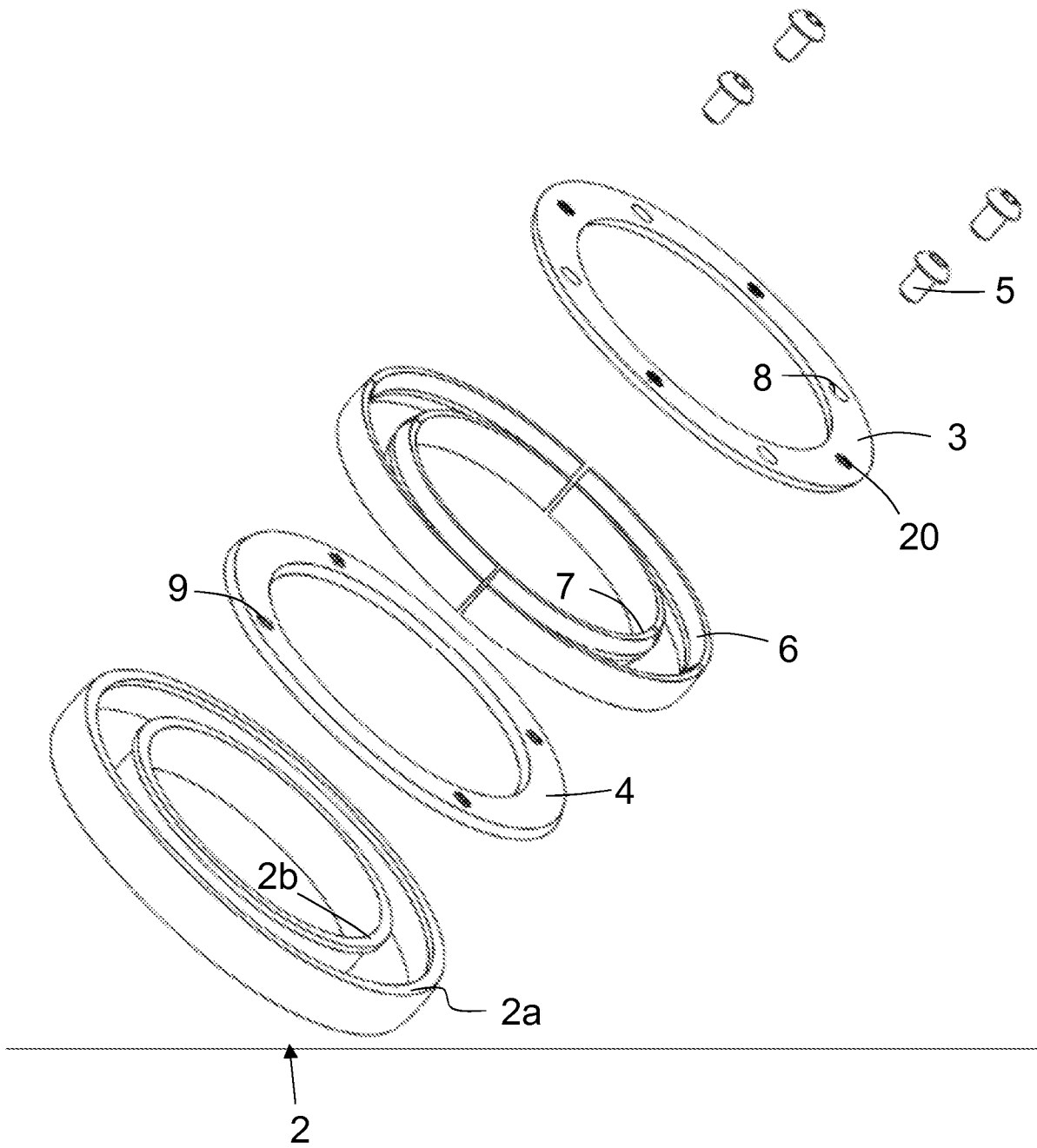


FIG. 4

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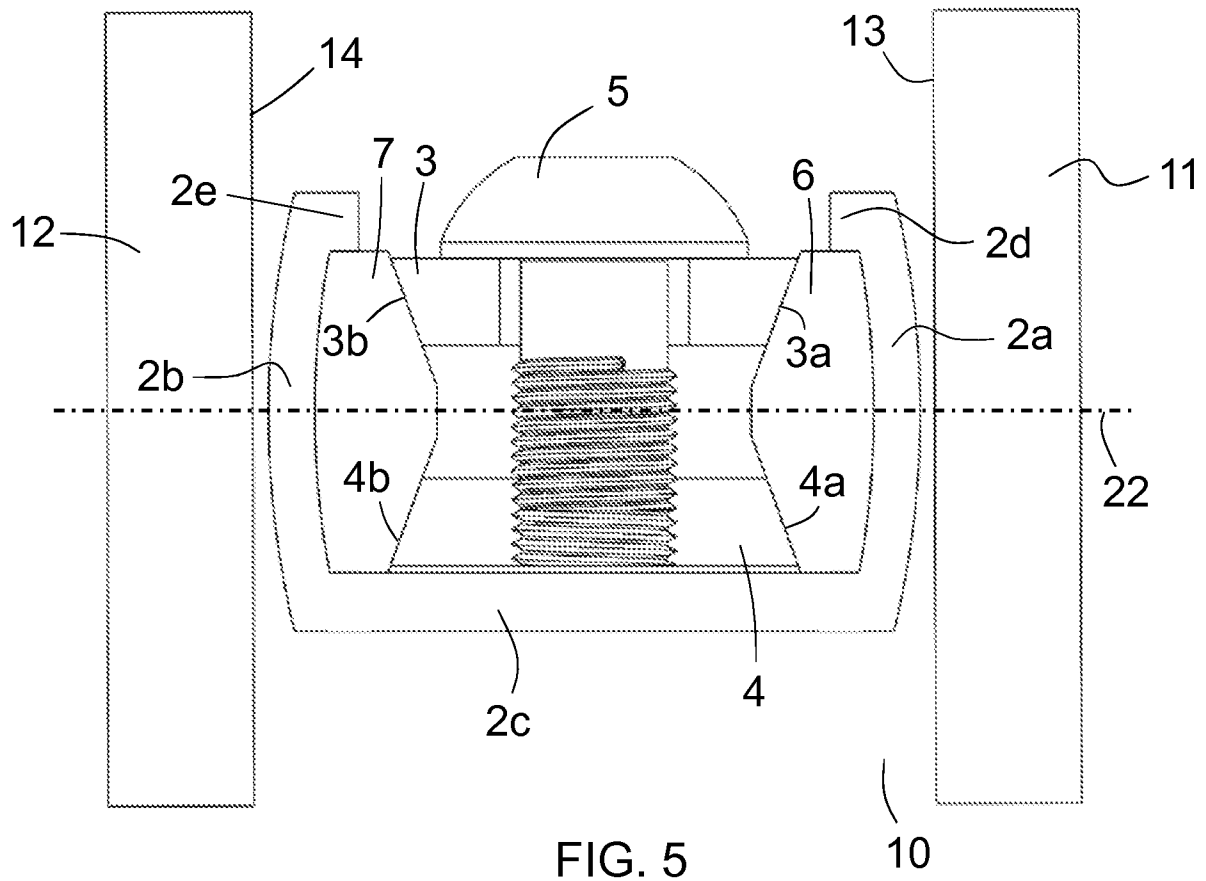


FIG. 5

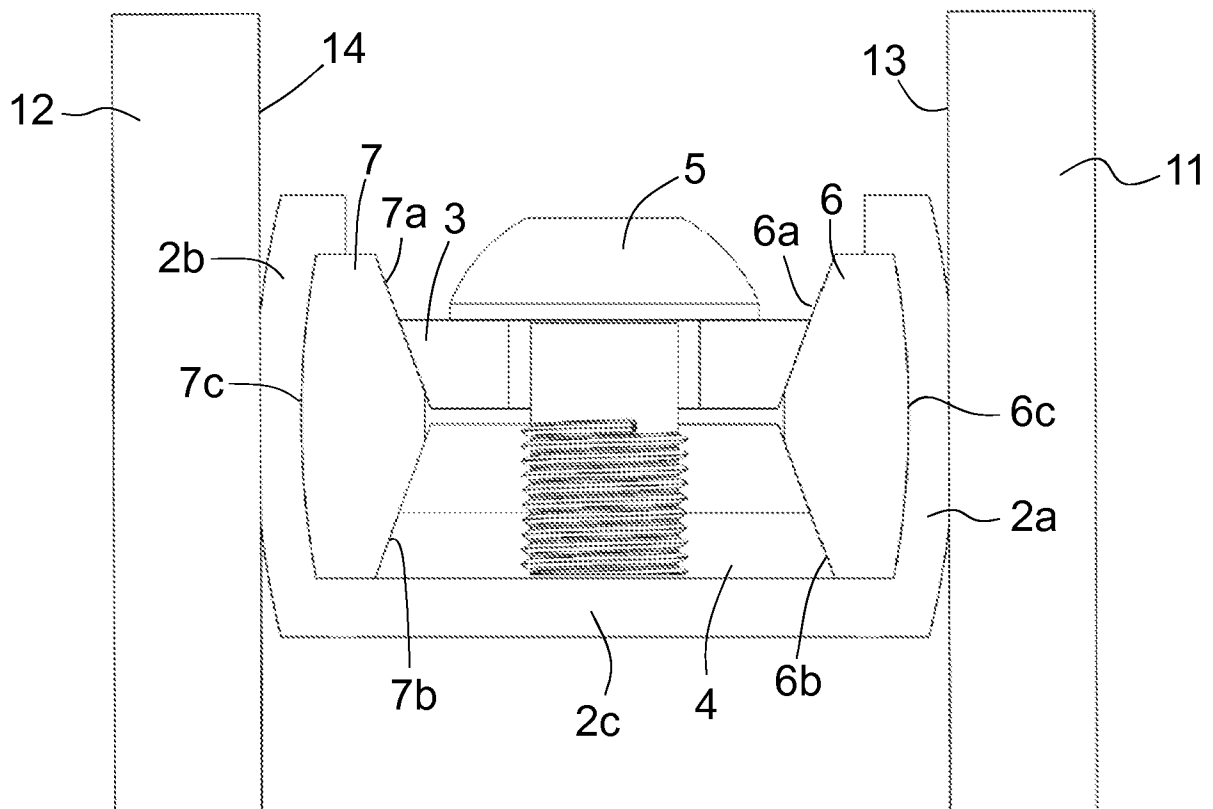


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2018/050949

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16J15/06 F16L5/08 F16L7/02 F16J15/08
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16J F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01/81807 A1 (DSI ROHRLEITUNGSBAU ZUBEHOER [DE]; SKERRA BERND [DE]) 1 November 2001 (2001-11-01)	1,2,9-13
A	page 7, lines 9-10 page 8, line 17 - page 9, line 6; claims 1, 8; figures 1-3 page 10, lines 1-18 -----	3-8,14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

18 June 2019

Date of mailing of the international search report

26/06/2019

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/FI2018/050949

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO 0181807	A1	01-11-2001	DE 10020493 A1	08-11-2001
			WO 0181807 A1	01-11-2001
