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(54) **DISC BRAKE CALIPER**

SCHEIBENBREMSSATTEL

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(56) References cited:
EP-A1- 2 191 160
US-A1- 2004 245 055
US-B1- 6 523 833

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Description

. Field of the invention

[0001] The present invention relates to a disc brake caliper, in particular for a disc brake comprising an electromechanical parking brake. Solutions of this type are known from US 2004/245055 A1 and EP 2 191 160 A1

Background art

[0002] . In recent years, the development of electromechanical parking brakes (EPBs) has focused on increasing their parking performance, both in terms of the generated clamping force and service life.

[0003] . In particular, the current EPB devices are required to be able to sustain at least 200,000 load cycles.

[0004] . It has been observed that a correct fluid sealing of the braking system plays a key role in increasing the service life of an EPB device, and thus its number of load cycles.

[0005] . Undesired brake fluid leakage and undesired air ingress from outside cause the deterioration of the EPB devices.

[0006] . Indeed, in the absence of correct sealing, the braking fluid can enter the ratio motor chamber of the EPB device and damage its operation, e.g., causing plastic gears to swell or the motor to short-circuit.

[0007] . Additionally, due to the loss of optimal sealing, the resulting brake fluid oozing generates a vicious cycle that further reduces the life of EPB devices.

[0008] . To address these critical issues, the current EPB devices are generally provided with a seal consisting of an O-ring coupled with a backup ring/anti-extrusion ring configured to prevent extrusion of the O-ring rubber, which can be generated by high brake fluid pressures.

[0009] . This known solution is not optimal because the resulting fluid sealing is highly dependent on the compression of the O-ring within the housing in which it is accommodated.

[0010] . Furthermore, since the O-ring is mounted directly on the screw shaft of the EPB device, the relative creep and heat generated during the handling of the screw cause severe wear and abrasion of the O-ring. The O-ring wear generates a significant reduction in its own compression, causing brake fluid leakage and reducing caliper life.

[0011] . A further problem caused by O-ring wear and its associated loss of compression is the ingress of air during brake actuation without the presence of pressurized brake fluid.

[0012] . Indeed, implementing the brake without the application of pressurized fluid causes the movement of the brake piston to generate negative pressure at the EPB screw.

[0013] . In the presence of a worn sealing system, the negative pressure causes air to be sucked in from the outside, and causes a spongy feel to the pedal, reducing braking performance.

[0014] . It has been attempted to solve these critical issues and increase the tightness of the system by placing multiple O-rings side by side.

[0015] . However, placing multiple O-rings within the same housing has not been shown to be decisive because it does not solve the critical issues related to high braking fluid pressures acting on the plurality of O-rings, which determine the oozing of braking fluid past the plurality of juxtaposed O-rings.

[0016] . US2013037357A1 describes a disc brake caliper in which a dual-stage sealing is applied to a service brake translating member (the piston). One of the two sealing stages comprises a square cross-section seal, configured to be compressed in the axial direction and easily deformable to provide the piston with a "roll-back" effect. This known solution, although suitable for application to a translating member, is not adapted to ensure a correct sealing to a rotating member of a parking brake system because the rotation of the rotating member would exacerbate the deformation of the seal, which would then be unable to effectively prevent the oozing of brake fluid.

[0017] . EP2273149A1 also describes a disc brake caliper in which a dual-stage sealing is applied to a service brake translating member (i.e. the piston). One of the two sealing stages comprises a seal configured to act initially in an integral manner with the translating member. This known solution is not applicable to a rotating member because an adhesion with the rotating member would quickly damage the seal and its sealing ability.

Solution

[0018] . It is the object of the present invention to make available a caliper for disc brake, comprising an improved parking braking system and configured to solve at least some of the drawbacks of the background art.

[0019] . These and other objects are obtained by means of a disc brake caliper according to claim 1.

[0020]] . The dependent claims relate to preferred and advantageous embodiments of the present invention.

Drawings

[0021] . In order to better understand the invention and appreciate the advantages thereof, some non-limiting exemplary embodiments thereof will be described below with reference to the accompanying drawings, in which:

- figure 1 is a perspective view of a caliper for a disc brake taken along an axial section according to an embodiment of the invention;
- figure 2 is a side view of the caliper for a disc brake shown in figure 1;
- figure 3 is a perspective view of a caliper for a disc brake taken along an axial section according to an embodiment of the invention;

- figure 4 is a side view of the caliper for a disc brake shown in figure 3;
- figure 5 is a partially sectioned upper perspective view of a caliper for a disc brake according to an embodiment of the invention;
- figure 6 is a detail view of a part of figure 5;
- figure 7 is a partially sectioned upper view of a caliper for a disc brake according to a further embodiment of the invention;
- figure 8 is a detail view of a part of figure 7;
- figure 9 is a front view of a component of a caliper for a disc brake along an axial section according to an embodiment of the invention;
- figure 10 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 11 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 12 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 13 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 14 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 15 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention;
- figure 16 is a front view of a component of a caliper for a disc brake along an axial section according to a further embodiment of the invention.

Description of some preferred embodiments

[0022] . With reference to the figures, a disc brake caliper is generally indicated by reference numeral 1.

[0023] . The disc brake caliper 1 comprises a caliper body 2 arranged straddling a brake disc having a rotation axis, which defines an axial direction A-A and opposite friction surfaces.

[0024] . The caliper 1 comprises pads 3 accommodated in the caliper body 2 so as to be able to slide substantially in an axial direction A-A with respect to the brake disc to act respectively on the opposite friction surfaces.

[0025] . <}Furthermore, the caliper 1 comprises a cylinder 4, which forms a cylindrical wall 5 and a bottom wall 6 transverse to the cylindrical wall 5.

[0026] . The caliper 1 further comprises a piston 7, which forms a side wall 8 and a thrust wall 9 substantially transverse to the side wall 8 and opposite to the bottom wall 6 of the cylinder 4.

[0027] . The bottom wall 6 forms an inner surface 25 facing towards the piston 7 and an opposite outer surface 26 facing opposite to the piston 7.

[0028] . The piston 7 is accommodated within the cylinder 4, and the side wall 8 of the piston 7 is adapted to slide within the cylindrical wall 5 of the cylinder 4.

[0029] . The piston 7 is configured to be biased by a pressurized brake fluid injectable within the cylinder 4, to bias at least one of the pads 3 against one of the brake disc friction surfaces, along a thrust direction substantially parallel to the axial direction A-A.

[0030] . The caliper 1 further comprises a parking-braking system 10 which comprises a rotating member 11.

[0031] . The rotating member 11 is rotatably accommodated within a rotation housing 12 formed in the bottom wall 6 of the cylinder 4 so that the rotating member 11 is rotatable about a rotation axis substantially parallel to the axial direction A-A.

[0032] . According to an aspect of the invention, the cylinder 4 defines a first annular housing 13 and a second annular housing 14 made in the bottom wall 6.

[0033] . The first and second annular housings 13, 14 extend into the bottom wall 6 in a direction transverse to the axial direction A-A and leading into the rotation housing 12.

[0034] . The second annular housing 14 is distinct from said first annular housing 13 and is positioned in a direction opposite to the inner surface 25 of the bottom wall 6 with respect to the first annular housing 13.

[0035] . The first annular housing 13 accommodates a first seal 15, and the second annular housing 14 accommodates a second seal 16.

[0036] . The first and second seals 15, 16 are configured to act between the rotating member 11 and the bottom wall 6 of the cylinder 4 to be fluid-tight.

[0037] . Advantageously, the first and second seals 15, 16 provide high sealing and drastically reduce unwanted brake fluid leakage and air ingress from outside.

[0038] . Specifically, the first seal 15, closest to the pressurized brake fluid, shields the pressure and provides most of the sealing. The second seal 16 makes it possible to stop droplets of braking fluid from oozing past the first seal 15, thus achieving a high sealing.

[0039] . According to an embodiment, the parking braking system 10 comprises a screw-nut system formed by a screw 17 and a nut 18.

[0040] . A rotation of the screw 17 corresponds to a translation of the nut 18, relative to the caliper body 2, along a direction parallel to the axial direction A-A.

[0041] . The nut 18 is configured to bias at least one of the pads 3 against one of said friction surfaces of the brake disc.

[0042] . The rotating member 11 constitutes the screw 17.

[0043] . Optionally, the screw-nut system defines a thread and said thread is of the irreversible type.

[0044] . Advantageously, said configuration drastically reduces the oozing of braking fluid past screw 17, thus preserving the correct operation of the additional components of the EPB device.

[0045] . According to the invention, the first seal 15 comprises an O-ring 19 coupled with a sealing ring that

also has the backup function and will be called backup ring 20 hereafter.

[0046] . The backup ring 20 is interposed between the O-ring 19 and the rotating member 11 and is made of less deformable material than the material of the O-ring 19.

[0047] . Optionally, the backup ring 20 is made of polymeric material, such as polytetrafluoroethylene (PTFE), or polymeric material with PTFE filler in the polymer matrix.

[0048] . Advantageously, said configuration of the first seal 15 avoids relative rotations between the O-ring 19 and the screw 17, which occur between the screw 17 and the backup ring 20, instead. In this manner, the O-ring 19 works as subjected to static and not dynamic conditions allowing a significant reduction in wear cross-sectional area (or chord) of the O-ring.

[0049] . According to an embodiment, the second seal 16 is a scraper.

[0050] . Advantageously, a scraper ensures a high sealing against brake fluid oozing, dust and rust ingress, or air leakage from outside, achieving a high fluid sealing in synergy with the first seal 15.

[0051] . Further advantageously, the scraper makes up for any wear, and consequent reduction in tightness, of the backup ring 20 of the first seal 15, thereby continuing to preserve the tightness of the entire braking system.

[0052] . According to an embodiment, the second seal 16 is:

- an O-ring; or
- an X-ring; or
- a symmetrical or asymmetrical lip seal; or
- a lip seal, symmetrical or asymmetrical, incorporating a reinforcing insert 23, made of metallic or polymeric material; or
- a lip seal defining three lobes 21 in a section parallel to the axial direction A-A; or
- a lip seal defining four lobes 21 in a section parallel to the axial direction A-A.

[0053] . Advantageously, the scrapers thus configured make up for any deviations in geometric tolerances, due to temperature variations, for example, to preserve proper sealing of the braking system.

[0054] . According to an embodiment, said second seal 16 is a lip seal which defines a three-lobe profile 21 in a section parallel to the axial direction A-A.

[0055] . Two of the three lobes 21 are biased against the rotating member 11 and one of the three lobes 21 is biased against the bottom wall 6 of the cylinder 5.

[0056] . Optionally, two of the three lobes 21 are pinned against the rotating member 11 opposite each other along a direction parallel to the axial direction A-A.

[0057] . Optionally, one of the three lobes 21 biased against the bottom wall 6 of the cylinder 5 is pinned against said bottom wall 6 in the direction of the inner surface 25 of the bottom wall 6.

[0058] . Optionally, the second seal 16 is a lip seal which defines a four-lobe profile 21 in a section parallel to the axial direction A-A, and in which two of the four lobes 21 are biased against the rotating member 11 and two opposite lobes 21 are biased against the bottom wall 6 of the cylinder 5.

[0059] . Optionally, two of the four lobes 21 are pinned against the rotating member 11 opposite each other along a direction parallel to the axial direction A-A, and two opposite lobes 21 are pinned against the bottom wall 6 opposite each other along a direction parallel to the axial direction A-A.

[0060] . According to an embodiment, the second seal 16 comprises a seal body 22 made of polymeric material, and a reinforcing insert 23, preferably metal, incorporated within the seal body 22.

[0061] . The reinforcing insert 23 is configured to promote the gripping of the second seal 16 to the bottom wall 6.

[0062] . Optionally, the second seal 16 defines a three-lobe profile 21 in a section parallel to the axial direction A-A, and in which one of the three lobes 21 is biased against the bottom wall 6 of the cylinder 5, and in which the reinforcing insert 23 is incorporated within said lobe 21.

[0063] . Advantageously, the reinforcing insert 23 is configured to prevent the elastic deformation of said lobe 21.

[0064] . According to an embodiment, the second annular housing 14 defines a concave polygon-shaped profile in a section parallel to the axial direction A-A.

[0065] . Optionally, said concave polygon has at least one concave angle of about 270°.

[0066] . Optionally, the second seal 16 accommodated by the second annular housing 14 is an asymmetrical lip seal.

[0067] . According to an embodiment, the bottom wall 6 of the cylinder 4 forms, at the second annular housing 14, at least one backing step 24 that determines said concave polygon-shaped profile of the second annular housing 14 in a section parallel to the axial direction A-A.

[0068] . The second seal 16 defines a three-lobe profile 21 or four-lobe profile 21 in the section parallel to the axial direction A-A.

[0069] . At least one lobe 21 of the second seal 16 is positioned abutting against said at least one backing step 24.

[0070] . According to an embodiment, between the first annular housing 13 and the second annular housing 14, along a section parallel to the axial direction A-A, the bottom wall 6 of the cylinder 4 defines a distance D comprised between:

- 2.0 mm and 6.0 mm; or
- 2.4 mm and 5.2 mm; or
- 2.9 mm and 3.8 mm.

[0071] . Advantageously, this distance D strengthens the inner surface 25 of the bottom wall 6, which is biased by the pressure of the braking fluid.

[0072] . According to an embodiment, the first annular housing 13 leads into said inner surface 25 of the bottom wall 6.

[0073] . Optionally, the second annular housing 14 leads into said outer surface 26 of the bottom wall 6.

[0074] . Advantageously, when it leads into the outer surface 26 and is free from a backing step 24, a seal incorporating a reinforcing insert 23 can be inserted within the second annular housing 14.

[0075] . Optionally, between the first annular housing 13 and said inner surface 25, along a section parallel to the axial direction A-A, the bottom wall 6 defines a first distance L1 comprised between:

- 0.5 mm and 4.0 mm; or
- 1.0 mm and 3.0 mm; or

equal to 2.8 mm.

[0076] . Optionally, between the second annular housing 14 and said outer surface 26, along a section parallel to the axial direction A-A, the bottom wall 6 defines a second distance L2 comprised between:

- 0.5 mm and 4.0 mm; or
- 1.0 mm and 3.0 mm; or

. equal to 2.3 mm; or
. equal to 2.5 mm.

[0077] . Optionally, along a section parallel to the axial direction A-A, the first annular housing 13 has a length comprised between:

. 3.0 mm and 4.0 mm; or
. equal to 3.6 mm.

[0078] . Optionally, along a section parallel to the axial direction A-A, the second annular housing 14 has a length comprised between:

. 2.5 mm and 5.0 mm; or
. equal to 3.1 mm; or
. equal to 3.9 mm; or
. equal to 4.7 mm.

[0079] . Optionally, along a section transverse to the axial direction A-A, the first annular housing 13 defines a first diameter D1 relative to the rotational axis of the rotating member 11 comprised between:

. 18.0 mm and 21.0 mm; or
. equal to 19.6 mm.

[0080] . Optionally, along a section transverse to the axial direction A-A, the second annular housing 14 defines a second diameter D2 relative to the rotational axis of the rotating member 11 comprised between:

. 16.0 mm and 20.0 mm; or
. equal to 16.6 mm; or
. equal to 18.6 mm;
. equal to 19.6 mm.

[0081] . Optionally, at the second annular housing 14, the bottom wall 6 of the cylinder 4 forms at least one backing step 24 which defines, along a cross-sectional section of the axial direction A-A, a third diameter D3 relative to the rotation axis of the rotating member 11 comprised between:

- 15.0 mm and 18.0 mm; or
- 16.0 mm and 17.0 mm; or equal to 16.6 mm.

[0082] **.** Optionally, along a section parallel to the axial direction A-A, the bottom wall 6 of the cylinder 4 defines a thickness W between the inner surface 25 and the outer surface 26 comprised between:

. 12.0 mm and 14.0 mm; or
. equal to 13.5 mm.

[0083] **.** Obviously, a person skilled in the art will be able to make changes or adaptations to the present invention, without however departing from the scope of the following claims.

LIST **OF REFERENCES**

[0084]

1. Caliper
2. Caliper body
3. Pads
4. Cylinder
5. Cylindrical wall
6. Bottom wall
7. Piston
8. Side wall
9. Thrust wall
10. Parking brake system
11. Rotating member
12. Rotation housing
13. First annular housing
14. Second annular housing
15. First seal
16. Second seal
17. Screw
18. Nut
19. O-ring
20. Backup ring
21. Lobes
22. Seal body
23. Reinforcement insert

24. Backing step
25. Inner wall
26. Outer wall
A-A. Axial direction
D. Distance
D1. First diameter
D2. Second diameter
D3. Third diameter
L1. First length
L2. Second length
W. Thickness

Claims

1. A disc brake caliper (1) comprising a caliper body (2) arranged straddling a brake disc having a rotation axis defining an axial direction (A-A) and opposite friction surfaces, said caliper (1) comprising pads (3) accommodated in said caliper body (2) so as to be able to slide substantially in an axial direction (A-A) with respect to the brake disc to act respectively on said opposite friction surfaces,

said caliper (1) comprising:

- a cylinder (4), forming a cylindrical wall (5) and a bottom wall (6) transverse to the cylindrical wall (5);
- a piston (7), forming a side wall (8) and a thrust wall (9) substantially transverse to the side wall (8) and opposite to the bottom wall (6) of the cylinder (4),

wherein said bottom wall (6) forms an inner surface (25) facing towards the piston (7) and an opposite outer surface (26) facing opposite to the piston (7),
wherein the piston (7) is accommodated within the cylinder (4), and the side wall (8) of the piston (7) is adapted to slide within the cylindrical wall (5) of the cylinder (4),
wherein the piston (7) is configured to be biased by a pressurized brake fluid injectable within the cylinder (4), to affect at least one of said pads (3) against one of said brake disc friction surfaces, along a thrust direction substantially parallel to the axial direction (A-A),
said caliper (1) further comprising a parking-braking system (10) which comprises a rotating member (11);
said rotating member (11) being rotatably accommodated within a rotation housing (12) formed in the bottom wall (6) of the cylinder (4) so that the rotating member (11) is rotatable about a rotation axis substantially parallel to the axial direction (A-A),
wherein the cylinder (4) defines a first annular housing (13) and a second annular housing (14) made in the bottom wall (6),
said first and second annular housings (13, 14) extending into the bottom wall (6) in a direction transverse to the axial direction (A-A) and leading into the rotation housing (12),
said second annular housing (14) being distinct from said first annular housing (13), and being positioned in a direction opposite to the inner surface (25) of the bottom wall (6) with respect to said first annular housing (13),
wherein the first annular housing (13) accommodates a first seal (15), and the second annular housing (14) accommodates a second seal (16), and wherein the first and second seals (15, 16) are configured to act between said rotating member (11) and said bottom wall (6) of the cylinder (4) to be fluid-tight;
characterized in that, the first seal (15) comprises an O-ring (19) coupled to a backup ring (20),
said backup ring (20) being interposed between said O-ring (19) and the rotating member (11), and being formed of less deformable material with respect to the material constituting the O-ring (19).

2. A caliper (1) according to claim 1, wherein the parking-braking system (10) comprises a screw-nut system formed by a screw (17) and a nut (18),

wherein to a rotation of the screw (17) corresponds a translation of the nut (18), relative to the caliper body (2), along a direction parallel to the axial direction (A-A),
said nut (18) being configured to bias at least one of said pads (3) against one of said friction surfaces of the brake disc,
and wherein the rotating member (11) constitutes said screw (17),
and wherein, optionally, the screw-nut system defines a thread, and said thread is of the irreversible type.

3. A caliper (1) according to claim 1 or 2, wherein the second seal (16) is a scraper.

4. A caliper (1) according to any one of the preceding claims, wherein the second seal (16) is:

- an O-ring; or
- an X-ring; or
- a symmetrical or asymmetrical lip seal; or
- a lip seal, symmetrical or asymmetrical, incorporating a reinforcing insert (23), preferably metallic; or
- a lip seal defining three lobes (21) in a section parallel to the axial direction (A-A); or

- a lip seal defining four lobes (21) in a section parallel to the axial direction (A-A).

5. A caliper (1) according to any one of the preceding claims, wherein the second seal (16) is a lip seal which defines a three-lobed profile (21) in a section parallel to the axial direction (A-A),

and wherein two of the three lobes (21) are biased against the rotating member (11) and one of the three lobes (21) is biased against the bottom wall (6) of the cylinder (5),
and/or wherein two of the three lobes (21) are pinned against the rotating member (11) opposite each other along a direction parallel to the axial direction (A-A),
and/or wherein one of the three lobes (21) biased against the bottom wall (6) of the cylinder (5) is pinned against said bottom wall (6) in the direction of the inner surface (25) of the bottom wall (6), and/or wherein the second seal (16) is a lip seal which defines a four-lobe profile (21) in a section parallel to the axial direction (A-A), and wherein two of the four lobes (21) are biased against the rotating member (11) and two opposite lobes (21) are biased against the bottom wall (6) of the cylinder (5),
and/or wherein two of the four lobes (21) are pinned against the rotating member (11) opposite each other along a direction parallel to the axial direction (A-A), and two opposite lobes (21) are pinned against the bottom wall (6) opposite each other along a direction parallel to the axial direction (A-A).

6. A caliper (1) according to any one of the preceding claims, wherein the second seal (16) comprises a seal body (22) in polymeric material, and a reinforcing insert (23) incorporated within the seal body (22),

wherein the reinforcing insert (23) is configured to promote the gripping of the second seal (16) onto the bottom wall (6),
wherein, optionally, the second seal (16) defines a three-lobe profile (21) in a section parallel to the axial direction (A-A), and wherein one of the three lobes (21) is biased against the bottom wall (6) of the cylinder (5), and wherein the reinforcing insert (23) is incorporated within said lobe (21),
and wherein, optionally, the reinforcing insert (23) is configured to prevent the elastic deformation of said lobe (21).

7. A caliper (1) according to any one of the preceding claims, wherein the second annular housing (14) defines a concave polygon-shaped profile in a section parallel to the axial direction (A-A),

wherein, optionally, said concave polygon has at least one concave angle of about 270°,
and wherein, optionally, the second seal (16) accommodated by the second annular housing (14) is an asymmetrical lip seal.

8. A caliper (1) according to claim 7, wherein the bottom wall (6) of the cylinder (4) forms, at the second annular housing (14), at least one backing step (24) which determines said concave polygon-shaped profile of the second annular housing (14) in a section parallel to the axial direction (A-A),

wherein the second seal (16) defines a three-lobe profile (21) or four-lobe profile (21) in the section parallel to the axial direction (A-A),
and wherein at least one lobe (21) of the second seal (16) is positioned abutting against said at least one backing step (24).

9. A caliper (1) according to any one of the preceding claims, wherein between the first annular housing (13) and the second annular housing (14), along a section parallel to the axial direction (A-A), the bottom wall (6) of the cylinder (4) defines a distance (D) comprised between:

- 2.0 mm and 6.0 mm; or
- 2.4 mm and 5.2 mm; or
- 2.9 mm and 3.8 mm.

10. A caliper (1) according to any one of the preceding claims, wherein the first annular housing (13) leads into said inner surface (25) of the bottom wall (6);

and/or wherein the second annular housing (14) leads into said outer surface (26) of the bottom wall (6);
and/or wherein, between the first annular housing (13) and said inner surface (25), along a section parallel to the axial direction (A-A), the bottom wall (6) defines a first distance (L1) comprised between:

- 0.5 mm and 4.0 mm; or
- 1.0 mm and 3.0 mm; or

equal to 2.8 mm,
and/or wherein between the second annular housing (14) and said outer surface (26), along a section parallel to the axial direction (A-A), the bottom wall (6) defines a second distance (L2) comprised between:

- 0.5 mm and 4.0 mm; or
- 1.0 mm and 3.0 mm; or

equal to 2.3 mm; or

equal to 2.5 mm,
and/or wherein along a section parallel to the axial direction (A-A), the first annular housing (13) has a length comprised between:

3.0 mm and 4.0 mm; or
equal to 3.6 mm,

and/or wherein along a section parallel to the axial direction (A-A), the second annular housing (14) has a length comprised between:

2.5 mm and 5.0 mm; or
equal to 3.1 mm; or
equal to 3.9 mm; or
equal to 4.7 mm,

and/or wherein along a section transverse to the axial direction (A-A), the first annular housing (13) defines a first diameter (D1) relative to the rotational axis of the rotating member (11) comprised between:

18.0 mm and 21.0 mm; or
equal to 19.6 mm,

and/or wherein along a section transverse to the axial direction (A-A), the second annular housing (14) defines a second diameter (D2) relative to the rotational axis of the rotating member (11) comprised between:

16.0 mm and 20.0 mm; or
equal to 16.6 mm; or
equal to 18.6 mm;
equal to 19.6 mm,

and/or wherein at the second annular housing (14), the bottom wall (6) of the cylinder (4) forms at least one backing step (24) which defines, along a cross-sectional section of the axial direction (A-A), a third diameter (D3) relative to the rotation axis of the rotating member (11) comprised between:

- 15.0 mm and 18.0 mm; or
- 16.0 mm and 17.0 mm; or

equal to 16.6 mm;
and/or wherein, along a section parallel to the axial direction (A-A), the bottom wall (6) of the cylinder (4) defines a thickness (W) between the inner surface (25) and the outer surface (26) comprised between:

12.0 mm and 14.0 mm; or
equal to 13.5 mm.

Patentansprüche

1. Scheibenbremssattel (1), umfassend einen Sattelkörper (2), welcher rittlings an einer Bremsscheibe angeordnet ist, welche eine Drehachse, welche eine axiale Richtung (A-A) definiert, und entgegengesetzte Reibflächen aufweist, wobei der Sattel (1) Beläge (3) umfasst, welche in dem Sattelkörper (2) aufgenommen sind, um dazu in der Lage zu sein, im Wesentlichen in einer axialen Richtung (A-A) in Bezug auf die Bremsscheibe zu gleiten, um jeweils auf die entgegengesetzten Reibflächen einzuwirken,

   wobei der Sattel (1) umfasst:

   - einen Zylinder (4), welcher eine zylindrische Wand (5) und eine Bodenwand (6) transversal zu der zylindrischen Wand (5) bildet;
   - einen Kolben (7), welcher eine Seitenwand (8) und eine Schubwand (9) im Wesentlichen transversal zu der Seitenwand (8) und entgegengesetzt zu der Bodenwand (6) des Zylinders (4) definiert,

   wobei die Bodenwand (6) eine innere Fläche (25) bildet, welche dem Kolben (7) zugewandt ist, und eine entgegengesetzte äußere Fläche (26) bildet, welche von dem Kolben (7) abgewandt ist,
   wobei der Kolben (7) innerhalb des Zylinders (4) aufgenommen ist, und die Seitenwand (8) des Kolbens (7) dazu eingerichtet ist, innerhalb der zylindrischen Wand (5) des Zylinders (4) zu gleiten,
   wobei der Kolben (7) dazu eingerichtet ist, durch ein unter Druck gesetztes Bremsfluid, welches innerhalb des Zylinders (4) injizierbar ist, vorgespannt zu sein, um wenigstens einen der Beläge (3) gegen eine der Bremsscheiben-Reibflächen entlang einer Schubrichtung, welche im Wesentlichen parallel zu der axialen Richtung (A-A) ist, einwirken zu lassen,
   wobei der Sattel (1) ferner ein Parkbremssystem (10) umfasst, welches ein Drehelement (11) umfasst;
   wobei das Drehelement (11) drehbar innerhalb eines Drehgehäuses (12) aufgenommen ist, welches in der Bodenwand (6) des Zylinders (4) gebildet ist, so dass das Drehelement (11) um eine Drehachse drehbar ist, welche im Wesentlichen parallel zu der axialen Richtung (A-A) ist,
   wobei der Zylinder (4) ein erstes ringförmiges Gehäuse (13) und ein zweites ringförmiges Gehäuse (14) definiert, welche in der Bodenwand (6) hergestellt sind,
   wobei sich das erste und das zweite ringförmige Gehäuse (13, 14) in die Bodenwand (6) in einer

Richtung erstrecken, welche transversal zu der axialen Richtung (A-A) ist und in das Drehgehäuse (12) führt,
wobei das zweite ringförmige Gehäuse (14) von dem ersten ringförmigen Gehäuse (13) verschieden ist und in einer Richtung positioniert ist, welche der inneren Fläche (25) der Bodenwand (6) in Bezug auf das erste ringförmige Gehäuse (13) entgegengesetzt ist, wobei das erste ringförmige Gehäuse (13) eine erste Dichtung (15) aufnimmt und das zweite ringförmige Gehäuse (14) eine zweite Dichtung (16) aufnimmt, und wobei die erste und die zweite Dichtung (15, 16) dazu eingerichtet sind, zwischen dem Drehelement (11) und der Bodenwand (6) des Zylinders (4) derart zu wirken, dass sie fluiddicht sind;
dadurch gekennzeichnet, dass die erste Dichtung (15) einen O-Ring (19) umfasst, welcher mit einem Stützring (20) gekoppelt ist,
wobei der Stützring (20) zwischen dem O-Ring (19) und dem Drehelement (11) eingefügt ist und aus einem Material gebildet ist, welches in Bezug auf das Material, welches den O-Ring (19) bildet, weniger verformbar ist.

2. Sattel (1) nach Anspruch 1, wobei das Parkbremssystem (10) ein Schraube-Mutter-System umfasst, welches durch eine Schraube (17) und eine Mutter (18) gebildet ist, wobei einer Drehung der Schraube (17) eine Verlagerung der Mutter (18) relativ zu dem Sattelkörper (2) entlang einer zu der axialen Richtung (A-A) parallelen Richtung entspricht,

wobei die Mutter (18) dazu eingerichtet ist, wenigstens einen der Beläge (3) gegen eine der Reibflächen der Bremsscheibe vorzuspannen,
und wobei das Drehelement (11) die Schraube (17) bildet,
und wobei, optional, das Schraube-Mutter-System ein Gewinde definiert und das Gewinde vom irreversiblen Typ ist.

3. Sattel (1) nach Anspruch 1 oder 2, wobei die zweite Dichtung (16) ein Abstreifer ist.

4. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei die zweite Dichtung (16) folgendes ist:

- ein O-Ring; oder
- ein X-Ring; oder
- eine symmetrische oder asymmetrische Lippendichtung; oder
- eine Lippendichtung, symmetrisch oder asymmetrisch, welche einen, vorzugsweise metallischen, Verstärkungseinsatz (23) enthält; oder
- eine Lippendichtung, welche drei Nasen (21) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert; oder
- eine Lippendichtung, welche vier Nasen (21) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert.

5. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei die zweite Dichtung (16) eine Lippendichtung ist, welches ein drei-nasiges Profil (21) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert,

und wobei zwei der drei Nasen (21) gegen das Drehelement (11) und eine der drei Nasen (21) gegen die Bodenwand (6) des Zylinders (5) vorgespannt ist,
und/oder wobei zwei der drei Nasen (21) gegen das Drehelement (11) befestigt sind, einander entgegengesetzt entlang einer Richtung, welche parallel zu der axialen Richtung (A-A) ist,
und/oder wobei eine der drei Nasen (21), welche gegen die Bodenwand (6) des Zylinders (5) vorgespannt ist, gegen die Bodenwand (6) in der Richtung der inneren Fläche (25) der Bodenwand (6) befestigt ist,
und/oder wobei die zweite Dichtung (16) eine Lippendichtung ist, welche ein vier-nasiges Profil (21) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert,
und/oder wobei zwei der vier Nasen (21) gegen das Drehelement (11) vorgespannt sind und zwei entgegengesetzte Nasen (21) gegen die Bodenwand (6) des Zylinders (5) befestigt sind,
und/oder wobei zwei der vier Nasen (21) gegen das Drehelement befestigt sind, einander entgegengesetzt entlang einer Richtung, welche parallel zu der axialen Richtung (A-A) ist, und zwei entgegengesetzte Nasen (21) gegen die Bodenwand (6) befestigt sind, einander entgegengesetzt entlang einer Richtung, welche parallel zu der axialen Richtung (A-A) ist.

6. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei die zweite Dichtung (16) einen Dichtungskörper (22) in einem Polymermaterial und einen Verstärkungseinsatz (23) umfasst, welcher innerhalb des Dichtungskörpers (22) enthalten ist,

wobei der Verstärkungseinsatz (23) dazu eingerichtet ist, das Greifen der zweiten Dichtung (16) auf die Bodenwand (6) zu unterstützen,
wobei optional die zweite Dichtung (16) ein dreinasiges Profil (21) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert, und wobei eine der drei Nasen (21) gegen die Bodenwand (6) des Zylinders (5) vorgespannt ist und wobei der Verstärkungseinsatz (23) innerhalb der Nase (21) enthalten ist,
und wobei optional der Verstärkungseinsatz

(23) dazu eingerichtet ist, die elastische Verformung der Nase (21) zu verhindern.

7. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei das zweite ringförmige Gehäuse (14) ein konkaves polygonförmiges Profil in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert,

wobei optional das konkave Polygon wenigstens einen konkaven Winkel von etwa 270° aufweist,
und wobei optional die zweite Dichtung (16), welche durch das zweite ringförmige Gehäuse (14) aufgenommen ist, eine asymmetrische Lippendichtung ist.

8. Sattel (1) nach Anspruch 7, wobei die Bodenwand (6) des Zylinders (4) an dem zweiten ringförmigen Gehäuse (14) wenigstens eine Stützstufe (24) bildet, welche das konkave polygonförmige Profil des zweiten ringförmigen Gehäuses (14) in einem zu der axialen Richtung (A-A) parallelen Querschnitt definiert,

wobei die zweite Dichtung (16) ein drei-nasiges Profil (21) oder ein vier-nasiges Profil (21) in dem zu der axialen Richtung (A-A) parallelen Querschnitt definiert,
und wobei wenigstens eine Nase (21) der zweiten Dichtung (16) anliegend gegen die wenigstens eine Stützstufe (24) positioniert ist.

9. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei zwischen dem ersten ringförmigen Gehäuse (13) und dem zweiten ringförmigen Gehäuse (14) entlang eines zu der axialen Richtung (A-A) parallelen Querschnitts die Bodenwand (6) des Zylinders (4) einen Abstand (D) definiert, welcher umfasst ist zwischen:

- 2,0 mm und 6,0 mm; oder
- 2,4 mm und 5,2 mm; oder
- 2,9 mm und 3,8 mm.

10. Sattel (1) nach einem der vorhergehenden Ansprüche, wobei das erste ringförmige Gehäuse (13) in die innere Fläche (25) der Bodenwand (6) führt;

und/oder wobei das zweite ringförmige Gehäuse (14) in die äußere Fläche (26) der Bodenwand (6) führt;
und/oder wobei zwischen dem ersten ringförmigen Gehäuse (13) und der inneren Fläche (25) entlang eines zu der axialen Richtung (A-A) parallelen Querschnitts die Bodenwand (6) einen ersten Abstand (L1) definiert, welcher umfasst ist zwischen:

- 0,5 mm und 4,0 mm; oder
- 1,0 mm und 3,0 mm; oder

gleich 2,8 mm ist,
und/oder wobei zwischen dem zweiten ringförmigen Gehäuse (14) und der äußeren Fläche (26) entlang eines zu der axialen Richtung (A-A) parallelen Querschnitts die Bodenwand (6) einen zweiten Abstand (L2) definiert, welcher umfasst ist zwischen:

- 0,5 mm und 4,0 mm; oder
- 1,0 mm und 3,0 mm; oder

gleich 2,3 mm ist; oder
gleich 2,5 mm ist,
und/oder wobei entlang eines zu der axialen Richtung (A-A) parallelen Querschnitts das erste ringförmige Gehäuse (13) eine Länge aufweist, welche umfasst ist zwischen:

3,0 mm und 4,0 mm; oder
gleich 3,6 mm ist,

und/oder wobei entlang eines zu der axialen Richtung (A-A) parallelen Querschnitts das zweite ringförmige Gehäuse (14) eine Länge aufweist, welche umfasst ist zwischen:

2,5 mm und 5,0 mm; oder
gleich 3,1 mm ist; oder
gleich 3,9 mm ist; oder
gleich 4,7 mm ist,

und/oder wobei entlang eines zu der axialen Richtung (A-A) transversalen Querschnitts das erste ringförmige Gehäuse (13) einen ersten Durchmesser (D1) relativ zu der Drehachse des Drehelements (11) definiert, welcher umfasst ist zwischen:

18,0 mm und 21,0 mm; oder
gleich 19,6 mm ist,

und/oder wobei entlang eines Abschnitts transversal zu der axialen Richtung (A-A), das zweite ringförmige Gehäuse (14) einen zweiten Durchmesser (D2) relativ zu der Drehachse des Drehelements (11) definiert, welcher umfasst ist zwischen:

16,0 mm und 20,0 mm; oder
gleich 16,6 mm ist, oder
gleich 18,6 mm ist;
gleich 19,6 mm ist;

und/oder wobei an dem zweiten ringförmigen Gehäuse (14) die Bodenwand (6) des Zylinders (4) wenigstens eine Stützstufe (24) bildet, wel-

che entlang eines Querschnitt-Abschnitts der axialen Richtung (A-A) einen dritten Durchmesser (D3) relativ zu der Drehachse des Drehelements (11) definiert, welcher umfasst ist zwischen:

- 15,0 mm und 18,0 mm; oder
- 16,0 mm und 17,0 mm; oder

gleich 16,6 mm ist;
und/oder wobei entlang eines Abschnitts parallel zu der axialen Richtung (A-A) die Bodenwand (6) des Zylinders (4) eine Dicke (W) zwischen der inneren Fläche (25) und der äußeren Fläche (26) definiert, welche umfasst ist zwischen:

12,0 mm und 14,0 mm; oder
gleich 13,5 mm ist.

Revendications

1. Étrier de frein à disque (1) comprenant un corps d'étrier (2) agencé en chevauchant un disque de frein présentant un axe de rotation définissant une direction axiale (A-A) et des surfaces de frottement opposées, ledit étrier (1) comprenant des plaquettes (3) logées dans ledit corps d'étrier (2) de manière à pouvoir coulisser sensiblement dans une direction axiale (A-A) par rapport au disque de frein pour agir respectivement sur lesdites surfaces de frottement opposées,

ledit étrier (1) comprenant :

- un cylindre (4), formant une paroi cylindrique (5) et une paroi inférieure (6) transversale à la paroi cylindrique (5) ;
- un piston (7), formant une paroi latérale (8) et une paroi de poussée (9) sensiblement transversale à la paroi latérale (8) et opposée à la paroi inférieure (6) du cylindre (4),

dans lequel ladite paroi inférieure (6) forme une surface intérieure (25) faisant face vers le piston (7) et une surface extérieure opposée (26) faisant face à l'opposé du piston (7),
dans lequel le piston (7) est logé à l'intérieur du cylindre (4), et la paroi latérale (8) du piston (7) est adaptée pour coulisser à l'intérieur de la paroi cylindrique (5) du cylindre (4),
dans lequel le piston (7) est configuré pour être sollicité par un fluide de frein pressurisé injectable à l'intérieur du cylindre (4), pour affecter au moins l'une desdites plaquettes (3) contre l'une desdites surfaces de frottement de disque de frein, le long d'une direction de poussée sensiblement parallèle à la direction axiale (A-A),
ledit étrier (1) comprenant en outre un système de frein de stationnement (10) qui comprend un élément rotatif (11) ;
ledit élément rotatif (11) étant logé en rotation à l'intérieur d'un boîtier de rotation (12) formé dans la paroi inférieure (6) du cylindre (4) de sorte que l'élément rotatif (11) puisse tourner autour d'un axe de rotation sensiblement parallèle à la direction axiale (A-A),
dans lequel le cylindre (4) définit un premier boîtier annulaire (13) et un second boîtier annulaire (14) constitué dans la paroi inférieure (6),
lesdits premier et second boîtiers annulaires (13, 14) s'étendant dans la paroi inférieure (6) dans une direction transversale à la direction axiale (A-A) et menant dans le boîtier de rotation (12),
ledit second boîtier annulaire (14) étant distinct dudit premier boîtier annulaire (13), et étant positionné dans une direction opposée à la surface intérieure (25) de la paroi inférieure (6) par rapport audit premier boîtier annulaire (13),
dans lequel le premier boîtier annulaire (13) loge un premier joint (15), et le second boîtier annulaire (14) loge un second joint (16),
et dans lequel les premier et second joints (15, 16) sont configurés pour agir entre ledit élément rotatif (11) et ladite paroi inférieure (6) du cylindre (4) pour être étanches aux fluides ;
caractérisé en ce que le premier joint (15) comprend un joint torique (19) couplé à une bague d'appui (20),
ladite bague d'appui (20) étant interposée entre ledit joint torique (19) et l'élément rotatif (11), et étant formée de moins de matériau déformable par rapport au matériau constituant le joint torique (19).

2. Étrier (1) selon la revendication 1, dans lequel le système de frein de stationnement (10) comprend un système vis-écrou formé par une vis (17) et un écrou (18),

dans lequel à une rotation de la vis (17) correspond une translation de l'écrou (18), par rapport au corps d'étrier (2), le long d'une direction parallèle à la direction axiale (A-A),
ledit écrou (18) étant configuré pour solliciter au moins l'une desdites plaquettes (3) contre l'une desdites surfaces de frottement du disque de frein,
et dans lequel l'élément rotatif (11) constitue ladite vis (17),
et dans lequel, facultativement, le système vis-écrou définit un filetage, et ledit filetage est du type irréversible.

3. Étrier (1) selon la revendication 1 ou 2, dans lequel le second joint (16) est un racleur.

4. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel le second joint (16) est :

- un joint torique ; ou
- un joint quadrilobe ; ou
- un joint à lèvre symétrique ou asymétrique ; ou
- un joint à lèvre, symétrique ou asymétrique, incorporant un insert de renfort (23), de préférence métallique ; ou
- un joint à lèvre définissant trois lobes (21) dans une section parallèle à la direction axiale (A-A) ; ou
- un joint à lèvre définissant quatre lobes (21) dans une section parallèle à la direction axiale (A-A).

5. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel le second joint (16) est un joint à lèvre qui définit un profil trilobé (21) dans une section parallèle à la direction axiale (A-A),

et dans lequel deux des trois lobes (21) sont sollicités contre l'élément rotatif (11) et l'un des trois lobes (21) est sollicité contre la paroi inférieure (6) du cylindre (5),
et/ou dans lequel deux des trois lobes (21) sont plaqués contre l'élément rotatif (11) à l'opposé l'un de l'autre le long d'une direction parallèle à la direction axiale (A-A),
et/ou dans lequel l'un des trois lobes (21) sollicité contre la paroi inférieure (6) du cylindre (5) est plaqué contre ladite paroi inférieure (6) dans la direction de la surface intérieure (25) de la paroi inférieure (6),
et/ou dans lequel le second joint (16) est un joint à lèvre qui définit un profil quadrilobe (21) dans une section parallèle à la direction axiale (A-A), et dans lequel deux des quatre lobes (21) sont sollicités contre l'élément rotatif (11) et deux lobes (21) opposés sont sollicités contre la paroi inférieure (6) du cylindre (5),
et/ou dans lequel deux des quatre lobes (21) sont plaqués contre l'élément rotatif (11) à l'opposé l'un de l'autre le long d'une direction parallèle à la direction axiale (A-A), et deux lobes (21) opposés sont plaqués contre la paroi inférieure (6) à l'opposé l'un de l'autre le long d'une direction parallèle à la direction axiale (A-A).

6. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel le second joint (16) comprend un corps de joint (22) en matériau polymère, et un insert de renfort (23) incorporé à l'intérieur du corps de joint (22),
dans lequel l'insert de renfort (23) est configuré pour promouvoir la préhension du second joint (16) sur la paroi inférieure (6),
dans lequel, facultativement, le second joint (16) définit un profil trilobé (21) dans une section parallèle à la direction axiale (A-A), et
dans lequel l'un des trois lobes (21) est sollicité contre la paroi inférieure (6) du cylindre (5), et dans lequel l'insert de renfort (23) est incorporé à l'intérieur dudit lobe (21),
et dans lequel, facultativement, l'insert de renfort (23) est configuré pour empêcher toute déformation élastique dudit lobe (21).

7. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel le second boîtier annulaire (14) définit un profil en forme de polygone concave dans une section parallèle à la direction axiale (A-A),

dans lequel, facultativement, ledit polygone concave présente au moins un angle concave d'environ 270°,
et dans lequel, facultativement, le second joint (16) logé dans le second boîtier annulaire (14) est un joint à lèvre asymétrique.

8. Étrier (1) selon la revendication 7, dans lequel la paroi inférieure (6) du cylindre (4) forme, au second boîtier annulaire (14), au moins un pas d'appui (24) qui détermine ledit profil en forme de polygone concave du second boîtier annulaire (14) dans une section parallèle à la direction axiale (A-A),

dans lequel le second joint (16) définit un profil trilobé (21) ou un profil quadrilobe (21) dans la section parallèle à la direction axiale (A-A),
et dans lequel au moins un lobe (21) du second joint (16) est positionné en butée contre ledit au moins un pas d'appui (24).

9. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel, entre le premier boîtier annulaire (13) et le second boîtier annulaire (14), le long d'une section parallèle à la direction axiale (A-A), la paroi inférieure (6) du cylindre (4) définit une distance (D) comprise entre :

- 2,0 mm et 6,0 mm ; ou
- 2,4 mm et 5,2 mm ; ou
- 2,9 mm et 3,8 mm.

10. Étrier (1) selon l'une quelconque des revendications précédentes, dans lequel le premier boîtier annulaire (13) mène dans ladite surface intérieure (25) de la paroi inférieure (6) ;

et/ou dans lequel le second boîtier annulaire (14) mène dans ladite surface extérieure (26)

de la paroi inférieure (6) ;
et/ou dans lequel, entre le premier boîtier annulaire (13) et ladite surface intérieure (25), le long d'une section parallèle à la direction axiale (A-A), la paroi inférieure (6) définit une première distance (L1) comprise entre :

- 0,5 mm et 4,0 mm ; ou
- 1,0 mm et 3,0 mm ; ou

égale à 2,8 mm,
et/ou dans lequel, entre le second boîtier annulaire (14) et ladite surface extérieure (26), le long d'une section parallèle à la direction axiale (A-A), la paroi inférieure (6) définit une seconde distance (L2) comprise entre :

- 0,5 mm et 4,0 mm ; ou
- 1,0 mm et 3,0 mm ; ou

égale à 2,3 mm, ou
égale à 2,5 mm,
et/ou dans lequel, le long d'une section parallèle à la direction axiale (A-A), le premier boîtier annulaire (13) présente une longueur comprise entre :

3,0 mm et 4,0 mm ; ou
égale à 3,6 mm,

et/ou dans lequel, le long d'une section parallèle à la direction axiale (A-A), le second boîtier annulaire (14) présente une longueur comprise entre :

2,5 mm et 5,0 mm ; ou
égale à 3,1 mm ; ou
égale à 3,9 mm ; ou
égale à 4,7 mm,

et/ou dans lequel, le long d'une section transversale à la direction axiale (A-A), le premier boîtier annulaire (13) définit un premier diamètre (D1) par rapport à l'axe de rotation de l'élément rotatif (11) compris entre :

18,0 mm et 21,0 mm ; ou
égal à 19,6 mm,

et/ou dans lequel, le long d'une section transversale à la direction axiale (A-A), le second boîtier annulaire (14) définit un deuxième diamètre (D2) par rapport à l'axe de rotation de l'élément rotatif (11) compris entre :

16,0 mm et 20,0 mm ; ou
égal à 16,6 mm ; ou
égal à 18,6 mm ;
égal à 19,6 mm,

et/ou dans lequel, au second boîtier annulaire (14), la paroi inférieure (6) du cylindre (4) forme au moins un pas d'appui (24) qui définit, le long d'une section en coupe transversale de la direction axiale (A-A), un troisième diamètre (D3) par rapport à l'axe de rotation de l'élément rotatif (11) compris entre :

- 15,0 mm et 18,0 mm ; ou
- 16,0 mm et 17,0 mm ; ou

égal à 16,6 mm ;
et/ou dans lequel, le long d'une section parallèle à la direction axiale (A-A), la paroi inférieure (6) du cylindre (4) définit une épaisseur (W) entre la surface intérieure (25) et la surface extérieure (26) comprise entre :

12,0 mm et 14,0 mm ; ou
égale à 13,5 mm.

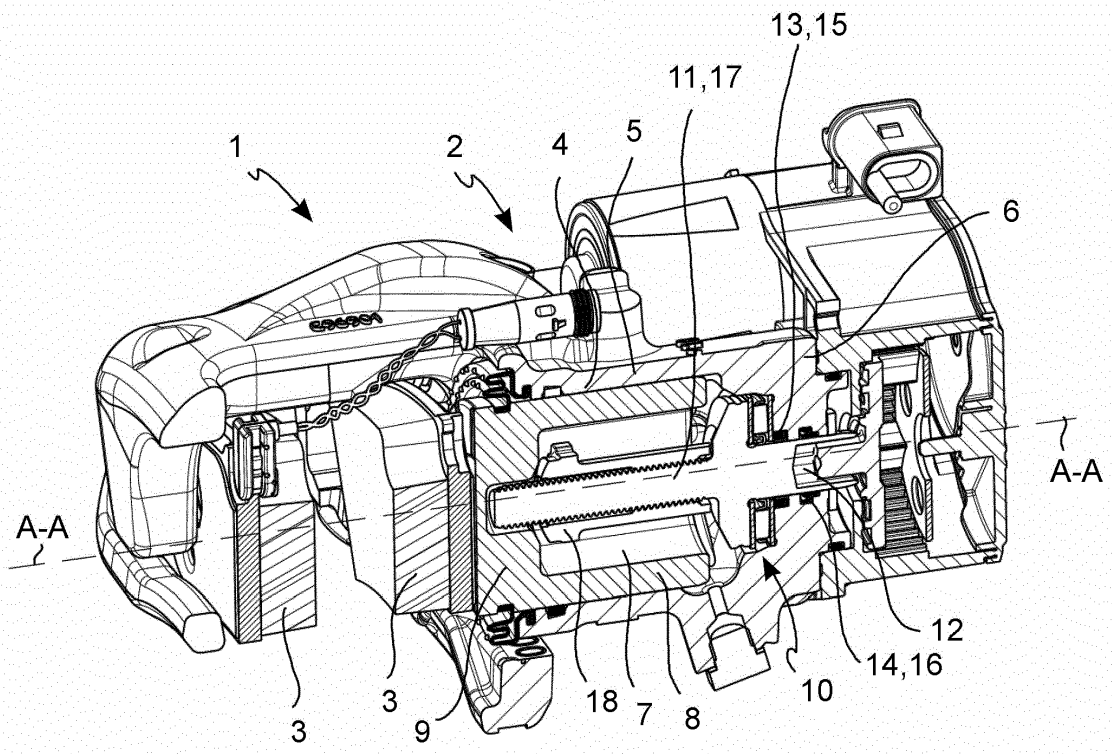
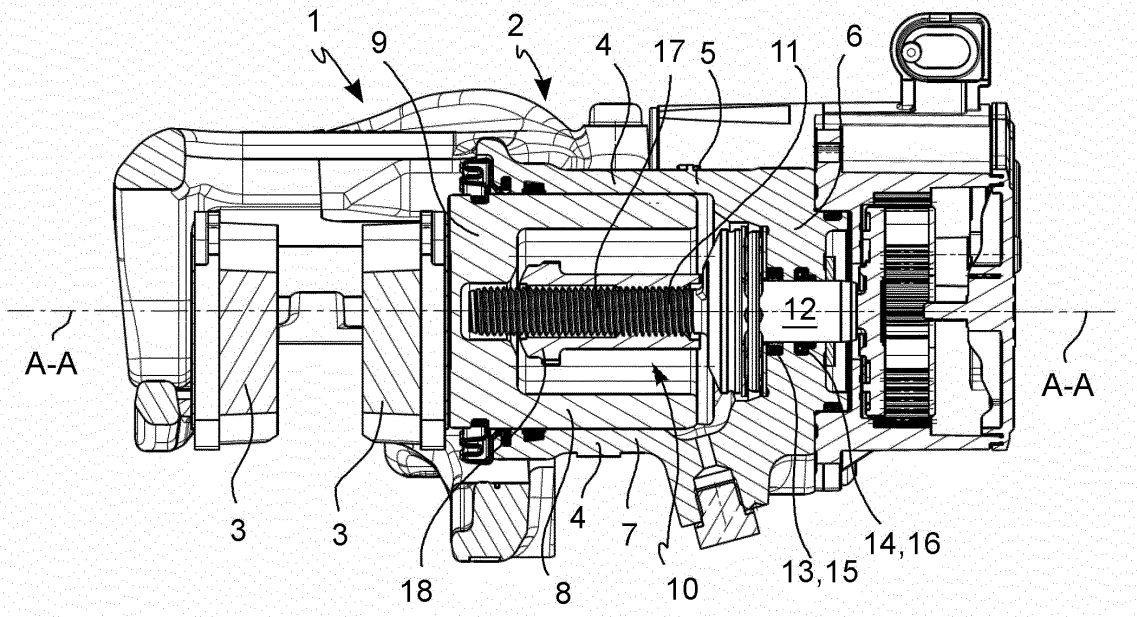

13,15
11,17
1
2
4
5
6
A-A
A-A
12
14,16
10
3
3
9
18
7
8

FIG. 1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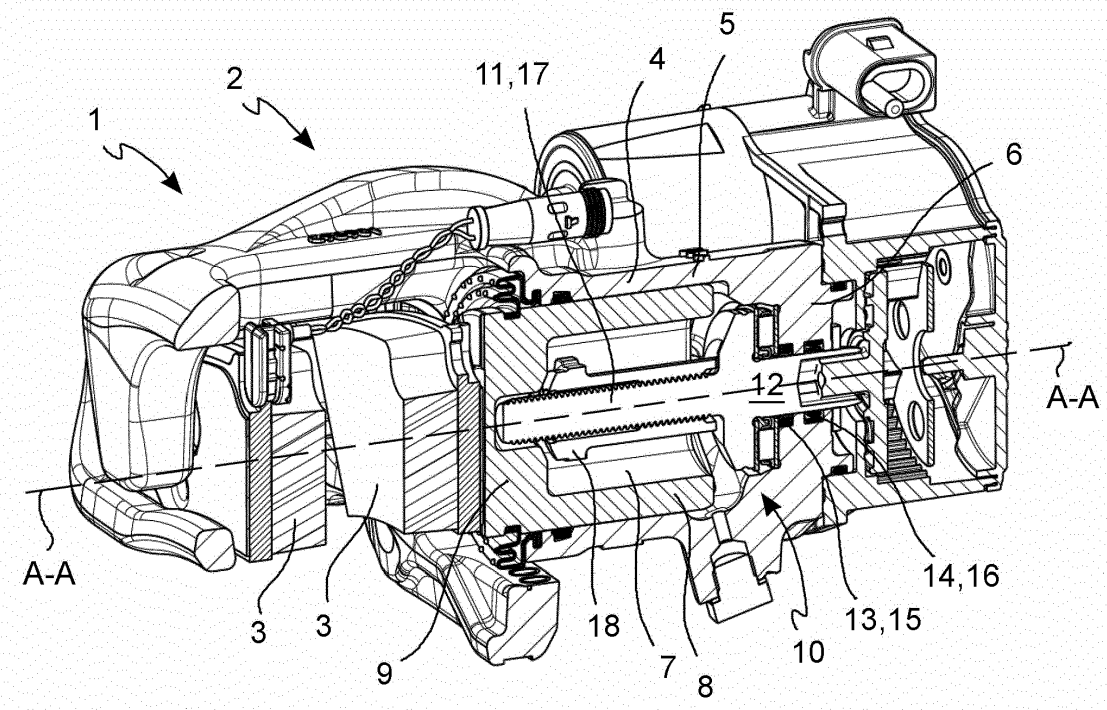
13,15
14,16

FIG. 2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A-A
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FIG. 3

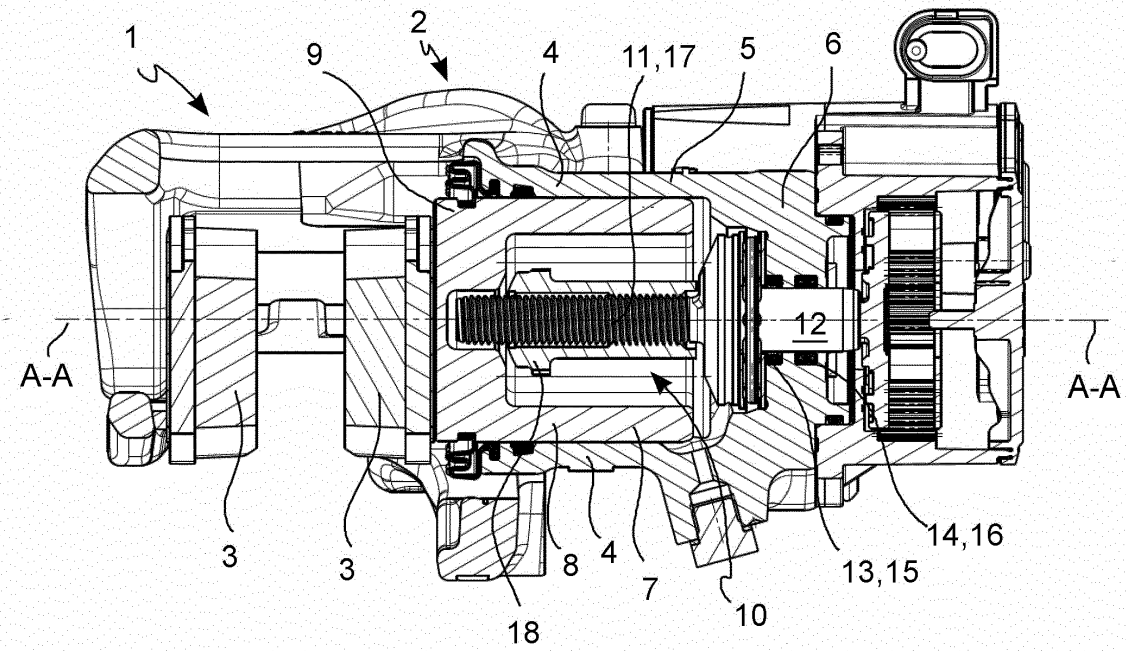
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FIG. 4

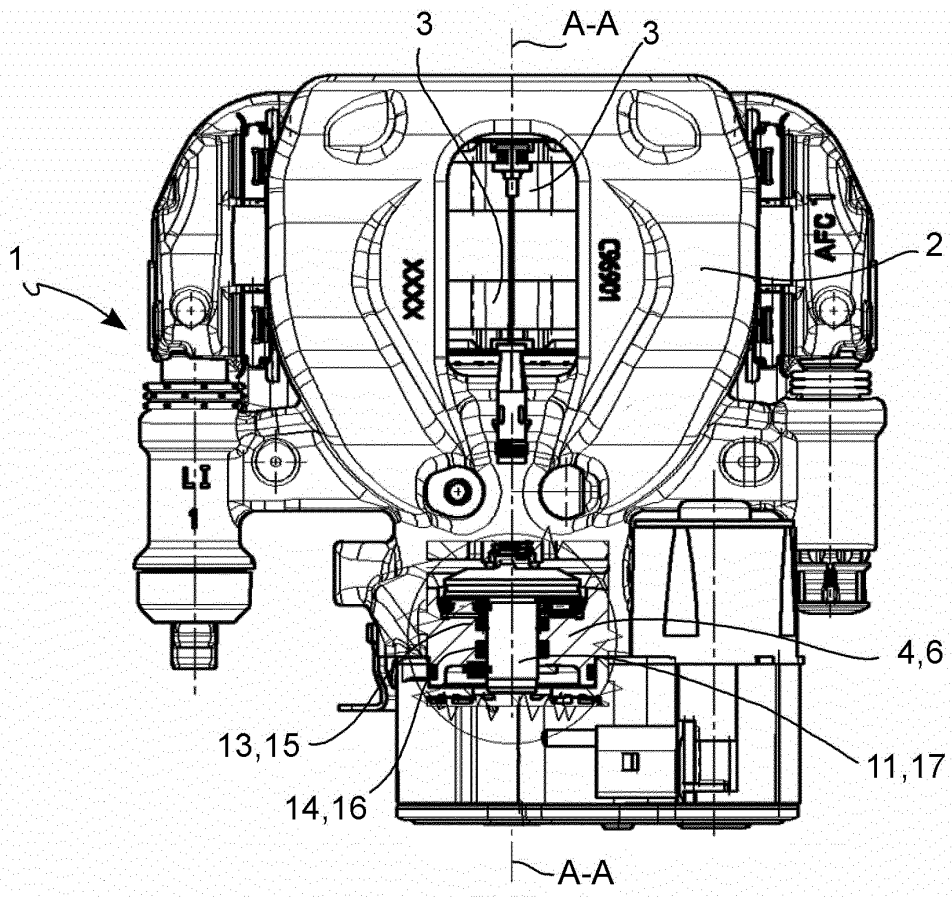
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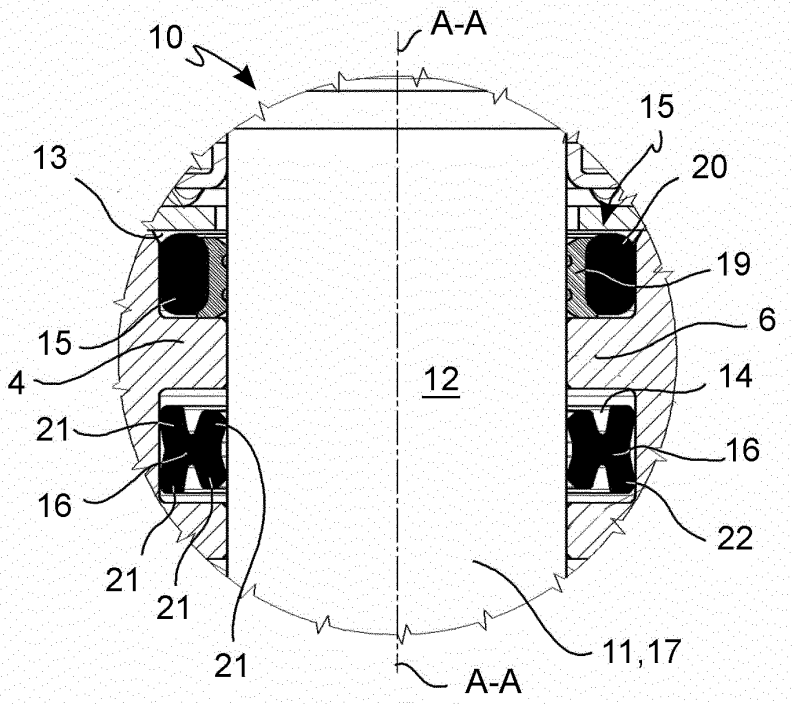
FIG. 5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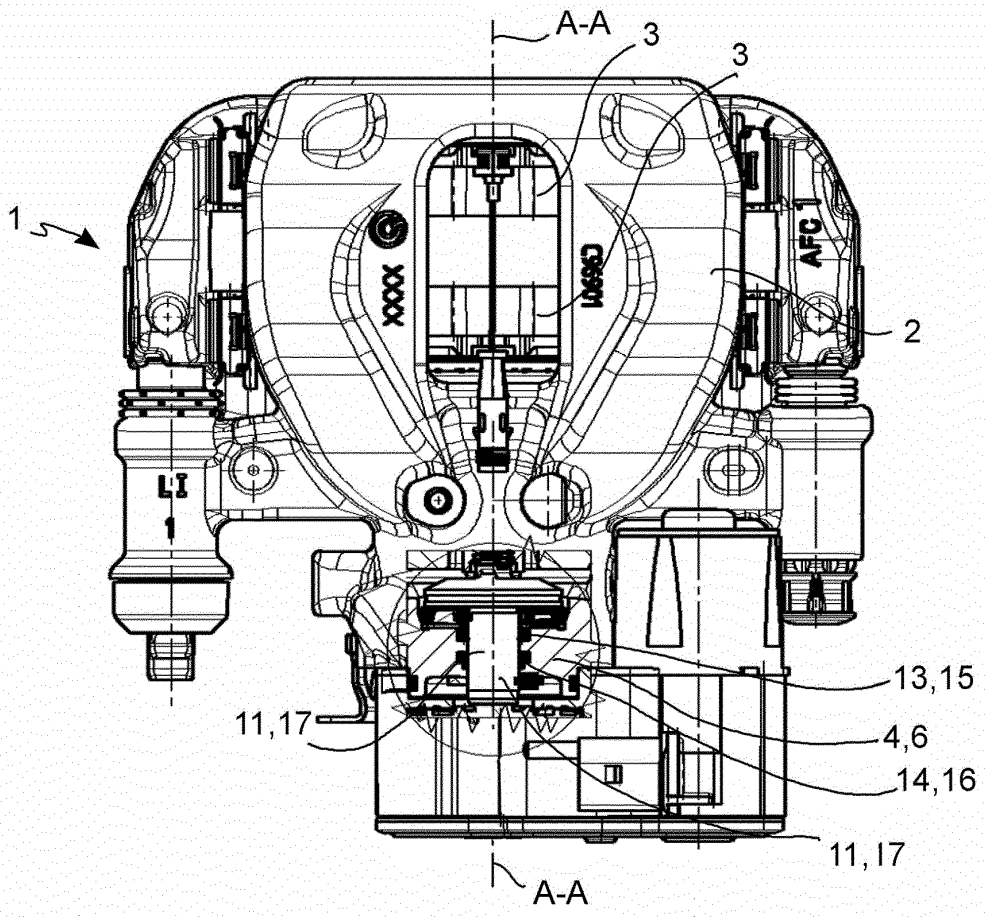
11,17
A-A

FIG. 6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4,6
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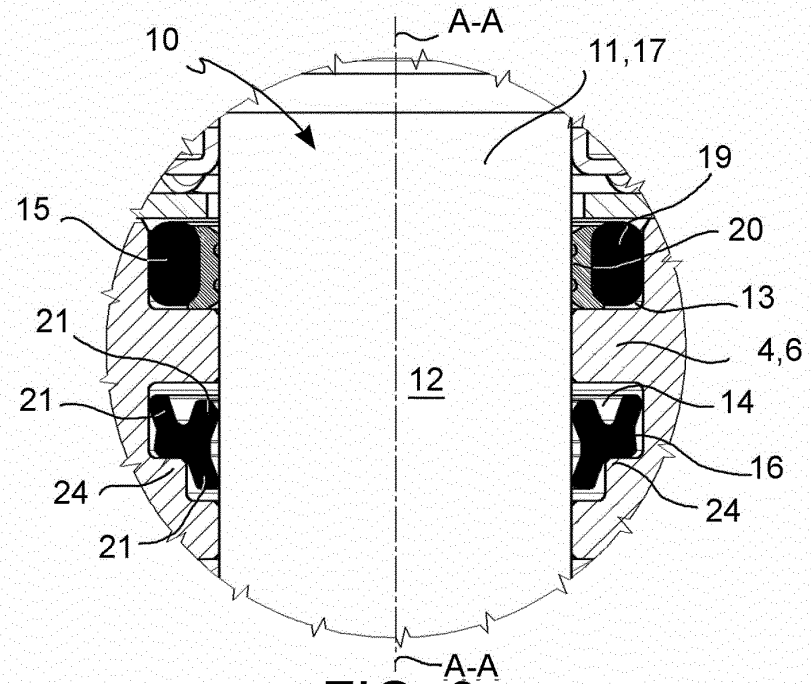
11,17
A-A

FIG. 7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21
A-A

FIG. 8

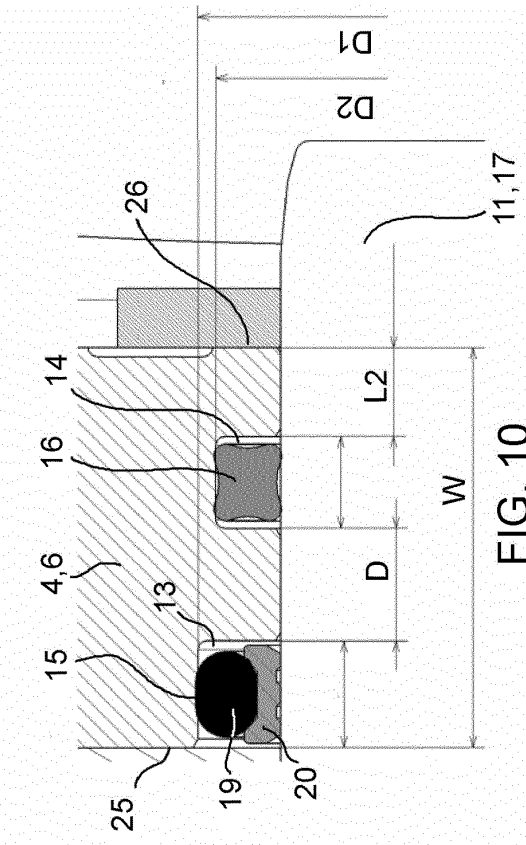

FIG. 10

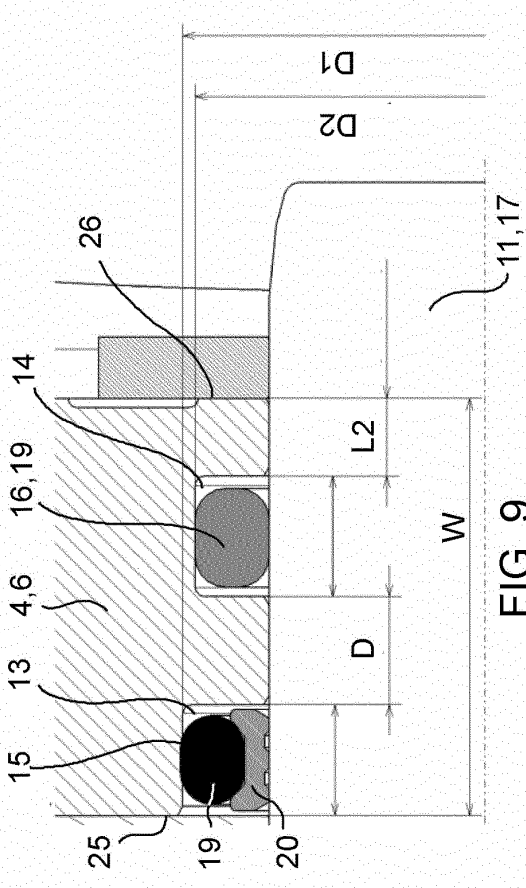

FIG. 9

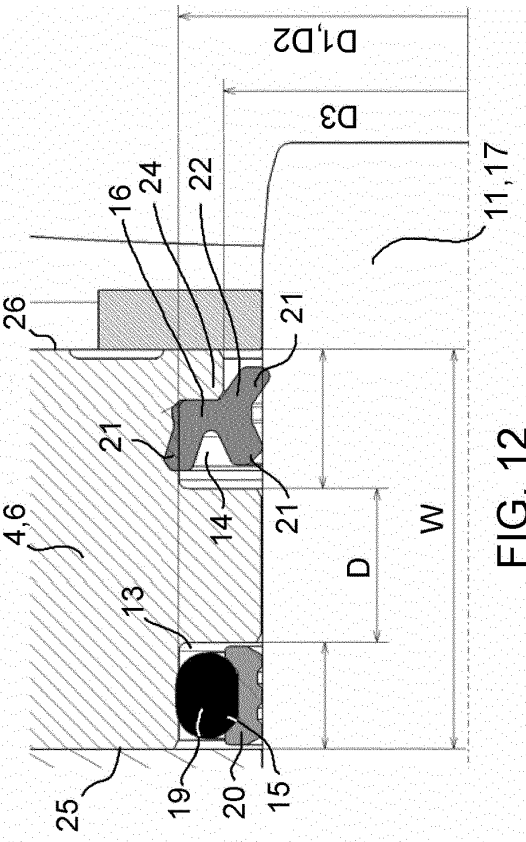

FIG. 12

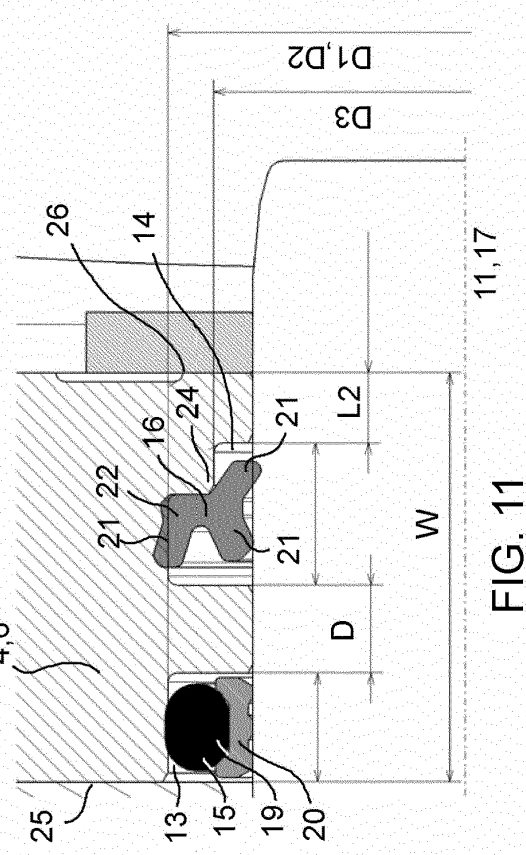

FIG. 11

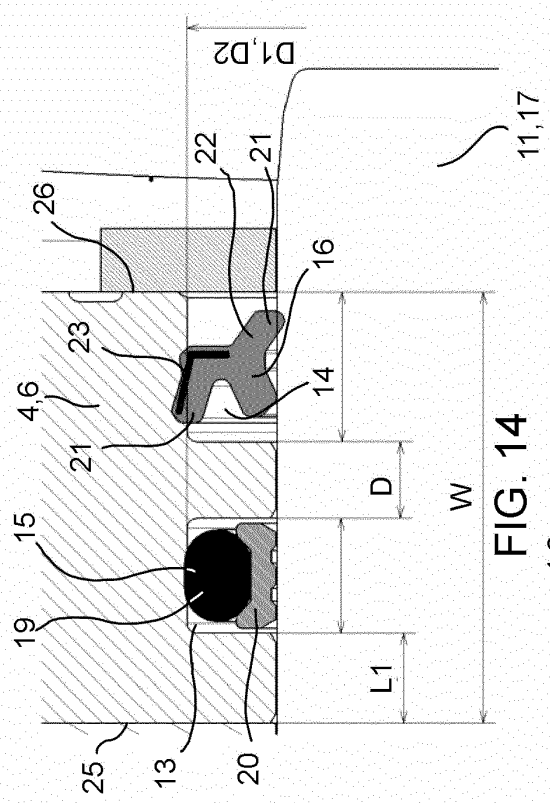

FIG. 14

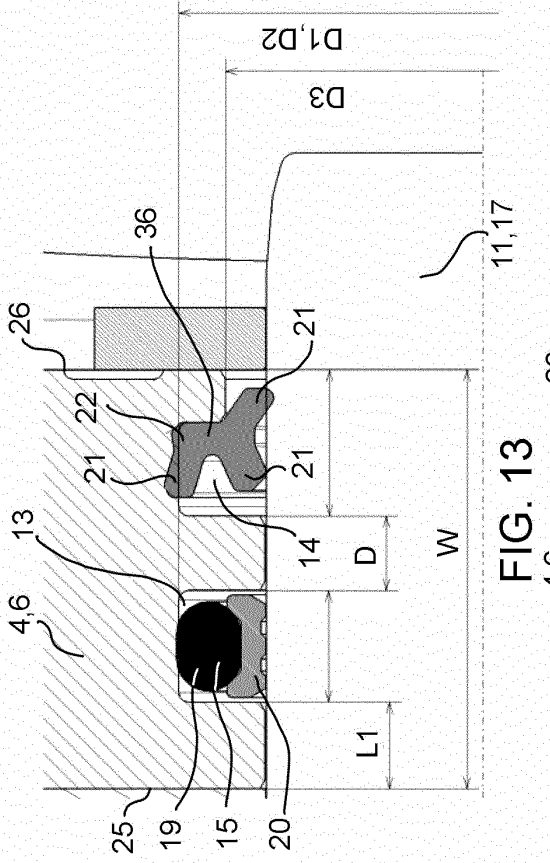

FIG. 13

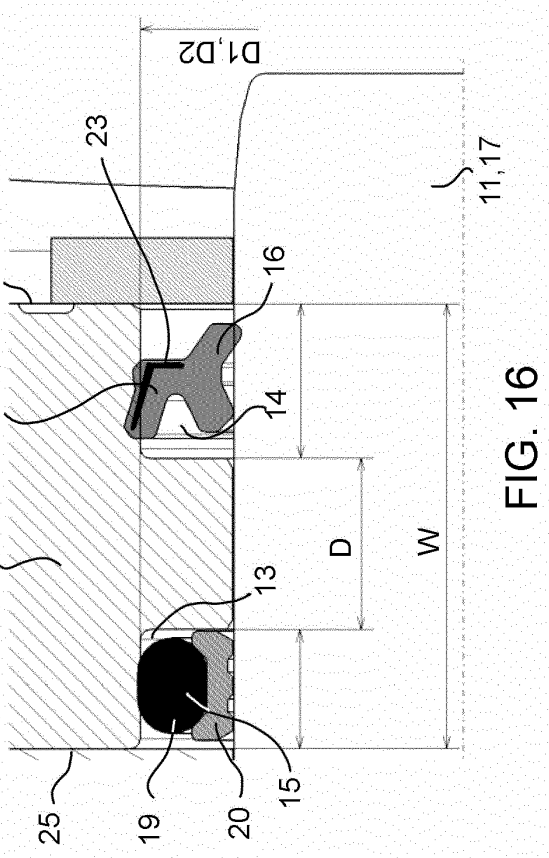

FIG. 16

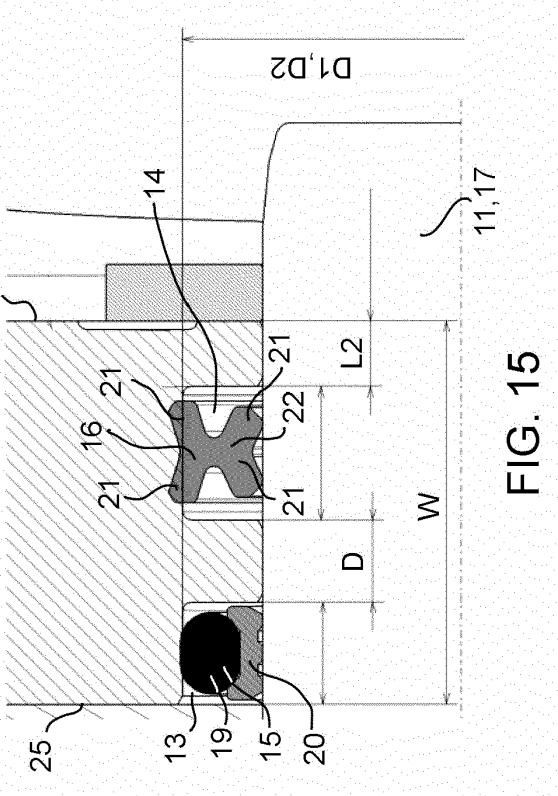

FIG. 15

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2004245055 A1 **[0001]**
- EP 2191160 A1 **[0001]**
- US 2013037357 A1 **[0016]**
- EP 2273149 A1 **[0017]**