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DE-U1- 202012 009 001

Traction cylinder piston unit

The invention relates to a piston unit of a traction cylinder (also known as a pull
5 cylinder).

Various solutions for coupling a piston to a piston rod are known from the state of the art. These solutions include form-fit, force-fit and positive-substance couplings.

10 As far as form-fit and force-fit couplings are concerned, the problem is that measures must be taken to prevent the coupling of the piston and piston rod from loosening.

It is known from the prior art, for example, to screw the piston and the piston rod
15 together. To secure this connection, metal adhesive is used, for example. The disadvantage of this method is that, after hardening, the adhesive may break out between the contours of the thread clearance due to insufficient elasticity under load. Another option is to use additional screw connections, which can be either lock nuts or tensioning elements provided with a counter-rotating thread in the
20 opposite direction.

US 2016/0325778 A1 describes a solution with a piston unit comprising a piston which is split into two parts. In this disclosure, the two parts of the piston are screwed against one another. The disadvantage of this solution is that the screw
25 connection can become loose or come apart under operational load, unless additional measures are taken.

The solutions described do not actually provide a completely secure connection, especially in cases in which exact positioning during the extension and retraction of
30 the piston rod is important or when the piston unit is exposed to high dynamic loads. If retaining elements are used to prevent loosening, there is a risk that these themselves may become loose or come apart.

It is also known from the prior art to provide a piston unit by means of a positive-substance connection. Such solutions can prevent loosening but involve other disadvantages. Welded connections are known, in particular, but they require the
5 deployment of specially qualified personnel, are time-consuming and cost-intensive and disadvantageously cause thermal stress on the coupling partners. Furthermore, they have the disadvantage that it is practically not possible to disassemble such positive-substance connections.

10 Furthermore, DE 20 2012 008 999 U1 discloses a very reliable solution for a form-fit coupling of a piston and a piston rod by means of a spring-loaded coupling ring, although in this case one of the coupling partners must be provided with a deeper ring groove.

15 In addition, DE 20 2012 009 001 U1 shows a similar form-fit coupling but this solution relates to the coupling between a cylinder tube and a closure part.

The task of the invention is to provide a piston unit for a traction cylinder that is particularly reliable concerning the coupling, results in cost savings in production
20 and enables easy assembly and disassembly.

The task is solved by the features specified in claim 1. Preferred further developments result from the sub-claims.

25 According to the invention, the traction cylinder piston unit comprises a piston rod, a piston as well as a coupling ring and a fixing ring.

The coupling ring and the fixing ring are also hereinafter collectively referred to as the piston rings.

30

The piston rod according to the invention comprises an outer ring groove.

The cross-sectional shape of the outer ring groove corresponds to the cross-sectional shape of the coupling ring. The outer ring groove is designed in such a way that it can partially receive the coupling ring. The cross-sectional shape of the coupling ring is preferably circular, and the cross-sectional shape of the outer ring groove is preferably semicircular. However, other cross-sectional shapes, for example rectangular cross-sections, are also possible.

According to the invention, the coupling ring is split, preferably in two parts. For easy assembly, the coupling ring is preferably designed in two parts so that it can be easily inserted into the outer ring groove without tools. In a two-part design, each coupling ring section encloses an angle of about 180 degrees.

According to the invention, the piston has an axial bore hole in which the piston rod is received. At a piston crown side end of the piston, an inner ring groove is arranged which is axially open on one side towards the piston crown side end. The inner diameter of the axial bore hole is larger than the outer diameter of the piston rod. Thus, the piston rod can be inserted into the axial bore hole. The piston crown side end, at which the axially open inner ring groove is located, is arranged at the side of the piston facing away from the load.

20

The piston crown side end of the piston is to be understood to be the side of the piston that points in the direction of the piston chamber and is not subject to the full operating pressure of the fluid when the piston unit is arranged as intended in a working cylinder which is designed as a traction cylinder. The piston rod side end is axially opposite the piston crown side end. The piston rod side end is also referred to as the guide side end. The piston rod side end of the piston is understood to be the side of the piston that, when the piston unit is arranged as intended in a traction cylinder, points in the direction of the piston rod chamber and is subject to the operating pressure of the fluid in order to generate a force in the pulling direction, hereinafter also referred to as the traction force. The pulling direction is the direction in which the piston moves when hydraulic pressure is applied to the piston ring space. Hereinafter, the pulling direction is also referred to as the retraction

30

direction. The direction opposite to the retraction direction of the piston unit is the extension direction.

According to the invention, the inner ring groove of the piston is characterized by
5 the fact that it comprises a coupling ring section and a fixing ring section. The coupling ring section and the fixing ring section are formed by the shape of the contour of the inner ring groove.

The coupling ring section is designed to radially enclose the multi-part coupling ring.
10 In this design, the contour of the coupling ring section and the section of the outer contour of the coupling ring facing the inner ring groove preferably correspond to each other. Preferably, the coupling ring has a circularly convex cross-section and thus the coupling ring section has a part-circularly, in a preferred embodiment a quarter-circularly, concave shape. Here, the contour of the coupling ring section is
15 shaped such that it is open on one side, allowing the piston to be axially pushed onto the inserted coupling ring.

The fixing ring section is adjacent to the coupling ring section. And the contour of the fixing ring section also preferably corresponds to the outer contour of the fixing
20 ring. Furthermore, the fixing ring section comprises an undercut contour. For the purposes of this application, this contour is understood to be a contour that has a recess so that a flank is formed at which the inserted fixing ring rests in the extension direction.

25 According to the invention, the outer ring groove and the coupling ring section together form a coupling ring groove space in which, according to the invention, the coupling ring is arranged.

According to the invention, the coupling ring is radially enclosed by the coupling ring
30 section. Radially enclosed means that the coupling ring is covered on its outer side at least to such an extent that it cannot fall out of or be removed from the coupling ring groove space. Once the coupling ring has been inserted in the outer ring

groove, the piston is pushed with the inner ring groove over the coupling ring up to the point at which the coupling ring has reached the coupling ring section. In this way, the coupling ring is fixed in its position in a form-fit manner.

- 5 In the pulling direction, the piston is axially fixed by the coupling ring on one side on the piston rod in a form-fit manner according to the invention. The coupling ring functions such that it limits, in a form-fit manner, the axial movability of the piston on the piston rod in the direction of the load-bearing coupling ring. When the piston unit moves towards the pulling direction, a compressive force is applied to the piston
- 10 ring surface due to the application of a hydraulic fluid under operating pressure to the piston rod chamber. First, the piston transfers the force to the piston ring via the contour of the inner ring groove in the coupling ring section. Then, the piston ring transfers the force to the piston rod via the outer ring groove.
- 15 According to the invention, the fixing ring is arranged in the fixing ring section between the undercut contour and the coupling ring. The fixing ring is provided in one piece.

- The fixing ring is designed to be resilient and, in a relaxed position, it engages in
- 20 the space between the undercut contour and the coupling ring in the area of the outer ring groove. When the piston has been installed, the inner ring groove remains axially accessible on one side, i.e., on the piston crown side. From where, when the piston has been installed, the resilient fixing ring is inserted into the inner ring groove in the area described. It has the only function to fix the piston position
- 25 on the piston rod and, in contrast to the coupling ring, it is not loaded with the full operating load when the traction cylinder is in operation.

- The fixing ring axially fixes the piston on one side on the piston rod in an extension direction in a form-fitting manner. The extension direction is the direction of the
- 30 movement of the piston opposite the pulling direction, wherein the force that causes the extension direction is usually applied by the external tensile load on the piston rod or, if necessary, by a reduced operating pressure on the piston crown side. In

this design, the fixing ring rests on one side on the undercut contour and, on the other side, on the coupling ring for a form-fit fixation. The comparatively low force to be transmitted between the piston rod and the piston by the fixing ring acts on the undercut contour of the fixing ring section. That means that the forces for an

5 actively effected movement of the piston unit in the extension direction, which is caused by pressure application to the piston chamber, are indirectly transmitted from the piston to the fixing ring first, then from the fixing ring to the coupling ring and from the coupling ring to the piston rod.

10 In the case of a possibly passive retraction, which could be caused by a thrust load on the piston rod, the forces are also indirectly transmitted in the reverse order, i.e., from the piston rod indirectly to the coupling ring first, then from the coupling ring to the fixing ring and from the fixing ring to the piston.

15 In the interaction of the outer ring groove, the coupling ring and the fixing ring as well as the inner ring groove with its special design, the piston is axially fixed relative to the piston rod in a form-fit manner in both directions.

The traction piston unit has the specific advantages described below.

20

A first advantage is given by the fact that the piston is completely fixed in a form-fit manner on the piston rod. This design has the advantage of reliably preventing the piston from becoming loose or coming apart during operation.

25 Furthermore, preload forces that would reduce the operational load capacity do not exist.

It is particularly advantageous that the piston rod only needs to be machined to a very small extent during production. It is only necessary to machine a groove in the

30 outer ring. Thus, damages to the piston rod during machining are avoided and a high level of concentricity is made possible. This advantage is particularly effective here because a piston rod of a traction cylinder must have an only low buckling

stability and can therefore be designed with a particularly high slenderness ratio, resulting in material savings.

A particular advantage is that only a single outer ring groove is to be machined into the piston rod. This reduces the time required for machining operations. In addition, the outer ring groove is located near the piston crown side end of the piston rod and thus outside the critical zone of the piston rod for buckling loads. In particular, grooves or changes in the cross-section of the piston rod in the area of the guide side end of the piston and thus notch effects in this critical area can be avoided.

Furthermore, a particular advantage is the simple manner of assembly. Assembly can be carried out completely without tools. Moreover, the piston unit according to the invention is not susceptible to assembly errors, since the components cannot be assembled incorrectly thanks to their geometry. Another advantage is given by the fact that neither chips nor any other contamination are/is produced during assembly. In addition, the piston unit can be used immediately, since curing times do not have to be taken into consideration as it is the case with metal adhesives, in particular. Furthermore, there is the advantage of easy disassembly so that repairs can also be carried out quickly and easily and, if necessary, by semiskilled personnel.

According to an advantageous further development, the fixing ring has a flattened radial cross-section, hereinafter also referred to as an ovalized cross-section in some cases. The fixing ring is preferably designed as a so-called BOA spring ring, where BOA stands for Bevel-Oval-Application. This ovalized cross-section has the advantage that, firstly, it has a smaller axial extent than a round ring and therefore requires less installation space. Furthermore, the fixing ring formed in this way can rest with an ovalized flat flank over a large area on the then easily shapable undercut contour, thus avoiding high surface pressure values.

In this further development, the ovalized cross-section of the fixing ring is preferably designed as a flattened radial cross-section. The flattened radial cross-section has a cross-sectional longitudinal axis and a cross-sectional transverse axis.

- 5 The cross-sectional longitudinal axis and the cross-sectional transverse axis are orthogonally positioned with respect to each other. The two axes can be inscribed in the flattened radial cross-section. Wherein the cross-section extends longer along the cross-sectional longitudinal axis than along the cross-sectional transverse axis.

10

Along the cross-sectional longitudinal axis, the cross-section comprises opposing flat boundaries which form a first and a second ring or annular surface. The boundaries of the cross-section are designed to be substantially parallel and, with respect to a main longitudinal axis, inclined. Each of the annular surfaces is
15 arranged on an inner side and on an outer side of the fixing ring. In the sense of geometry, the annular surfaces substantially correspond to a lateral surface of a truncated cone.

20

In this further development, the fixing ring is also elastically resilient. For this purpose, the fixing ring is made of a flexible and resilient material, preferably of spring steel. Thus, the fixing ring is capable to react to a load force by elastic deformation.

25

According to the invention, the fixing ring is designed to adopt a tensioned position under the influence of a force and a relaxed position without the influence of a force. In the tensioned position, the fixing ring is elastically deformed by the acting force and is thus tensioned. When the force is not applied any longer, the fixing ring returns to its relaxed position.

30

In a relaxed position, the cross-sectional longitudinal axis is inclined by an angle α with respect to a ring plane.

The ring plane is understood to be the plane that is arranged orthogonally to the main longitudinal axis of the fixing ring. Furthermore, the circumferential ring axis is understood to be the circular entirety of the points of intersection of the respective cross-sectional transverse axis with the cross-sectional longitudinal axis in all cross-sections. The ring plane and the circumferential ring axis are parallel to each other.

The angle α is preferably between 20 and 70 degrees, in a particularly preferred design between 45 and 60 degrees. This results in a conical shape of the fixing ring.

The fixing ring can be tensioned to a tensioned position by deformation with a change in the longitudinal cross-section around the circumferential ring axis, wherein the cross-sectional longitudinal axis is inclined at an angle β in the tensioned position, and the angle β is greater than the angle α .

When the fixing ring is tensioned by means of an acting force, the fixing ring deforms such that the cross-sectional longitudinal axis straightens up towards the ring plane. Thus, the angle between the cross-sectional longitudinal axis and the ring plane becomes greater than in the relaxed position. Preferably, the difference between the angle α and the angle β is more than 20 degrees.

The deformation caused by a torsion around the circumferential ring axis overlaps with a radial expansion when entering the fixing ring section of the inner ring groove. When the fixing ring is inserted into the fixing ring section of the inner ring groove and brought into its relaxed position, both the inner diameter and the outer diameter increase. However, the difference between the inner diameter and the outer diameter also increases. If the inner and outer diameters are projected onto the ring plane or onto a plane parallel to the ring plane, a projection area of the fixing ring is created. The projection area can also be referred to as the axial overlap area.

The axial overlap area decreases in the tensioned position and increases in the relaxed position.

5 This makes it possible, as a special advantage of this favourable further development, to make the ring gap for inserting the fixing ring particularly narrow and, thus, the undercut contour comparatively wide and consequently with a comparatively large area so that high surface pressure values are avoided.

10 Another advantage is that the fixing ring can provide higher forces against the elastic deformation by a torsion around the circumferential ring axis than, for example, by a mere radial expansion or radial compression.

15 In a particularly preferred design, the fixing ring is provided with a wedge-shaped flattening on both sides, wherein the wedge shape acts in the relaxation direction. If a beginning motion clearance between the piston, the piston rings and the piston rod is generated by alternating movements in the pulling direction and the extension direction, the fixing ring will be capable to continue to further relax and penetrate deeper with its wedge shape into the space between the coupling ring and the undercut and, thus, cancel out a motion clearance.

20

The invention is explained as an exemplary embodiment in more detail by means of the following figures. They show:

25 Fig. 1 Partially sectional view of the piston unit in a first exemplary embodiment with a fixing ring with a round cross-section

Fig. 2 Partially sectional view of the piston unit in a second exemplary embodiment with a fixing ring with an ovalized cross-section

30 Fig. 3 Detailed sectional view of the piston with inner ring groove

Fig. 4 Axial view of the piston rod with coupling ring

Fig. 5 Fixing ring with ovalized cross section according to the second exemplary embodiment (top view and axial section)

- 5 Fig. 6 Fixing ring with ovalized cross-section according to the second exemplary embodiment (functional scheme).

Fig. 1 shows a first exemplary embodiment of the traction cylinder piston unit with a fixing ring with a round cross-section in a partially sectional view.

- 10 In this figure, the traction cylinder piston unit is shown in the assembled state. The traction piston unit comprises a piston rod 1, a piston 2, a coupling ring 3 and a fixing ring 4.

The piston 2 has an axial bore hole 2.1 into which the piston rod 1 is inserted.

- The diameter of the axial bore hole 2.1 corresponds to the outer diameter of the piston rod 1 and is selected such that the piston rod 1 can be placed on the piston 2 without a radial clearance. At the piston crown side end 2.2, the diameter of the axial bore hole 2.1 is larger, thus making it possible to insert the fixing ring 4 during the assembly process, as described in more detail below. The piston rod 1 has an outer ring groove 5. Furthermore, the piston 2 has a corresponding inner ring groove 6. The inner ring groove 6 is divided into two sections. These sections are the coupling ring section 6.1 and the fixing ring section 6.2, wherein the fixing ring section 6.2 comprises the undercut contour 6.3. In the assembled state, the coupling ring 3 rests in the annular space enclosed by the coupling ring section 6.1 and the outer ring groove 5 of the piston rod 1.

- 25 After insertion, the fixing ring 4 is arranged behind the coupling ring 3 in the fixing ring section 6.2 and fixes the coupling ring 3 in its position. When a shearing load acts on the traction cylinder piston unit during an active extension movement, the undercut contour 6.3 absorbs the forces acting on the fixing ring 4.

- 30 Fig. 2 shows a further exemplary embodiment of the traction cylinder piston unit, in which the fixing ring 4 has an ovalized cross-section. In Fig. 2, the traction cylinder piston unit is also shown in an assembled state. The piston 2 has an axial bore hole

2.1, the inner diameter of which is adjusted to the outer diameter of the piston rod 1 in such a way that the piston rod 1 can be received in the axial bore hole 2.1 without radial clearance. The piston rod 1 has the outer ring groove 5, which has a semicircular contour in this embodiment. The coupling ring 3 is arranged in the
5 outer ring groove 5 and, as shown in more detail in Fig. 4, is divided into two parts.

The piston 2 has an inner ring groove 6 with a specially designed contour. Here, the inner ring groove 6 comprises a coupling ring section 6.1 and a fixing ring section 6.2. Together with the outer ring groove 5, the coupling ring section 6.1 forms a
10 coupling ring groove space 7, the arrangement of which is indicated by means of a dashed line in Fig. 3. The coupling ring 3 is arranged in this coupling ring groove space 7. The coupling ring 3 is radially enclosed by the coupling ring section 6.1 and thus fixed in its position.

The fixing ring 4 has a resilient design and oval shape with flattened sides. Thus, it
15 occupies the space between the coupling ring 3 and the undercut contour 6.3 of the piston 2 and rests against the undercut contour 6.3. The fixing ring 4 blocks the axial movement of the piston relative to the piston rod 1 in the pulling direction in a form-fitting manner. The interaction of the coupling ring 3 and the fixing ring 4 axially fixes the piston 2 relative to the piston rod 1 in both directions.

20

Fig. 3 shows a sectional view of the piston 2, which illustrates in particular the design of the inner ring groove 6 in more detail. The inner ring groove 6 is provided in the inner wall of the axial bore hole 2.1 of the piston 2. The inner ring groove 6 comprises the coupling ring section 6.1 and the fixing ring section 6.2. The coupling
25 ring section 6.1 provides the axial form fit between the coupling ring 3 and the piston 2.

The undercut contour 6.3 is a part of the fixing ring section 6.2 and provides the axial form fit between the fixing ring 4 and the piston 2.

30 Fig. 4 shows the coupling ring 3 with the piston rod 1 in more detail. In this embodiment, the coupling ring 3 is divided into two parts. The two halves of the coupling ring 3 are inserted into the outer ring groove 5. For the purpose of a better

illustration, Fig. 3 shows one part of the coupling ring 3 (on the right) as being already inserted into the outer ring groove 5 and the other part of the coupling ring 3 (on the left) being still in an unmounted state. The arrow indicates the radial assembly direction for this part of the coupling ring 3.

5

A possible assembly of the traction cylinder piston unit is described below, thus summarizing Figs. 1 to 4.

10 In a first procedural step, the two parts of the split coupling ring 3 are inserted into the outer ring groove 5 of the piston rod 1 in a radial movement direction.

Subsequently, the piston 2 is placed on the guide side end of the piston rod 1 and pushed on the piston rod 1 in the direction of the piston crown side end 2.2 until the inner ring groove 6, which is open on one-side, slides over the coupling ring 3, and
15 the coupling ring 3 is arranged in the coupling ring groove space 7 formed by the coupling ring section 6.1 and the outer ring groove 5. Now, the coupling ring 3 is radially enclosed by the piston 2 with its inner ring groove and cannot fall out of the outer ring groove 5 any longer. Furthermore, the outer contour of the coupling ring 3 rests in a form-fit manner in the outer ring groove 5 and in the coupling ring section
20 6.1 so that the piston 2 is axially fixed with respect to the piston rod 1 in the pulling direction and is capable to transfer forces acting axially in the pulling direction to the piston rod 1 during operation.

To fix the piston position, the flexible fixing ring 4 is inserted from the piston crown
25 side end 2.2 of the piston 2 into the axial bore hole 2.1. When it reaches the fixing ring section 6.2, it expands and enters the fixing ring section 6.2. Thus, a form-fit connection is established to the undercut contour 6.3 and the fixing ring 4. For this purpose, the fixing ring 4 is designed as an annular ring in the first embodiment and as a flexible conical ring with an oval-bevelled cross-section in the second
30 embodiment.

Figures 5 and 6 show the fixing ring in a particular embodiment with a flattened radial cross section 4.2.

Figure 5 (a) shows a top view of the fixing ring 4. In this embodiment, the fixing ring
5 4 comprises a fixing ring gap 4.1.

Figure 5 (b) shows a sectional view along the sectional plane (A-A) of the fixing ring. This figure shows the flattened radial cross section 4.2 of the fixing ring 4 in an enlarged view. The cross-sectional longitudinal axis 4.3 and the cross-sectional transverse axis 4.4 are inscribed in this cross section 4.2. The ring plane 4.5 goes
10 through their points of intersection. The outer diameter 4.9 and the inner diameter 4.8 are formed by rounded contours. The two boundaries parallel to the cross-sectional longitudinal axis 4.3 form the two annular surfaces 4.6, 4.7, wherein the first annular surface 4.6 represents the radial inner side and the second annular surface 4.7 represents the radial outer side of the fixing ring 4.

15 The angle α is enclosed between the cross-sectional longitudinal axis 4.3 and the ring plane 4.5.

Fig. 6 shows a functional scheme of the tensioned fixing ring 4. Here, the relaxed position is shown in the upper section of the figure and the tensioned position
20 (indicated by a dashed line) is shown in the lower section. The representation is analogous to Figure 5 (b).

In the tensioned position, the angle between the cross-sectional longitudinal axis 4.3 and the ring plane 4.5 increases. This angle in the tensioned position is indicated as angle β in the lower section of the figure.

25 The axial coverage area 4.10 is limited by the inner and outer diameter 4.8, 4.9 of the fixing ring 4, which is projected onto the ring plane 4.5 in Fig. 6. For the purpose of a better overview, this representation shows the axial coverage area 4.10 outside the actual ring plane 4.5 by two perpendicular auxiliary lines on the inner diameter 4.8 and the outer diameter 4.9

30 When the angle is increased, the axial coverage area 4.10 is reduced in the tensioned position. The axial coverage area 4.10 is shown as a dashed bold line in the tensioned position and as a continuous bold line in the relaxed position.

List of reference numerals

	1	Piston rod
	2	Piston
5	2.1	Axial bore hole
	2.2	Piston crown side end
	3	Coupling ring
	4	Fixing ring
	4.1	Ring gap
10	4.2	Flattened radial cross section
	4.3	Cross-sectional longitudinal axis
	4.4	Cross-sectional transverse axis
	4.5	Ring plane
	4.6	First annular surface
15	4.7	Second annular surface
	4.8	Inner diameter
	4.9	Outer diameter
	4.10	Axial coverage area
	5	Outer ring groove
20	6	Inner ring groove
	6.1	Coupling ring section
	6.2	Fixing ring section
	6.3	Undercut contour
	7	Coupling ring groove space
25	α	Angle alpha
	β	Angle beta

Patentkrav

1. Stempelenhed af en trækcylinder,
omfattende en stempelstang (1), et stempel (2), en koblingsring (3) og en fikseringsring (4),
5 hvor stempelstangen (1) har en ydre ringrille (5),
hvor stemplet (2) har et aksialt borehul (2.1), hvori stempelstangen (1) er optaget, og en indre ringrille (6), som er aksialt åben på den ene side mod en ende (2.2) på stempelkronesiden,
10 hvor den indre ringrille (6) har en koblingsringsektion (6.1) og en fikseringsringsektion (6.2), der grænser op hertil, og hvor fikseringsringsektionen (6.2) har en underskåret kontur (6.3)
hvor den ydre ringrille (5) og koblingsringsektionen (6.1) danner et koblingsringsrillerum (7), hvori koblingsringen (3) er anbragt,
15 hvor koblingsringen (3) har en delt udformning og er radialt omsluttet af koblingsringsektionen (6.1),
og hvor stemplet (2) ved hjælp af koblingsringen (3) er fastgjort aksialt formltilpasset på den ene side på stempelstangen (1) i en trækretning,
hvor fikseringsringen (4) er anbragt i fikseringsringssektionen (6.2) mellem den
20 underskårne kontur (6.3) og koblingsringen (3),
hvor fikseringsringen (4) har en elastisk udformning, og i en afslappet stilling går den i indgreb med fikseringsringsektionen (6.2) af den indre ringrille (6), og
hvor fikseringsringen (4) fastgør stemplet (2) aksialt og formltilpasset på den ene side på stempelstangen (1) i returretning,
25 **karakteriseret ved,**
at fikseringsringen (4) har et affladet radiale tværsnit (4.2),
at det affladede radiale tværsnit (4.2) har en langsgående tværsnitsakse (4.3) og en tværgående tværsnitsakse (4.4),
at tværsnittet (4.2) strækker sig længere langs den langsgående tværsnitsakse (4.3) end langs den tværgående tværsnitsakse (4.4),
30

at tværsnittet (4.2) langs den langsgående tværsnitsakse (4.3) har modstående plane grænser, som danner en første og en anden ringformet overflade (4.6, 4.7),

at fikseringsringen (4) er udformet elastisk fjedrende,

- 5 **at** fikseringsringen (4) er udformet således, at den indtager en spændt stilling under påvirkning af en kraft og en afspændt stilling uden påvirkning af en kraft, **at** i en afspændt stilling er den langsgående tværsnitsakse (4.3) skråtstillet med en vinkel α i forhold til et ringplan (4.5),

- 10 **at** fikseringsringen (4) kan spændes til en spændt stilling ved hjælp af en ændring af den langsgående tværsnitsakse (4.3) om en periferisk ringakse, **at** i den spændte stilling er den langsgående tværsnitsakse (4.3) skråtstillet med en vinkel β , og at vinklen β er større end vinklen α .

Fig. 2

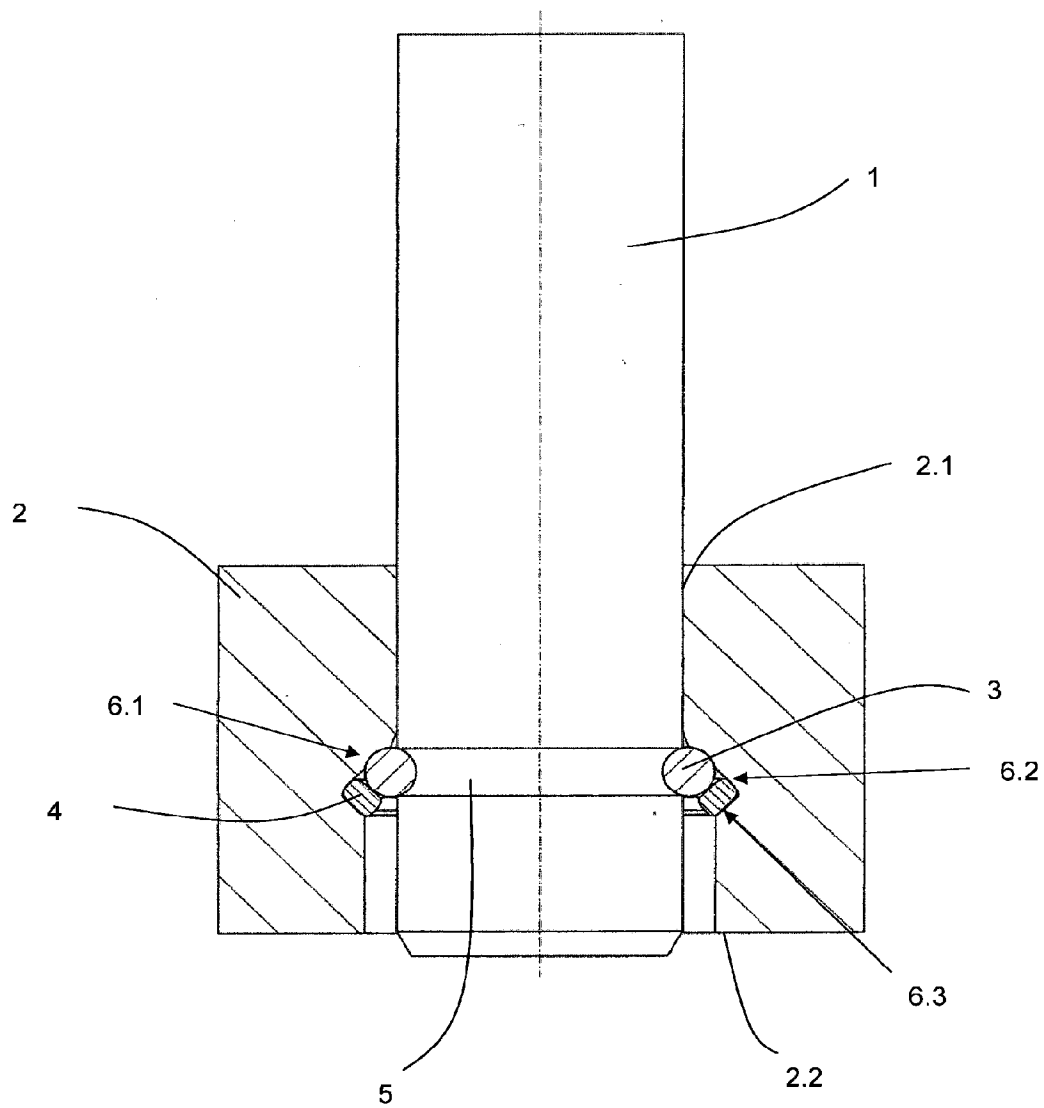


Fig. 3

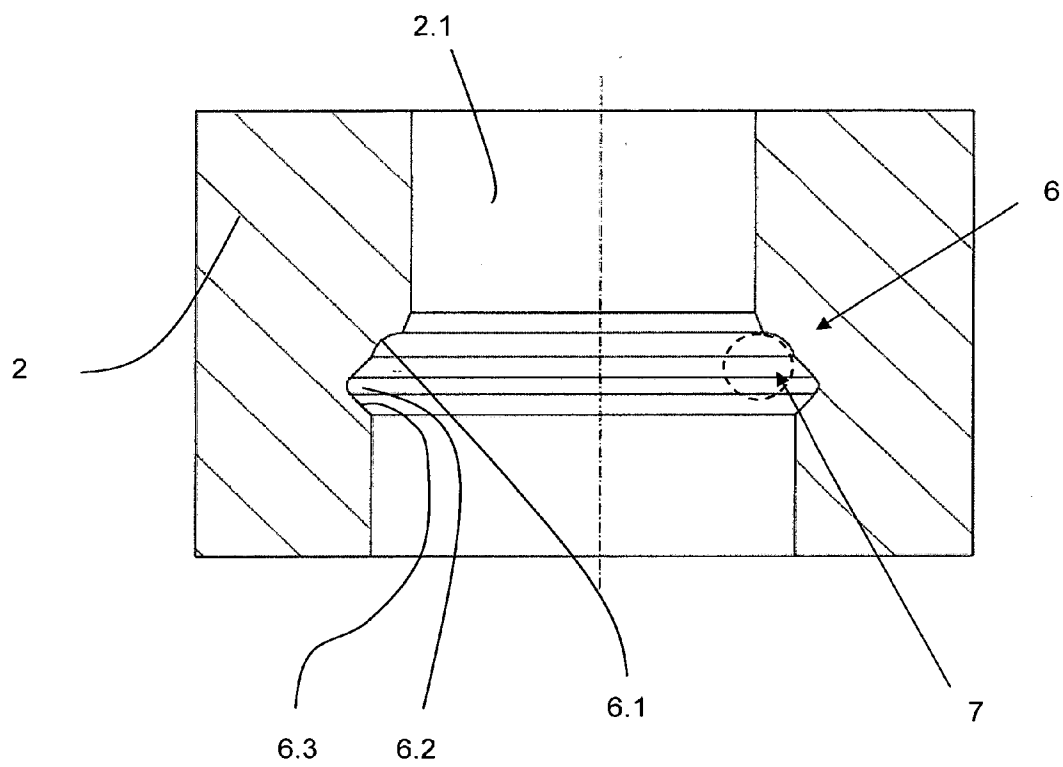


Fig. 4

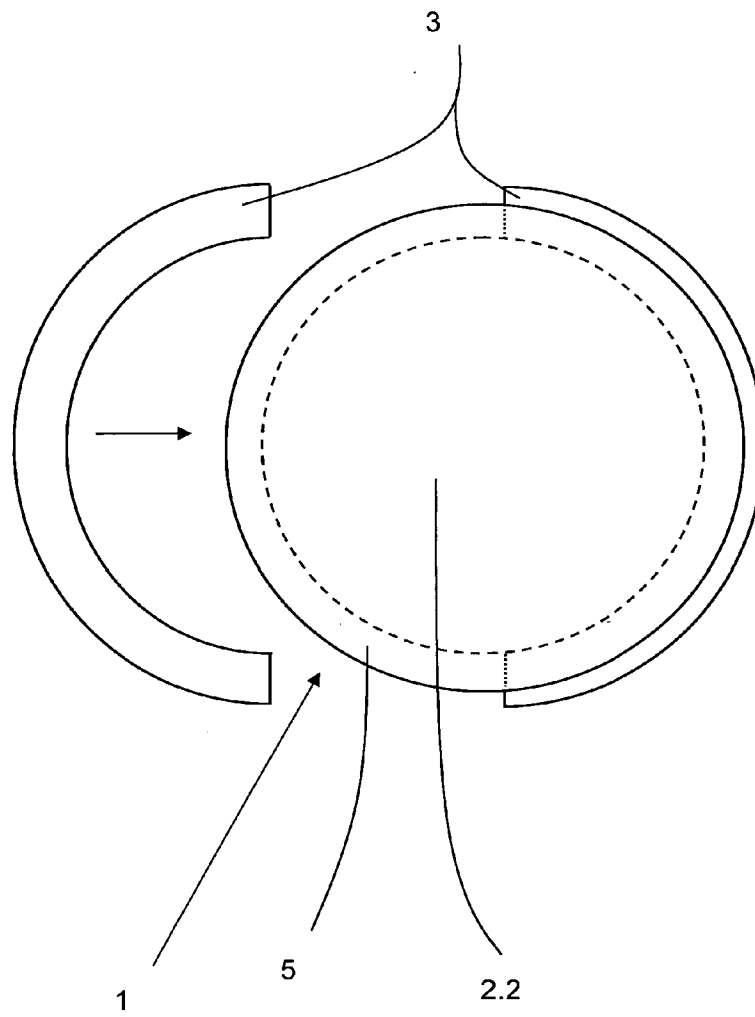


Fig. 5

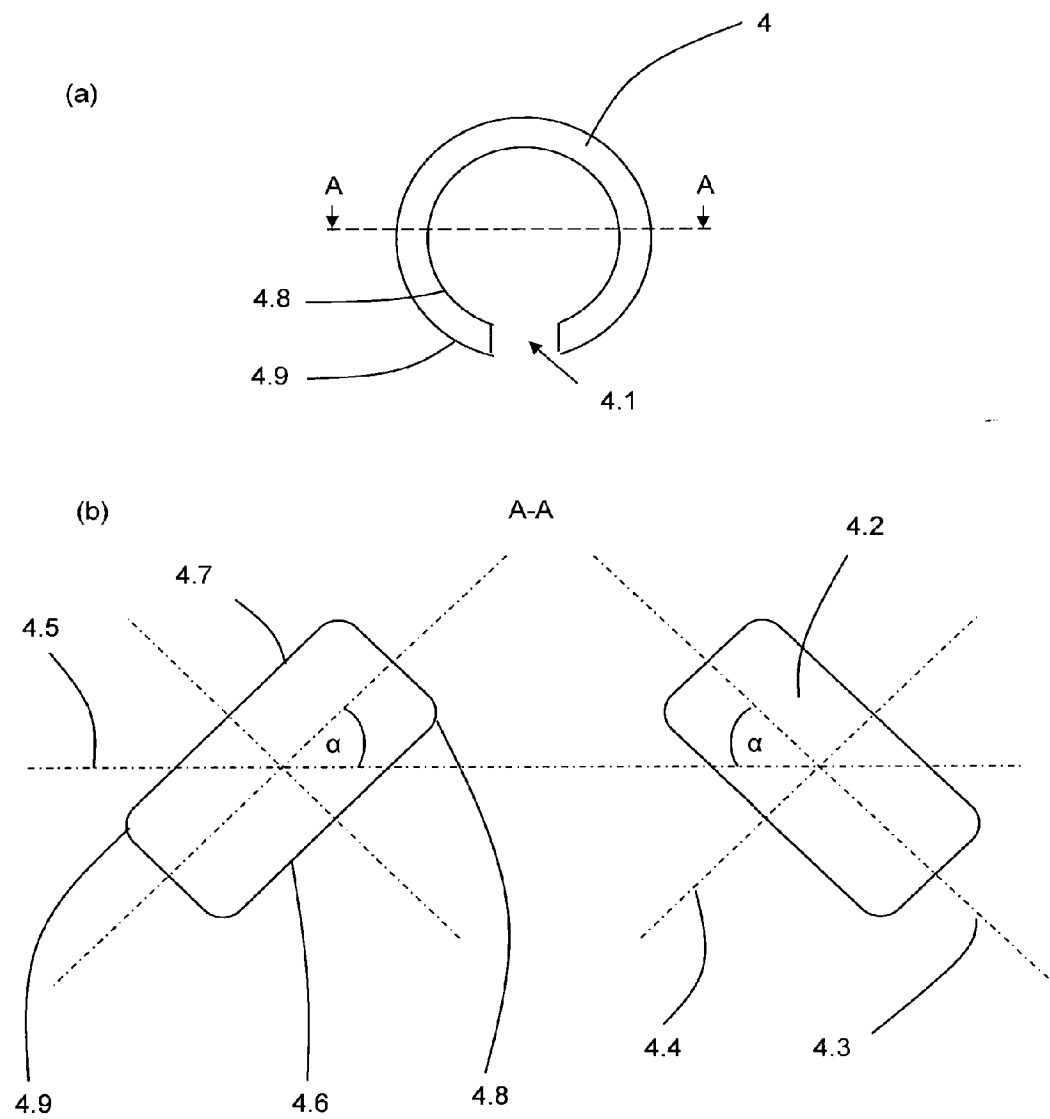


Fig. 6

