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CIRCUMFERENTIAL SEALING ARRANGEMENT

Description

The invention relates to a bearing assembly comprising a sealing assembly having a preferably one-piece circumferential rubber-like sealing material for sealing the sealing space for use in a slewing ring according to the patent claims.

Current commercially available and in use seals for slewing rings and large-diameter antifriction bearings which contain an inner ring (IR) and an outer ring (AU) are very different in shape and design, although the application is often very similar. It is always a matter of protecting the slewing ring, the slewing drive or the large-diameter antifriction bearing or antifriction bearing in general reliably against external influences such as moisture, flying sand or impurities or dirt, foreign bodies, etc.

A seal arrangement that is suitable for practical use is also designed to ensure resistance to the internal pressure of the lubricant in the bearing. In principle, the seal should meet the requirements to prevent foreign bodies from penetrating into the bearing construction of the connection. At the same time, the seal must provide support to ensure that the lubricant remains in the bearing or only comes out of the overall arrangement in small and defined quantities. It must therefore be able to withstand the internal pressure of the bearing caused by the lubricant to a reasonable extent. The expert speaks of a sealing effect of the seal.

It is currently state of the art that lubricants or emollients that come into contact with the sealing material are used in slewing rings, large-diameter antifriction bearings and slewing drives.

It is also state of the art that commercially available and used gaskets can be vulcanized and manufactured using all common processes for the production of gasket geometries from elastic rubber-like materials such as FPM, Viton, NBR, ECO, HNBR and similar.

A common feature of the usual state of the art seal arrangements is that they are usually either one-piece or multi-piece, i.e. they consist of at least one seal component.

Very often various annular sealing strands are inserted into the slewing ring or fastened in one or more recesses or grooves in the solid material of the slewing ring or on the rolling bearing so that a fixation takes place. The fixing is done by inserting the elastic sealing material into a groove in the (metallic) solid

material of the arrangement to be sealed. This groove is often created by machining as a result of the so-called "recess turning" during the manufacture of the slewing ring or bearing.

It is often the case that several such grooves or recesses are present in the overall arrangement to be sealed. Often at least as many of these grooves exist as elastic sealing strands are to be inserted into the arrangement and fixed.

In normal cases, the sealing strands or sealing profiles are fixed in the grooves or recesses by positive locking, since the elastic springs or lips of the sealing strand or sealing profile that are inserted into the grooves often have barb-like profile geometry(s), and, on the other hand, in that any deformation forces which may occur always act on the seals as a result of the operation of the slewing ring in accordance with the application approximately perpendicular to the insertion axis of the aforementioned groove and thus not in the direction in which the profile geometry(s) of the sealing ring would be extracted from the aforementioned groove or groove.

It is also the case that the above-mentioned fixation of the seal arrangement in the metallic solid material can usually be loosened again by applying force. This means that by applying a certain tensile force, which must act in the opposite direction to the insertion force of the seal into the solid material, the practitioner or specialist detaches the seal from the metallic arrangement (slewing ring, swivel drive or generally: large-diameter antifriction bearing).

According to the known state of the art and mainly due to the described fact, it is often the case that the part of the sealing profile used that is to be inserted into a groove or a recess is designed in a barb-like manner.

According to the known state of the art, each seal is fixed in at least one position in the solid material of the slewing ring or the large-diameter antifriction bearing by the aforementioned method of fixing in order not to leave the fixed position during normal operation. The sealing effect is generally respectable.

It is currently frequently seen that an elastic part of the described profile geometry(s) of the sealing arrangement is fixed to one rotating part of a rotary joint and another part of the same sealing arrangement is fixed to the other rotating part of a rotary joint, and that the sealing effect is caused by the interaction of all sealing components involved in the overall arrangement (for example a first elastic seal, an additional stainless steel strip, an additional tension spring strip and a second elastic seal, possibly third elastic sealing components).

For example, EP 1 920 176 B1, based on DE 10 2005 041720 A1, describes such a successful arrangement for sealing a rotating connection, in which the sealing arrangement consists of many individual components, each of which extends annularly and in which the sealing ring is fixed to one of the rotating parts in the above manner. The respective groove or groove for fixing the seal in the bearing component can either be in the same direction as the seal gap or perpendicular to the seal gap, as can be clearly seen here.

The DE 103 09 383 A1 is also an annularly extending circumferential sealing ring which is fixed to one of the rotating parts in the above manner. In this case, the barb-shaped part is pressed into a groove or recess perpendicular to the seal gap in one of the rotating bearing components. In order to further fix this seal in the horizontal direction, a second circumferential element is required for this solution.

DE 10 2006 053 832 A1 should also be mentioned here. It is a one-piece circumferential sealing element in which, as mentioned above, part of the seal is pressed into a groove or recess perpendicular to the seal gap in one of the rotating bearing components.

According to the current state of the art, sealing arrangements are very often found in the field where the groove or groove is either located in the gap to be sealed between the two bodies which can be rotated against each other and in such a way that the groove or groove is perpendicular to the gap, as for example the small gap seal on the bearing side in DE 10 2005 041 720 A1, which, however, cannot develop a sealing effect on its own, but for this reason is only used as a support and in connection with other, larger sealing arrangements.

Or, according to the current state of technology, such one-piece circumferential further developments can be found in seal arrangements in the field, in which the groove or groove lies in the direction of the gap. In particular, the German applications DE 10 2008 025 725 A1 and DE 10 2008 027 890 A1 deal with sealing systems in which a groove - or better - is in the same direction as the gap. Here, too, the strongly asymmetrical geometries of the sealing profiles are present, which are applied at several points on the rotating opposite part or the rotating opposite bearing component.

Document WO 2010/043249 A1, which also describes a one-piece circumferential sealing component, is also very striking. It is also good to see here that there is a barb-like part which is pressed into the groove in the direction of the sealing gap.

The solutions WO 2010/043249 A1 as well as DE 10 2008 025 725 A1 and DE 10 2008 027 890 A1 clearly show that there are upper and lower sealing lips respectively which lie against the opposite bearing

component in order to seal there and which can deform upwards or downwards when the bearing moves towards one another or to compensate for any bearing play, whereby the upper sealing lip is then pressed upwards and the lower sealing lip is pressed downwards. In all cases, however, this upper and lower sealing lip not only provides a sealing effect, but also serves to fix the respective bearing arrangement against axial pressing out. However, this fixing is only available if the bearing clearance (i.e. the gap size between inner ring and outer ring) is not too large. The larger the gap size, the more the strength of the seal fixation in the penetration depends on how well the barbs hold in the penetration. This is particularly disadvantageous if the internal pressure in the bearing rises sharply.

All these solutions have in common that they can be used, for example, to seal slewing rings used in wind turbines - for example, to seal slewing rings of azimuth bearings, tower bearings, rotor bearings or bearings for adjusting rotor blades. However, any other form of application within the above scope is also conceivable.

In practice, profile geometry(s) of such sealing arrangements, which can be inserted between the two rotating parts, have a good fixation and achieve a very good and, above all, lasting sealing effect, are increasingly desired in recent times. A major problem with many of the aforementioned seal arrangements is that their good sealing effect depends on how stable or good the seal remains in the installation position. Many of today's sealing systems fail during operation because if the internal bearing pressure is too high (e.g. due to too much lubricant), the seal arrangement is pushed out of the mounting position.

In practice, it is always very disadvantageous if the seals fall out of the slewing rings because the entire system fails as a result. In particular, the barb-shaped part of the seal occasionally or after deformation falls out of the groove of the slewing ring or is pressed out axially as a result of excessive lubricant pressure. All the solutions mentioned so far have been designed to withstand many years of use under weather conditions and still provide a reliable seal. However, practical experience has shown that all the seals mentioned so far do not represent simple sealing solutions, or that the sealing solutions lose their positional stability in the seal or are simply pressed out of the seal after some operating periods due to a lack of fixing options.

Particularly in the case of multi-part solutions, there are additional complexities in assembly (several individual parts must be assembled for this). This costs time and money in practice.

In particular, the last three mentioned technical documents WO 2010/043249 A1 and DE 10 2008 025 725 A1 as well as DE 10 2008 027 890 A1 are very similar in their geometry and therefore have the

problem that they run the risk of losing their positional stability during operation, i.e. the seals can be pushed out of the bearing during plant operation as a result of too high deformations or as a result of too high internal pressure in the bearing, which is conducted to the outside via the seal chamber or seal gap. Even if this process happens gradually, this means that the slewing ring to be sealed or the associated complete system will fail in the foreseeable future. This also costs time and money in practice.

In the case of the documents DE 10 2008 025 725 A1 and DE 10 2008 027 890 A1, which represent a current state of the art, it is particularly the case that on the side of the bearing on which the seal is fixed in a recess, there is no other arrangement that secures the seal against axial extraction. Assuming that the internal bearing pressure is too high as a result of lubricant, a seal according to the two solutions described above is only secured against axial extraction by the barb-shaped design of the seal in the recess. In practice, this is far from sufficient to guarantee a reliable position of the seal. Although the WO 2010/043249 A1 is based on such a desired type of securing - here we are talking about an annular groove whose shape is reminiscent of a tongue-and-groove type of securing common in robust construction - this is by far not sufficient to ensure a reliable positional securing of the seal against axial pressing out as a result of excessive pressure from the centre of the bearing.

WO2010/043249 A1 concerns an arrangement under the heading of patent claim 1.

DE 10 2006 053 832 A shows a similar arrangement with a single sealing lip at the bottom.

From the point of view of the practitioner, what is really needed is a one-piece solution (fewer parts means faster assembly, less complexity, etc...) and solutions that circulate around the entire slewing ring, made of conventional sealing materials, or even of a magnetisable or magnetic elastomer material that remains very securely in the seal. In particular, the practitioner wants a seal arrangement that is formally held strong in the seal by a correspondingly sensible design of the geometry of the bearing component. Ideally, the seal is not only held strongly, but its cross-sectional profile is designed in such a way that with increasing pressure from the direction of the sealing space to be sealed, i.e. from the direction of the bearing interior, there is also an increasing counterforce which counteracts axial pressing out. The practitioner therefore wants a sealing solution that practically "clings" to its place when the pressure inside the bearing increases and threatens to push the seal out of the bearing.

Considering these disadvantages, it is important to create the best possible seal arrangement, which offers the best possible position stability. The ultimate goal is to create a cost-effective and versatile one-piece solution for the sealing of rolling bearings, large-diameter rolling bearings, slewing rings, slewing

drives, etc. to create. In particular, the seal may be excellently suited for use in slewing rings of wind turbines.

In order to reduce the aforementioned disadvantages of the current state of the art and to create a sealing solution with maximum position stability that can be used in many applications, especially against being pushed out of the bearing, the present invention, which possesses significant improving advantages and features, is particularly suitable. The problems relating to the above disadvantages are solved by the features defined in patent claim 1.

The solution of the disadvantageous problems according to the conventional state of the art is particularly successful if the arrangement in accordance with the invention or the element for sealing the arrangement to be sealed has such a geometry that it can always remain integrated in the overall construction, both during operation of the slewing ring and during resting phases, without the involvement of other components, and thus without falling out.

One of the primary tasks is always to seal the opening to be sealed by the arrangement according to the invention. This can be achieved in particular by an advantageous design of a so-called material bulge on one of the bearing components, for example on the outer ring, in which the seal arrangement is fixed in a recess.

The bearing arrangement according to the invention has a sealing arrangement. It serves to seal the sealing chamber or the bearing gap and is made in particular of a one-piece circumferential rubber-like sealing material. The main load of a pressure load from the bearing is absorbed by a sealing area on the bearing side. The seal is used, for example, between the outer ring and inner ring of a slewing ring, whereby the solution can also be used in slewing rings consisting of multi-part outer or inner rings. In order to ensure that the seal can be replaced in the field in the event of a repair, without having to replace the entire bearing, the seal assembly can be removed from the recess in which it is fixed and replaced (for example, the old seal is replaced by a brand-new seal). The seal arrangement is not irretrievably fixed in a groove but is detachably and replaceably connected, whereby the technician speaks of a positive and non-positive connection. Positive on the one hand due to the geometry of the recess, non-positive on the other hand due to the barb-shaped parts of the sealing profile. As already known, the aforementioned recess lies in the direction of the bearing gap, i.e. in a surface parallel to the horizontal outer surface of the rotatable bearing component.

The most characteristic feature of the invention is a material bulge, for example on the outer ring, in which the recess is also made and where the seal arrangement is consequently located. This material

bulge is not a proverbial annular groove, but rather a geometry protruding into the sealing space, on the underside of which, i.e. the underside of the bearing, the seal arrangement clings so tightly that it can withstand the lubricant pressure in the bearing in any situation and installation position. Only because this material bulge projects in the direction of the bearing centre and is enclosed by the seal on the underside of the bearing can a counterforce be built up in the bearing at high pressure, which counteracts the axial pressing out of the seal. The fact that the seal does not rest on the underside of the bearing in a punctiform but on a flat surface means that the counterpressure that can be generated in this way is higher than when the seal touches the surface in a purely punctiform manner. (The counterforce thus generated corresponds to the product of pressure and this area.)

The above-mentioned effect of "tight gripping", which is desired in accordance with the invention, is achieved above all when the material bulge or, more generally, a material undercut lying in the bearing gap at the bearing part to which the seal is decisively fastened lies where the seal can counteract the maximum axial forces. Therefore the material undercut or the material bulge must lie in the bearing gap itself in order to unfold its maximum effect. The effect of the tight grip would not be so good if the material undercut or the material bulge were placed outside the bearing gap. The effect of the tight grip would not be good if the material undercut or the material bulge on a surface perpendicular to the bearing gap were placed. The aforementioned effect of "tight gripping" is particularly high when the material bulge protrudes in the direction of the opposite rotatable bearing component (which limits the bearing gap on the opposite side).

The position of the arrangement in accordance with the invention is stabilized by the fact that the seal arrangement, for example, is applied to further surfaces of the outer ring (if necessary multi-part) and the inner ring (if necessary multi-part). It has a number of sealing lips on the opposite bearing side (e.g. on the inner ring), but they always touch the opposite second rotatable bearing component in such a way that all contact points or contact surfaces either lie above the horizontal outer surface of the first rotatable bearing component or below the horizontal outer surface of this first rotatable bearing component (e.g. the outer ring). At least two sealing lips with different widths may be provided. This means that the seal arrangement can be easily adapted to the geometry or the surfaces of, for example, the second rotatable bearing component. Preferably, the surfaces of the opposite, second, rotatable bearing component are substantially completely contacted.

This design compensates for the disadvantage of the documents 10 2008 025725 A1 and DE 10 2008 027890 A1 and WO 2010/043249 A1 mentioned in the latter state of the art, namely that the strength of the fixation of the seal in the bearing depends essentially on the size of the bearing gap. In the present

invention, the strength of the invention depends to a large extent on the fixing effect of the enclosed material bulge.

In order to ensure as planar a surface as possible, the sealing geometry according to the invention is adapted to the shape of the bearing component (e.g. the outer ring) in such a way that the upper edge of the sealing arrangement is approximately flush with the horizontal outer surface (e.g. the outer ring) in which the material bulge of the sealing arrangement is present. As a further feature, the seal arrangement can be multi-part if, for example, in addition to the one-piece rubber-like material of the seal arrangement, at least one circumferential ring element in the form of a tension spring strand is inserted at the top edge of the seal arrangement. This step additionally promotes the position stability of the seal arrangement. A further possibility for additional fixing of the seal arrangement is offered by additional screw or rivet connections, which are inserted from above into the bearing component (e.g. the outer ring) and serve to hold down the upper edge of the seal arrangement. This is usually achieved by means of several circumferential screws or rivets which are countersunk in the bearing component where the seal is to be fixed. For example, the groove or the recess (for example in the outer ring) can be completely omitted if the circumferential seal arrangement is fixed to the bearing component with screws or rivets. In this case, the barb-shaped fixing part of the seal arrangement may also be omitted.

The surfaces or edges of the bearing components (e.g. the outer ring) into which the seal arrangement is inserted or which are in the immediate vicinity of the seal arrangement may be non-metallic or metallic coated. As can be seen in the following drawings, it is irrelevant whether the other surfaces or edges, for example of the outer ring or those of the corresponding (opposite) inner ring, are bevelled or always rectangular. Practical examples are sloping surfaces at the points where the sealing lips are in contact with or opposite the sealing arrangement. Inclined surfaces are also advantageous where the material bulge or undercut is in contact with the seal.

A further essential characteristic of the arrangement according to the invention is the approximately "joint-like" design of the seal arrangement, which is realized by an approximately central tapering area. The taper point of the gasket will be where the top and bottom recesses of the gasket material (this is referred to as rounded "deformation spaces") allow the gasket geometry to be deformed. The centre of the rejuvenation area lies approximately in the middle of this rejuvenation area. In the event of radial position changes of the bearing components which can be rotated against each other, for example when the inner ring moves in the direction of the outer ring as a result of changing bearing load and the bearing gap thereby becomes smaller, the seal is deformed in such a way that a part of the seal arrangement, for example the upper side, is pressed in the direction of the outer ring, while the lower side of the seal arrangement remains essentially stable due to the fixing to the material bulge. As a result

of the relative movement, a moment arises in the sealing material, which results in a joint-like movement around the centre of the rejuvenation area. For this reason, the rejuvenation area, or the centre of the rejuvenation area, serves as a kind of resilient joint. This spring-loaded joint is used to compensate radial positional changes of the bearing components which can be rotated against each other.

Again coming back to tapered area, it will be stated, radius of centre of tapered area relative to central axis of slewing ring can be smaller than radius of outer radial surface

of the outer rotatable bearing component (e.g. the outer ring) with the central axis of the slewing ring. However, the radius of the centre of this tapered area relative to the central axis of the slewing ring may be greater than the radius of the inner radial surface of the inner rotatable bearing component (e.g. the inner ring) with the central axis of the slewing ring.

The upper deformation space can be limited in axial extension approximately by the plane which defines the axial surface for limiting the outer bearing component in the space, e.g. the horizontal outer surface of the outer ring. For example, the lower deformation space can be located axially ergo below this plane.

Returning again to the material bulge, it is stated that the sealing material comprises the material bulge, which is an integral part of the bearing component in which the circumferential seal is incorporated (e.g. as an integral part of the outer ring), without being supported by the adjacent surface and without entering into a frictional connection with a radial sealing surface in the sealing area. As mentioned above, the fixing effect is mainly caused by the fact that the underside, i.e. bearing-side, surface acts as a counter bearing against axial pressing out (e.g. due to grease/lubricant pressure). An adjacent radial surface could therefore not act as a counter bearing.

The bearing arrangement has the following characteristics in another preferred form of the invention:

- a rotary arrangement having at least one outer ring rotatable about an axis of rotation and at least one inner ring rotatable about said axis of rotation;
- a gap formed between the outer ring and the inner ring;
- at least one sealing element which is arranged at or in the gap and seals the gap circumferentially in a substantially liquid-tight manner with respect to the environment;
- wherein the at least one outer ring and/or the at least one inner ring have at least one shape which is at least partially circumferential along a ring circumference and which is designed for releasably fastening the sealing element;

- wherein the at least one sealing element has a cross-section whose shape is designed such that the sealing element is in substantially positive connection with the shaping of the outer ring and/or inner ring.

A positive connection between the sealing element and the bearing arrangement means that no connecting elements are required to fasten the sealing element. Furthermore, a secure fit of the sealing element is also ensured when the slewing ring is operated. Nevertheless, the sealing element can be easily replaced during maintenance or in the event of damage.

In a further configuration of the invention, the shaping of the outer ring and/or inner ring has an undercut and the shape of the cross-section of the sealing element has a corresponding undercut, so that the positive connection is formed by the interaction of the two undercuts, in particular in such a way that loosening of the sealing element in the event of an excess pressure in the interior of the gap is prevented.

This creates a positive connection between the sealing element and at least one of the rings of the bearing arrangement, so that the gap is well sealed in the direction of action of the overpressure. The design of the moulds as undercuts results in an increased tightness of the connection as a result of the tight fit with increasing pressure.

In a further version of the invention, the cross-section of the sealing element has at least two sealing lips which bear against a bearing surface of the outer ring and/or inner ring in such a way that a labyrinth seal is formed, in particular so that the sealing effect of the sealing element with respect to the gap is ensured when the outer ring and inner ring are moved relative to one another.

By forming two sealing lips, a labyrinth effect can be formed in an advantageous way, which also achieves a good sealing effect as a grinding seal with rings moving against each other.

In a further development of the invention, the outer ring and/or inner ring have a recess or a recess in which a fixing part of the sealing element, in particular a barb-shaped fixing part, engages, so that the positive connection between the sealing element and the inner ring and/or outer ring is additionally secured.

An additional fixing part offers the advantage that the positive connection can be determined, for example, by two pincer-shaped structures on the outer ring and/or inner ring. This improves the form-fit

connection even further. In addition, the additional securing of the sealing element can be provided in an easily manufactured recess or recess.

In accordance with the features described above, the fixation in the slewing ring or rolling bearing as well as the positional stability of the comprehensive seal arrangement, in addition to other advantages, are significantly improved compared to the current state of the art solutions.

Other features, characteristics, advantages and effects based on the invention can be derived from the following descriptions of a preferred form of implementation of the invention, as well as other advantageous forms of the invention, which can be seen from the drawings. Show here:

Fig. 1 A first look at the cut geometry of a one-piece version of this seal arrangement 1 when looking at the face cut surface of a cut segment; it is a cut through a slewing ring 1 that can use ball, roller, taper, barrel rolling elements 11 or sliding components, or a hybrid form of all of them. The seal arrangement is fixed by the recess 2, and by the material recess 18 on one bearing component and is fixed by the contact of the upper sealing lips 26; 27 on the opposite bearing component.

Fig. 2 a further example of this cut geometry of this one-piece version of this seal arrangement 1, whereby the contours, especially concerning the sealing space 24, are slightly changed due to the no longer inclined surface 13 in contrast to Fig.1.

Fig. 3 shows a variation of the surfaces which limit the seal arrangement 1 in the area of the material bulge or undercut 18. In particular, it is shown that the arrangement in accordance with the invention is not dependent on vertical or straight surfaces 3; 5, but can also be effective in hybrid forms.

Fig. 4, on the other hand, shows another variation of the surfaces 13; 14; 3; 5, which delimit the sealing space and are located in the vicinity of the sealing arrangement 1, which can also be inclined as mentioned above. The surface 15 on which the seal arrangement 1 "rests" can also be designed as a slope.

In all figures Fig. 1 up to and including Fig. 6 it can be seen that the sealing arrangement is positively inserted into a recess 2 on one of the two bearing components 7, for example on the outer ring, and that, in addition to this insertion, there is always the surrounding of a material bulge 18 or of a material undercut, the material bulge being an integral component of the bearing component. In a further advantageous design, it would also be conceivable, for example, that the material bulge would be realized by an additional and separately introduced body, which would be introduced at the bearing

component. In the present example, however, the material bulge was introduced into the bearing component, for example the outer ring 7, by the turning manufacturing process, for example. Characteristic as in all figures Fig. 1 up to and including Fig. 6 it is easily recognisable that the material bulge can protrude into the sealing chamber.

In a further advantageous design, the outer surface 5 of this material bulge 18 is even raised in relation to the surfaces which limit the gap at the point of the sealing space 9, so that the material bulge 18 can definitely project into the bearing gap. This could create an even larger area 10. Thus the counterforce or the counterpressure against axial pressing out of the seal would be even stronger and the fixing effect even higher. The material bulge 18 can also be designed to have small dimensions relative to the dimensions of the interior 9 to be sealed. This can simplify the assembly process, for example. Generally speaking, the dimensioning of the material projection 18 should be such that the seal arrangement can be easily and safely installed and the material projection 18 should be such that a very good fixing effect is guaranteed.

In all figures Fig. 1 up to and including Fig. 6 it is clearly visible how the barb-shaped parts of seal arrangement 1 are designed so that the positive and non-positive fixation of arrangement 1 is achieved in recess 2. It should be noted that seal 1, for example, is inserted into recess 2 by manual pressing, can also be removed manually, and can therefore be replaced in the field, for example during repair, by a new seal arrangement 1 of the same or similar design. It is conceivable that in future designs the insertion can also be automated by means of a special assembly process. In all figures, in particular Fig. 3, the seal area on the bearing side is clearly visible, which separates the space 9 to be sealed from the surroundings outside the bearing gap in which the seal is inserted in an arc.

Reference sign list

- | | |
|---|---|
| 1 | Sealing arrangement |
| 2 | puncture |
| 3 | outer radial surface of a rotatable bearing component |
| 4 | Top edge of seal assembly |
| 5 | The area of the material bulge
the one rotatable bearing component |
| 6 | Tension spring strand (optional) |
| 7 | First rotatable bearing component, e.g: outer ring |

- 8 Second rotatable bearing component, e.g: inner ring
- 9 sealing chamber
- 10 lower, bearing-side, surface of the material bulge (rear cut)
- 11 Part of a rolling element of the slewing ring
- 12 outer radial surface of the second rotatable bearing component
- 13 horizontal surface of the second rotatable bearing component
- 14 inner radial surface of the second rotatable bearing component
- 15 Horizontal surface section on which the seal arrangement rests against the one rotatable bearing component.
- 16 vertical surface section to which the seal arrangement rests against the second rotatable bearing component
- 17 Sealing area of the seal arrangement on the bearing side
- 18 protruding material bulge as integral part of a rotatable bearing component
- 19 Part of a cage element of the slewing ring (optional)
- 20 Horizontal outer surface of the first rotatable bearing component
- 21 Horizontal outer surface of the second rotatable bearing component
- 22 Tapered area of the seal arrangement
- 23 Centre of the tapered area of the seal arrangement
- 24 upper deformation chamber
- 25 lower deformation chamber

- 26 upper sealing lip adjacent to second rotatable bearing component
- 27 upper sealing lip adjacent to second rotatable bearing component
- 28 Part of a rolling element of the slewing ring (roller, ball, cylinder, barrel)
- 29 Barb-shaped fixing part (for inserting the seal arrangement into the bearing component)

Patentkrav

- 1.** Lejeindretning med en tætningsindretning (1) af et, især i et stykke udformet, omløbende og/eller elastomert, fortrinsvis kautsjukagtigt tætningsmateriale til tætning af tætningsrummet (9) indeholdende et tætningsområde (17) på
- 5 lejesiden og indsat mellem mindst en ydre ring eller en ydre drejelig lejekomponent (7) og mindst en mod hinanden om den samme centrale akse drejelig og af en spalte (9) adskilt indre ring eller en indre drejelig lejekomponent (8) i en drejeforbindelse, idet tætningsindretningen er forbundet form- og kraftsluttende aftageligt og atter udskifteligt med en struktur, især et med en
- 10 vandret ydre overflade (20) på den første drejelige lejekomponent parallel flade udført lille hul (2), samt en fremstående materialeudbugtning (18) med en nedre overflade (10) på lejesiden som integral del af denne første, ydre eller indre, drejelige lejekomponent (7), omfattende følgende elementer:
- en overkant (4) på tætningsindretningen (1);
- 15 to øvre tætningslæber (26, 27);
- et øvre deformationsrum (24) som udsparring i tætningsmaterialet; tætningsområdet (17) på lejesiden;
- en modhageformet fastgørelsesdel (29) til indføring af tætningen i lejekomponenten (7);
- 20 et område på tætningsindretningen (1), der ligger an mod en nedre flade (10) på lejesiden af materialeudbugtningen (18);
- et nedre deformationsrum (25) som udsparring i tætningsmaterialet;
- kendetegnet ved, at**
- a) tætningsindretningens (1) overkant (4) slutter omtrent i flugt med den
- 25 første drejelige lejekomponents (7) vandrette ydre overflade (20), i hvilken materialeudbugtningen (18) på tætningsindretningen (1) befinder sig; idet
- b) alle berøringspunkter eller -flader på de to øvre tætningslæber (26, 27) ligger på den overfor liggende anden drejelige lejekomponent (8) over den første drejelige lejekomponents (7) vandrette ydre overflade (20);
- 30 c) tætningsområdet (17) på lejesiden adskiller det rum (9), der skal tættes, buformigt fra omgivelserne uden for den spalte (9), i hvilket tætningsindretningen (1) er indsat; og
- d) materialeudbugtningen (18) har en geometri, der rager ind i det rum (9), der skal tættes, til hvis nedre, mod lejet vendende flade (10)
- 35 tætningsindretningen (1) hager sig fast, idet materialeudbugtningen (18)

rager ind i retning af lejets centrum og omsluttet af tætningsindretningen (1) på den nedre, mod lejet vendende flade (10).

2. Lejeindretning ifølge krav 1, **kendetegnet ved, at** tætningsindretningen (1) 5 ligger an med en flade, især ikke punktformigt mod denne nedre, mod lejet vendende flade (10) af materialeudbugtningen (18).

3. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** materialeudbugtningen (18) i radial retning begrænses af en flade (5), som 10 stikker frem i retning mod den modstående drejelige lejekomponent i forhold til de flader på den ydre eller indre drejelige lejekomponent (7; 8), der afgrænser tætningsrummet (9).

4. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** 15 tætningsindretningen ved anlæg mod flader (5; 10) på den ydre drejelige lejekomponent (7) og flader (12; 13) på den indre drejelige lejekomponent (8) opnår yderligere stabilisering af beliggenheden mellem lejekomponenterne (7; 8).

5. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** der er 20 tilvejebragt to tætningslæber (26; 27), som har forskellig bredde, således at fladerne på den overfor liggende, anden drejelige lejekomponent i det væsentlige er i fuldstændig berøring.

6. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** der 25 foruden det i et stykke udformede kautsjukagtig materiale i tætningsindretningen er indført mindst et omløbende ringelement i form af en trækfjederstreng (6) ved overkanten (4) af tætningsindretningen (1).

7. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** 30 tætningsindretningens beliggenhed har mindst en yderligere skrue- eller nitteforbindelse, indført i den pågældende drejelige lejekomponent (7; 8), i hvilken materialeudbugtningen (18) på tætningsindretningen (1) befinder sig, som tjener til at holde tætningsindretningens (1) overkant (4) nede.

8. Lejeindretning ifølge krav 7, **kendetegnet ved, at** noten eller det lille hul (2) i en af lejekomponenterne (7; 8) samt den geometrisk lignende og tilhørende modhageformede fastgørelsesdel på tætningsindretningen (29) kan bortfalde, når der findes mindst en skrue- eller nitteforbindelse.

5

9. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** mindst en af de flader eller kanter (12; 13; 14; 10; 3; 5; 15; 16), der begrænser tætningsindretningens (1) eller det lille huls (2) område, samt de yderste flader (20; 21) på den drejelige lejekomponent (7; 8) er belagt ikke-metallisk eller

10 metallisk.

10. Lejeindretning ifølge et af de foregående krav, **kendetegnet ved, at** mindst en af de flader eller kanter (12; 13 ;14; 10; 3; 5; 15; 16), der begrænser tætningsindretningens (1) eller det lille huls (2) område, hver især er udformet

15 som skrå eller affasede flader.

11. Lejeindretning med mindst en tætningsindretning (1) ifølge et af kravene 1 til 10 med:

20 en drejeforbindelse med mindst en om en omdrejningsakse drejelig ydre ring (7) samt mindst en om den nævnte omdrejningsakse drejelig indre ring (8);

en spalte (9), som er dannet mellem den ydre ring (7) og den indre ring (8);

25 idet mindst et tætningselement i tætningsindretningen (1) er anbragt ved eller i spalten (9) og tætnet denne i det væsentlige væsketæt omløbende i forhold til omgivelserne;

idet den mindst ene ydre ring (7) og/eller den mindst ene indre ring (8) har mindst en i det mindste delvis langs en ringomkreds omløbende formning (18), der er udformet til aftagelig fastgørelse af tætningselementet;

30 idet det mindst ene tætningselement har et tværsnit, hvis form er således udformet, at tætningselementet med formningen (18) af den ydre (7) og/eller den indre ring (8) er i det væsentlige i formsluttende forbindelse.

12. Lejeindretning ifølge krav 11, **kendetegnet ved, at** formningen af den ydre 35 (7) og/eller den indre ring (8) har en underskæring (10) og formen af

tætningselementets tværsnit en tilsvarende underskæring, således at der ved de to underskæringers samvirken dannes en i det væsentlige formluttende forbindelse.

5 **13.** Lejeindretning ifølge et af kravene 11 eller 12, **kendetegnet ved, at** tætningselementets tværsnit har mindst to tætningslæber (26, 27), som ligger således an mod en anlægsflade på den ydre og/eller den indre ring, at der dannes en labyrinttætning, især således at tætningselements tætningsvirkning i forhold til spalten (9) er sikret, når den ydre (7) og den indre ring (8) bevæges i forhold til
10 hinanden.

14. Lejeindretning ifølge et af kravene 11 til 13, **kendetegnet ved, at** den ydre (7) og/eller den indre ring (8) har et lille hul (2) eller en udsparring, i hvilken en, især modhageformet, fastgørelsesdel (29) på tætningselementet griber ind,
15 således at den i det væsentlige formluttende forbindelse mellem tætningselement og den indre (8) og/eller den ydre ring (7) yderligere er sikret.

FIG 1

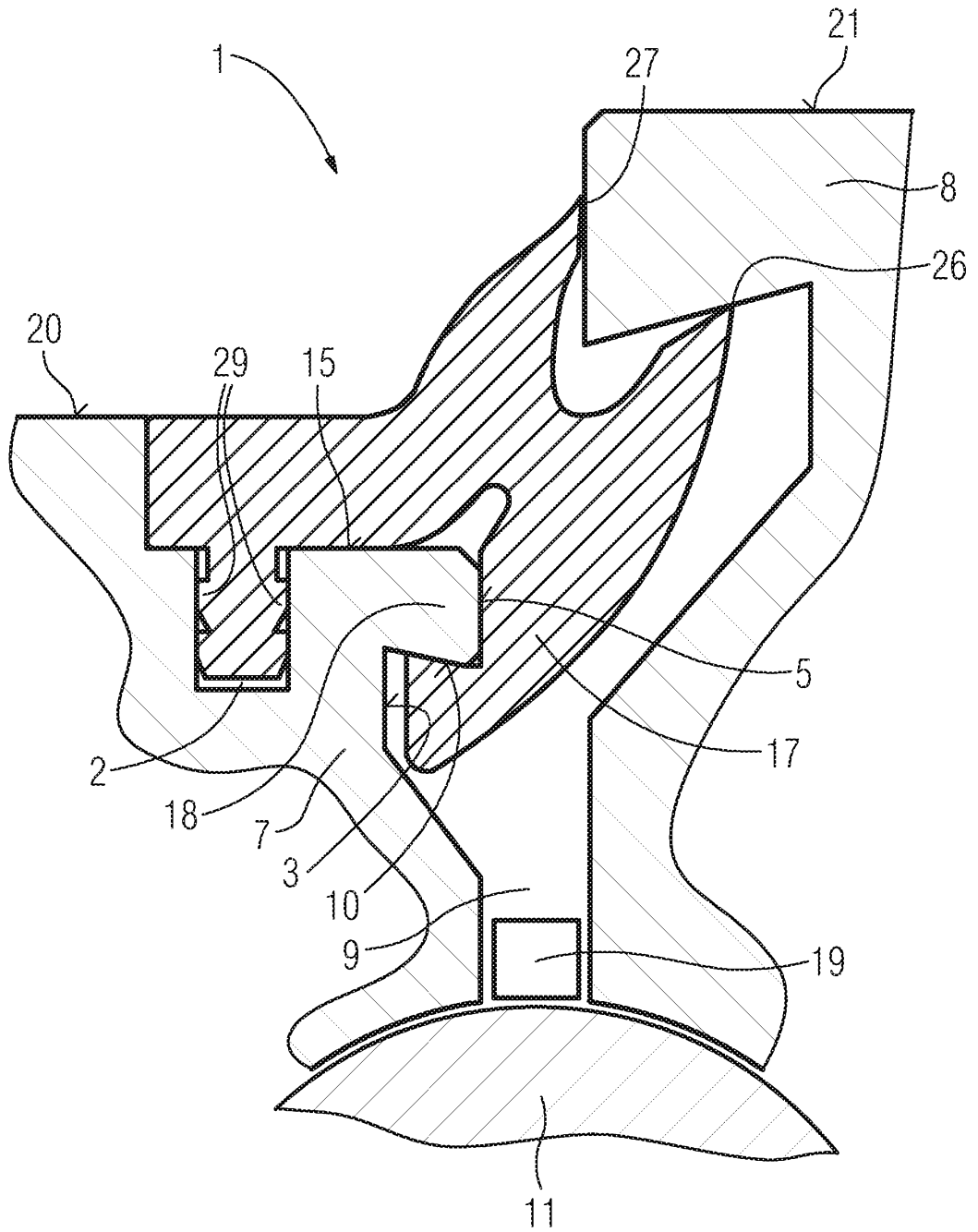


FIG 2

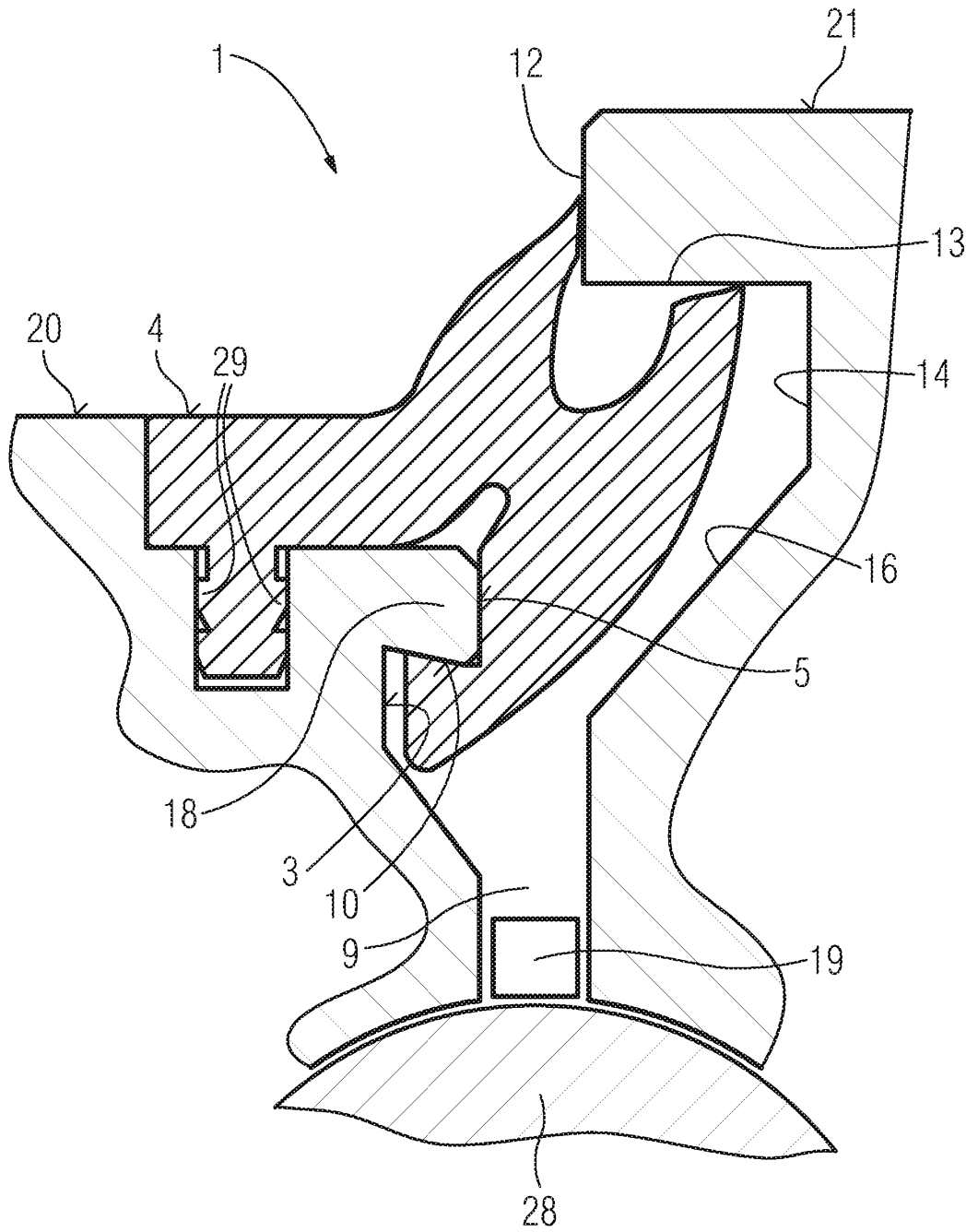


FIG 3

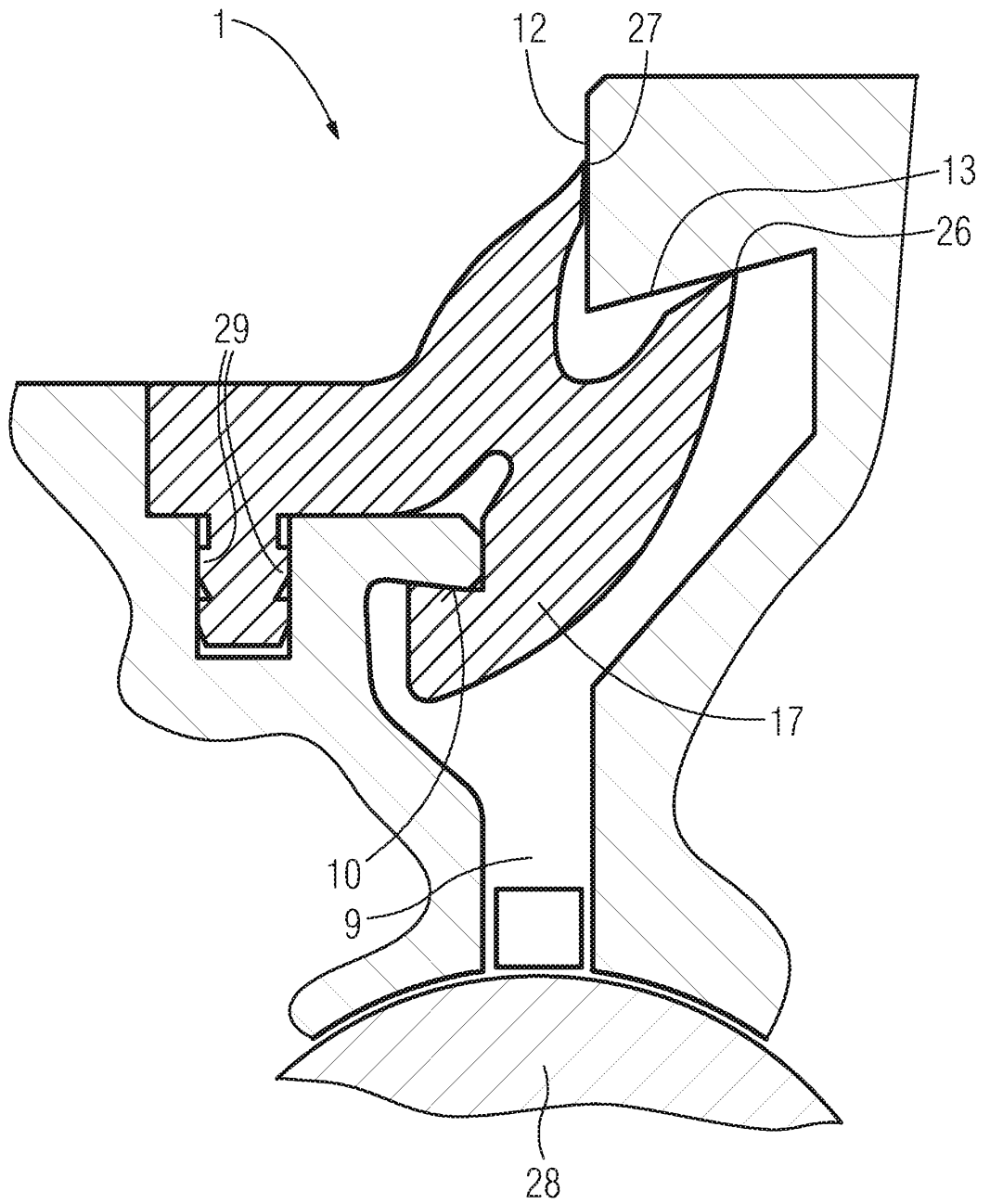


FIG 4

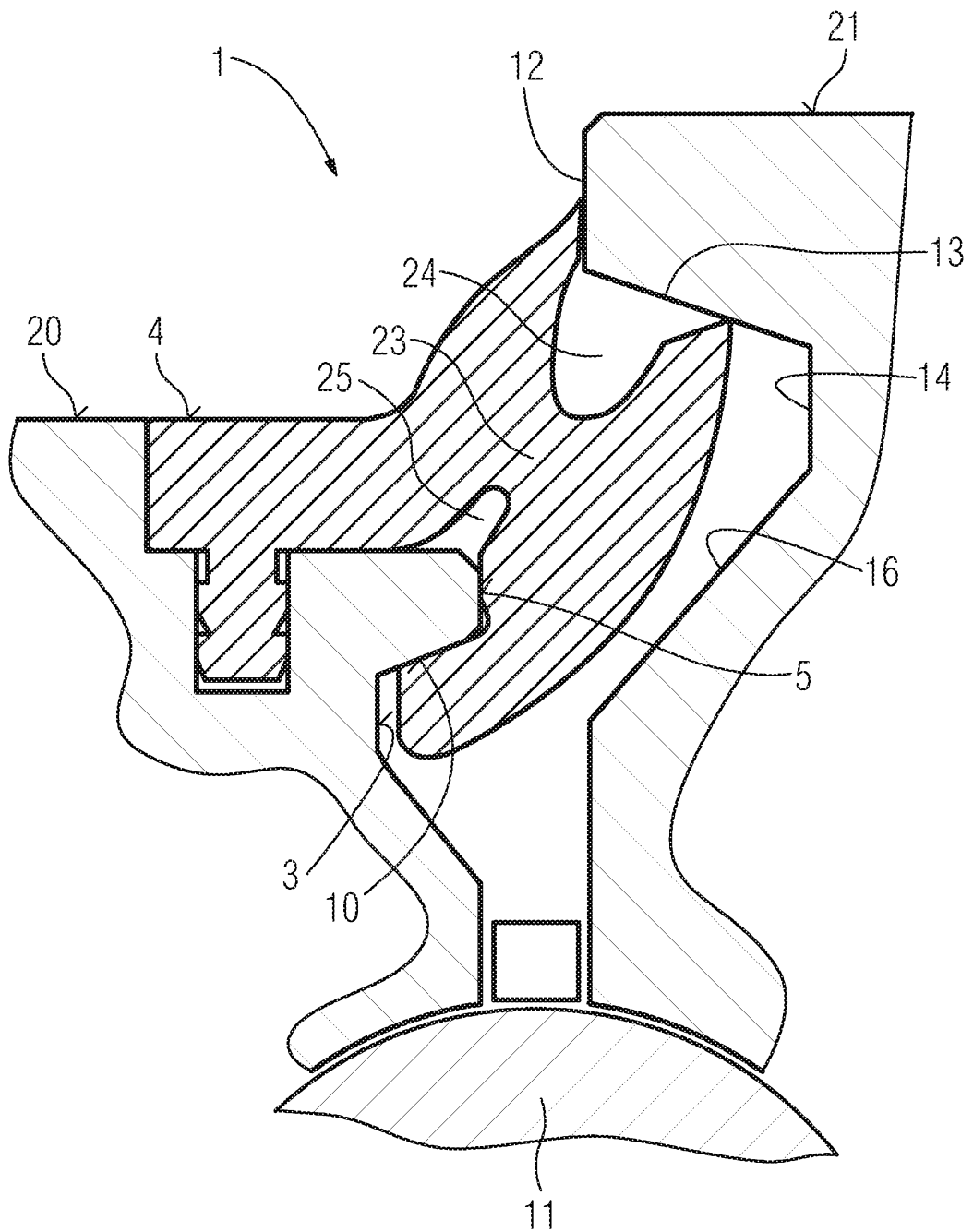


FIG 5

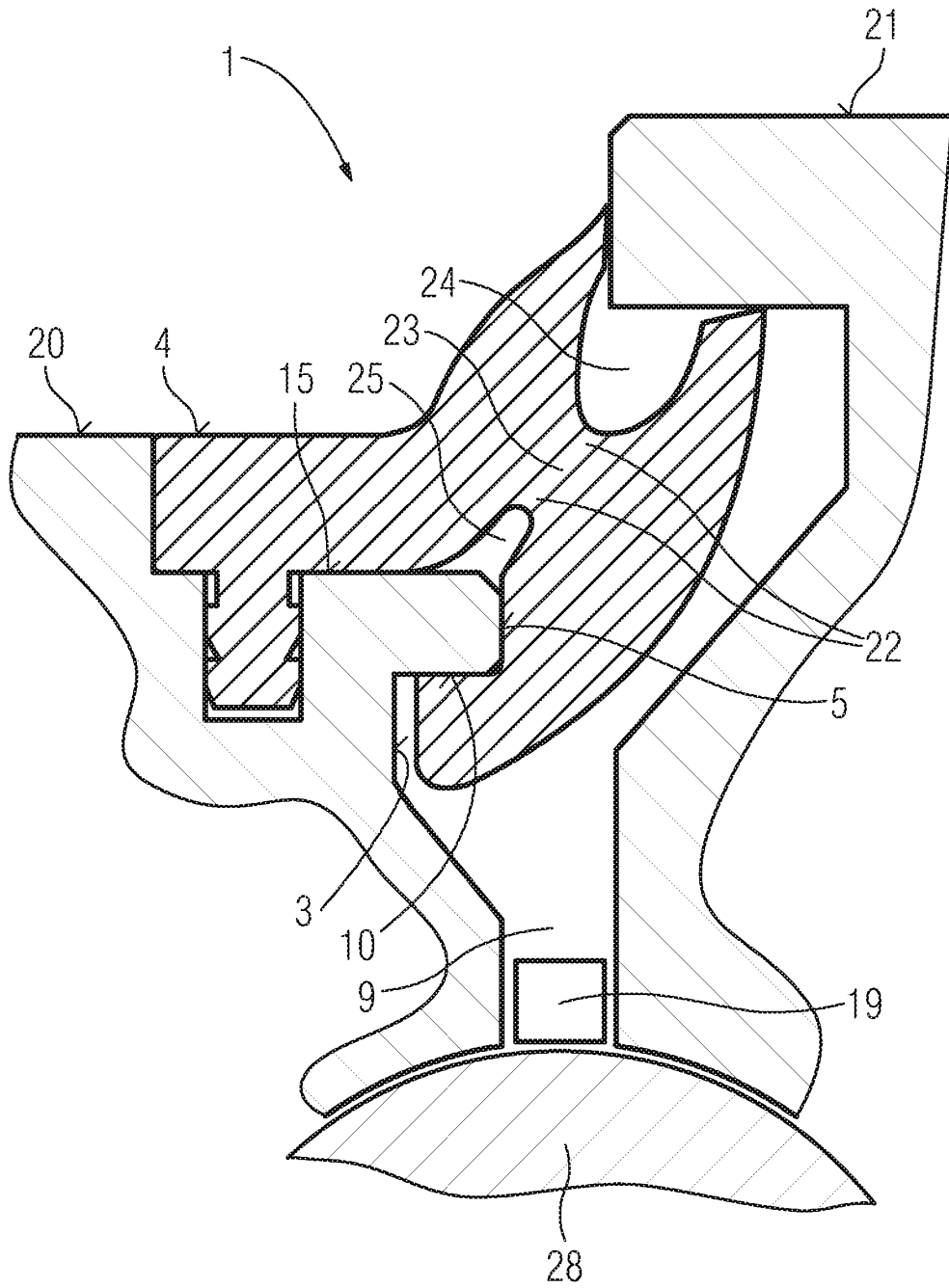


FIG 6

