

Description

Pump arrangement comprising a plain bearing arrangement

- 5 The invention relates to a pump arrangement, in particular a magnetic clutch pump arrangement, having an interior space formed by a pump casing of the pump arrangement, having a containment can which hermetically seals off a chamber surrounded by said
10 containment can with respect to the interior space formed by the pump casing, having an impeller shaft which is mounted by way of a plain bearing arrangement and which can be driven in rotation about an axis of rotation, having an impeller arranged on one end of the
15 impeller shaft, having a first bearing sleeve connected rotationally conjointly to the impeller shaft, having a second bearing sleeve connected rotationally conjointly to the impeller shaft, having a first bearing bushing which interacts by way of a radial bearing surface with
20 the first bearing sleeve and which is connected rotationally conjointly to the pump casing or to a component fastened to the pump casing, having a second bearing bushing which interacts by way of a radial bearing surface with the second bearing sleeve and
25 which is connected rotationally conjointly to the pump casing or to a component fastened to the pump casing, and having a retaining ring arranged between the first and second bearing bushings.
- 30 EP 0 771 956 A1 has disclosed a magnetic clutch pump of said type with a plain bearing arrangement, in the case of which the static bearing parts are received in a bearing ring carrier, referred to as outer casing, and the bearing parts which rotate about the axis of
35 rotation are positioned on the shaft. Here, the axial bearings are each assigned a static bearing part from the outside. This has the disadvantage that the impeller and the bearing bushing arranged closest to

the impeller are spaced apart to a relatively great extent, and thus there is a relatively large spacing between said bearing bushing and the radial force that arises at the impeller. Furthermore, an exchange of the static bearing parts is possible only with great outlay and using special tools.

It is the object of the invention to further develop a generic pump arrangement such that the lubrication of the axial bearing is further improved, the radial bearing forces under given loads are reduced, and ease of servicing is increased.

The object of the invention is achieved in that a first ring groove, which receives a first axial bearing ring, is formed in the retaining ring on the face side facing toward the first bearing bushing, and a second ring groove, which receives a second axial bearing ring, is formed in the retaining ring on the face side facing toward the second bearing bushing.

Owing to the positioning of the axial bearing rings between the first and second bearing bushings, the lubrication and cooling of the axial bearing arrangements thus formed is optimized in relation to the prior art. Likewise, the two axial bearing arrangements are thus situated at a position with the least shaft bending, whereby axial bearing tilting is reduced in relation to the prior art, and the contact ratio is increased.

In an advantageous refinement, the first bearing sleeve and the first bearing bushing are arranged in an opening of the casing cover.

In this way, it is possible for the first bearing sleeve and first bearing bushing to be positioned closer to the impeller, whereby the radial forces in

the bearing can be reduced, and a lower likelihood of bearing failure at operating points that are critical with regard to radial thrust is realized.

5 To achieve secure seating of the axial bearing rings, it is provided, in a preferred refinement of the invention, that the first axial bearing ring is clamped in the first ring groove by way of an undular washer, and the second axial bearing ring is clamped in the
10 second ring groove by way of an undular washer.

In a preferred refinement of the invention, for optimum lubrication and cooling of the plain bearing arrangement, it is provided that, in the retaining
15 ring, there is formed at least one bore which connects the first ring groove to a further ring groove formed in the retaining ring in a region facing toward the impeller shaft.

20 For the same reason, according to the invention, in the retaining ring, there is formed at least one bore which connects the second ring groove to the ring groove formed in the retaining ring in the region facing toward the impeller shaft.

25 For simple and inexpensive assembly, in an advantageous refinement of the invention, an opening in a casing cover of the pump casing has an opening region of increased diameter, in which opening region there is
30 formed an encircling groove which receives a tolerance ring, and in which opening region the first bearing bushing is positioned and connected rotationally conjointly to the casing cover by way of the tolerance ring.

35 Furthermore, it is expediently the case that an opening in the bearing ring carrier has an opening region of increased diameter, in which opening region there is

formed an encircling groove which receives a tolerance ring, and in which opening region the second bearing bushing is accommodated and connected rotationally conjointly to the bearing ring carrier by way of the tolerance ring.

An arrangement of the first bearing bushing in the casing cover and of the second bearing bushing in the bearing ring carrier has the advantage that the plain bearing arrangement or parts thereof can be exchanged in an easy manner with regard to servicing, without the use of special tools.

Exemplary embodiments are illustrated in the drawing and will be described in more detail below. In the drawings:

figure 1 shows the longitudinal section through a magnetic clutch pump arrangement having a plain bearing arrangement according to the invention, and

figure 2 shows a plain bearing arrangement corresponding to figure 1 in an enlarged illustration.

Figure 1 shows a pump arrangement 1 in the form of a magnetic clutch pump arrangement. The pump arrangement 1 has a multi-part pump casing 2 of a centrifugal pump, which pump casing comprises a hydraulics casing 3 in the form of a spiral casing, a casing cover 4, a bearing carrier cage 5, a bearing carrier 6 and a bearing cover 7.

The hydraulics casing 3 has an inlet opening 8 for the intake of a delivery medium and has an outlet opening 9 for the discharge of the delivery medium. The casing cover 4 is arranged on that side of the hydraulics

casing 3 which is situated opposite the inlet opening 8. The bearing carrier cage 5 is fastened to that side of the casing cover 4 which is averted from the hydraulics casing 3. The bearing carrier 6 is mounted on that side of the bearing carrier cage 5 which is situated opposite the casing cover 4. The bearing cover 7 in turn is fastened to that side of the bearing carrier 6 which is averted from the bearing carrier cage 5.

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A containment can 10 is fastened to that side of the casing cover 4 which is averted from the hydraulics casing 3, and said containment can extends at least partially through an interior space 11 delimited by the pump casing 2, in particular by the casing cover 4, by the bearing carrier cage 5 and by the bearing carrier 6. The containment can 10 hermetically seals off a chamber 12, which is enclosed by said containment can, with respect to the interior space 11.

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An impeller shaft 13 which is rotatable about an axis of rotation A extends from a flow chamber 14, which is delimited by the hydraulics casing 3 and by the casing cover 4, into the chamber 12 through an opening 15 provided in the casing cover 4.

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An impeller 16 is fastened to a shaft end, situated within the flow chamber 14, of the impeller shaft 13, and an inner rotor 17 arranged within the chamber 12 is arranged on the opposite shaft end, which has two shaft sections 13a, 13b with increasing diameters in each case. The inner rotor 17 is equipped with multiple magnets 18 which are arranged on that side of the inner rotor 17 which faces toward the containment can 10.

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Between the impeller 16 and the inner rotor 17 there is arranged a plain bearing arrangement 19 which is

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operatively connected to the impeller shaft 13, which can be driven in rotation about the axis of rotation A.

A drive motor, preferably an electric motor, which is not illustrated drives a drive shaft 20. The drive shaft 20, which can be driven about the axis of rotation A, is arranged substantially coaxially with the impeller shaft 13. The drive shaft 20 extends through the bearing cover 7 and through the bearing carrier 6 and is mounted in two ball bearings 21, 22 which are accommodated in the bearing carrier 6. On the free end of the drive shaft 20 there is arranged an outer rotor 24, which bears multiple magnets 23. The magnets 23 are arranged on that side of the outer rotor 24 which faces toward the containment can 10. The outer rotor 24 extends at least partially over the containment can 10 and interacts with the inner rotor 17 such that the rotating outer rotor 24, by way of magnetic forces, sets the inner rotor 17 and thus likewise the impeller shaft 13 and the impeller 16 in rotation.

The plain bearing arrangement 19 illustrated on an enlarged scale in figure 2 comprises a first retaining ring 25, which is arranged on the impeller shaft 13 and which bears by way of one side against the impeller 16. A first bearing sleeve 26, which has likewise been pushed onto the impeller shaft 13, bears against that side of the retaining ring 25 which is situated opposite the impeller 16. The first bearing sleeve 26 is surrounded by a first bearing bushing 27, which is connected rotationally conjointly to the casing cover 4. The first bearing sleeve 26, which is situated close to the impeller 13, and the first bearing bushing 27, which is situated close to the impeller 13, are in this case arranged entirely, or at least partially or predominantly, in the opening 15 of the casing cover 4. The opening 15 of the casing cover 4 has an opening

region 28 of increased diameter, in which opening region there is formed an encircling groove 30 which receives a tolerance ring 29, wherein the bearing bushing 27 positioned in the opening region 28 is
5 connected rotationally conjointly to the casing cover 4 in a secure manner by way of the tolerance ring 29.

A second retaining ring 31, which has been pushed onto the impeller shaft 13, bears against that side of the
10 bearing sleeve 26 which is situated opposite the retaining ring 25. In the retaining ring 31 there is formed a first ring groove 32 which points toward the first bearing bushing 27 and in which a first axial bearing ring 33 is arranged. The first bearing bushing
15 27 and first axial bearing ring 33 are arranged so as to be situated substantially opposite one another. On the side situated opposite the first ring groove 32, the retaining ring 31 has a second ring groove 34 in which a second axial bearing ring 35 is accommodated.
20 In the embodiment shown, the retaining ring 31 is of single-part form. In an alternative embodiment, the retaining ring 31 may be formed in two parts, wherein both retaining ring parts have in each case only one ring groove 32 and 34 respectively. The first axial
25 bearing ring 33 is clamped in the first ring groove 32 by way of an undular washer 36. In the same way, the second axial bearing ring 35 is clamped in the second ring groove 34 by way of a further undular washer 37.

30 A second bearing sleeve 38 arranged on the impeller shaft 13 bears against that side of the retaining ring 31 which is situated opposite the first bearing sleeve 26, and said second bearing sleeve is surrounded by a second bearing bushing. The second bearing bushing 39
35 and second axial bearing ring 35 are arranged so as to substantially face one another. A third retaining ring 40, which has been pushed onto the impeller shaft 13,

bears, at the side facing away from the retaining ring 31, against the second bearing sleeve 38.

As can be seen from figures 1 and 2, the plate spring
5 pack 41 is arranged between the retaining ring 40 and
the shaft section 13a and exerts a spring force on the
clamped assembly composed of impeller 16, an impeller
nut 43 which fastens the impeller 16 to the impeller
shaft 13 via a disk 42, retaining ring 25, first
10 bearing sleeve 26, retaining ring 31, second bearing
sleeve 38, retaining ring 40 and inner rotor 17 in such
a way that the clamped assembly is held in abutment, in
particular by way of the inner rotor 17, with a certain
degree of elasticity against an abutment surface 44
15 which arises owing to the different diameters of the
shaft sections 13a and 13b, wherein the diameter of the
shaft section 13b is greater than the diameter of the
shaft section 13a and the diameter of the shaft section
13a is greater than the diameter of that part of the
20 impeller shaft 13 which adjoins the shaft section 13a
at the side facing away from the shaft section 13b. The
clamped assembly comprises substantially the components
which rotate with the impeller shaft 13 about the axis
of rotation A.

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Owing to differently acting axial thrust forces during
the operation of the pump arrangement 1, either the
first axial bearing ring 33 abuts against the first
bearing bushing 27, wherein first axial bearing ring 33
30 and first bearing bushing 27 form a first axial bearing
arrangement 45, or the second axial bearing ring 35
abuts against the second bearing bushing 39, wherein
second axial bearing ring 35 and second bearing bushing
39 form a second axial bearing arrangement 46.

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A bearing ring carrier 47 is fastened, coaxially with
respect to the axis of rotation A, by way of a flange-
like region 48 to the casing cover 4 by means of a

screw connection (not illustrated), and said bearing ring carrier extends into the chamber 12. Here, said bearing ring carrier substantially surrounds the retaining ring 31 with the axial bearing rings 33, 35, the second bearing sleeve 38, the second bearing bushing 39 and, at least in part, the retaining ring 40. From the flange-like region 48 to its free end 49, the outer diameter of the bearing ring carrier 47 decreases in sections. The bearing ring carrier 47 has an interior region 50 within which the retaining ring 31 is arranged. On the free end 49, the bearing ring carrier 47 has an opening 51 through which the impeller shaft 13 extends, which opening has an opening region 52 of increased diameter situated adjacent to the interior region 50, in which opening region there is formed an encircling groove 54 which receives a tolerance ring 53. The second bearing bushing 39, which is accommodated in the opening region 52, is connected rotationally conjointly to the bearing ring carrier 47 in a secure manner by way of the tolerance ring 53.

An abutment surface 55 is realized owing to the transition from the opening 15 to the opening region 28 of increased diameter, and an abutment surface 56 is realized owing to the transition from the opening 51 to the opening region 52 with increased diameter, which abutment surfaces hold the plain bearing arrangement 19 in its intended position.

Passage openings 57, 58 are provided in the casing cover 4, and passage openings 59, 60 are provided in the bearing ring carrier 47. The passage openings 57, 58 connect the flow chamber 14 to the chamber 12 which is substantially surrounded by the containment can 10 and the casing cover 4, and the passage openings 59, 60 connect the chamber 12 to the interior region 50 of the bearing ring carrier 47. In the retaining ring 31 there is formed at least one bore 61 which connects the first

ring groove 32 to a further ring groove 62 which is formed in the retaining ring 31 in the region facing toward the impeller shaft 13. At least one bore 63 connects the second ring groove 34 likewise to the ring groove 62. Furthermore, at least one axial groove 64 running parallel to the axis of rotation is situated in the first bearing bushing 27 on the radial bearing surface which interacts with the first bearing sleeve 26, and an axial groove 65 is situated in the second bearing bushing 39 on the radial bearing surface which interacts with the second bearing sleeve 38.

Thus, for the cooling and lubrication of the plain bearing arrangement 19, delivery medium can be extracted from the flow chamber 14 and supplied via the passage openings 57, 58, 59, 60 to the axial bearing rings 33, 35 and to the mutually assigned surfaces of the bearing sleeves 26, 38 and bearing bushings 27, 39. Via the bores 61, 63, the delivery medium is delivered into the ring groove 62. Via at least one radial bore 66 formed in the impeller shaft 13, the delivery medium is delivered into an axial duct (not illustrated), which extends through the entire impeller shaft 13 from one end to the other, and then back into the flow chamber 14. If required, at least one further radial bore 67 is formed in the impeller shaft close to the retaining ring 40 or disk spring pack 41, which at least one further radial bore is likewise connected to the axial duct extending through the impeller shaft 13. Via at least one radial bore (not illustrated in the figures) in the retaining ring 40, the delivery medium is delivered from the interior region 50 of the bearing ring carrier 48 to the at least one radial bore 67. By virtue of the fact that the radial bores 66, 67 are arranged relatively far away from the impeller 16, greater fatigue strength of the impeller shaft 13 is realized.

List of reference designations

1	Pump arrangement	33	First axial bearing
2	Pump casing		ring
3	Hydraulics casing	34	Second ring groove
4	Casing cover	35	Second axial bearing
5	Bearing carrier cage		ring
6	Bearing carrier	36	Undular washer
7	Bearing cover	37	Undular washer
8	Inlet opening	38	Second bearing
9	Outlet opening		sleeve
10	Containment can	39	Second bearing
11	Interior space		bushing
12	Chamber	40	Retaining ring
13	Impeller shaft	41	Plate spring pack
13a	Shaft section	42	Disk
13b	Shaft section	43	Impeller nut
14	Flow chamber	44	Abutment surface
15	Opening	45	First axial bearing
16	Impeller	46	Second axial bearing
17	Inner rotor	47	Bearing ring carrier
18	Magnet	48	Flange-like region
19	Plain bearing	49	Free end
	arrangement	50	Interior region
20	Drive shaft	51	Opening
21	Ball bearing	52	Opening region
22	Ball bearing	53	Tolerance ring
23	Magnet	54	Groove
24	Outer rotor	55	Abutment surface
25	Retaining ring	56	Abutment surface
26	First bearing sleeve	57	Passage opening
27	First bearing	58	Passage opening
	bushing	59	Passage opening
28	Opening region	60	Passage opening
29	Tolerance ring	61	Bore
30	Groove	62	Ring groove
31	Retaining ring	63	Bore
32	First ring groove	64	Axial groove

65 Axial groove

66 Radial bore

67 Radial bore

A Axis of rotation

Patent claims

Pump arrangement comprising a plain bearing arrangement

- 5 1. A pump arrangement, in particular magnetic clutch
pump arrangement, having an interior space formed
by a pump casing of the pump arrangement, having a
containment can which hermetically seals off a
chamber surrounded by said containment can with
10 respect to the interior space formed by the pump
casing, having an impeller shaft which is mounted
by way of a plain bearing arrangement and which
can be driven in rotation about an axis of
rotation, having an impeller arranged on one end
15 of the impeller shaft, having a first bearing
sleeve connected rotationally conjointly to the
impeller shaft, having a second bearing sleeve
connected rotationally conjointly to the impeller
shaft, having a first bearing bushing which
20 interacts by way of a radial bearing surface with
the first bearing sleeve and which is connected
rotationally conjointly to the pump casing or to a
component fastened to the pump casing, having a
second bearing bushing which interacts by way of a
25 radial bearing surface with the second bearing
sleeve and which is connected rotationally
conjointly to the pump casing or to a component
fastened to the pump casing, and having a
retaining ring arranged between the first and
30 second bearing bushings,

characterized in that

- 35 a first ring groove (32), which receives a first
axial bearing ring (33), is formed in the
retaining ring (31) on the face side facing toward
the first bearing bushing (27), and a second ring
groove (34), which receives a second axial bearing

ring (35), is formed in the retaining ring (31) on the face side facing toward the second bearing bushing (39).

- 5 2. The pump arrangement as claimed in claim 1, characterized in that the first bearing sleeve (26) and the first bearing bushing (27) are arranged in an opening (15) of the casing cover (4).
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3. The pump arrangement as claimed in claim 1 or 2, characterized in that the first axial bearing ring (33) is clamped in the first ring groove (32) by way of an undular washer (36), and the second
- 15 axial bearing ring (35) is clamped in the second ring groove (34) by way of an undular washer (37).
4. The pump arrangement as claimed in one of claims 1 to 3, characterized in that, in the retaining ring (31), there is formed at least one bore (61) which connects the first ring groove (32) to a further
- 20 ring groove (62) formed in the retaining ring (31) in a region facing toward the impeller shaft (13).
- 25 5. The pump arrangement as claimed in one of claims 1 to 4, characterized in that, in the retaining ring (31), there is formed at least one bore (63) which connects the second ring groove (34) to the ring groove (62) formed in the retaining ring (31) in
- 30 the region facing toward the impeller shaft (13).
6. The pump arrangement as claimed in one of claims 1 to 5, characterized in that the opening (15) in a casing cover (4) of the pump casing (2) has an
- 35 opening region (28) of increased diameter, in which opening region there is formed an encircling groove (30) which receives a tolerance ring (29), and in which opening region the first bearing

bushing (27) is positioned and connected rotationally conjointly to the casing cover (4) by way of the tolerance ring (29).

- 5 7. The pump arrangement as claimed in one of claims 1 to 6, characterized in that an opening (51) in a bearing ring carrier (47) has an opening region (52) of increased diameter, in which opening region there is formed an encircling groove (54) which receives a tolerance ring (53), and in which opening region the second bearing bushing (39) is accommodated and connected rotationally conjointly to the bearing ring carrier (47) by way of the tolerance ring (53).
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