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Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

(54) Title: ROTARY VANE PUMP WITH VARIABLE CONVEYING QUANTITY

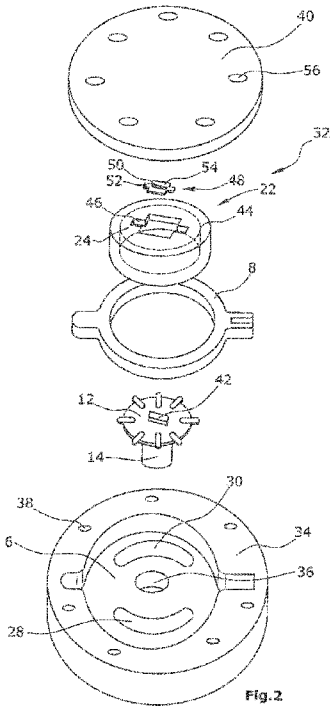


Fig.2

(57) Abstract: A rotary vane pump with variable conveying quantity, comprising a housing arrangement (4) which encloses a housing chamber (6) having arranged therein a displaceable eccentric ring (8) accommodating an inner rotor member (12) that is rota table relative to the eccentric ring (8) and that is supported in the housing arrangement (4) to be driven by drive means via a rotary axis (14), wherein the inner rotor member (12) comprises slits (16) having vane elements (18) displaceably supported in them, wherein a cover element (40) is provided for closure of the housing chamber (6) and wherein the housing arrangement (4) has an inlet opening (28) and an outlet opening (30) provided in it, wherein, in the housing chamber (6), between the eccentric ring (8) and the inner rotor member (12), an outer rotor member (22) is provided which on its inner side (24) is engaged by the vane elements (18) so as to enclose pump chambers (26), wherein the outer rotor member (22) is coupled via a coupling arrangement (32) to the inner rotor member (12) in a torsionally rigid manner while, however, being displaceable in radial direction.

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DESCRIPTION

Rotary vane pump with variable conveying quantity

The invention relates to a rotary vane pump with variable conveying quantity, said rotary vane pump comprising a housing arrangement which encloses a housing chamber having arranged therein a displaceable eccentric ring accommodating an inner rotor member that is rotatable relative to the eccentric ring and that is supported in the housing arrangement to be driven by drive means via a rotary axis, wherein the inner rotor member comprises slits in which vane elements are displaceably supported, wherein a cover element is provided for closure of the housing chamber and wherein the housing arrangement has an inlet opening and an outlet opening provided in it.

A rotary vane pump of this type is known e.g. from Japanese Laid-open Patent Application JP 2007-309249 A. Such pumps, which are also referred to as cell pumps, serve e.g. for the conveyance of lubricant for an internal combustion machine. In this respect, in the state of the art, the ends of the vane elements supported within the inner rotor member are in abutment on the inner sides of the eccentric ring and in this manner enclose a plurality of pump chambers. Via an inlet opening, lubricant will be sucked in, be condensed within the pump chambers and then, via an outlet opening, be supplied to corresponding consumers. The higher the eccentricity of the eccentric ring relative to the inner rotor member is, the larger will be the condensation effected by the inner rotor member moving relative to the eccentric ring. A disadvantage of this known rotary vane pump resides in that, due to the relative movement of the inner rotor member with respect to the eccentric ring, the inner surface of the eccentric ring and respectively the ends of the vane elements are subjected to considerable forces and wear, which can leadto fatique fracture of pump parts. Furthermore it may have the consequence that the chambers will not be entirely sealed

anymore relative to each other and, as a result, an optimal condensation will not be possible anymore.

Thus, it is an object of the invention to provide a rotary vane pump in which the above disadvantage is avoided in a simple and inexpensive manner.

This object is achieved in that, in the housing chamber, between the eccentric ring and the inner rotor member, an outer rotor member is provided which on its inner side is engaged by the vane elements so as to enclose pump chambers, wherein the outer rotor member is coupled via a coupling arrangement to the inner rotor member in a torsionally rigid manner while, however, being displaceable in radial direction. Since no relative movement will take place anymore between the inner rotor member and the outer rotor member, the vane element will not be subjected to forces and wear anymore so that the mutual sealing of the pump chambers is guaranteed over the entire operational life of the rotary vane pump.

In a particularly advantageous manner, the outer rotor member is cup-shaped, wherein a bottom member is facing toward the cover element and comprises a coupling member recess having arranged in it a coupling member comprising an inner rotor member recess which is engaged by an inner rotor hub. Herein, it is particularly advantageous if the coupling member recess is cross-shaped (other designs are admissible) and the inner rotor member recess is of a rectangular shape, wherein the inner rotor hub is designed as a feather key. In this case, the coupling arrangement is designed in analogy to the principle of a per se known Oldham coupling.

According to a further advantageous embodiment of the invention, the inner rotor hub can be integrally connected to the inner rotor member.

The invention will be explained in greater detail hereunder with reference to a drawing wherein:

Figure 1 is a plan view of a schematically represented rotary vane pump in its opened state, and

Figure 2 is an exploded view of the rotary vane pump of Figure 1.

In Figure 1, a rotary vane pump 2 according to the invention is shown in plan view in schematic representation. The rotary vane pump 2 comprises, in a known manner, a housing arrangement 4 enclosing a housing chamber 6. In this housing chamber 6, a hydraulically displaceable eccentric ring 8 is arranged which in a known manner is kept subjected to a bias by a spring 10. In the present view, the eccentric ring 8 has been pressed into its maximum possible eccentricity relative to a center 11 of an inner rotor member 12. By the chain-dotted line, there is schematically marked a rotary axis 14 of the inner rotor member 12 via which the inner rotor member 12 is driven in a known manner by a drive means, not specifically illustrated. This drive means can be both an electric motor and e.g. a toothed wheel, wherein, in the latter case, the toothed wheel is in turn coupled to a crankshaft. Herein, the rotary axis 14 is supported in the housing arrangement 4 in a non-displaceable manner. In the present exemplary embodiment, internally of inner rotor member 12, eight displaceably arranged vane elements 18 are provided in eight radially extending slits 16, which vane elements 18 are biased by means of a spring ring (not shown) in the direction of an outer rotor member 22 and engage an inner side 24 of outer rotor member 22 in such a manner that pump chambers 26 are formed between respectively two vane elements 18. Further, in housing arrangement 4, an inlet opening 28 and an outlet opening 30 for lubricant are provided in a known manner. By way of a coupling arrangement 32, shown in Figure 2, the outer rotor member 22 is coupled to the inner rotor member 12 in a torsionally rigid manner so that no relative movement can take place anymore between the vane elements 18 and the inner side 24 of the outer rotor member 22.

In Figure 2, the rotary vane pump 2 from Figure 1 is shown in perspective exploded view. Designated by 34 herein is a base portion of housing arrangement 4, in which a support site 36 for rotary axis 14 as well as the inlet opening 28 and the outlet opening 30 are arranged. Further shown are the housing chamber 6 and bores 38 for connection to a cover element 40.

The inner rotor member 12 is supported at the support site 36 by means of the rotary axis 14 in non-rotatable manner. Within the inner rotor member 12, the spring ring (not shown) is arranged. Further, the inner rotor member comprises, on the side facing away from base portion 34, an inner rotor hub 42 which in the present exemplary embodiment is realized as a feather key and is integrally connected to the inner rotor member 12. An inner rotor hub 42 is a part of the coupling arrangement 32 which is already mentioned in the context of the description of Figure 1. Reference numeral 8 designates, as already described in connection with Figure 1, the eccentric ring which in a known manner is inserted into the base portion 34 of housing arrangement 4. Between the eccentric ring 8 and the inner rotor member 12, the outer rotor member 22 is placed which on its inner side 24 is engaged by the vane elements 18 of inner rotor member 12. In the present exemplary embodiment, the outer rotor member 22 is cup-shaped and comprises a bottom portion 44 which faces toward cover element 40 and has a cross-shaped coupling member recess 46 that, together with a coupling member 48 and the inner rotor hub 42, forms a part of the coupling arrangement 32. The coupling member 48, which itself comprises a rectangular inner rotor member recess 50, is insertable into the cross-shaped coupling member recess 46, wherein the inner rotor member recess 50 is engaged by the inner rotor hub 42 for rotary force transmission. In this arrangement, the cross-shaped recess 46 of outer rotor member 22 is dimensioned larger in such a manner that mutually intersecting legs 52, 54 of coupling member 48 can be displaced within recess 46 according to the principle of an Oldham coupling. Thereby, it is possible to realize the eccentricity - shown in Figure 1 - of the outer rotor member 22 relative to the inner rotor member 12. The rotary vane pump is sealed off e.g. with the

aid of screws which engage into the bores 38 of base portion 34 via through bores 56 of cover element 40.

CLAIMS

1. A rotary vane pump with variable conveying quantity, said rotary vane pump comprising a housing arrangement (4) which encloses a housing chamber (6) having arranged therein a displaceable eccentric ring (8) accommodating an inner rotor member (12) that is rotatable relative to the eccentric ring (8) and that is supported in the housing arrangement (4) to be driven by drive means via a rotary axis (14), wherein the inner rotor member (12) comprises slits (16) having vane elements (18) displaceably supported in them, wherein a cover element (40) is provided for closure of the housing chamber (6) and wherein the housing arrangement (4) has an inlet opening (28) and an outlet opening (30) provided in it,
characterized in that,
in the housing chamber (6), between the eccentric ring (8) and the inner rotor member (12), an outer rotor member (22) is provided which on its inner side (24) is engaged by the vane elements (18) so as to enclose pump chambers (26), wherein the outer rotor member (22) is coupled via a coupling arrangement (32) to the inner rotor member (12) in a torsionally rigid manner while, however, being displaceable in radial direction.

2. The rotary vane pump according to claim 1,
characterized in that
the outer rotor member (22) is cup-shaped, wherein a bottom member (44) is facing toward the cover element (40) and comprises a coupling member recess (46) having arranged in it a coupling member (48) comprising an inner rotor member recess (50) engaged by an inner rotor hub (42).

3. The rotary vane pump according to claim 2,
characterized in that

the coupling member recess (46) is cross-shaped and the inner rotor member recess (50) is of a rectangular shape, wherein the inner rotor hub (42) is designed as a feather key.

4. The rotary vane pump according to claim 2,
characterized in that
the inner rotor hub (42) is integrally connected to the inner rotor member (12).

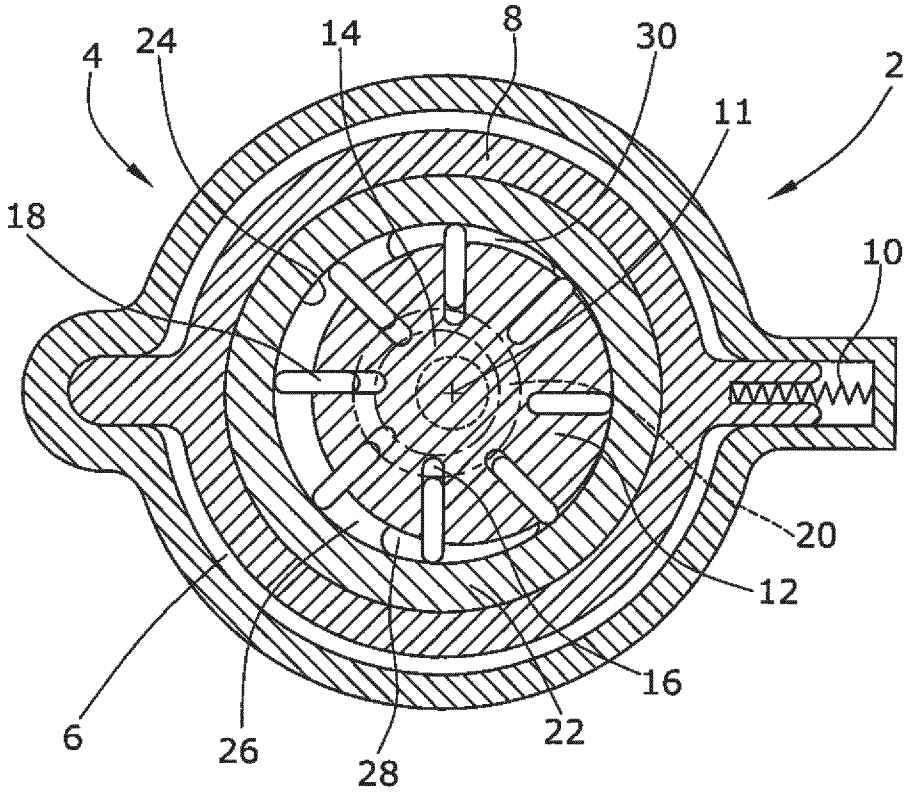


Fig.1

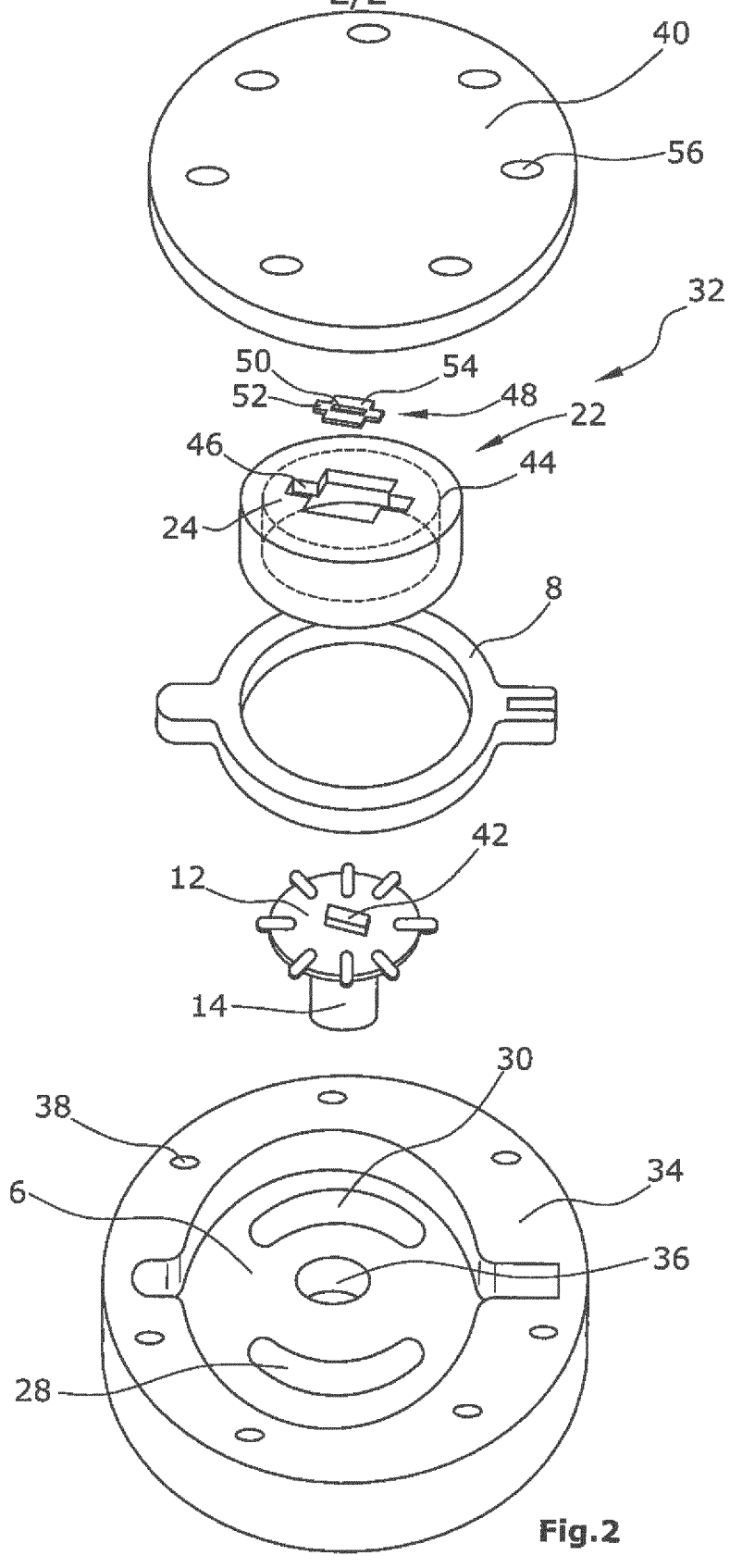


Fig.2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/074763

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04C2/344 F04C2/348 F04C14/22 F04C15/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04C

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10 2011 000533 A1 (ZF LENKSYSTEME GMBH [DE]) 9 August 2012 (2012-08-09) paragraph [0025] - paragraph [0028] abstract; claim 1; figures 1,2	1-4
A	US 6 135 742 A (CHO BONG-HYUN [KR]) 24 October 2000 (2000-10-24) column 2, line 42 - column 3, line 49 figure 3	1-4
A	WO 2014/077835 A1 (MOOG INC [US]) 22 May 2014 (2014-05-22) paragraph [0047] - paragraph [0054] figures 1-4	1-4
A	WO 2017/109606 A1 (VHIT SPA [IT]) 29 June 2017 (2017-06-29) page 3, line 24 - page 5, line 3 figures 1-6	1-4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2018	04/05/2018

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/074763

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