United States Patent

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[54] **GEARED PUMPS**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **418/132**
[51] **Int. Cl.** **F04c 5/00, F01c 19/08**
[50] **Field of Search** 418/132, 131, 133

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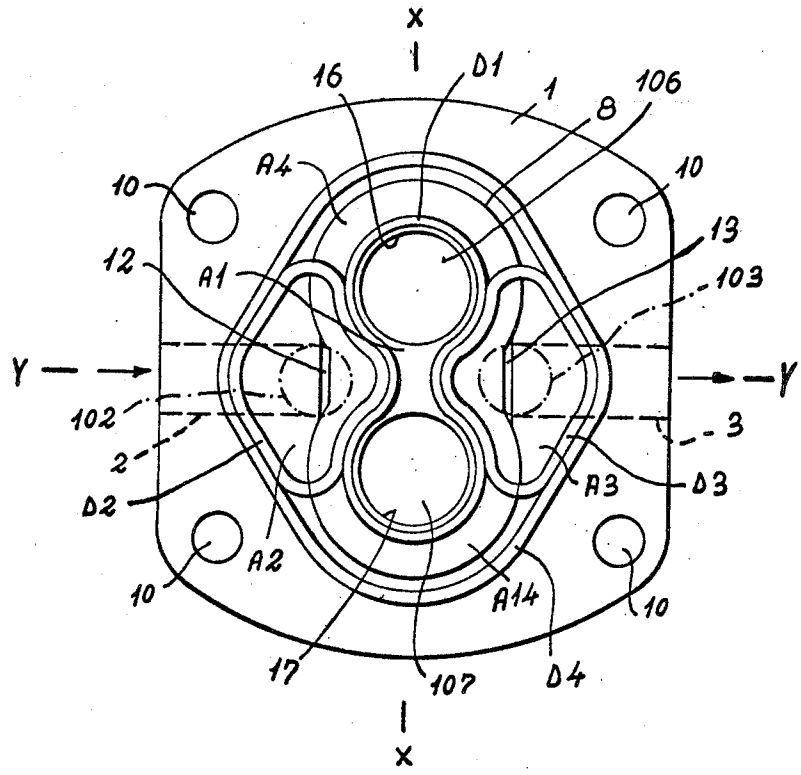
ABSTRACT: A gear pump has, on the outer face of each bearing plate, four annular symmetrical and symmetrically arranged packings, comprising a central packing which is disposed around the gear wheel pivots and which may be of approximately 8-shaped form, two intermediate packings one on each side of and closely adjacent the central packing, and a peripheral packing encircling both the central packing and the intermediate packing and closely adjacent the latter.



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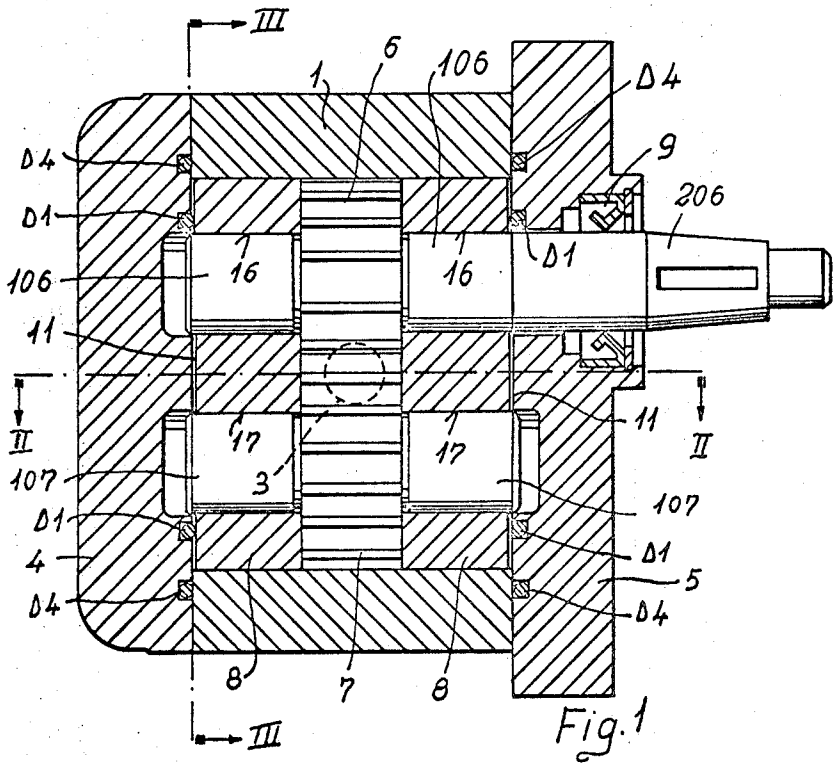

Fig. 1

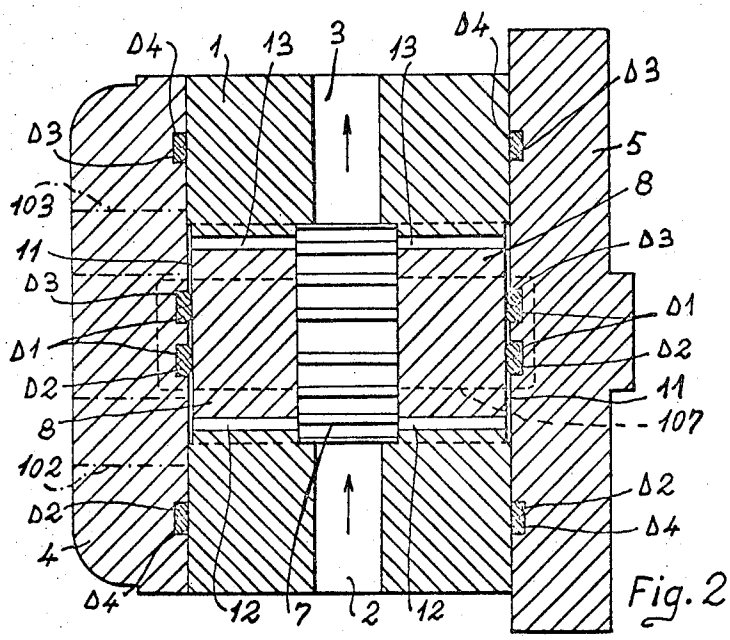

Fig. 2

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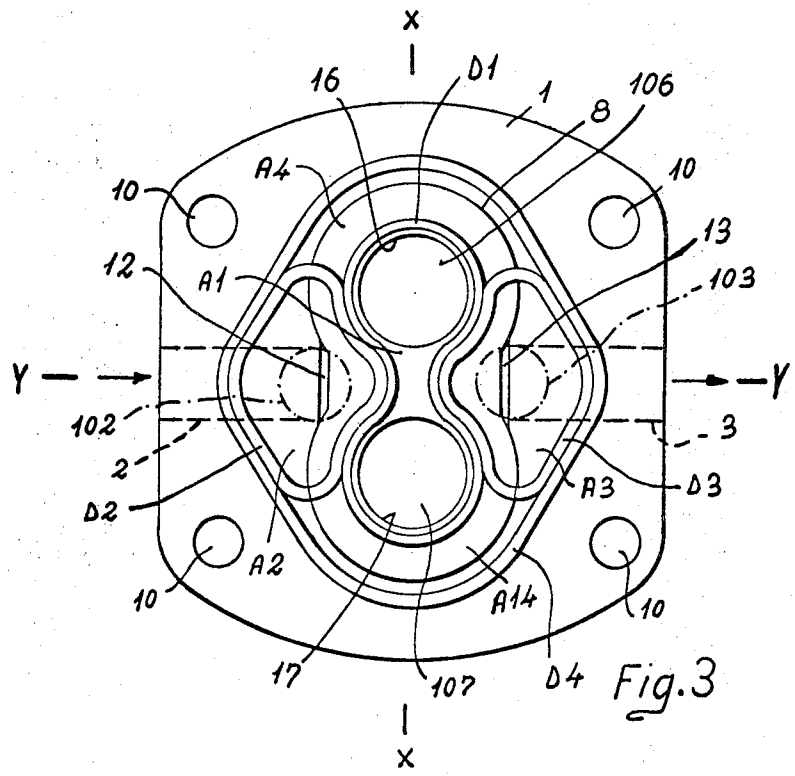

Fig.3

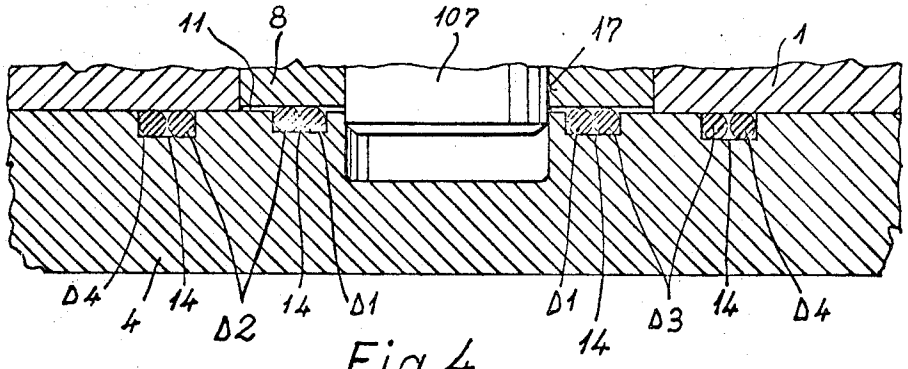

Fig.4

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GEARED PUMPS

The present invention relates to geared pumps in which the pivots on both sides of the gear wheels are each pivoted in a bearing plate which is arranged in the pump housing bore and which butts tightly against the respective side face of the gearwheels, and in which as constant as possible a play is provided between each bearing plate and the associated pump housing cover, this play being established by a narrow separating gap, whose zones communicating with the delivery channel and the suction channel of the pump, are bounded and sealed by closed annular packings.

In the case of the known geared pumps of this kind, the zones of the separating gap between the bearing plates and the associated pump housing covers which are subject to suction and delivery pressure, and consequently also the packing surrounding these zones, have an asymmetrical shape or arrangement. It is therefore practically impossible to reverse the direction of rotation or feed of these geared pumps, or to use them as hydraulic motors.

It is an object of the invention to obviate this disadvantage and to provide a geared pump, of the type hereinbefore described which in conjunction with a better equalization of the pressures acting on the bearing plates of the pivots and a reduced compressive load of the bearing plates which is distributed as uniformly as possible, renders possible by simple and not very expensive constructional means, the reversal of the direction of rotation of the gear wheels and consequently of the feed direction of the pump or the use of this latter as a motor.

According to the invention, this task is solved by providing on the outside of each bearing plate, four annular closed frontal packings which have a symmetrical shape and which are arranged symmetrically both with respect to the plane of engagement of the toothed wheels and with respect to the median plane at right angles thereto and passing through the gearwheel axes, said four packings comprising a central packing surrounding the bearing bores of the two gearwheel pivots at the minimum possible spacing, two intermediate packings arranged symmetrically on opposite sides of the central packing and bounding the zones of the separating gap communicating with the delivery channel and suction channel, and a peripheral packing encircling both the central packing and the intermediate packings.

With this arrangement, the pressures acting on the bearing plates of the pivots are limited superficially and distributed symmetrically in such a way as to achieve substantial balancing of these pressures and a reduced compressive stress of the bearing plates without difficulty and at the same time the bearing plates can perform only those movements which are necessary to maintain an optimum abutment of the same against the associated side faces of the gearwheels and for maintaining a corresponding satisfactory sealing. Moreover, the direction of rotation of the gearwheels or the delivery direction of the pump can be reversed or the latter can be used as a motor, without causing any harmful or impermissible effects on the pressure balance on the stressing of the bearing plates or on the seal.

The advantageous result achieved by means of the invention can, according to a further feature of the invention, be additionally facilitated in that adjacent sections of the intermediate packings on the one hand and of the central packing or of the peripheral packing on the other hand extend closely side-by-side, preferably in direct contact one with another. By this means, the zone enclosed by the peripheral packing and lying outside the central packing and the intermediate packings is in addition subdivided into two separate symmetrical zone portions which lie transverse to the plane of engagement of the gearwheels on opposite sides of the central packing, and which contribute substantially to the uniform stressing of the bearing plates and to the pressure equalization.

In a particularly advantageous specific embodiment of the invention the central packing has an approximately 8-shaped form and the intermediate packings or the peripheral packing

have an approximately rhomboid or diamond-shaped form. By this means, the two zones which are acted upon by different pressures (suction pressure and delivery pressure) and which lie on opposite sides of the central constriction of the central, approximately 8-shaped zone bounded by the central packing are superficially reduced to such an extent that the resulting nonuniform or unsymmetrical stressing of the bearing plate can readily be tolerated and is in any case kept within considerably smaller limits than in the case of the known pump constructions.

Preferably the peripheral packing is clamped between the pump housing and the housing cover, and the central packing is clamped between the bearing plate and the housing cover. In this case the intermediate packings are arranged with their sections extending alongside the central packing between the bearing plate and the housing cover, and with their sections extending alongside the peripheral packing between the pump housing and the housing cover. This arrangement also achieves sealing between the pump housing and housing covers in a manner which is economical in respect of material and work.

The packings are preferably formed as O-rings and are arranged in insert grooves of the housing cover. In this case a separate correspondingly shaped insert groove may be provided for each individual packing. A substantial simplification or economy in work and cost can, however, in accordance with the invention be additionally achieved in that adjacent sections of the intermediate packings and of the central packing or of the peripheral packing are arranged in common insert grooves.

By way of example one form of embodiment of a geared pump according to the invention is illustrated in the drawings in which:

FIG. 1 is a longitudinal section of the geared pump;

FIG. 2 is a cross section of the pump along the line II–II of FIG. 1;

FIG. 3 is a view of the left-hand side of the geared pump of FIG. 1 in the direction of the arrow III–III, with the left-hand housing cover removed;

FIG. 4 is a partial section on a larger scale through the left-hand housing cover of FIG. 2 in the region of a pivot.

In the embodiment illustrated, 1 is the pump housing which has a suction channel 2 and a delivery channel 3 and which is closed on each side by covers 4 and 5. Arranged on each side of the two intermeshing gearwheels 6, 7 in the pump housing 1 is a bearing plate 8, which exactly fits the bore of housing 1 and is movable in the latter in the axial direction. The bore of the pump housing 1 and the bearing plates 8 have an approximately 8-shaped form, as is more especially seen in FIG. 3. The cooperating surfaces of the pump housing 1 and of the bearing plates 8 i.e., the inner bounding surface of the housing bore and the outer generated surface of the bearing plates are machined with the smallest possible tolerances.

The gearwheels 6, 7 are provided on both sides with pivots 106, 107 respectively, pivoted in corresponding bores 16, 17 respectively of the bearing plates 8. One pivot 106 of one gearwheel 6 is extended beyond the associated bearing plate 8 and becomes the pump driving shaft 206. This shaft 206 is led with the aid of a sleeve packing 9 through the flanged cover 5 and out of the pump housing. The covers 4, 5 are connected to the pump housing 1 by bolts (not shown) which are axially parallel to the gearwheels 6, 7 and which pass through corresponding bores 10.

The bearing plates 8 butt tightly against the associated side faces of the gearwheels 6, 7. Between the external side face of each bearing plate 8 and the opposed inner bounding surface of the associated cover 4 or 5 is a narrow separating gap 11, which in practice amounts to a few tenths or hundredths of a millimeter but which is excessively exaggerated in the drawings for reasons of clarity. The two gaps 11 communicate with the suction channel 2 and delivery channel 3 via connecting passages 12 or 13, directed axially parallel to the gearwheels 6, 7 and hollowed out between the bearing plates 8

and the pump housing 1 approximately in the plane of contact Y–Y of the said gearwheels, as is more especially shown in FIG. 2.

Provided on the outside of each bearing plate 8 are four frontal packings D1, D2, D3, D4 of symmetrical closed ringlike form and comprising a central packing D1, two intermediate packings D2, D3 and a peripheral packing D4. The central packing D1 surrounds, at minimum possible spacing, the bearing bores 16, 17 of the two gearwheel pivots 106, 107 respectively and is approximately 8-shaped in design, i.e. it has a shape constricted in the center between two bearing bores 16, 17, as is more especially seen from FIG. 3. The two intermediate packings D2, D3 are symmetrically arranged on opposite sides of the central packing D1 outside the latter and define respectively a region A2 or A3 of the gap 11, communicating via the connecting passage 12 with the suction channel 2 or via the connecting passage 13 with the delivery channel 3 of the pump. Each intermediate packing D2 or D3 has an approximately rhomboid form and its surface facing or adjacent the central packing D1, extends as closely as possible alongside the said packing D1, preferably in direct contact therewith.

The peripheral packing D4 surrounds both the central packing D1 and the two intermediate packings D2 and D3 and is likewise approximately of rhomboid form. The surface of the peripheral packing D4 facing or adjacent the intermediate packings D2 and D3 extends as near as possible to the said packings and is preferably in direct contact therewith. In this way within the separating gap 11 are defined two further regions A4, A14 which are respectively closed upon themselves and which lie transversely to the plane of contact Y–Y of the gears 6, 7 on opposite sides of the central packing D1.

The packings D1, D2, D3, D4 are formed as O-rings and are arranged in corresponding insert grooves of the associated housing cover 4 or 5. The 8-shaped central packing D1 is in this case clamped over its entire length between the bearing plate 8 and the associated housing cover 4 or 5. The rhomboid peripheral packing D4 on the other hand, lies completely between the pump housing 1 and the associated housing cover 4 or 5. The intermediate packings D2, D3 are arranged with their sections extending alongside the central packing 1 or in contact with this latter, between the bearing plate 8 and the housing cover 4 or 5 and with their sections extending alongside the peripheral packing D4 or in contact with the latter, between the pump housing 1 and the housing cover 4 or 5.

The packings D1, D2, D3, D4 may lie each in separated insert grooves in the associated housing cover 4 or 5. Preferably, however, the sections, extending side-by-side, of the intermediate packings D2, D3 and of the central packing D1 or of the peripheral packing D4 are arranged in common correspondingly widened parts 14 of the insert grooves, as is more especially seen in FIG. 4.

With the described construction and arrangement of the packings D1, D2, D3, D4 provided on the outside of each bearing plate 8, the corresponding separating gap 11 is subdivided into five separated and closed zones A1, A2, A3, A4 and A14, as is more especially seen from FIG. 3. These zones are symmetrically formed or arranged both with respect to the median plane X–X extending through the axes of the two gearwheels 6, 7 and with respect to the plane of contact Y–Y of the gearwheels 6, 7 extending normal thereto. Consequently it is readily possible to reverse the direction of rotation of the gearwheels 6, 7 and, by this means, also the delivery direction of the pump, i.e., to suck liquid to be conveyed through channel 3 and to force it into channel 2. Moreover, the pump can also be used as a motor.

At the same time, in all cases there is ensured both a pressure balance in each separating gap 11 or on each side face of the gearwheels 6, 7, which is completely adequate for the satisfactory sealing and mode of operation of the pump, and a satisfactorily uniform, symmetrically distributed, reduced compressive load on each individual bearing plate 8.

In the central 8-shaped region A1 bounded by the central packing D1, there prevails in general a pressure which is less than the delivery pressure of the pump and corresponds approximately to the suction pressure of the latter. The pressure exerted in this central region A1 on the bearing plate 8 can therefore in no event have any damaging effect on the bearing plates 8 of the gearwheel pivots. In the two outer regions A4, A14, which are approximately segment shaped and which are arranged on opposite sides of the central packing D1 with respect to the plane of contact Y–Y of the gearwheels, there prevail equal pressures, which are generally greater than the pressure in the central region A1 and may, for example, reach the value of the pump feed pressure. The forces exerted by the pressures in these regions A4 and A14 on the bearing plate 8 are, however, distributed completely symmetrically both with respect to the plane of contact Y–Y of the gearwheels 6, 7 and with regard to the median plane X–X extending perpendicular thereto, so that they also do not represent a harmful load.

In the two rhomboid-shaped zones A2 or A3, which are bounded by the intermediate packings D2 and D3 and which lie on opposite sides of the central packing D1 with respect to the median plane X–X of the pump, there do indeed prevail different pressures corresponding to the suction pressure or the delivery pressure of the pump, but the stressed parts of the bearing plate 8 are firstly symmetrical with respect to the plane of contact Y–Y of the gearwheels 6, 7 and secondly are so small, especially in comparison with the known pump constructions that the corresponding stresses of the bearing plate 8 lie far below the permissible limits.

The pump described can thus be designed with a relatively smaller amount of play in the direction parallel to the gearwheel axes and has, in combination with a satisfactory sealing and improved delivery, also a longer useful life.

The invention is, of course, not limited to the particular form of embodiment shown, and, within the framework of the general inventive concept, several solutions differing in structural respects, are possible. Thus, for example, it is not absolutely essential that the suction and delivery channels 2, 3 respectively should be hollowed out in the pump housing 1 and arranged approximately in the plane of contact Y–Y of the gearwheels 6, 7 at right angles to the median plane X–X as in the case of the embodiment illustrated. The inventive concept can, on the contrary, also be applied in the case of those geared pumps in which the suction and delivery channels 102, 103 respectively are provided in a housing cover 4 and are directed approximately axially parallel to the gearwheels 6, 7 as is shown in dot-dash lines in FIGS. 2 and 3. It is important only that these suction and delivery channels 102, 103 respectively communicate with the zones A2, A3 of the separating gap 11 bounded by the intermediate packings D2, D3 on the outsides of the two bearing plates 8.

On the other hand, all the features which are disclosed by the specification and the drawings, including the constructional details, can also be materially inventive in any desired combination.

I claim:

1. A gear pump assembly comprising a housing containing said pump, interengaging pump gearwheels each rotatably mounted on a pivot extending on both sides of said wheel and disposed in a bearing bore, two bearing plates located within said housing and each abutting closely against opposed side faces of said gearwheels, two housing covers each closing opposed sides of said housing and each located closely adjacent one of said bearing plates and defining between said cover and the adjacent plate a very narrow gap, pump suction and delivery channels, means affording communication between said channels and said gap, the outwardly facing surface of each bearing plate being provided with frontal annular closed sealing elements of symmetrical form and disposed symmetrically with respect to the plane of engagement of said gearwheels and with respect to the median plane at right angles thereto and passing through the gearwheel axes, said sealing elements comprising a central element surrounding and

located closely adjacent the said bearing bores, at least two intermediate elements arranged symmetrically on opposed sides of said central element and defining zones of said gap, said zones being in communication with said suction and delivery channels, and a peripheral element encircling both the said central element and said intermediate elements.

2. A gear pump according to claim 1, wherein one of said intermediate elements is closely adjacent the said central element, and another of said intermediate elements is closely adjacent said peripheral element.

3. A gear pump according to claim 1, wherein the central element has an approximately 8-shaped form and at least some of the intermediate elements or peripheral elements have an approximately rhomboid form.

4. A gear pump according to claim 1, wherein said peripheral element is held between said pump housing and the associated cover and the central element is held between the associated bearing plate and the associated cover.

5. A gear pump according to claim 1, wherein at least some of said intermediate elements are held so as to extend alongside the central element between the associated bearing plate and the associated cover and at least some of said intermediate elements are held so as to extend alongside the peripheral element between said pump housing and the associated cover.

6. A gear pump according to claim 1, wherein the sealing elements are formed as O-rings and are disposed in separate insert grooves in the associated housing cover.

7. A gear pump according to claim 1, wherein at least one intermediate element extends side-by-side together with a central element in a common insert groove in the associated housing cover, and at least one intermediate element extends side-by-side together with a peripheral element in a common insert groove in the associated housing cover.