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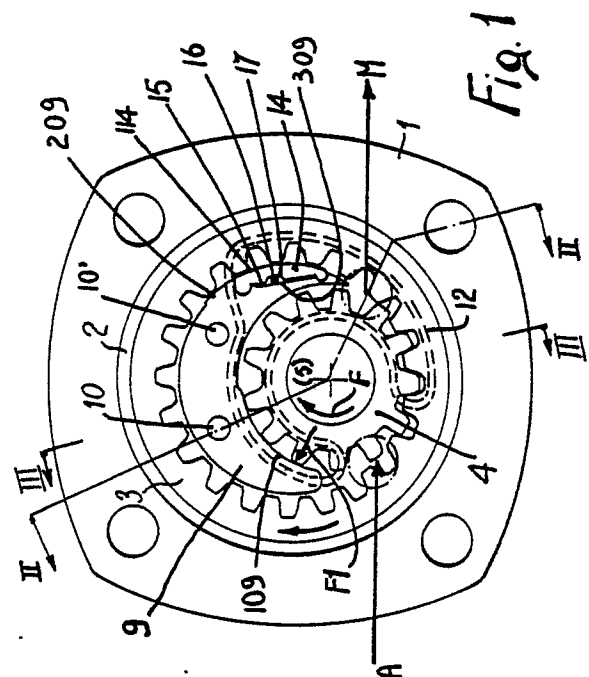
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Internal gear hydraulic pump.

An internal gear pump is disclosed, in which the high and low pressure zones (M,A) are separated from each other by inserts (9,14) preferably acting only on a section of the externally toothed gear (4) at a short distance from the suction zone (A), and acting only on a section of the internally toothed crown gear (3) at a short distance from the delivery side, the whole in such a manner that any friction produced by the said sealing inserts (9,14) will be of a limited amount, and will be in substantially opposite positions with respect to the axes of rotation of the gears (3,4), so that the heat resulting from any such friction will be evenly distributed to the several components of the pump, which therefore can be operated with no inconvenience even at any very high pressure value.



"Internal gear hydraulic pump"

The invention refers to a hydraulic internal gear pump, comprising an internally toothed crown gear and an externally toothed driving gear which are mounted for an axial rotation within a suitable housing, the internally toothed crown gear meshing with the externally toothed driving gear, and being provided with inserts located in the region where the gears are apart from each other, and which operate by contacting the teeth of said gears, whereby the suction (low pressure) zone is separated from the delivery (high pressure) zone of the pump.

In the pumps of known type, the sealing inserts generally are all arranged at the delivery side of the pump, where they act both on the externally toothed gear and on the internally toothed crown gear. It ensues that any friction produced by the sealing inserts and the heat resulting therefrom will subject the pump to unbalanced localized stresses, which impair the pump operation at any high pressure value.

Some embodiments are also known, according to which the sealing inserts operate in substantially opposite positions with respect to the axes of rotation of the gears, thus solving the problem of friction and heat distribution to the pump components. These embodiments however have the drawback of producing a friction having a very high value, since each sealing insert acts on both of the gears, at the suction side and at the delivery side of the pump.

The invention suggests a hydraulic pump with internal gears, in which the sealing inserts are so made that they act only on a section of the externally toothed gear, at the suction side, and only on a section of the internally toothed gear, at the delivery side, so that the advantage arising from a friction having a limited value is added to the advantage of the proper distribution to the pump components of the heat resulting from any such friction.

According to a first embodiment of the invention, in the suction zone of the pump a first insert is provided, which is fixedly secured to the static portion of the pump, and is so constructed that also thanks to a suitable rotatable support for the externally toothed gear, this gear will operate, owing to the pressure in the delivery circuit, by intimately contacting the inward side of the said stationary insert. In the delivery zone of the pump a second insert is provided on the extension of the body of the said stationary insert and is tightly connected thereto, the said second insert being movable, and being positively sealed in an intimate manner

against a sufficient number of teeth of the internally toothed crown gear by the bias of a preload spring and by the pressure in the delivery circuit of the pump.

According to a modified embodiment of the invention, only one sealing insert is provided, which is intermediately fulcrumed about a stationary pin parallel to the gear axes, and which is so long as to have its extremities respectively reaching the delivery zone and the suction zone of the pump. At least one preload spring urges against the crown gear the arm of the insert which is turned toward the delivery zone, and which is so urged also by the pressure in the delivery circuit, since the said arm is to a suitable extent longer than the opposite arm which operates by contacting the externally toothed gear. Compensating shoes may be provided on at least one of the active end sections of the said movable or swingable sealing insert.

More features of the improved pump according to the invention, and the advantages arising therefrom, will more clearly appear in the following specification of some preferred embodiments thereof, which are shown merely by way of non-limiting examples in the two annexed sheets of drawings, in which:

Figure 1 is an axial view of a first embodiment of the pump, with the closure cover plate and the relative wear plate thereof being omitted on the side from which the pump is considered.

Figure 2 shows further details in the construction of the pump shown in figure 1, in a sectional view taken on line II-II.

Figures 3 and 4 respectively show a modified embodiment of the pump as shown in figures 1, 5 and 6, in a sectional view taken on line III-III in figure 1.

Figures 5 and 6 are axial views of the pump, respectively showing a different embodiment of said pump.

Figure 7 shows some details in the construction of the pump shown in figure 5, in a sectional view taken on line VII-VII.

Referring first of all to figures 1 and 2, by numeral 1 there is designated the pump casing, and by numeral 2 there is designated the cylindrical cavity formed in the said casing, within which the internally toothed crown gear 3 is rotated axially, and is caused to mesh with an externally toothed gear 4 which is keyed onto, or is made of one piece with a co-axial shaft 5 rotatably supported by the cover plates 6,6' which in turn are secured by means of screws to the opposite ends of casing 1, with the interposition of seals diagrammatically shown at 7,7' and wear plates to be

described later on. The cover plates 6,6' carry the supports on which the shaft 5 is rotatably supported, may be with the interposition of bearings, not shown. Numeral 8 denotes a sealing ring. The shaft 5 shall be rotatably supported in such a manner that any radial stresses to which the gear wheel 4 is subjected due to the high pressure in the delivery circuit of the pump, will be not counterbalanced entirely, in view of the fact that the invention, as it will be more fully stated later, counts also on such stresses in order to assure the proper operation of the pump at any high pressure. In figure 1, by references A and M and by dash-and-dot lines there are respectively designated the apertures through which the suction and the delivery duct formed, for example, in one of the cover plates 6 or 6', open into the hollow space defined by the gears 3,4, respectively upstream and downstream of the area in which the said gears are seen to be mutually in mesh. According to the invention, the shaft 5 for the gear 4 is driven in rotation in the fixed direction indicated by arrow F. A moon crescent-shaped insert 9 extending from the suction zone to the delivery zone, is provided within the hollow space defined by the gears 3,4, and is fixedly secured to static components of the pump, in accordance with any one of the embodiments which by way of examples will be disclosed hereinafter. The inward side of insert 9 is so shaped that a section thereof, as shown at 109, situated at a short distance from the suction zone A of the pump, will result into contact with a sufficient number of teeth of the gear wheel 4. The rest of the profile of insert 9 is preferably suitably spaced both from the said gear 4 and from the crown gear 3, but for a possible section designated by 209. When the pump is set in operation, the pressure difference between the zones A and M and the dynamic reaction between the gears 3,4 will subject the gear wheel 4 to such a radial stress having a component in the direction of arrow F1, that an intimate contact of said gear with the section 109 of insert 9 is assured, and the separation of said zones A and M is guaranteed, even at any high pressure value in the delivery circuit of the pump. The shaft 5 will be rotatably supported in such a manner as to aid the aforesaid condition, for example, by the provision of a proper play in correspondence of the shaft supports. It is understood that differently from what is shown in the drawings, the insert 9 could operate by contacting the gear wheel 4 with the interposition of a shoe (see hereinafter) tightly secured in a removable manner to the inward side of insert 9, so as to form the previously disclosed sealing surface 109. The insert 9 may be made from any material or composition of materials fit for the purpose for which the said insert is intended. As shown in figure 2, the insert 9 is

secured by means of a pair of pins 10,10' to the cover plates 6,6' of the pump. The pins are passed through the wear plates 11,11' which perform their function by contacting the gears of the pump, and which are located underneath the cover plates 6,6' with the interposition of annular seals 12,12' having in plan view a configuration of the type as shown by way of an example in figure 1, such as to delimit at their interior sealed areas into which the pressure of the delivery circuit of the pump is led through bores 13,13' made in the said wear plates, so that the said wear plates will be axially urged against the gears 3,4 whereby to assure the seal and automatically adjust the wear to which the wear plates are subjected.

According to the modified embodiment shown in figure 4, the insert 9 may be formed of one piece with one of the wear plates 11,11' or, according to the modified embodiment shown in figure 3, the said insert 9 may be formed of one piece with the pump casing 1' incorporating the bottom cover plate 6. In this instance, the pump will be provided only with the wear plate 11' and the relative cover plate 6'. It is understood that the plates 11,11' will have a thickness fit for the use for which they are intended, even not proportional to the thickness shown in the drawings. According to a further modified embodiment, not shown, the insert 9 may be removably secured by means, for example, of screws, to one or both of the wear plates 11,11'.

The outward side of the end section of insert 9, which terminates in correspondence of the delivery zone M of the pump, is shaped as shown at 309 or in any other suitable manner, such that with the said end section there can be associated under sealing conditions and with the possibility of an outward movement, an additional insert 14 having its outward side shaped as shown at 114, in such a manner that it will intimately operate on a sufficient number of teeth of the crown gear 3 so as to affect them throughout their depth, and that between the insert 14 and the end section 309 there will be a small cavity 15 which is fluid-tight relative to the low pressure zone A, and is connected in any suitable manner, for example, to ducts, such that the pressure in the delivery circuit M will flow into the said cavity, whereby the said pressure will guarantee the required sealing of 14 against 3. On starting the pump, a small preload spring 16, for example of the leaf type, received in a housing 17 formed between the components 14 and 309, guarantees the required sealing of insert 14 against the crown gear 3. It is evident that since the insert 9 is stationary, it is not adversely conditioned by the movements of insert 14. Consequently, also the relative movements of gears 3,4 do not impair the performance of the sealing inserts. The friction areas of inserts 9 and 14 are widely apart from

each other, in substantially diametrically opposite positions with respect to the gear wheel 4. Therefore, any heat generated at the said friction areas 109 and 114 is evenly distributed to the pump assembly, thus avoiding any localized stresses which instead occur in the pumps of known type. This condition guarantees a safe operation of the pump even at any high pressure in the delivery circuit M. According to the modified embodiment shown in figure 5, the insert 9' is of a length which is substantially limited to the length of the sealing surface 109 and is fixedly secured to stationary components of the pump, for example according to one of the possibilities as disclosed in connection with the embodiment shown in figure 1. By means of a cylindrically shaped articulated joint 18, the end of insert 9' which is turned toward the high pressure zone, cooperates with the associated end section of an additional insert 19 which is intermediately fulcrumed about a pin 20 fixedly secured to the cover plates 6-6' and parallel to shaft 5, the axis of said pin being the center of the said articulated surfaces 18, the tight connection of which is ensured by the provision of a linear seal 21. The outward side of insert 19 is so shaped that it will intimately contact a sufficient number of teeth of the crown gear 3, against which it is urged by the bias of a preload spring 16' and by the pressure in the delivery zone M of the pump. The insert 19 can operate on the crown gear 3 either by directly contacting same or with the interposition of a shoe 22 made of any suitable material, and which can be easily replaced whenever it is worn out. The shoe 22 can be removably secured to insert 19, for example, by means of screws, or, as shown in figure 5, it can be associated with the said insert so as to be allowed to perform an articulated movement around an axis parallel to the fulcrum 20, whereby to uniformly adapt itself to the crown gear 3 even when the angle of incidence of insert 19 with this crown gear changes.

In the modified embodiment shown in figure 6, the stationary insert 9 has been eliminated and replaced with the insert 19' which is now so sized that it has its extremities reaching the delivery zone M and the suction zone A respectively, and which is intermediately fulcrumed about a pin 20', similarly to the embodiment shown in figure 5. The arm 119' of insert 19' which is turned toward the delivery side, is to a suitable extent longer than the opposite arm 219' which is turned toward the suction side A, the whole in such a manner that the action of the pressure in the delivery circuit will force the said insert to turn in anti-clockwise direction as viewed in figure 6, thus assuring the required contact of 109' with 3 and of 209' with 4. Numeral 16" denotes a preload spring which guarantees the fluid-tight cooperation of insert 19' with

the gears in the initial step of starting the pump. In order to avoid that any relative movement of the gears would impair the operation of insert 19', it is foreseen that this insert may work on at least one of the two gears or on both, with the interposition of a compensating shoe. In the example shown in figure 6, a shoe 23 is arranged on the arm 219' of insert 19' with the interposition of at least one seal 24 and an expanding elastic means 25, as well as in such a manner that also the pressure in the delivery circuit by penetrating between a portion of members 23,219', will guarantee the steady cooperation of said shoe with the externally toothed gear.

It is understood that the specification refers to some preferred, but not the only embodiments of the invention to which, therefore, numerous changes and modifications may be brought, the more so in construction. It is also understood that the described pump may be further improved even by using known embodiments.

In order to improve the cooling of inserts 9,9',14,19-22, 19', the surface of these inserts which does not contact the gears 3,4 may be suitably finned and/or roughened. This and all those considerations which are however conceivable by those skilled in the art, do not depart from the scope of the invention, as set forth above, as shown, and as claimed hereinafter.

Claims

1) An internal gear hydraulic pump, consisting of a housing (2) within which two gears are axially rotated, the one (3) being internally toothed and the other (4) being externally toothed, and the said housing being closed by cover plates (6,6') with wear plates (11,11') being fitted therebetween, and being urged against the said gears by axially balancing means (12,12',13,13') connected to the high pressure circuit of the pump, characterized in that the high pressure zone (M) and the low pressure zone (A) are separated from each other by inserts of any suitable type and shape, and in any suitable number, which preferably operate only on a section of the externally toothed gear (4), at a short distance from the suction zone (A), and only on a section of the internally toothed crown gear (3), at a short distance from the delivery side (M), the whole in such a manner that any friction produced by the said sealing inserts will be of a limited amount and in substantially opposite positions with respect to the axes of rotation of said gears, so that the heat resulting from any such friction will be evenly distributed to the several components of the pump, which therefore can be operated with no inconvenience even at any very high pressure value.

2) The pump according to claim 1, characterized in that the low and high pressure zones are separated from each other by at least two inserts, one of which (9,9') is fixedly secured in the gear housing, and a section thereof which is near to the low pressure zone (A), has its inward side (109) cooperating in a fluid-tight manner with a sufficient number of teeth of the externally toothed gear (4), while the other insert (14,19) located in correspondence of the high pressure zone (M), is structurally connected in a fluid-tight manner to the former, and is however so movable as to be capable to cooperate in a fluid-tight manner with a sufficient number of teeth of the internally toothed crown gear (3), the said condition being assured by the pressure in the delivery circuit of the pump, which acts on the whole or on a portion of the inner surface of the said movable insert, as well as by the bias of at least one preload spring (16), provisions being made for the shaft (5) of the externally toothed gear (4) to be supported with a sufficient play by means intended for this purpose, so that owing to the radial stress to which the gear (4) is subjected by the delivery pressure, the said gear will cooperate in a sure condition of contact and then of seal, with the stationary insert (9 or 9'), the whole being provided in such a manner that the friction surfaces (109,114) of the two inserts will be away from each other, in substantially opposite positions with respect to the axis of the externally toothed gear, so that the heat generated by the said surfaces will be well distributed to the several components of the pump, and the pump can be safely operated even at any very high pressure.

3) The pump according to claims 1 and 2, characterized in that the stationary insert (9 or 9') can be fixedly secured by means of a pair of pins (10,10') to the cover plates (6, 6') of the pump casing.

4) The pump according to claim 2, characterized in that the stationary insert (9 or 9') can be fixedly secured to one or both of the wear plates (11,11'), for example, by means of screws, and/or by any other suitable means.

5) The pump according to claim 2, characterized in that the stationary insert (9 or 9') is formed of one piece with one of the wear plates (11,11') of the pump.

6) The pump according to claim 2, characterized in that the stationary insert (9 or 9') is formed of one piece with the bottom of casing (1') provided with a housing (2) in which the gears (3,4) are rotated, and which is closed by only one cover plate (6') with the relative wear plate (11').

7) The pump according to the preceding claims, characterized in that the stationary insert (9 or 9') cooperates with the externally toothed gear

(4) either by directly contacting same, or with the interposition of an insert or shoe which can be replaced whenever it is needed.

8) The pump according to the preceding claims, characterized in that the stationary insert (9) may be so shaped as to have a small section (209) of its outward side which operates by contacting a portion of the internally toothed crown gear (3), in correspondence of the movable insert (14) which operates on the said crown gear.

9) The pump according to the preceding claims, characterized in that the stationary insert (9) extends as far as the high pressure zone (M) where it terminates with a section (309) which is so constructed that it performs the function of guiding and sealing element for the small movable insert (14) which cooperates with the internally toothed crown gear (3), a small cavity being provided between the two inserts, which is connected to the high pressure circuit (M), and a housing (17) being formed in the said cavity for the preload spring (16), the whole in order to guarantee the required sealing of the movable insert against the crown gear.

10) The pump according to claims 1 to 8, characterized in that the stationary insert (9') is structurally connected to the movable insert (19) by means of a cylindrical articulated joint (18), and the movable insert is fulcrumed about a pin (20) fixedly secured, for example, to the cover plates (6,6') of the pump, parallelly to the axes of the gears, the contact surfaces of the said articulated joint being so provided that they will have the center of curvature in correspondence of the axis of said fulcrum pin (20), and that their fluid-tight connection will be assured by a suitable seal (21), and the said movable or swingable insert being so provided that it will be urged against the internally toothed crown gear (3) by the bias of a small preload spring (16) and by the pressure in the delivery circuit, which acts on the whole or on a portion of said insert surface, which is turned toward the interior of the pump, and which is for this purpose suitably sized.

11) The pump according to claim 10, characterized in that the fulcrum pin (20) is located at a short distance from the end of the movable or swingable insert (19) which through the cylindrical articulated joint (18) cooperates with the stationary insert (9').

12) The pump according to claim 10, characterized in that the fulcrum pin (20) for the swingable insert (19) is located in correspondence of the intermediate portion of said insert.

13) The pump according to claims 10 to 12, characterized in that the swingable insert (19) may cooperate with the crown gear (3) either by directly contacting it or with the interposition of a shoe (22).

14) The pump according to claim 13, characterized in that the shoe (22) arranged on the swingable insert (19) is removably secured thereto, for example, by means of screws, or by being restrained therein.

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15) The pump according to claim 13, characterized in that the shoe (22) arranged on the swingable insert (19) is associated therewith and is allowed to swing at least parallelly to the fulcrum pin (20) for said insert, so as to adapt itself to the crown gear (3) even when the angle of incidence of said swingable insert (19) is varying relative to the said crown gear.

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16) The pump according to claim 1, characterized in that only one sealing insert (19') is provided, which is intermediately fulcrumed about a stationary pin (20') set in parallel relation with the axes of the gears (3,4), and which is so long as to have its extremities respectively reaching the delivery zone (M) and the suction zone (A) of the pump, at least one preload spring (16'') being provided for urging against the internally toothed crown gear (3) the sealing insert arm (119') which is turned toward the delivery side (M), and which is normally so urged also by the pressure in the delivery circuit, since the said arm is to a suitable extent longer than the opposite arm (219') which works by contacting the externally toothed gear (4), and at least one, or both, of the active sealing insert extremities being so provided that they will operate by contacting the respective gear (3,4), with the interposition of a compensating shoe (23).

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17) The pump according to the preceding claims, characterized in that the surfaces of the radially sealing inserts (9,9',14,19-22), which do not cooperate with the gears (3,4), may be conveniently finned and/or roughened for a better cooling of said inserts.

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