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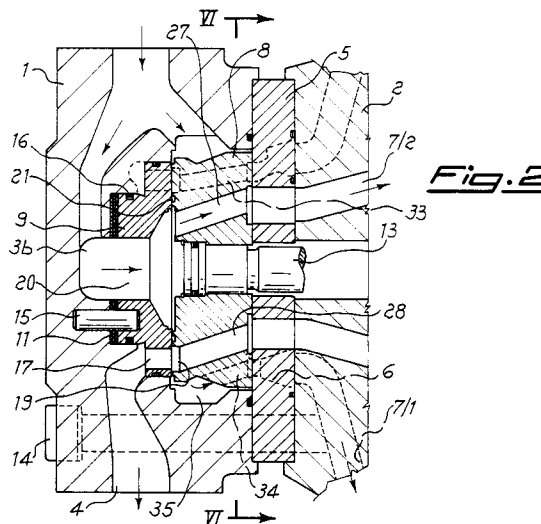
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I-20123 Milano (IT)(54) **Distribution unit for hydraulic radial piston motors.**

(57) A front-sealed rotary unit for the distribution of fluid under pressure, particularly for hydraulic motors having a double series of actuators operating on a shaft consisting of two eccentric portions staggered at 180°, such unit comprising a rotary distributor disc (8) connected to the drive shaft and tightly secured between a front-sealed reaction ring (9), capable of sliding axially and provided with separate passages (17, 20) connected to hydraulic fluid supply and discharge ducts (3a, 3b, 4), and a fixed distribution plate (5) provided with holes (6, 36) for the outflow from hydraulic fluid intake and discharge ducts (7/1, 7/2) to the two series of actuators (10) of the motor, in which such distributor disc (8) is traversed in an axial sense by at least two pairs of independent holes (27, 28, 33, 34) for communication between their opposed flat surfaces (8a, 8b), respectively in contact with reaction ring (9) and with distribution plate (5), which holes are capable of performing a double distribution in counterphase of fluid to the actuators with each revolution of distributor disc.



The object of this invention is a front-sealed rotary unit capable of performing, with each revolution thereof, a (double) distribution in counterphase of fluid under pressure for the operation of radial-piston hydraulic motors having two series of actuators located on the same shaft.

There are known in engineering radial-piston hydraulic motors which require, for the operation thereof, a rotary distributor which brings about in succession the supply to and discharge from the individual actuators, thereby causing rotary movement of the shaft of the said motor.

There are also known designs in which it is advantageous to duplicate the series of actuators on the same drive shaft in order to obtain an increase of the driving torque without it being necessary to increase the radial dimensions of the casing in which they are housed.

The design of motors with two series of radial actuators normally provides for the two eccentric portions of the rotary shaft on which the actuators operate to be set in counterposition at 180° , in order to achieve dynamic balancing of the said shaft.

Additionally, with the said phase displacement of 180° between the two series of actuators there is obtained greater regularity of the output torque and, therefore, the possibility of obtaining angular velocities with fewer fluctuations at low speeds of rotation.

Such rotary distribution unit of known type is substantially comprised of a rotary disc integral with the drive shaft and interposed between two housings in which are provided the openings of the hydraulic fluid supply and discharge ducts for the actuators; on the rotary disc are accordingly provided through-holes which place such openings in communication with the supply ducts of the individual actuators present in the double housing of the motor, thus bringing about the connection of a part thereof to the supply and of another part to the discharge. The front surfaces of the rotary disc should therefore slide rubbing against the flat surfaces of the housings between which they are located and in which are provided the hydraulic ducts to be connected, while at the same time providing a seal to avoid any possibility of drawing of the fluid through the various openings located on the faces of the distributor disc.

The contact surfaces of the distributor disc and of the parts between which it is secured are therefore lapped by the hydraulic fluid in which the entire distribution unit is immersed. However, following the axial thrust imparted to exert sealing action, it becomes necessary to counterbalance in part the said thrust in order to reduce the friction force which comes to be generated between the rotating contact surfaces.

To prevent seizure in operation, the distributor disc and the parts secured to it should therefore be made of materials having anti-wear properties.

A distribution unit of such nature is known from patent application 22592 A/86 in the name of the same applicant. In it, the said distributor has the surface of the distributor disc turned toward the distribution plate and the surface of the plate itself is provided with holes and cavities arranged on concentric circumferences, in order to connect periodically the hydraulic fluid to be transferred, during rotation, to the relevant sealing and delimiting surfaces.

Such known unit is not, however, suitable for the distribution of the supply to motors with two series of actuators in counterphase.

Other known designs provide for distributors with radial rather than axial passage openings. Consequently in such design, where provision is to be made for double distribution, a considerable increase results in both the axial dimensions and the drawing of fluid.

There is therefore posed the technical problem of providing a rotary unit for the distribution of the supply to series of hydraulic motors and to radial actuators connected in parallel and set in counterposition, capable of bringing about a distribution in counterphase of the supply to the actuators in order to obtain a sum of the individual torques of each motor as well as high regularity of the output torque.

The rotary unit should moreover be of small axial dimensions and readily accessible for maintenance operations without involving difficult procedures for the dismantling of parts.

Such technical problem is resolved, according to this invention, by a front-sealed rotary distribution unit, particularly for hydraulic motors having a double series of actuators located out of phase from one another and operating on an eccentric shaft consisting of two portions staggered at 180° , of the type comprising a rotary distributor disc connected to the drive shaft and secured between a front-sealed reaction ring, capable of sliding axially and provided with separate passages connected to the hydraulic fluid supply and discharge ducts, and a fixed distribution plate provided with holes for the outflow from the hydraulic fluid intake and discharge ducts to the two series of actuators of the motor, in which such distributor disc is traversed in an axial sense by at least two pairs of ducts, independent of one another, capable of placing in communication their opposed flat surfaces respectively in contact with the reaction ring and with the distribution plate, such pairs of ducts being capable of performing a double distribution in counterphase of fluid to the actuators with each revolution of the distribution cylinder.

According to a preferred form of implementation of the unit, provision is made for the flat surface of the distributor disc turned toward the distribution plate to be provided with two series of arched cavities arranged concentrically with respect to the axis of rotation of the distributor disc, and for the flat surface turned toward the reaction ring to be provided with continuous flat sliding surfaces for the delimitation and separation in a sealed manner of the respective outlets of the holes of the distributor disc.

Such pairs of arched cavities concentric with respect to the axis of rotation are furthermore set in positions diametrically opposed to one another.

According to this invention, such distribution plate is provided with discharge holes respectively in relation to such arch-shaped cavities of the distributor disc, there being furthermore present at least two series of blind holes, respectively arched and circular, arranged on two circumferences alternately concentric to the openings, such holes being capable of lubricating the opposed flat portions of the distributor disc and of maintaining the hydrostatic balance of the rotary unit during rotation.

A further feature of the rotary distribution unit for hydraulic motors according to the invention is the fact that at least one of such arch-shaped cavities of the distributor disc communicates with an annular chamber in the casing of the said distributor disc, inside the motor housing, via longitudinal holes which are inclined with respect to the axis of rotation of the unit, such annular chamber being in turn in communication with the motor supply duct.

Further details may be obtained from the following description with reference to the attached drawings, which show:

- In figure 1 : a partial-section schematic view of a hydraulic motor with a double series of actuators operating on the same eccentric shaft;
- In figure 2 : a schematic cross-section of the rotary distribution unit fitted to the radial-piston hydraulic motor, drawn according to two axial planes not aligned to one another;
- In figure 3 : an exploded view of the rotary distribution unit according to the invention;
- In figure 4 : a front view of the reaction ring;
- In figure 4a : a cross-section according to plotting plane IVa-IVa of fig. 4;
- In figure 5 : a front view of the distributor disc;
- In figure 6 : a cross-section of the disc per-

pendicular to the axis of rotation according to a plane perpendicular to plotting axis VI-VI of fig. 2;

- 5 In figure 7 : an external view of the distributor disc from the side of the distribution plate;
- In figure 8 : a front view of the distribution plate;
- 10 In figure 8a : a cross-section of the plate according to plotting plane VIIIa-VIIIa of fig. 8.

As shown in figure 1, the rotary unit for the distribution of fluid under pressure for radial-piston hydraulic motors comprises an external case 1, integral with motor housing 2, within which are provided ducts 3a, 3b and 4 for the intake and discharge of the hydraulic fluid to actuators 10 operating on eccentric shaft 10a of the motor.

Inside case 1 is located a distribution plate 5 in which are provided holes 6 (fig. 2) for connection to intake ducts 7/1 and 7/2 leading to individual actuators 10 of the two series operating on the same shaft, against which plate 5 bears distributor disc 8.

Against distributor disc 8 also bears, at the opposite side with respect to plate 5, an external reaction ring 9 fitted with a preloading spring 11 capable of securing reaction ring 9 against distributor disc 8.

Plate 5 is attached to motor housing 2 by means of screws 14 (fig. 2), while distributor 8 is connected to the drive shaft via a splined shaft 13.

With reference to figure 2, external reaction ring 9 is attached to distributor case 1 via a pin 15 or the like and exerts sealing action via gaskets 16; it has a multiplicity of holes 17 capable of placing annular cavity 19 of rotary distributor disc 8 in communication with fluid discharge duct 4 separately from communication via its central passage 20.

As shown more clearly in figures 2 and 5, distributor disc 8 has, on the front surface turned toward ring 9, an annular cavity 19 set in relation to holes 17 of reaction ring 9. As shown in figures 3 and 4, holes 17 are arranged on a circumference centred on the axis of rotation of distributor disc 8, while cavity 19 is located concentrically on the same axis and is bounded by two annular edges, respectively inner 23 and outer 24.

However, in order to maintain in its interior the position of discharge of holes 17, annular cavity 19 of distributor disc 8 is made with a width greater than or equal to the diameter of holes 17 located on the circumference of reaction ring 9.

A drainage duct 21, provided with appropriate discharge channels 22, is located concentrically to cavity 19 and is separated therefrom by annular edge 23, while from the inner part toward the axis

of rotation duct 21 is delimited by an annular edge 26 which also constitutes the outer retaining edge of a central hole 25 in front of which discharges central passage 20 of reaction ring 9.

As illustrated in figs. 2 and 6, distributor disc 8 is traversed by passage holes 27 and 28 respectively discharging at one end into central hole 25 and into annular cavity 19, which link the opposite end with shaped cavities 29, 30, as can be seen more clearly in figure 7. Such shaped cavities 29 and 30 have the function of defining the supply cycle for the first series of actuators and are surrounded by annular cavities 31, 32 into which discharge secondary ducts 33, 34 traversing obliquely distributor disc 8 and respectively connected to the end opposite cavity 19 and to annular seat 35 of outer case 1 (fig. 2).

When one of such cavities 31 or 32 is supplied with fluid under pressure, shaped cavity 29 or 30 adjacent and parallel thereto is made to discharge, while opposite cavity 30, 29 is under pressure. In this way the thrust exerted by the fluid on the surface of the cavity balances the thrust of the fluid present in the opposite part within the shaped cavity, thus bringing about the balancing of the distributor disc in each phase of its rotation, while at the same time there is obtained the supply to and discharge from the second series of actuators.

Distribution plate 5 is illustrated in figure 8 in front view. It has series of arched holes 36 and circular holes 6 for the discharge from the supply ducts of actuators 10, as well as series of blind circular 37 and arched 38 cavities. The blind holes and cavities of uniform section are arranged alternately on concentric circumferences, in particular holes 6 and circular cavities 37 on a circumference further inward than that of arched holes 36 and cavities 38.

As is apparent from figure 8, the positions of through-holes 6, 36 and of blind cavities 37, 38 of distribution plate 5 are shown diametrically opposed to one another in order to achieve both static balancing and improved lubrication of the sliding parts.

Opposing through-holes 6 and 36, respectively connected to the supply of the pressurized hydraulic fluid and to the discharge, determine the motor rotation cycle. Simultaneously with the supply to the actuators, blind cavities 37 and 38 are set in relation to through-holes 29, 30, 31 and 32, respectively provided on surface 8b of distributor disc 8. Following the transfer therein of the hydraulic operating fluid, surfaces 39 and 40 on the rear face of distributor disc 8 are wetted by the hydraulic fluid and are thus lubricated.

Furthermore, the design of distributor disc 8 and of relevant distribution plate 5 makes it possible to obtain, during the entire rotation, full balanc-

ing of thrust, thus ensuring that wear on sliding surfaces 39, 40, 26, 23 and 24 does not affect planarity and therefore ensures longer sealing life.

Many variants may be introduced without thereby departing from the scope of the invention in regard to its general features.

Claims

1. A front-sealed rotary unit for the distribution of fluid under pressure, particularly for hydraulic motors having a double series of actuators located out of phase from one another and acting on an eccentric shaft consisting of two portions staggered at 180° , of the type comprising a rotary distributor disc (8) connected to the drive shaft and tightly secured between a front-sealed reaction ring (9), capable of sliding axially and provided with separate passages (17, 20) connected to hydraulic fluid supply and discharge ducts (3a, 3b, 4), and a fixed distributor disc (5) provided with holes (6, 36) for the outflow from hydraulic fluid intake and discharge ducts (7/1, 7/2) to the two series of actuators (10) of the motor, characterized in that such distributor disc (8) is traversed in an axial sense by at least two pairs of independent holes (27, 28, 33, 34) for communication between their opposed flat surfaces (8a, 8b), respectively in contact with reaction ring (9) and with distribution plate (5), which holes are capable of performing a double distribution in counterphase of fluid to the actuators with each revolution of distributor disc (8).
2. A rotary distribution unit according to claim 1, characterized in that the flat surface of distributor disc (8) turned toward distribution plate (5) is provided with two series of arched cavities (29, 30, 31, 32) arranged concentrically with respect to the axis of rotation of the distributor disc, and in that the flat surface turned toward reaction ring (9) is provided with continuous flat sliding surfaces (26, 23, 24) for the delimitation and separation in a sealed manner of respective outlets (19, 25) of holes (27, 28) of distributor disc (8).
3. A rotary distribution unit for hydraulic motors according to claim 1, characterized in that such pairs of arch-shaped cavities (29, 30, 31, 32) extending over two concentric circumferences with respect to the axis of rotation are located in positions diametrically opposed to one another.
4. A rotary distribution unit according to claim 1, characterized in that such distribution plate (5)

is provided with discharge holes (6, 36) in relation to such arch-shaped cavities (29, 30, 31, 32) of distributor disc (8), there being furthermore present at least two series of blind cavities (38, 37), respectively arched and circular and arranged on two circumferences alternately to openings (6, 36) on two concentric circumferences, such cavities being capable of lubricating opposing flat portions (39, 40) of distributor disc (8) and of maintaining the hydrostatic balance of the rotary unit during rotation.

5. A rotary distribution unit for hydraulic motors according to the invention 1, characterized in that at least one (32) of such arch-shaped cavities (29, 30, 31, 32) of distributor disc (8) communicates with an annular chamber (35) in the housing of said distributor disc (8), via longitudinal holes (34) which are inclined with respect to the axis of rotation, such annular chamber (35) being in turn in communication with motor supply duct (3b).

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Fig. 1

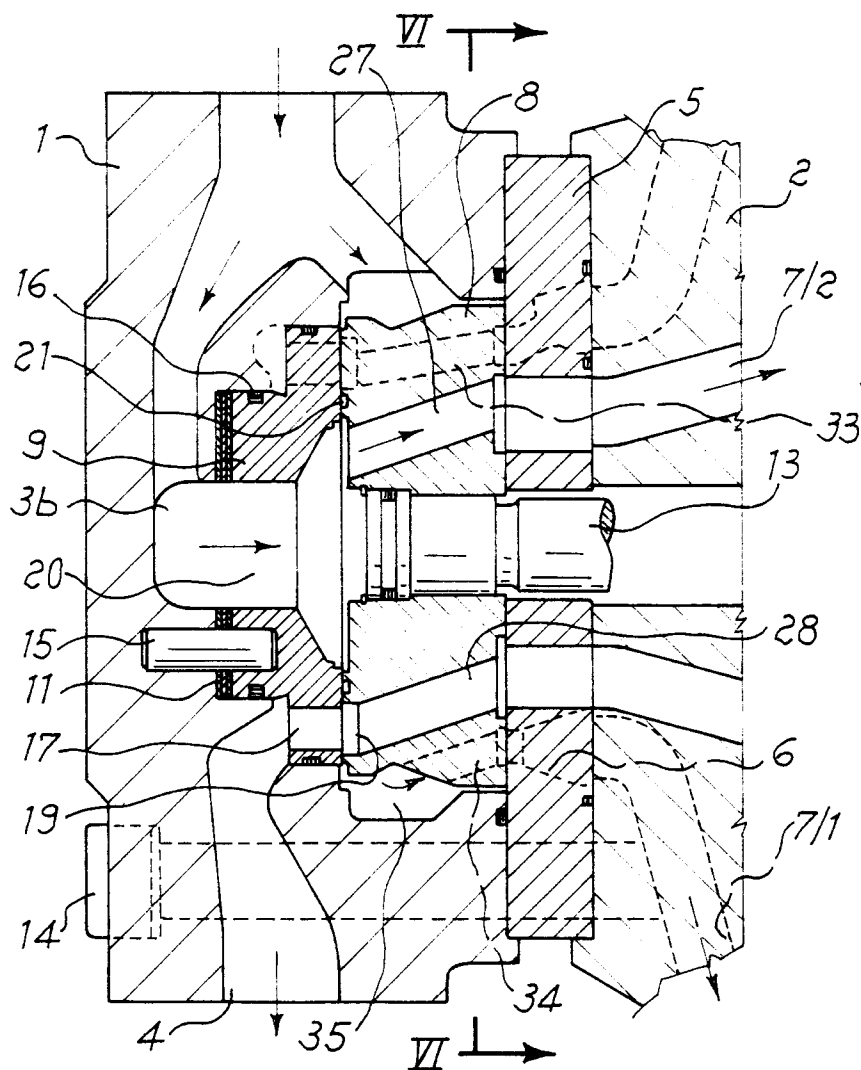
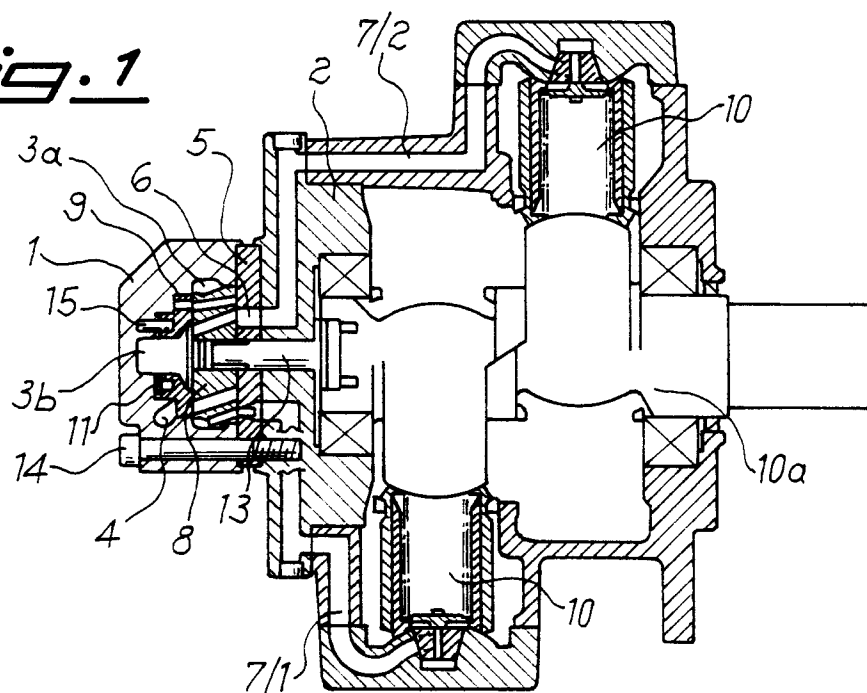
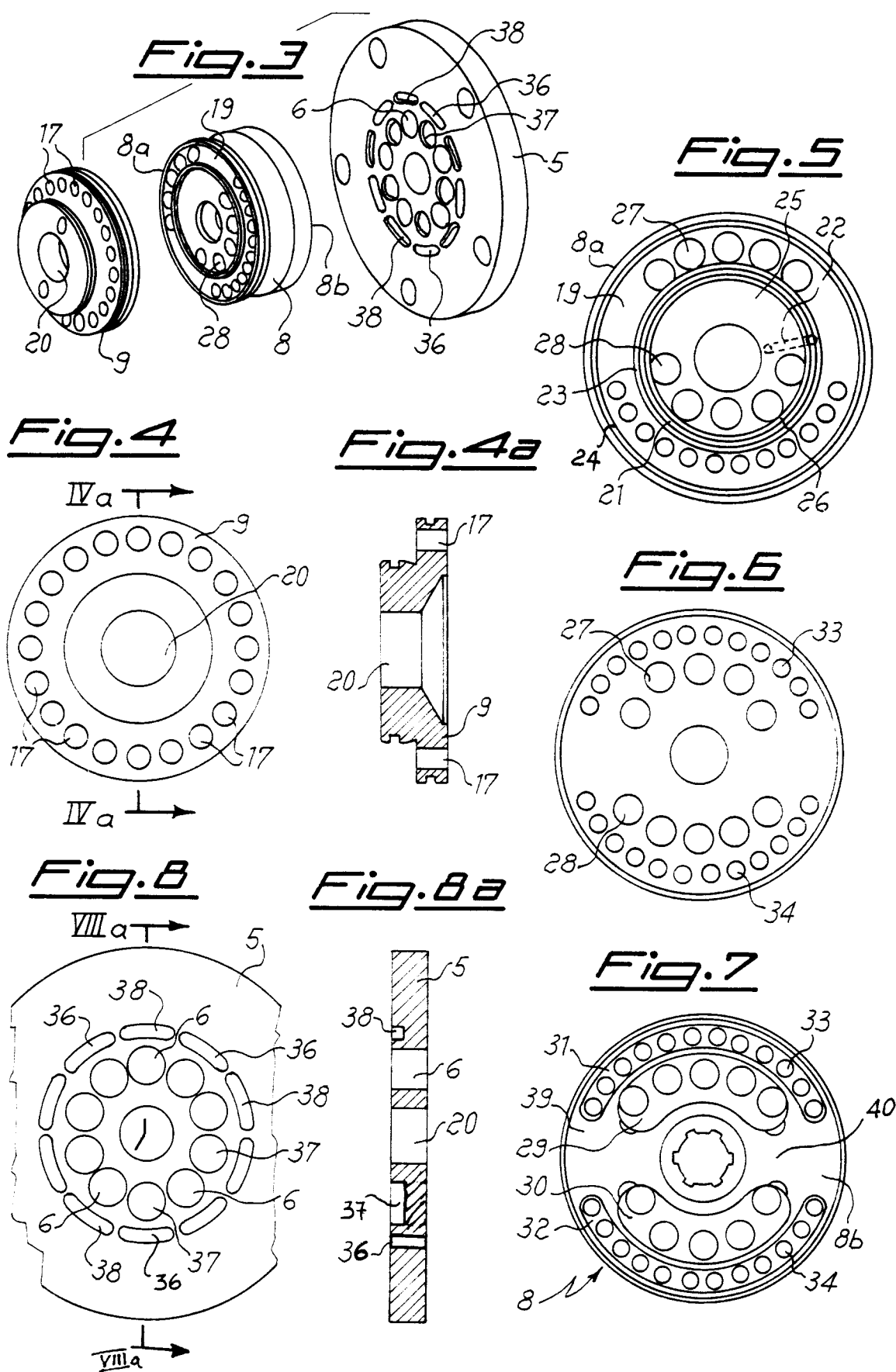


Fig. 2





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EUROPEAN SEARCH REPORT

Application Number
EP 94 20 2930

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	FR-A-2 296 778 (REXROTH-SIGMA) * the whole document * ---	1-3,5	F03C1/04 F03C1/053
A	FR-A-2 381 173 (RIVA CALZONE S.P.A.) * the whole document * ---	1	
A	GB-A-173 264 (CARDINI) * the whole document * ---	1	
A	CH-A-447 821 (GUNSETT) * the whole document * -----	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F03C F04B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 19 December 1994	Examiner Von Arx, H
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