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(54) **PUMP FOR LIQUIDS WITH RADIAL CYLINDERS**

FLÜSSIGKEITSPUMPE MIT RADIALEN ZYLINDERN

POMPE POUR LIQUIDES A CYLINDRES RADIAUX

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Description

[0001] The invention relates to: a radial-cylinder fluid pump, i.e. a pump equipped with radial cylinders having a limited-dimensions cylinder architecture, advantageous for manufacturing pumps for low-viscosity fluids which, like fuels, have not always sufficient lubricating features.

[0002] The prior art comprises various types of radial-cylinder pumps being effective to generate high pressures in the fluid being treated. These pumps, as described in the Italian patent no. 1218675, are formed by radial cylinders being arranged in a rim with an eccentric or cam operating on the respective piston for the reciprocating motion drive, the backward stroke being obtained by interposing springs. The eccentric or cam is located within the rim and, consequently, the ports are formed by automatic blade valves arranged in ring-shaped chamber increasing the rim diameter and though always being complex to manufacture and maintain. In some embodiments the connection ports to the suction and delivery ducts are centrally located with the driving shaft or in ring-shaped areas far outside the cylinder rim, increasing the pump external dimensions diameter. If some distributors, being axial to the shaft, are used, the pump dimensions diameter is increased by the need to provide the distributor housing, which, if located in the internal diameter of the cylinder rim, further increases the dimensions thereof.

[0003] It is thus known in the prior art to arrange the radial cylinders so to obtain high pressures in the pumped fluid, but with embodiments having, as previously mentioned, such considerable dimensions, and subsequent masses, as to advise against the use thereof in light vehicles, like racers. In fact the need to have a high delivery pressure of the pumped fluid collides with the opposite need to have reduced dimensions and masses. Moreover, the fuel flow rate being required in the different vehicle operating phases is certainly not constant, since highest flow rate requirement phases, obviously requiring however the highest pressure, alternate with lowest flow rate phases, wherein, even if the flow rate is minimum, the pressure must be kept high in the pumped fluid delivery branch.

Not least, fuel pumps are very sensitive to the lubricating qualities thereof. In fact, if with fuels like gas oil the lubricating quality is satisfactory, with drier fuels like petrol the motion of the pump components can be compromised just because of the poor lubricating quality.

Therefore, in the specific petrol pump field radial-cylinder pumps are not known. Gear or roller positive-displacement pumps are instead known, wherein pumping elements do not achieve a satisfactory mechanical and volumetric efficiency in order to reduce the power used for pumping, when a higher delivery pressure is required. Then, in gear pumps, inner element sliding problems arise, in the teeth meshing and/or in the gear side contact with the walls, which are not suitable for low viscosity and

low lubricating quality fluids. Moreover, this kind of pump is particularly sensitive to fuel impurities and during operation it produces polluting metallic particles.

From the patent GB 2080441 it is known to manufacture gas compressor with two pairs of opposed radial cylinders and pistons being stiffly connected by means of a stem passing through the crank; the two stems contact the crankpin on the same radial plane as the cylinder rim and the stems are realised with a large and flat section in order to allow the crank housing and to achieve a sufficient fraction section between the pistons. The considerable piston diameter required for the gas compression favours the crank and cylinder assembly, allowing automatic unidirectional blade suction valves to be directly housed above each piston and similar delivery valves in the cylinder head. These dimensions allow compressors with a really minimum detrimental volume to be manufactured. On the other hand, this compressor structure does not allow fluid pumps to be manufactured likewise, the fluid flow rate being in any case very high and the pump dimensions excessive.

[0004] This prior art can undergo considerable improvements concerning the opportunity to manufacture a radial-cylinder pump overcoming the above-mentioned drawbacks, capable to operate also with fluid having poor lubricating qualities and having small dimensions and, consequently, a small mass.

[0005] From the above, in order to solve the technical problem, it derives the need to find a new arrangement for the fluid pump radial cylinders having, first of all, reduced dimensions, compatibly with the displacement produced, and capable to operate very efficiently both with a high and low flow rate, without considerably affecting the delivery pressure, which can range from few bars to several tens, keeping the pump operation optimum and a high total efficiency. Not least, the pump must have a limited mass and a simple structure in order to limit production costs too.

[0006] The invention solves the above technical problem by resorting to: a radial-cylinder fluid pump, comprising a rim of radial cylinders arranged in pairs and opposed on a same radial axis lying on a perpendicular plane to a driving shaft equipped with a crank-connected to pistons in reciprocating motion in the cylinders; the pistons are stiffly connected to a stem contacting the crank by means of a bilateral guide having perpendicular walls to the axis of said cylinders; a crankpin is arranged in bilateral contact with the guide walls by means of a rolling bearing; as well as comprising fluid distribution means to the cylinders during suction and delivery associated in a pump casing and composed of unidirectional blade valves; further comprising a pair of radial cylinders formed by liners being pressed in the pump casing; each liner has radial through openings of the pumped fluid in connection with suction and delivery ports in the casing; the unidirectional blade valves being arranged next to the pump casing.

[0007] Moreover, in a further and preferred embodiment

ment, by resorting to: several pairs of opposed radial cylinders equipped each with a stem joining the corresponding pistons wherein a thickness cut is performed in the stem, in the central portion wherein the stem couples, through the guide thereof, with the crankpin; each stem has a thickness cut being compatible, when coupling, with the other thickness cut/s of the other stem/s, in order to allow each guide to contact the same crankpin. Advantageously, the pairs of opposed radial cylinders have the respective axis angularly arranged equally spaced in the rim from the other axis/axes of the pair/s of said cylinders.

[0008] Moreover, in a further and preferred embodiment, by resorting to: the pump casing being advantageously split into two half-shells on the radial plane comprising the cylinder rim.

[0009] Furthermore, in a further and preferred embodiment, by resorting to: the pistons being equipped with a lip seal in the contact between the piston and the cylinder inner diameter.

[0010] Furthermore, in a further and preferred embodiment, by resorting to: the suction or delivery blade valves are formed on a respective single disc and coupled on one side or on the opposite side of the pump casing, in order to define the casing suction or delivery side; moreover, blade housings are comprised in the casing and on the sides of the means associated thereto in the disc-blade assembly, in order to define the automatic unidirectional valves.

[0011] Moreover, in a further and preferred embodiment, by resorting to: upstream of the unidirectional automatic suction valves, a pumped liquid pressurisation stage, comprising a centrifugal impeller being rotation-connected to the driving shaft.

[0012] Finally, in a further and preferred embodiment, by resorting to: the unidirectional automatic suction valve of at least a cylinder being directly connected to a suction duct of the fluid from a tank, while the unidirectional automatic suction valves of the remaining cylinders are connected to a recycle duct of the fluid pumped from a delivery duct, by means of a sequence valve being calibrated at a slightly lower pressure than the regulation pressure of a pressure regulation valve to the user; the recycle duct is connected to the suction duct of the fluid from the tank by means of an unidirectional automatic valve, which interrupts the connection when the sequence valve is open.

[0013] An embodiment of the invention is shown, by simple way of example, in the seven accompanying figures in which: Figure 1 is an axial section of the pump according to the invention made on a radial plane comprising a pair of cylinders; Figures 2 and 3 are perspective views of the pump equipped with a driving electric motor; Figure 4 is the axial section of the pump of figure 1 made on a radial plane not comprising a pair of cylinders, but comprising the feeding and delivery ducts; Figure 5 is the section of the pump of figure 1 being enlarged and only limited to cylinders and blade valves; Figure 6

is an exploded perspective view of the pump with the two pairs of opposed cylinders, the delivery blade valves and the head with the pipe connection holes; Figure 7 follows up the exploded perspective view of the previous figure wherein the suction blade valves, the disc with the housings, the shaft with the crank and the first pressurisation stage with the centrifugal impeller can be seen; Figure 8 is a perspective view of a pump with a single pair of opposed cylinders; Figure 9 is a perspective view being similar to the previous one, comprising the pairs of pistons but not two liners; Figure 10 is a perspective view of the two pairs of pistons of a four-radial-cylinder pump; Figure 11 is the suction and delivery connection diagram of the single cylinders and of the pump as a whole, when reducing the flow rate according to the delivery pressure.

[0014] Figure 1 shows a head 1 of the pump 2 formed by pairs of opposed radial cylinders 3, each cylinder comprising a liner 4 and a piston 5, stiffly connected and translating in the reciprocating motion with the piston of the radially opposed cylinder, under the effect of a crankpin 6 of a deriving shaft 7. The driving shaft is supported in rotation by means of rolling bearings 8, advantageously ball bearings, and it is rotation-driven by an electric motor 9; a centrifugal impeller 10 is keyed to the shaft 7 for a first compression stage of the pumped fluid; suction is performed through a hole 11 or through the suitable hole in the head 1. The fluid being pumped through a ring-shaped chamber 12 flows upstream of a set of automatic blade valves 13 and, afterwards, up to radial openings 14 in the liners pistons 5 move by a reciprocating motion with the crankpin 6 contact within a guide 15 equipping a connection stem 16 between the pistons 5; advantageously, the contact between the crankpin 6 pivot and the guide is performed by means of a rolling bearing 17. In the delivery stroke the piston, by pressing the fluid against the suction blade 13, closes it and simultaneously opens a blade 18 of a set of automatic blade valves, for the delivery to a duct 19 of the fluid under pressure. In order to prevent excessive delivery overpressures, the highest pressure regulation valve 20 is provided, for the recycle in the tank.

[0015] Figures 2 and 3 show a suction hole 21 of the head 1, a delivery hole 22 towards the user of the liquid under pressure and a backward hole 23 towards the tank (not shown).

[0016] Figure 4 shows two shells 24 of the pump casing 25 enclosed in the external tight shell 26 for possible leaks. In the following figure 5 said details can be more clearly understood. In fact, the pistons have a lip seal 27 on an inner diameter of the liner 4, while the liner has static-seal rings 28 on an external diameter. The stem 16, joining the pair of pistons 5, has around the guide 15 a thickness cut 29, in the sense of the shaft 7 axis, in order to allow the intersection with a similar thickness cut of the stem 16, between the other pair of pistons 5, arranged in correspondence with the previous thickness cut 29.

[0017] Finally figures 6 and 7 show a set 30 of auto-

matic delivery blade valves 18 being aligned with corresponding housings 31, for the blade controlled opening, formed in the upper shell 24 of the pump casing 25; a further group 32 of automatic suction blade valves 13 being aligned with corresponding housings 33, for the blade controlled opening, formed in a disc 34 being aligned with the pump casing lower shell 24. The impeller 10 of the fluid precompression stage is enclosed in a hollow casing 35, the feeding hole 11 being realised in the base thereof, and wherein the lower rolling bearing 8 is supported; the hollow casing has a ring-shaped scroll slot 36 and it is coupled to a baffle 37, interposed between the hollow casing and the disc 34 with the ring-shaped slot 12, for the fluid distribution downstream of the impeller 10 and upstream of the suction blade valves 13.

The pump exploded figures show with A the path of the fluid being sucked and with M the path of the compressed fluid being delivered; the fluid outputted from the delivery pressure regulation valve 20 is instead indicated with R. The use of the impeller 10 serves to perform in the fluid a slight pressurisation in the cylinder suction, allowing the automatic suction blade valves 13 stiffness to be mastered without cavitating, when the stiffness thereof fits a high fluid pressure and a high opening frequency.

The shown pump structure provides the manufacture of the pump casing 25 in two half-shells 24, but with a slight different sizing of the liners 4 with respect to the size of the stem 16 and of the guide 15, it is possible to manufacture the pump casing enbloc achieving considerable manufacturing savings.

[0018] Finally, figure 11 shows the schematic component assembly, the phases of the four pistons of the two pairs rising therefrom, wherein two pistons are half-stroke, first pair, and two are in opposed positions in respective dead centres, second pair in the 90 degree phase, since they are stiffly connected to the stem 38; the delivery to the user U and the pumped fluid tank S can be seen. The set 30 of suction valves 13, in this case, is split by means of a baffle 39 in order to divide three suction blade valves 13 from the remaining one 40. Said three suction valves are connected to a recycle duct C which is feed by a supplementary check valve 41 or by a sequence valve 42 housed with the previous supplementary check valve in a supplementary baffle 43, enbloc or divided from the baffle 39.

[0019] The pump operation with the baffles 39 and 43 proceed as follows. The suction duct A is directly connected only to one of the automatic blade valves 13 so that the corresponding cylinder, the first cylinder, delivers in all cases the pumped fluid in the delivery duct M. The baffle 39 provides to split in 40 the recycle duct C and the suction valve 13 of the first cylinder from the remaining ones. The duct C is fed by the suction duct A, in the operation at a lower pressure than the sequence valve 42 calibration, by means of the supplementary check valve 41. Upon exceeding the calibration pressure of the sequence valve 42 the recycle duct C is put in communication with the delivery duct M, for the sequence valve

42 opening, and the supplementary check valve 41 closes, allowing the pumped fluid recycle to be performed, at a constant and equal pressure between the delivery and the suction for the three remaining cylinders being concerned. The result is to allow the pump to dissipate power proportionally to the delivery of a single cylinder if the pressure further rises above the calibration limit of the pressure regulation valve 20, certainly less than the power to be dissipated if there were no reduction. This latter condition occurs when the user U has sudden changes of the flow rate required from zero to the highest flow rate. In racers this traditionally happens when pumping the fuel, the petrol, in the release phases after a hard acceleration phase.

At the following acceleration the regulation valve 20 immediately closes and the pressure of the duct M is immediately available for feeding the fluid; afterwards, having a flow rate request being higher than the one produced by the single cylinder, also the sequence valve closes, thus allowing the original situation to be recovered, i.e. with the four cylinders all pumping at a pressure being slightly lower than the sequence valve calibration pressure.

[0020] The advantages achieved by the present invention are: the fluid pump with pairs of opposed cylinders according to the invention has reduced dimensions because of the limitation of crank means formed by a simple crankpin 6 arranged within a guide 15 with a direction being to the axis identified by the pair of cylinders; a further advantage in the dimensions reduction is achieved by arranging the automatic suction and delivery valves on parallel planes to the plane of the cylinder rim; the stiff connection between the pistons 5 of the pair allows the backward stroke of a piston to occur with the forward stroke of the other, in a desmodromic way, avoiding the use of return springs for the single piston. Furthermore, the radial thrusts on the pistons are reduced because of the lower frictions of the pistons 5 and of the seal 27 on the liner 4, resulting in a higher mechanical efficiency and thus fewer losses and absorbed powers. Moreover, the precompression stage realised by the centrifugal impeller 10 allows delivery pressures even of 100-150 bars to be produced only by means of the suction blade valves, taking care to size the blade 13 for the high delivery pressure and the estimated opening frequency. Finally, the pressure regulation valve 20 at the user U is advantageously integrated in the ducts of the pump head 1.

[0021] In the practical implementation, the materials, the size, the operational details could be different from the indicated ones, but technically equivalent thereto, without moving for this reason from the scope of the present invention. Moreover, the pump being shown can be rotation-connected to any drive being suitable for the aim, besides to the electric motor 9 being shown, also to the thermal motor or the transmission thereof; the pump can provide seal means effective to tightly divide the ducts and chambers concerned by the pumped fluid, with respect to the mechanical crank means. The division al-

lows a suitable amount of lubricant to be held in the chambers which are tightly insulated from the chambers concerned by the pumped fluid, in order to lubricate the crank means and thus make them suitable for greater specific loads than in the shown embodiment.

Claims

1. A radial-cylinder fluid pump, comprising a rim of radial cylinders arranged in pairs (3) opposed on a same radial axis lying on a perpendicular plane to a driving shaft (7) equipped with a crank (6) connected to pistons (5) in reciprocating motion in the cylinders; the pistons are stiffly connected to a stem (16) contacting the crank by means of a bilateral guide (15) having perpendicular walls to the axis of said cylinders; a crankpin (6) is arranged in bilateral contact with the guide walls by means of a rolling bearing (17); as well as comprising fluid distribution means to the cylinders during suction and delivery associated in a pump casing (25) composed of unidirectional blade valves (13, 18), further comprising a pair of radial cylinders (3) formed by liners (4) pressed in the pump (2) casing (25), **characterised in that** each liner has radial through openings (14) of the pumped fluid in connection with suction and delivery ports in the casing; the unidirectional blade valves (13, 18) being arranged next to the pump casing.
2. A pump according to the previous claim 1, **characterised in that** it has several pairs of opposed radial cylinders (3) equipped each with a stem (16, 38) joining the corresponding pistons (5) wherein a thickness cut (29) is performed in the stem, in the central portion wherein the stem couples, through the guide (15) thereof, with the crankpin (6); each stem has a thickness cut (29) being compatible, when coupling, with the other thickness cut/s of the other stem/s (16, 38), in order to allow each guide (15) to contact the same crankpin (6).
3. A pump according to the previous claim 2, **characterised in that** it has the pairs of opposed radial cylinders (3) whose respective axis is angularly arranged equally spaced in the rim from the other axis/axes of the pair/s of said cylinders.
4. A pump according to the previous claim 1, **characterised in that** it has the pump casing (25) advantageously split into two half-shells (24) on the radial plane comprising the cylinder rim.
5. A pump according to any of the previous claims 1 to 4, **characterised in that** it has the pistons (5) equipped with a lip seal (27) in the contact between the piston and the liner (4) inner diameter.

6. A pump according to the previous claim 5, **characterised in that** it has the suction or delivery blade valves formed on a respective single disc (30, 32) and coupled on one side or on the opposite side of the pump casing (25), in order to define the casing suction or delivery side; moreover, blade (18, 13) housings (31, 33) are comprised in the casing (25) and on the sides of the means (1, 34) associated thereto when assembling the discs (30, 32) with the blades, in order to define the automatic unidirectional valves.
7. A pump according to any of the previous claims 1 to 6, **characterised in that** it has, upstream of the unidirectional automatic suction valves (13), a pumped liquid pressurisation stage, comprising a centrifugal impeller (10) being rotation-connected to the driving shaft (7).
8. A pump according to any of the previous claims 1 to 7, **characterised in that** it has the unidirectional automatic suction valve (13) of at least a cylinder being directly connected to a suction duct (A) of the fluid from a tank (S), while the unidirectional automatic suction valves of the remaining cylinders are connected to a recycle duct (C) of the fluid pumped from a delivery duct (M), by means of a sequence valve (42) being calibrated at a slightly lower pressure than the regulation pressure of a pressure regulation valve (20) to the user (U); the recycle duct is connected to the suction duct of the fluid from the tank by means of an unidirectional automatic valve (41), which interrupts the connection when the sequence valve (42) is open.
9. A pump according to any of the previous claims 1 to 8, **characterised in that** it has a pressure regulation valve (20) to the user (U) being directly connected to the pump (2) and integrated in one of the components (1) thereof.
10. A pump according to any of the previous claims 1 to 9, **characterised in that** it has, as motive power source, an electric motor (9), a shaft thereof being connected to and rotating with the driving shaft (7) of the pump (2).

Patentansprüche

1. Flüssigkeitspumpe mit radialen Zylindern, die einen Kranz von radialen Zylindern umfasst, die paarweise (3) auf derselben radialen Achse gegenübergestellt sind, welche auf einer Fläche ruht, die sich senkrecht zu einer Antriebswelle (7) befindet, die über eine Kurbel (6) verfügt, die mit Hin- und Herbewegungen mit Kolben (5) in den Zylindern verbunden ist, ausführen; die Kolben sind untereinander steif mit einem

Gestell (16) verbunden, das sich in Kontakt mit der Kurbel mittels einer zweiseitigen Führung (15) mit zur Achse der besagten Zylinder senkrechten Wänden befindet; ein Kurbelknopf (6) ist in zweiseitigem Kontakt mit den Führungswänden mittels eines Wälzlagers (17) angebracht; ferner umfasst sie Verteilerelemente der Flüssigkeit zu den Zylindern für den Einlass und die Förderung, welche in einem Körper (25) der Pumpe gepresst sind, die aus einseitig gerichteten Lamellenventilen (13, 18) bestehen; sie umfasst außerdem ein Paar von radialen Zylindern (3), das aus Buchen (4) besteht, die sich in den Körper (25) der Pumpe (2) einfügen, **dadurch gekennzeichnet, dass** jede Buchse radiale Löcher (14) für den Durchlauf der gepumpten Flüssigkeit in Verbindung mit sich im Körper befindlichen Öffnungen für den Einlass und die Förderung aufweist; wobei die einseitig gerichteten Lamellenventile (13, 18) seitlich vom Pumpenkörper angeordnet sind.

2. Pumpe nach vorherigem Anspruch 1, **dadurch gekennzeichnet, dass** sie mehrere Paare von gegenübergestellten radialen Zylindern (3) aufweist, jedes von denen über ein Gestell (16, 38) für die Zusammenfügung der übereinstimmenden Kolben (5) verfügt, wobei eine Dickebegrenzung (29) im Mittelteil des Gestells erzeugt wird, in dem sich das Gestell mit der eigenen Führung (15) an den Kurbelknopf (6) kuppelt; jedes Gestell weist eine Begrenzung (29) der Dicke auf, die in der Kupplung mit der/den anderen Begrenzung/en der Dicke des/der anderen Gestell/e (16, 38) kompatibel ist, damit jede Führung (15) in Kontakt mit demselben Kurbelknopf (6) stehen kann.
3. Pumpe nach vorherigem Anspruch 2, **dadurch gekennzeichnet, dass** sie die Paare der gegenübergestellten radialen Zylinder (3) aufweist, deren entsprechende Achse winkelförmig im Kranz mit dem gleichen Abstand der anderen Achse/n des/der Paar/e der besagten Zylinder ausgerichtet ist.
4. Pumpe nach vorherigem Anspruch 1, **dadurch gekennzeichnet, dass** sie den Körper (25) der Pumpe vorteilhafterweise in zwei Halbschalen (24) auf der radialen Fläche aufgeteilt aufweist, die den Zylinderkranz enthält.
5. Pumpe nach einem der vorherigen Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** sie die Kolben (5) aufweist, die über eine Lippendichtung (27) in Kontakt zwischen dem Kolben und dem inneren Durchmesser der Buchse (4) verfügt.
6. Pumpe nach vorherigem Anspruch 5, **dadurch gekennzeichnet, dass** sie die Lamellenventile für den Einlass oder die Förderung, die auf einer einzelnen entsprechenden Scheibe (30, 32) gewonnen wurden,

aufweist und diese an eine Seite oder an die gegenüberliegende Seite des Körpers (25) der Pumpe gekuppelt sind, um die Einlass- oder Förderungsseite des Körpers zu bestimmen; im Körper (25) und auf den Seiten der Elemente (1, 34), die mit ihm durch die Montage der Scheiben (30, 32) mit den Lamellen verbunden sind, befinden sich außerdem Sitze (31, 33) für die Aufnahme der Lamellen (18, 13), um die einseitig gerichteten automatischen Ventile zu bestimmen.

7. Pumpe nach einem der vorherigen Ansprüche von 1 bis 6, **dadurch gekennzeichnet, dass** sie stromaufwärts der einseitig gerichteten automatischen Einlassventile (13) eine Stufe der Druckbeaufschlagung der gepumpten Flüssigkeit aufweist, die ein drehendes Gebläserad (10) umfasst, die durch Rotation mit der Antriebswelle (7) verbunden ist.
8. Pumpe nach einem der vorherigen Ansprüche von 1 bis 7, **dadurch gekennzeichnet, dass** sie das einseitig gerichtete automatische Einlassventil (13) von mindestens einem Zylinder direkt mit einem Einlasskanal (A) der Flüssigkeit aus einem Tank (S) verbunden aufweist, während die einseitig gerichteten automatischen Ventile der verbliebenen Zylinder mit einem Umwälzkanal (C) für die Flüssigkeit verbunden sind, die von einem Förderkanal (M) mittels eines Folgeventils (42) gepumpt wird, das mit einem leicht niedrigeren Druck als dem Regeldruck eines Druckregelventils (20) zum Verbraucher (U) ausgerichtet ist; der Umwälzkanal ist mit dem Einlasskanal der Flüssigkeit aus einem Tank mittels eines einseitig gerichteten automatischen Ventils (41) verbunden, das die Verbindung bei bestehender Öffnung des Folgeventils (42) unterbricht.
9. Pumpe nach einem der vorherigen Ansprüche von 1 bis 8, **dadurch gekennzeichnet, dass** sie ein Druckregelventil (20) zum Verbraucher (U) aufweist, das direkt mit der Pumpe (2) verbunden und in einem der Teile seiner Komponenten (1) eingefügt ist.
10. Pumpe nach einem der vorherigen Ansprüche von 1 bis 9, **dadurch gekennzeichnet, dass** sie als Quelle für die Antriebsleistung einen Elektromotor (9) aufweist, von welchem eine Welle mit der Antriebswelle (7) der Pumpe (2) drehend und verbunden ist und sich mit ihr dreht.

Revendications

1. Pompe pour liquides à cylindres radiaux, comportant une couronne de cylindres radiaux agencés par couple (3) les uns vis-à-vis des autres sur un même axe radial gisant sur un plan perpendiculaire par rapport à un arbre moteur (7) muni d'une manivelle (6) reliée

- à des pistons (5) en mouvement alternatif dans les cylindres ; les pistons sont reliés rigidement entre eux avec un fût (16) en contact avec la manivelle moyennant un guide bilatéral (15) avec des parois perpendiculaires par rapport à l'axe des cylindres susdits ; un bouton de manivelle (6) est aménagé en contact bilatéral avec les parois du guide moyennant un palier à roulement (17) ; comportant aussi des organes de distribution du liquide aux cylindres par aspiration et par refoulement associés dans un corps (25) de la pompe constitués de vannes unidirectionnelles à lamelles (13, 18) ; comportant ultérieurement un couple de cylindres radiaux (3) constitués de chemises (4) ramenées dans le corps (25) de la pompe (2) **caractérisée en ce que** chaque chemise présente des ouvertures radiales (14) de passage du liquide pompé en liaison avec des orifices d'aspiration et refoulement présents dans le Corps ; les vannes unidirectionnelles à lamelles (13, 18) étant agencées latéralement au corps pompe.
2. Pompe, selon la revendication précédente 1, **caractérisée en ce qu'**elle présente plusieurs couples de cylindres radiaux les uns vis-à-vis des autres (3) chacun des couples susdits étant muni d'un fût (16, 38) d'assemblage des pistons (5) y correspondant où une limitation d'épaisseur (29) est réalisée dans le fût, dans la partie centrale où le fût est accouplé, avec son propre guide (15), au bouton de manivelle (6) ; chaque fût présente une limitation d'épaisseur (29) compatible dans l'accouplement avec la/les autre/s limitation/s d'épaisseur de l'/des autre/s fût/s (16, 38), pour permettre à chaque guide (15) d'être en contact avec le même bouton de manivelle (6).
3. Pompe, selon la revendication précédente 2, **caractérisée en ce qu'**elle présente les couples de cylindres radiaux les uns vis-à-vis des autres (3) dont l'axe respectif est agencé angulairement équidistant dans la couronne de l'/des autre/s axe/s du/des couple/s des cylindres susdits.
4. Pompe, selon la revendication précédente 1, **caractérisée en ce qu'**elle présente le corps (25) de la pompe avantageusement réparti en deux demi-coquilles (24) sur le plan radial contenant la couronne de cylindres.
5. Pompe, selon l'une des revendications précédentes 1 à 4, **caractérisée en ce qu'**elle présente les pistons (5) munis d'une étanchéité en lèvre (27) dans le contact entre le piston et le diamètre intérieur de la chemise (4).
6. Pompe, selon la revendication précédente 5, **caractérisée en ce qu'**elle présente les vannes à lamelle d'aspiration ou de refoulement obtenues sur un disque unique respectif (30, 32) et accouplées sur un côté ou sur le côté opposé du corps (25) de la pompe, pour définir le côté d'aspiration ou de refoulement du corps ; sont présents, en outre, dans le corps (25) et sur les côtés des organes associés (1. 34) à celui-ci lors du montage des disques (30, 32) avec les lamelles, des sièges (31, 33) de logement des lamelles (18, 13) pour définir les vannes automatiques unidirectionnelles.
7. Pompe, selon l'une des revendications précédentes 1 à 6, **caractérisée en ce qu'**elle présente en amont des vannes automatiques unidirectionnelles d'aspiration (13) un étage de pressurisation du liquide pompé, comportant une roue à ailettes centrifuge (10) reliée par rotation à l'arbre moteur (7).
8. Pompe, selon l'une des revendications précédentes 1 à 7, **caractérisée en ce qu'**elle présente la vanne automatique unidirectionnelle par aspiration (13) d'au moins un cylindre directement reliée à une conduite d'aspiration (A) du liquide depuis un réservoir (S), tandis que les vannes automatiques unidirectionnelles d'aspiration des cylindres restants reliées à une conduite de recirculation (C) du liquide pompé par une conduite de refoulement (M), moyennant un clapet de séquence (42) calé à une pression légèrement inférieure par rapport à la pression de réglage d'une vanne de régulation (20) de la pression à l'utilisateur (U) ; la conduite de recirculation est reliée à la conduite d'aspiration du liquide depuis le réservoir moyennant une vanne automatique unidirectionnelle (41), qui coupe la liaison en présence de l'ouverture du clapet de séquence (42).
9. Pompe, selon l'une des revendications précédentes 1 à 8, **caractérisée en ce qu'**elle présente une vanne de réglage de la pression (20) à l'utilisateur (U) directement reliée à la pompe (2) et intégrée dans une des parties dont elle se compose (1).
10. Pompe, selon l'une des revendications précédentes 1 à 9, **caractérisée en ce qu'**elle présente comme source de puissance motrice un moteur électrique (9), dont un arbre est relié et tournant avec l'arbre moteur (7) de la pompe (2).

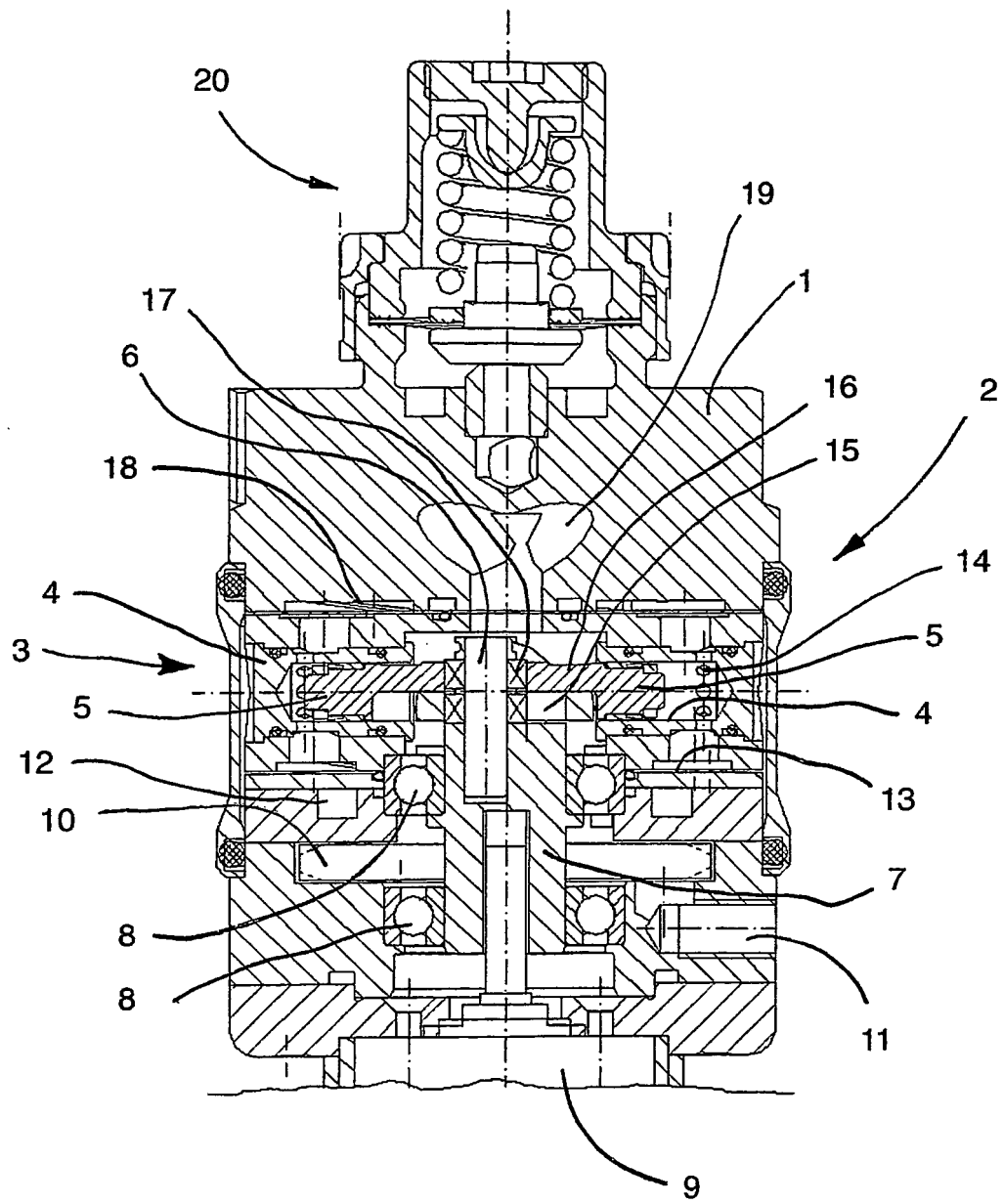


Fig. 1

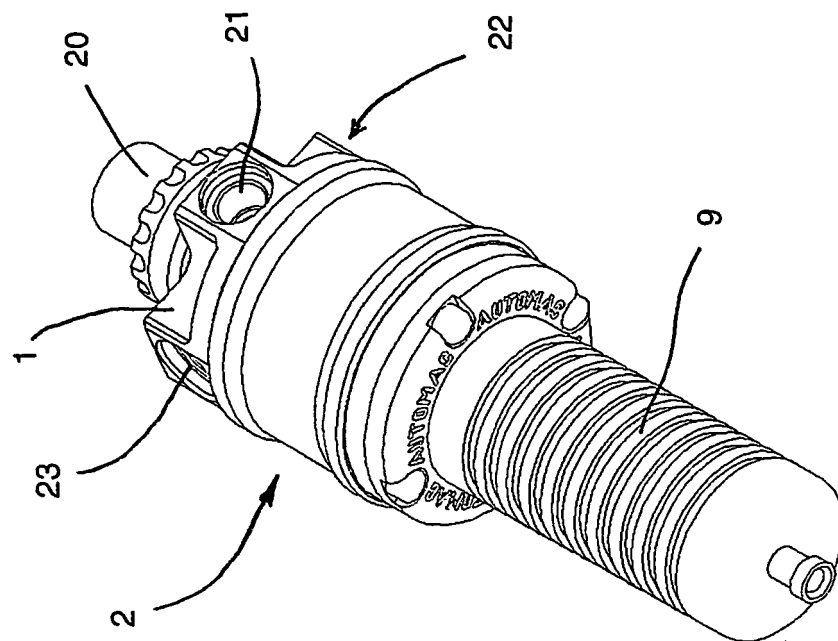


Fig. 3

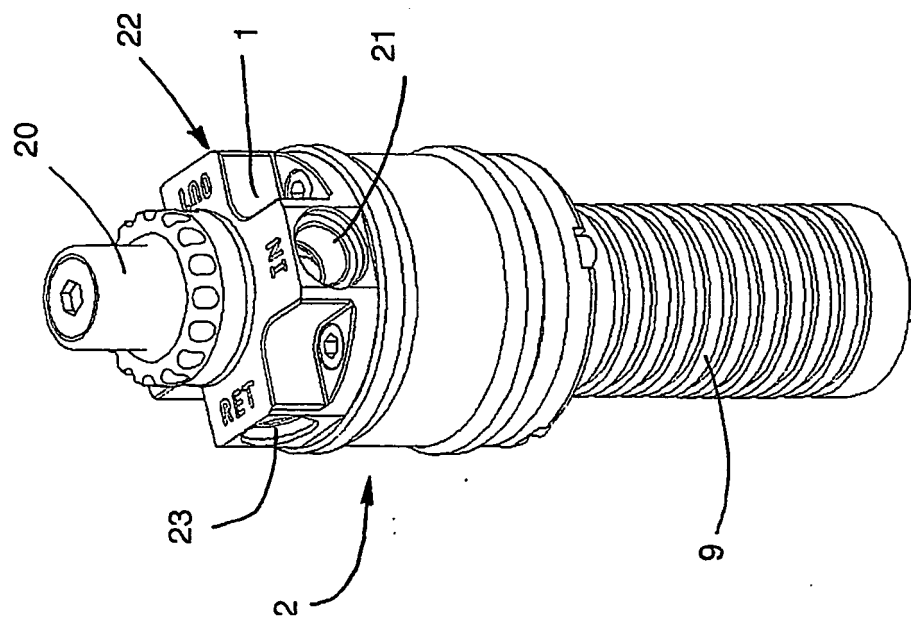


Fig. 2

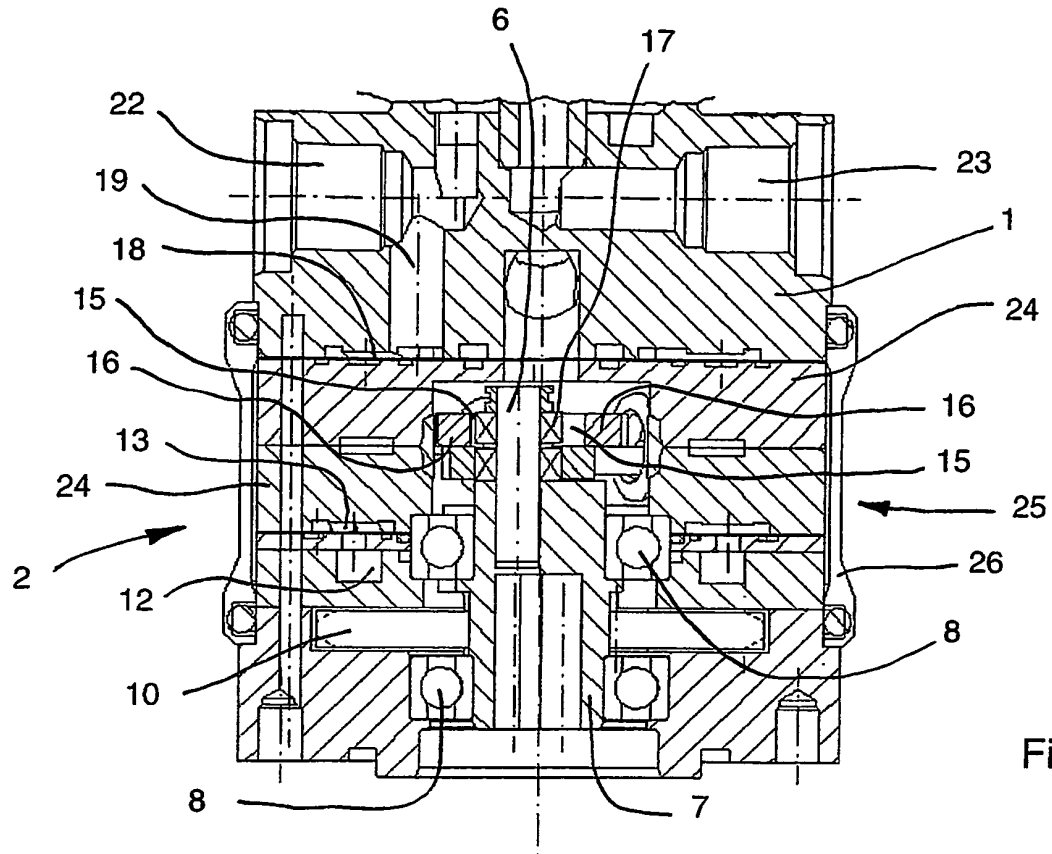


Fig. 4

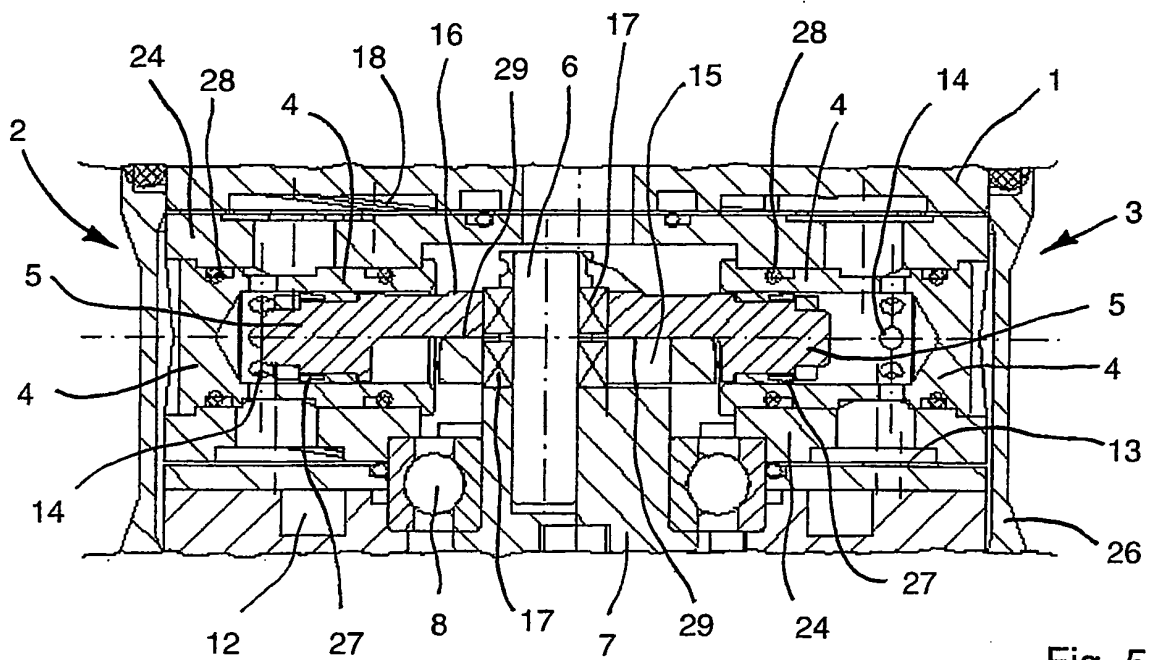
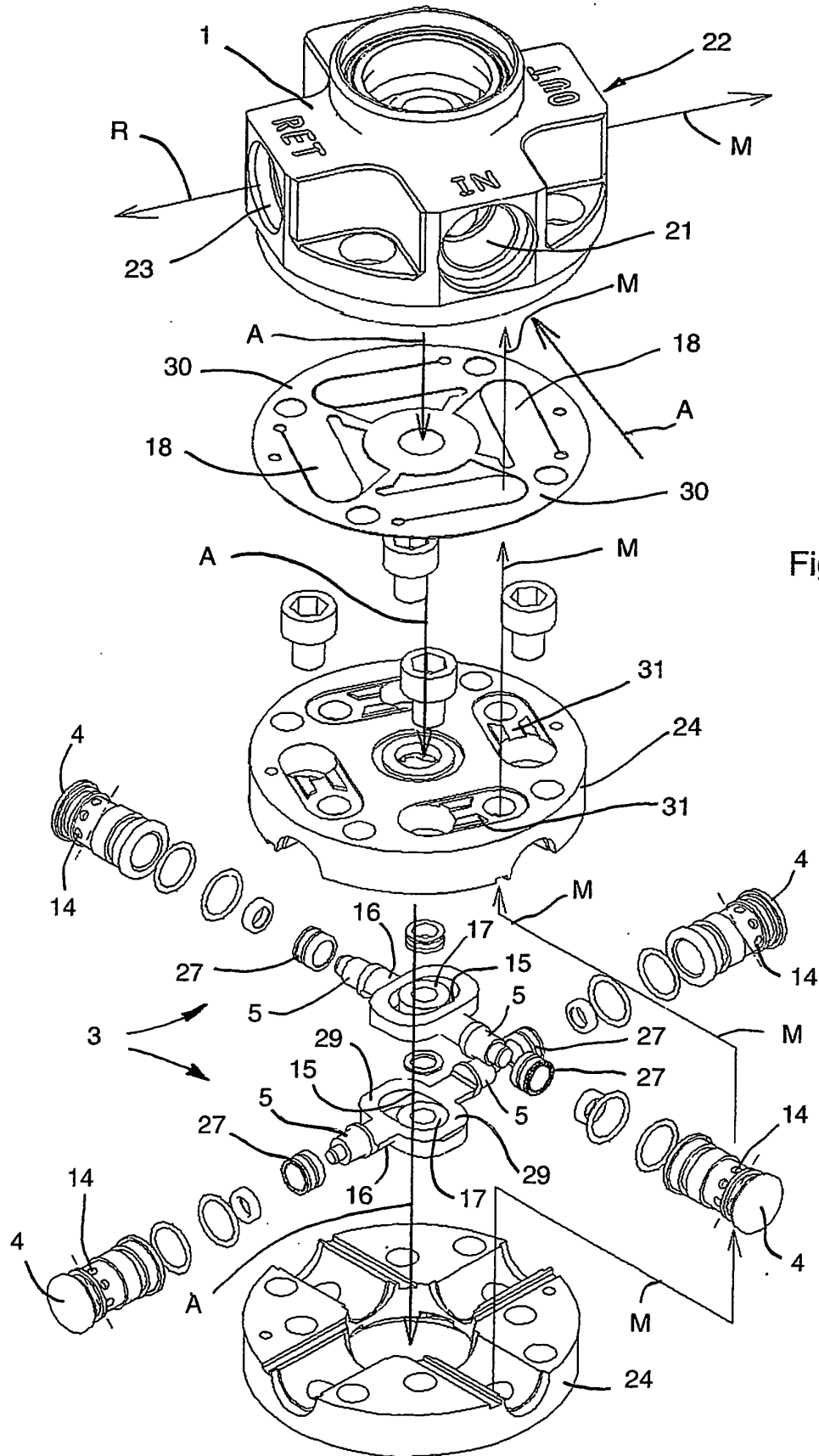


Fig. 5



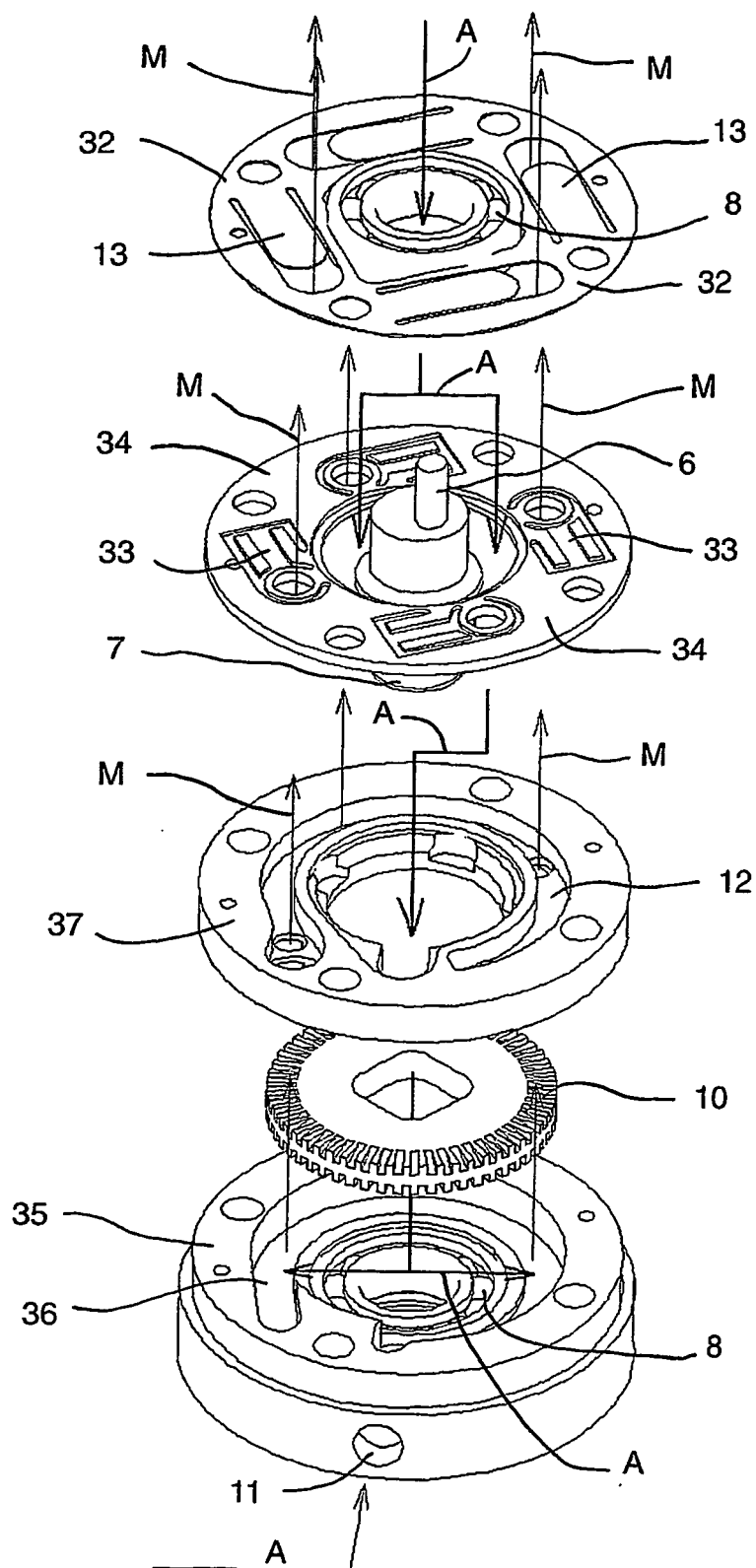


Fig. 7

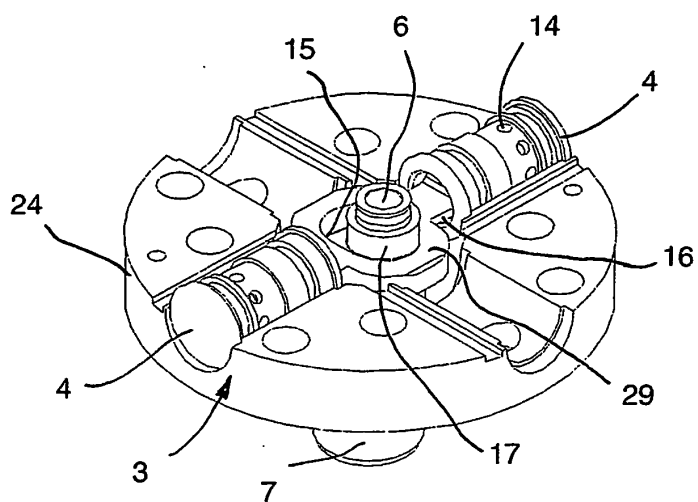


Fig. 8

Fig. 9

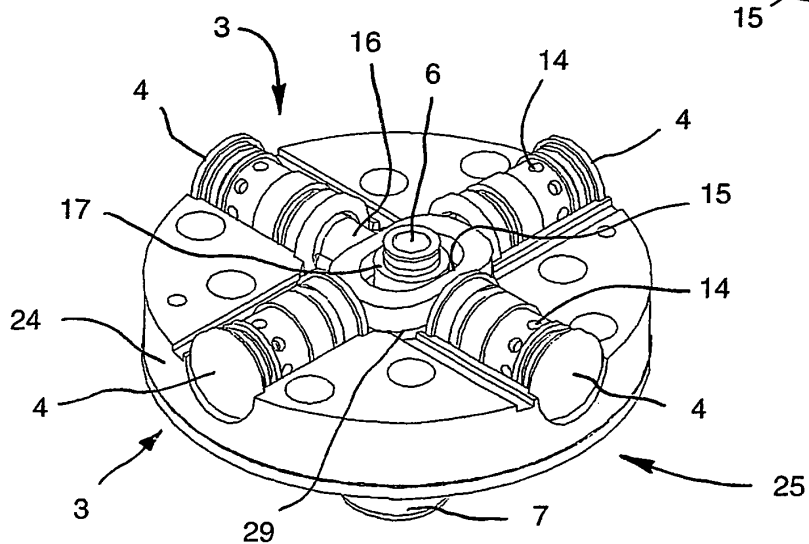
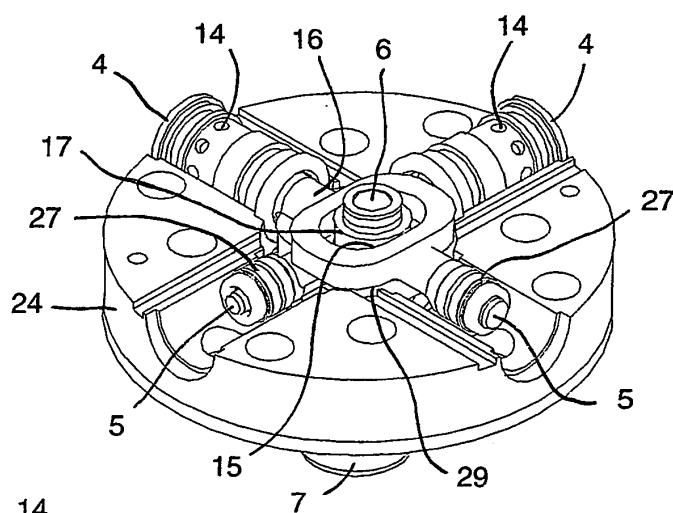


Fig. 10

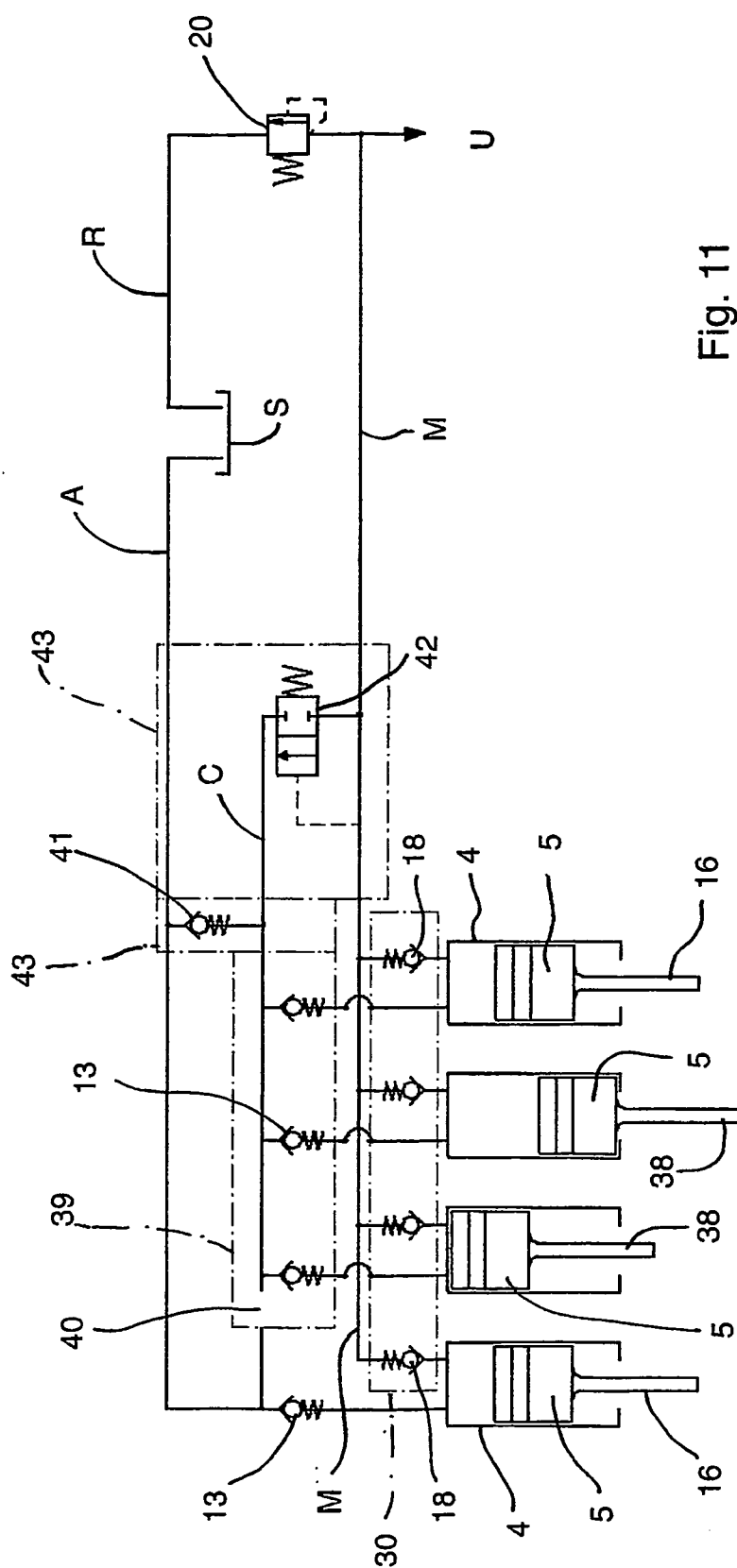


Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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