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(54) PUMP, SYSTEM AND USE OF A PUMP

(57) The disclosure relates to a pump comprising a first disc being rotatable around a geometrical rotation axis through a centre of the disc, the disc having a major surface, the major surface having a normal forming an angle with the geometrical rotation axis, a plurality of stationary piston cylinder arrangements distributed around the geometrical rotation axis, each stationary piston cylinder arrangement comprising a cylinder, a piston head and a piston shaft, the piston head being arranged in the cylinder dividing the cylinder into a first cylinder volume and a second cylinder volume and being connected to the piston shaft, wherein the piston shaft extends in parallel with the geometrical rotation axis

whereby rotation of the disc forces the piston shaft to move back and forth thereby providing reciprocal movement of the piston head in the cylinder,
the pump further comprising an inlet flow channel and an outlet flow channel both extending at least partly around the geometrical rotation axis,
wherein each inlet to the first cylinder volume and each inlet to the second cylinder volume is connected to the inlet flow channel, and
wherein each outlet of the first cylinder volume and each outlet of the second cylinder volume is connected to the outlet flow channel. The disclosure also relates to a system including such a pump and to a use of such a pump.

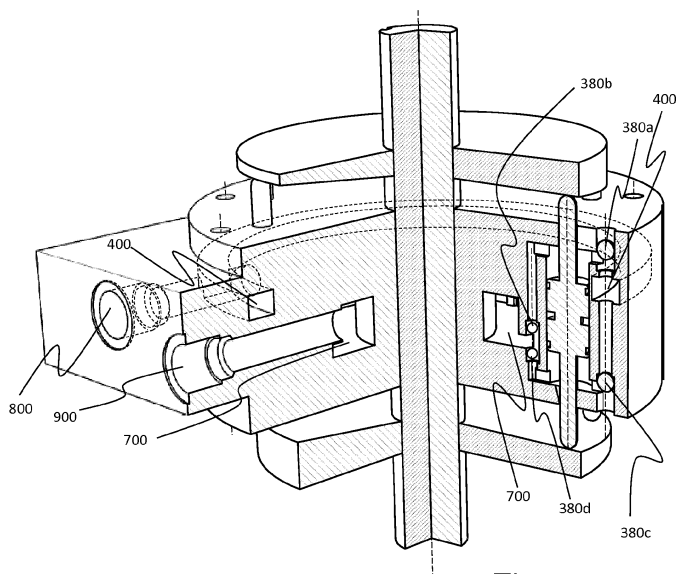


Fig. 2

Description

Field of invention

- [0001]** The invention relates to a pump.
[0002] The invention also relates to a system comprising such a pump.
[0003] The invention also relates to a use of such a pump.

Technical Background

[0004] Within many fields of industry and medicine, pumps are used to facilitate transport of fluids for many different purposes such as lubrication, extraction, cooling et cetera. One category of pumps uses reciprocal motion of a piston to put and remove pressure on the fluid being pumped. This can be done by mounting one or more pistons arranged in a central block. The central block is rotatable about a central axis. The pistons in the rotating central block are in contact with a swash plate whereby the sweeping movement of the pistons about the central axis is converted into a linear reciprocal motion of the piston(s).

[0005] A pump which may be said to be an example of this kind of pump is e.g. disclosed in Chinese Utility Model CN2040033305U which discloses a hydraulic pump comprising a shell, a pair of rotating hydraulic cylinders, a rotating shaft, swash plates and control plates.

[0006] British Patent GB1,199,600 discloses an axial piston unit for use as a liquid pump comprising an outer housing, a cylinder block disposed in and rotatable relative to the housing, said cylinder block having a plurality of cylinders, a piston received and sealingly guided in each of the cylinders. The axial piston unit also comprises a drive shaft for rotating the cylinder block. The axial piston unit also comprises an oblique disc (swash plate) disposed in the housing and operatively connected with the pistons such that when the cylinder block is rotated the oblique disc forces the pistons to perform a reciprocating movement.

[0007] US Patent US3,611,879 discloses an axial piston barrel device having a slipper shoe contacting an inclined or inclinable cam wherein a shoe-engaging cage or spider plate is positioned non-concentrically to the slipper shoes, so that a shoe drivingly engages the spider plate only when moving while on the retraction portion or the cycle.

[0008] A problem with the kind of pumping arrangement disclosed e.g. in CN2040033305U and GB1,199,600 is that it is complex to design and manufacture. There exists a need for a pump with a simpler and more robust construction.

Summary of invention

[0009] It is an object of the invention to at least mitigate some of the problems mentioned in the background. Other

advantages with the invention will occur in the description below.

[0010] The invention relates according to a first aspect to a pump comprising

- 5 a first disc being rotatable around a geometrical rotation axis through a centre of the disc, the disc having a major surface, the major surface having a normal forming an angle, preferably an acute angle, with the geometrical rotation axis,
- 10 a plurality of stationary piston cylinder arrangements distributed around the geometrical rotation axis, each stationary piston cylinder arrangement comprising a cylinder, a piston head and a piston shaft, the piston head being arranged in the cylinder dividing the cylinder into
- 15 a first cylinder volume and a second cylinder volume and being connected to the piston shaft, wherein the piston shaft extends in parallel with the geometrical rotation axis whereby rotation of the disc forces the piston shaft to move back and forth thereby providing reciprocal movement of the piston head in the cylinder,
- 20 wherein each stationary piston cylinder arrangement further comprises a first inlet to the first cylinder volume and a first outlet from the first cylinder volume, the first inlet being provided with a first inlet check valve and the first outlet being provided with a first outlet check valve,
- 25 whereby the reciprocal movement of the piston head in the cylinder provides a pumping action from the first inlet, via the first cylinder volume to the first outlet, wherein each stationary piston cylinder arrangement further comprises a second inlet to the second cylinder volume and a second outlet from the second cylinder volume,
- 30 the second inlet being provided with a second inlet check valve and the second outlet being provided with a second outlet check valve, whereby the reciprocal movement of the piston head in the cylinder provides a pumping action from the second inlet, via the second cylinder volume to the second outlet,
- 35 the pump further comprising an inlet flow channel and an outlet flow channel both extending at least partly around the geometrical rotation axis,
- 40 wherein each inlet to the first cylinder volume and each inlet to the second cylinder volume is connected to the inlet flow channel, and wherein each outlet of the first cylinder volume and each outlet of the second cylinder volume is connected to the outlet flow channel.

[0011] This has, amongst others, the advantage of providing a simple pump, as the components which are in contact with the fluid being pumped are held stationary. This allows for easy leakage proofing. There is no immediate need to provide any sealing between rotating parts and non-rotating parts. Thereby the seals are not subjected to wear and stresses to any significant degree. Moreover, the mechanism that provides the motion for the pumping action can be made simple and robust, e.g. using a drive shaft to provide rotation of the disc. Moreover, there is no need to take into account fluid behaviours, such as wobbling inside the cylinders, otherwise

occurring when the pistons are rotated about their axis. Furthermore, any problems related to the shifting weight of the fluid passing into and out of the cylinders which otherwise might create vibrations which increases noise and wear on the pump are avoided.

[0012] The pump is especially suitable for pumping hydraulic fluid to a hydraulically motivated device.

[0013] The configuration of the stationary piston cylinder arrangements with a first and a second cylinder volume allows for the stationary piston cylinder arrangements to provide pumping action from the inlet flow channel to the outlet flow channel with every half-stroke of the stationary piston cylinder arrangement, thereby providing an efficient and compact pump.

[0014] It may be noted that the disc forcing the piston shaft to move back and forth thereby providing reciprocal movement of the piston head in the cylinder may be provided in a number of different ways.

[0015] Each piston shaft or piston head may e.g. be biased, such as by a spring, towards the disc. Alternatively, the major surface of the disc may be provided with a mushroom shaped groove extending around the geometrical rotation axis and the piston shaft may be provided with a mushroom shaped end inserted into the groove, whereby the disc will alternately push and pull the piston shaft during the rotation of the disc. In the preferred embodiment, the pump is provided with a second disc, which will be elaborated in more detail below.

[0016] The pump may further comprise a second disc, the first and second discs being rotatable around a common geometrical rotation axis through the centre of respective disc and have a respective major surface, the major surface of each disc principally facing the other disc and having a normal, the normal of each major surface forming an angle, preferably an acute angle, with the common geometrical rotation axis.

[0017] By the inclusion of the second disc it is possible to allow for a readily synchronised movement of the stationary piston cylinder arrangements.

[0018] The pump may further comprise a drive shaft, the drive shaft connecting to both discs and having an extension along the common geometrical rotation axis. This makes it possible to provide a robust and simple design and may be used to prevent synchronization issues which may arise from independent driving of each disc.

[0019] The plurality of stationary piston cylinder arrangements, the inlet flow channel and the outlet flow channel may be positioned between the first and second discs. This makes it possible to provide all components and connections associated with the flow of the fluid between the discs which in turn avoids the need for having any channel extending or component positioned outside the peripheral edge of the discs, thereby making it possible to provide a compact pump.

[0020] The inlet flow channel may extend a complete lap and forms a ring around the geometrical rotation axis. This makes it possible to provide a straightforward and

compact design.

[0021] The outlet flow channel may extend a complete lap and forms a ring around the geometrical rotation axis. This also contributes to making it possible to provide a straightforward and compact design.

[0022] One of the inlet flow channel or the outlet flow channel may extend around the geometrical rotation axis at an outer position being radially outside the plurality of stationary piston cylinder arrangements and the other one of the inlet flow channel and the outlet flow channel may extend around the geometrical rotation axis at an inner position being radially inside the plurality of stationary piston cylinder arrangements. This also contributes to making it possible to provide a straightforward and compact design.

[0023] The inlet flow channel may be provided with a main inlet extending between the inlet flow channel and a connection surface of the pump. This provides a convenient connection of the pump to other components of the system.

[0024] The outlet flow channel may be provided with a main outlet extending between the outlet flow channel and a connection surface of the pump. This provides a convenient connection of the pump to other components of the system.

[0025] The main inlet and the main outlet may extend from the inlet flow channel and the outlet flow channel, respectively, in a common direction having a major component transverse to the geometrical rotation axis, or in separate directions each having a major component transverse to the geometrical rotation axis. By extending in one or more directions having a major component(s) transverse to the geometrical axis it is possible to provide a compact pump since there is no need to provide any channel passing outside the surfaces of the discs.

[0026] The invention relates according to a second aspect to a system comprising a pump according to what is disclosed above and what is disclosed in the complete disclosure, wherein the system further comprises an electrical motor driving the rotation of the first disc about the geometrical rotation axis. Electrical driving of the pump provides a convenient means of controlling the rotational speed and thereby the pumping action.

[0027] The electrical motor may be controlled by a frequency modifying device, such as a frequency converter/ or frequency inverter. This also contributes to the provision of a convenient controlling of the rotational speed and pumping action.

[0028] The system may further comprise a hydraulically motivated or powered device, wherein the pump is configured to provide flow and pressure of hydraulic fluid driving the hydraulically motivated device.

[0029] The invention relates according to a third aspect to a use of a pump according to what is disclosed above and what is disclosed in the complete disclosure. The use relates to a use of the pump in a hydraulic drive system comprising the pump and at least one hydraulically motivated device wherein the pump is configured to pro-

vide flow and pressure of hydraulic fluid to the hydraulic drive system driving the hydraulically motivated device.

[0030] The invention may also according to an aspect be said to relate to a pump comprising a first disc being rotatable around a geometrical rotation axis through a centre of the disc, the disc having a major surface, the major surface having a normal forming an angle with the geometrical rotation axis, a plurality of stationary piston cylinder arrangements distributed around the geometrical rotation axis, each stationary piston cylinder arrangement comprising a cylinder, a piston head and a piston shaft, the piston head being arranged in the cylinder dividing the cylinder into a first cylinder volume and a second cylinder volume and being connected to the piston shaft, wherein the piston shaft extends in parallel with the geometrical rotation axis whereby rotation of the disc forces the piston shaft to move back and forth thereby providing reciprocal movement of the piston head in the cylinder, the pump further comprising an inlet flow channel and an outlet flow channel both extending at least partly around the geometrical rotation axis, wherein each inlet to the first cylinder volume and each inlet to the second cylinder volume is connected to the inlet flow channel, and wherein each outlet of the first cylinder volume and each outlet of the second cylinder volume is connected to the outlet flow channel.

Brief description of the drawings

[0031] The invention will by way of example be described in more detail with reference to the appended schematic drawings, which shows a presently preferred embodiment of the invention.

Figure 1A is an exploded perspective view of a pump. Figure 1B is a view corresponding to figure 1A with the pump in an assembled state.

Figure 2 shows a perspective view of the pump, with the left hand side of the view showing a cross-section through an inlet/outlet communicating with an inner channel and with the right hand side showing a cross-section through a piston cylinder arrangement.

Figure 3a is a view of the pump in which the surfaces forming the channels inside the pump are shown.

Figure 3b is discloses in more details the cylinder indicated by the arrow in figure 3a.

Figure 4 is a view showing the surfaces forming the inner and outer flow channels.

Figure 5 is a cross-section of the pump.

Figure 6 discloses a hydraulic system including the pump.

Figure 7 discloses a variant of the piston; the piston being divided into two parts which are urged away from each other by the hydraulic fluid.

Detailed description of preferred embodiments

[0032] The invention will now be described in more de-

tail with reference to the drawings. It is contemplated that there are numerous modifications of the embodiments described herein, which are still within the scope of the invention as defined by the appended claims.

[0033] In Fig. 1 an exploded schematic of a pump is shown. A first disc 200 comprising a centrally located through-going hole 220 is mounted on a rotatable drive shaft 600. The drive shaft 600 extends along a geometrical rotation axis 100. The disc 200 comprises an abutment surface 240, which is inclined in relation to the geometrical rotation axis 100. In the depicted embodiment, the drive shaft 600 extends through the disc 200. This need not be the case, however; for example, the disc 200 can be mounted on the end of the drive shaft 600, or the disc 200 may comprise cogs or sprockets around its edge driving a rotation of the disc 200. Such an arrangement could for example be driven by chains or bands. The disc 200 may be connected to the drive shaft 600 e.g. by welding or a toothed arrangement, such as a spline joint. The disc 200 and the drive shaft 600 may also of course be cast or forged as one piece. The disc 200 and drive shaft 600 are preferably made of metal, and more preferably of steel. The disc 200 and drive shaft 600 may also of course be made from plastic, carbon or any other material which provides sufficient strength and resilience. The drive shaft 600 passes through and by various other components to be further mentioned later in the detailed description, and connects to a second disc 500. Analogous to the first disc 200, the second disc 500 can be connected to the drive shaft 600 in a variety of ways. The connection of the drive shaft 600 to the second disc 500 synchronises the movement of the first and second discs 200, 500. The movement of the first and second discs 200, 500 can of course be synchronised in any way which is suitable in regard to how the discs 200, 500 are to be rotated. For example, in the case of chain-driven discs 200, 500, the chains could be connected to the same driving arrangement, or to otherwise synchronised driving arrangements.

[0034] Fig. 1 also depicts a plurality of stationary piston cylinder arrangements 300. These will in the following section be referred to as cylinders 300 for brevity. In the preferred embodiment there is provided nine such stationary piston cylinder arrangements 300. It is preferred that the number of stationary piston cylinder arrangements 300 is between three and fifteen, preferably between five and thirteen. The stationary piston cylinder arrangements 300 are preferably equidistantly positioned along the flow channels 400, 700.

[0035] As shown in cross-section in Fig. 2 and in Fig. 3, each cylinder 300 comprises a first and a second piston head 320, 322 stiffly connected to each other. This may also be referred to as a single piston head 320 having one portion 320 in the first cylinder volume and a second portion 322 in the second cylinder volume. The piston head 320 is connected to a piston shaft 330. As the first disc 200 rotates, the inclination of the abutment surface 240 of said first disc 200 in relation to the geometrical

rotation axis 100 causes, during a portion of a turn of the discs, a linear motion of the piston shaft 330. The inclination of the abutment surface 540 of the second disc 500 is arranged to analogously cause a linear motion of the piston shaft 330 in the opposite direction during a different part of the turn of the discs, thereby resulting in a reciprocal linear motion of the piston shaft 330. In an embodiment without the second disc 500 a spring or other counteracting member is mounted opposite the first disc 200 to provide a reciprocal motion of the piston shaft 330. The ends of the piston shaft 330 may comprise wheels or rollers to decrease friction wear of the said ends. Another example of how to reduce friction between the ends of the piston shaft 330 and the discs 200, 500 is to manufacture the ends of the piston shaft 300 in a rounded manner. They could then also comprise a wear part designed to be replaced when worn down. The first and second discs 200, 500 could also comprise wear parts.

[0036] Each of the cylinders 300 comprises a first cylinder volume 340. The first cylinder volume 340 is filled with fluid when the piston shaft 330 moves in a pulling phase. The fluid is then ejected from the first cylinder volume when the motion of the piston shaft 330 decreases the available volume for the fluid to fill by moving in a pushing phase. The fluid is drawn into the first cylinder volume 340 by way of a first inlet 360. The fluid is then ejected through a first outlet 370. The first inlet 360 is provided with a first inlet check valve 380a. The pictured check valves 380a each comprise a ball which rests in an aperture of the first inlet. The ball is pushed out of the way by fluid entering the cylinder 300, and is pushed against an abutment surface or seat of the check valve by fluid trying to exit the cylinder 300 by way of the first inlet 360. The check valve 380a may of course be of any suitable kind. The first outlet 370 is provided with a first outlet check valve 380b. Each cylinder 300 comprises a second cylinder volume 350 which is then provided with a second inlet 362 and a second outlet 372 for filling and ejecting fluid from the second cylinder volume 350 in analogy with the first cylinder volume 340. The second inlet 362 is analogously provided with a second inlet check valve 380c. The second outlet 372 is analogously provided with a second outlet check valve 380d. All the check valves 380a-d are of the kind disclosed in relation to the first inlet check valve 380a. It may be noted that other kinds of check valves may be used. It may also be noted that e.g. the inlet check valves 380a, 380c may be of a first kind and the outlet check valves 380b, 380d may be of another kind. The first and second cylinder volumes 340, 350 are served by the same piston shaft, 330, such that when the piston shaft 330 moves into the first cylinder volume 340 in a pushing phase to eject fluid from the first cylinder volume 340, it is simultaneously moving out of the second cylinder volume 350 in a pulling phase to draw fluid into the second cylinder volume 350. Thus, as shown in figure 3b, each cylinder arrangement is provided with four check valves 380a-d. One check valve 380a-d in each of the two inlets and the two outlets.

[0037] As is also shown e.g. in figure 3b, the mouths of respective inlet 360, 362 are positioned within the axial extension of the cylinders 310. The mouths of respective inlet 360, 362 are positioned on a radially facing surface of the respective cylinder 310. The mouths of respective outlet 370, 372 are positioned within the axial extension of the cylinders 310. The mouths of respective outlet 370, 372 are positioned on a radially facing surface of the respective cylinder 310. The cylinders 300 are mounted in a base 1200. The base 1200 comprises a slot for each of the cylinders 300. The cylinders 300 are secured in place by a plate 1100 comprising through-going holes 1400 for the piston shafts 330. The cylinders 300 can of course be secured in many different ways, for example by mounting them on a rail with a circumferential extension. The base is encased in a housing 1000. The housing 1000 comprises a main inlet 800 and a main outlet 900 for the fluid to be pumped.

[0038] The cylinders 300 are interconnected by an inlet flow channel 400. The inlet flow channel 400 transports fluid to be pumped to first inlets 360 and the second inlets 370 of the cylinders 300. Counting the half-strokes of the cylinder shaft 330 of each of the cylinders 300 will inject fluid from the inlet flow channel 400 into the first cylinder volume 340, and simultaneously eject fluid from the second cylinder volume 350. Similarly, every odd half-stroke of the cylinder shaft 330 will inject fluid from the inlet flow channel 400 into the second cylinder volume 350 and eject fluid from the first cylinder volume 340.

[0039] Ejected fluid from the cylinders 300 flows through an outlet flow channel 700, and is allowed to flow away from the pump via the main outlet 900.

[0040] As e.g. shown in Fig. 5, the plurality of stationary piston cylinder arrangements 300, the inlet flow channel 400 and the outlet flow channel 700 are positioned between the first and second discs 200, 500.

[0041] As e.g. shown in Fig. 4, the inlet flow channel 400 extends a complete lap and forms a ring around the geometrical rotation axis 100. The outlet flow channel 700 also extends a complete lap and forms another ring around the geometrical rotation axis. 100

[0042] The inlet flow channel 400 extends around the geometrical rotation axis 100 at an outer position being radially outside the plurality of stationary piston cylinder arrangements 300. The outlet flow channel 700 extends around the geometrical rotation axis 100 at an inner position being radially inside the plurality of stationary piston cylinder arrangements 300. The inlet flow channel 400 is, as seen in an axial direction along the axis 100, positioned within the axial extension of the cylinders 310 of the cylinder arrangements 300. The outlet flow channel 700 is, as seen along in an axial direction along the axis 100, positioned within the axial extension of the cylinders 310 of the stationary piston cylinder arrangements 300. This axial positioning of the inlet flow channel 400 and the outlet flow channel 700, is preferably also related to the axial positioning of the respective channels 400, 700

connections with the respective cylinder volume 340, 350. The inlet flow channel 400 extending around the rotation axis 100 and radially outside the stationary piston cylinder arrangements 300 is, as seen along an axial direction along the drive shaft, preferably positioned between on one hand a flow connection between the inlet flow channel 400 and the first cylinder volume 340 and on the other hand a flow connection between the inlet flow channel 400 and the second cylinder volume 350. The outlet flow channel 700 extending around the rotation axis 100 and radially inside the stationary piston cylinder arrangements 300 is preferably positioned, as seen along an axial direction along the drive shaft, between on one hand a flow connection between the outlet flow channel 700 and the first cylinder volume 340 and on the other hand a flow connection between the outlet flow channel 700 and the second cylinder volume 350. It may also or alternatively be said that the inlet flow channel 400 extends in a path being positioned radially outside and at a radial distance from the stationary piston cylinder arrangements 300, with this radial distance providing space for a radially inner wall of the inlet flow channel 400 and a radially outer wall for the stationary piston cylinder arrangements 300. It may also or alternatively be said that the outlet flow channel 700 extends in a path being positioned radially inside and at a radial distance from the stationary piston cylinder arrangements 300, with this radial distance providing space for a radially outer wall of the outlet flow channel 700 and a radially inner wall for the stationary piston cylinder arrangements 300. It may be noted that it is also conceivable that the arrangement is the opposite one with the inlet flow channel 400 extends around the geometrical rotation axis 100 at an inner position being radially inside the plurality of stationary piston cylinder arrangements 300 and the outlet flow channel 700 extends around the geometrical rotation axis 100 at an outer position being radially outside the plurality of stationary piston cylinder arrangements 300.

[0043] As e.g. shown in Fig. 1B and Fig. 2, the inlet flow channel 400 is provided with a main inlet 800 extending between the inlet flow channel 400 and a connection surface 1001 of the pump. The outlet flow channel 700 is provided with a main outlet 900 extending between the outlet flow channel 700 and a connection surface 1001 of the pump. As e.g. shown in the simplified Fig. 4, the main inlet 800 and the main outlet 900 extend from the inlet flow channel 400 and the outlet flow channel 700, respectively, in a common direction having a major component transverse to the geometrical rotation axis 100, or in separate directions each having a major component transverse to the geometrical rotation axis 100. In the preferred embodiment the main inlet 800 and main outlet 900 extend transverse to the geometrical rotation axis 100.

[0044] The pump 10 may e.g. as is shown in Fig. 6, be used in a system, such as a hydraulic system, comprising the pump 10 and an electrical motor 20 driving the rota-

tion of the disc 200 (or discs 200, 500) about the geometrical rotation axis 100. The electrical motor 20 is e.g. controlled by a frequency modifying device such as a frequency converter/inverter 30, which in turn may be connected to mains. As also shown in Fig. 6, the system further comprises a hydraulically motivated or driven device 40. The pump 10 is configured to provide flow and pressure of hydraulic fluid driving the hydraulically motivated or driven device 40.

[0045] In Fig. 7, there is schematically disclosed a variant of the piston head. The cylinder arrangement is of the same basic set-up as disclosed above. It has e.g. four check valves; one for each of the two inlets and the two outlets. The piston head is in this variant divided into two parts 320 and 322. The two parts are movable relative to each other along the direction of the reciprocal movement and a space 321 is formed between the two parts 320 and 322. A fluid connection 321a is formed between the space 321 and the first cylinder volume. A fluid connection 321b is formed between the space 321 and the second cylinder volume. The pressure of the fluid will urge the two parts 320 and 322 away from each other. This may be used to secure that the piston shafts always about the respective disc with a distinct force, thereby avoiding the risk of having play between the components.

[0046] It is contemplated that there are numerous modifications of the embodiments described herein, which are still within the scope of the invention as defined by the appended claims.

[0047] The pump may for instance be designed with only one disc pushing the piston shafts and whereby the return movement is provided by springs or an active pulling by the disc, such as by mushroom shaped piston shaft ends interacting with a mushroom shaped groove in the disc.

Claims

1. Pump (10) comprising
 - a first disc (200) and a second disc (500), wherein the first and second discs (200, 500) are rotatable around a common geometrical rotation axis (100) through the centre of respective disc (200, 500) and have a respective major surface (240, 540), the major surface of each disc principally facing the other disc and having a normal, the normal of each major surface (240, 540) forming an angle with the common geometrical rotation axis (100),
 - a drive shaft (600), the drive shaft (600) connecting to both discs (200, 500) and having an extension along the common geometrical rotation axis (100),
 - a plurality of stationary piston cylinder arrangements (300) distributed around the geometrical rotation axis (100), each stationary piston cylinder arrangement (300) comprising a cylinder (310), a piston head (320) and a piston shaft (330), the piston head (320) being arranged in the cylinder (310) dividing the cyl-

inder (310) into a first cylinder volume (340) and a second cylinder volume (350) and being connected to the piston shaft (330), wherein the piston shaft (330) extends in parallel with the geometrical rotation axis (100) whereby rotation of the disc (200) forces the piston shaft (330) to move back and forth thereby providing reciprocal movement of the piston head (320) in the cylinder (310),

wherein each stationary piston cylinder arrangement (300) further comprises a first inlet (360) to the first cylinder volume (340) and a first outlet (370) from the first cylinder volume (340), the first inlet (360) being provided with a first inlet check valve (380a) and the first outlet (370) being provided with a first outlet check valve (380b), whereby the reciprocal movement of the piston head (320) in the cylinder (310) provides a pumping action from the first inlet, via the first cylinder volume to the first outlet, wherein each stationary piston cylinder arrangement (300) further comprises a second inlet (362) to the second cylinder volume (350) and a second outlet (372) from the second cylinder volume (350), the second inlet (362) being provided with a second inlet check valve (380c) and the second outlet (372) being provided with a second outlet check valve (380d), whereby the reciprocal movement of the piston head (320) in the cylinder (310) provides a pumping action from the second inlet, via the second cylinder volume to the second outlet,

the pump (10) further comprising an inlet flow channel (400) and an outlet flow channel (700) both extending at least partly around the geometrical rotation axis (100),

wherein one of the inlet flow channel (400) and the outlet flow channel (700) extends around the geometrical rotation axis (100) at an outer position being radially outside the plurality of stationary piston cylinder arrangements (300) and wherein the other one of the inlet flow channel (400) and the outlet flow channel (700) extends around the geometrical rotation axis (100) at an inner position being radially inside the plurality of stationary piston cylinder arrangements (300),

wherein each inlet (360) to the first cylinder volume (340) and each inlet (362) to the second cylinder volume (350) is connected to the inlet flow channel (400), and

wherein each outlet (370) of the first cylinder volume (340) and each outlet (372) of the second cylinder volume (350) is connected to the outlet flow channel (700),

wherein the pump further comprises a main inlet (800) and a main outlet (900), the main inlet (800) extending from the inlet flow channel (400) in a direction having a major component transverse to the geometrical rotation axis (100) and the main outlet (900) extending from the outlet flow channel (700) in a direction having a major component transverse

to the geometrical rotation axis (100).

2. Pump according to claim 1, wherein the plurality of stationary piston cylinder arrangements (300), the inlet flow channel (400) and the outlet flow channel (700) are positioned between the first and second discs (200, 500).
3. Pump according to claim 1 or 2, wherein the inlet flow channel (400) extends a complete lap and forms a ring around the geometrical rotation axis (100).
4. Pump according to any one of claims 1-3, wherein the outlet flow channel (700) extends a complete lap and forms a ring around the geometrical rotation axis (100).
5. Pump according to any one of claims 1-4, wherein one of the inlet flow channel (400) or the outlet flow channel (700) extends around the geometrical rotation axis (100) at an outer position being radially outside the plurality of stationary piston cylinder arrangements (300) and the other one of the inlet flow channel (400) and the outlet flow channel (700) extends around the geometrical rotation axis (100) at an inner position being radially inside the plurality of stationary piston cylinder arrangements (300).
6. Pump according to any one of claims 1-5, wherein the main inlet (800) of the inlet flow channel (400) extends between the inlet flow channel (400) and a connection surface (1001) of the pump (10).
7. Pump according to any one of claims 1-6, wherein the main outlet (900) of the outlet flow channel (700) extends between the outlet flow channel (700) and a connection surface (1001) of the pump (10).
8. Pump according to any one of claims 1-7, wherein the main inlet (800) and the main outlet (900) extend from the inlet flow channel (400) and the outlet flow channel (700), respectively, in a common direction having a major component transverse to the geometrical rotation axis (100).
9. System comprising a pump (10) according to any one of claims 1-8, the system further comprising an electrical motor (20) driving the rotation of the first disc (200) about the geometrical rotation axis (100).
10. System according to claim 9, wherein the electrical motor (20) is controlled by a frequency modifying device (30).
11. System according to claim 9 or 10, wherein the system further comprises a hydraulically motivated device (40), wherein the pump (10) is configured to provide flow and pressure of hydraulic fluid driving

the hydraulically motivated device (40).

12. Use of a pump according to any one of claims 1-8 in a hydraulic drive system comprising the pump (10) and at least one hydraulically motivated device (40) wherein the pump (10) is configured to provide flow and pressure of hydraulic fluid to the hydraulic drive system driving the hydraulically motivated device (40).

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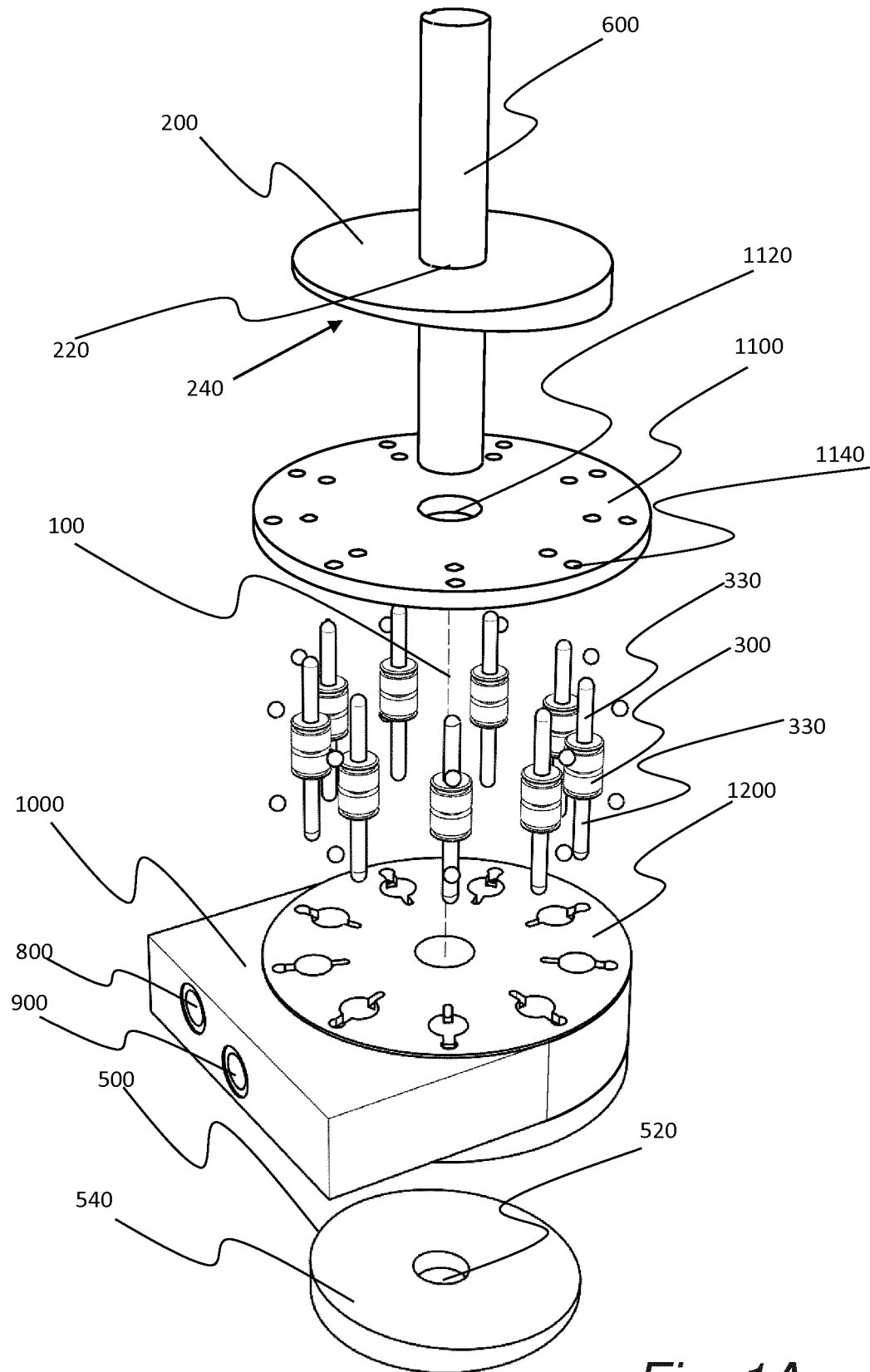
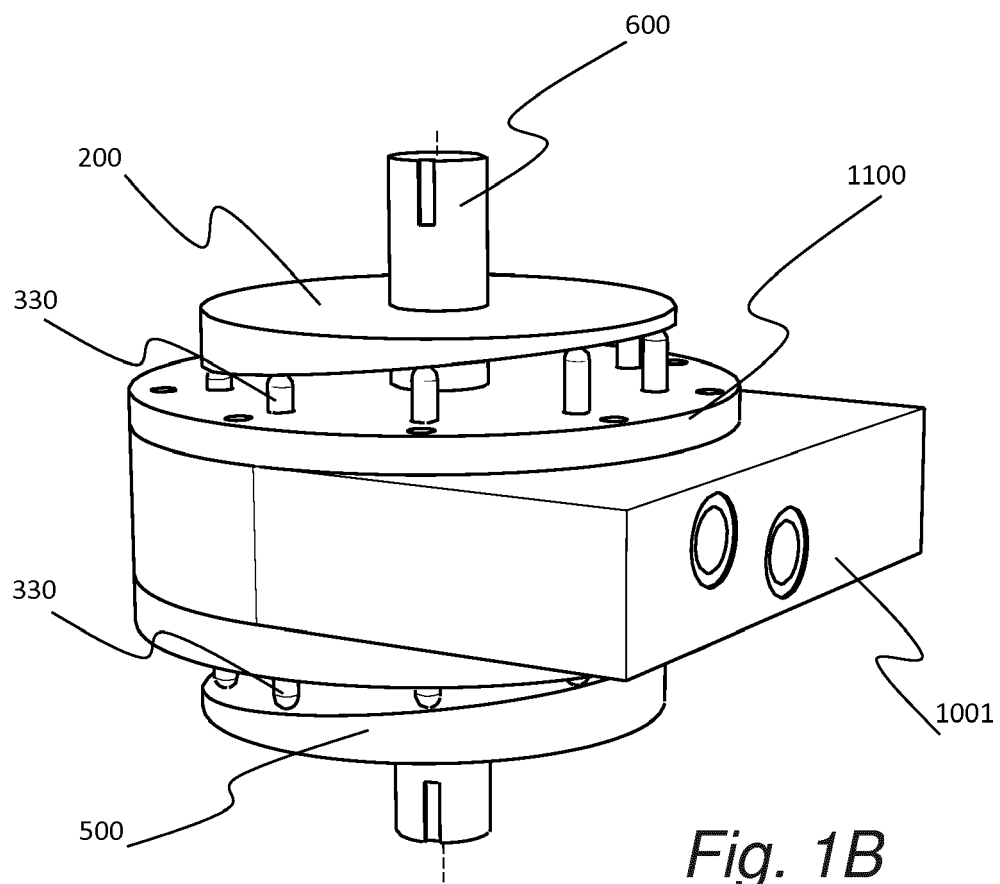
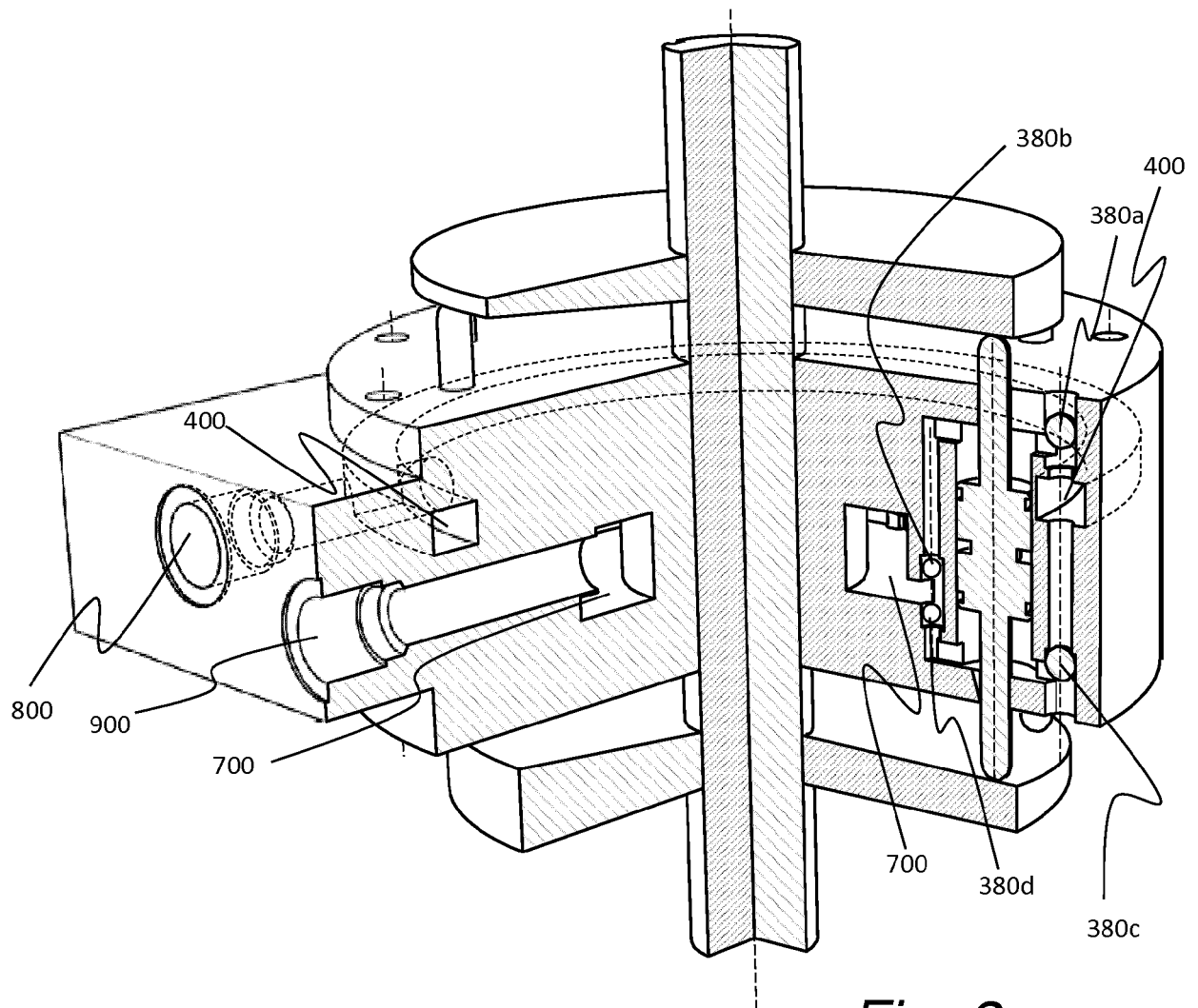
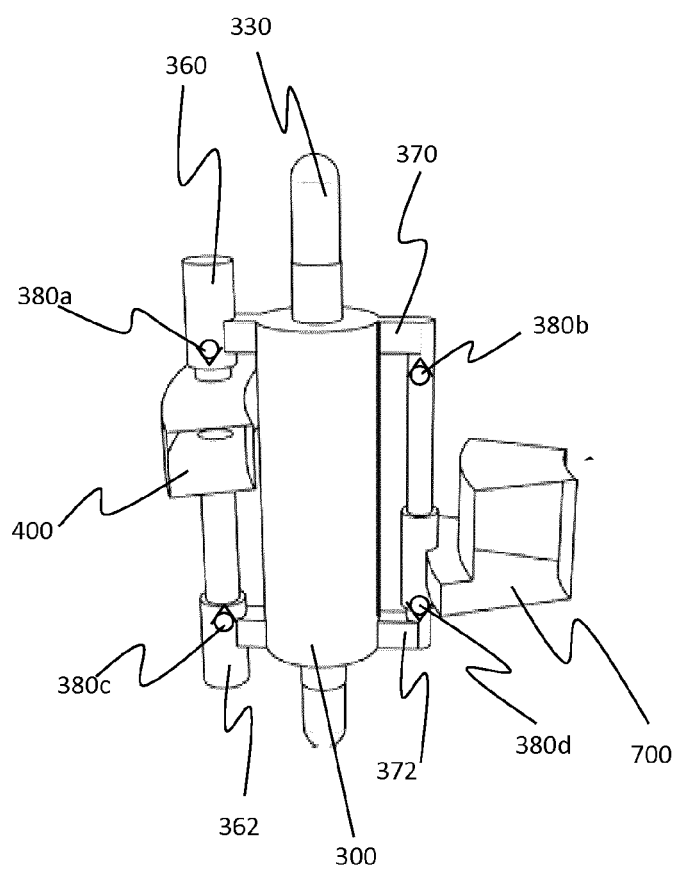
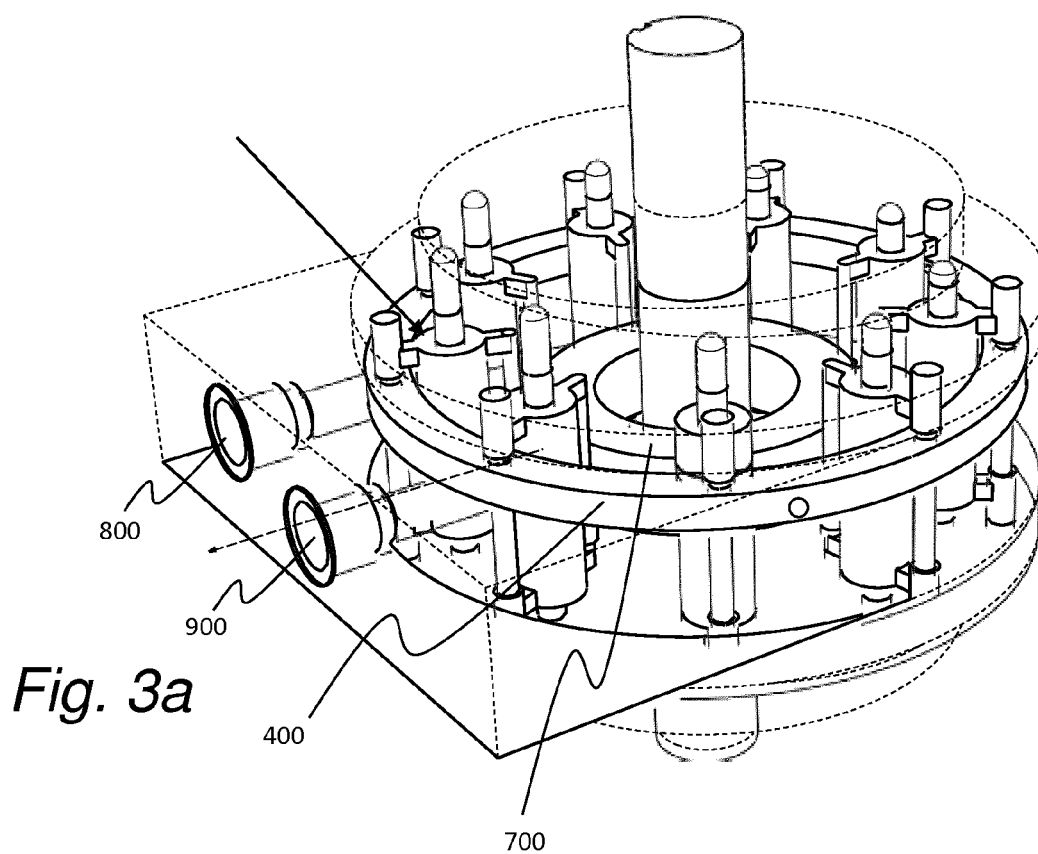


Fig. 1A







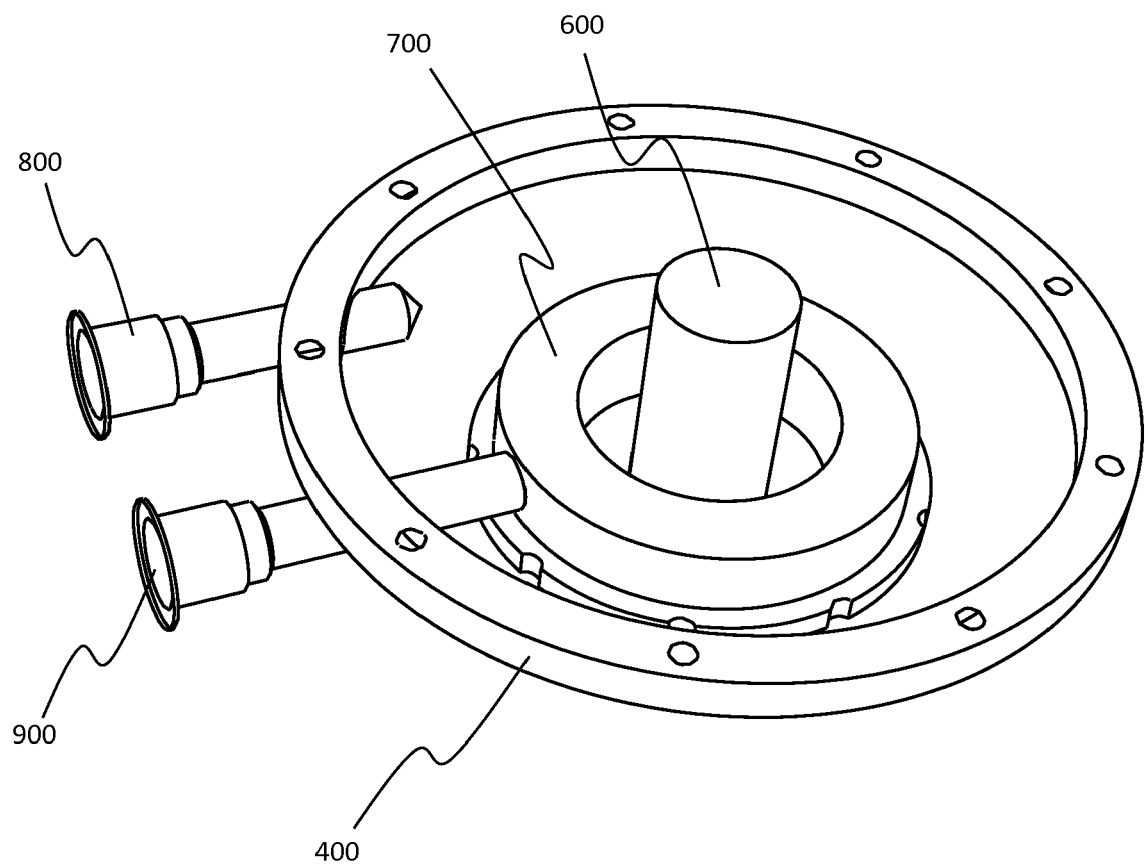


Fig. 4

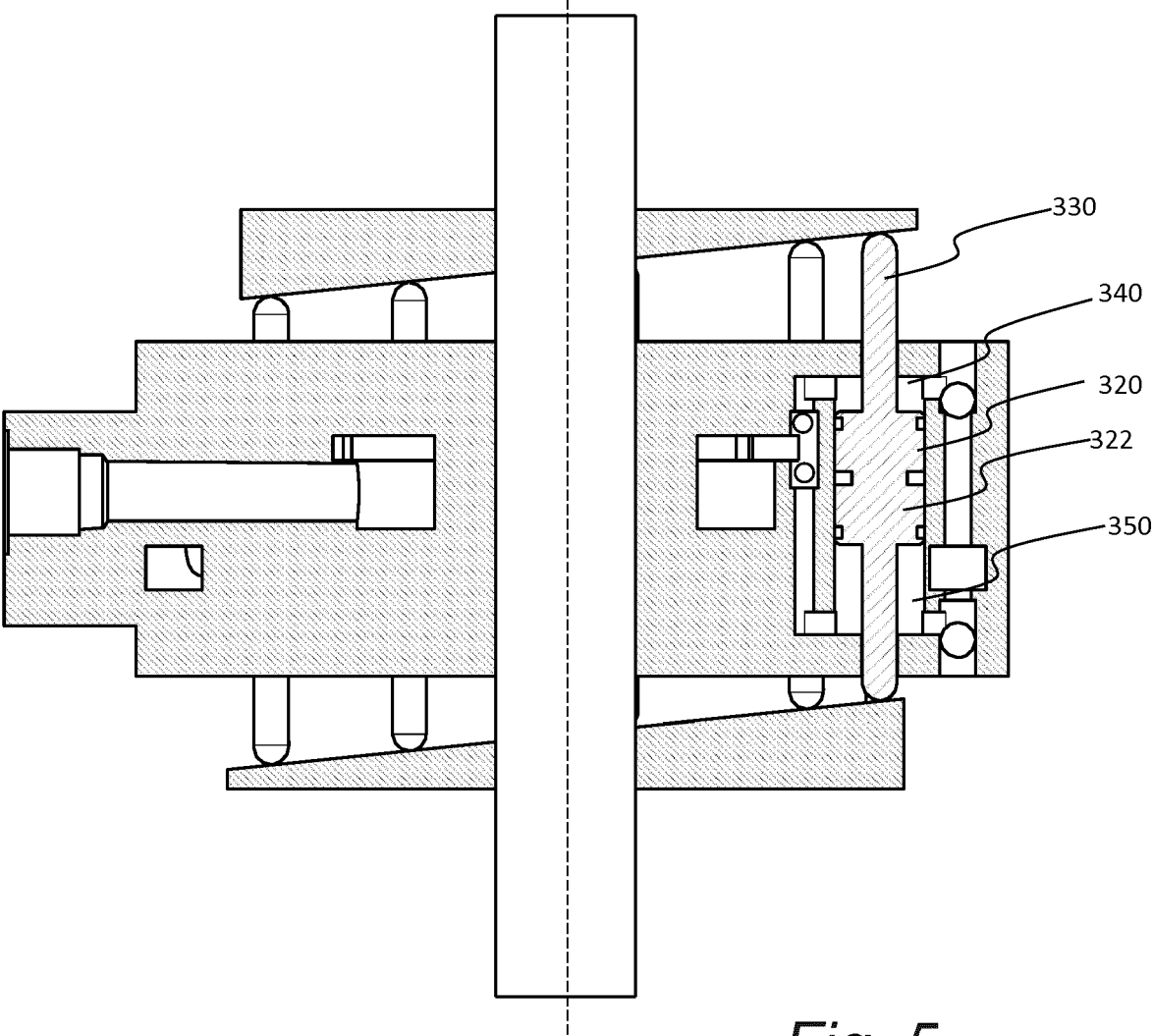


Fig. 5

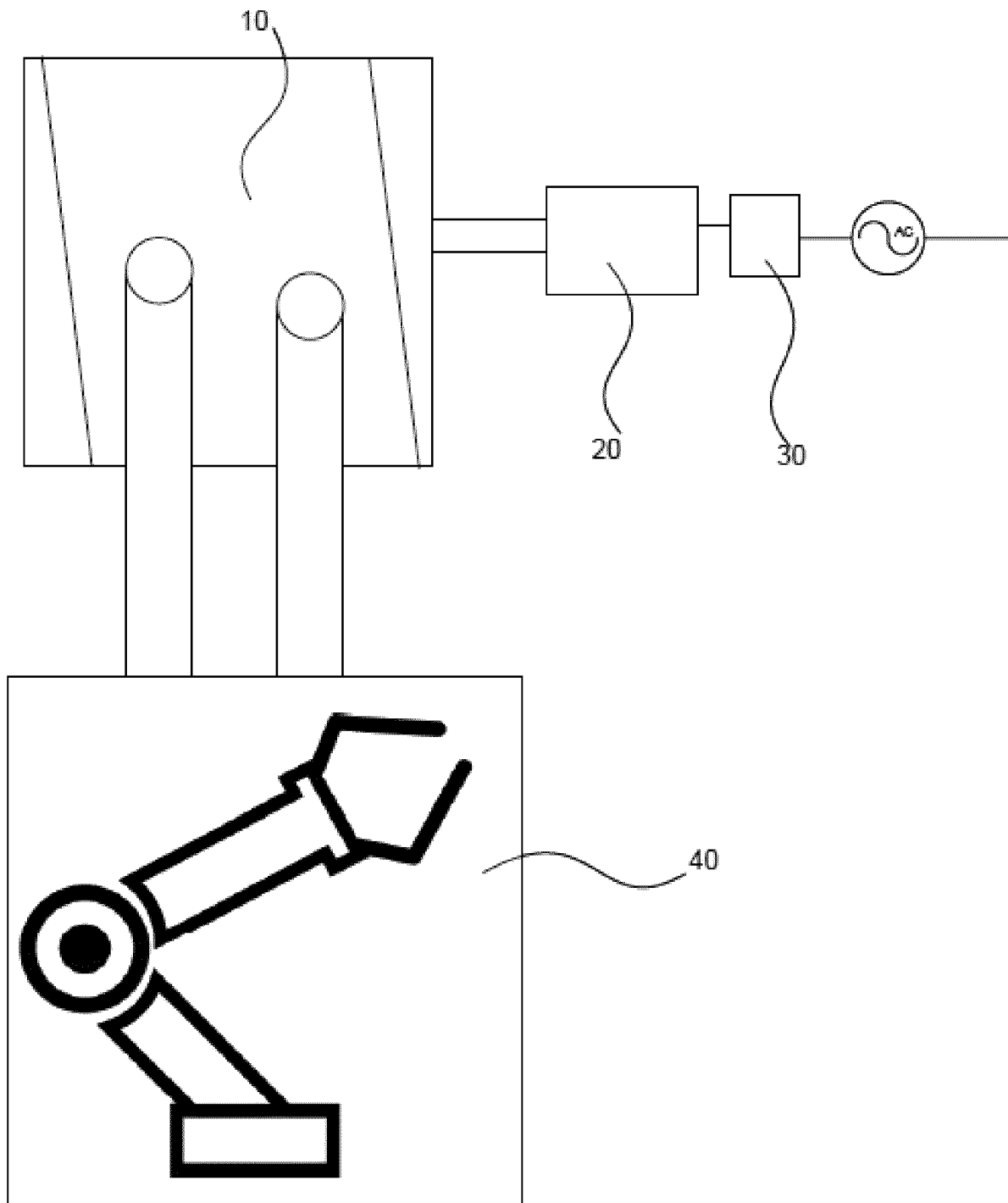


Fig. 6

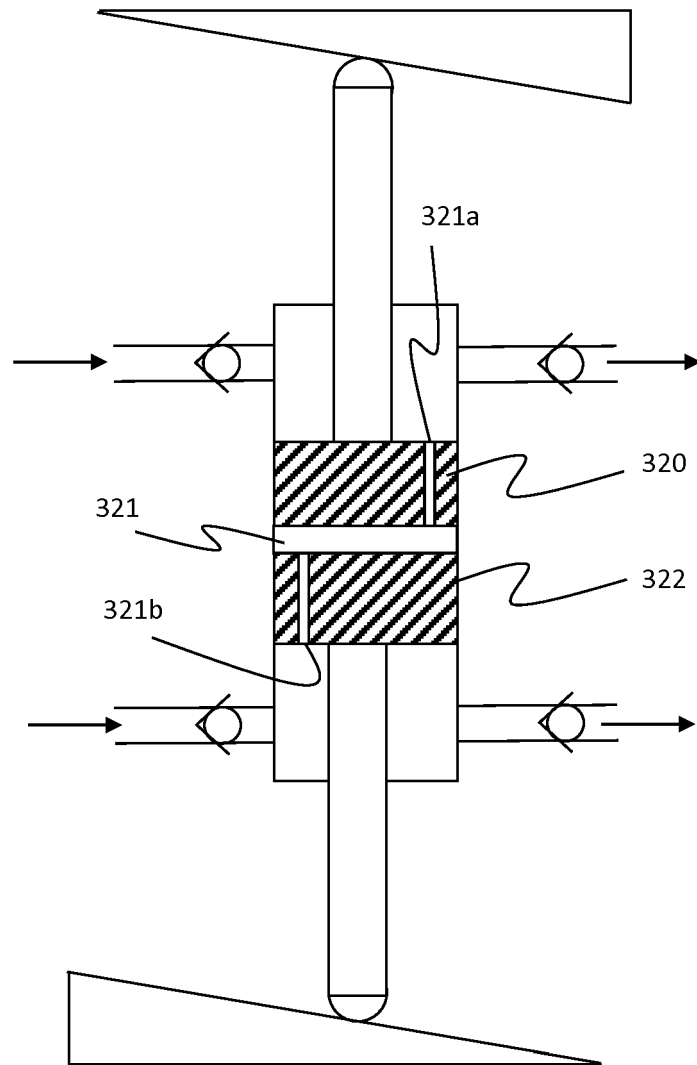


Fig. 7



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Place of search Munich		Date of completion of the search 11 October 2018	Examiner Pinna, Stefano
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