(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 557 564 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
16.07.2008 Bulletin 2008/29

(51) Int Cl.:
F04B 7/06 *(2006.01)*

(21) Application number: **04250372.2**

(22) Date of filing: **23.01.2004**

(54) **Reversible pump for driving hydraulic cylinders**

Umkehrbare Pumpeneinheit zum Antrieb hydraulischer Zylinder

Unité de pompage réversible pour l'entrainement de cylindres hydrauliques

(84) Designated Contracting States:
FR IT

(43) Date of publication of application:
27.07.2005 Bulletin 2005/30

(73) Proprietor: **Sraosha Consulting, Inc**
West Vancouver, BC V7V 1M9 (CA)

(72) Inventor: **Wood, Robert A., Rocky Mountain Parabolic Prod. Lt**
West Vancouver V7V 1M9 (CA)

(74) Representative: **Wightman, David Alexander**
Barker Brettell LLP
138 Hagley Road
Edgbaston
Birmingham
B16 9PW (GB)

(56) References cited:
US-A- 3 083 895
US-A- 4 902 208
US-A- 5 015 157

EP 1 557 564 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] This invention relates to a pump assembly according to the preamble of claim 1. Such a pump assembly is known from US-A-3,083,895..

[0002] Although the subject invention may have other uses it is particularly useful in applications where a pump is required to drive a single hydraulic cylinder to perform useful work. The pump is connected to the cylinder using two tubes that connect between two ports on the cylinder and two ports on the pump. An electric motor on the pump can be made to rotate in alternate directions and the resultant pumping action will expand or retract the cylinder according to the direction of rotation of the motor.

[0003] Such combinations of hydraulic pump and cylinder are used for applications such as cranes on trucks, portable log splitters and automatic pilots on ships. It is desirable in such systems that fluid flow from the cylinder to the pump be blocked when the pump is at rest as in this way any load placed on the hydraulic cylinder is restrained in position when the pump is not running.

[0004] If the double acting hydraulic cylinder is constructed with the piston rod passing right through the piston and exiting through glands at both the mounting and the rod ends of the cylinder the fluid flow leaving and returning to the pump is exactly equal and the pump and cylinder can be constructed as a closed loop through which the fluid flows. In such a system no external reservoir is required.

[0005] In most applications, because of cost and space limitations, the hydraulic cylinder is of the type with a single cylinder rod attached to the piston with this rod passing through a gland on one end of the cylinder only. No rod passes through the mounting end of the cylinder. In such applications when a quantity of fluid is fed into the mounting end of the cylinder less fluid will emerge from the rod end of the cylinder the difference being equal to the swept volume of the cylinder rod. Conversely when fluid is fed into the rod end of the cylinder a greater quantity will flow from the mounting end of the cylinder the difference being equal to the swept volume of the cylinder rod. Under these circumstances a system cannot be constructed as a closed loop and a means must be provided to introduce extra fluid into the loop as the cylinder expands and remove surplus fluid from the loop as the cylinder contracts. Such fluid must be stored in a system reservoir and the level of fluid in this reservoir will drop as the cylinder expands and rise as the cylinder contracts. The reservoirs that are used for this purpose may be an integral part of the pumping unit or a separate entity.

[0006] Simple gear pumps are frequently used in such applications but the nature of a gear pump is that it does not offer the capability to support a load on the cylinder when the pump is at rest and requires complicated spool valves to support a load and return fluid to the reservoir as the cylinder retracts. The subject invention is simple and economical to manufacture. It has no gears and no spool valves, has the ability to hold a load on the cylinder when the pump is at rest, provides a simple means of returning fluid to the reservoir as the cylinder retracts and provides a simple means of supplying extra fluid to the cylinder as it expands.

[0007] Piston pumps having a single piston that reciprocates and rotates about a single axis are known in the prior art but the subject invention incorporates features that make such pumps simpler. For example the devices shown in U.S. Patents 4,479,759, 5,161,491, and 3,083,895, all show pistons that reciprocate and rotate simultaneously but rely on grooves in the piston to accomplish this motion. U.S. Patent 3,930,762 shows a device containing a piston that reciprocates and rotates simultaneously but which relies on a system of cams to produce such motion. U.S. Patents 5,015,157 and 3,168,872 show devices containing a piston that reciprocates and rotates simultaneously but such motion is achieved by setting the drive motor axis at an angle to the axis of the piston. U.S. Patent 4,902,208 discloses a pump suitable for driving a hydraulic cylinder that includes a rotating valve mechanism but the pumping action in this invention takes place in a separate cylinder at right angles to the rotating valve axis.

[0008] None of the above documents discloses methods to connect these devices to a hydraulic cylinder so as to allow for variation in fluid flows produced by the hydraulic cylinder.

[0009] According to the present invention there is provided a pump assembly as defined in claim 1. Other preferred features are the subject of the dependent claims.

[0010] The pump assembly preferably includes a housing supporting the cylinder and also supporting an electric motor with a shaft so as the axis of rotation of the motor shaft coincides with the axis of rotation of the piston.

[0011] Any suitable means may be employed for coupling the motor shaft to the piston for rotating the piston, for example, a transverse pin in the motor shaft engaging with a slot provided in the end of the piston.

[0012] The cylinder member is preferably open except for the piston member to establish only one pumping chamber between the members with the commutating valve means for establishing fluid flow into the single pumping chamber during one half of each revolution to charge the pumping chamber and for establishing fluid flow from the pumping chamber during the second half of each revolution.

[0013] The arrangement of the porting is such that the first and second fixed ports alternatively communicate with the radial port so the fluid flows in one direction through the fixed ports upon rotation of the piston in one direction and through the fixed ports in the opposite direction when the direction of rotation of the piston is reversed.

[0014] The pump assembly preferably also provides a system reservoir that is connected to the pumping components by three passages. The first and second of these passages are fitted with one way check valves which

allow additional fluid to enter the pump exit ports as required when the attached hydraulic cylinder is expanding. The third of these passages is fitted with a bleed device that allows surplus fluid to be returned to the reservoir when the attached hydraulic cylinder is contracting.

[0015] As the single acting piston pump provides excellent sealing between the piston and the cylinder, and, as such a single acting piston pump cannot be driven by hydraulic pressure as a motor, the pump is essentially non reversing and any load on the hydraulic cylinder will be held for long periods without such a load causing significant movement in the hydraulic cylinder shaft.

[0016] These and other features, benefits and advantages of the present invention will be readily appreciated from the following detailed description, given by way of non-limiting example only, in conjunction with the accompanying drawings wherein:

FIG. 1 shows a pump assembly constructed in accordance with the subject invention as it would be connected in a typical application to a double acting hydraulic cylinder in order to raise a load. The mounting end of the cylinder is on the top and the rod end of the cylinder is on the bottom.

FIG. 2 is a half sectional view of the preferred embodiment of the subject invention with the piston withdrawn the maximum amount from the piston chamber.

FIG. 3 is a cross sectional view of the preferred embodiment of the subject invention taken substantially along line A-A of FIG. 2 with the position of the piston being the same as in Fig 2.

FIG. 4 is a similar cross sectional view of the invention with the components positioned as would be the case with the pump turning in a clockwise direction and delivering fluid to a hydraulic cylinder so as to cause the hydraulic cylinder to expand.

FIG. 5 is a similar cross sectional view of the invention with the components positioned as would be the case with the pump turning in an anti-clockwise direction and delivering fluid to a hydraulic cylinder so as to cause the hydraulic cylinder to contract.

FIG 6 Shows an alternative assembly of components used to reciprocate the piston.

[0017] A pump assembly 10, constructed in accordance with the subject invention, is shown in Fig. 1 as it would be connected in a typical application to a double acting hydraulic cylinder in order to raise a load. Two tubes from the cylinder connect to ports 1 and 2. Also shown is reservoir cap 3 and drive motor 4

[0018] A half sectional side elevation of the pump assembly 10 is shown in Fig. 2 where the section is made along the axis of the piston member 5. Pump housing 11 includes a reservoir 24 with vented filler cap 3.

[0019] Piston member 5 is in a telescoping relationship with cylinder 6 to define a pumping chamber 7 therebetween. The cylinder 6 is closed except for the piston 5 to define or establish only one pumping chamber 7 between the members 5 and 6 so that the piston member 5 is single acting.

[0020] Housing 11 incorporates cylinder 6 and also secures a drive means comprising an electric motor 4 that rotates a shaft 9. Housing 11 secures the axis of shaft 9 in exact alignment with the axis of piston 5 and cylinder 6. Motor shaft 9 enters a recess in the end of piston 5.

[0021] Pin 8 inserted at right angles into shaft 9 engages with slot 12 cut across the end of piston 5. Slot 12 is provided in the end of piston 5 to enable the rotation of shaft 9 to be transmitted to piston 5 by pin 8 acting in slot 12. Slot 12 also allows piston 5 movement along the axis of cylinder 6 without disrupting the rotational connection between shaft 9 and piston 5.

[0022] Alternative forms of coupling which transmit rotary motion between shaft 9 and piston 5 may be employed in place of pin 8 and slot 12 provided that such forms of coupling allow axial movement of piston 5 along the axis of cylinder 6 without disrupting the rotational connection between shaft 9 and piston 5.

[0023] A commercially available single row ball bearing 13 is mounted on a cylindrical surface formed on the end of piston 5. The cylindrical surface on which single row ball bearing 13 mounts has an axis inclined at an angle to the main axis of piston 5. The single row ball bearing 13 is secured to the piston 5 by means of a retaining ring 14. A passage 38 allows fluid to flow from the reservoir into cavity 39 in order to lubricate single row ball bearing 13. Fluid seal 40 prevents fluid escaping along motor shaft 9 from cavity 39.

[0024] A cylindrical pin 15 is secured in housing 11 with the axis of said pin 15 intersecting the axis of piston 5 at right angles. Cylindrical pin 15 presents a cylindrical surface to the edge of single row ball bearing 13 at the outer circumference. A spring loaded plunger arrangement consisting of ball 16 and spring 17 applies pressure to the edge of single row ball bearing 13 and forces single row ball bearing 13 against the cylindrical surface of pin 15. The action of ball 16 and spring 17 acting on single row ball bearing 13 restricts the movement of the surface of single row ball bearing 13 in contact with the cylindrical surface of pin 15 along an axis parallel with the axis of piston 5.

[0025] Alternatively the cylindrical surface formed by pin 15 in contact with single row ball bearing 13 can be replaced by similar cylindrical surface formed as part of pump housing 11. A cylindrical surface on the pin 15 or housing 11 may not always be required and it will be understood the invention is not limited thereto.

[0026] Alternatively ball 16 and spring 17 can be replaced by a plunger of another nature which provides a means of keeping single row ball bearing 13 in contact

with a cylindrical surface such as that provided by pin 15.

[0027] Alternatively cylindrical pin 15, ball 16, and spring 17 can be replaced as in FIG 6. with a fork 41, having a slot 42 into which single row ball bearing 13 locates. Fork 41 has a spherical outer surface that is restrained but free to swivel in a spherical or cylindrical socket such as 43 in housing 11.

[0028] As motor 4, through shaft 9 and pin 8, causes piston 5 to rotate, single row ball bearing 13 is forced to oscillate about piston 5 by the restraint of the plunger pressing single row ball bearing 13 against the cylindrical surface of pin 15. A similar oscillation is produced using the alternative methods described.

[0029] The oscillation of single row ball bearing 13 causes piston 5 to reciprocate in cylinder 6. The rate of reciprocation of piston 5 in cylinder 6 is equal to the rate of rotation of piston 5 in cylinder 6. The stroke of reciprocation of piston 5 is such that pin 8 does not become disengaged from slot 12.

[0030] Fig 3 is a cross sectional view along line A-A in Figure 2 and shows a commutating valve means for delivering fluid to the pumping chamber 7 and for receiving fluid from pumping chamber 7. The commutating valve means includes a passage 18 which connects pumping chamber 7 to a radial port 19 which is rotatable with piston 5.

[0031] In an alternative embodiment passage 18 is omitted and radial port 19 is extended to the end of piston 5 to communicate directly with pumping chamber 7.

[0032] Housing 11 includes first and second fixed or stationary ports 20 and 21 spaced circumferentially from one another and diametrically opposite one another on the axis of piston 5 so that the axis of ports 20 and 21 is at right angles to the axis of the cylindrical surface formed by pin 15.

[0033] The ports 20 and 21 independently communicate with the radial port 19 during rotation of piston 5 relative to housing 11. The ports 20 and 21 extend through passages 22 and 23 respectively into threaded ports 1 and 2 which may be utilised for hose or hydraulic tubes leading away from the pump to a hydraulic cylinder.

[0034] The stationary or fixed ports 20 and 21 are aligned relative to the piston 5 with radial port 19 for alternatively communicating with the radial port 19. Consequently fluid will flow from port 20 through the radial port 19 and passage 18 to pumping chamber 7 and from pumping chamber 7 back through passage 18, radial port 19 and out through second port 21 upon rotation of piston 5 in one direction, but will flow in the opposite direction from fixed port 21 through radial port 19 and passage 18 to the pumping chamber 7 and out of pumping chamber 7 through passage 18 to fixed port 20 when the rotation of the piston is in the opposite direction.

[0035] Passages 22 and 23 extend into reservoir 24. A one way ball check valve consisting of ball 25 and spring 26 allows fluid from reservoir 24 to flow into exit port 1 but not return. A one way ball check valve consisting of ball 27 and spring 28 allows fluid from reservoir 24 into exit port 2 but not return.

[0036] Alternately reservoir 24 could be remotely mounted and connected by a single tube that connected between such a remotely mounted reservoir and a common connection on the pump assembly from which passages 22,23 and 35 extended.

[0037] A passage 29 connects outlet ports 1 and 2. Two balls 30 and 31 that are a loose fit in passage 29 are placed in the centre of passage 29 and restrained from moving outwards towards outlet port 1 by retaining ring 32 and restrained from moving outwards towards port 2 by retaining ring 33. When balls 30 and 31 are pressed towards port 1 and ball 30 is in contact with retaining ring 32 a rubber O ring 36 seals ball 31 against the walls of passage 29 and prevents fluid flowing past ball 31. When balls 30 and 31 are pressed towards port 2 and ball 31 is in contact with retaining ring 33, a rubber O ring 34 seals ball 30 against the walls of passage 29 and prevents fluid from flowing past ball 30. A passage 35 connects the centre of passage 29 to reservoir 24.

[0038] Alternatively retaining rings 32 and 33 may be replaced by another stopping means such as a pin that arrests the movement of balls 30 and 31 in the desired positions.

[0039] Figure 4 shows the relative position of the components of the invention when the pump is rotating in the direction of the arrow shown and smaller arrows in the figure indicate the direction of fluid flow. The pump is connected as shown in Fig. 1. As fluid is pumped from outlet port 1 the hydraulic cylinder is extending to lower the load. The swept volume of the cylinder rod exiting the hydraulic cylinder creates a condition where more fluid is exiting port 1 than is entering port 2. A partial vacuum thus develops in port 1 and additional fluid is drawn from reservoir 24 past check ball 25 and spring 26 to make up the extra fluid required.

[0040] Figure 5 shows the relative position of the components of the invention when the pump is rotating in the direction of the arrow shown and smaller arrows in the figure indicate the direction of fluid flow. The pump is connected as shown in Fig. 1. As fluid is pumped from outlet port 2 the hydraulic cylinder is retracting to raise the load. The swept volume of the cylinder rod entering the hydraulic cylinder creates a condition where more fluid is entering port 1 than is exiting from port 2. As pressure builds up in port 2 balls 30 and 31 are forced by said pressure against retaining ring 32. Rubber O ring seal 36 acting against ball 31 seals passage 29 to prevent pressurised fluid escaping from port 2 to passage 35. Excess fluid entering port 1 from the hydraulic cylinder can however flow past loose fitting ball 30 and flow up passage 35 to the reservoir.

[0041] It will be seen that as the components of the invention are supplied in a symmetrical manner it makes no difference which end of the hydraulic cylinder is connected to ports 1 and 2 as the fluid flows described can be duplicated in opposite halves of the invention.

[0042] When the pump is at rest the cylinder to which

it is attached will be held in position against a load. With the pump stopped and an external cylinder supporting a load as in Figure 1 pressure will be applied to exit port 2. This pressure will drive balls 30 and 31 over towards exit port 1 and rubber O ring 36 will seal the passage past ball 31. If pressure in port 21 passes into rotating port 19 and passes through passage 18 into pumping chamber 7 the effect on piston 5 will be to cause piston 5 to move outward rotating as it goes until port 21 becomes blocked by piston 5. With both passage 29 and port 21 closed the load on the hydraulic cylinder will be held in place.

Claims

1. A pump assembly comprising piston and cylinder members (5,6) in telescoping relationship with one another for reciprocating movement along a first axis to define a single pumping chamber (7) therebetween, means (4;8,12) for rotating said piston member (5) relative to said cylinder member (6) about said first axis, means (13,15) for reciprocating said piston member (5) relative to said cylinder member (6) as it rotates about said first axis, commutating valve means (18,19,20,21) for establishing fluid flow into said pumping chamber (7) during one portion of each revolution to charge said pumping chamber (7) and for establishing fluid flow from said pumping chamber (7) during the remainder of each revolution, said commutating valve means (18,19,20,21) including a single radial port (19) communicating with the pumping chamber (7) and rotatable about the axis of said piston (5) for independent fluid communication with first and second fixed ports (20,21) spaced circumferentially from one another **characterised in that** said means (13,15) for reciprocating said piston member (5) comprises a single row ball bearing (13) secured to a cylindrical surface of said piston member (5) having a second axis inclined at an angle to said first axis and where said single row ball bearing (13) is restrained at one point (15) from moving in the direction of the first axis.

2. A pump assembly as set forth in Claim 1 further **characterised by** having a first check valve (25,26) and a second check valve (27,28) that allow fluid to be drawn from a reservoir (24) when the said pump assembly (10) is working and said pump assembly (10) is connected to a hydraulic cylinder that is driven in the expanding direction.

3. A pump assembly as set forth in Claim 2 further **characterised by** a bleed valve (30,31) that allows excess fluid to be bled from the low pressure side of said pump assembly (10) to said reservoir (24) when said pump assembly (10) is connected to a hydraulic cylinder which is driven in the contracting direction.

4. A pump assembly as set forth in Claim 3 wherein said bleed valve (30,31) consists of two balls (30,31) placed in a passage (29) and restrained in said passage (29) in such fashion that said balls (30,31), when acted upon by pressure from one of the pump exit ports (1,2), said one port (1) is connected to the reservoir (24) and the other port (2) is sealed from the reservoir (24).

5. A pump assembly according to claim 4 further **characterised by** said balls (30,31), when acted upon by pressure from one of the pump exit ports (1,2), are placed in a position where said passage (29) is sealed by contact between one of said balls (30,31) and one of two rubber O-ring seals (34,36), and a second passage (35) is opened to enable excess fluid to be bled from the low pressure side of said assembly (10) to said reservoir (24) when the pump assembly (10) is connected to a hydraulic cylinder which is driven in the contracting direction.

6. A pump assembly as set forth in any preceding Claim further **characterised by** having a plunger assembly (16,17) to hold an outer circumference of the single row ball bearing (13) in contact with a cylindrical surface (15) in order to cause the said single row ball bearing (13) to oscillate when said piston (5) is rotated and thus cause said piston (5) to reciprocate once for every revolution made by said piston (5).

7. A pump assembly as set forth in any of Claims 1 to 5 further **characterised by** having a fork (41) embracing the edge of the single row ball bearing (13) where the outside of the fork (41) is of a spherical shape and free to move in a spherical or cylindrical socket (43) in order to cause said single row ball bearing (13) to oscillate when said piston (5) is rotated and thus cause said piston (5) to reciprocate once for every revolution made by said piston (5).

8. A pump assembly as set forth in any preceding Claim further **characterised by** having an electric motor (4) with a shaft (9) arranged on the first axis of the piston (5) and coupled thereto by a pin and slot arrangement (8,12) to cause said piston (5) to rotate while permitting said piston (5) to reciprocate.

9. A pump assembly as set forth Claim 2 or Claim 3 further **characterised by** having the reservoir (24) either forming an integral part of a housing (11) for the pump assembly (10) or remotely mounted independent of a housing (11) for the pump assembly (10).

Patentansprüche

1. Pumpvorrichtung, umfassend Kolben- und Zylinder-

teile (5,6) in teleskopartiger Beziehung zueinander, für eine Hin- und Herbewegung längs einer ersten Achse, um eine einzelne Pumpkammer (7) dazwischen zu bilden, Mittel (4;8,12) zum Drehen des Kolbenteils (5) bezüglich des Zylinderteils (6) um genannte erste Achse, Mittel (13,15) zum Hin- und Herbewegen des Kolbenteils (5) bezüglich des Zylinderteiles (6), während sich dieser um genannte erste Achse dreht, Umschaltventilmittel (18,19,20,21) zur Erzeugung einer Strömung in die Pumpkammer (7) während eines Teils jeder Drehung zum Füllen der Pumpkammer (7) und zur Erzeugung eines Medienstroms aus der Pumpkammer (7) während des Rests jeder Umdrehung, wobei die Umschaltventilmittel (18,19,20,21) eine einzelne radiale Öffnung (19) einschließen, die mit der Pumpkammer (7) in Verbindung steht und um die Achse des Kolbens (5) für eine unabhängige Medien führende Verbindung mit ersten und zweiten feststehenden Öffnungen (20,21) drehbar ist, welche um den Umfang voneinander beabstandet sind, **dadurch gekennzeichnet, dass** genannte Mittel (13,15) für die Hin- und Herbewegung des Kolbenteils (5) ein einreihiges Kugellager (13) umfasst, welches an einer zylindrischen Oberfläche des Kolbenteils (5) befestigt ist, und eine zweite Achse aufweist, die im Winkel zu der genannten ersten Achse geneigt ist, wobei das einreihige Kugellager (13) an einem Punkt (15) gegen eine Bewegung in Richtung der ersten Achse festgehalten ist.

2. Pumpanordnung nach Anspruch 1, ferner **gekennzeichnet durch** ein erstes Rückschlagventil (25,26) und ein zweites Rückschlagventil (27,28), welche es ermöglichen, dass Flüssigkeit aus einem Vorratsbehälter (24) angesaugt wird, wenn die Pumpanordnung (10) arbeitet und genannte Pumpanordnung (10) an einen Hydraulikzylinder angeschlossen ist, welcher in Ausfahrrichtung angetrieben wird.

3. Pumpanordnung nach Anspruch 2, ferner **gekennzeichnet durch** ein Entlastungsventil (30,31), welches es ermöglicht, dass überschüssige Flüssigkeit aus der Niederdruckseite der Pumpanordnung (10) zu dem Vorratsbehälter (24) abgelassen wird, wenn die Pumpanordnung (10) an einen Hydraulikzylinder angeschlossen ist, der in Zusammenziehrichtung angetrieben ist.

4. Pumpanordnung nach Anspruch 3, wobei das Entlastungsventil (30,31) aus zwei Kugeln (30,31) besteht, die in einem Durchlass (29) angeordnet und in dem Durchlass (29) derart zurückgehalten sind, dass die genannten Kugeln (30,31) unter Wirkung von Druck von einer der Auslassöffnungen (1,2) der Pumpe beeinflusst werden, wobei die eine Öffnung (1) an den Vorratsbehälter (24) angeschlossen und die andere Öffnung (2) gegenüber dem Vorratsbehälter (24) abgedichtet ist.

5. Pumpanordnung nach Anspruch 4, ferner **dadurch gekennzeichnet, dass** die genannten Kugeln (30,31) bei Beaufschlagung durch Druck von einer der Auslassöffnungen (1,2) der Pumpe in einer Position angeordnet werden, wo der Durchlass (29) durch Berührung zwischen einer der Kugeln (30,31) und einem von zwei O-Ringen (34,36) aus Gummi abgedichtet ist, und ein zweiter Durchlass (35) geöffnet ist, um es zu ermöglichen, dass überschüssige Flüssigkeit von der Niederdruckseite der Pumpanordnung (10) zu dem Vorratsbehälter (24) abgelassen wird, wenn die Pumpanordnung (10) an einen Hydraulikzylinder angeschlossen ist, er in Zusammenziehrichtung angetrieben ist.

6. Pumpanordnung nach einem der vorstehenden Ansprüche, ferner **dadurch gekennzeichnet, dass** eine Tauchkolbenanordnung (16,17) vorgesehen ist, um einen Außenumfang des einreihigen Kugellagers (13) in Berührung mit einer zylindrischen Oberfläche (15) zu halten, um das genannte einreihige Kugellager (13) zum Schwingen zu bringen, wenn der Kolben (5) gedreht wird, um dadurch zu bewirken, dass der Kolben (5) einmal für jede durch den Kolben (5) ausgeführte Umdrehung hin- und herbewegt wird.

7. Pumpanordnung nach einem der Ansprüche 1 bis 5, ferner **dadurch gekennzeichnet, dass** eine Gabel (41) vorgesehen ist, welche die Kante des einreihigen Kugellagers (13) umfasst, wobei die Außenseite der Gabel (41) eine kugelförmige Gestalt aufweist und sich frei in einer kugelförmigen oder zylindrischen Fassung (43) bewegen kann, um das einreihige Kugellager (13) zum Schwingen zu bringen, wenn der Kolben (5) gedreht wird, und um so zu bewirken, dass der Kolben (5) sich einmal für jede durch den Kolben (5) durchgeführte Drehung hin und her bewegt.

8. Pumpanordnung nach einem der vorstehenden Ansprüche, ferner **dadurch gekennzeichnet, dass** ein Elektromotor (4) mit einer Welle (9) vorgesehen ist, welche auf der ersten Achse des Kolbens (5) angeordnet und durch eine Stift- und Schlitzanordnung (8,12) mit diesem gekoppelt ist, um den Kolben (5) zu drehen, während sich der Kolben (5) hin und her bewegen kann.

9. Pumpanordnung nach Anspruch 2 oder Anspruch 3, ferner **dadurch gekennzeichnet, dass** der Vorratsbehälter (24) entweder einen einstückigen Teil eines Gehäuses (11) für die Pumpanordnung (10) bildet oder unabhängig von dem Gehäuse (11) der Pumpanordnung (10) entfernt montiert ist.

Revendications

1. Ensemble de pompage comprenant des éléments de piston et de cylindre (5,6) en relation télescopique l'un avec l'autre en vue d'un mouvement alternatif le long d'un premier axe pour définir une seule chambre de pompage (7) entre eux, des moyens (4 ; 8, 12) pour faire tourner ledit élément de piston (5) relativement audit élément de cylindre (6) autour dudit premier axe, des moyens (13, 15) pour amener ledit élément de piston (5) à effectuer un mouvement alternatif relativement audit élément de cylindre (6) lorsqu'il tourne autour dudit premier axe, commutant des moyens de vanne (18, 19, 20, 21) pour établir l'écoulement du fluide dans ladite chambre de pompage (7) pendant une portion de chaque tour pour charger ladite chambre de pompage (7) et pour établir un écoulement de fluide de ladite chambre de pompage (7) pendant le reste de chaque tour, lesdits moyens de commutation de vanne (18, 19 20, 21) incluant un seul orifice radial (19) communiquant avec la chambre de pompage (7) et apte à tourner autour de l'axe dudit piston (5) pour une communication fluidique indépendante avec des premier et second orifices fixes (20, 21) espacés circonférenciellement l'un de l'autre, **caractérisé en ce que** ledit moyen (13, 15) pour conférer un mouvement alternatif audit élément de piston (5) comprend un roulement à billes à rangée unique (13) fixé à une surface cylindrique dudit élément de piston (5) ayant un second axe incliné selon un angle audit premier axe, et où ledit roulement à billes à rangée unique (13) est empêché à un point (15) de se déplacer dans la direction du premier axe.

2. Ensemble de pompage selon la revendication 1, **caractérisé en** outre en comportant une première vanne de retenue (25, 26) et une seconde vanne de retenue (27, 28) qui permettent le retrait du fluide d'un réservoir (24) lorsque ledit ensemble de pompage (10) fonctionne et que ledit ensemble de pompage (10) est relié à un vérin hydraulique qui est entraîné dans la direction d'expansion.

3. Ensemble de pompage selon la revendication 2, **caractérisé en outre par** une vanne de purge (30, 31) qui permet la purge du fluide excédentaire du côté basse pression dudit ensemble de pompage (10) audit réservoir (24) lorsque ledit ensemble de pompage (10) est relié à un vérin hydraulique qui est entraîné dans la direction de contraction.

4. Ensemble de pompage selon la revendication 3, où ladite vanne de purge (30, 31) est constituée de deux boules (30,31) placées dans un passage (29) et retenues dans ledit passage (29) de telle manière que lesdites boules (30, 31), lorsqu'elles sont soumises à la pression d'un des orifices de sortie de pompe (1, 2), un orifice précité (1) est relié au réservoir (24) et l'autre orifice (2) est rendu étanche relativement au réservoir (24).

5. Ensemble de pompage selon la revendication 4, **caractérisé en outre en ce que** lesdites boules (30, 31), lorsqu'elles subissent la pression d'un des orifices de sortie de pompe (1, 2), sont placées dans une position dans laquelle ledit passage (29) est rendu étanche par le contact entre une desdites boules (30, 31) et un de deux joints toriques en caoutchouc (34, 36), et un second passage (35) est ouvert pour permettre la purge du fluide excédentaire du côté basse pression dudit ensemble (10) audit réservoir (24) lorsque l'ensemble de pompage (10) est relié à un vérin hydraulique qui est entraîné dans la direction de contraction.

6. Ensemble de pompage selon l'une des revendications précédentes, **caractérisé en outre en ce qu'**il comporte un ensemble de plongeur (16, 17) pour maintenir une circonférence extérieure du roulement à billes à rangée unique (13) en contact avec une surface cylindrique (15) pour amener ledit roulement à billes à rangée unique (13) à osciller lorsque ledit piston (5) est entraîné en rotation et amène ainsi ledit piston (5) à effectuer un mouvement alternatif une fois pour chaque tour fait par ledit piston (5).

7. Ensemble de pompage selon l'une des revendications 1 à 5, **caractérisé en** outre en ayant une fourche (41) couvrant le bord du roulement à billes à rangée unique (13), où l'extérieur de la fourche (41) a une forme sphérique et peut se déplacer librement dans une douille sphérique ou cylindrique (43) pour amener ledit roulement à billes à rangée unique (13) à osciller lorsque ledit piston (5) est entraîné en rotation, et amener ainsi ledit piston (5) à effectuer un mouvement alternatif une fois pour chaque tour effectué par ledit piston (5).

8. Ensemble de pompage selon l'une des revendications précédentes, **caractérisé en** outre en ayant un moteur électrique (4) avec un arbre (9) agencé sur le premier axe du piston (5) et couplé à celui-ci par un agencement à axe et à fente (8, 12) pour amener ledit piston (5) à tourner tout en permettant audit piston (5) d'effectuer un mouvement alternatif.

9. Ensemble de pompage selon la revendication 2 ou la revendication 3, **caractérisé en outre en ce que** le réservoir (24) est soit une partie intégrale du boîtier (11) de l'ensemble de pompage (10) soit est installé à distance indépendamment d'un boîtier (11) de l'ensemble de pompage (10).

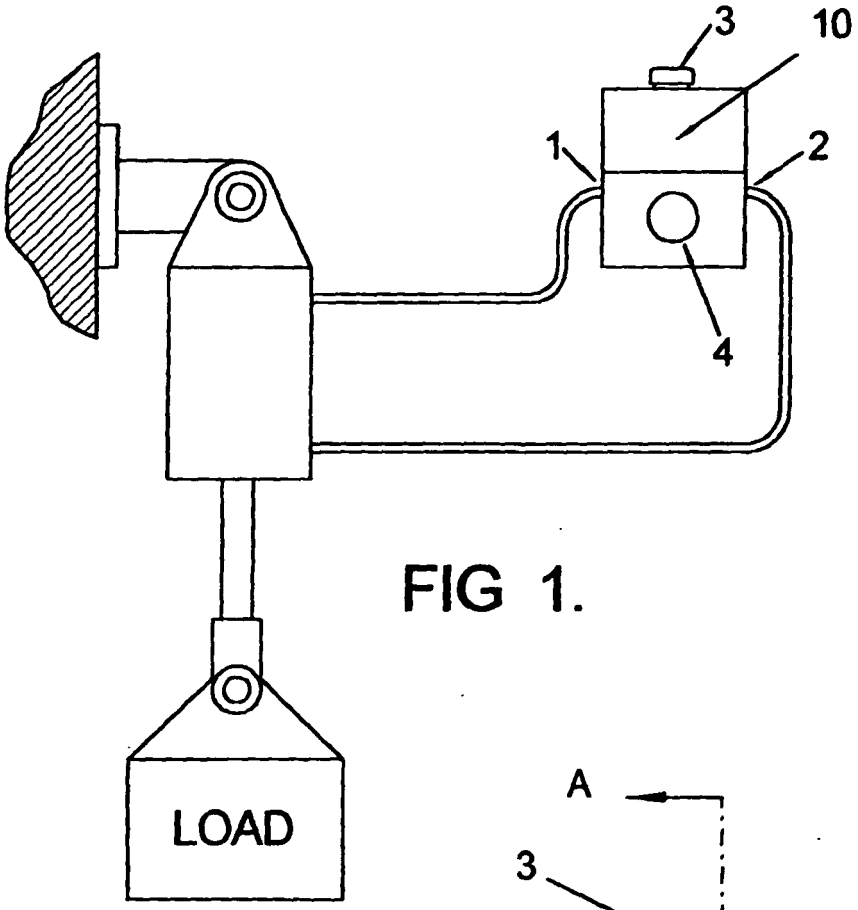
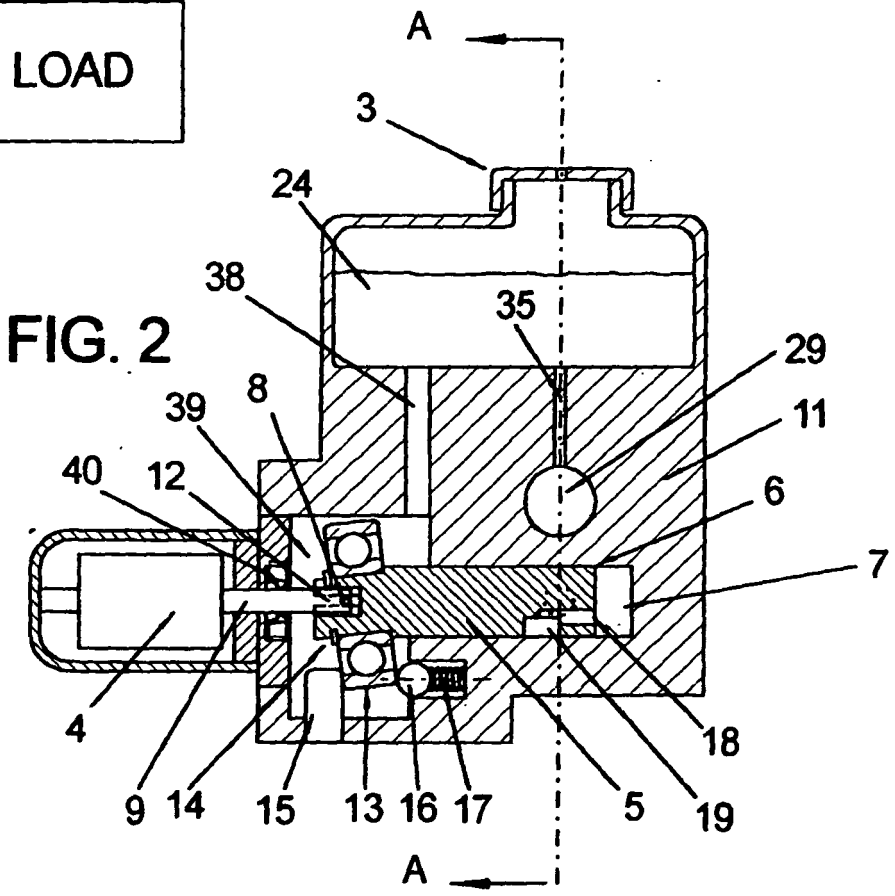


FIG 1.

FIG. 2



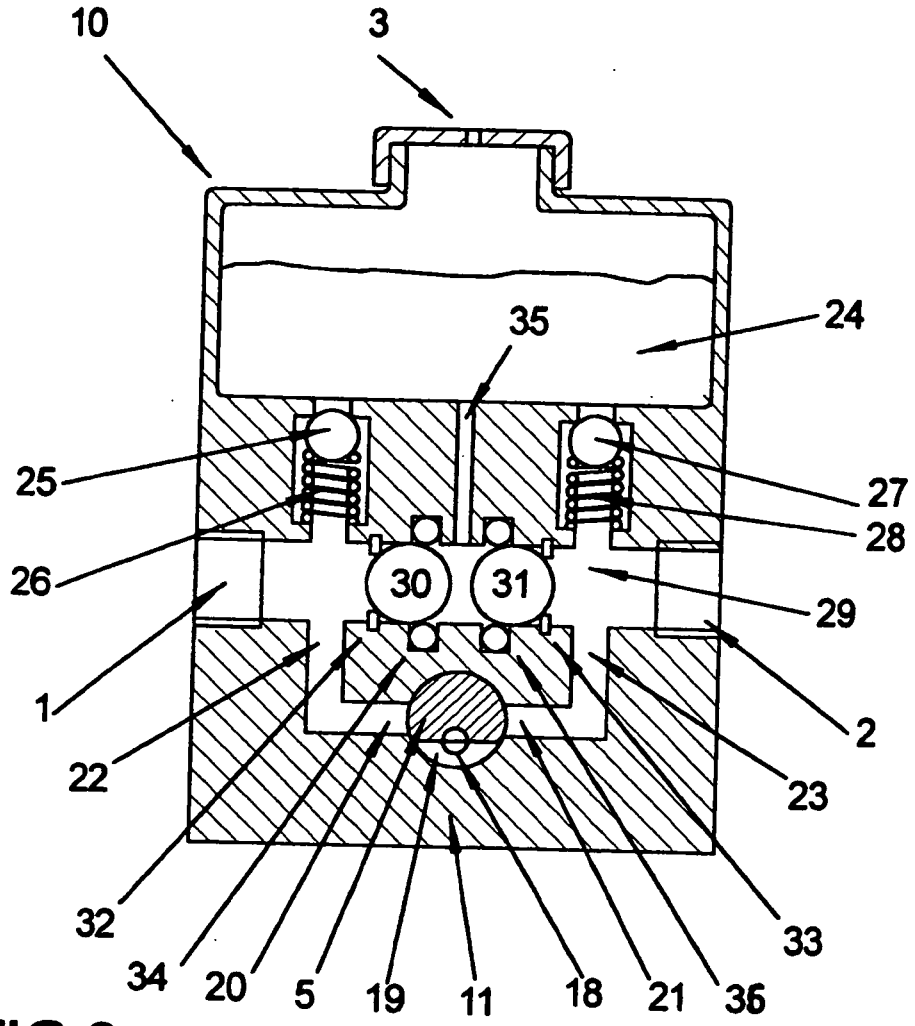


FIG.3

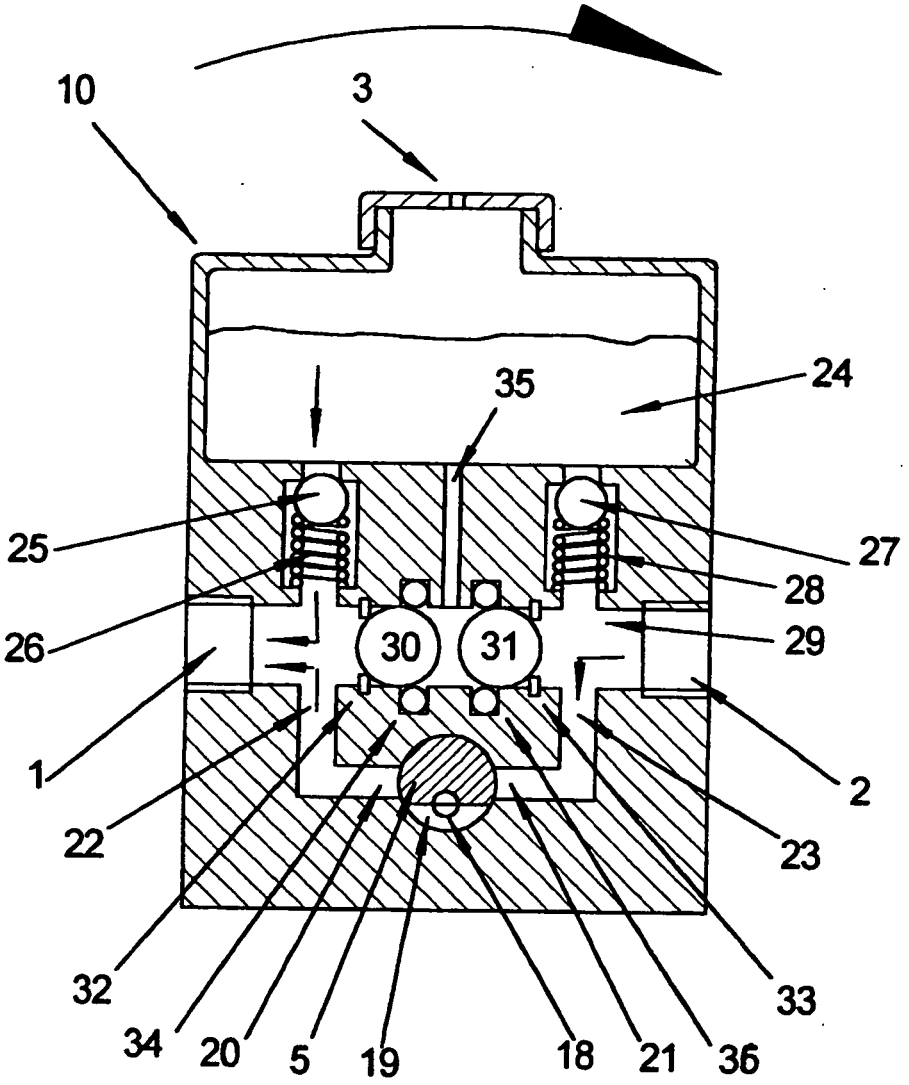


FIG.4

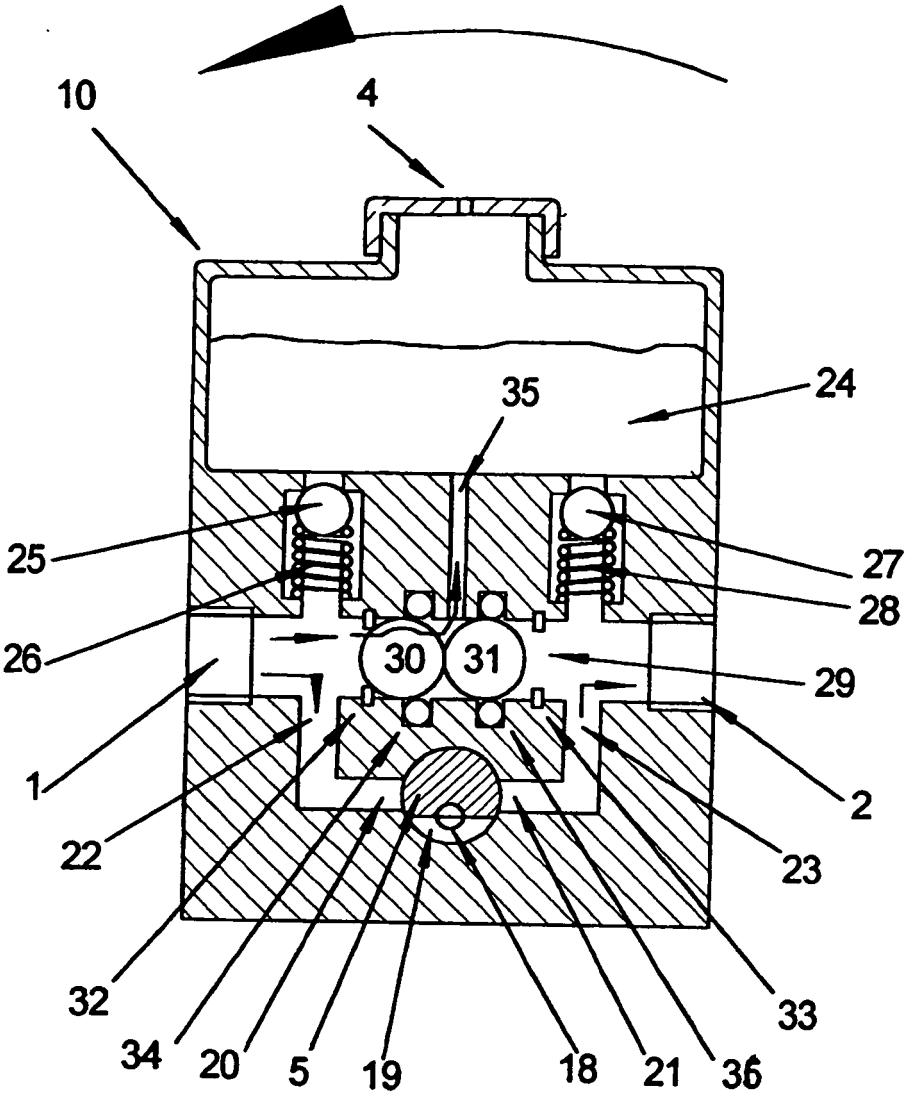

10
4
24
35
25
27
28
26
30
31
29
1
2
22
23
32
33
34
20
5
19
18
21
36

FIG.5

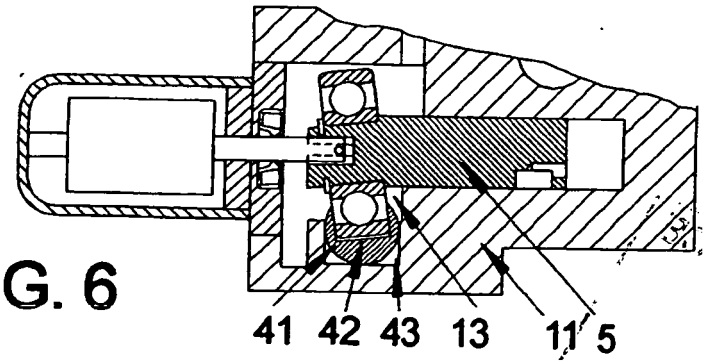

41
42
43
13
11
5

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 3083895 A **[0001] [0007]**
- US 4479759 A **[0007]**
- US 5161491 A **[0007]**
- US 3930762 A **[0007]**
- US 5015157 A **[0007]**
- US 3168872 A **[0007]**
- US 4902208 A **[0007]**