



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
13.05.2009 Bulletin 2009/20

(51) Int Cl.:
F04B 43/02 (2006.01)

(21) Application number: **07120132.1**

(22) Date of filing: **07.11.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
 Designated Extension States:
AL BA HR MK RS

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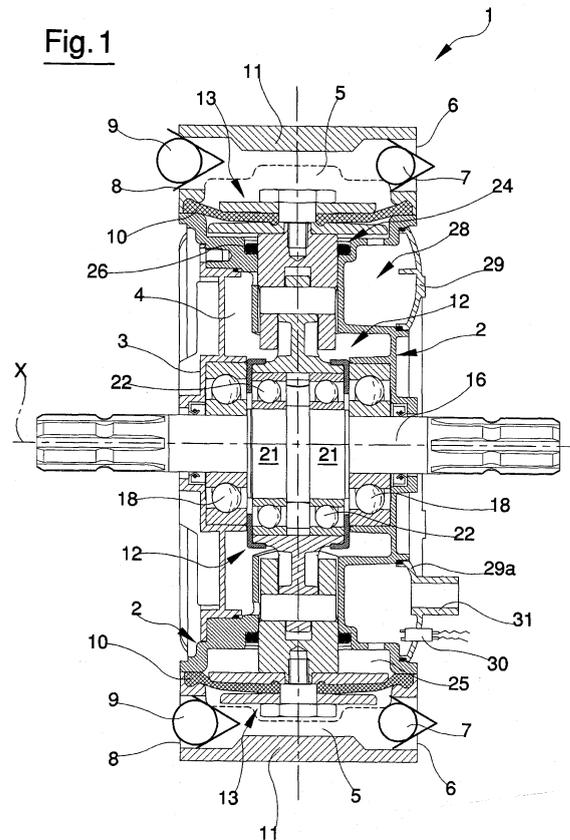
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Remarks:

Amended claims in accordance with Rule 137(2) EPC.

(54) **Pump**

(57) A pump comprises a containing body (2) and a closing flange (3) which define an inner chamber (4) containing a lubricant; at least one main chamber (5) communicating with the inner chamber (4) and comprising an intake mouth (6) and a delivery mouth (8) for a fluid; the main chamber (5) comprising a flexible membrane (10) isolating the main chamber (5) and inner chamber (4) from each other and movable between a first operative position further away from the inner chamber (4) and a second operative position closer to the inner chamber (4); and movement means (12) contained at least partly inside the inner chamber (4) and acting on the movable membrane (10) so as to move the movable membrane (10). The pump also comprises sealing means (24) defining in association with said membrane (10) a cavity (25) situated between the inner chamber (4) and the main chamber (5) and able to isolate said cavity (25) from said inner chamber (4); and at least one hole (27) formed in the containing body (2) opposite the cavity (25) for favouring the fluid communication between the cavity (25) and the exterior of the pump.



Description

[0001] The present invention relates to a pump. In particular the present invention relates to a membrane pump.

[0002] The present invention can be advantageously used in the agricultural and/or gardening sector.

[0003] Membrane pumps consisting of a plurality of chambers intended to pump a fluid are known.

[0004] The arrangement of the chambers may vary depending on the type of pump employed and may have a circumferential, radial or in-line layout. Each pump has a number of pumping chambers which may vary from at least one to a plurality of chambers, each having a movable deformable membrane.

[0005] The said deformable membrane is movable between a first operative position where the same, reaching a top dead centre, favours delivery of a fluid, and a second operative position where the same, reaching a bottom dead centre, favours intake of a fluid.

[0006] The chamber therefore has a variable volume. Each chamber has an inlet opening, which forms the intake mouth, and an outlet opening, which forms the delivery mouth. Both the intake mouth and the delivery mouth are provided with a respective one-way valve.

[0007] Each movable membrane is connected to suitable movement means.

[0008] In an applicational example, these movement means consist of a driving shaft arranged along a central axis of the pump.

[0009] A cam is situated in the vicinity of a central portion of the shaft and has a connecting rod connected thereto. The connecting rod is connected to a piston by means of a pin. The movement means impart an alternating linear movement to the membrane.

[0010] This membrane may be connected directly to the piston or may be connected to a first disk situated between the membrane and the piston. Advantageously the pump also comprises a second disk connected to the membrane and lying entirely inside the chamber, thus defining a movable wall. The second disk facilitates recall of the membrane when the same reaches the bottom dead centre.

[0011] The pumps of the known type also comprise a main containing body for enclosing the movement means. This containing body defines an inner chamber. The movement means are housed inside the inner chamber in a lubricating bath in order to ensure the necessary lubrication of the said means.

[0012] During operation, the piston displaces the membrane from the top dead centre, further away from the inner chamber, to the bottom dead centre, closer to the inner chamber.

[0013] In this way, the volume of the chamber increases and a vacuum is created inside the chamber itself. A fluid then enters from the intake mouth into the chamber through the one-way intake valve.

[0014] When the piston displaces the membrane from

the bottom dead centre, closer to the inner chamber, to the top dead centre, further away from the inner chamber, the volume of the chamber decreases and the fluid is forced out from the delivery mouth through the associated one-way valve.

[0015] In this structural configuration the membrane, being subject to a continuous compression and expansion cycle, may break as a result of wear.

[0016] Since the membrane is the sole separating part between, the lubricant, contained in the inner chamber, and the pumped fluid, contained in the main chamber, the breakage thereof results in mixing of the lubricant and the pumped fluid, causing serious damage to the entire pump and subsequently producing the complete break-down thereof.

[0017] In fact, when the lubricant contained in the inner chamber flows out, following tearing of the membrane, lubrication of the movement means is limited considerably, causing serious damage to the said means.

[0018] Mixing of the lubricant with the pumped fluid also causes contamination of the latter, resulting in a significant wastage of fluid.

[0019] Finally, since the pumping fluids may contain plant protection products or other herbicidal/pesticidal agents, breakage of the membrane results in the concentrated dispersion in the environment of the pumped liquid, causing serious environmental pollution.

[0020] In this context, the technical object of the present invention is to propose a pump which does not possess the disadvantages of the pumps of the prior art.

[0021] In particular, the object of the present invention is to provide a pump in which, following breakage of the membrane, there is no mixing between the lubricating substance and the pumped fluid.

[0022] Another object of the present invention is to provide a pump in which, following breakage of the membrane, the wastage of fluid and at the same time the dispersion thereof is significantly reduced.

[0023] A further object of the present invention is to provide a pump which ensures a constant lubricating efficiency even following breakage of the membrane.

[0024] These objects, together with others, which will emerge more clearly during the course of the following description, are substantially achieved by a pump according to one or more of the accompanying claims.

[0025] Further characteristic features and advantages will appear more clearly from the detailed description of a preferred but not exclusive embodiment of a pump according to the present invention.

[0026] This description will be provided hereinbelow with reference to the accompanying drawings which are provided solely by way of a non-limiting example and in which:

- 55 - Figure 1 shows a cross-section through a pump according to the present invention;
- Figure 2 shows a cross-section through a detail of the pump according to Figure 1.

[0027] With reference to the said figure, 1 denotes overall a pump according to the present invention.

[0028] The pump 1 comprises a containing body 2 and a closing flange 3 which define an inner chamber 4 containing a lubricant.

[0029] The pump 1 also comprises at least one main chamber 5, in communication with the inner chamber 4.

[0030] In general, the pump 1 comprises a variable number of main chambers 5. The latter may be arranged in circular fashion, linearly or in other arrangements. In the embodiment described here, the main chambers 5 are arranged in circular fashion around a central axis "X" of the pump 1 and are spaced equidistantly from each other.

[0031] Each main chamber 5 comprises an intake mouth 6 provided with an associated one-way valve 7 and a delivery mouth 8 provided with an associated one-way valve 9. The fluid which must be pumped flows between the intake mouth 6 and the delivery mouth 8.

[0032] The main chamber 5 also comprises a flexible membrane 10 which isolates the inner chamber 4 and the main chamber 5 itself from each other. Moreover, the membrane 10 is deformable and movable between a top dead centre and a bottom dead centre. In other words, the membrane 10 is movable between a first operative position further away from the inner chamber 4 and a second operative position closer to the inner chamber 4.

[0033] Each main chamber 5 is delimited at the bottom by the membrane 10 and at the top by a head-piece 11 connected to the containing body 2. By way of example, each main chamber 5 has a semispherical shape and the membrane 10 is fixed between the main body 2 and the head-piece 11. In the example shown here, the membrane 10 has a circular shape.

[0034] The main chamber 5 has a variable volume. When the membrane 10 is displaced from the first operative position into the second operative position, a vacuum is created inside the main chamber 5 and draws the fluid inside the pump 1. When the membrane 10 is displaced from the second operative position into the first operative position, an overpressure is created inside the main chamber 5 and pushes the fluid outside the pump 1.

[0035] The pump 1 also comprises movement means 12 which are operationally connected to the membrane 10 and cause displacement of the membrane 10 movable between the first and second operative position. In greater detail, the movement means 12 are connected to a movable wall 13 associated with the membrane 10.

[0036] The movable wall 13 comprises a first disk 14 arranged concentrically with the membrane 10 and situated on the opposite side to the main chamber 5. The movable wall 13 also comprises a second disk 15 arranged concentrically with the membrane 10 and the first disk 14 and contained entirely inside the main chamber 5. In other words, the membrane 10 is arranged between the first disk 14 and the second disk 15.

[0037] In the embodiment described, the movement means 12 comprises a shaft 16 which is associated with

a motor (not shown) and which extends along the central axis "X" and a piston 17 associated with the membrane 10.

[0038] The driving shaft 16 is supported on the containing body 2 and on the closing flange 3 by means of first ball bearings 18. By way of completion of the preferred embodiment of the said movement means 12 a connecting rod 19 is provided, being connected, respectively, to the piston 17, by means of a pin 20, and to a cam 21, by means of second ball bearings 22.

[0039] The movable wall 13 is fixed to the piston 17 by means of a screw 23.

[0040] The pump 1 also comprises sealing means 24 which define at least one cavity 25 in association with the membrane 10. In other words, the cavity 25 is defined by the membrane 10 as well as by the said sealing means 24. Therefore, the pump 1 comprises at least one cavity 25 associated with each main chamber 5.

[0041] The sealing means 24 have the function of isolating the cavity 25 from the inner chamber 4. In this way it is not possible for the pumped fluid to mix with the lubricant in the event of breakage of the membrane 10.

[0042] The sealing means 24 are defined by a seal 26 which is arranged between the containing body 2 and the piston 17 and inside which the piston 17 is seated, in order to isolate the cavity 25 and the inner chamber 4 from each other.

[0043] Moreover, the pump 1 has at least one hole 27 which facilitates the fluid communication between the cavity 25 and the exterior of the pump 1. The hole 27 is formed in the containing body 2 opposite the cavity 25. In greater detail, when the membrane 10 is intact, the hole 27 allows the passage of air which is drawn in or pumped during the movement of the membrane 10. When the membrane 10 is torn, the hole 27 allows the outflow of the pumped fluid which seeps out from the main chamber 5 into the cavity 25. In this way the outflowing fluid is prevented from being able to break the seal 26, thus allowing mixing of the pumped fluid with the lubricant.

[0044] The pump 1 may also have, in the vicinity of the cavity 25, at least one tank 28 for collecting the fluid, communicating therewith via the hole 27. In particular, the pump 1 may comprise at least one tank 28 associated with each cavity 25. Alternatively, the pump 1 may comprise a single tank 28 situated so as to be connected to each cavity 25.

[0045] In the embodiment described here, the tank 28 is formed along a side edge of the containing body 2. In particular, the tank 28 is formed by means of suitable shaping of the containing body 2. The storage tank 28 therefore has an annular shape.

[0046] The tank 28 also comprises a cover 29 which is connected directly to the containing body 2.

[0047] The tank 28 is also associated with a sensor 30 for detecting the presence of fluid in the tank 28.

[0048] This sensor 30 detects the presence of fluid in the tank 28. The sensor 30 is advantageously connected

to an acoustic or visual signalling system (not shown). Therefore, in the event of the membrane 10 associated with one of the main chambers 5 tearing and the tank 28 being filled with fluid, the signalling system signals the breakage of the membrane 10 which has occurred.

[0049] Moreover the storage tank 28 comprises a pipe 31 which prevents the accumulation of fluid in the tank 28. This pipe 31 is formed in the vicinity of a bottom portion 29a of the cover 29.

[0050] The present invention achieves the objects proposed and results in significant advantages.

[0051] First of all, the presence of the sealing means 24 prevents mixing of the pumped fluid with the lubricant contained in the inner chamber 4. In fact, if breakage of the membrane 10 occurs, the pumped fluid which flows out of the main chamber 5 passes into the cavity 25. The seal 26 prevents this fluid from penetrating into the inner chamber 4 and being mixed with the lubricant.

[0052] Consequently, a further advantage which is obtained is that relating to the fact that, owing to the presence of the tank 28, any wastage of the pumped fluid is avoided, preventing moreover the latter from being dispersed into the surrounding environment, causing environmental pollution.

[0053] Moreover, the sealing means 24 and the hole 27 ensure that the lubricant remains confined inside the inner chamber 4 and cannot flow out even following breakage of the membrane 10. In this way, the constant and efficient lubrication of the movement means 12 is ensured.

[0054] Finally, the presence of the sensor 30 allows rapid detection of a breakage of the membrane 10. The operator may therefore take prompt action and limit generally the damage.

Claims

1. Pump comprising:

- a containing body (2) and a closing flange (3) which define an inner chamber (4) containing a lubricant;
- at least one main chamber (5) communicating with the inner chamber (4) and comprising an intake mouth (6) and a delivery mouth (8) for a fluid; the main chamber (5) comprising a flexible membrane (10) isolating the main chamber (5) and inner chamber (4) from each other and movable between a first operative position further away from the inner chamber (4) and a second operative position closer to the inner chamber (4);
- movement means (12) contained at least partly inside the inner chamber (4) and acting on the movable membrane (10) so as to move the movable membrane (10);

characterized in that it comprises

- sealing means (24) defining in association with said membrane (10) a cavity (25) situated between the inner chamber (4) and the main chamber (5) and able to isolate said cavity (25) from said inner chamber (4);
- at least one hole (27) formed in the containing body (2) opposite the cavity (25) for favouring the fluid communication between the cavity (25) and the exterior of the pump.

2. Pump according to Claim 1, **characterized in that** said movement means (12) comprise at least one piston (17) connected, by means of a movable wall (13), to the membrane (10), so as to guide the latter between the first operative position and the second operative position.
3. Pump according to Claim 2, **characterized in that** said sealing means (24) are defined by a seal (26) arranged between the containing body (2) and the piston (17) and seating inside it the piston (17) in order to isolate the cavity (25) and inner chamber (4) from each other.
4. Pump according to Claim 2, **characterized in that** the movable wall (13) comprises a first disk (14) and a second disk (15) placed on opposite sides of the membrane (10); the movable wall (13) being constrained to the piston (17) by means of a screw (23).
5. Pump according to Claim 1, **characterized in that** it also comprises at least one tank (28) for storing the fluid, situated in the vicinity of the cavity (25) and communicating therewith via the hole (27).
6. Pump according to Claim 5, **characterized in that** the tank (28) also comprises a cover (29), the cover (29) also comprising a pipe (31) for preventing the accumulation of fluid inside the tank (28).
7. Pump according to Claim 5, **characterized in that** it also comprises a sensor (30) for detecting the presence of a fluid inside the tank (28).
8. Pump according to Claim 2, **characterized in that** the movement means (12) also comprise a driving shaft (16) arranged along a central axis (X) of the pump (1) and provided with a cam (21) situated in a central portion of the shaft (16).
9. Pump according to Claim 8, **characterized in that** the movement means (12) also comprise at least one connecting rod (19) connected to the piston (17) by means of a pin (20), the connecting rod (19) being connected to the cam (21).

10. Pump according to Claim 1, **characterized in that** it comprises a plurality of main chambers (5) which are angularly spaced equidistantly from each other, the main chambers (5) being connected to the tank (28).

Amended claims in accordance with Rule 137(2) EPC.

1. Pump comprising:

- a containing body (2) and a closing flange (3) which define an inner chamber (4) containing a lubricant;
- at least one main chamber (5) delimited at the bottom by a membrane (10) and at the top by a head-piece (11) connected to said containing body (2) and comprising an intake mouth (6) and a delivery mouth (8) for a fluid; the main chamber (5) comprising said flexible membrane (10) isolating the main chamber (5) and inner chamber (4) from each other and movable between a first operative position further away from the inner chamber (4) and a second operative position closer to the inner chamber (4) ;
- movement means (12) contained at least partly inside the inner chamber (4) and acting on the movable membrane (10) so as to move the movable membrane (10); said movement means (12) comprising at least one piston (17) connected, by means of a movable wall (13), to said membrane (10), so as to guide the latter between the first operative position and the second operative position;

characterized in that it comprises

- sealing means (24) defined by a seal (26) arranged between said containing body (2) and said piston (17) and seating inside it said piston (17); said sealing means (24) defining in association with said membrane (10) a cavity (25) situated between the inner chamber (4) and the main chamber (5) and able to isolate said cavity (25) from said inner chamber (4);
- at least one hole (27) formed in the containing body (2) opposite the cavity (25) for favouring the fluid communication between the cavity (25) and the exterior of the pump.

2. Pump according to Claim 1, **characterized in that** the movable wall (13) comprises a first disk (14) and a second disk (15) placed on opposite sides of the membrane (10); the movable wall (13) being constrained to the piston (17) by means of a screw (23).

3. Pump according to Claim 1, **characterized in that**

it also comprises at least one tank (28) for storing the fluid, situated in the vicinity of the cavity (25) and communicating therewith via the hole (27).

4. Pump according to Claim 3, **characterized in that** the tank (28) also comprises a cover (29), the cover (29) also comprising a pipe (31) for preventing the accumulation of fluid inside the tank (28).

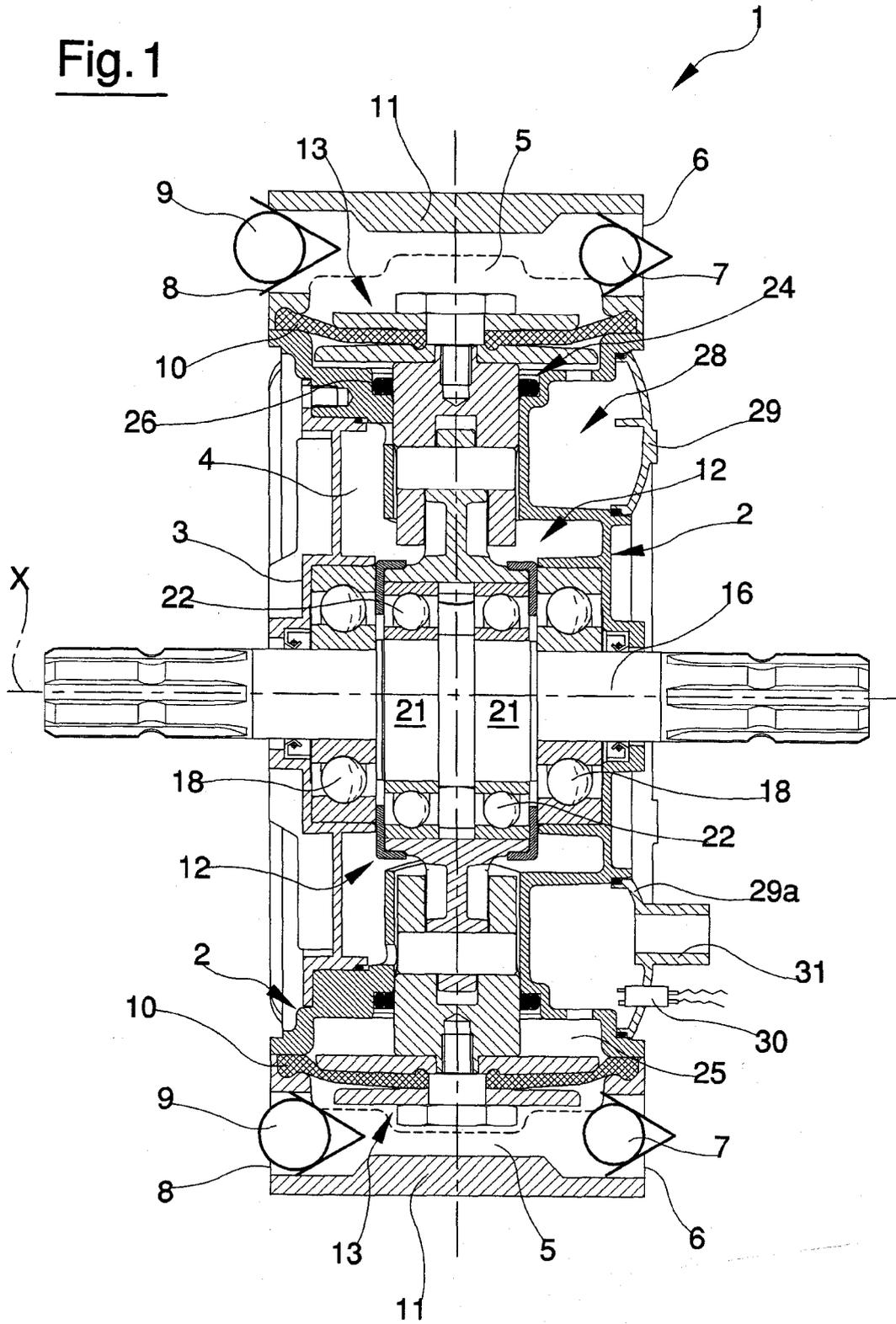
5. Pump according to Claim 3, **characterized in that** it also comprises a sensor (30) for detecting the presence of a fluid inside the tank (28).

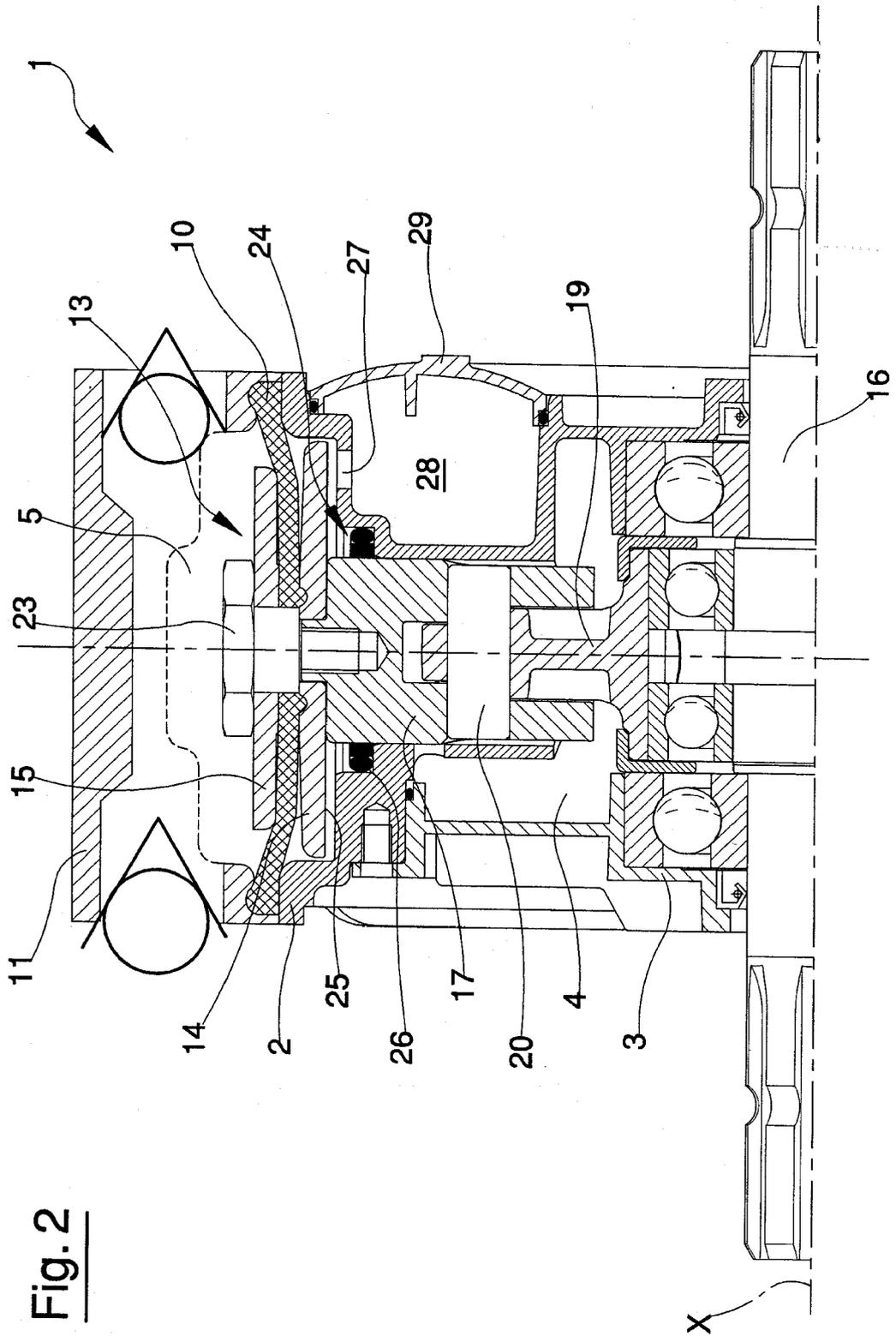
6. Pump according to Claim 1, **characterized in that** the movement means (12) also comprise a driving shaft (16) arranged along a central axis (X) of the pump (1) and provided with a cam (21) situated in a central portion of the shaft (16).

7. Pump according to Claim 6, **characterized in that** the movement means (12) also comprise at least one connecting rod (19) connected to the piston (17) by means of a pin (20), the connecting rod (19) being connected to the cam (21) .

8. Pump according to Claim 1, **characterized in that** it comprises a plurality of main chambers (5) which are angularly spaced equidistantly from each other, the main chambers (5) being connected to the tank (28).

Fig. 1







DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 February 2008	Examiner Pinna, Stefano
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 12 0132

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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