Pumping unit for feeding oil under pressure to a user

A pumping unit for feeding oil under pressure to a user (3) is provided with a gas accumulator (11) having a piston (17), which is slidingly mounted in a cylinder (12), and within the cylinder (12) itself, defines a first chamber (19) containing a gas under pressure and a second chamber (20), which is hydraulically connected to the user (3), and houses a pump (24) therein, having a delivery outlet (29) hydraulically connected to the second chamber.
The present invention relates to a pumping unit for feeding oil under pressure to a user. In particular, the present invention relates to a pumping unit of the type comprising a volumetric pump, preferably a gear pump, having at least one inlet to draw the oil into the pump and at least one outlet to deliver the oil to the user; and a gas accumulator comprising a cylinder and a piston, which is slidingly engaged in the cylinder, and within the cylinder itself, defines a first chamber containing a gas under pressure and a second chamber hydraulically connected to the delivery outlet of the pump by means of a hydraulic duct.

According to the present invention, there is provided a pumping unit comprising a volumetric pump, preferably a gear pump, which is housed within a cylinder, and within the cylinder itself, defines a first chamber containing a gas under pressure and a second chamber hydraulically connected to the delivery outlet of the pump by means of a hydraulic duct. A gas accumulator comprising a cylinder and a piston, which is slidingly engaged in the cylinder, and within the cylinder itself, defines a first chamber containing a gas under pressure and a second chamber hydraulically connected to the delivery outlet of the pump by means of a hydraulic duct.

Figure 1 is an exploded perspective view of a preferred embodiment of the pumping unit according to the present invention; figure 2 is a longitudinal section of the pumping unit in figure 1; and figure 3 schematically illustrates a hydraulic circuit provided with the pumping unit in figures 1 and 2.

With reference to figures 1, 2 and 3, numeral 1 indicates as a whole a pumping unit for feeding oil under pressure from a containment tank 2 at atmospheric pressure to a user 3 comprising, in this case, a cylinder 4 and a piston 5, which is movable within cylinder 4, and defines two chambers 6, 7 within cylinder 4.

Pumping unit 1, tank 2, and user 3 define part of a hydraulic circuit 8 further comprising an over-pressure valve 9, which is mounted between pumping unit 1 and user 3, and is shaped to open when the pressure value of the oil fed to user 3 is substantially equal to a predetermined threshold value, and a solenoid valve 10 movable between a closed position of circuit 8 (figure 3), a first operative position (not shown), in which solenoid valve 10 is arranged so as to allow the pumping unit 1 to feed oil under pressure into chamber 6, and chamber 7 to discharge oil under pressure into tank 2, and a second operative position (not shown), in which solenoid valve 10 is arranged so as to allow the pumping unit 1 to feed oil under pressure into chamber 7, and chamber 6 to discharge oil under pressure into tank 2.

Pumping unit 1 is provided with a gas accumulator 11 comprising a cylinder 12, which has a longitudinal axis 13, and comprises in turn a bell-shaped housing 14, which is coaxial to axis 13, is closed at a first end thereof by a bottom wall 15 substantially perpendicular to axis 13, and is closed at a second end thereof by a substantially cylindrical plate 16 arranged perpendicularly to axis 13.

Accumulator 11 further comprises a piston 17, which is mounted within cylinder 12 coaxially to axis 13, is cup shaped with the concavity facing plate 16, is slidingly coupled to housing 14, and is further fluid-tightly coupled with cylinder 12, by interposing an annular gasket 18 mounted to piston 17 coaxially to axis 13.

Within cylinder 12, piston 17 defines a first chamber 19 which is axially closed by wall 15 and contains a gas under pressure therein, e.g. nitrogen, and a second chamber 20 which is axially closed by plate 16 and hydraulically communicates with user 3 through a delivery hole 21 obtained in plate 16.

Plate 16 is fluid-tightly coupled with housing 14 by interposing an annular gasket 22 mounted to plate 16 coaxially to axis 13, is slidingly coupled to housing 14, and is held within cylinder 12 by a stop ring 23 mounted within housing 14 coaxially to axis 13 and on the opposite side of piston 17 with respect to plate 16.

Pumping unit 1 further comprises a volumetric pump 24, in this case a gear pump, which is housed within chamber 20, and comprises in turn a pump body 25, which is axially closed on one side by plate 16 and on the other side by a substantially cylindrical lid 26 arranged perpendicularly to axis 13, and is mounted to plate 16 by means of two centring pins (not shown) engaged in respective holes 27 obtained in the plate 16 itself, parallel to axis 13.

Pump body 25 hydraulically communicates with tank 2 through a suction hole 28 obtained through plate 16, and hydraulically communicates with chamber 20 through a delivery hole 29 which is obtained, in this case, through lid 26, and cooperates with a check valve 30 (figure 3) adapted to prevent the oil under pressure from returning into the pump body 25.
Pump 24 further comprises an inlet shaft 31, which has a longitudinal axis 32 parallel to axis 13, and extends through plate 16; and a waved spring 33, which is substantially U-shaped, extends about lid 26, and is secured to the lid 26 itself.

When pump 24 is off, piston 17 is displaced, and normally held, by the gas under pressure contained in chamber 19 in a locking position (figure 2), in which piston 17 is arranged in contact with a stop ring 34 mounted between plate 16 and piston 17, coaxially to axis 13, and is further arranged in contact with lid 26 by interposing spring 33 to lock pump body 25 and lid 26 against plate 16.

Upon activating pump 24 and closing solenoid valve 10, chamber 20 is filled with the oil under pressure fed through the delivery hole 29. When the pressure of the oil contained in chamber 20 is higher than the pressure of the gas contained in chamber 19, piston 17 is displaced towards wall 15 from its locking position, so as to reduce the volume of chamber 19, compress the gas contained in chamber 19, and allow accumulator 11 to accumulate potential energy which will then be returned to the hydraulic circuit 8 in the maximum absorption phases of user 3.

Since the cross-section available to the oil within pump body 25 is smaller than the surface of lid 26, the force exerted on lid 26 by the oil contained in chamber 20 is greater than the force exerted on lid 26 by the oil contained in pump body 25, and therefore it ensures pump body 25 and lid 26 to be locked against plate 16.

From the above description, pump 24 is hydraulically connected in series with chamber 20 and user 3, and assembling pump 24 within chamber 20 allows:

- a pumping unit 1 which is relatively simple, compact and cost-effective to be implemented;
- pump body 25 and lid 26 to be simply locked against plate 16 by means of piston 17 when pump 24 is off and by means of the oil under pressure fed into chamber 20 when pump 24 is on; and
- using locking screws and making corresponding holes through plate 16, pump body 25, and lid 26 to be avoided, with the consequent reduction of friction inside pump 24 and the performance increase of pump 24.

Furthermore, the combination of oil under pressure within chamber 20 and gas under pressure within chamber 19 increases the capacity of pumping unit 1 to reduce both the pressure pulsations along the hydraulic circuit 8 and the irregularities in the flow of oil under pressure fed to user 3.

Claims

1. A pumping unit for feeding oil under pressure to a user (3), the pumping unit comprising a pump (24) having at least one suction inlet (28) for the oil into the pump (24) and at least one delivery outlet (29) for the oil to the user (3); and a gas accumulator (11) comprising a cylinder (12) and a piston (17), which is slidingly engaged in the cylinder (12), and defines within the cylinder (12) a first chamber (19) containing a gas under pressure and a second chamber (20) hydraulically connected with the delivery outlet (29) of the pump (24); and being characterised in that the pump (24) is housed within the second chamber (20); the pump (24), the second chamber (20), and the user (3) being hydraulically connected in series to one another.

2. Pumping unit according to claim 1, wherein the cylinder (12) comprises a closing header (16) of the second chamber (20); the pump (24) comprising a pump body (25) arranged between the header (16) and a closing lid (26) of the pump body (25).

3. Pumping unit according to claim 2, wherein the cylinder (12) further comprises stop means (34) adapted to stop the piston (17) in a locking position of the lid (26) and of the body pump (25) against the header (16).

4. Pumping unit according to claim 3, wherein the pump (24) further comprises a waved spring (33) mounted on the lid (26); the piston (17) being arranged in contact with the lid (26) with the interposition of the waved spring (33) upon its displacement in said locking position.

5. Pumping unit according to any of claims 2 to 4, wherein each suction inlet (28) is obtained through the header (16).

6. Pumping unit according to any of claims 2 to 5, wherein the gas accumulator (11) comprises a further delivery outlet (21), which is hydraulically connected with the user (3), and is provided through the cylinder (12) at the second chamber (20).

7. Pumping unit according to any of claims 2 to 6, wherein the pump (24) has an inlet shaft (31) extending through said header (16).

8. Pumping unit according to any of the preceding claims and further comprising a check valve (30) arranged at said delivery outlet (29).
**DOCUMENTS CONSIDERED TO BE RELEVANT**

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<tr>
<td>A</td>
<td>FR 2 157 546 A5 (KLOECKNER HUMBOLDT DEUTZ AG) 1 June 1973 (1973-06-01) * claims 1,2; figure 2 *</td>
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**CLASSIFICATION OF THE APPLICATION (IPC)**

- INV.
- F04C11/00
- F04C2/10

**TECHNICAL FIELDS SEARCHED (IPC)**

- F04B
- F01C
- F04C

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The present search report has been drawn up for all claims

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Date of completion of the search: 3 August 2011  
Examiner: Descobes, Pierre
ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO. EP 11 15 8363

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 03-08-2011.

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For more details about this annex: see Official Journal of the European Patent Office, No. 12/82