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(54) Pumping device for particularly abrasive slurries.

(57) The invention refers to a pumping device for particularly abrasive and aggressive slurries. The device includes a pump body (10) split up into two chambers (21; 22), by a flexible but unstretchable bag (20).

The first chamber (21) contains the abrasive liquid and is equipped with intake and delivery ducts (11, 12) for it, fitted with suitably controlled or automatic valves. The second chamber (22) contains an incompressible and non-aggressive liquid.

In order to achieve the required pumping effect inside the first chamber, there are also means (15) for moving the flexible membrane (20), entailing cyclic variations of its volume, in both directions.

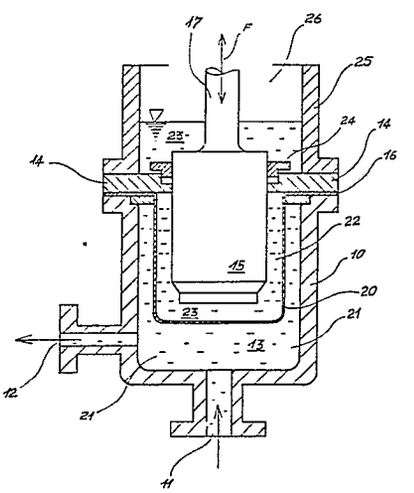

Fig. 1

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Description

Pumping device for particularly abrasive slurries

The pumping of fluids, such as coal-water slurries, which are particularly abrasive, brings up the problem of the life of the pumps used both to provide thrust and for transfer.

Currently the pumps suggested for this type of service, and which have been experimentally tested, are of two types:

- rotary pumps with hardened steel rotors and rubber stators
- plunging piston alternating pumps.

In the first type, because of the high degree of abrasiveness of the fluid, there is rapid decay of both the rotor and the stator which reduces its duration, as a thrust pump, to a few thousand hours only, and this means that it cannot be used for continuous-cycle furnaces or energy-producing plants. The second type has problems concerning wear of the seals, and requires special arrangements for continuous flushing with water.

The purpose of this invention is to overcome these drawbacks by eliminating all contact between the abrasive mixture in question and the reciprocally mobile stiff parts of the pumping device.

According to the invention this aim is achieved by inserting into the body of the pump a sealed flexible bag, so that the inside volume of the pump body is split up into two cavities: the first is connected to the intake and delivery ducts for the abrasive liquid, and it contains no stiff moving parts; the second contains a non-abrasive liquid, such as water, oil, glycerin or another similar liquid; the pumping effect is brought about by means for moving the flexible membrane causing a cyclic variation of the volume of the first chamber in both directions.

According to a first form of embodiment, movement of the flexible membrane is obtained by means of a plunging piston which acts inside said second chamber.

A second form of embodiment calls instead for said second chamber to be connected alternately to means which force in and out the non-abrasive liquid contained in said second chamber.

Figure 1 shows schematically the cross-section of a device according to the preferred form of embodiment of the invention.

Figure 2 shows the cross-section of an alternative form of embodiment of the invention.

With particular reference to figure 1, 10 indicates a pump body equipped with an intake duct 11 and a delivery duct 12 for an abrasive liquid 13. These ducts are fitted with suitable check valves not shown in the drawing.

The pump body 10 is closed at the top by a cover 14 with a central hole fitted with a seal through which a plunging piston 15 passes. Between the cover 14 and the upper edge of the pump body 10 the outer rim 16 of a flexible and sealed bag 20 is tightened to form a seal. The bag thus divides the inside volume of the pump body 10 into two chambers, one outer chamber indicated as 21 in which the abrasive liquid 13 is contained, and one inner chamber, 22, on the same axis as the first, in which a non-abrasive liquid 23 such as water, oil, glycerin and so on is contained. A sealing ring 24 is arranged on top of the cover, around the hole through which the plunging piston 15 passes.

In addition to this, a cylindrical wall 25, fitted above the rim of the pump body 10, creates a tank 26, partly filled with the same liquid 23 contained in the inner chamber 22. The liquid 23 inside the tank 26 functions as a reserve and means of controlling the sealing of the ring 24, as explained further below. During the alternating movement of the piston 15, controlled by a rod 17, the volume of the inner chamber 22 remains constant, due to the flexible nature of the bag 20. As a consequence of this, the alternating movement of the plunging piston 15 will be accompanied by periodical variations in the volume of the outer chamber 21 which, accompanied by a suitable control of the valves of the two ducts 11 and 12, create a pumping effect in the outer chamber. It should be noted that the moving stiff organ, in this instance the plunging piston 15, never comes into contact with the abrasive liquid 13.

The constant volume of the non-aggressive liquid inside the chamber 22, and which is a condition for correct operation, is ensured, in spite of the inevitable leaks through the sealing ring 24, by the liquid contained in the tank 26: with each cycle the chamber 22 is placed in communication with the tank 26 by means of a slight reduction in the diameter of the plunging piston 15, when the piston is at its upper dead centre, allowing compensation of any leaks occurring through said sealing ring during the compression phase.

According to the alternative form of embodiment illustrated in figure 2, again there are a pump body 10, intake and delivery ducts 11 and 12, and the sealed flexible bag 20; there is also a cover 114, through which a rod 117 passes through a sealing ring 124. In this case, too, the inside volume of the pump body 10 is split up into two chambers 21 and 122 by the flexible bag 20. In this case, however, the volume of the inner chamber 122 is not constant but variable, thanks to a duct 30 which cyclically forces in and out of the inner chamber 122 a predetermined quantity of non-abrasive liquid.

For this purpose there is a conventional pump, not illustrated in the drawing, which works continuously and which, through a standard two-position four-way valve feeds the liquid at a pressure into the chamber 122 and alternately sucks it out of the chamber. The rod 117 which passes through the cover 114 ends at the bottom with a plate 115, the sole purpose of which is to accompany and guide movement of the sealed flexible bag 20. The movement of

the rod 117 is used to control reversing of said four-way two-position valve, so as to cause the cyclic variations in the volume of the inner chamber 122 and thus of the outer chamber 21.

The suggested system provides the following advantages as compared to the currently used pumps:

- lack of wear of parts submerged in the aggressive fluid, due to the absence of contact, and therefore of rubbing, between them;
- very limited wear of the pumping element, that is to say the bag 20, on the aggressive fluid side, due to the low relative speeds of the fluid and the bag itself;
- the mechanical resistance of the flexible pumping bag is very high since this is always at a balanced pressure;
- the dynamic seals are of a conventional type, since they come into contact with a non-aggressive fluid;
- ease of maintenance and replacement of worn parts, with consequent reduced stopping times;
- no blowby of the liquid to be pumped from the delivery to the intake;
- possibility of making either high-delivery low-head pumps for transferring or moving large masses or high- head pumps required, for example, for the thrust of coal-water slurry towards the burners.

Some significant variants to the invention are possible, in particular:

- the flexible membrane may be of any shape;
- the membrane may be made of any metallic or non-metallic material;
- the pumping organ for the non-aggressive fluid may be either inside the membrane (as shown in figure 1) or outside it (as shown in figure 2);
- the intake and delivery valves may be automatic or controlled, and may be located either inside the pump body or on line on the relevant pipe-lines;
- the flow rate may be adjustable either by varying the actual average speed of the pumping organ or by varying the travel;
- the pump body may have any number of cylinders and any specific piston displacement;
- the non-aggressive fluid may be any fluid, as long as it is incompressible;
- the power operation of the plunging piston in the version illustrated in figure 1 may be either mechanical (i.e. by means of a connecting-rod and crank) or hydrodynamic, by means of a double-acting thrust circuit;
- the four-way two-position valve in the version illustrated in figure 2 may be of any type and may be fitted either in a fixed position or solid with the central rod, as in servo controls.

Claims

1. Device for pumping particularly abrasive or aggressive slurries, characterized by the fact that it includes a pump body (10) split up into two chambers (21, 22;122) by means of a flexible and unstretchable bag (20); in which:
- the first chamber (21) contains the abrasive liquid (13) and is equipped with intake and delivery ducts (11; 12) for said liquid, fitted with suitably controlled or automatic valves;
- the second chamber (22; 122) contains an incompressible and non-aggressive liquid;
- means (15; 30) are also provided for moving the flexible membrane (20), entailing a cyclic variation of the volume of the first chamber (21), in both directions, creating in this way a pumping effect.

2. Pumping device for particularly abrasive and aggressive slurries, according to the foregoing claim, characterized in that according to a first form of embodiment, it has a plunging piston (15) which acts inside the second chamber (22), causing in this way movement of the flexible membrane (20).

3. Pumping device for particularly abrasive and aggressive slurries, according to claim 2, characterized in that said plunging piston (15) passes through a seal in the wall of the pump body adjacent to the second chamber (22), so that the volume of said second chamber is constant.

4. Pumping device for particularly abrasive and aggressive slurries, according to claims 2 and 3, characterized in that sealing of the plunging piston (15) passing through the wall of the pump body is achieved by means of a sealing ring (24) beyond which there is a tank (26) for the non-abrasive liquid contained in the second chamber (22); in which there are means for connecting said tank and said second chamber, and means for opening said means of connection which intervene when the plunging piston (15) is in the dead centre position corresponding to the end of the suction stage.

5. Pumping device for particularly abrasive and aggressive slurries, according to claim 1, characterized by the fact that in an alternative form of embodiment it has input and suction means (30) respectively of the non-abrasive liquid contained in said second chamber (122), which therefore has a variable volume.

6. Pumping device for particularly abrasive and aggressive slurries, according to claim 5. characterized by the fact that it comprises:
- a pump for said non-abrasive and non-corrosive liquid;
- valve-operated means for connecting said second chamber alternately to the intake and to the delivery of said pump.

7. Pumping device for particularly abrasive and aggressive slurries, according to claims 5 and 6, characterized by the fact that said sealed flexible bag (20) is guided by a plate (115) sustained by a rod (117) which passes through the wall of the pump body in way of the second chamber (122); said rod (117) being suitably connected to said valve-operated means.

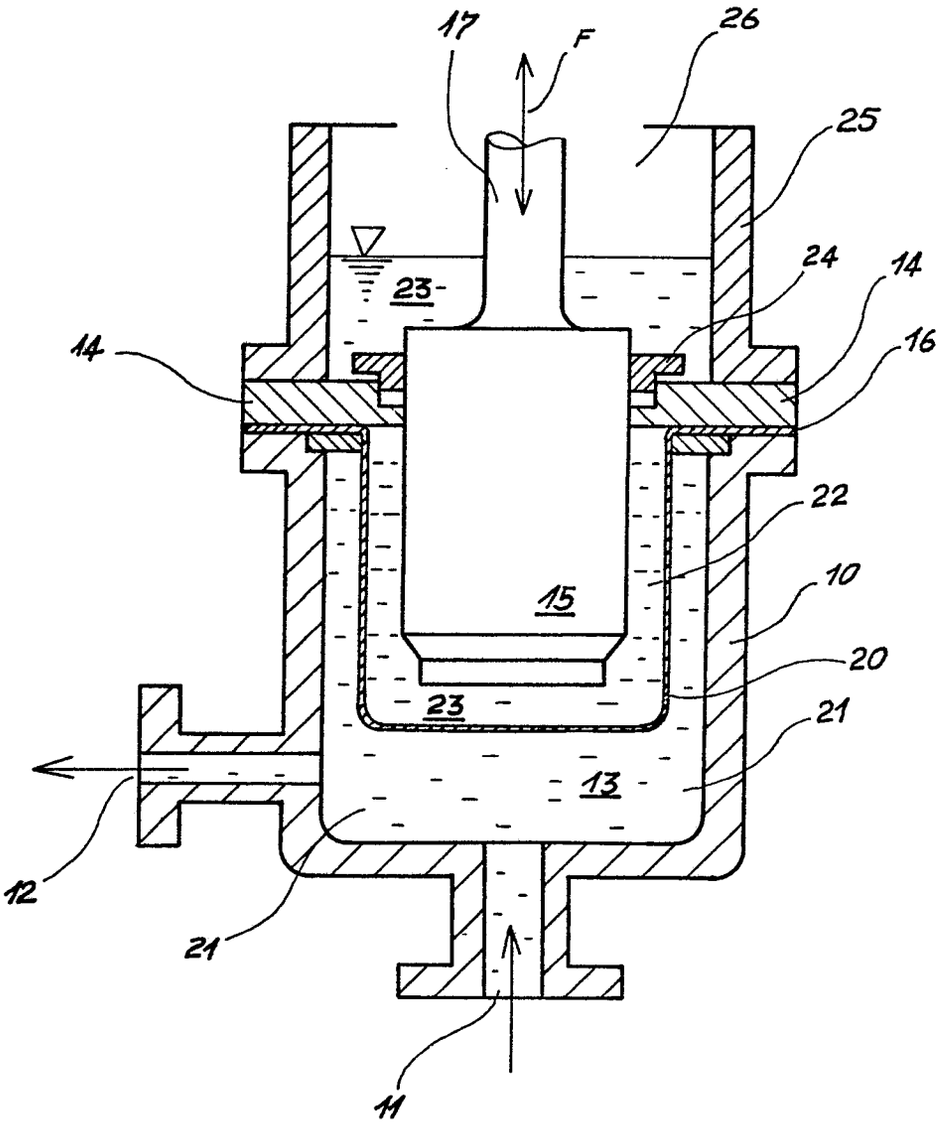

Fig. 1

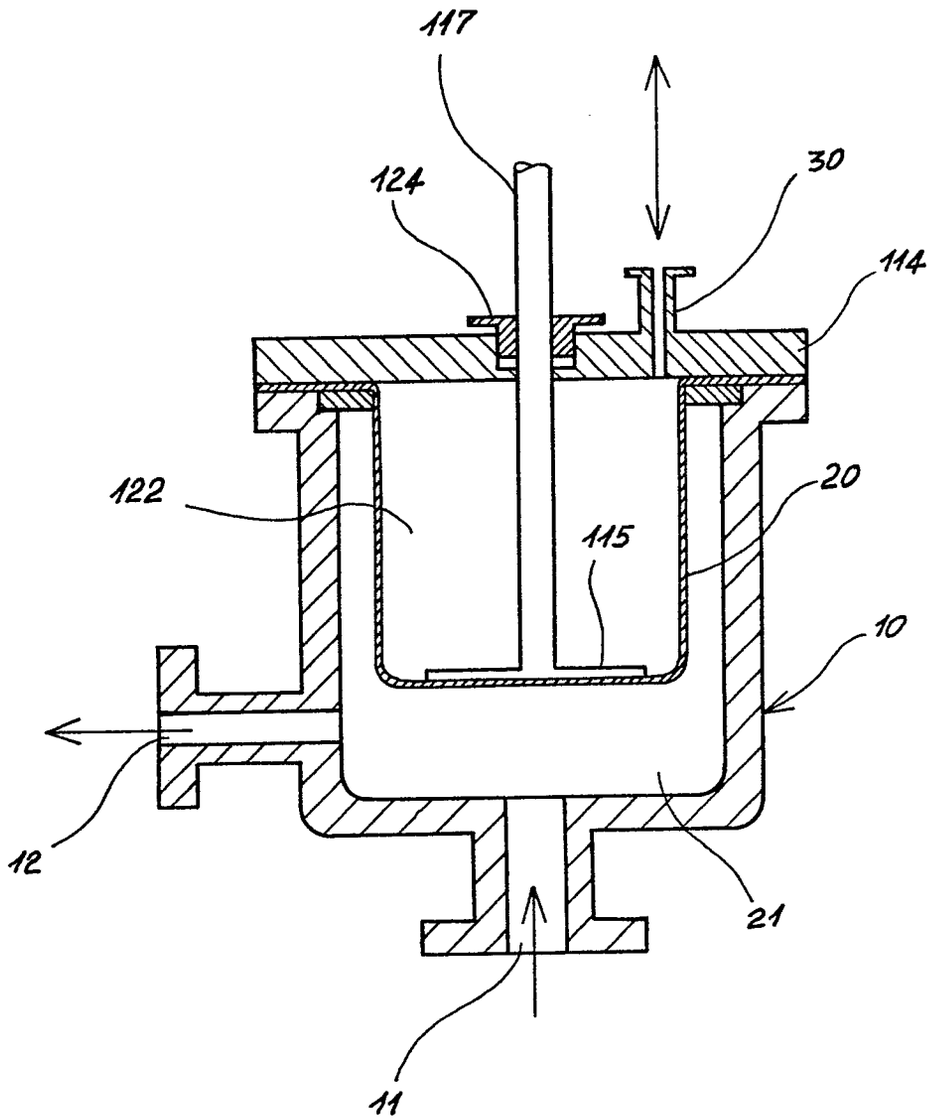

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number

EP 89 83 0355

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A- 597 106 (McCLELLAND) * Page 1, line 54 - page 4, line 6; figures 1-3 *	1-4	F 04 B 43/06
X	GB-A- 875 509 (MILTON ROY CO.) * Page 2, line 7 - page 3, line 64; figure 1 *	1-4	
X	GB-A- 887 774 (SIMPSON) * Page 1, line 9 - page 2, line 54; figures 1-4 *	1,5-7	
X	CH-A- 345 800 (REINERS & CO.) * Page 1, line 24 - page 3, line 10; figures 1-3 *	1,5-7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) F 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-09-1989	VON ARX H.P.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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E : earlier patent document, but published on, or after the filing date
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