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(71) Applicant: **CALPEDA S.p.A.**
I-36050 Montorso Vicentino (VI) (IT)

(72) Inventor: **Matteazzi, Giuliano**
36040 Brendola (VI) (IT)

(74) Representative: **Bonini, Ercole**
Studio Bonini Srl
Corso Fogazzaro, 8
36100 Vicenza (IT)

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(54) **PUMP WITH A PROTECTION UNIT AGAINST WATER HAMMER**

(57) A pump (1) comprising: a pump body (2) having a suctioning mouth (3); a delivery head (5) connected to the pump body (2) and in which a delivery mouth (4) is obtained; a tubular jacket (7) arranged inside the pump body (2) and containing an electric motor (8) and a pumping unit (9); a cover (12) applied on the tubular jacket (7) and comprised between the delivery head (5) and the electric motor (8); an annular body (13) comprised between the cover (12) and the delivery head (5) to delimit a delivery chamber (15) communicating with the delivery mouth (4); a tubular interspace (14) defined between the pump body (2) and the tubular jacket (7) which places the suctioning mouth (3) in communication with the delivery mouth (4) through second flow ways (17) made in the annular body (13). In the annular body (13) there are first connection means (18) configured to axially constrain the annular body (13) and the cover (12) to each other and second connection means (19) configured to axially constrain the annular body (13) and the delivery head (5) to each other.

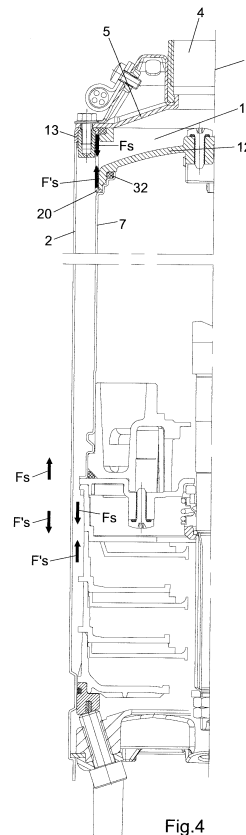


Fig.4

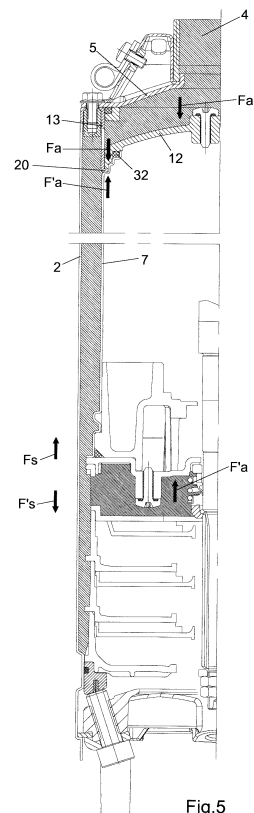


Fig.5

Description

[0001] The invention regards a pump with a protection unit against water hammer.

[0002] It is known that the term water hammer indicates a hydraulic phenomenon which is generated in a conduit traversed by a flowing liquid when the flow is suddenly interrupted by the sudden closure of a valve.

[0003] Similarly, water hammer also occurs when a valve present in the conduit is suddenly opened to create a liquid flow.

[0004] Substantially, water hammer consists in a pressure wave which is generated by the inertia of the fluid column flowing along the conduit when the flow, as mentioned, is suddenly interrupted or opened.

[0005] The maximum pressure value generated by the pressure wave can even reach very high levels and such to even seriously damage the conduits and the hydraulic apparatus that are upstream of the closed valve.

[0006] For example, in case of systems and hydraulic circuits in which there are hydraulic machines, for example pumps, the water hammer affects the pumping unit and can damage it, especially when the pumping unit is made of plastic material.

[0007] Devices and systems are known for protecting systems, hydraulic circuits and hydraulic machines against water hammer which are mainly based on the use of deformable chambers, check valves or expansion chambers which absorb the pressure wave during the propagation thereof upstream of the area in which it was produced, preventing the energy thereof from propagating to the vital and weaker parts of the systems, hydraulic circuits and/or hydraulic machines.

[0008] Though being efficient, such devices reveal however the drawback of being rather expensive and they also often lead to an increase of the overall dimensions.

[0009] As a matter of fact, such devices are aggregated to the systems or hydraulic circuits or hydraulic machines and thus constitute elements which integrate them and which are also subjected to periodic maintenance and/or replacement operations.

[0010] The present invention aims at eliminating these drawbacks.

[0011] In particular, the first object of the invention is to provide a pump provided with a protection unit against water hammer arranged inside the pump and constituting a structural element of the pump.

[0012] Another object of the invention is to provide a pump with smaller overall dimensions with respect to the equivalent pumps without protection against water hammer.

[0013] Another object of the invention is to provide a pump with considerably lower production costs with respect to those of the equivalent pumps without protection against water hammer.

[0014] Last but not least, an object of the invention is to provide a protection unit against water hammer con-

figured to be applied inside a pump.

[0015] The aforementioned objects are attained by the pump of the invention whose characteristics are described in the main claim to which reference shall be made.

[0016] Further characteristics of the invention are described in the dependent claims. Advantageously, given that in the pump of the invention the protection unit against water hammer is integrated in the structure of the pump, specific periodic maintenance is not required, excluding normal maintenance operations to which the pump should be subjected.

[0017] In addition, advantageously, the protection unit against water hammer that is the subject of the invention may be applied on a standard pump with the aim of modifying it and thus making it suitable to be protected against water hammer.

[0018] The aforementioned objects and advantages will be more apparent from the description of a preferred embodiment of the invention provided hereinafter, by way of non-limiting example, with reference to the attached drawings wherein:

- fig. 1 represents the pump of the invention in longitudinal section;
- figs. 2 to 5 represent details of the pump of fig. 1.

[0019] The pump of the invention is represented in longitudinal section in fig. 1 where it is indicated as a whole with **1**.

[0020] It should be observed that the pump is of the submerged type, but generally the description outlined hereinafter may refer to a pump of any type.

[0021] It comprises a pump body **2** in which it is possible to identify a suctioning mouth **3** and a delivery mouth **4**, the latter belonging to a delivery head **5** connected to the pump body **2**, on the opposite side of the suctioning mouth **3** in this specific case.

[0022] A tubular jacket **7** is arranged inside the pump body **2** and it is configured to contain an electric motor **8** and a pumping unit **9** which are connected to each other through a transmission shaft **10**.

[0023] A sealing unit **11** is arranged in a position substantially intermediate to the transmission shaft **10**, and it is contained in the tubular jacket **7** as well and positioned between the electric motor **8** and the pumping unit **9**.

[0024] In this way, in the tubular jacket **7** it is defined a motor housing **8a** in which it is contained the electric motor **8** and a pumping housing **9a** in which it is contained the entire pumping unit **9** including a rotor **9b** and a distributor **9c**.

[0025] A cover **12** is applied on the tubular jacket **7** and it is comprised between the delivery head **5** and the electric motor **8**.

[0026] In addition, there is an annular body **13** which is comprised between the cover **12** and the delivery head **5** so as to delimit a delivery chamber **15** communicating

with the delivery mouth 4.

[0027] Between the pump body 2 and the tubular jacket 7 it is defined a tubular interspace 14 which communicates with the pumping housing 9a through a plurality of first flow ways 16 which, as can be observed, are made according to an annular crown in the tubular jacket 7.

[0028] In addition, a plurality of second flow ways 17 are made in the annular body 13 and they are configured to place the delivery chamber 15 in communication with the tubular interspace 14.

[0029] When the electric motor 8 drives the rotor 9b of the pumping unit 9 in rotation, the fluid, in particular water or any other fluid which can be pumped, is suctioned through the suctioning mouth 3 and, after traversing the pumping unit 9 according to the longitudinal axis Y, reaches the tubular interspace 14 through the first flow ways 16 and thus, passing through the second flow ways 17 obtained in the annular body 13, reaches the delivery chamber 15 and the delivery mouth 4 to be conveyed in the distribution network.

[0030] According to the invention, in the annular body 13 there are first connection means 18 which are configured to axially constrain the annular body 13 and the cover 12 to each other and second connection means 19 which are configured to axially constrain the annular body 13 and the delivery head 5 to each other.

[0031] As regards the first connection means 18, it should be observed, with particular reference to figs. 2 and 3, that they comprise a first annular edge 20 which is projecting towards the inside of the annular body 13 and it is configured to be arranged to cover the corresponding perimeter edge 12a of the cover 12 arranged at the level of the tubular jacket 7.

[0032] In this way, due to the presence of the first annular edge 20 which projects towards the inside of the annular body 13, the latter encloses the cover 12 therein constraining it stably.

[0033] In addition, there is an annular channel 21 which is defined between the cover 12 and the tubular jacket 7 and it is configured to receive the first annular edge 20 after being arranged adhering and covering the corresponding perimeter edge 12a of the cover 12.

[0034] As regards the second connection means 19, they comprise a second annular edge 22 which is projecting towards the outside of the annular body 13 and it has a substantially U-shaped profile.

[0035] This U-shaped profile identifies a concavity 23 facing towards the tubular interspace 14 when the second annular edge 22 is comprised between the cover 12, the pump body 2 and the delivery head 5.

[0036] In addition, in the second annular edge 22 there are through holes 24 which are configured to receive means 25 for fixing the annular edge 22 to the delivery head 5.

[0037] More precisely, the second annular edge 22 comprises a first surface 26 placed against the lateral surface 12b of the cover 12 and a second surface 27, faced and substantially parallel to the first surface 26,

welded in axial head contact with the pump body 2.

[0038] Lastly, a third surface 28 is comprised between the first surface 26 and the second surface 27 and it is substantially orthogonal to both.

5 [0039] In the third surface 28 there are the through holes 24 that are used to house the fixing means 25 of the annular edge 22 against the delivery head 5.

[0040] The delivery head 5 in turn comprises through counter holes 29 which are arranged coaxial to the through holes 24 obtained in the second annular edge 22 and they are configured to receive the fixing means 25.

10 [0041] The latter, in particular, comprise a plurality of screws 30 each of which comprises a manoeuvring head 30a facing towards the outside environment and placed in contact with the delivery head 5 and a threaded shank 30b arranged passing through the through holes 24 and the through counter holes 29 coaxial to each other.

15 [0042] In addition, there are a plurality of holder nuts 31 each of which is housed in the concavity 23 of the second annular edge 22 and receives the coupling of the threaded shank 30b of a corresponding screw 30.

20 [0043] Each holder nut 31 is stably sealingly fixed in the concavity 23, preferably but not exclusively by welding.

25 [0044] At the joining edges of the elements forming the pump and along which the hydraulic sealing is obtained, there are gaskets suitably shaped according to the prior art.

30 [0045] In particular, a gasket of the O-ring type 32 is interposed between the cover 12 and the tubular jacket 7, as observable in the figures.

[0046] Operatively, when the pump 1 is assembled, the fastening of the screws 30 causes the axial compression of the annular body 13 since it is fastened between the delivery head 5, the cover 12 and the tubular jacket 7.

35 [0047] Upon completion of the assembly, the annular body 13 is thus subjected to the two fastening forces F_s and $F's$ equal and opposite to each other observable in fig. 4, which axially compress the annular body 13 according to the longitudinal axis direction Y.

[0048] The same compression forces also act on the pumping unit 9 and the tubular jacket 7, still as observable in fig. 4, while the pump body 2 is stretched by the same forces F_s and $F's$ opposite to each other.

45 [0049] When a pressure wave caused by water hammer acts with a force F_a on the cover 12, as observable in fig. 5, the force F_a , through the first annular edge 20, is transmitted by the cover 12 and by the tubular jacket 7 to the annular body 13 while the reaction thereof $F'a$ is transmitted by the fluid present in the pumping housing 9a to the sealing unit 11.

[0050] In this way, as observable, the annular body 13 is generally discharged.

50 [0051] Thus, advantageously, the thrust F_a due to the water hammer and the reaction thereof $F'a$ do not act on the pumping unit 9, as it otherwise occurs in the embodiments of the know type, but on the annular body 13 which is discharged.

[0052] Thus, it is obtained the object of protecting the internal members of the pump and particularly the pumping unit **9** through a protection unit against water hammer, in this case constituted by the annular body **13**, which is arranged inside the pump and constitutes a structural element of the pump itself.

[0053] In addition, it should be observed that the area of the pump comprised between the cover **12** and the sealing unit **11** is subjected to the compression forces **F_a** and **F'_a** opposite to each other due to water hammer and the annular body **13** is thus substantially floating inside the pump body **2**.

[0054] Simultaneously, the thrust **F_a** due to water hammer compresses the sealing ring **32** arranged between the cover **12** and the tubular jacket **7**, and this facilitates hydraulic sealing.

[0055] According to the above, it is thus clear that the pump of the invention, provided with a protection unit against water hammer, attains all the preset objects.

[0056] First and foremost, it is obtained the main object of the invention which consists in providing a pump provided with a protection unit against water hammer arranged inside the pump and which constitutes a structural element of the pump itself.

[0057] As a matter of fact, the annular body **13**, which constitutes the protection unit against water hammer, is constrained between the delivery head **5** and the cover **12** associated to the tubular chamber which contains the electric motor **8** and the pumping unit **9**.

[0058] It is also obtained the object according to which the pump of the invention provided with a protection unit against water hammer substantially has the same overall dimensions as the equivalent pumps without protection against water hammer.

[0059] Indeed, it has been observed that the annular body **13** has a small axial overall dimension such not to considerably modify the overall dimension of the pump. In addition, the annular body **13** is not subjected to wear or deformations during use and thus it does not require neither to be replaced over time nor to undergo maintenance operations.

[0060] Thus, the pump of the invention only requires to receive standard maintenance operations to which all prior art pumps are subjected to.

[0061] In addition, in presence of water hammer, the entire thrust does not weigh on the pumping unit **9** but discharges on the annular body **13** which even improves the operating conditions thereof since it is discharged by the axial force through which it had been pre-compressed when mounting the pump. As a consequence, in presence of water hammer the structural static conditions of the pump are even improved.

[0062] It is also clear that the annular body **13** may provide for annular edges delimiting it to be variously configured, so as to be stably joined to the delivery head and the cover of the tubular jacket containing the pumping unit of pumps with shapes different from each other, so as to transform any standard operating pump into a pump

of the invention configured with a protection unit against water hammer.

[0063] In the construction stage, the pump of the invention and the protection unit against water hammer with which it is provided may be subjected to modifications not described and not represented herein.

[0064] However, it shall be observed that any modifications, should they fall within the scope of the claims below, shall be deemed all protected by the present patent.

Claims

1. Pump (1) comprising:

- a pump body (2) in which it is possible to identify a suctioning mouth (3) and a delivery mouth (4);
 - a delivery head (5) connected to said pump body (2) and in which said delivery mouth (4) is obtained;
 - a tubular jacket (7) arranged inside said pump body (2) and configured to contain an electric motor (8) and a pumping unit (9) connected through a transmission shaft (10);
 - a sealing unit (11) arranged inside said tubular jacket (7) between said electric motor (8) and said pumping unit (9) to delimit a motor housing (8a) containing said electric motor (8) and a pumping housing (9a) containing said pumping unit (9);
 - a cover (12) applied on said tubular jacket (7) and comprised between said delivery head (5) and said electric motor (8);
 - an annular body (13) comprised between said cover (12) and said delivery head (5) to delimit a delivery chamber (15) communicating with said delivery mouth (4);
 - a tubular interspace (14) defined between said pump body (2) and said tubular jacket (7);
 - a plurality of first flow ways (16) made in said tubular jacket (7) and configured to place said pumping housing (9a) in communication with said tubular interspace (14);
 - a plurality of second flow ways (17) made in said annular body (13) and configured to place said delivery chamber (15) in communication with said tubular interspace (14),
- characterised in that** in said annular body (13) there are first connection means (18) configured to axially constrain said annular body (13) and said cover (12) to each other and second connection means (19) configured to axially constrain said annular body (13) and said delivery head (5) to each other.

2. Pump (1) according to claim 1, **characterised in that** said first connection means (18) comprise a first an-

nular edge (20) projecting towards the inside of said annular body (13) and configured to be arranged to cover a corresponding perimeter edge (12a) of said cover (12) arranged at the level of said tubular jacket (7).

3. Pump (1) according to claim 2, **characterised in that** it comprises an annular channel (21) defined between said cover (12) and said tubular jacket (7) and configured to receive said first annular edge (20).

4. Pump (1) according to any one of the preceding claims, **characterised in that** said second connection means (19) comprise a second annular edge (22) projecting towards the outside of said annular body (13) and having a substantially U-shaped profile which identifies a concavity (23) facing towards said tubular interspace (14), said second annular edge (22) being comprised between said cover (12), said pump body (2) and said delivery head (5), said second annular edge (22) being provided with through holes (24) configured to receive means (25) for fixing said second annular edge (22) to said delivery head (5).

5. Pump (1) according to claim 4, **characterised in that** said second annular edge (22) comprises:

- a first side (26) arranged against the lateral surface (12b) of said cover (12);
- a second side (27) faced and substantially parallel to said first side (26) welded in axial head contact with said pump body (2);
- a third side (28) comprised between said first side (26) and said second side (27) and substantially orthogonal to both, said third side (28) being provided with said through holes (24) to receive said means (25) for fixing said second annular edge (22) against said delivery head (5).

6. Pump (1) according to claim 5, **characterised in that** said delivery head (5) comprises through counter holes (29) coaxial to said through holes (24) and configured to receive said fixing means (25).

7. Pump (1) according to claim 6, **characterised in that** said fixing means (25) comprise:

- a plurality of screws (30) each of which comprises a manoeuvring head (30a) facing towards the outside and placed in contact with said delivery head (5) and a threaded shank (30b) arranged passing through said through holes (24) and said through counter holes (29);
- a plurality of holder nuts (31) each of which is housed in said concavity (23) of said second annular edge (22) and receives the coupling of the threaded shank (30b) of a corresponding screw

(30).

8. Protection unit (13) for protecting a pump (1) against water hammer, said pump (1) comprising:

- a pump body (2) in which it is possible to identify a suctioning mouth (3) and a delivery mouth (4);
- a delivery head (5) connected to said pump body (2) and in which a delivery mouth (4) is obtained;
- a tubular jacket (7) arranged inside said pump body (2) and configured to contain at least one pumping unit (9);
- a transmission shaft (10) configured to connect said pumping unit (9) to an electric motor (8);
- a cover (12) applied on said tubular jacket (7) and comprised between said tubular jacket (7) and said delivery head (5);

said protection unit being **characterised in that** it comprises an annular body (13) configured to be axially comprised between said cover (12) and said delivery head (5) to delimit a delivery chamber (15) communicating with said delivery mouth (4) through a plurality of second flow ways (17) made in said annular body (13), said annular body (13) comprising first connection means (18) configured to constrain said annular body (13) to said cover (12) and second connection means (19) configured to axially constrain said annular body (13) and said delivery head (5) to each other, said first connection means (18) comprising a first annular edge (20) projecting towards the inside of said annular body (13) and configured to be arranged to cover a corresponding perimeter edge (12a) of said cover (12) arranged at the level of said tubular jacket (7).

9. Protection unit (13) according to claim 8, **characterised in that** said second connection means (19) comprise an annular channel (21) defined between said cover (12) and said tubular jacket (7) and configured to receive said first annular edge (20).

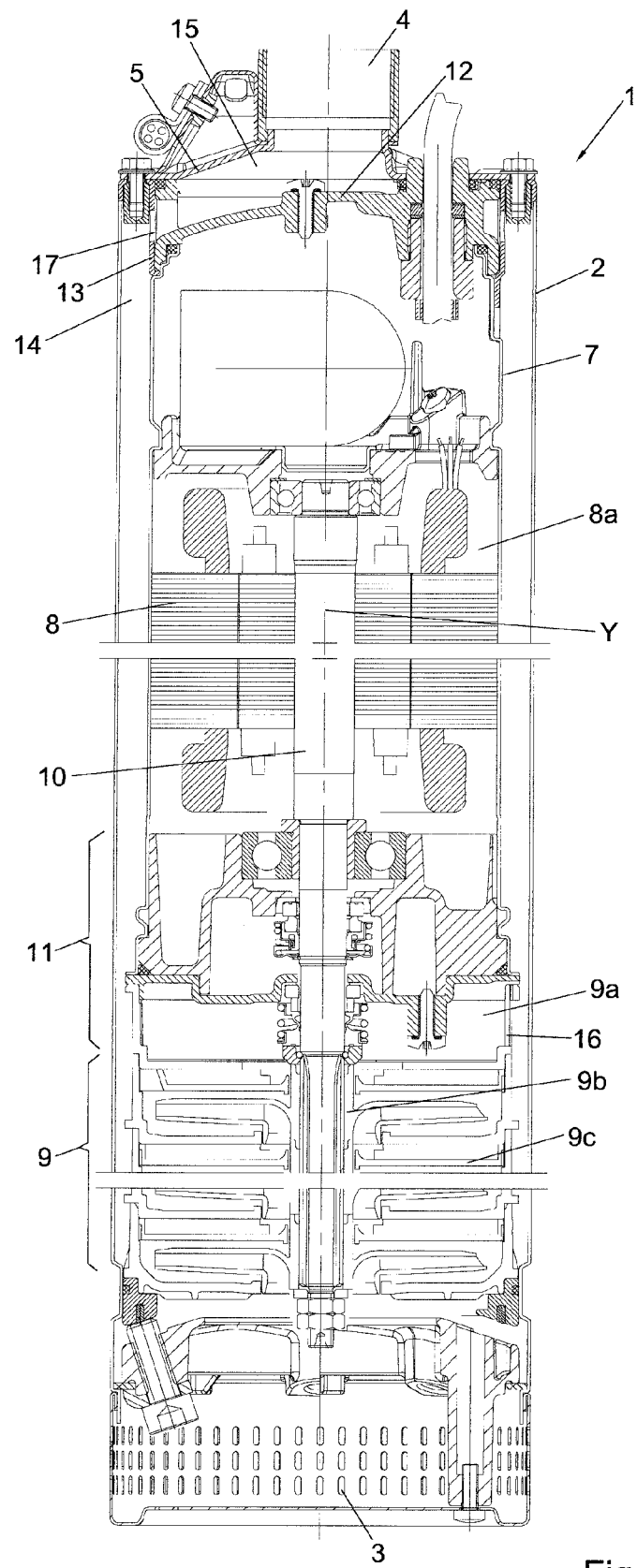


Fig.1

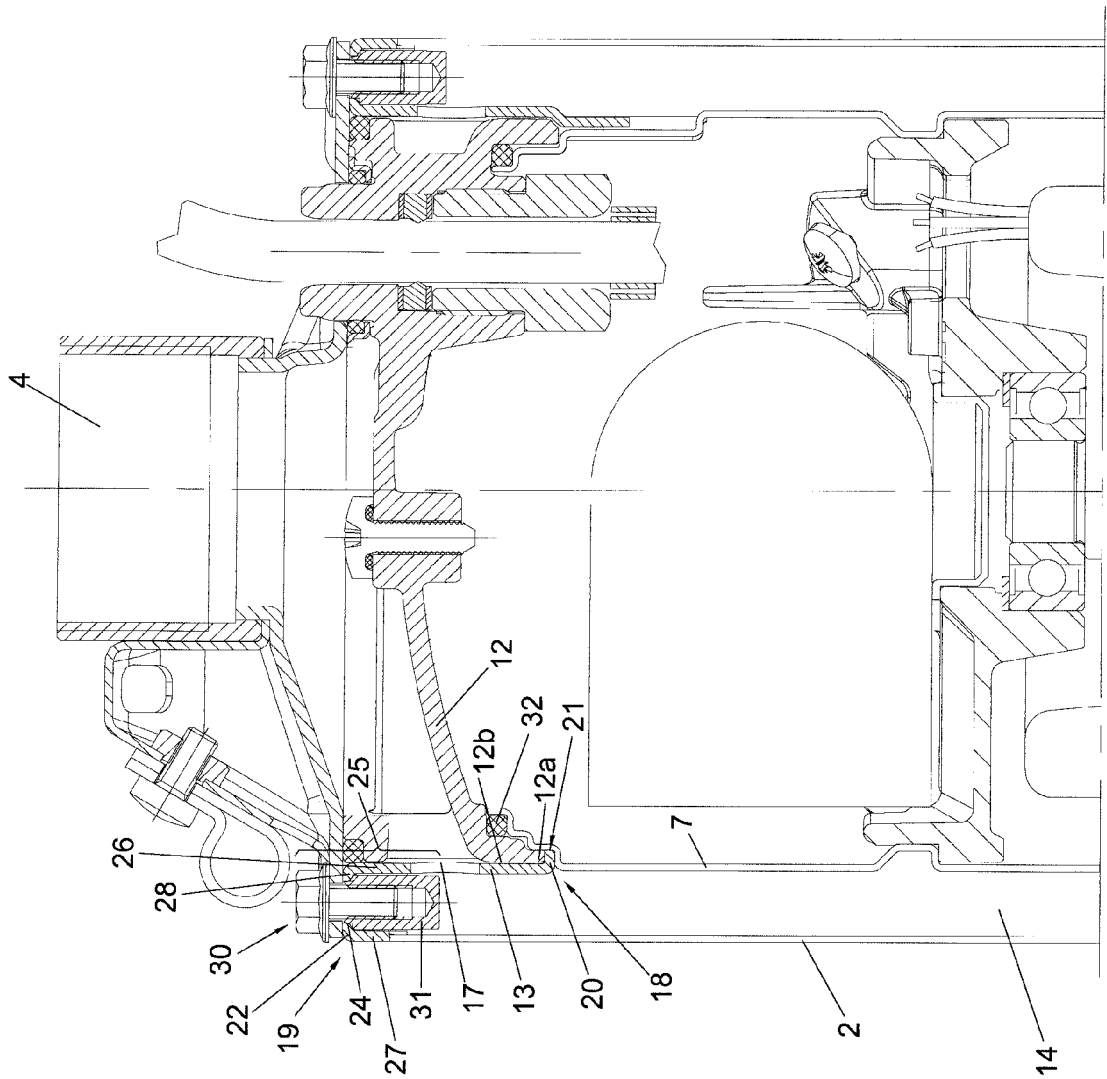


Fig.2

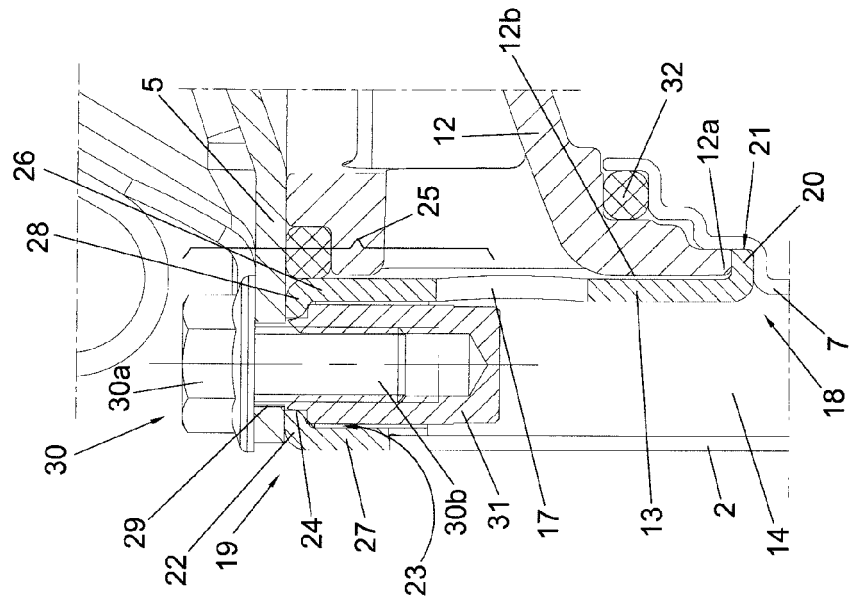
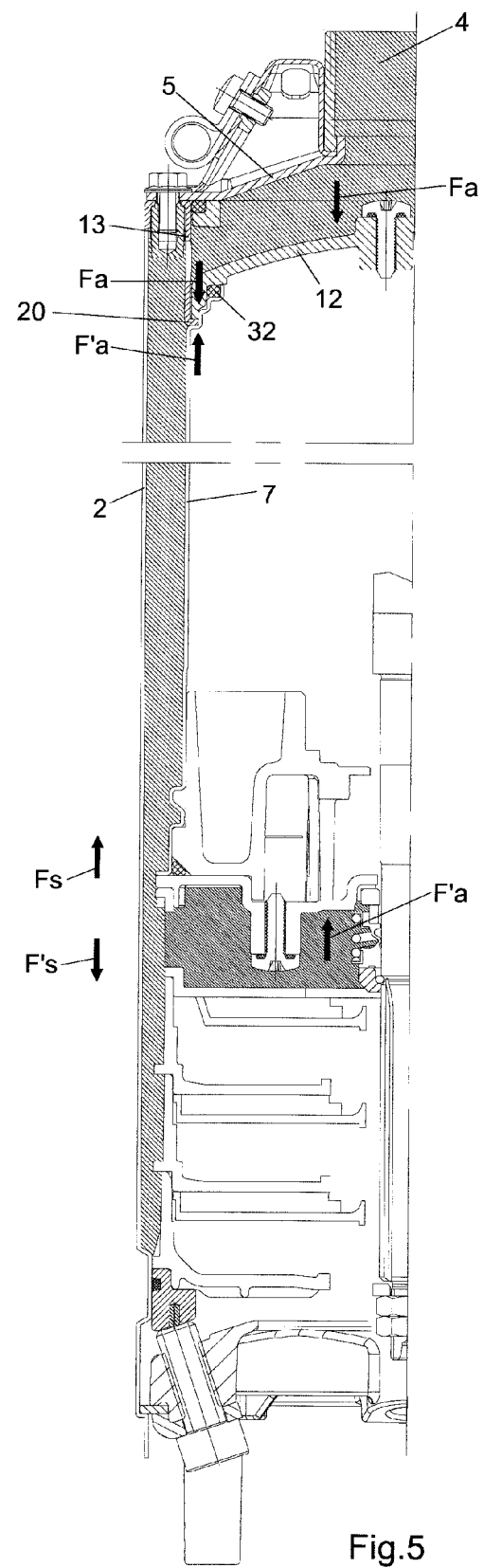
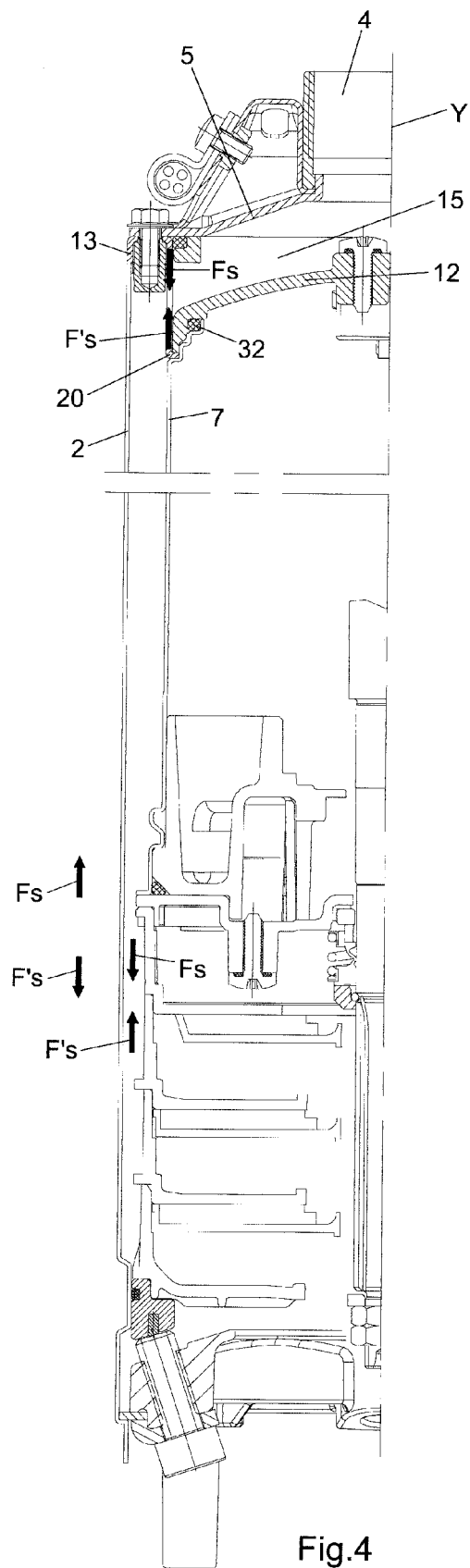


Fig.3





EUROPEAN SEARCH REPORT

Application Number
EP 15 15 9250

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 366 906 A2 (CALPEDA A SPA [IT]) 21 September 2011 (2011-09-21) * figure 5 *	8,9	INV. F04D29/42 F04D13/10 F04D15/00
A	----- US 3 171 355 A (HARRIS JACOB W ET AL) 2 March 1965 (1965-03-02) * figure 2 * * column 2, lines 60-72 * * column 3, lines 60-63 *	1-7	
A	----- US 2 311 963 A (PYLE HOWARD C) 23 February 1943 (1943-02-23) * figures 4,5 *	1-8	
A	----- EP 1 006 282 A2 (GEP UMWELTTECHNIK GMBH [DE]) 7 June 2000 (2000-06-07) * the whole document *	1-8	

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F04D
Place of search		Date of completion of the search	Examiner
The Hague		16 July 2015	Brouillet, Bernard
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		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 15 15 9250

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
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16-07-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2366906 A2	21-09-2011	CN 102192123 A EP 2366906 A2	21-09-2011 21-09-2011
US 3171355 A	02-03-1965	NONE	
US 2311963 A	23-02-1943	NONE	
EP 1006282 A2	07-06-2000	DE 19855845 A1 EP 1006282 A2	08-06-2000 07-06-2000

EPO FORM P0459

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