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(54) CENTRIFUGAL MOTOR PUMP

(57) Centrifugal motor pump (1) comprising: a first casing (2) which delimits a pumping chamber (3) and which is provided with an inlet mouth (4), an outlet mouth (5) and a first through opening (6); a motor (7) enclosed in a second casing (8) provided with a second through opening (9) facing the first through opening (6); a third casing (10) delimiting an intermediate chamber (11) interposed between the first through opening (6) and the second through opening (9) and placing them in communication with each other; a rotor (12) arranged in the pumping chamber (3); a shaft (13) arranged through the first through opening (6), the second through opening (9) and the intermediate chamber (11), wherein the shaft connects the rotor (12) to the motor (7) in order to set the former rotating and cause the liquid to flow according to a corresponding direction of flow; a recirculation duct (14) communicating at its first end (15) with the intermediate chamber (11) and at its second end (16) with the inlet mouth (4) in order to convey a liquid present in the intermediate chamber (11) towards the inlet mouth (4).

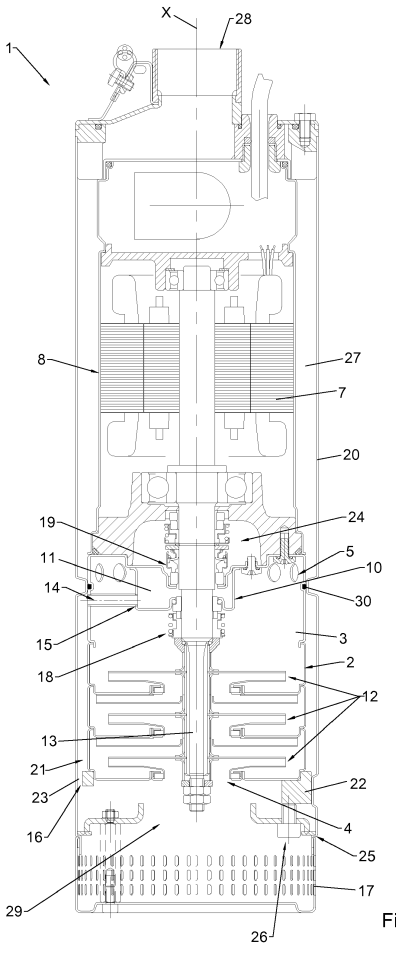

Fig.1

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Description

[0001] The present invention concerns a centrifugal motor pump particularly suitable for pumping liquids containing solid impurities and provided with an intermediate chamber which separates the pumping area from the motor area. In general, a centrifugal motor pump of the known type comprises a casing that defines a pumping chamber, wherein said pumping chamber communicates with the outside through an inlet mouth and an outlet mouth.

[0002] In the pumping chamber there is a rotor unit which, when it is set rotating, draws a liquid, generally water, from the outside of the pump through the inlet mouth and conveys it towards the outlet mouth.

[0003] The rotor unit is set rotating by a motor, through a shaft that projects from the motor casing and passes through a through opening provided in the casing that defines the pumping chamber. A sealing device interposed between the through opening and the shaft avoids leakages of the pumped liquid through the through opening itself.

[0004] Centrifugal motor pumps are known which are configured in such a way that they can be immersed in the liquid.

[0005] A pump of the type mentioned above is described in the patent document EP 2 916 008.

[0006] These motor pumps, which can be distinguished between "submersible" and "submerged" depending on their use, in any case are structured in such a way as to prevent the pumped liquid from getting into the motor.

[0007] According to a known embodiment, the motor comprises a chamber which surrounds the shaft and is filled with oil. A mechanical seal arranged in said oil-filled chamber prevents the oil from flowing out of the chamber and the pumped liquid from getting into it.

[0008] The embodiment just described above poses the drawback that, owing to the higher pressure present in the pumping chamber, small quantities of liquid leak through the mechanical seal of the pumping chamber and are pushed into the oil-filled chamber. The latter becomes filled with liquid over time and this ends up with affecting the correct operation of the motor.

[0009] In order to avoid the drawback described above, in a different known embodiment there is an intermediate chamber which is suited to separate the pumping chamber from the oil-filled chamber. Said intermediate chamber is open towards the external environment, in such a way that the pressure inside it is equal to the external pressure. In this way, the leakages through the mechanical seal of the pumping chamber are discharged outside the motor pump and, therefore, do not affect the operation of the motor.

[0010] However, a drawback posed by the embodiment just described above lies in that during the periods of inactivity of the motor pump the intermediate chamber, being open towards the outside, can be filled with sediments present in the surrounding liquid. Said sediments are frequently present especially in the operating conditions of submersible or submerged motor pumps and tend to solidify and form encrustations over time. These encrustations limit the functionality of the intermediate chamber and sometimes may even impair it completely.

[0011] The patent document WO03/056185 is known, which describes a motor pump provided with an intermediate chamber and with a drainage duct communicating with the environment outside the pump.

[0012] The motor pump described in the document mentioned above has the limitation that it is not suitable for pumping liquids with solid impurities suspended inside them, since the impurities flow through the drainage duct, thus finding their way into the intermediate chamber, especially during the periods of inactivity of the pump itself.

[0013] It is the object of the present invention to overcome all the drawbacks of the known art described above.

[0014] In particular, it is the object of the present invention to provide a centrifugal motor pump which is suitable for submersion, in particular submersible or submerged, and capable of preventing the pumped liquid from getting into the motor in a more effective way compared to the motor pumps of the known type.

[0015] Said object is achieved by a centrifugal motor pump made according to the main claim.

[0016] Further characteristics and details of the invention are described in the corresponding dependent claims.

[0017] The object described above, together with other advantages of the invention, is highlighted in the following description of a preferred embodiment of the motor pump of the invention, which is provided by way of non-limiting example with reference to the attached drawings, wherein:

- Figure 1 shows a longitudinal sectional view of the motor pump according to the invention;
- Figure 2 shows an enlarged detail of the motor pump illustrated in Figure 1. The centrifugal motor pump which is the subject of the invention and is indicated as a whole by the reference number 1 is particularly suitable for pumping liquids containing solid impurities that tend to sediment and generate encrustations.

[0018] Therefore, the motor pump **1** is particularly suited to be used for lifting water from wells and/or tanks, and also for the circulation of industrial liquids, or for analogous applications.

[0019] The motor pump **1** comprises a first casing **2** that delimits a pumping chamber **3** which houses a plurality of rotors **12** arranged in series.

[0020] Obviously, variant embodiments of the invention, which are not illustrated in the drawings, may be provided with a number of rotors **12** different from that shown in Figure 1, even with one rotor only.

[0021] The first casing **2** is provided with an inlet mouth **4** suited to allow the pumped liquid to flow into the pumping chamber **3** and with an outlet mouth **5** suited to allow the same liquid to flow out of the pumping chamber **3.**

[0022] The rotor **12** is set rotating by a motor **7,** enclosed in a second casing **8** which prevents the liquid in which the motor pump **1** is immersed from penetrating in the motor **7.**

[0023] The connection between the rotor **12** and the motor **7** is obtained by means of a shaft **13** which defines a longitudinal axis **X.** The shaft **13** is arranged through a first through opening **6** provided in the first casing **2,** distinct from the inlet mouth **4** and from the outlet mouth **5,** and through a second through opening **9** provided in the second casing **8,** arranged so that it faces said first through opening **6.**

[0024] Preferably, there is a first sealing device **18** interposed between the shaft **13** and the first through opening **6,** which prevents the pressurized liquid present in the pumping chamber **3** from flowing out through the first through opening **6** during the operation of the motor pump **1.**

[0025] Preferably, the motor pump **1** comprises also a second sealing device **19** interposed between the shaft **13** and the second through opening **9.** Preferably, the first sealing device **18** and/or the second sealing device **19** comprise a mechanical seal.

[0026] Still preferably, the second sealing device **19** comprises an oil-filled chamber **24** which separates the second through opening **9** from the motor **7** and which is closed by said second sealing device **19.** Advantageously, the oil-filled chamber **24** hinders the penetration of the liquid that should leak through the second sealing device **19** into the motor.

[0027] The motor pump **1** comprises also a third casing **10,** visible in greater detail in Figure 2, which delimits an intermediate chamber **11** that separates the first through opening **6** provided in the first casing **2** from the second through opening **9** provided in the second casing **8** and places them in communication with each other. Said intermediate chamber **11** houses the section of the shaft **13** included between the two through openings **6** and **9,** in such a way that the pumping chamber **3,** the intermediate chamber **11** and the space inside the second casing **8** form a single interconnected volume.

[0028] Advantageously, the intermediate chamber **11** allows the release of the pressurized liquid that leaks through the first through opening **6,** preventing the liquid from penetrating in the second casing **8.**

[0029] Preferably, the third casing **10** is tightly associated with the first casing **2,** for example through a welding operation or through any other known means. Obviously, in variant embodiments of the invention the third casing **10** can be integral with the first casing **2.**

[0030] According to the invention, the motor pump **1** comprises a recirculation duct **14** developing between a first end **15,** which communicates with the intermediate chamber **11,** and a second end **16,** which communicates with the inlet mouth **4.**

[0031] It can be understood that the recirculation duct **14** allows the liquid present in the intermediate chamber **11** to be conveyed directly into the inlet mouth **4,** with no need to open the intermediate chamber **11** towards the outside of the motor pump **1.**

[0032] In this way, the intermediate chamber **11** is not provided with openings placing it in direct communication with the environment outside the motor pump **1,** which prevents the liquid in which the motor pump **1** is immersed from sedimenting in the intermediate chamber **11** during the periods of inactivity of the motor pump **1.**

[0033] Since said sediments would obstruct the outlet duct of the intermediate chamber **11** and would limit the functionality of the latter, favouring the flow of the liquid into the second casing **8,** it can be understood that the motor pump **1** described up to now prevents the flow of the pumped liquid into the motor **7** in a more effective way than the motor pumps carried out according to the known art, thus achieving the object of the invention.

[0034] In particular, since during the operating phase the intermediate chamber **11** comes to be positioned above the inlet mouth **4,** the recirculation duct **14** is oriented downwards, thus preventing the solid impurities from reaching the intermediate chamber **11.** Preferably, the aspect just described above is further improved by directing the second end **16** of the recirculation duct **14** downwards.

[0035] Preferably, the motor pump **1** comprises a filtering element **17** positioned upstream of the inlet mouth **4** according to the direction of advance of the liquid flowing through the inlet mouth **4** itself. Advantageously, the filtering element **17** prevents solid impurities from getting into the pumping chamber **3** and, consequently, even into the intermediate chamber **11,** thus also preventing the liquid present in the motor pump **1** from sedimenting in the intermediate chamber **11** during the periods of inactivity of the motor pump **1** and further increasing the efficiency of the invention.

[0036] Preferably, the second end **16** of the recirculation duct **14** is positioned downstream of the filtering element **17** according to the direction of flow of the liquid through the filtering element **17.**

[0037] Advantageously, this prevents the solid impurities from moving back from the outside of the motor pump **1** into the intermediate chamber **11** through the second end **16,** thus further increasing the efficiency of the invention. Preferably, the motor pump **1** comprises a tubular jacket **20** which accommodates the first casing **2.** Advantageously, the tubular jacket **20** makes it possible to maintain the integrity of the first casing **2** when this is made up of a plurality of elements stacked on top of one another in the axial direction, as in the case of modular multistage motor pumps. In fact, it is possible to maintain said elements compressed on the motor **7** through a thrusting device **26** which rests on conveniently shaped parts **25** of the tubular jacket **20.** Preferably, an intermediate space **21** is obtained between the first casing **2** and

the tubular jacket **20,** wherein said intermediate space defines a part of the recirculation duct **14.** Advantageously, making the recirculation duct **14** in the manner just described above makes it possible to exploit the presence of the tubular jacket **20** to define a part of the recirculation duct **14,** with no need to use additional pipes.

[0038] Preferably, the tubular jacket **20** and the first casing **2** are both cylindrical and coaxial with the shaft **13.** Still preferably, the inner diameter of the tubular jacket **20** is larger than the outer diameter of the first casing **2,** in such a way as to define a hollow space which corresponds to said intermediate space **21.** Still preferably, an annular element **22** belonging to the thrusting device **26** is interposed between the tubular jacket **20** and the first casing **2** and ensures the mutual centering of the two components, in addition to maintaining the elements compressed as described above.

[0039] Preferably, the passage of the liquid from one side of the annular element **22** to the other is ensured by channels **23** obtained between the tubular jacket **20** and the annular element **22.** Preferably, said channels **23** are obtained through corresponding corrugations of the tubular jacket **20** facing the annular element **22.** In a variant embodiment of the invention not represented in the drawings, said channels **23** can be obtained also through grooves and/or holes made in the annular element **22.**

[0040] Preferably, the suction mouth **29** of the motor pump **1** is defined by one end of the tubular jacket **20.** Still preferably, the filtering element **17** is associated with said end of the tubular jacket **20.**

[0041] Preferably, the tubular jacket **20** contains also the motor **7** with the second casing **8,** which is preferably cylindrical.

[0042] Preferably, the outer diameter of the second casing **8** is smaller than the inner diameter of the tubular jacket **20,** in such a way that a hollow space **27** is defined between the two elements, wherein said hollow space at one end communicates with the outlet mouth **5** of the pumping chamber **3** and at the opposite end communicates with the delivery mouth **28** of the motor pump **1.** Advantageously, the flow of the pumped liquid through said hollow space **27** makes it possible to cool down the motor **7.**

[0043] Still advantageously, the fact that the motor **7** and the pumping chamber **3** are both contained in the tubular jacket **20** and that the suction mouth **29** and the delivery mouth **28** correspond to the two ends of the tubular jacket **20** makes the motor pump **1** particularly suitable for use in a well.

[0044] Preferably, in the hollow space **27** there is a sealing gasket **30,** even more preferably of the O-ring type, which prevents the return of the liquid from the outlet mouth **5** of the pumping chamber **3** towards the inlet mouth **4** through the recirculation duct **14.**

[0045] As regards the outlet mouth **5,** this is preferably defined by a plurality of holes obtained in the lateral cylindrical surface of the first casing **2** and distributed along its entire circumference, which advantageously allow the pumped liquid to effectively flow from the pumping chamber **3** into the hollow space **27.**

[0046] According to a variant embodiment not represented in the drawings, the tubular jacket **20** comprises a through hole communicating with the intermediate space **21.** Advantageously, said through hole allows the intermediate chamber **11** to be washed.

[0047] Said through hole is particularly useful in applications in which the suction mouth **29,** instead of being left open in a well or a tank, is connected to a duct. In this case it may be necessary to separate the intermediate space **21** from the suction area of the motor pump **1,** in order to allow the release of any overpressure generated by a closure of the delivery duct, preventing said overpressure from reaching the intermediate chamber **11.**

[0048] In these cases, said through hole may be connected to a drainage duct whose opposite end is free. Said drainage duct makes it possible to drain the liquid from the intermediate space **21,** in such a way as to maintain the functionality of the intermediate chamber **11** unchanged, while at the same time ensuring the release of said overpressure.

[0049] When it is not used, said through hole can be closed by means of a plug.

[0050] In the operating phase, the rotors **12** draw the liquid in which the motor pump **1** is immersed through the suction mouth **29,** the filtering element **17** and the inlet mouth **4,** and convey it through the outlet mouth **5,** the hollow space **27** and the delivery mouth **28.**

[0051] The liquid which, due to imperfections in the first sealing device **18,** or more simply due to the normal operation of the latter, should leak through the first sealing device **18** itself towards the outside of the pumping chamber **3** remains enclosed in the intermediate chamber **11** and is conveyed again into the suction area of the motor pump **1** through the recirculation duct **14.**

[0052] In this way, said liquid is prevented from flowing into the oil-filled chamber **24** of the motor **7.**

[0053] When the motor pump **1** is stopped, the intermediate chamber **11** is insulated from the external environment and therefore the solid impurities present in the external environment cannot obstruct the intermediate chamber **11** and/or its outlet towards the outside, thus preserving the functionality of the chamber itself.

[0054] Furthermore, the presence of the filtering element **17** ensures that all the liquid contained in the motor pump **1** is relatively free of solid impurities. Therefore, the latter impurities cannot cause the obstruction of the intermediate chamber **11,** either, thus contributing to better preserve the functionality of the chamber. According to the above, it can be understood that the motor pump described above achieves the object of the invention.

Claims

1. Centrifugal motor pump (1) comprising:

- a first casing (2) delimiting a pumping chamber (3) and provided with: an inlet mouth (4) for the introduction of a liquid in said pumping chamber (3); an outlet mouth (5) for the exit of said liquid from said pumping chamber (3); a first through opening (6) distinct from said inlet mouth (4) and from said outlet mouth (5);
- a motor (7) enclosed in a second casing (8), said second casing (8) being provided with a second through opening (9) facing said first through opening (6);
- a third casing (10) delimiting an intermediate chamber (11), said intermediate chamber (11) being interposed between said first through opening (6) and said second through opening (9) and placing them in communication with each other;
- a rotor (12) arranged in said pumping chamber (3);
- a shaft (13) which connects said rotor (12) to said motor (7) in such a way as to set said rotor (12) rotating and cause said liquid to flow according to a corresponding direction of flow, said shaft (13) being arranged through said first through opening (6), said second through opening (9) and said intermediate chamber (11);

characterized in that the intermediate chamber (11) comprises a recirculation duct (14) which at its first end (15) communicates with said intermediate chamber (11) and at its second end (16) communicates with said inlet mouth (4), in such a way as to convey a liquid present in said intermediate chamber (11) towards said inlet mouth (4).

2. Centrifugal motor pump (1) according to claim 1, **characterized in that** said intermediate chamber (11) is in communication with the outside of said centrifugal motor pump (1) exclusively through said recirculation duct (14).

3. Centrifugal motor pump (1) according to claim 1 or 2, **characterized in that** it comprises a filtering element (17) arranged upstream of said inlet mouth (4) according to said direction of flow, said filtering element (17) being suited to prevent solid impurities from getting into said pumping chamber (3).

4. Centrifugal motor pump (1) according to claim 3, **characterized in that** said second end (16) of said recirculation duct (14) is arranged downstream of said filtering element (17) according to said direction of flow.

5. Centrifugal motor pump (1) according to any of the preceding claims, **characterized in that** it comprises a first sealing device (18) interposed between said shaft (13) and said first through opening (6).

6. Centrifugal motor pump (1) according to any of the preceding claims, **characterized in that** it comprises a second sealing device (19) interposed between said shaft (13) and said second through opening (9).

7. Centrifugal motor pump (1) according to any of the preceding claims, **characterized in that** it comprises a tubular jacket (20) containing said first casing (2), said recirculation duct (14) being at least partially defined by an intermediate space (21) included between said first casing (2) and said tubular jacket (20).

8. Centrifugal motor pump (1) according to claim 7, **characterized in that** said tubular jacket (20) contains also said second casing (8).

9. Centrifugal motor pump (1) according to claim 7 or 8, **characterized in that** said tubular jacket (20) and said first casing (2) are both cylindrical and coaxial with said shaft (13), an annular element (22) being interposed between said tubular jacket (20) and said first casing (2) in order to obtain their mutual centering.

10. Centrifugal motor pump (1) according claim 9, **characterized in that** said tubular jacket (20) is provided with one or more corrugations facing said annular element (22) in order to delimit corresponding channels (23) between said tubular jacket (20) and said annular element (22), wherein said liquid can flow from one side of said annular element (22) to the other through said channels.

11. Centrifugal motor pump (1) according claim 9, **characterized in that** said annular element (22) is provided with one or more grooves facing said tubular jacket (20) in order to delimit corresponding channels (23) between said tubular jacket (20) and said annular element (22), wherein said liquid can flow from one side of said annular element (22) to the other through said channels.

12. Centrifugal motor pump (1) according to any of the preceding claims, **characterized in that** it is suitable for submersion.

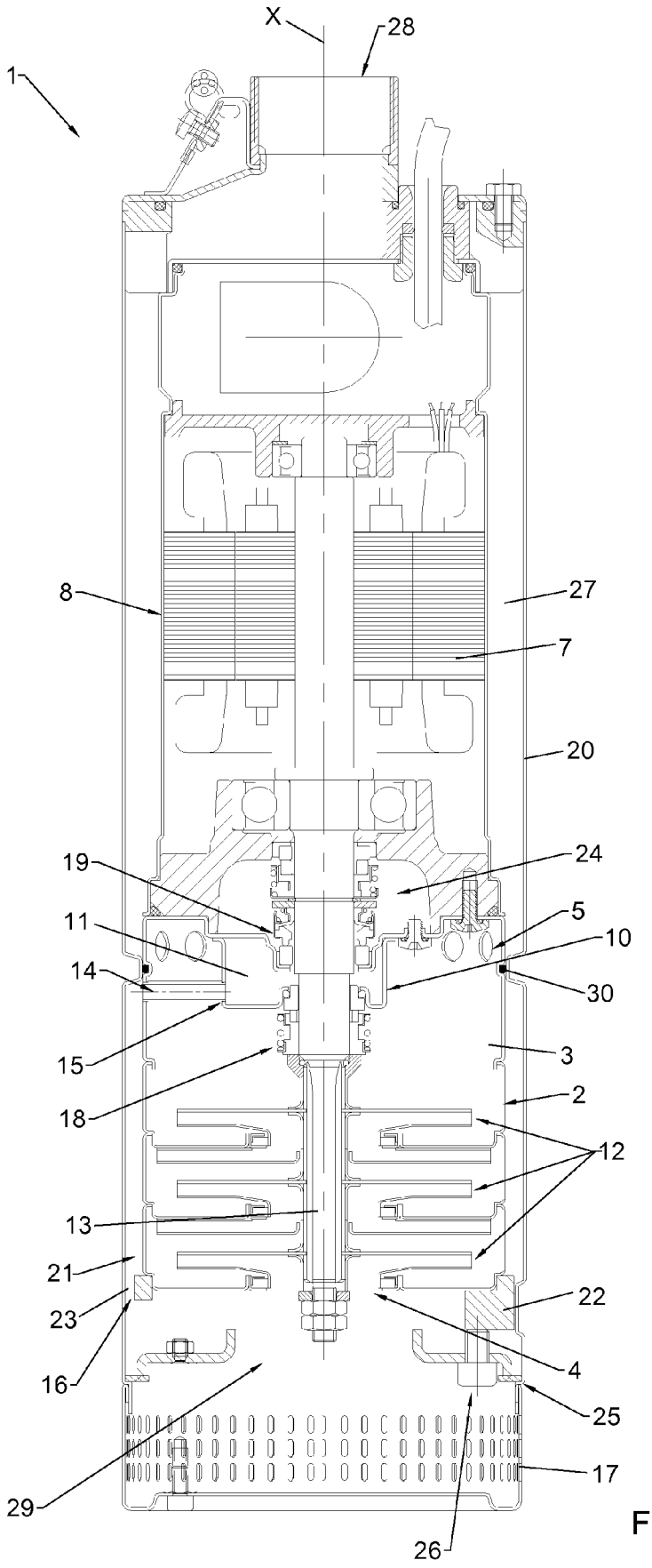
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Fig.1

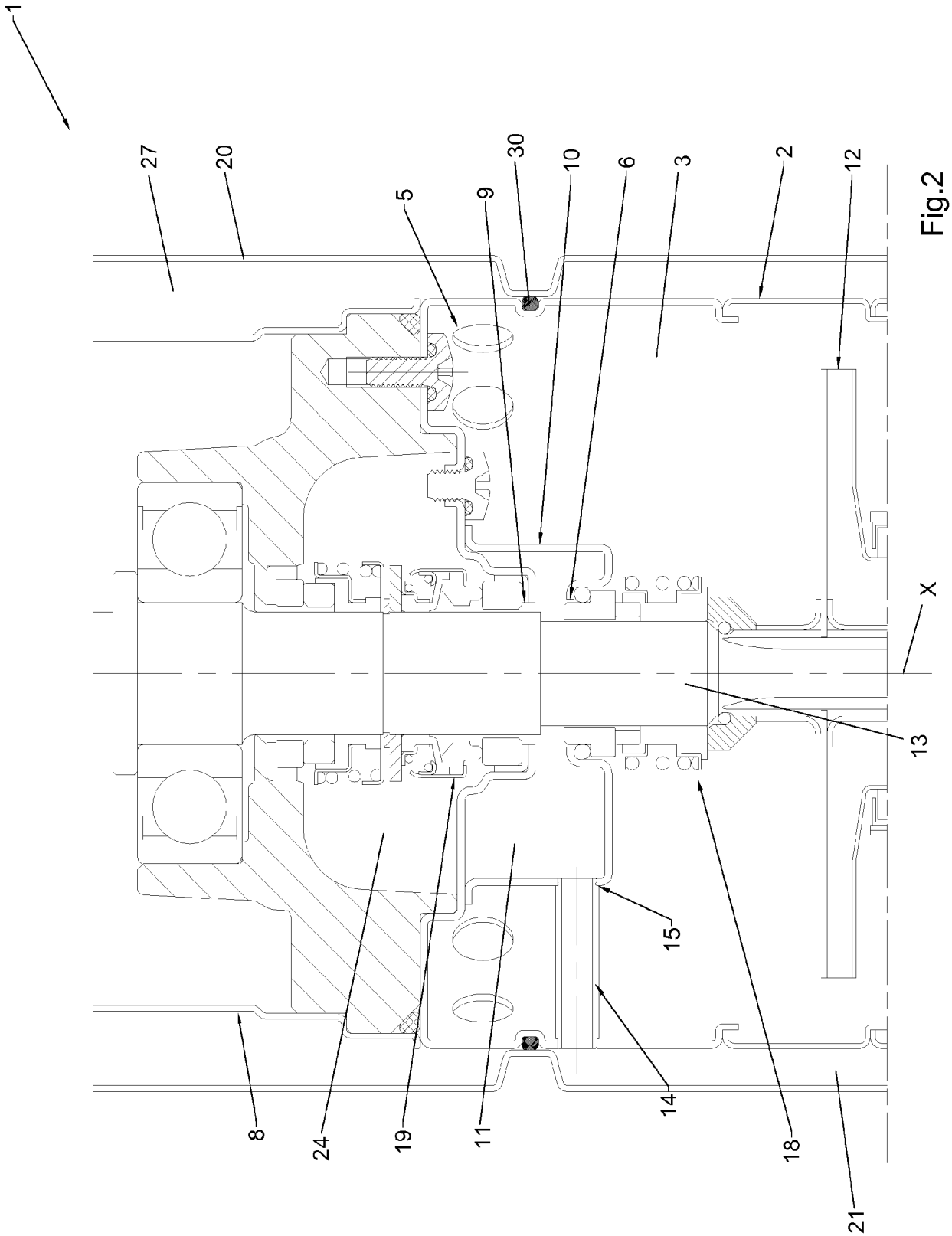

Fig.2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 9555

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	WO 03/056185 A1 (BOGEMAR S L [ES]; PAGES PAGES JOSEP [ES]) 10 July 2003 (2003-07-10) * page 7, lines 21-24; figures 1,3 * -----	1-12	INV. F04D7/04 F04D13/08 F04D29/10 F04D1/06
A	EP 2 916 008 A1 (CALPEDA A SPA [IT]) 9 September 2015 (2015-09-09) * abstract; figure 1 * -----	1	F04D29/08
A	FR 2 500 890 A1 (KLEIN SCHANZLIN & BECKER AG [DE]) 3 September 1982 (1982-09-03) * page 3, lines 31-38; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 January 2018	de Martino, Marcello

CATEGORY OF CITED DOCUMENTS

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