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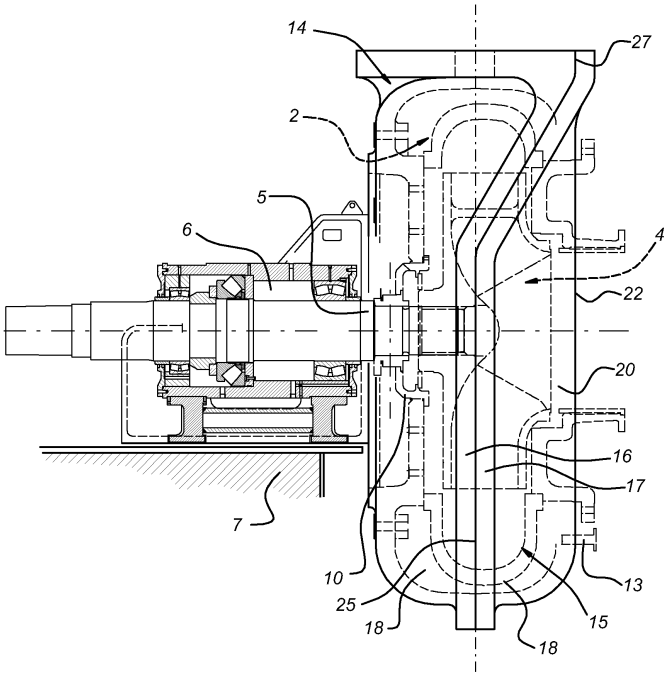
(54) Centrifugal pump having an inner casing and an outer casing

(57) A centrifugal pump comprises an inner casing and an outer casing surrounding the inner casing in a fluid tight way. The outer casing has an inlet at an axial end and a tangentially oriented outlet at its circumference. The outer casing comprises at least two outer casing parts which can be joined to each other in a fluid tight way along a joining face. The joining face extends along at least two planes that are oriented at an angle with respect to each other. The joining face runs continuously outside of the tangentially oriented outlet at the circumference of the outer casing.

Fig 2



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Description

[0001] The invention relates to a centrifugal pump, comprising an inner casing, an outer casing surrounding the inner casing in a fluid tight way, said outer casing having an inlet at an axial end and a tangentially oriented outlet at its circumference, and said outer casing comprising at least two outer casing parts which can be joined to each other in a fluid tight way along a joining face.

[0002] Such a centrifugal pump is generally known. This centrifugal pump has an impeller which is rotatably mounted within the inner casing, and a shaft connected to the impeller. The shaft extends out of the outer casing, and can be driven by a motor. The inner casing comprises a tangentially oriented outflow nozzle. This outflow nozzle is received in the corresponding outlet of the outer casing.

[0003] The outer casing of this centrifugal pump consists of two outer casing halves, i.e. the two outer casing parts form two symmetrical cup-shaped parts. These outer casing halves each have an end face provided with flanges, which can be bolted together in a fluid tight way. The joining face of the clamped outer casing halves extends centrally between them. Because of this configuration, the loads exerted on the outer casing can be dissipated effectively.

[0004] However, the joining face between the two casing parts also divides the outlet of the outer casing into two halves. The outlet of the outer casing also comprises an outlet flange at its end face, which flange is intended for being bolted together with a flange of a discharge pipe. Then, the central joining face between the two outer casing halves meets the joint between the clamped flanges of the outlet and discharge tube. At this location, there is a relatively high risk of leakage. If the two outer casing halves and/or the flanges of the outlet and discharge pipe are not precisely joint together perpendicularly, a small slit will be present, which can jeopardize the fluid tight connection between the outer casing parts and the discharge pipe.

[0005] The object of the invention is to provide a centrifugal pump, wherein the risk of leakage is reduced.

[0006] This object is achieved according to the invention in that said joining face extends along at least two planes that are oriented at an angle with respect to each other, said joining face running continuously outside of the tangentially oriented outlet at the circumference of the outer casing.

[0007] According to the invention the joining face runs alongside of the tangentially oriented outlet at the circumference of the outer casing, i.e. the joining face does not intersect with the outlet. In other words, the tangentially oriented outlet at the circumference of the outer casing is situated as a whole in one of the casing parts. One casing part is provided with an integral outlet. An outlet flange delimiting the outlet can therefore be uninterrupted. It is then possible to bolt the flange of a discharge pipe securely together with the outlet flange in a leakproof manner.

[0008] It is noted that a centrifugal pump is known, which comprises an outer casing that is provided with a cup-shaped outer casing part and a covering plate for closing the outer casing part. The outer casing part has such great dimensions that it fully receives the inner casing of the centrifugal pump. This outer casing part comprises a flange at its side end, which is bolted together with the covering plate. The outlet of the outer casing then completely extends within the outer casing part, which reduces the risk of leakage. However, the joining face between the outer casing part and the covering plate is flat, i.e. it does not extend in at least two planes that are oriented at an angle with respect to each other. The covering plate as a whole is thus situated on a side of the outer casing, so that the strength of the outer casing is unevenly distributed. It may therefore be required to reinforce the outer casing, which increases the manufacturing costs.

[0009] It is preferable according to the invention that the joining face comprises a central section which substantially coincides with a central plane of the outer casing. The outer casing has a width extending in the axial direction. When the outer casing parts are joined together, the width of the outer casing will be defined by the distance between the outer side surfaces of the outer casing parts. In this embodiment of the invention, the joining face extends partially along half of this width. As a result, the strength of the outer casing is relatively well distributed.

[0010] In an embodiment of the invention, the joining face between the two outer casing parts comprises a side section which extends adjacent to the outlet of the outer casing. This side section of the joining face at least partially extends along a side of the outer casing thus circumventing the outlet of the outer casing, so that the flange of the outlet can be integrally formed.

[0011] It is possible according to the invention that the side section of the joining face runs substantially parallel to central section. In this case, the side section and the central section are both parallel to the central plane of the outer casing.

[0012] According to the invention, the joining face may comprise a connecting section which extends between the central section and the side section of the joining face. The central section and the side section of the joining face are connected to each other by means of the connecting section. The connecting section is inclined with respect to the central plane of the outer casing.

[0013] In this case, the joining face is formed by three partial faces, i.e. the central section, the connecting section and the side section. The central section of the joining face is located substantially in the central plane of the outer casing, i.e. the outer casing parts have substantially the same width on either side of the central section. The side section of the joining face extends in a plane that is at a distance from the central plane, such that the side section does not intersect with the outlet of the outer cas-

ing. The plane of the side section may be inclined with respect to the central plane. The connecting section of the joining face extends in a plane oriented at an angle with respect to the planes of the central section and side section. The connecting section connects the central section and side section together.

[0014] Of course, the joining face can be constructed in a different manner. For example, the joining face may comprise a connecting section that extends in two different planes that are inclined with respect to each other. Also, these planes may be separated, i.e. the connecting section forms two connecting sections. This depends, for example, on the location of the outlet.

[0015] In order to increase the stiffness of both casing parts with respect to the internal overpressure, both outer casing parts may be generally cup-shaped. In that case, they may both have a flange at an end face, said flanges being connected to each other in a fluid tight way. It is noted that the casing parts can also be connected to each other in a fluid tight way in various other ways. For example, the casing parts can be clamped together or snap-fitted to each other.

[0016] Furthermore, in the centrifugal pump according to the invention, the pump may comprise an impeller which is rotatably mounted within the inner casing, and a shaft connected to the impeller, said shaft extending out of the outer casing at its axial end opposite the inlet. Then, the outer casing comprises a shaft cover through which the shaft extends in a fluid tight way. Also, it is possible that the outer casing comprises an inlet cover through which an inlet tube part extends.

[0017] The invention will now be described further with reference to an embodiment shown in the drawings.

Figure 1 shows a top view of the centrifugal pump according to the invention.
Figure 2 shows a side view of the pump of figure 1.
Figure 3 shows a front view of the pump of figure 1.

[0018] The centrifugal pump shown in figures 1-3 comprises a housing 1, which consists of an inner casing 2 and an outer casing 3. The inner casing 2 is mounted within the outer casing 3, i.e. the outer casing 3 surrounds the inner casing 2 as a whole. The inner casing 2 usually consists of a hard, wear-resistant material, for example hardened steel or cast iron. The materials which are transported through the centrifugal pump, e.g. materials which have been obtained through dredging or mining operations, may comprise highly abrasive components. Furthermore, such materials may comprise lumps of material which may lead to impact forces while being transported through the inner casing 2. Additionally, pressure surges may occur within the inner casing 2 when performing dredging or mining operations. Thus the centrifugal pump, in particular the inner casing 2, is subjected to wear.

[0019] In view of the brittle character of hard materials such as hardened steel or cast iron, these materials are not quite fit for accommodating impact forces or pressure surges. In particular, said materials cannot yield very well and therefore cannot adapt to such loadings. This may lead to ruptures in the inner casing 2. The occurrence of ruptures is however very dangerous because of the dimensions of the pump and the relatively high pressures which prevail therein. In the case of a rupture, the debris and materials which are being pumped may be flung through the surroundings, which causes high risks to the personnel and environment.

[0020] The outer casing 3 intends to reduce this risk. The outer casing 3 has been designed to contain any materials which may be flung out of a ruptured inner casing 2. To that end, the outer casing 3 comprises a material which is well fit for accommodating impacts and the like. Thus, the material of the outer casing 3 preferably comprises a tough and yieldable material, which is also fit for maintaining the overpressure within the outer casing 3. The outer casing 3 is made of, for example, plastic.

[0021] The inner casing 2 of the centrifugal pump forms a spiral casing. The inner casing 2 has an an inlet 20 at an axial end and a tangentially oriented outlet 21 at its circumference. The outlet 21 forms a nozzle or spout. The inner casing 2 comprises an impeller 4 that is mounted on a shaft 5, which is rotatably supported with respect to a frame 7 by means of the bearing arrangement 6. Thus the impeller 4 can rotate within the inner casing 2.

[0022] At the side facing the bearing arrangement 6, the outer casing 3 comprises a shaft cover 10 which by means of the sealing, which is known per se, is sealed with respect to the shaft 5. The shaft cover is usually referred to as water chamber. At the opposite end, an inlet tube (not shown) can be connected, known per se as well.

[0023] The outer casing 3 of the centrifugal pump has an inlet 22 at an axial end and a tangentially oriented outlet 23 at its circumference. The inlet 22 is aligned with the inlet 20 of the inner casing 2, while the outlet 23 corresponds to the outlet nozzle 21 of the inner casing 2.

[0024] As the internal pressure within the inner casing 2 can rise to e.g. 40 atm, the inner casing can be supported from the outside by pressurising the internal space of the outer casing 3. To that end, the outer casing 3 comprises a pressure connection 13 by means of which an overpressure can be maintained which, for example, amounts to about 80% of the overpressure within the inner casing 2.

[0025] As shown most clearly in figures 1 and 2 the outer casing 3 consists of two outer casing parts 14, 15. The casing parts 14, 15 are both cup-shaped having a rim portion 18. The rim portion 18 provides a certain inherent stifness to the casing parts 14, 15. The outer casing part 14 has a flange 16, while the outer casing part 15 is provided with a corresponding flange 17. These flanges 16, 17 can be joined together in a leakproof manner, e.g. using bolts.

[0026] The flanges 16, 17 define a joining face of the outer casing parts 14, 15. The outer casing parts 14, 15

and their flanges 16, 17 are designed such that this joining face extends along at least two intersecting planes that are oriented at an angle with respect to each other. In other words, the joining face between the outer casing parts 14, 15 is not flat - it contains at least one twist. The cup-shaped outer casing parts 14, 15 of the outer casing 3 are non-symmetrical with respect to the central plane A of the outer casing 3.

[0027] The joining face between the outer casing parts 14, 15 of this exemplary embodiment comprises a central section 25 which substantially coincides with the central plane A of the outer casing 3, i.e. the central section 25 is located at half of the width w of the outer casing 3. The joining face is thus situated at least partially symmetrically with respect to the central plane. This is beneficial for the stifness of the outer casing 3.

[0028] The joining face further comprises a side section 27 which extends adjacent to the outlet 23 of the outer casing 3. In this exemplary embodiment, the side section 27 is inclined with respect to the vertical. The upper connecting line of the side section 27 at the top of the outer casing 3, adjacent to the outlet 23, is substantially parallel to central section 25 (see figure 1). From there the side section 27 forms an oblique section that runs inwardly downwards. The side section 27 then continues into the central section 25 (see figure 3).

[0029] Because the joining face runs alongside the outlet 23 of the outer casing 3 at the side section 27, the outlet 23 of the outer casing 3 extends only in the outer casing part 14. The flange 16 of the outer casing part 14 can therefore also extend continuously around the outlet 23 of the outer casing 3. Thus, the flange 16 delimiting the outlet 23 of the outer casing 3 is uninterrupted. This enables a reliable leakproof connection to an outlet tube (not shown).

[0030] The joining face also has a connecting section 26 which extends between the central section 25 and the side section 27 of the joining face (see figure 1). The connecting section 26 is inclined with respect to the central plane of the outer casing 3.

[0031] Since the joining face between the outer casing parts 14, 15 is devised around the outlet 23 of the outer casing 3, while a portion of the joining face remains in the central plane of the outer casing 3, the outer casing 3 enables attachment of an outlet tube in a leakproof manner and has sufficient stifness.

[0032] The invention is not limited to the exemplary embodiment shown in the figures. The person skilled in the art can modify the centrifugal pump according to the invention in various ways.

Claims

1. Centrifugal pump, comprising an inner casing (2), an outer casing (3) surrounding the inner casing (2) in a fluid tight way, said outer casing (3) having an inlet (22) at an axial end and a tangentially oriented outlet (23) at its circumference, and said outer casing (3) comprising at least two outer casing parts (14, 15) which can be joined to each other in a fluid tight way along a joining face, **characterised in that** said joining face extends along at least two planes that are oriented at an angle with respect to each other, and **in that** said joining face runs continuously outside of the tangentially oriented outlet (23) at the circumference of the outer casing (3).

2. Centrifugal pump according to claim 1, wherein the joining face comprises a central section (25) which substantially coincides with a central plane of the outer casing (3).

3. Centrifugal pump according to claim 1 or 2, wherein the joining face comprises a side section (27) which extends adjacent to the outlet (23) of the outer casing (3).

4. Centrifugal pump according to claim 3, wherein the side section (27) of the joining face runs substantially parallel to central section (25).

5. Centrifugal pump according to claim 3 or 4, wherein the joining face comprises at least one connecting section (26) which extends between the central section (25) and the side section (27) of the joining face.

6. Centrifugal pump according to one of the preceding claims, wherein both outer casing parts (14, 15) are generally cup-shaped and have a flange (16, 17) at an end face, said flanges (16, 17) being connected to each other in a fluid tight way.

7. Centrifugal pump according to one of the preceding claims, wherein a connection (13) is provided for maintaining an overpressure within the outer casing (3).

8. Centrifugal pump according to one of the precedings claims, wherein the pump comprises an impeller (4) which is rotatably mounted within the inner casing (2), and a shaft (5) connected to the impeller (4), said shaft (5) extending out of the outer casing (3) at its axial end opposite the inlet (22).

9. Centrifugal pump according to claim 8, wherein the outer casing (3) comprises a shaft cover (8) through which the shaft (5) extends in a fluid tight way.

10. Use of a centrifugal pump according to one of the preceding claims.

Fig 1

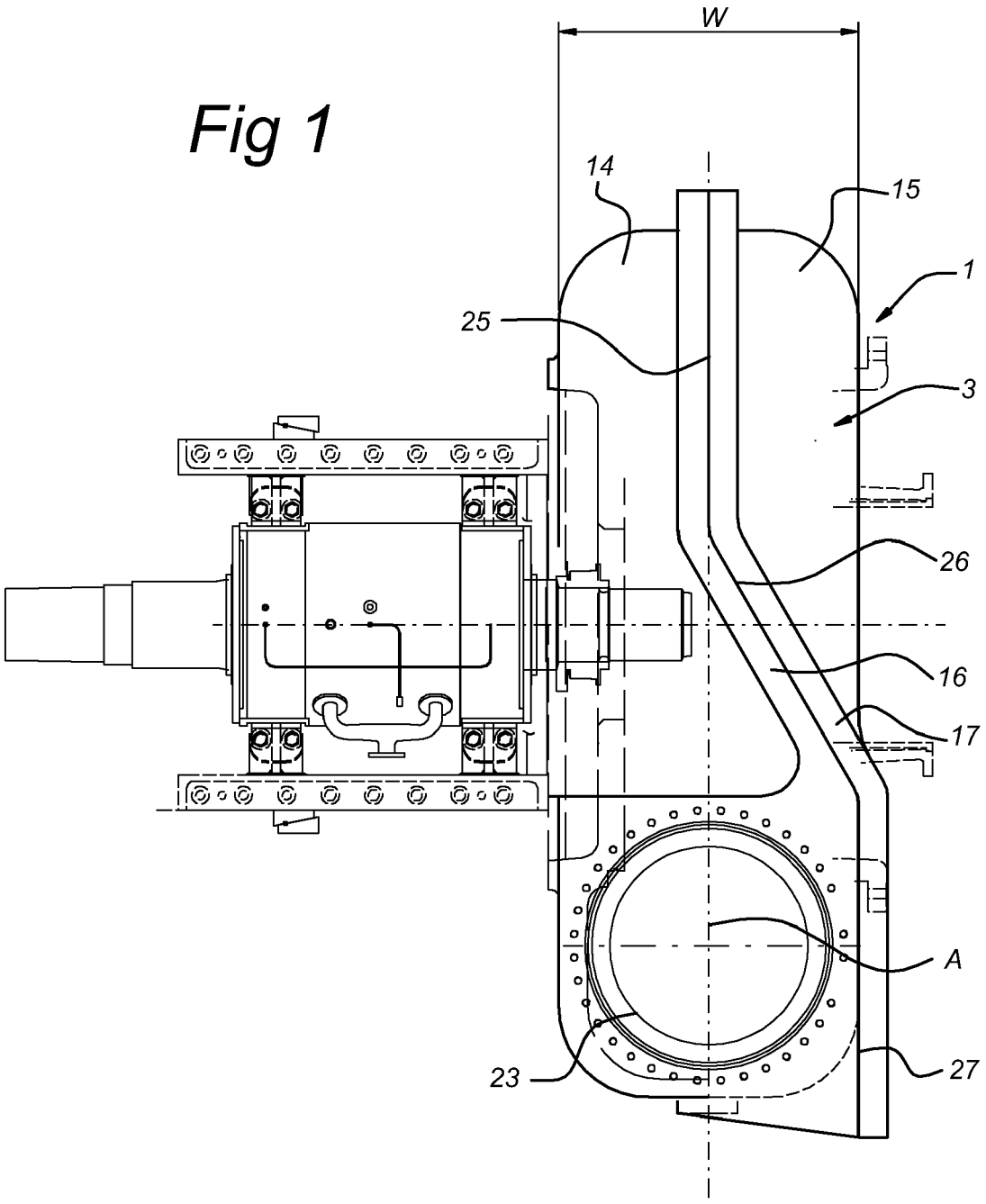


Fig 2

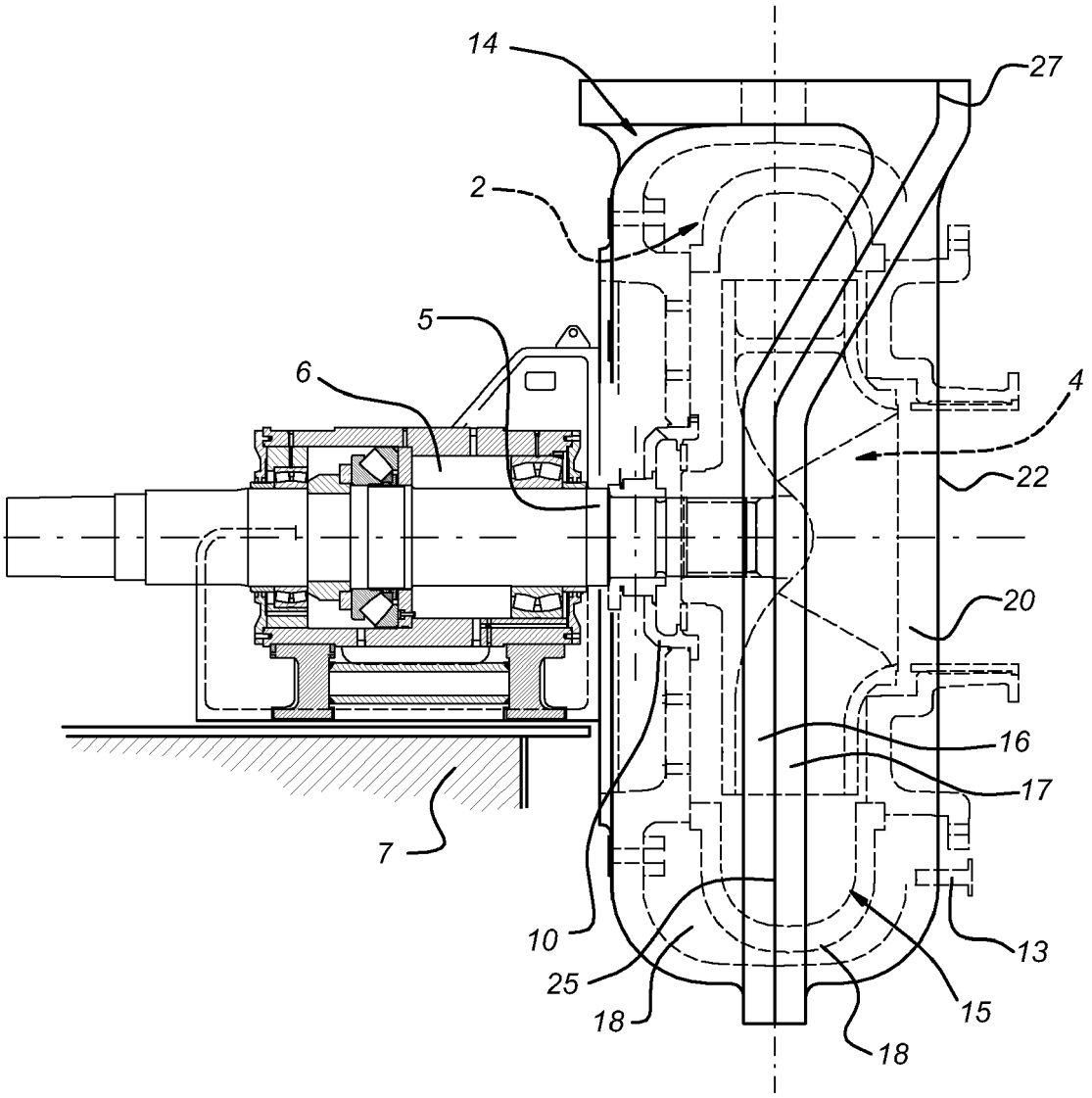
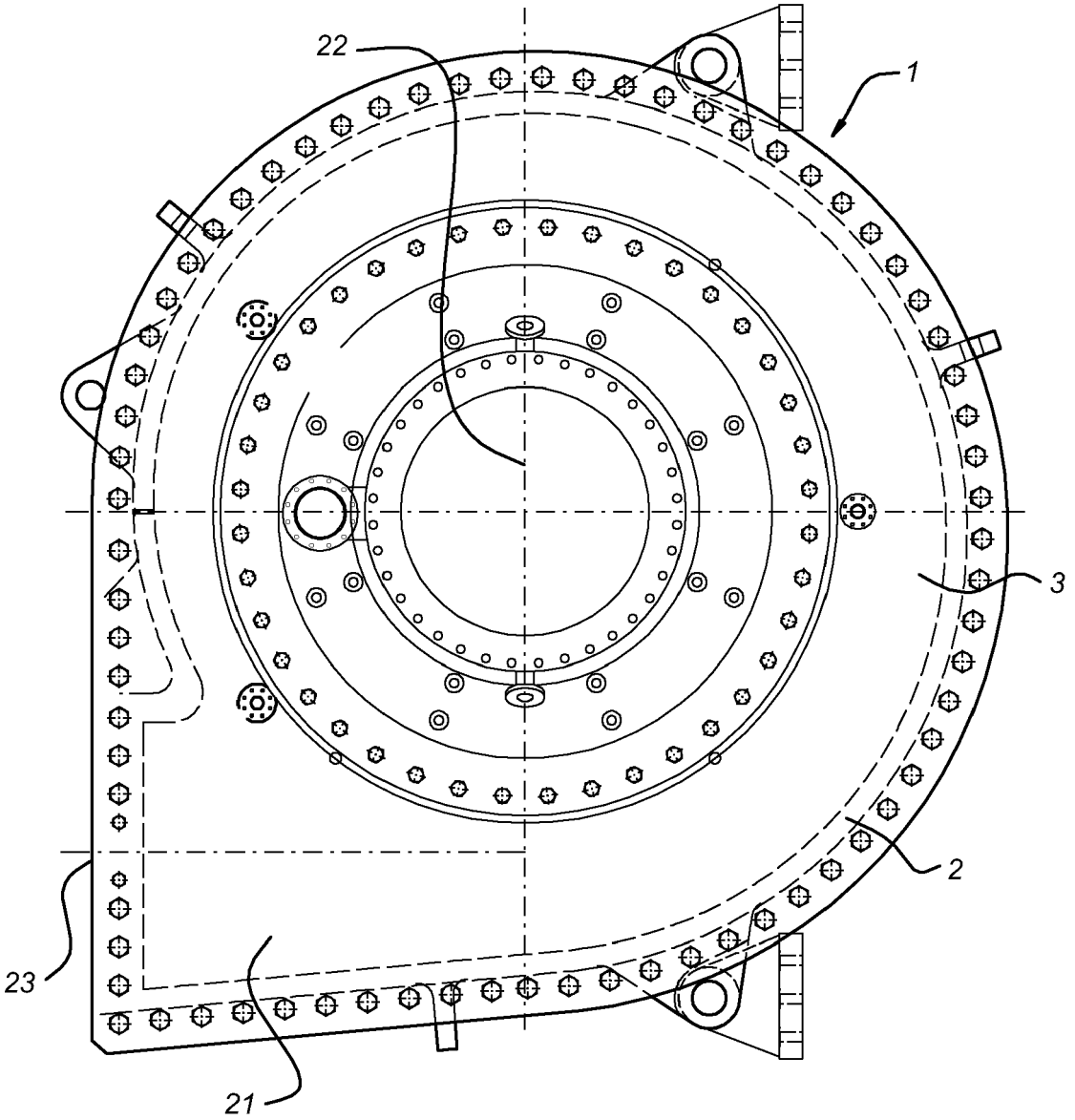


Fig 3



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EUROPEAN SEARCH REPORT

Application Number
EP 06 12 0910

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2005/024243 A (WEIR WARMAN LTD [AU]; BURGESS KEVIN EDWARD [AU]) 17 March 2005 (2005-03-17) * the whole document *	1	INV. F04D29/42
A	WO 2004/033919 A (DUECHTING PUMPEN MASCHF GMBH [DE]; ZIES GERO [DE]; ZARGES GUENTER [DE]) 22 April 2004 (2004-04-22) * the whole document *	1	
A	US 5 127 800 A1 (HYLL JOHN [US] ET AL) 7 July 1992 (1992-07-07) * the whole document *	1	
A	US 2 110 079 A1 (BUTLER CLYDE A) 1 March 1938 (1938-03-01) * the whole document *	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	28 March 2007	Giorgini, Gabriele

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28-03-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2005024243 A	17-03-2005	BR PI0414138 A	31-10-2006
		CA 2533615 A1	17-03-2005
		CN 1842658 A	04-10-2006
		EP 1660778 A1	31-05-2006
		KR 20060061358 A	07-06-2006
		MX PA06002539 A	20-06-2006
		US 2007014662 A1	18-01-2007
WO 2004033919 A	22-04-2004	AT 311539 T	15-12-2005
		AU 2002342716 A1	04-05-2004
		DE 50205144 D1	05-01-2006
		EP 1511939 A1	09-03-2005
		US 2005241793 A1	03-11-2005
US 5127800 A1		NONE	
US 2110079 A1		NONE	

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