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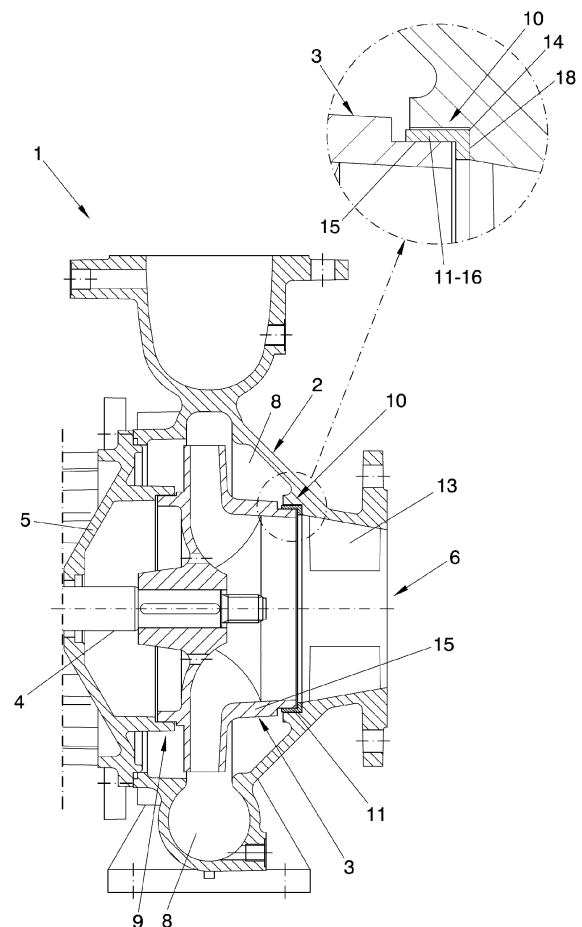
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BA ME(30) Priority: **21.02.2011 ES 201130216**(71) Applicant: **DESARROLLOS EMPRESARIALES
VALAR, S.L.****08002 Barcelona (ES)**(72) Inventor: **Soler Álvarez, Marina****08840 Barcelona (ES)**(74) Representative: **Ungria Lopez, Javier****Avda. Ramón y Cajal, 78
28043 Madrid (ES)****(54) Improvements in centrifugal pumps**

(57) These pumps (1) comprise a housing (2) having a inlet mouth (6) and an outlet mouth (7) for a fluid, while inside is housed a turbine (3) coupled to a rear support and to another front support, separating the latter a suction chamber (13) and a discharge chamber (8). The improvements are characterized in that they comprise an axial fluid-tight sealing ring that provides a perimeter sealing between said chambers (8-13), which ring is located in an angular hole (16) established in correspondence with the front support (10). The sealing ring is coupled with a certain tightening in the terminal portion (15) of the turbine (3), rotation of which drags the ring performing the axial closure by contacting the same against a flat front section (18) of an angular recess (14) in the housing (2) of the pump (1).

**FIG. 2****EP 2 489 882 A2**

Description

OBJECT OF THE INVENTION

[0001] The present invention, as stated in the title of this specification, refers to some improvements in centrifugal pumps which are specifically made in a characteristic sealing ring that prevents part of the pumped fluid from passing through an undue area from the discharge chamber to the suction chamber, thereby achieving an increase of the driven flow rate of around 10%, as well as an increase in the hydraulic performance of the pump of around 8%.

[0002] Thus, the typical sealing ring made of a polyamide material, prevents leakage of fluid from the discharge chamber with higher pressure to the suction chamber at a lower pressure, through an undue area corresponding to the support of the front face of the turbine coupled within a housing attached by its axis to a rear support.

BACKGROUND OF THE INVENTION

[0003] Centrifugal pumps generally include a pump housing or body (static part) and a centrifugal turbine or runner (rotating part), so that the better the fit between both elements, the better the performance of the pump will be.

[0004] On this basis, the mixed-flow centrifugal pumps traditionally, due to the difficulty of mechanically adjusting the turbine with respect to the housing, have been mounting these two elements with the use of an intermediate element, such as a tow material or wear ring inside of the suction mouth of the pump housing.

[0005] This intermediate element provided a seal between the suction chamber and the discharge chamber by maintaining a constant radial friction in the suction mouth of the turbine.

[0006] This friction, in addition to needing a much comprehensive maintenance in exchange for a better sealing of the suction chamber to the discharge chamber, resulted in a loss of engine power, thereby it should be oversized.

[0007] More recently, due to the inclusion of numerical control machine tools and machining centers, a better adjustment between the turbine and the pump housing was achieved; thereby the use of intermediate elements such as a tow material or wear ring was abandoned.

[0008] The tolerance of the mentioned adjustment existing between the neck of the turbine and the pump housing, is now usually in the order of about 0.2 mm.

DESCRIPTION OF THE INVENTION

[0009] In order to achieve the objectives and avoid the drawbacks mentioned in the preceding paragraphs, the invention proposes some improvements in centrifugal pumps that are of the type having a turbine placed inside

a housing having an inlet mouth for a fluid and an outlet mouth for the same fluid, in a front support that separates a suction chamber corresponding to the inlet mouth and a discharge chamber corresponding to an internal hole of the body pump wherein the turbine is located, and by a rear support through the motor shaft.

[0010] The improvements are characterized in that they comprise an axial fluid-tight sealing ring with an angular profile that provides a perimeter sealing between said chambers, while such sealing ring is located in an angular hole established in correspondence with the front support of the turbine.

[0011] That angular hole is defined between the suction mouth of the turbine and an angular recess of the housing, with the sealing ring being coupled with a certain tightening in the suction mouth of the turbine that rotates dragging the mentioned sealing ring, front section of which axially contacts by its outer flat face against a flat front section of the angular recess of the housing.

[0012] This axial contact provides the perimeter sealing between the suction chamber and the discharge chamber, such sealing ring being placed into the angular hole of the front support of the turbine with an axial clearance and with a radial clearance as well.

[0013] The radial clearance of the sealing ring will be delimited between the outer face of its annular path radial section and the curved surface, having also an annular path, of the angular recess of the housing corresponding to the front support of the turbine.

[0014] The radial clearance of the sealing ring will be between 0.1 mm and 0.8 mm. While the axial clearance of the sealing ring being higher, because of the pressure differences between the two chambers, it is axially moved against the flat front section of the angular recess of the pump housing getting smaller adjustments at 0.1 mm.

[0015] Another feature of the invention is that the sealing ring, includes in one of its second embodiments, an axial driving spring device that is integral with said sealing ring itself, pushing the same at all times against the flat front section of the angular recess in the pump housing.

[0016] The referred spring device is characterized in that it comprises several cantilever elastic wings arranged in the same annular plane of the radial section of the sealing ring, such elastic wings being joined by their ends to some angular extensions starting from the radial section radial of the sealing ring, such elastic wings contacting at all times a front seat that outside limits the terminal portion of the turbine.

[0017] Another feature of the invention is that the elastic wings of the spring device comprise pairs of sections that converge on common raised areas by one end, with this areas being elastically deformed in their support on the front seat of the turbine.

[0018] The sealing ring is made in all its embodiments of a polyamide material.

[0019] Thus, the mentioned improvements of the invention achieve an increase of the driven flow rate of around 10%, as well as an increase in the pump hydraulic

performance of around 8%, because undue leakage of fluid is prevented from the discharge chamber with a higher pressure to the suction chamber with a lower pressure of the fluid.

[0020] Hereinafter to provide a better understanding of this specification and being an integral part thereof, some figures in which with an illustrative and not limitative manner the object of the invention has been represented, are attached.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Figure 1.- Shows a perspective view of a centrifugal pump that includes the improvements object of the invention. These basically consist of the inclusion of a characteristic sealing ring that prevents that part of the pumped fluid from flowing from the discharge chamber with a higher pressure to the suction chamber with a lower pressure of the fluid, thus achieving a higher performance of the pump.

Figure 2.- Shows a sectional view of a centrifugal pump wherein the location of the sealing ring in a first embodiment is shown in detail.

Figure 3.- Shows a detailed partial sectional view of a second embodiment of the sealing ring.

Figure 4.- Shows a perspective view of a first embodiment of the sealing ring.

Figure 5.- Shows a sectional view of the sealing ring in a first embodiment shown in the figure above.

Figure 6.- Shows a perspective view of a second embodiment of the sealing ring.

Figure 7.- Shows a sectional view of the sealing ring in a second embodiment shown in the figure above.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] Considering the numbering adopted in the figures, a centrifugal pump 1 comprises in principle a housing 2 as a static element, and a turbine 3 as a dynamic element that rotates by a driving element not shown in the figures, with the interposition of an intermediate shaft 4, so that the housing 2 is closed on the rear side corresponding to the intermediate shaft 4 via a rear cover 5, while on the front side of the housing 2 is located the inlet mouth 6 for the fluid. An outlet mouth 7 for the fluid is radially placed in the housing 2.

[0023] On this basis, the turbine is located in an inner hole of the housing 2 establishing the discharge chamber 8, setting the turbine 3 on a rear support 9 of the rear cover 5 and on a front support 10 of the housing 2 with the interposition of a sealing ring 11-12, which as stated earlier, prevents some of the fluid from perimeter passing from the discharge chamber 8 with a higher pressure of the fluid to a suction chamber 13 with a lower pressure of the fluid, with the discharge chamber 8 corresponding with the inner hole of the housing 2 wherein the turbine

3 is located. It should be also note that the inlet mouth 6 for the fluid is continued by the suction chamber 13.

[0024] The front support 10, wherein the characteristic sealing ring 11-12 is located, includes an annular recess 14 faced with a terminal portion 15 of the turbine 3, generating between said annular recess 14 of the housing 2 and the terminal portion 15 of the turbine 3, a small angular hole 16 wherein the sealing ring 11-12 is set with an undetermined axial clearance and with a radial clearance of about 0.5 mm, existing between the annular outer face of the sealing ring 11-12 and the annular surface of the angular recess 14 of the housing 2. The radial clearance can be as large as desired, within reasonable limits, since the sealing ring 11-12 does not generate any radial sealing, but axial, as will be described in detail below.

[0025] The obstruction on the front support 10 is achieved by the axial pressure exerted by the sealing ring 11-12 against a flat front section 18 of the angular recess 14 made inside the housing 2.

[0026] The sealing ring 11-12 is freely coupled with some adjustment to the terminal portion 15 of the turbine 3, so that it partially draws on its rotation at all times the sealing ring 11-12.

[0027] In a first embodiment, the sealing ring 11 comprises an angular profile consisting of a radial section and a front section. The axial adjustment of the sealing ring 11 against the flat front section 18 of the angular recess 14 of the housing 2 is produced as a result of the pressure differences between the two discharge and suction chambers.

[0028] In a second more effectively embodiment, the sealing ring 12 comprises an angular structure formed in principle by a radial section and a front section, combined with the addition of an axial driving spring device 17 that is part of the sealing ring 12 itself, such spring device 17 section from the radial section.

[0029] The spring device 17 always tends to axially the sealing ring 12 against the flat front section 18 of the angular recess 14 of the housing 2 in the centrifugal pump 1, even when it is inactive, thus also avoiding in this position undue leakage of the fluid.

[0030] The spring device 17 abuts against a front seat 19 which externally defines the terminal portion 15 of the turbine 3.

[0031] In turn, the said spring device 17 comprises several cantilevered elastic wings 20 arranged in the same annular plane as the radial section of the sealing ring 12, such wings being joined by their ends to angular extensions 21 that also start from the radial section of the sealing ring 12.

[0032] The cantilevered elastic wings 20 comprise pairs of sections that converge on common raised areas by one of their ends, with these areas being elastically deformed on their support against the front seat 19 of the turbine 3, thereby the support of the elastic wings 20 against the front seat 19 axially pushes the sealing ring 12 against the flat front section 18 of the angular recess 14 in the housing 2, thereby producing a more effective

seal between the suction chamber 13 with a lower pressure and the discharge chamber 8 with a higher pressure.

[0033] The sealing ring 11-12 is made of polyamide by using an injection molding process, without excluding other plastic materials.

[0034] Thus, in summary, the sealing between the suction chamber 13 and the discharge chamber 8 is the result of the axial friction between the outer side of the front section of the sealing ring 11-12 and flat front section 18 of the angular recess 14 made in the casing 2 of the pump 1.

[0035] Indeed, by the effect of centrifugal speed of the turbine 3, in the suction chamber 13 a suction or pressure drop is produced, while in the discharge chamber 8 an increase of pressure is produced. This pressure difference makes the sealing ring 11-12 to suffer a thrust out with a force equal to the result of multiplying the difference of the axial front surface of the sealing ring 11-12 by the pressure of the discharge chamber, minus the same axial surface of the sealing ring by the pressure of the suction chamber, so that as the surface is the same, it is clear that the result will be positive.

[0036] As indicated above, the sealing ring has a sliding fit with the outer area of the mouth of the centrifugal turbine or runner 15, so that the sealing ring will be axially moved until axially rubbing against the flat front section of the angular recess 14 in the housing 2 of the pump 1, resulting in the sealing or hydraulic separation of the suction and discharge chambers.

[0037] Inasmuch as the centrifugal pump start and because the sealing ring is at rest (no thrusting force by the pressure difference of the suction and discharge chambers), there could be the fact that the sealing ring is not in its normal working position, that is, rubbing against the flat front section 18 of the angular recess 14 in the housing 2 of the pump 1, which would cause a hydraulic leak from the discharge chamber to the suction chamber, resulting in an equal pressure between the two opposite axial faces of the hoop or sealing ring, and consequently it would not produce the axial thrusting force described above.

[0038] In order to avoid this problem, the sealing ring includes into its most advantageous embodiment the spring device 17, so even when the pump at rest, the axial contact between the sealing ring 12 and the flat front section 18 of the angular recess 14 in the housing of the pump is guaranteed.

[0039] Finally it should be noted that the initial tightness in the absence of pressure difference (pump off) between the two chambers 8-13, such initial tightness is caused by the spring device 17 of the sealing ring 12.

Claims

1. Improvements in centrifugal pumps, these pumps (1) being of the type having a turbine (3) placed inside a housing (2) having a inlet mouth (6) for a fluid and an outlet mouth (7) for the same fluid, said turbine

(3) being coupled to a rear support (9) and to a front support (10) that separates a suction chamber (13) corresponding to the inlet mouth (6) and a discharge chamber (8) corresponding to an internal hole wherein the turbine (3) is located, **characterized in that** they comprise an axial fluid-tight sealing ring with an angular profile that provides a perimeter sealing between said chambers (8-13), while said ring is located in an angular hole (16) established in correspondence with the front support (10) of the turbine (3), angular hole (16) defined between a terminal portion (15) of the turbine (3) and an angular recess (14) of the housing (2), with the sealing ring being coupled with a certain tightening in the terminal portion (15) of the turbine (3) that rotates dragging the mentioned sealing ring, front section of which axially contacts by its outer flat face against a flat front section (18) of the angular recess (14) in the housing (2), with this axial contact providing the perimeter sealing between the suction chamber (13) and the discharge chamber (8), with the sealing ring being placed into the angular hole (16) of the front support (10) with an axial clearance and with a radial clearance as well.

2. Improvements in centrifugal pumps, according to claim 1, **characterized in that** the radial clearance of the sealing ring is delimited between the outer face of its annular path radial section and the curved surface, also with an annular path, of the angular recess (14) in the housing (2).
3. Improvements in centrifugal pumps, according to claim 2, **characterized by** the radial clearance of the sealing ring is between 0.1 mm and 0.8 mm.
4. Improvements in centrifugal pumps according to claim 1, **characterized in that** the sealing ring (12) includes an axial driving spring device (17) integral with the sealing ring (12) itself, pushing the same all times against the flat front section (18) of the angular recess (14) in the housing (2) of the pump (1).
5. Improvements in centrifugal pumps, according to claim 4, **characterized in that** the spring device (17) comprises several cantilevered elastic wings (20) arranged in the same annular plane as the annular section of the radial section of the sealing ring (12), said elastic wings (20) being joined by their ends to angular extensions (21) that start from the radial section of the sealing ring (12), said elastic wings (20) contacting at any time against a front seat (19) which externally defines the terminal portion (15) of the turbine (3).
6. Improvements in centrifugal pumps, according to claim 5, **characterized in that** the elastic wings (20) of the spring device (17) comprise pairs of sections

that converge on common raised areas by one of their ends, with these areas being elastically deformed on their support over the front seat (19) of the turbine (3).

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7. Improvements in centrifugal pumps, according to claim 1, **characterized in that** the sealing ring comprises a polyamide material.

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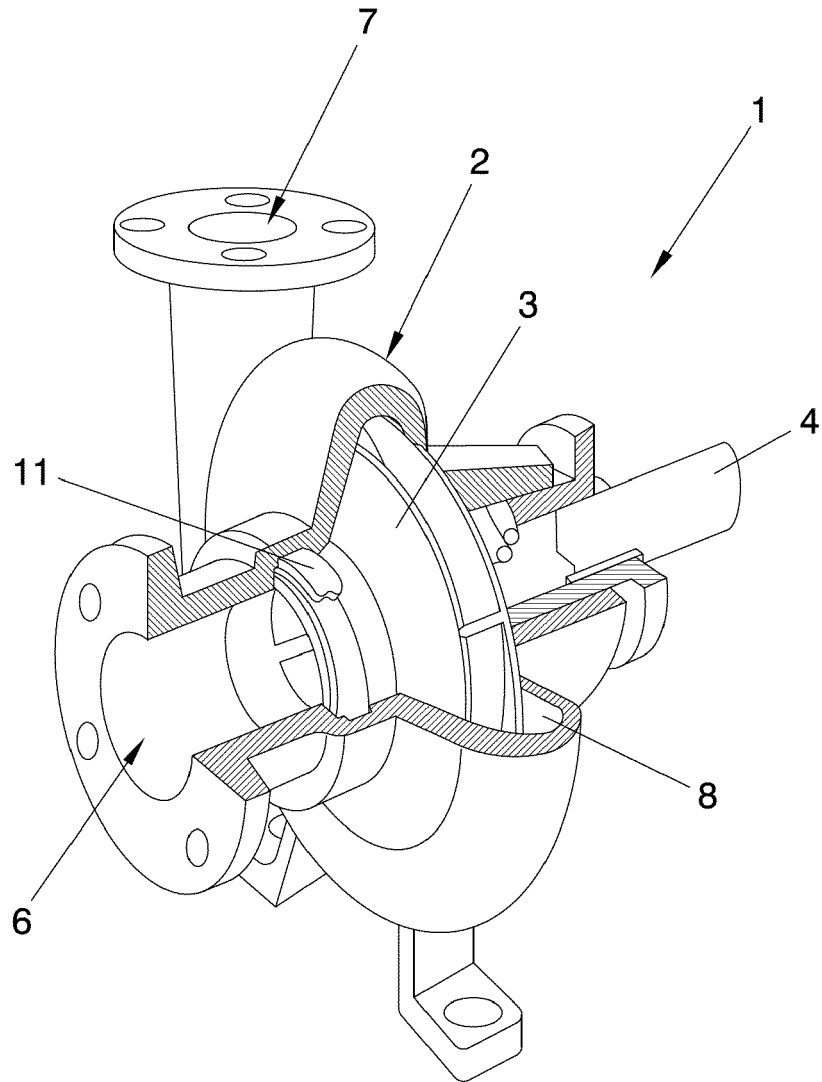
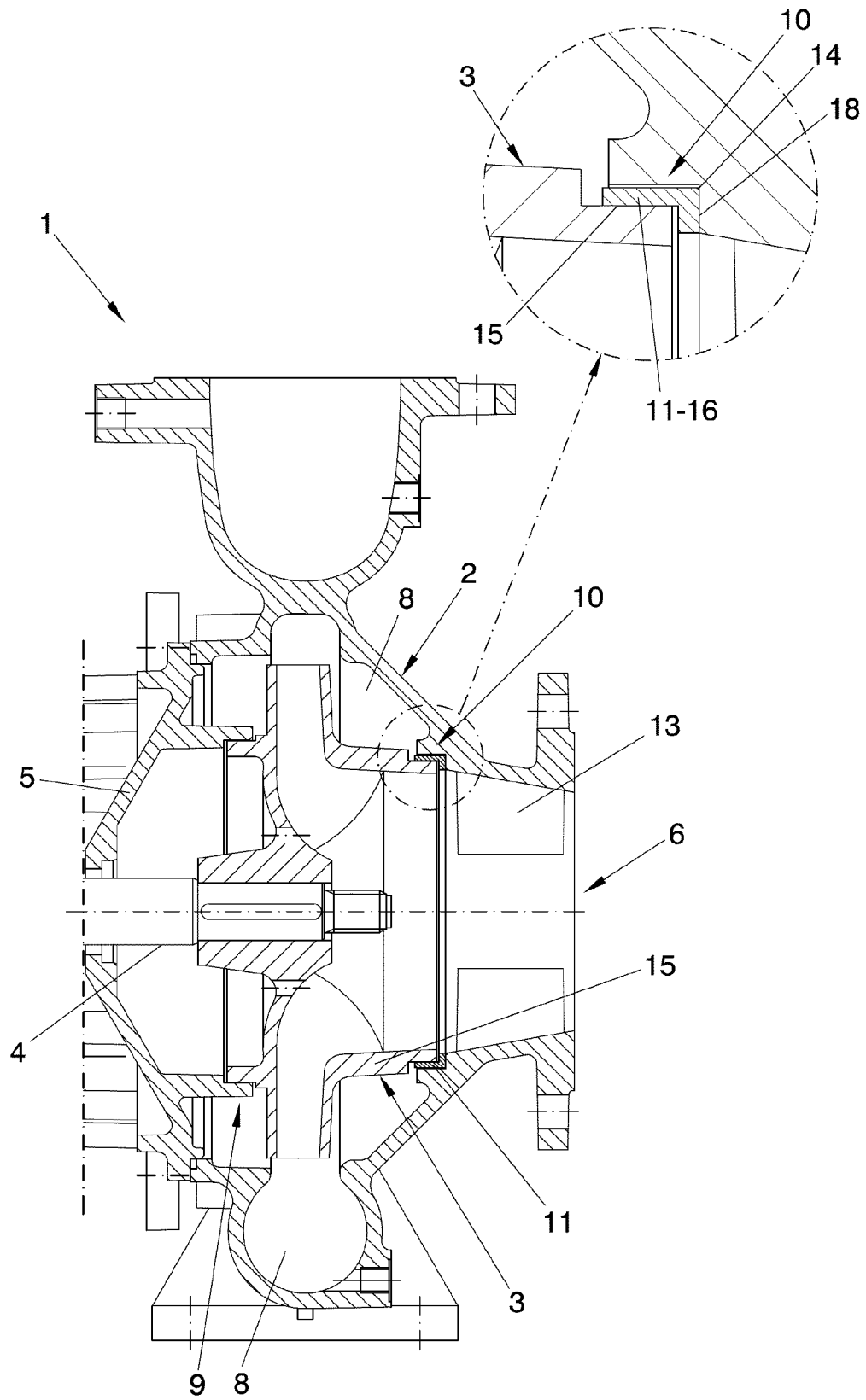


FIG. 1



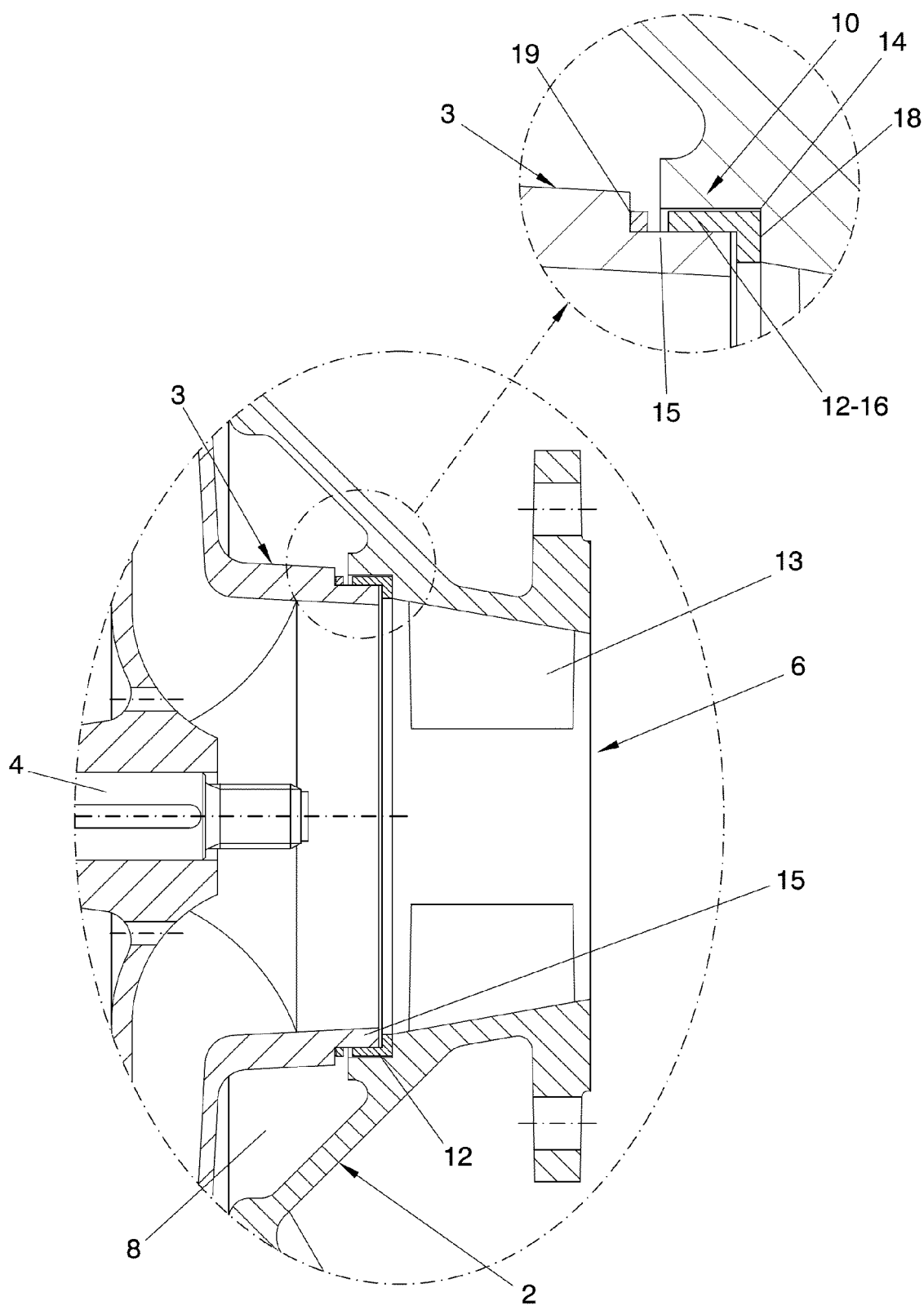


FIG. 3

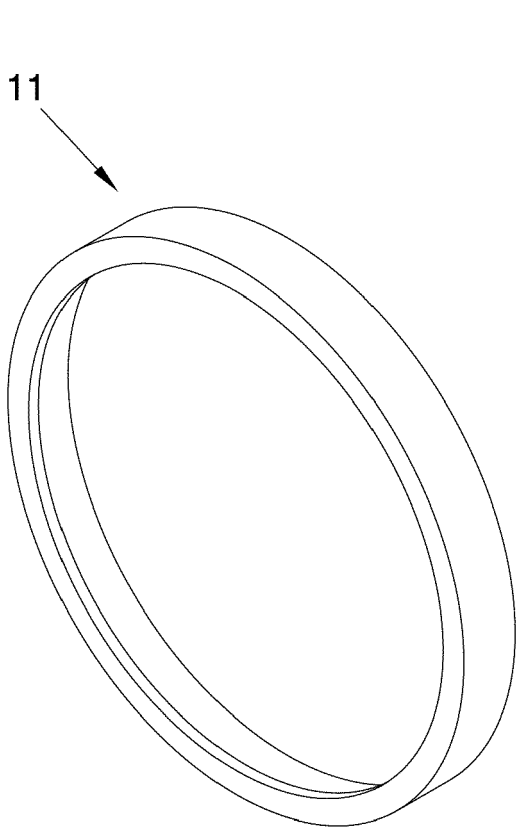


FIG. 4

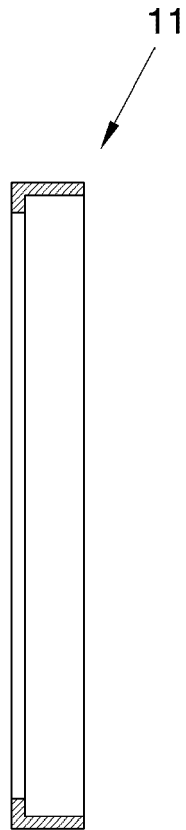


FIG. 5

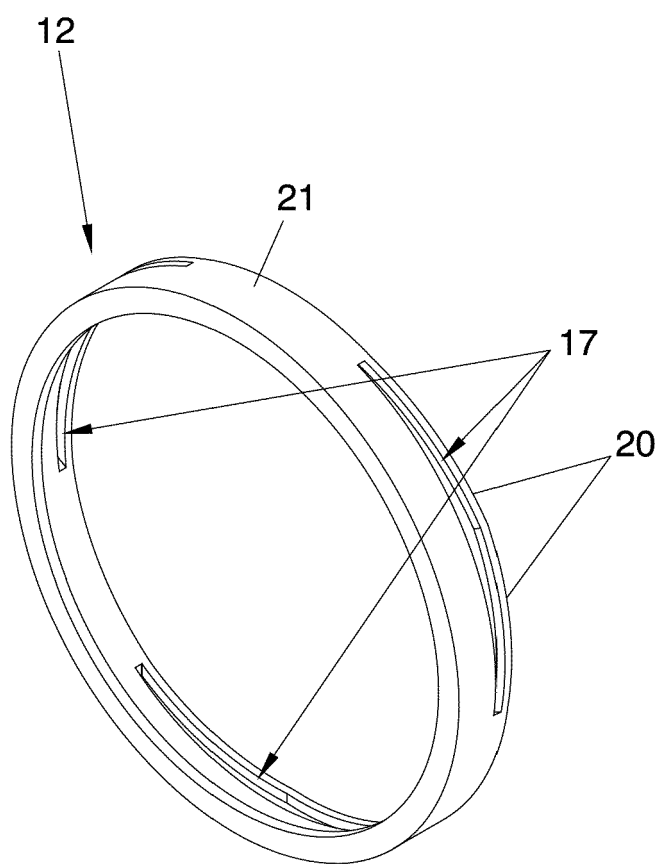


FIG. 6

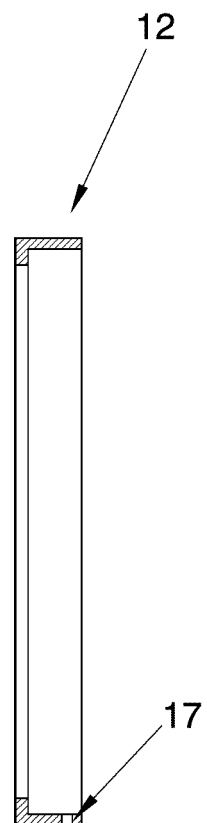


FIG. 7