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(54) **Centrifugal pump**

Kreiselpumpe

Pompe centrifuge

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Description

[0001] The present invention relates to a pump, more specifically, a hydraulic one.

Description of the Prior Art

[0002] At present, there are different types of electro-mechanical pumps used for driving fluids, generally constituted of a chamber containing the electro-magnetic part, basically comprising the stator and the rotor armature, as well as another chamber with a hydraulic part, basically formed of the hydraulic turbine that drives the liquid. However, the electro-magnetic and hydraulic chambers need to be insulated from each other so as to prevent the liquid from reaching the stator and the rotor, causing short-circuits and even irreparable damage. Thus, in order to achieve this insulation of the chambers and transmission of rotation movement from the rotor to the hydraulic turbine, several mechanical apparatus are required, such as an axle, roller bearings, bearing journals, cooling systems, hydraulic seals, among others.

[0003] The roller bearing journals, for instance, have the function of supporting the rotor axle, on which the rotor cage is mounted, so that, when the latter is induced by magnetic forces from the stator, the rotor turns, assisted by these bearings. Of course, the journals are lubricated with oil or grease so as to decrease friction and wear between the parts in contact.

[0004] One end of the rotor axle is connected to the hydraulic turbine, formed of blades, which, upon induction of the rotor, begins a rotational movement driving the liquid to be pumped.

[0005] To prevent the temperature of both the stator and the rotor from reaching undesired levels during their functioning, external cooling systems are used, usually constituted of ventilators. Such cooling systems generally comprise propellers coupled to the end of the rotor axle, outside the pump and opposed to the hydraulic pump, which, taking advantage of the rotation of the rotor, turns to cool both the stator and the rotor.

[0006] The pumps of the prior art depend upon the perfect functioning of the mechanical seals to prevent the liquid from passing from the hydraulic chamber into the electro-magnetic chamber. As already mentioned, this undesirable contact of the liquid with the stator and rotor may cause short-circuits, as well as a decrease in the lubrication of the journals, resulting in possible seizure of the rotor.

[0007] Therefore, one can verify the fact that the prior art pumps have hydraulically insulated chambers, wherein an induced, rotor located in a hermetically sealed chamber, transmits rotation by means of its axle to a hydraulic turbine located in another liquid-passage chamber, making it necessary for these pumps to have a number of sealing mechanisms to prevent the occurrence of damage that might even render them useless. In addition, with use the consequent wear of these mech-

anisms, such pumps lose their mechanical efficiency. Thus, this combination has the drawback of entailing high costs, because it involves expensive parts, a complex manufacturing process and constant maintenance to keep such pumps functioning.

[0008] In view of this, the main objective of the present invention is to simplify the composition of a traditional pump by eliminating sealings, such as mechanical seals or gaskets, as well as roller bearings, axles and external cooling systems, such as ventilators, thereby reducing the chance of the pump being damaged. This new pump motor further provides cooling of the stator-rotor assembly by circulating the pumped fluid itself, as described in patent application PI 0004206-4.

[0009] In addition, the invention also has the objective of providing a new pump that is more compact than the present ones, easy to manufacture and assemble, by virtue of its smaller number of components, thus resulting in better automation and cost reduction.

[0010] Another objective of the present invention is to provide a pump that is more efficient, that is, presenting lower energy loss.

[0011] In addition, the invention aims at providing a safer, more protected and corrosionproof pump motor, enabling immersion and installation in environments that are aggressive and without cooling.

[0012] A further objective of the present invention is to provide a pump with a very low noise level and lubrication provided by the circulating fluid itself.

[0013] DE 38 22897 discloses a centrifugal pump having vanes mounted at one end of an axle, the axle being supported by mechanical bearings close to its both ends. The pumped medium flows, from an inlet at one end of the axle, between the axle and a rotor of an electric motor mounted about the axle to rotate the vanes, along to the vanes which then impel the medium through an outlet at the circumference of the vanes.

[0014] EP 0612 135 discloses a centrifugal pump having a turbine which pumps a fluid from an inlet at the centre of the turbine to an outlet at its circumference. The turbine is connected by a short shaft to a rotor of a motor that turns the turbine, and the turbine and rotor are disposed inside a common chamber. The rotor is provided with two axially spaced rings, which locate the rotor and turbine for rotation inside the walls of the chamber. A duct, external to the chamber is provided between the inlet and the far side of the rotor to allow the fluid to circulate over the rotor.

Summary of the Invention

[0015] The present invention achieves all these objectives by means of a pump comprising a casing, having at least one first hermetically sealed chamber and at least one second chamber adjacent to said first chamber, provided with a fluid passage and having an inlet and an outlet for fluids. Said chambers are separated by means of walls, preferably made of injected polymer.

[0016] The pump further comprises a stator located in the first chamber. In a preferred embodiment, the stator is in a position adjacent to the walls that separate the first chamber from the second, so that the fluid circulating through the second chamber will cool it by heat transmission.

[0017] An integral rotor-turbine assembly, wholly located in the second chamber, is provided, and at least a portion of said assembly is positioned concentrically in relation to the stator. This assembly is induced by the stator to drive a fluid from the inlet to the outlet. When the pump is functioning, at least a fluid film is maintained around the assembly, in order to bring about perfect rotation with minimum friction and without any need for journals. The space between said assembly and the stator, called a gap, is substantially filled with said walls of the first and second chambers, including, furthermore, the fluid film circulating between them.

[0018] A metallic component, called the rotor cage, preferably composed of iron and aluminium, capable of being induced by the stator, is provided inside the hermetically sealed assembly. In the preferred embodiment, such an assembly is made from polymeric material. The assembly is bored through to provide a passage for the turbine inside the rotor. In possible embodiments of the present invention, the turbine of said assembly is composed of turbine blades to centrifuge the fluids. In this way, upon functioning of a possible embodiment of the pump, the fluid, after passing through the inlet of the second chamber, goes into the rotor-turbine assembly, passes through the internal passageway and, after reaching the turbine blades, is driven towards the outlet.

[0019] However, a portion of the fluid, instead of coming out directly through the outlet, circulates around the first chamber and cools the stator by heat transmission. In this way, the need for an external cooling system is eliminated, since the heat exchange between the circulating fluid and the driving assembly will result in cooling this assembly, so that its temperature will always remain at desirable levels for its good functioning.

[0020] In addition, the circulating fluid is also used as a lubricant. A film of circulating fluid will pass between the walls of the second chamber and the rotor-turbine assembly, allowing the latter to make a floating rotary movement within the second chamber by virtue of the inducing forces.

[0021] In view of the foregoing, the pump of the present invention provides a simpler configuration with less expensive manufacture, since it is basically composed of an induction means and a movement-transmission means similar to those of the prior art, such as stators and rotors, which eliminate the use of a ventilator, as well as roller bearings, axles and mechanical seals.

Brief Description of the Drawings

[0022] The present invention will now be described in greater detail with reference to the drawings.

Figure 1 is a cross-section side view of a typical pump motor of the prior art; and

Figure 2 is a cross-section side view of the device for driving fluids of the present invention.

Detailed Description of the Figures

[0023] Figure 1 shows a present-day pump, encountered in the prior art, comprising a coiled stator 4, a rotor 5 and roller bearings 3, which support the axle 9 on which the cage of said rotor 5 is mounted. The axle 3 will be responsible for transmitting driving force from the rotor 5 by means of induction of the magnetic field of the stator 4. One can also note in this figure the existence of a ventilator 1, which is responsible for cooling the stator-rotor assembly, and of covers 2 located on both sides of the rotor 5, which support said roller bearings.

[0024] In addition, in order to achieve a good functioning of this type of pump motor, the rotor 5 has to be perfectly centered with respect to the stator 4, so as to avoid contact between their magnetic iron. In the pump motor represented in figure 1, this space between the rotor 5 and the stator 4, called a gap, is filled with air.

[0025] Figure 1 further illustrates mechanical seals 8, which are widely used in the pump motors of the prior art, to guarantee ventilation and separation between the electric part and the hydraulic part of the pump motor, the hydraulic part being constituted of the turbine 7 and the volute 6.

[0026] Figure 2, on the other hand, illustrates a preferred embodiment of the present invention, in which some of the elements shown in figure 1 are absent. This embodiment illustrates a pump 10 comprising a casing 14 having a first hermetically sealed chamber 19 and a second internal chamber 17 with at least one inlet 15 and one outlet 16 defining the passageway 18 between said inlet and outlet. The casing 14 may be made from a polymeric material or any other type of material suitable for the specified conditions, including bad weather.

[0027] An integral rotor-turbine assembly 11 is located in the chamber 17 to drive the fluids that pass through said chamber. This assembly is made from a polymeric material and, in addition, is bored through to define a passageway for the turbine inside the rotor. In this embodiment, the turbine of said assembly is composed of blades for centrifuging the fluids. In this way, when in operation, the fluid, after passing through the inlet 15 of the chamber 17, goes into the rotor-turbine assembly 11, passes through the internal passageway, and, after reaching the turbine blades, is driven toward the outlet 16.

[0028] The casing 14 also has a first chamber 19, hermetically sealed from the fluids that circulate through the second chamber 17. Both the external walls of the casing and the walls that separate the second chamber 17 from the first chamber 19 are formed of injectable polymeric material. In addition, the stator 12, which may be any one of those known from the prior art, is installed in this first chamber 19 to induce, by means of a magnetic field, the

driving of the rotor-turbine assembly 11, located in the second chamber 17 of fluid circulation.

[0029] This embodiment of the pump of the present invention also has its second chamber 17 defining passageways other than that going from the inlet to the outlet, so that a portion of the fluids will circulate through this chamber. Such passageways in this embodiment cause the fluid to circulate around the first chamber 19, cooling the stator 12 located therein by heat transmission.

[0030] In addition, a small portion of the fluid that enters inlet 15 and circulates through the second chamber 17 passes through the communication means 13 between one of the walls of the second chamber 17 and the rotor-turbine assembly 11, creating a constant fluid film, which enables this assembly to turn freely submerged in the liquid, without having any contact with the walls of the second chamber 17 while the pump is functioning. In this way, such a film acts as a support for the assembly 11 and, at the same time, as a lubricant that virtually eliminates friction between the walls of the second chamber and of the assembly 11, further resulting in a very low noise level. Although the assembly 11 is submerged in the liquid, without contact with the walls of the second chamber 17, the magnetic field created by the stator 12 maintains the former in a balanced position around its axle, so that, upon rotational movement, the magnetic forces prevent the assembly from contacting the walls of the second chamber 17.

[0031] In view of the foregoing, since the second chamber 17 has passageways that enable the liquid to circulate through it, a reduction in noise level is achieved, and this also eliminates the need for industrial lubricants and external cooling systems. Since the pump is basically composed of an injectable polymeric material and there is a decrease in the number of components (i.e. does not include seals) in comparison with those of the prior art, it becomes simpler and less expensive to assemble. In addition, the energy losses are minimised by the low friction between the rotor-turbine assembly 11 and the walls of the second chamber 17.

[0032] Another important aspect of the present invention is that the space between the stator 4 and the rotor 5 of the pumps of the prior art, the so-called gaps, are filled with air. In the present invention, on the other hand, in addition to the liquid layer 13, there is the polymeric wall of both the second chamber 17 and the rotor-turbine assembly 11, guaranteeing a perfect centering of the magnetic materials of the stator 12 and the assembly 11, as well as a better balanced position of the latter around its axle, so that, upon rotation, contact with the walls of the second chamber 17 will be avoided.

[0033] In addition, the present invention also provides a non-corrosive pump, since only the surface covered with polymer will have contact with the fluid. Therefore, the latter may be aggressive without causing any damage to the pump motor. In addition, since the liquid itself is used as a coolant, the pump of the present invention may be installed in environments without ventilation or even

submerged.

[0034] Having described an example of a preferred embodiment of the invention, it should be understood that the scope of the present invention embraces other possible variations, being limited only by the contents of the accompanying claims.

Claims

1. A centrifugal pump (10) comprising:

a casing (14) having at least one first hermetically sealed chamber (19), and at least one second chamber (17) adjacent to said first chamber, defining a passageway (18) for fluids and having an inlet (15) and an outlet (16) for the fluids, the first and second chambers being separated from each other by walls;

a stator (12) located in said first chamber (19); a rotor-turbine assembly (11), with rotor and turbine, capable of being induced by the stator (12) to drive a fluid from the inlet (15) to the outlet (16), at least a portion of the assembly (11) being positioned concentrically with respect to the stator, the rotor and the turbine being integral and wholly located in the second chamber (17), so that, when in operation, at least a film of fluid (13) will be maintained around said assembly (11), the rotor-turbine assembly (11) being bored through, defining a passageway for the turbine inside the rotor through which the pumped liquid flows.

characterized in that

the film of fluid supports the rotor-turbine assembly to prevent contact with the walls of the second chamber.

2. A pump (10) according to claim 1, **characterized in that** said walls of the first (19) and second (17) chambers are made of injectable polymer.

3. A pump (10) according to claim 1 or claim 2, **characterized in that** said rotor-turbine assembly (11) is of a polymeric material, having a metallic component inside, which is capable of being induced by the stator (12).

4. A pump (10) according to claim 3 **characterized in that** the polymeric part of the rotor-turbine assembly is one piece.

5. A pump (10) according to claim 3 or claim 4, **characterized in that** said metallic component is composed of iron and aluminium.

6. A pump (10) according to any one of claims 1 to 5, **characterized in that** said stator (12) is located in

a position adjacent to the walls that separate said first chamber (19) from said second chamber (17), so that the circulating fluid can cool it by heat transmission.

7. A pump (10) according to any one of claims 1 to 6, **characterized in that** the turbine of said assembly is composed of blades for centrifuging the fluids.
8. A pump (10) according to any one of claims 1 to 7, **characterised in that** the space between the assembly (11) and the stator (12) is substantially filled up by the walls of the first (19) and second (17) chambers.

Patentansprüche

1. Zentrifugalpumpe (10), die Folgendes aufweist:

- ein Gehäuse (14), das mindestens eine erste hermetisch abgedichtete Kammer (19), und mindestens eine zweite Kammer (17) angrenzend an die erste Kammer aufweist, wobei das Gehäuse (14) einen Durchgang (18) für Fluide bildet und einen Einlass (15) und einen Auslass (16) für die Fluide aufweist, wobei die ersten und zweiten Kammern durch Wände voneinander getrennt sind;

- einen Stator (12), der in der ersten Kammer (19) angeordnet ist;

- eine Rotorturbinenanordnung (11) mit einem Rotor und einer Turbine, die geeignet ist, durch den Stator (12) dazu angeregt zu werden, um ein Fluid von dem Einlass (15) zu dem Auslass (16) zu führen, wobei zumindest ein Bereich der Anordnung (11) konzentrisch in Bezug auf den Stator positioniert ist, wobei der Rotor und die Turbine integral ausgebildet sind und vollständig in der zweiten Kammer (17) angeordnet sind, so dass im Betrieb zumindest ein Fluidfilm (13) um die Anordnung (11) herum aufrecht-erhalten wird, wobei die Rotorturbinenanordnung (11) durchbohrt ist und einen Durchgang für die Turbine innerhalb des Rotors bildet, durch den die gepumpte Flüssigkeit strömt,

dadurch gekennzeichnet,

dass der Flüssigkeitsfilm die Rotorturbinenanordnung stützt, um einen Kontakt mit den Wänden der zweiten Kammer zu verhindern.

2. Pumpe (10) nach Anspruch 1, **dadurch gekennzeichnet,** **dass** die Wände der ersten Kammer (19) und der zweiten Kammer (17) aus einspritzbarem Polymer hergestellt sind.
3. Pumpe (10) nach Anspruch 1 oder 2,

dadurch gekennzeichnet, dass

die Rotorturbinenanordnung (11) aus einem Polymermaterial besteht, das im Inneren eine Metallkomponente aufweist, die dazu geeignet ist, von dem Stator (12) angeregt zu werden.

4. Pumpe (10) nach Anspruch 3, **dadurch gekennzeichnet,** **dass** das polymere Teil der Rotorturbinenanordnung (11) einstückig ist.

5. Pumpe (10) nach Anspruch 3 oder 4, **dadurch gekennzeichnet,** **dass** die Metallkomponente Eisen und Aluminium aufweist.

6. Pumpe (10) nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet,** **dass** der Stator (12) in einer Position angrenzend zu den Wänden, die die erste Kammer (19) von der zweiten Kammer (17) trennen, derart angeordnet ist, dass ihn das zirkulierende Fluid durch Wärmeübertragung kühlen kann.

7. Pumpe (10) nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet,** **dass** die Turbine der Anordnung Schaufeln zum Zentrifugieren des Fluids aufweist.

8. Pumpe (10) nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet,** **dass** der Abstand zwischen der Anordnung (11) und dem Stator (12) im Wesentlichen durch die Wände der ersten Kammer (19) und der zweiten Kammer (17) gefüllt ist.

Revendications

1. Pompe centrifuge (10) comprenant :

un boîtier (14) ayant au moins une première chambre hermétiquement scellée (19) et au moins une seconde chambre (17) adjacente à ladite première chambre, définissant une voie de passage (18) pour les fluides et ayant une entrée (15) et une sortie (16) pour les fluides, les première et seconde chambres étant séparées l'une de l'autre par des parois ;

un stator (12) positionné dans ladite première chambre (19) ;

un ensemble de rotor-turbine (11) avec un rotor et une turbine, pouvant être induit par le stator (12) afin d'entraîner un fluide de l'entrée (15) à la sortie (16), au moins une partie de l'ensemble (11) étant positionnée de manière concentrique par rapport au stator, le rotor et la turbine étant solidaires et totalement positionnés dans la se-

conde chambre (17), de sorte que, lorsqu'ils sont en fonctionnement, au moins un film de fluide (13) est maintenu autour dudit ensemble (11), l'ensemble de rotor-turbine (11) étant alésé, définissant une voie de passage pour la turbine à l'intérieur du rotor, à travers laquelle le liquide pompé s'écoule,

caractérisée en ce que :

le film de fluide supporte l'ensemble de rotor-turbine pour empêcher le contact avec les parois de la seconde chambre.

2. Pompe (10) selon la revendication 1, **caractérisée en ce que** lesdites parois des première (19) et seconde (17) chambres sont réalisées avec un polymère injectable.
3. Pompe (10) selon la revendication 1 ou la revendication 2, **caractérisée en ce que** ledit ensemble de rotor-turbine (11) est réalisé avec un matériau polymère, ayant un composant métallique à l'intérieur de ce dernier, qui est capable d'être induit par le stator (12).
4. Pompe (10) selon la revendication 3, **caractérisée en ce que** la partie polymère de l'ensemble de rotor-turbine est d'un seul tenant.
5. Pompe (10) selon la revendication 3 ou la revendication 4, **caractérisée en ce que** ledit composant métallique est composé de fer et d'aluminium.
6. Pompe (10) selon l'une quelconque des revendications 1 à 5, **caractérisée en ce que** ledit stator (12) est positionné dans une position adjacente aux parois qui séparent ladite première chambre (19) de ladite seconde chambre (17), de sorte que le fluide circulant peut le refroidir par transmission de chaleur.
7. Pompe (10) selon l'une quelconque des revendications 1 à 6, **caractérisée en ce que** la turbine dudit ensemble est composée de pales pour centrifuger les fluides.
8. Pompe (10) selon l'une quelconque des revendications 1 à 7, **caractérisée en ce que** l'espace entre l'ensemble (11) et le stator (12) est sensiblement rempli par les parois des première (19) et seconde (17) chambres.

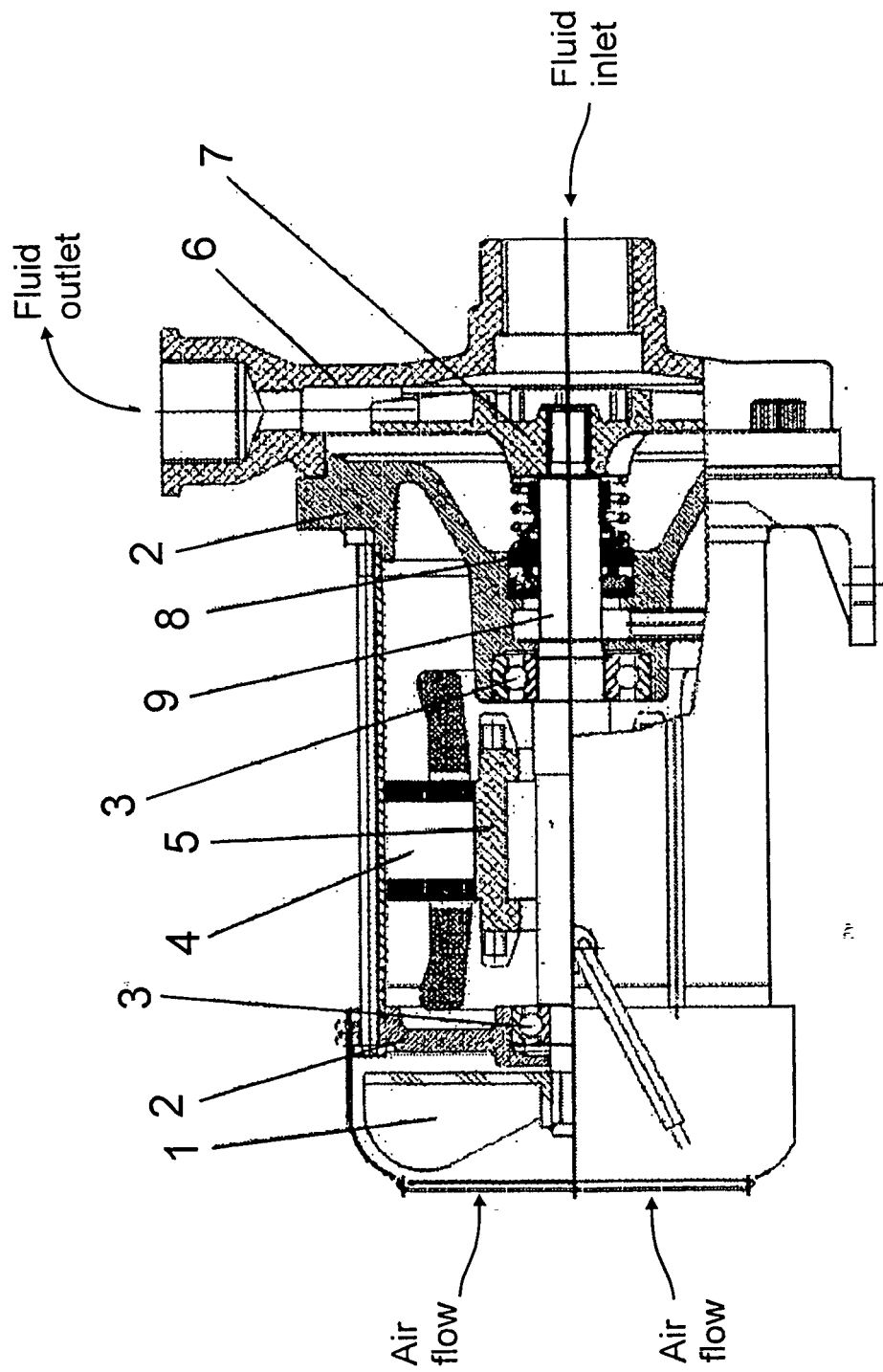


FIG. 1

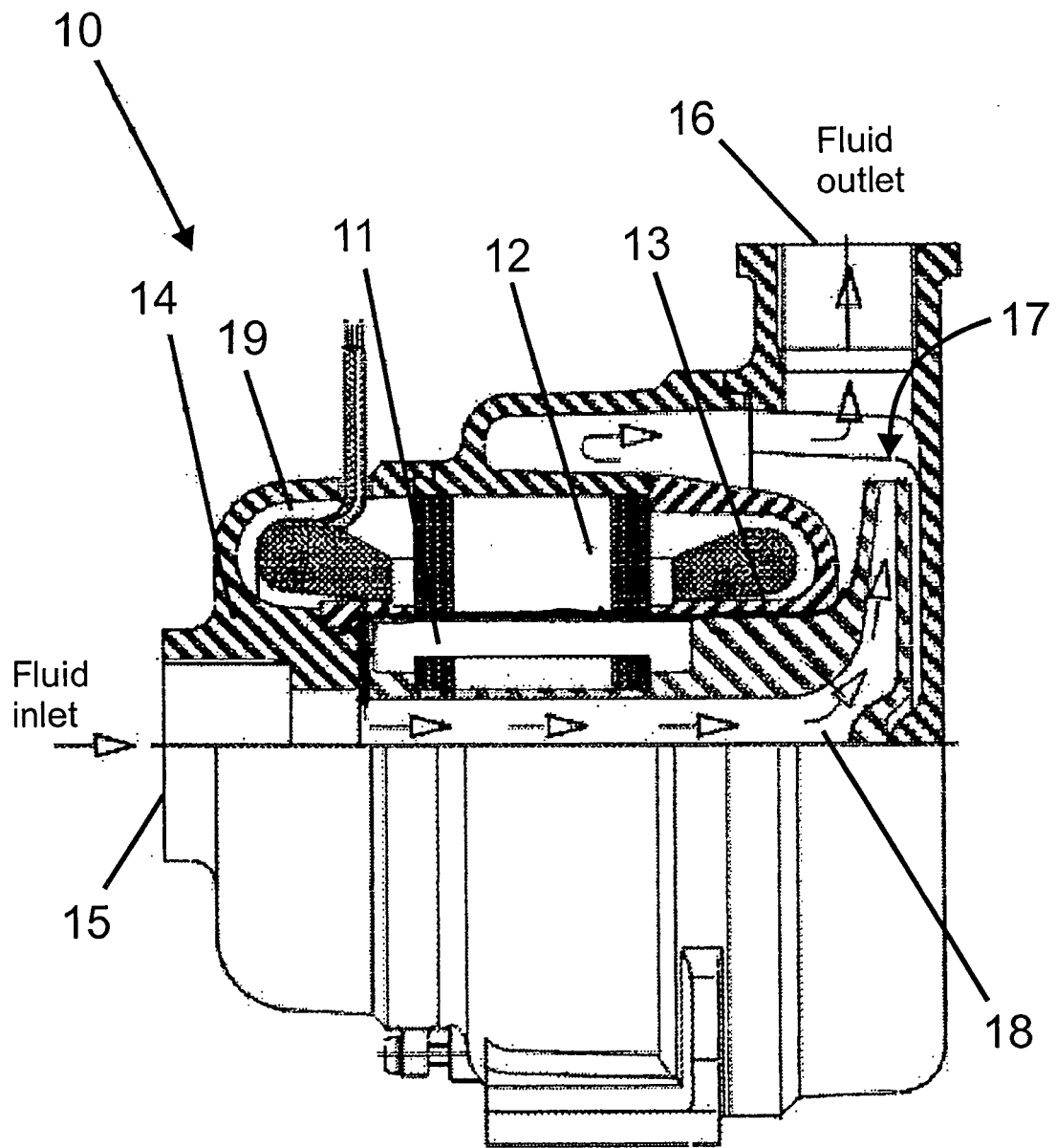


FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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