(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 810 314 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
26.06.2024 Bulletin 2024/26

(21) Application number: **19803929.9**

(22) Date of filing: **16.05.2019**

(51) International Patent Classification (IPC):
F04D 1/00 *(2006.01)* ***F04D 7/04*** *(2006.01)*
F04D 29/18 *(2006.01)* ***F04D 29/42*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04D 29/426; F04D 1/00; F04D 7/04; F04D 29/181; F05D 2260/604

(86) International application number:
PCT/NO2019/050109

(87) International publication number:
WO 2019/221610 (21.11.2019 Gazette 2019/47)

(54) **CENTRIFUGAL PUMP**

ZENTRIFUGALPUMPE

POMPE CENTRIFUGE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **16.05.2018 NO 20180691**

(43) Date of publication of application:
28.04.2021 Bulletin 2021/17

(73) Proprietor: **Hystad, Tore**
5416 Stord (NO)

(72) Inventor: **Hystad, Tore**
5416 Stord (NO)

(74) Representative: **Håmsø Patentbyrå AS**
P.O. Box 9
4068 Stavanger (NO)

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EP 3 810 314 B1

Description

[0001] The invention relates to improvements related to centrifugal pumps and, more specifically, to a centrifugal pump and a related method.

[0002] According to the prior art, centrifugal pumps are simple and reliable machines consisting of: 1) a fixed pump casing with an inlet and an outlet and a bearing housing placed centrally; 2) an impeller supported in the bearing housing and brought to rotate by a motor. The pumping medium is carried axially into the impeller and by way of the latter kinetic energy is imparted in the form of tangential and radial velocity. Part of the velocity is retarded in the spacious peripheral part of the casing; thereby there is a pressure rise in the medium.

[0003] A known problem with the prior art is that the impeller easily becomes clogged or damaged if the pumping medium contains larger solid or tough elements. If the solid elements are fragile, these are also easily damaged when passing the impeller. The problem has previously sought to be solved by withdrawing the impeller, with open blades, out of the fluid stream, so that it creates a rotating vortex in the pump casing that transmits the rotation to the fluid stream by viscous forces, which results in poor efficiency.

[0004] A known problem with the prior art is also that large-capacity centrifugal pumps become very costly to buy and operate: A low number of revolutions and high output require a strong shaft/bearing/seal system; a powerful gear box is often necessary for optimal operation. Casting and accurate machining of large metal parts such as the impeller, pump casing and shaft are expensive; maintenance/service is expensive as well.

[0005] Document DE20 2006 005 067 U1 describes a detachable pump. The pump has a main pump and a loading pump that are formed as separate units, where the main pump is designed as tandem pump.

[0006] Document DE 572 787 C describes an underwater propeller pump, in which the water is supplied to the propeller in a whirling direction opposite to the direction of rotation of the propeller.

[0007] Patent US 6,533,622 B1 describes an axial pump with a propeller located within a cylindrical inlet. An outlet is arranged as an increasing spiral channel immediately downstream of the propeller.

[0008] The invention has for its object to remedy or to reduce at least one of the drawbacks of the prior art or at least provide a useful alternative to the prior art.

[0009] According to a first aspect, the invention provides a centrifugal pump according to claim 1. Such a pump does not have a conventional, centrally placed impeller. The pump comprises a centrifugal pump casing having an inlet for fluid at the centre of the pump casing and an outlet at the periphery of the pump casing, wherein rotation of the fluid around the centre of the pump casing and thereby pressure increase and capacity of the fluid is obtained by one or more active propellers placed inside the pump casing at a distance from the centre of the pump casing and the propeller shaft is approximately tangential to the rotating fluid.

[0010] The propeller may have an adapted grating on the propeller's inlet side, and the propeller with the grating on the inlet side may act directly on a limited part of the fluid, so that harmful or fragile elements in the fluid may pass the pump unobstructedly and without contact with the propeller.

[0011] The propeller, or propellers, may be placed at an optimal distance from the pump centre, regardless of the pump-casing diameter.

[0012] In some embodiments, the propeller(s) may be placed in a pocket (pockets) or a pipe (pipes) in the casing side or casing periphery or where a propeller nozzle surrounds the propeller.

[0013] The centrifugal pump may further have a bearing, a bushing, a seal, a mounting flange and a motor coupling which with the propeller, the shaft and the motor are fitted together as a unit which can easily be released from the pump casing by releasing the mounting flange, so that servicing and inspection of these parts is simplified.

[0014] The centrifugal pump may have a fast-rotating propeller with an optimized pitch direct-coupled to a fast-rotating drive unit, so that it is possible to have a hydrodynamic step-down gearing system.

[0015] The pump casing may be submerged in the fluid, while the motor is placed above the liquid surface on an extended propeller shaft.

[0016] The propeller may have twistable blades, possibly twistable guide blades, so that the propeller pitch can be adjusted for different or varying operating conditions.

[0017] According to a second aspect, the invention provides a method according to claim 9, namely a method for pumping a medium by using a centrifugal pump according to the first aspect of the invention. The method may comprise activating the propeller into rotating about an axis so that the fluid from the pump inlet is set into rotation in the pump casing and is driven out of the outlet from the pump.

[0018] The invention is solely defined by the claims. Examples of embodiments according to the invention will now be described with reference to the accompanying drawings, in which:

Figure 1A	is a section along A-A in Figure 1B through a centrifugal pump according to one embodiment;
Figure 1B	is a section along B-B in Figure 1A;
Figure 2	is a section in larger scale, showing part of a centrifugal pump according to a further embodiment;
Figures 3A to 3D	are side representations, in smaller scale, of centrifugal pumps according to further embodiments with different propeller placements;
Figure 4	is a sectional representation of a

centrifugal pump according to a further embodiment, in which a unit is detachable from the pump casing; and

Figure 5 is a sectional representation of a centrifugal pump according to a further embodiment in use and in smaller scale.

[0019] A centrifugal pump 100 according to the invention as shown in Figures 1A and 1B has a generally conventional centrifugal pump casing 1, with an inlet 2 for the fluid at the centre and an outlet 3 at the periphery. An impeller/shaft system at the centre is eliminated. One (or more) motor-driven propeller(s) 4 is (are) placed in the fluid tangentially to the casing 1. When the propeller is activated in the fluid, the latter is set into rotation in the casing 1, both directly by the propeller jet and by viscous forces in the rest of the casing volume. The centrifugal force and a certain retardation of the fluid at the outlet produces pressure increase and capacity. The propeller 4 has a pitch which is adapted to the pump characteristics and the number of revolutions of the motor; a smaller fast-running motor with no step-down gearing may be used. The shaft/bearing/seal system, too, is reduced in size and simplified. The pump casing 1 is simplified and requires little machining.

[0020] A grating 5 as shown in Figure 2 may be placed on the inlet side of the propeller 4 and formed in such a way that larger solid, tough or fragile elements avoid contact with the latter.

[0021] Alternative placements of the tangential propeller 4 are shown in Figures 3A to 3D. As shown in Figure 4, the propeller 4 with a shaft 11, a bearing, a bushing 10, a seal 12, a mounting flange 8 and a motor with a motor coupling 13 may easily be built as a unit 6 which can be easily taken out of the pump casing 1 for service/cleaning/inspection by releasing the mounting flange 8.

[0022] To optimize the pump 100 for different or continuously varying operating conditions, the propeller 4 may have a settable or continuously adjustably pitch, or adjustable guide blades 14.

[0023] The pump 100 is not self-suctioning; when placed above the liquid surface, a suction line must normally have a check valve.

[0024] When placed below the liquid surface, a watertight motor may be used, or the motor 9 may be mounted above the liquid surface with an extended shaft 15, as shown in Figure 5.

Claims

1. A centrifugal pump without a centrally placed impeller, the centrifugal pump comprising a pump casing (1), one or more active propellers (4) and a corresponding propeller shaft (11) and motor (9), the pump casing (1) being a centrifugal pump casing (1) having an inlet (2) for fluid at the centre of the pump casing (1) and an outlet (3) at the periphery of the pump casing (1), **characterized in that**
rotation of the fluid around the centre of the pump casing (1) and thereby pressure increase and capacity of the fluid is obtained by the one or more active propellers (4) placed inside the pump casing (1) at a distance from the centre of the pump casing (1) and the propeller shaft (11) is approximately tangential to the rotating fluid.

2. A centrifugal pump according to claim 1, wherein an adapted grating (5) on the propeller's inlet side is configured to act directly on a limited part of the fluid, so that harmful or fragile elements in the fluid may pass the pump without obstruction and without contact with the propeller (4).

3. A centrifugal pump according to claim 1 or 2, wherein the distance is an optimal distance from the centre of the pump casing (1), regardless of the pump casing diameter.

4. A centrifugal pump according to any one of the preceding claims, wherein the propeller (4) is placed in a pocket or a pipe in the casing side or the casing periphery or wherein a propeller nozzle surrounds the propeller.

5. A centrifugal pump according to any one of the preceding claims, wherein the propeller (4) with the propeller shaft (11), a bearing, a bushing, a seal, a mounting flange and the motor (9) with a motor coupling are fitted together as a unit which can easily be released from the pump casing by releasing the mounting flange, so that servicing and inspection of these parts is simplified.

6. A centrifugal pump according to any one of the preceding claims, wherein the motor (9) is a fast-rotating drive unit direct-coupled to the propeller and wherein the propeller (4) has a corresponding optimized pitch, so that a hydrodynamic step-down gearing system is provided.

7. A centrifugal pump according to any one of the preceding claims, wherein the pump casing (1) is configured for being submerged in the fluid, wherein the propeller shaft (11) is an extended propeller shaft (15), and wherein the motor (9) is configured for being placed above the liquid surface on the extended propeller shaft (15).

8. A centrifugal pump according to any one of the preceding claims, wherein the propeller has twistable

blades, possibly twistable guide blades, so that the propeller pitch may be adapted for different or varying operating conditions.

9. A method of pumping a medium by using a centrifugal pump according to any one of the preceding claims.

10. A method according to claim 9, which further comprises activating the propeller (4) to rotate about the propeller shaft (11), so that the fluid from the pump inlet (2) is set into rotation in the pump casing (1) and driven out of the outlet (3) from the pump.

11. A method according to claim 9 or 10, wherein the pump casing (1) is located below the water surface.

Patentansprüche

1. Zentrifugalpumpe ohne mittig angeordnetes Flügelrad, wobei die Zentrifugalpumpe ein Pumpengehäuse (1), einen oder mehrere aktive Propeller (4) und eine entsprechende Propellerwelle (11) und einen Motor (9) umfasst,

wobei das Pumpengehäuse (1) ein Zentrifugalpumpengehäuse (1) ist, das einen Einlass (2) für Fluid in der Mitte des Pumpengehäuses (1) und einen Auslass (3) am Umfang des Pumpengehäuses (1) aufweist, **dadurch gekennzeichnet, dass**
eine Rotation des Fluids um den Mittelpunkt des Pumpengehäuses (1) und dadurch eine Druckerhöhung und Kapazität des Fluids durch einen oder mehrere aktive Propeller (4) erreicht wird, die im Pumpengehäuse (1) in einem Abstand von der Mitte des Pumpengehäuses (1) angeordnet sind, wobei die Propellerwelle (11) annähernd tangential zum rotierenden Fluid verläuft.

2. Zentrifugalpumpe nach Anspruch 1, wobei ein angepasstes Gitter (5) auf der Einlassseite des Propellers so ausgebildet ist, dass es direkt auf einen begrenzten Teil des Fluids einwirkt, so dass schädliche oder zerbrechliche Elemente in dem Fluid die Pumpe ungehindert passieren können, ohne mit dem Propeller (4) in Berührung zu kommen.

3. Zentrifugalpumpe nach Anspruch 1 oder 2, wobei der Abstand ein optimaler Abstand von der Mitte des Pumpengehäuses (1) ist, unabhängig vom Durchmesser des Pumpengehäuses.

4. Zentrifugalpumpe nach einem der vorstehenden Ansprüche, wobei der Propeller (4) in einer Tasche oder in einem Rohr an der Gehäuseseite oder am Gehäuseumfang angeordnet ist oder wobei eine Propellerdüse den Propeller umgibt.

5. Zentrifugalpumpe nach einem der vorstehenden Ansprüche, wobei
der Propeller (4) mit der Propellerwelle (11), ein Lager, eine Buchse, eine Dichtung, ein Befestigungsflansch und der Motor (9) mit einer Motorkupplung als eine Einheit zusammengebaut sind, die durch Lösen des Befestigungsflansches leicht vom Pumpengehäuse gelöst werden kann, so dass die Wartung und Inspektion dieser Teile vereinfacht wird.

6. Zentrifugalpumpe nach einem der vorstehenden Ansprüche, wobei
der Motor (9) ein schnell drehendes Antriebsaggregat ist, das direkt mit dem Propeller gekoppelt ist und wobei der Propeller (4) eine entsprechend optimierte Steigung aufweist, so dass ein hydrodynamisches Untersetzungsgetriebe bereitgestellt ist.

7. Zentrifugalpumpe nach einem der vorstehenden Ansprüche, wobei
das Pumpengehäuse (1) ausgebildet ist, um in das Fluid eingetaucht zu werden, wobei die Propellerwelle (11) eine verlängerte Propellerwelle (15) ist, und wobei der Motor (9) ausgebildet ist, um oberhalb der Flüssigkeitsoberfläche auf der verlängerten Propellerwelle (15) angeordnet zu werden.

8. Zentrifugalpumpe nach einem der vorstehenden Ansprüche, wobei der Propeller verdrehbare Blätter, gegebenenfalls verdrehbare Leitblätter, aufweist, so dass die Propellersteigung an unterschiedliche oder wechselnde Betriebsbedingungen angepasst werden kann.

9. Verfahren zum Fördern eines Mediums unter Verwendung einer Zentrifugalpumpe nach einem der vorstehenden Ansprüche.

10. Verfahren nach Anspruch 9, welches weiterhin die Aktivierung des Propellers (4) zur Drehung um die Propellerwelle (11) umfasst, so dass das vom Pumpeneinlass (2) kommende Fluid im Pumpengehäuse (1) in Rotation versetzt und aus dem Auslass (3) der Pumpe herausgetrieben wird.

11. Verfahren nach Anspruch 9 oder 10, wobei sich das Pumpengehäuse (1) unterhalb der Wasseroberfläche befindet.

Revendications

1. Pompe centrifuge sans roue placée au centre, la pompe centrifuge comprenant un boîtier (1) de pompe, une ou plusieurs hélices (4) actives et un arbre

d'hélice (11) et un moteur (9) correspondants,

le boîtier (1) de pompe étant un boîtier (1) de pompe centrifuge présentant une entrée (2) pour le fluide au centre du boîtier (1) de pompe et une sortie (3) à la périphérie du boîtier (1) de pompe, **caractérisée en ce que**
une rotation du fluide autour du centre du boîtier (1) de pompe et ainsi une augmentation de pression et une capacité du fluide sont obtenues par les une ou plusieurs hélices (4) actives placées à l'intérieur du boîtier (1) de pompe à une distance du centre du boîtier (1) de pompe et l'arbre d'hélice (11) est approximativement tangentiel au fluide en rotation.

2. Pompe centrifuge selon la revendication 1, dans laquelle une grille (5) adaptée sur le côté d'entrée de l'hélice est configurée pour agir directement sur une partie limitée du fluide, de sorte que des éléments nocifs ou fragiles dans le fluide puissent passer la pompe sans obstruction et sans contact avec l'hélice (4).

3. Pompe centrifuge selon la revendication 1 ou la revendication 2, dans laquelle la distance est une distance optimale à partir du centre du boîtier (1) de pompe, quel que soit le diamètre du boîtier de pompe.

4. Pompe centrifuge selon l'une quelconque des revendications précédentes, dans laquelle l'hélice (4) est placée dans une poche ou un tuyau dans le côté du boîtier ou la périphérie du boîtier ou dans laquelle une buse d'hélice entoure l'hélice.

5. Pompe centrifuge selon l'une quelconque des revendications précédentes, dans laquelle l'hélice (4) avec l'arbre d'hélice (11), un roulement, une bague, un joint, une bride de montage et le moteur (9) avec un accouplement de moteur sont assemblés ensemble en une unité qui peut facilement être libérée du boîtier de pompe en libérant la bride de montage, de sorte que l'entretien et l'inspection de ces pièces soient simplifiés.

6. Pompe centrifuge selon l'une quelconque des revendications précédentes, dans laquelle le moteur (9) est une unité d'entraînement à rotation rapide accouplée directement à l'hélice et dans laquelle l'hélice (4) présente un pas optimisé correspondant, de sorte qu'un système d'engrenage réducteur hydrodynamique soit fourni.

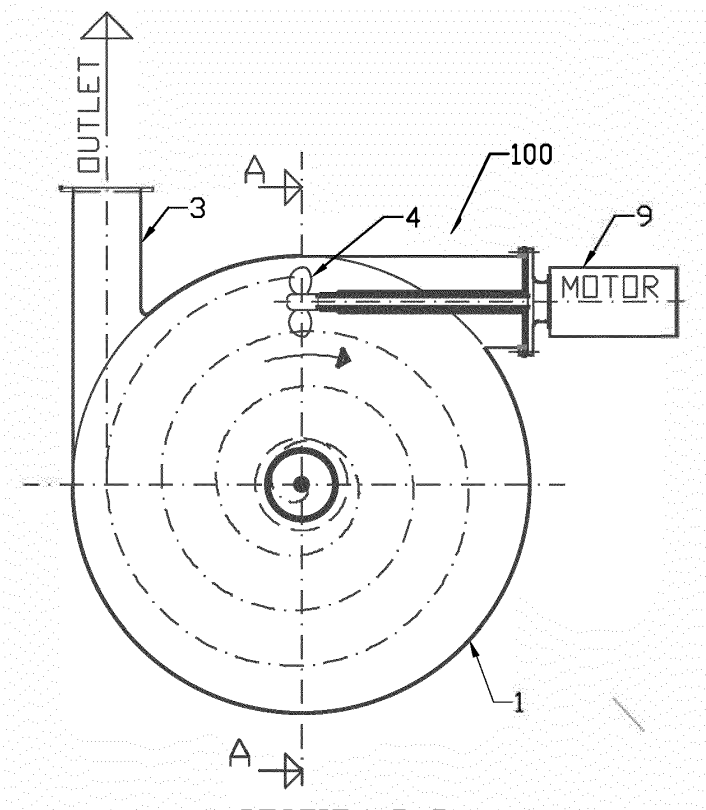
7. Pompe centrifuge selon l'une quelconque des revendications précédentes, dans laquelle le boîtier (1) de pompe est configuré pour être immergé dans le fluide, dans laquelle l'arbre d'hélice (11) est un arbre d'hélice étendu (15), et dans lequel le moteur (9) est configuré pour être placé au-dessus de la surface liquide sur l'arbre d'hélice étendu (15).

8. Pompe centrifuge selon l'une quelconque des revendications précédentes, dans laquelle l'hélice présente des pales déformables, éventuellement des pales de guidage déformables, de sorte que le pas de l'hélice puisse être adapté à des conditions de fonctionnement différentes ou variables.

9. Procédé de pompage d'un milieu à l'aide d'une pompe centrifuge selon l'une quelconque des revendications précédentes.

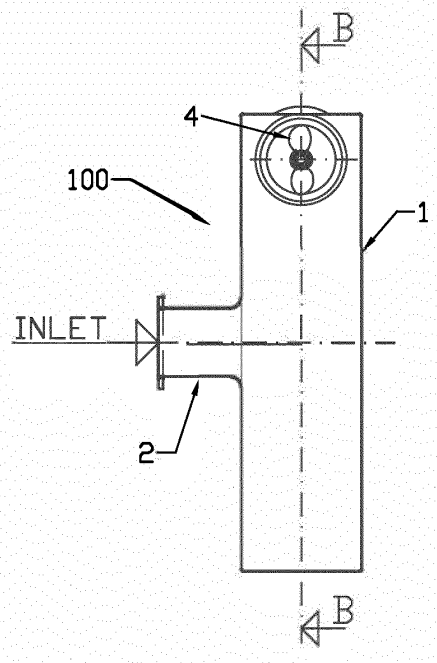
10. Procédé selon la revendication 9, comprenant en outre l'activation de l'hélice (4) pour tourner autour de l'arbre d'hélice (11), de sorte que le fluide provenant de l'entrée (2) de pompe soit mis en rotation dans le boîtier (1) de pompe et entraîné hors de la sortie (3) de la pompe.

11. Procédé selon la revendication 9 ou la revendication 10, dans lequel le boîtier (1) de pompe est situé sous la surface de l'eau.



SECTION B-B

Figure 1B



SECTION A-A

Figure 1A

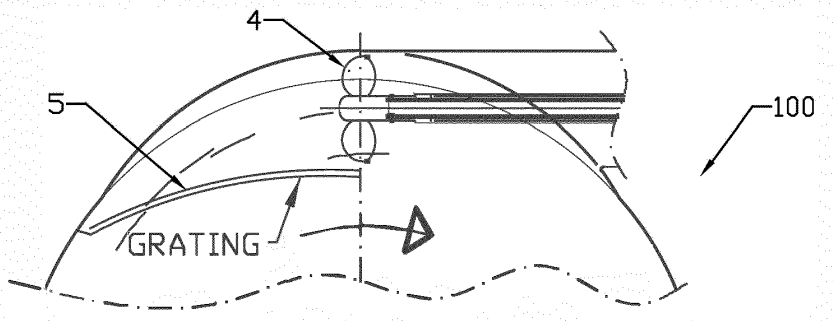


Figure 2

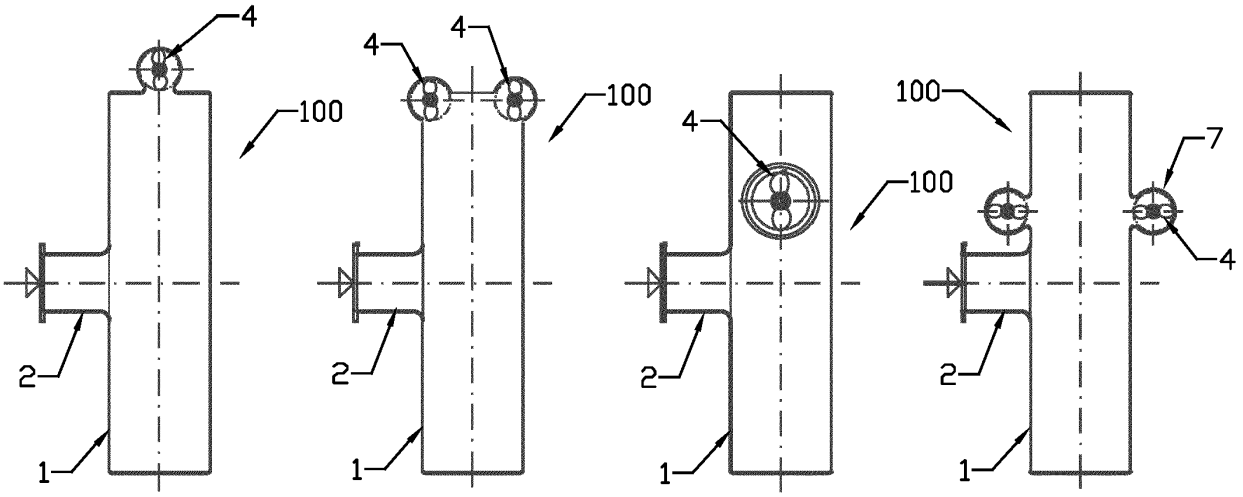


Figure 3A Figure 3B Figure 3C Figure 3D

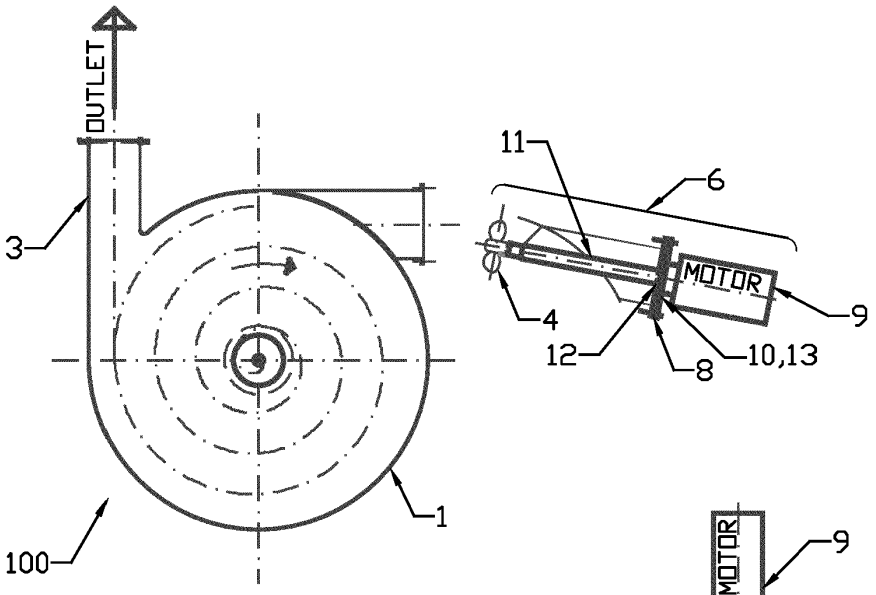


Figure 4

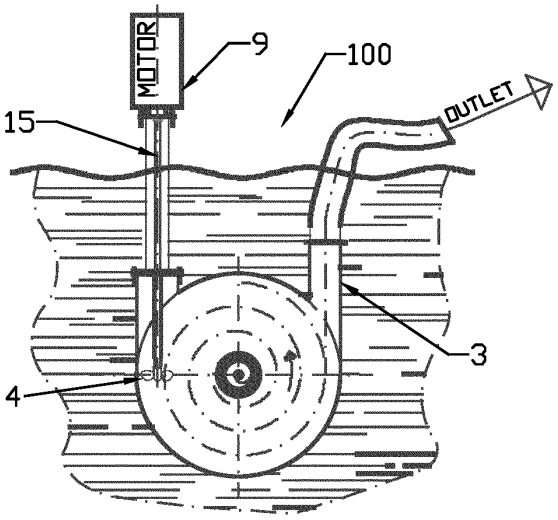


Figure 5

REFERENCES CITED IN THE DESCRIPTION

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