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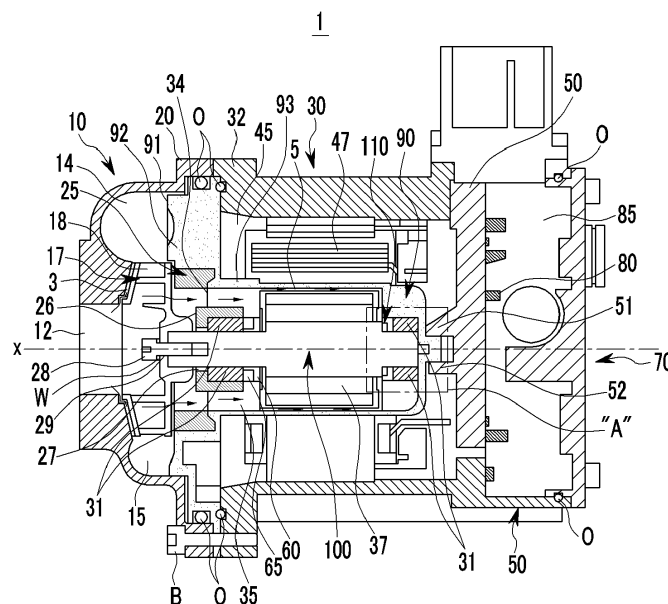
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(54) **ELECTRIC WATER PUMP**

(57) An electric water pump (1) includes a pump cover (10) having an inlet (12) through which coolant flows; a stator chamber (45) having a stator generating a magnetic field according to a control signal; a rotor chamber (35) having a rotor (37) rotating according to the magnetic field generated by the stator; a separation wall (90) configured to separate the stator chamber from the rotor chamber; a shaft (100) having a central axis, fixed to the

rotor so as to rotate together with the rotor about the central axis thereof; and an impeller (17) fixed to a front portion of the shaft so as to rotate together with the shaft, the impeller pressurizing a coolant having flowed in through the inlet, wherein at least one wing portion (110) is formed on a part of the shaft to increase a flow of the coolant.

FIG. 1



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority to Korean Patent Application No. 10-2015-0046992, filed in the Korean Intellectual Property Office on April 2, 2015, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to an electric water pump. More particularly, the present disclosure relates to an electric water pump having a wing portion in order to increase a flow of a coolant.

BACKGROUND

[0003] Generally, a water pump circulates coolant to an engine and a heater to cool the engine and heat a cabin. The coolant flowing out from the water pump circulates through and exchanges heat with the engine, the heater and/or the radiator, and flows back in the water pump.

[0004] The water pump is connected to a pulley fixed to a crankshaft of the engine and is driven according to the rotation of the crankshaft (i.e., the rotation of the engine). Therefore, the coolant amount flowing from the mechanical water pump is determined according to rotational speed of the engine. However, the coolant amount required in the heater and radiator is a specific value regardless of the rotational speed of the engine. Therefore, the heater and the radiator do not properly operate where the engine speed is slow. In order to operate the heater and the radiator normally, the engine speed must be increased. However, if the engine speed is increased, the fuel consumption of a vehicle is also increased.

[0005] The electric water pump is driven by a motor controlled by a control apparatus. The electric water pump can determine the coolant amount regardless of the rotational speed, and can reduce required power by 60-70% as compared with the mechanical water pump. Moreover, the electric water pump is advantageous in view of packaging over the mechanical water pump.

[0006] A DC motor is normally used in the electric water pump, particularly a BLDC (Brushless DC) motor. A controller which can control the BLDC motor is provided with the motor, and an electric circuit is built-in the inside of the controller. As the controller is operated, heat is generated in an electric device. Therefore, sufficient cooling therein is required in order to prevent overheating.

[0007] The BLDC motor has a coolant line between a stator wound with a coil and a rotor with a permanent magnet. However, a space between the stator and the rotor should be within a few millimeters so as to function. Because of such a space constraint, the amount of cool-

ant that flows between the stator and the rotor is not sufficient, and the coolant flow is not smooth. Therefore, the heat produced in the electric water pump is difficult to remove therefrom.

[0008] The above information disclosed in this Background section is only for enhancement of understanding of the background of the disclosure and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE DISCLOSURE

[0009] The present disclosure has been made in an effort to provide an electric water pump to increase a flow of a coolant. An exemplary embodiment of the present disclosure provides an electric water pump having a wing portion in order to increase a flow of a coolant and improve cooling performance.

[0010] The electric water pump may include a pump cover having an inlet through which coolant flows; a stator chamber having a stator generating a magnetic field according to a control signal; a rotor chamber having a rotor rotated by the magnetic field generated by the stator; a separation wall configured to separate the stator chamber from the rotor chamber; a shaft having a central axis, the shaft fixed to the rotor so as to rotate together with the rotor about the central axis; and an impeller fixed to a front portion of the shaft so as to rotate together with the shaft, the impeller pressurizing the coolant flowing through the inlet, wherein at least one wing portion is formed on a part (e.g. surface, e.g. outer surface) of the shaft so as to increase a flow of the coolant. The wing portion may be formed at a front or a rear end portion of the shaft. The shaft may comprise a trunk portion extended through a center of the separation wall along the central axis; and an extending portion having a smaller diameter than the trunk portion and extended from a front portion or a rear portion of the trunk portion along the central axis, wherein the wing portion has at least one rotatable blade protruding from the front portion or the rear portion of the trunk portion so as to increase the flow of the coolant. The wing portion may have at least one rotatable blade protruding outwardly in a radial direction from an exterior circumferential portion of the trunk portion or the extending portion so as to increase the flow of the coolant. The wing portion may have a tapered shape which becomes narrow gradually in a radial direction, and have a sharp end portion. The wing portion may comprise: at least one long blade configured to protrude from the exterior circumferential portion in a radially outward direction; and at least one short blade configured to protrude from the exterior circumferential portion in a radially outward direction, the at least one short blade having a smaller radius (e.g. length in radial direction) of rotation than the long blade. The at least one long blade and the at least one short blade may be alternately arranged (along the circumference). The electric water

pump may further comprise a body having the stator chamber and the rotor chamber; and a driver case mounted at a rear end of the body, having a fixing member protruding in a forward direction so as to fix the separation wall thereto. A separation space may be formed between a rear surface of the separation wall and a front surface of the driver case. A front end portion of the fixing member may be disposed apart from the rear surface of the separation wall.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a cross-sectional view of an electric water pump according to an exemplary embodiment of the present disclosure.

FIG. 2 is an enlarged schematic diagram of a portion A.

FIG. 3 is a perspective view of a wing portion that is applied to an electric water pump according to an exemplary embodiment of the present disclosure.

FIG. 4 is a cross-sectional view of a wing portion that is applied to an electric water pump according to an exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION

[0012] An exemplary embodiment of the present disclosure will hereinafter be described in detail with reference to the accompanying drawings.

[0013] Throughout this specification and the claims which follow, In addition, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements.

[0014] For better comprehension and ease of description, a direction which is left side of a drawing is referred to as "a front surface", "a front portion", or "frontward", and the opposite direction is referred to as "a rear side", "a rear portion" or "rearward".

[0015] Throughout the specification, components denoted by the same reference numerals are the same or similar components.

[0016] FIG. 1 is a cross-sectional view of an electric water pump according to an exemplary embodiment of the present disclosure.

[0017] An electric water pump 1 according to an exemplary embodiment of the present disclosure includes a pump cover 10, a body 30, a driver case 50 and a driver cover 70.

[0018] The body 30 is engaged to a rear end of the pump cover 10 so as to form a volute chamber 14 and a rotor chamber 35. The driver case 50 is engaged to a rear end of the body 30 to form a stator chamber 45, and a driver cover 70 is engaged to a rear end of the driver case 50 to form a driver chamber 85.

[0019] In addition, an impeller 17 is mounted in the volute chamber 14, and the rotor 37 fixed to a shaft 100 is mounted in the rotor chamber 35. A stator 47 is mounted in the stator chamber 45, and a driver 80 is mounted in the driver chamber 85. The shaft 100 has a central axis x, and the rotor 37, as well as the shaft 100, rotate about the central axis x. The stator 47 is disposed coaxially with the central axis x of the shaft 100.

[0020] The pump cover 10 is provided with an inlet 12 at a front end portion thereof and an outlet 15 at a side portion thereof. The coolant flows in the electric water pump 1 through the inlet 12, and the pressurized coolant in the electric water pump 1 flows out through the outlet 15. A slanted surface 3 is formed at a rear end portion 20 of the inlet 12 of the pump 1, and a rear end portion 20 is extended rearward from slanted surface 3. The rear end portion 20 of the pump cover 10 covers a mounting portion 32 of the body 30 by fixing means such as a bolt B. The slanted surface 3 is slanted with reference to the central axis x of the shaft 100.

[0021] The volute chamber 14 for pressurizing the coolant is formed in the pump cover 10, and the impeller 17 for pressurizing the coolant through the outlet 15 is mounted in the volute chamber 14. The impeller 17 is fixed to a front end portion of the shaft 100 and rotates together with the shaft 100. For this purpose, a bolt hole 29 is formed at a middle portion of the impeller 17 and a thread is formed at an interior circumference of the bolt hole 29. An impeller bolt 28 inserted in the bolt hole 29 is threaded to the front end portion of the shaft 100 such that the impeller 17 is fixed to the shaft 100. A washer w may be interposed between the impeller 17 and the impeller bolt 28.

[0022] The coolant flowing into the water pump 1 may be smoothly guided and performance of the water pump 1 may be improved as a consequence of disposing the centers of the impeller 17 and the rotor 37 (rotating elements of the water pump 1) and a center of the stator 47 (a fixed element of the water pump 1) on the central axis x.

[0023] In addition, the impeller 17 is divided into a plurality of regions by a plurality of blades 18. The coolant flowing into the plurality of regions is pressurized by rotation of the impeller 17. Meanwhile, as marked by the arrow in FIG. 1, the coolant flowing in the inlet 12 is delivered into the rotor chamber 35 via the impeller 17.

[0024] The body 30 has a hollow cylindrical shape that is opens to the rear, and is engaged to the rear end portion of the pump cover 10. The body 30 includes an adapter 25, a separation wall 90, the stator chamber 45 and the rotor chamber 35.

[0025] The adapter 25 supports the separation wall 90 at a rear end portion. A bearing mounting portion 26 protrudes rearward from the adapter 25, and a bearing is interposed between the bearing mounting portion 26 and the shaft 100 in order to make the shaft 100 smoothly rotate and to prevent the shaft 100 from being inclined.

[0026] A penetration hole 27 is formed at a middle portion of the adapter 25 such that the front end portion of

the shaft 100 protrudes into volute chamber 14 through the penetration hole 27. The impeller 17 is fixed to a front portion of the shaft 100. It is described in this specification that the impeller 17 is fixed to the shaft 100 by the impeller bolt 28. However, the impeller 17 may also be press-fitted to an exterior circumference of the shaft 100.

[0027] A connecting hole 34 is formed in the adapter 25 radially outward of the bearing mounting portion 26. Therefore, as marked by the arrow, the coolant flowing through the impeller 17 is delivered into the rotor chamber 35 through the connecting hole 34. In addition, the coolant flowing in the rotor chamber 35 passes through a gap 5 formed between the separation wall 90 and the rotor 37. Heat generated at the shaft 100, the rotor 37 and the stator 47 by operation of the water pump 1 is cooled by the coolant flow. Therefore, the durability of the water pump 1 may be improved. Further, floating materials in the coolant are prevented from accumulating in the rotor chamber 35.

[0028] The separation wall 90 is formed in a cup-shaped opened in the impeller 17 direction, and is interposed between the stator 47 and the rotor 37. The stator 47 is disposed outwardly in a radial direction, and the rotor 37 is disposed inwardly in a radial direction.

[0029] The separation wall 90 includes a front surface 91 forming a volute chamber 14 between the pump cover 10 and the front surface 91. The front surface 91 of the separation wall 90 is provided with a first partition 92, and a second partition 93 formed sequentially from an exterior circumference to a center thereof.

[0030] The first partition 92 is engaged to the rear end portion 20 of the pump cover 10. Sealing means such as an O-ring O may be interposed between the first partition and the rear end portion 20 to prevent leakage of the coolant from the volute chamber 14.

[0031] The second partition 93 protrudes rearward from the front surface 91, and defines a boundary between the stator chamber 45 and the rotor chamber 35. The stator 47 is mounted outwardly in the radial direction of the second partition 93.

[0032] The stator chamber 45 is formed at a radially outer portion of the separation wall 90, and the stator 47 is mounted in the stator chamber 45. The stator 47 is fixed to the body 30, directly or indirectly, and generates a magnetic field according to a control signal that is obtained from an outside source.

[0033] The rotor chamber 35 is formed at a radially inner portion of the separation wall 90, and a supporting portion 60, rotor 37 and shaft 100 are mounted in the rotor chamber 35.

[0034] The supporting portion 60 is made of an elastic rubber material, and relieves the thrust of the shaft 100 exerted to the bearing 31. Meanwhile, when the supporting portion 60 is connected with the bearing 31 directly, a rotational friction may be generated between the bearing 31 and the supporting portion 60 of the rubber material, and may deteriorate performance of the water pump 1. Therefore, a thrust ring 65 is mounted between the

bearing 31 and the supporting portion 60, and the rotation friction may be reduced.

[0035] The rotor 37 is fixed to the external circumference portion of the shaft 100 in a cylinder shape by, for example, a press-fit or weld. The permanent magnet is mounted at the rotor 37, and the rotor 37 rotates by the magnetic field generated in the stator 47.

[0036] Referring to FIG. 2 to FIG. 4, shaft 100 will be described in detail below.

[0037] FIG. 2 is an enlarged schematic diagram of a portion A, FIG. 3 is a perspective view of a wing portion that is applied to an electric water pump according to an exemplary embodiment of the present disclosure, and FIG. 4 is a cross-sectional view of a wing portion that may be applied to an electric water pump according to an exemplary embodiment of the present disclosure.

[0038] As shown in FIG. 2 to FIG. 4, shaft 100 may include a trunk portion 105, an extending portion 120 and a wing portion 110. The trunk portion 105 may be extended in a center of the separation wall 90 along the central axis x. The extending portion 120 may be extended from the trunk portion 105 forward or rearward in an axial direction which may have a smaller radius than the trunk portion 105.

[0039] At least one or more wing portions 110 may be provided on a front or rear portion of the shaft 100. If the shaft 100 rotates, the wing portion 110 rotates together with it. The wing portion 110 is formed in a wing shape so as to create more flow of a fluid when the shaft 100 rotates. In other words, the wing portion 110 may be extended in an axial direction from the front or rear side of the trunk portion 105, and may be extended from an exterior circumference of the extending portion 120 in a radially outward direction.

[0040] The wing portion 110 may be formed as a common blade, and it is well known to a person of ordinary skill in the art. Therefore, as the wing portion 110 rotates with rotation of the shaft 100, a kinetic energy generated by the wing portion 110 increases a flow of the fluid. The water pump 1 may be cooled quickly by the coolant passing through the gap 5 between the shaft 100 and the separation wall 90.

[0041] Meanwhile, the wing portion 110 may be in a shape integrally formed at the rear end portion of the shaft 100 in this specification, but the present disclosure is not limited thereto. The wing portion 110 may also be disposed or formed at any part (e.g. surface, e.g. outer surface) of the shaft 100, including the front end portion of the shaft 100 by which coolant flows.

[0042] According to an exemplary embodiment of the present disclosure, as shown in FIG. 3 to FIG. 4, the wing portion 110 may be provided to protrude from a lateral surface of the trunk portion 105 or the exterior circumference of the extending portion 120. The wing portion 110 may include at least one long blade 111 and at least one short blade 112.

[0043] Referring to FIG. 4, each long blade 111 may be formed at the exterior circumference of the extending

portion 120 and may be more extended than the short blade 112 in a radially outward direction. Also, each short blade 112 may be disposed between each long blade 111.

[0044] Therefore, when the shaft 100 rotates, a change of the flow may be higher than that caused when forming the long blade 111 and the short blade 112 as a same size. Thus, cooling performance may be improved.

[0045] While each long blade 111 and each short blade 112 may be extended in a radially outward direction, a thickness of each blade may be thinned. For example, the long and short blades 111, 112 may be in a tapered shape. The end portions of the long and short blades 111, 112 may be formed as a sharp shape. Therefore, lateral surfaces of each long blade 111 and each short blade 112 may be formed to be slanted, and the shaft 100 may rotate in order to increase the flow of coolant while minimally being affected by a torque resistance.

[0046] The driver case 50 is engaged to a rear end of the body 30 to form the stator chamber 45. As shown in FIG. 2, the driver case 50 may include a first fixing member 51 and a second fixing member 52 which may protrude forward in order to support the separation wall 90. A part of the separation wall 90 may be inserted between the first fixing member 51 and the second fixing member 52, and fixed therebetween.

[0047] Separation spaces D1, D2, and D3 may be formed between a rear surface of the separation wall 90 and a front surface of the driver case 50. Each separation space D1, D2, and D3 may be formed between the rear end surface of the separation wall 90 and the front end surface of the driver case 50, between the rear surface of the separation wall 90 and a front end of the first fixing member 51, and between the rear surface of the separation wall 90 and a front end of the second fixing member 52. These separation spaces D1, D2, and D3 prevent a vibration by the thrust of the shaft 100 from being exerted to driver 80 disposed at a rear of the driver case 50.

[0048] The driver cover 70 may be formed from the driver case 50 in an axial direction, and may be in a disk shape. The driver cover 70 is engaged to the driver case 50 by fixing means such as a bolt so as to form a driver chamber 85. Sealing means such as an O-ring O may be interposed radially outward of the driver cover 70 to prevent foreign substances, such as dust, from entering the driver chamber 85.

[0049] The driver 80 controlling operations of the water pump 1 is mounted in the driver chamber 85. The driver 80 includes microprocessors and a printed circuit board (PCB). The driver 80 is electrically connected to a controller (not shown) disposed at an exterior of the electric water pump 1 and receives a control signal from the controller.

[0050] As described above, according to an exemplary embodiment of the present disclosure, the shaft 100 rotates with a rotor 37 and is provided with the wing portion 110. Therefore, a flow of a coolant passing through the gap 5 between the shaft 100 and the separation wall 90

is increased. As a result, the electric water pump 1 may have a high cooling efficiency and performance level.

[0051] While this disclosure has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the disclosure is not limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

Claims

1. An electric water pump(1) comprising:

a pump cover(10) having an inlet(12) through which a coolant flows;
a stator chamber(45) having a stator that generates a magnetic field according to a control signal;
a rotor chamber(35) having a rotor(37) rotated by the magnetic field;
a separation wall(90) configured to separate the stator chamber(45) from the rotor chamber(35);
a shaft(100) having a central axis(x), the shaft(100) fixed to the rotor(37) so as to rotate together with the rotor(37) about the central axis(x); and
an impeller(17) fixed to a front portion of the shaft(100) that rotates together with the shaft(100) and pressurizes the coolant flowing through the inlet(12),
wherein at least one wing portion(110) is formed on a part of the shaft(100) to increase a flow of the coolant.

2. The electric water pump(1) of claim 1, wherein the wing portion(110) is formed at a front or a rear end portion of the shaft(100).

3. The electric water pump(1) of claim 1 or 2, wherein the shaft(100) comprises:

a trunk portion(105) extended through a center of the separation wall(90) along the central axis(x); and
an extending portion(120) having a smaller diameter than the trunk portion(105) and extended from a front portion or a rear portion of the trunk portion(105) along the central axis(x),
wherein the wing portion(110) has at least one rotatable blade (111,112) protruding from the front portion or the rear portion of the trunk portion(105) so as to increase the flow of the coolant.

4. The electric water pump(1) of claim 3, wherein the wing portion(110) has at least one blade(111,112)

protruding outwardly in a radial direction from an exterior circumferential portion of the trunk portion(105) and/or the extending portion(120) to increase the flow of the coolant.

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5. The electric water pump(1) of any one of claims 1 to 4, wherein the wing portion(110) has a tapered shape which becomes narrow gradually in a radial direction, and has a sharp end portion.

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6. The electric water pump(1) of any one of claims 1 to 5, wherein the wing portion(110) comprises:

at least one long blade(111) configured to protrude from the exterior circumferential portion in a radially outward direction; and

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at least one short blade(112) configured to protrude from the exterior circumferential portion in a radially outward direction, the at least one short blade(112) having a smaller radius of rotation than the long blade(111).

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7. The electric water pump(1) of claim 6, wherein the at least one long blade(111) and the at least one short blade(112) are alternately arranged.

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8. The electric water pump(1) of any one of claims 1 to 7, further comprising:

a body(30) having the stator chamber(45) and the rotor chamber(35); and

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a driver case (50) mounted at a rear end of the body(30), having a fixing member(52) protruding in a forward direction to fix the separation wall(90) thereto.

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9. The electric water pump(1) of claim 8, wherein a separation space is formed between a rear surface of the separation wall(90) and a front surface of the driver case(50).

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10. The electric water pump(1) of claim 9, wherein a front end portion of the fixing member(52) is disposed apart from the rear surface of the separation wall(90).

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FIG. 1

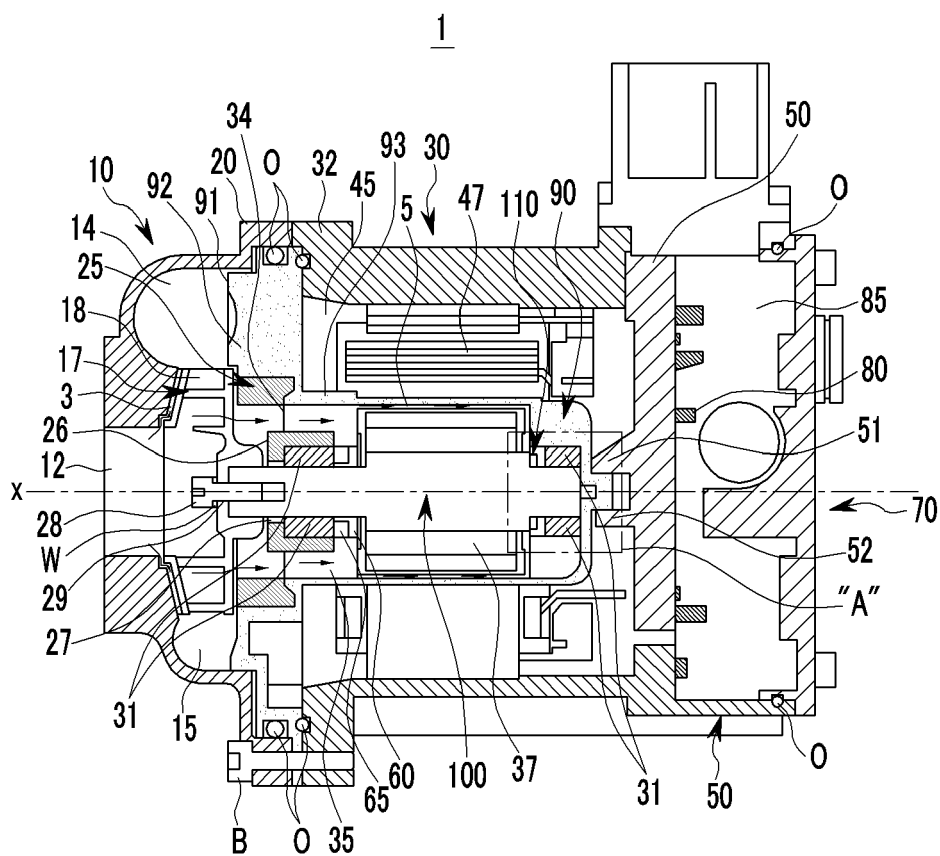


FIG. 2

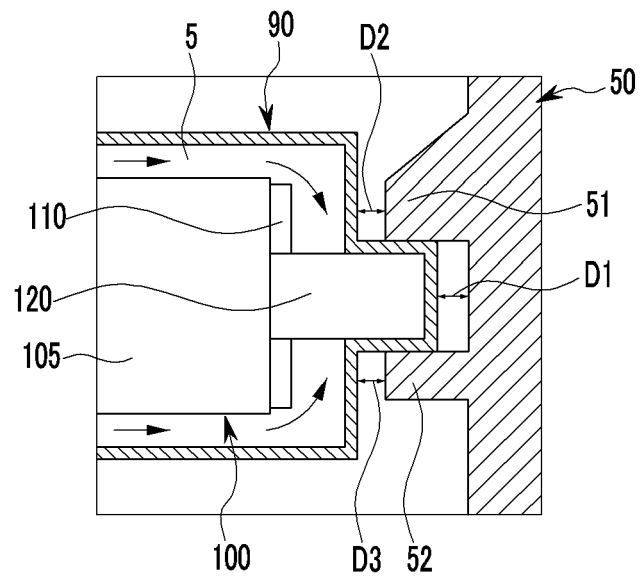


FIG. 3

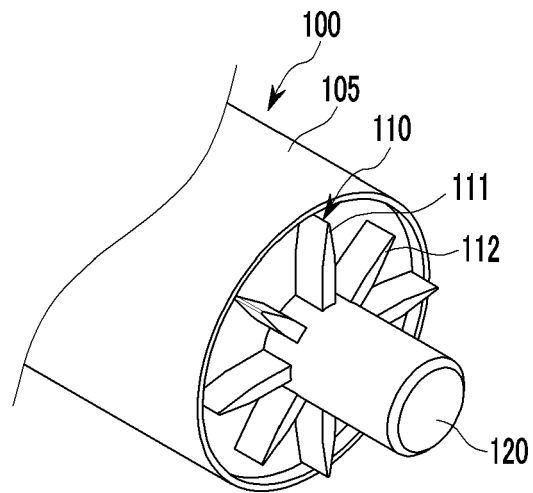
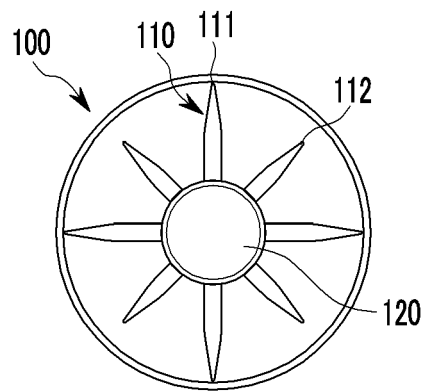


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 September 2016	Examiner de Martino, Marcello
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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