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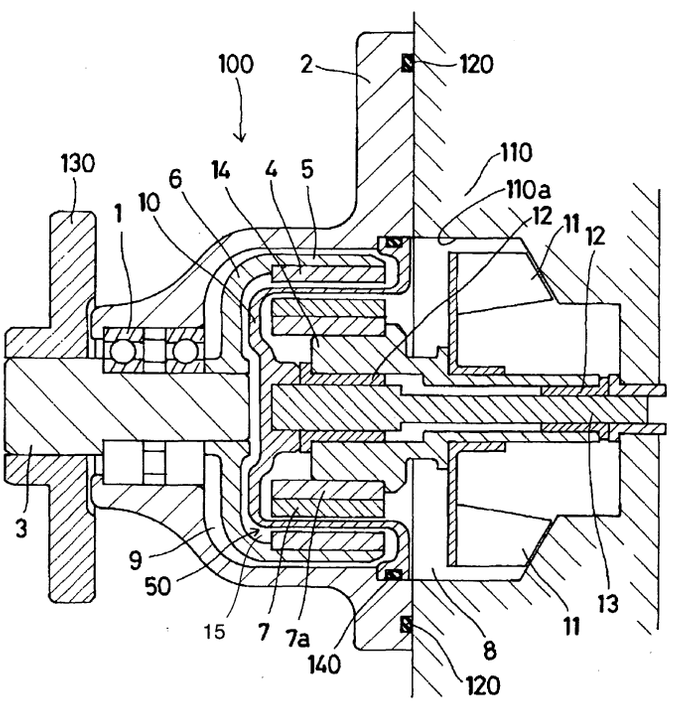
(54) Magnetic drive pump

(57) A magnetic drive pump includes a pump chamber, an impeller rotatably supported in the pump chamber, and a drive mechanism for rotating the impeller, characterized in that the drive mechanism includes a magnetic member integrally attached to a drive member rotatably disposed at an outside of a partition wall for separating the pump chamber from the outside and an inductor member including a conductor material, integrally attached to the impeller, and rotated by a driving force corresponding to an induction current generated by rotation of the magnetic member.

FIG. 1



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Description

FIELD OF THE INVENTION

[0001] This invention generally relates to magnetic drive pump. More particularly, the present invention pertains to the magnetic drive pump for rotating an impeller by means of magnetic force.

BACKGROUND

[0002] A water pump generally separates an outside (atmosphere) and a pump chamber by means of a mechanical seal. Although the mechanical seal causes considerable loss of driving force by friction. The friction loss is one of the sources of fuel consumption deterioration.

[0003] Correspondingly, a magnetic drive water pump is disclosed (JP10-089069A2) wherein an impeller of the water pump is rotated without using mechanical seal. In the disclosed art, rotational force from an engine is transmitted to the impeller using a magnetic joint including magnets which are disposed to face together. A partition wall separating the pump chamber from the outside is placed between each magnet. In this type of the water pump, although the friction loss is decreased, when a torque for driving the impeller exceeds a transmitted torque transmitted by the magnetic joint in high speed rotation of the engine, the rotation of the impeller may be stopped even if the engine is rotating (step out state). To prevent the step out state, capacity of the magnetic joint has to design higher (namely stronger magnets are used). In addition, in view of degaussing by temperature increase and response to variation of engine rotational speed, the capacity of the magnetic joints has to be higher.

[0004] Therefore, a need exists for a magnetic drive pump to prevent step out and follow rotation of the engine in high speed rotation of the engine and to downsize.

SUMMARY OF THE INVENTION

[0005] According to an aspect of the present invention, a magnetic drive pump includes a pump chamber, an impeller rotatably supported in the pump chamber, and a drive mechanism for rotating the impeller, characterized in that the drive mechanism includes a magnetic member integrally attached to a drive member rotatably disposed at an outside of a partition wall for separating the pump chamber from the outside and an inductor member including a conductor material, integrally attached to the impeller, and rotated by a driving force corresponding to an induction current generated by rotation of the magnetic member.

[0006] It is preferable that the pump chamber is disposed at an engine block.

[0007] It is preferable that the drive member includes a drive magnet.

[0008] It is preferable that the inductor member and the drive member place opposite together through the partition wall.

[0009] It is preferable that the drive mechanism is disposed in a space formed in a body closing the pump chamber.

[0010] It is preferable that a seal member is provided between the body and the engine block.

[0011] It is preferable that the drive member of the drive mechanism is rotatably supported by a bearing member against the body and a pulley seat is attached to the drive member.

[0012] It is preferable that the induction member is connected to the impeller via a rotatable member.

[0013] It is preferable that the pump chamber and a space separated by the partition wall and accommodating therein the induction member and the rotatable member are communicating with each other.

[0014] It is preferable that the rotatable member is rotatably supported by a shaft which is fixed to the partition wall at one side and fixed to the engine block at the other side.

[0015] According to these configuration, since the drive mechanism includes the magnetic member integrally attached to the drive member rotatably disposed at the outside of the partition wall for separating the pump chamber from the outside and the inductor member including the conductor material, rotation is transmitted without contacting to the impeller side and friction loss may be decreased. In addition, since the inductor member is disposed in the pump chamber, the inductor member is efficiently cooled when the inductor member is heated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The foregoing and additional features and characteristics of the present invention will become more apparent from the following detailed description considered with reference to the accompanying drawings, wherein:

[0017] Fig. 1 is a cross sectional view illustrating a water pump according to an embodiment of the present invention; and

[0018] Fig. 2 is a schematic view illustrating an operation condition of a water pump according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0019] A preferred embodiment of the present invention will be described hereinbelow in detail with reference to the accompanying drawings.

[0020] A water pump (a magnetic drive pump) 100 is shown in FIG. 1 as an example. The water pump 100 is attached to an engine block 110 (for example, a timing chain case may also be applicable as the attached side)

by means of a fastening means (not shown).

[0021] The water pump (the magnetic drive pump) 100 mainly includes a body 2 including a pump chamber 8 by covering a concave portion 110a of the engine block 110, an impeller 11 rotatably supported in the pump chamber 8 for generating fluid flow (flow of cooling water) in the pump chamber 8 by rotation, and a drive mechanism 50 for rotating the impeller 11.

[0022] The body 2 is attached to the engine block 110 via an O-ring (for example, a gasket and the like may be applicable) 120 as a seal member using a fastening means (not shown) in liquid-tight condition. A first shaft 3 is rotatably supported by the body 2 via a bearing (a bearing member) 1. At one end of the first shaft 3, a pulley seat 130 is attached for transmitting rotational driving force from an engine. At the other end of the first shaft 3, a drive magnet (a drive member) 6 is attached. The drive magnet 6 integrally includes a bracket 5 and permanent magnets (a magnetic member) 4 are attached to the bracket 5. The drive magnet 6 is rotatably disposed between the body 2 and a partition wall 10. The partition wall 10 is disposed at the pump chamber 8 side of the body 2 and separates the pump chamber 8 and an outside (an atmosphere). The permanent magnets 4 are disposed so as to alternate N-pole and S-pole in periphery of the bracket 5. The partition wall 10 is attached to the body 2 via an O-ring (for example, a gasket and the like may be applicable) 140 in liquid-tight condition.

[0023] An inductor member 7 is attached to an attaching member 7a and disposed so as to face to the drive magnet 6 through the partition wall 10. The inductor member 7 includes a conductor material which is applicable to rotate by means of a driving force corresponding to an induction current generated by rotation of the permanent magnets 4. The attaching member 7a attached to a one end of a rotatable member 14. At the other end of the rotatable member 14, the impeller 11 is attached. The rotatable member 14 is rotatably supported by a second shaft (a shaft) 13 provided in inside of the rotatable member 14 via submerged bearings 12 at both ends. The second shaft 13 is fixed to the partition wall 10 at one end and fixed to the engine block 110 at the other end. The drive mechanism 50 includes the permanent magnet 4 and the inductor member 7.

[0024] Next, an operation of the present embodiment will be explained.

[0025] When the first shaft 3 is rotated via the pulley seat 130 by rotational driving force from the engine, the permanent magnet 4 integrally attached to the first shaft 3 is rotated. With rotation of the permanent magnet 4, the induction current is generated in the induction member 7 facing the permanent magnet 4 through the partition wall 10. Then, the induction member 7 is rotated to the same direction with rotational direction of the permanent magnet 4 by means of the induction current of the induction member 7 and a magnetic flux of the permanent magnet 4. Since the induction member 7, the rotatable member 14 and the impeller 11 are integrally attached together, the impeller 11 is rotated with rotation of the rotatable member 14, fluid flow (flow of cooling water) is generated in the pump chamber 8.

[0026] In this condition, transmission of rotational torque by the induction current can be carried out even if difference in rotation speed between the permanent magnet 4 and the induction member 7 is took place. Therefore, step out (stopping of rotation of the induction member 7) may not occur. According to this configuration, the permanent magnet 4 may not have excessive magnetic force, may be designed with smaller shape or weaker magnetic force. As shown in FIG. 2, since the difference in rotation speed can be took place, an impeller rotational speed of the present embodiment (shown as dotted line) becomes lower value than that of the known art (wherein an impeller is directly driven) in high speed region of an engine rotational speed. Then the impellor rotational speed reaches adequate value. For example, in a low speed region of the engine rotational speed, flow rate of the cooling water may become relatively high for improving performance of a heating device of a vehicle room. In addition, in the high speed region of the engine rotational speed, loss of driving force may be reduced by preventing excessive amount of water supply.

[0027] The principles, preferred embodiment and mode of operation of the present invention have been described in the foregoing specification. However, the invention which is intended to be protected is not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. Variations and changes may be made by others, and equivalents employed, without departing from the sprit of the present invention. Accordingly, it is expressly intended that all such variations, changes and equivalents which fall within the spirit and scope of the present invention as defined in the claims, be embraced thereby.

[0028] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A magnetic drive pump, comprising:

a pump chamber (8);

an impeller (11) rotatably supported in the pump chamber (8); and
a drive mechanism (50) for rotating the impeller (11);

characterized in that the drive mechanism (50) includes a magnetic member (4) integrally attached to a drive member (6) rotatably disposed at an outside of a partition wall (10) for separating the pump chamber (8) from the outside and an inductor member (7) including a conductor material, integrally attached to the impeller (11), and rotated by a driving force corresponding to an induction current generated by rotation of the magnetic member (4).

2. A magnetic drive pump according to claim 1, wherein the pump chamber (8) is disposed at an engine block (110).

3. A magnetic drive pump according to claim 1 or 2, wherein the inductor member (7) and the drive member (6) face each other through the partition wall (10).

4. A magnetic drive pump according to one of claims 1 to 3, wherein the drive mechanism (50) is disposed in a space formed in a body (2) closing the pump chamber (8).

5. A magnetic drive pump according to one of claims 1 to 4, wherein a seal member (120) is provided between the body (2) and the engine block (110).

6. A magnetic drive pump according to one of claims 1 to 5, wherein the drive member (6) of the drive mechanism (50) is rotatably supported by a bearing member (1) in the body (2) and a pulley seat (130) is attached to the drive member (6).

7. A magnetic drive pump according to one of claims 1 to 6, wherein the induction member (7) is connected to the impeller (11) via a rotatable member (14).

8. A magnetic drive pump according to claim 7, wherein the pump chamber (8) and a space (15) separated by the partition wall (10) and accommodating therein the induction member (7) and the rotatable member (14) are communicating with each other.

9. A magnetic drive pump according to claim 7 or 8, wherein the rotatable member (14) is rotatably supported by a shaft (13) which is fixed to the partition wall (10) at one side and fixed to the engine block (110) at the other side.

10. A magnetic drive pump according to one of claims 1 to 9,
wherein the magnetic member (4) and the inductor member (7) face each other via a space which extends parallel to the rotation axis of the same, and/or
wherein the partition wall (10) has a bowl shape with the side wall of the bowl extending between the magnetic member (4) and the inductor member (7) and preferably parallel to the rotation axis of the same.

FIG. 1

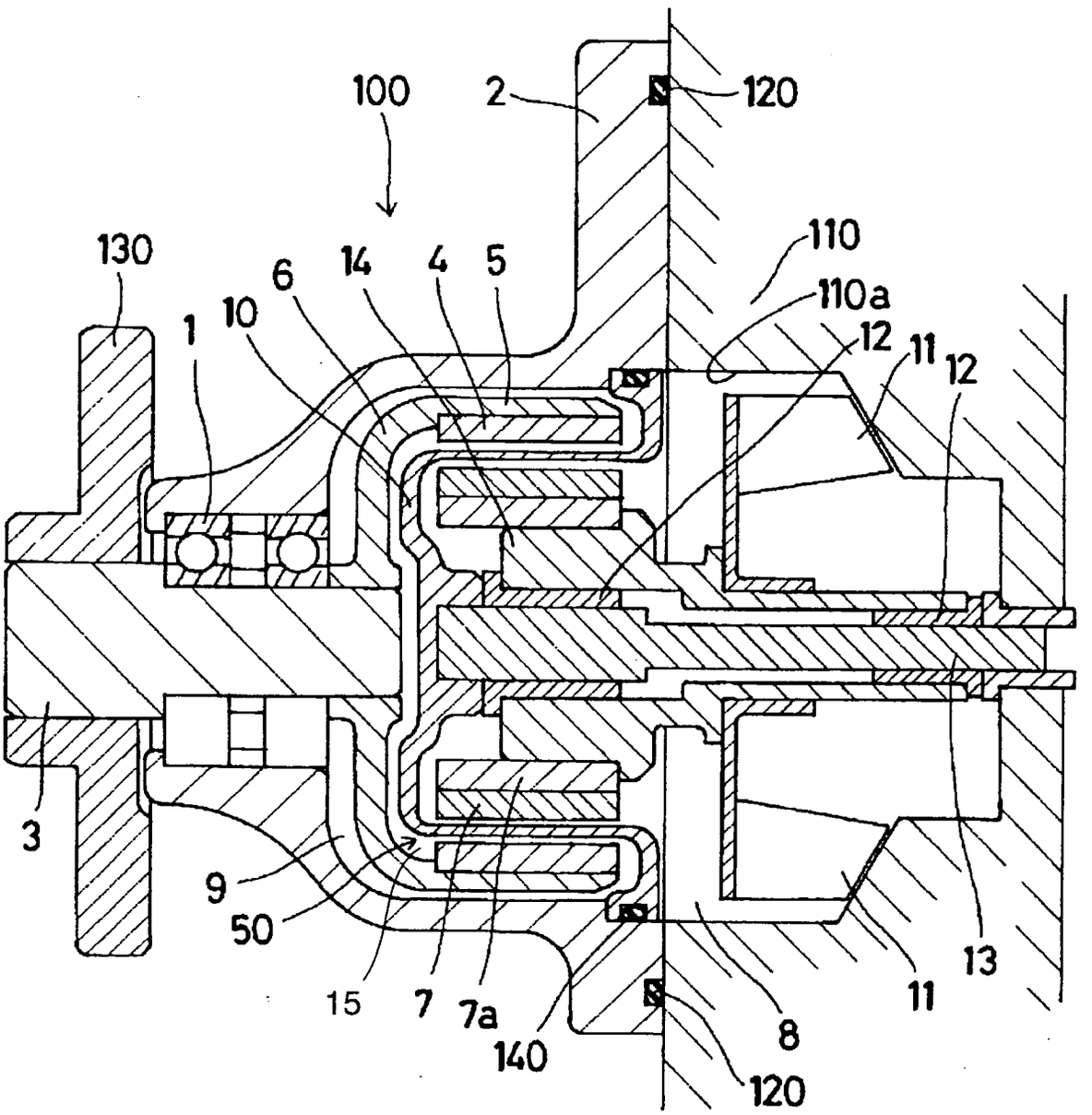
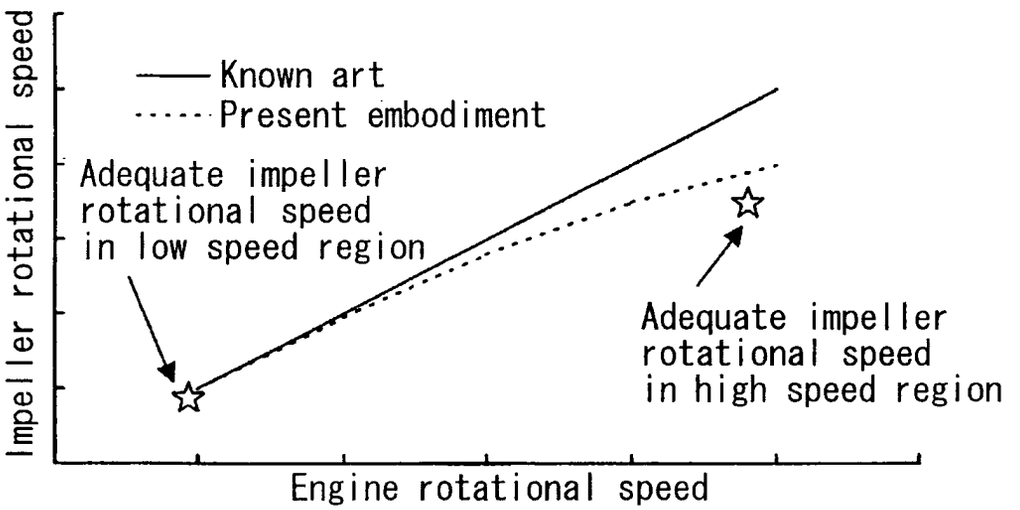

100
2
120
130
110
110a
6
14
4
5
1
10
12
11
12
3
9
50
15
7
7a
140
8
11
13
120

FIG. 2


Impeller rotational speed
Known art
Present embodiment
Adequate impeller rotational speed in low speed region
Adequate impeller rotational speed in high speed region
Engine rotational speed

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 02 5541

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2002/085933 A1 (FUKAMACHI MASATOSHI ET AL) 4 July 2002 (2002-07-04) * paragraphs [0009], [0027] - [0030]; figures 2,3 *	1-10	F04D13/02 F02B67/08
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F04D
F02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 November 2004	Tietje, K

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 02 5541

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