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(54) **ELECTRIC PUMP UNIT**

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(57) **ABSTRACT**

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An electric pump unit that may be compactified and that may be reduced in weight and cost is provided. An electric pump unit is configured such that a pump chamber having an oil suction port and an oil discharge port is formed on an inner side of a motor stator that is fixedly provided on an inner periphery of a synthetic resin unit housing and only part of an inner peripheral side of which is exposed to an inside of the unit housing, a pump outer rotor is arranged on an inner side of the motor stator in the pump chamber so as to be able to rotate using an inner periphery of the motor stator as a guide, a pump inner rotor that is supported for rotation by the unit housing is arranged on an inner side of the pump outer rotor, and a motor rotor is formed such that a permanent magnet is held by a synthetic resin permanent magnet holding portion that is provided by integral molding on an outer periphery of the pump outer rotor.

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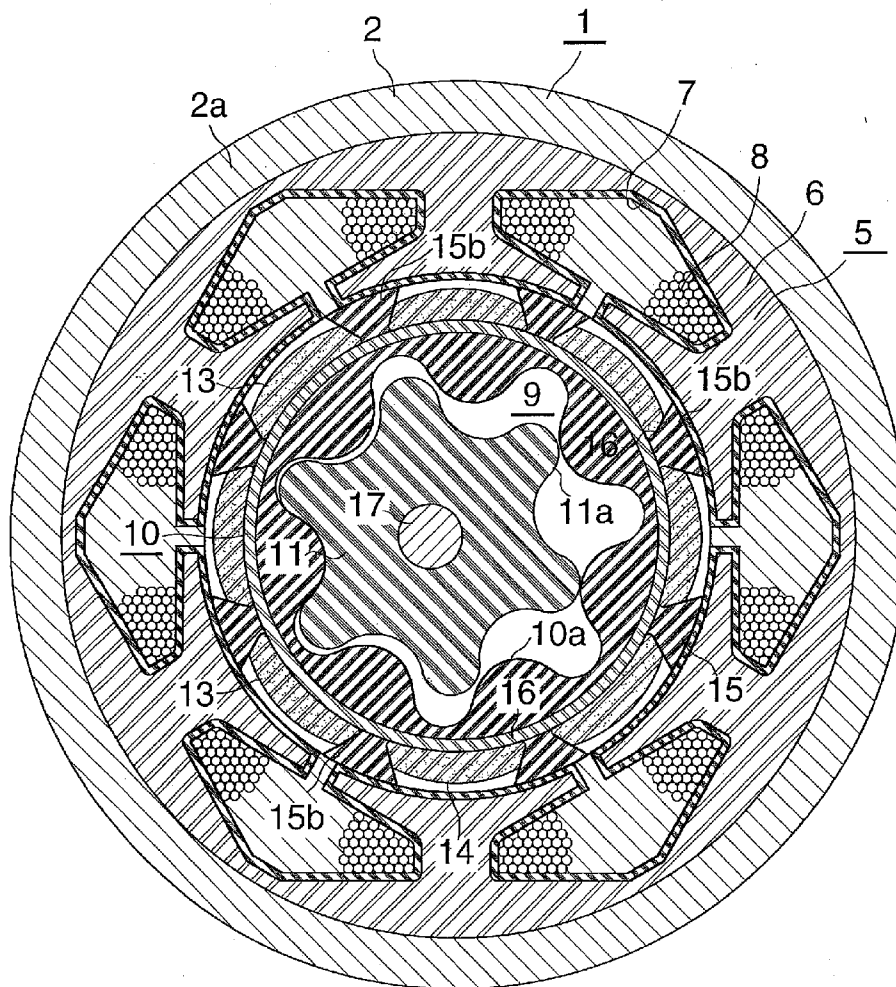


Fig. 1

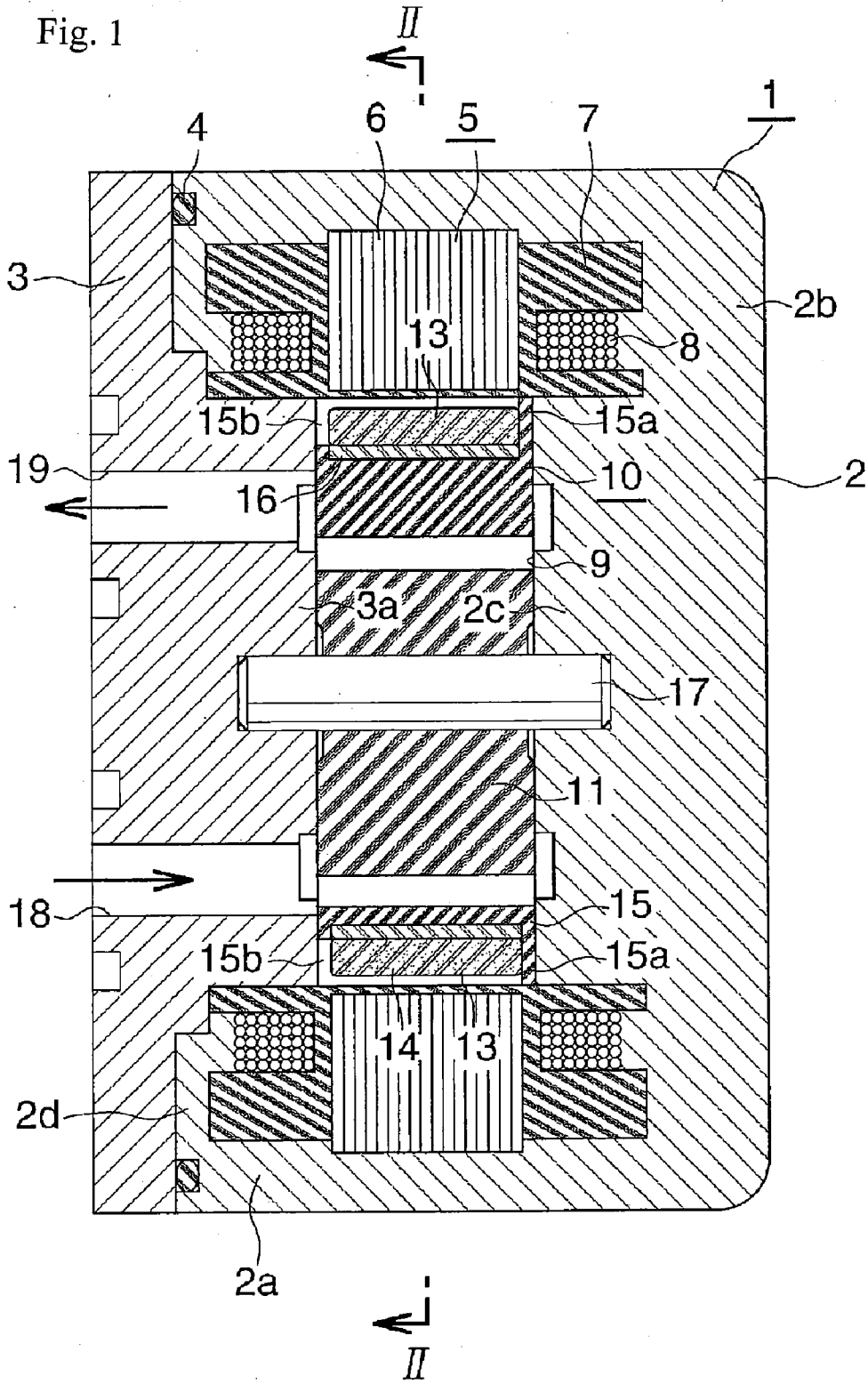
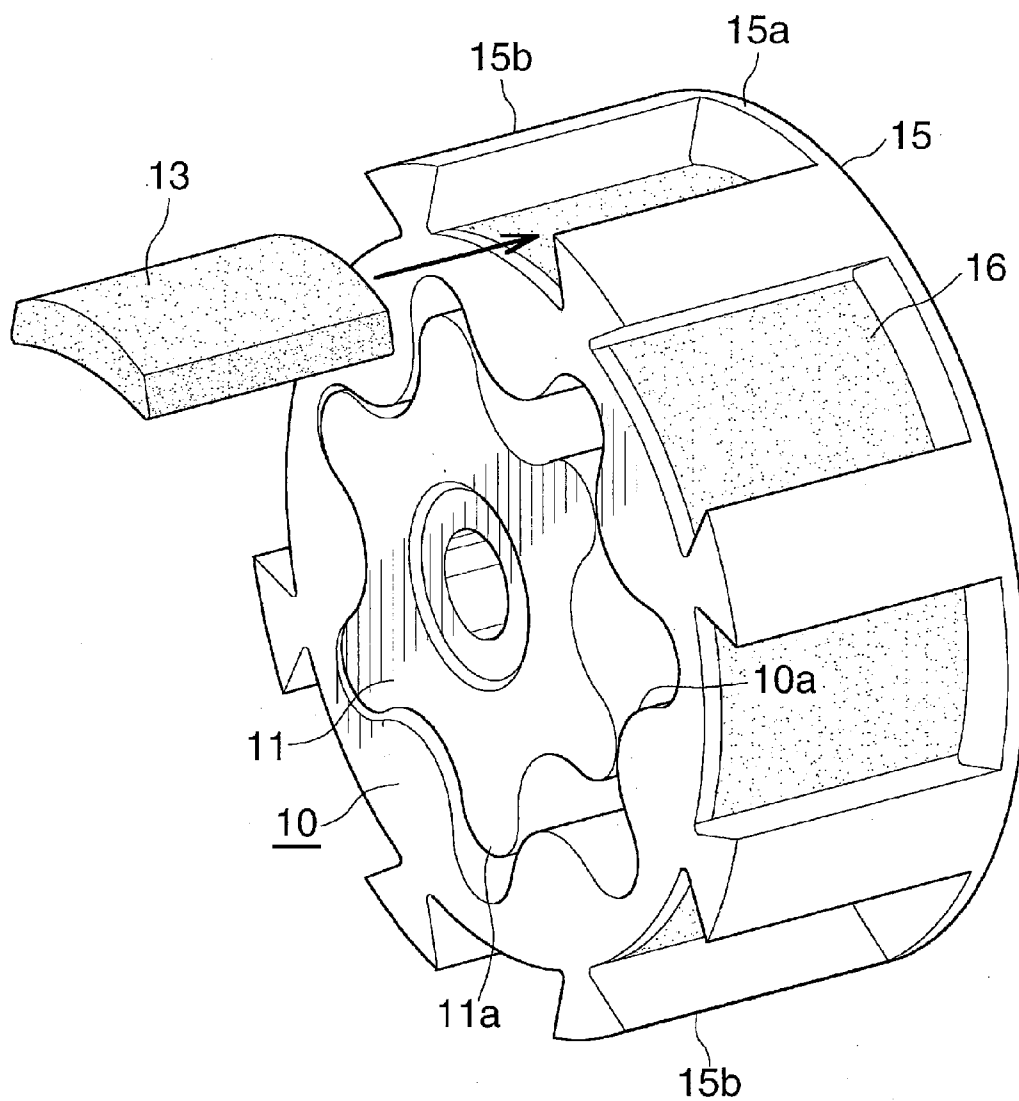


Fig. 3



ELECTRIC PUMP UNIT

TECHNICAL FIELD

[0001] The invention relates to an electric pump unit that is used as a hydraulic pump that supplies hydraulic pressure to, for example, a transmission (speed change gear), or the like, of an automobile.

BACKGROUND ART

[0002] In recent years, an electric pump unit is used as a hydraulic pump of an automobile in order to achieve energy saving by minutely controlling start and stop of the electric pump unit and to ensure hydraulic pressure supplied to a drive train, such as a transmission, even during a stop of an engine through an idle stop (idling stop).

[0003] An electric pump unit for an automobile is mounted in a limited space of a vehicle body, so the electric pump unit is required to be compactified, and also required to be light in weight and reduced in cost. There is suggested an electric pump unit in response to this request such that a pump, a pump driving electric motor and a controller of the motor are integrally assembled in a common unit housing (for example, see Patent Document 1).

RELATED ART DOCUMENT

Patent Document

[0004] Patent Document 1: Japanese Patent Application Publication No. 2008-215088

SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

[0005] In the above described existing electric pump unit, the pump and the motor are coupled via a motor shaft and are aligned in the axial direction, so the size in the axial direction is large, and there is a limit of compactification.

[0006] One object of the invention is to provide an electric pump unit that may be compactified and that may be reduced in weight and cost.

Means for Solving the Problems

[0007] An electric pump unit according to an aspect of the invention is configured such that a pump chamber having a fluid suction port and a fluid discharge port is formed on an inner side of a motor stator that is fixedly provided on an inner periphery of a synthetic resin unit housing and only part of an inner peripheral side of which is exposed to an inside of the unit housing, a pump outer rotor is arranged on an inner side of the motor stator in the pump chamber so as to be able to rotate using an inner periphery of the motor stator as a guide, a pump inner rotor that is supported for rotation by the unit housing is arranged on an inner side of the pump outer rotor, and a motor rotor is formed such that a permanent magnet is held by a synthetic resin permanent magnet holding portion that is provided by integral molding on an outer periphery of the pump outer rotor.

[0008] With the electric pump unit, as described above, it is possible to reduce the size in the axial direction, and further compactification and reduction in weight and cost are possible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a longitudinal sectional view of an electric pump unit that shows an embodiment of the invention.

[0010] FIG. 2 is a sectional view that is taken along the line II-II in FIG. 1.

[0011] FIG. 3 is an exploded perspective view of a pump outer rotor.

EMBODIMENTS OF THE INVENTION

[0012] Hereinafter, an embodiment in which the invention is applied to a hydraulic pump of an automobile will be described with reference to the drawings.

[0013] FIG. 1 is a longitudinal sectional view of an electric pump unit. Note that, in the following description, the left side in FIG. 1 is defined as front side, and the right side is defined as rear side.

[0014] The electric pump unit is formed such that a pump and a pump driving electric motor are integrally assembled in a unit housing **1** made of synthetic resin. In this example, the pump is an internal gear pump, and the motor is a DC brushless motor having three-phase coils. A controller (not shown) of the motor is provided separately from the electric pump unit.

[0015] The housing **1** is formed of a rear-side housing body **2** and a front-side lid **3**. The housing body **2** has a cylindrical shape such that the rear end of a cylindrical portion **2a** is closed by a rear wall **2b** and a front portion is open. A short cylindrical portion **2c** that has an outside diameter smaller than the bore diameter of the cylindrical portion **2a** and that is concentric with the cylindrical portion **2a** is integrally formed at the center of the front surface (inner surface) of the rear wall **2b**. The lid **3** has a disc shape, and a short cylindrical portion **3a** that is concentric with the short cylindrical portion **2c** of the housing body **2** and that has an outside diameter equal to the outside diameter of the short cylindrical portion **2c** is integrally formed at the center of the rear surface (inner surface) of the lid **3**. The outer peripheral portion of the lid **3** is fixed to the front end surface of the cylindrical portion **2a** of the housing body **2** via an O ring **4**. Although not shown in the drawing, a connector is provided at an appropriate portion of the outer surface of the housing body **2**.

[0016] A motor stator **5** is fixedly provided on the inner periphery of the cylindrical portion **2a** of the housing body **2**. The stator **5** is formed such that a portion that includes the inner peripheral surface of a core **6** formed of laminated steel plate is covered with an insulator (insulator made of synthetic resin) **7**, and coils **8** are wound around the portion of the insulator **7**. The coils **8** are connected to the connector (not shown). In this example, the stator **5** is integrally molded on the inner periphery of the cylindrical portion **2a**, the front portion of the insulator **7** and coils **8** is covered with an inward flange portion **2d** that is formed integrally with the front end of the cylindrical portion **2a** of the housing body **2**, and the rear portion of the insulator **7** and coils **8** is covered with the rear wall **2b** of the housing body **2**. In addition, the outer periphery of the portion of the insulator **7** on the front and rear sides of the core **6** is in close contact with the inner periphery of the cylindrical portion **2a**, the inner periphery of the insu-

lator 7 is in close contact with the outer periphery of the short cylindrical portion 3a of the lid 3 and the outer periphery of the short cylindrical portion 2c of the housing body 2, and the inner periphery of the insulator 7 on the inner side of the core 6 is exposed to the inside of the housing 2. Then, a pump chamber 9 is formed on the inner side of the stator 5 between both short cylindrical portions 2c and 3a.

[0017] A pump outer rotor (outer gear) 10 is arranged on the inner side of the stator 5 inside the pump chamber 9 so as to be able to rotate using the inner periphery of the stator 5 as a guide, and a pump inner rotor (inner gear) 11 that is supported for rotation by the housing 2 and that is in mesh with the outer rotor 10 is arranged on the inner side of the outer rotor 10.

[0018] The outer rotor 10 is made of synthetic resin. Teeth 10a are formed on the inner periphery of the outer rotor 10, and a motor rotor 14 having permanent magnets 13 is provided on the outer periphery of the outer rotor 10.

[0019] The motor rotor 14 is formed such that the segmented permanent magnets 13 are held at multiple portions (eight portions in this example) that equally divide a synthetic resin permanent magnet holding portion 15, which is fixedly provided on the outer periphery of the outer rotor 10, in the circumferential direction. The outer rotor 10 made of synthetic resin is integrally molded with the permanent magnet holding portion 15 in a state where a back yoke 16 made of an iron-based material is in-molded. The permanent magnet holding portion 15 has an outward rib 15a that is integrally formed with the outer peripheral rear end of the outer rotor 10 and permanent magnet holding protrusions 15b that are integrally formed at multiple portions that equally divide the outer periphery of the outer rotor 10 in the circumferential direction and that extend from the front surface of the rib 15a to the front end of the outer rotor 10. The outer peripheries of the protrusions 15b form a cylindrical surface as in the case of the rib 15a, and the diameters of both cylindrical surfaces are equal to each other. Each protrusion 15b has a V-shaped cross-sectional shape, and the mutual space between the adjacent protrusions 15b gradually reduces radially outward. The width of each permanent magnet 13 in the circumferential direction also gradually reduces radially outward, and each permanent magnet 12 is inserted from the front side and held between the adjacent protrusions 15b. The outer periphery of the rib 15a and the outer peripheries of the protrusions 15b are in slide contact with the inner periphery of the insulator 7 exposed to the inside of the housing 2, and the outer rotor 10 uses them as a guide to rotate. The outer peripheral surface of the back yoke 16 in-molded in the outer rotor 10 is exposed from the outer rotor 10 between the adjacent protrusions 15b, that is, the portions at which the permanent magnets 13 are held.

[0020] The inner rotor 11 is made of synthetic resin or made of a sintered compact of an iron-based material. Both ends of a shaft 17 extending in the longitudinal direction are rotationally supported by the short cylindrical portion 3a of the lid 3 and the short cylindrical portion 2c of the housing body 2, and the inner rotor 11 is fixed to the shaft 17. Teeth 11a are formed on the outer periphery of the inner rotor 11.

[0021] The lid 3 has an oil suction port 18 and an oil discharge port 19 that are in fluid communication with the pump chamber 9.

[0022] The electric motor is formed of the stator 5 and the rotor 14 of the outer rotor 10, and the pump is formed of the outer rotor 10 and the inner rotor 11.

[0023] The controller of the motor is arranged separately from the electric pump unit, and is connected to the motor via the connector (not shown) of the housing body 2.

[0024] While the vehicle is running, the motor is stopped, so the pump is stopped.

[0025] During a stop of the vehicle, the motor operates. By so doing, the outer rotor 10 integrated with the motor rotor 14 rotates, and the pump operates. As the pump operates, oil is introduced into the pump chamber 9 via the suction port 18, and is discharged via the discharge port 19.

[0026] The electric pump unit according to this embodiment is configured such that the pump is arranged inside the motor stator 5 that constitutes the electric motor, so the size in the axial direction is small, and further compactification is possible. In addition, the motor rotor 14 is integrated with the outer periphery of the pump outer rotor 10, so the number of components is small, and further reduction in weight and cost is possible. The outer rotor 10 integrated with the motor rotor 14 is configured to rotate using the inner periphery of the motor stator 5 as a guide, so it is possible to properly keep the gap in the radial direction between the motor stator 5 and the permanent magnets 12 of the motor rotor 14.

[0027] The motor rotor 14 is formed such that the permanent magnets 13 are held by the synthetic resin permanent magnet holding member 15 that is formed by integral molding on the outer periphery of the outer rotor 10, so it is not necessary to fix the permanent magnets 13 to the outer rotor 10 by adhesive agent and, therefore, there is no possibility of peeling of the permanent magnets 13.

[0028] In the electric pump unit according to this embodiment, for example, the outer periphery of the permanent magnet holding portion is guided by the inner periphery of the motor stator.

[0029] Furthermore, in the electric pump unit according to this embodiment, for example, the back yoke made of an iron-based material is in-molded in the pump outer rotor that is integrally molded with the permanent magnet holding portion.

[0030] By so doing, it is possible to easily mold the pump outer rotor integrated with the motor rotor.

[0031] The overall configuration and configuration of portions of the electric pump unit are not limited to the ones of the above embodiment, and may be appropriately modified.

[0032] In addition, the invention may be applied to an electric pump unit other than the electric pump unit for an automobile.

[0033] Furthermore, in the above embodiment, the electric pump unit that introduces and discharges oil is described; however, the electric pump unit is not limited to this configuration. The electric pump unit may introduce and discharge another fluid, such as water.

DESCRIPTION OF REFERENCE NUMERALS

- [0034] 1 unit housing
- [0035] 5 motor stator
- [0036] 9 pump chamber
- [0037] 10 pump outer rotor
- [0038] 11 pump inner rotor
- [0039] 13 permanent magnet
- [0040] 14 motor rotor
- [0041] 15 permanent magnet holding portion
- [0042] 16 back yoke
- [0043] 18 oil suction port
- [0044] 19 oil discharge port

1. An electric pump unit comprising:
a unit housing made of synthetic resin;
a motor stator that is fixed to an inner periphery of the unit housing in a state where part of an inner peripheral side of the motor stator is exposed; and
a pump chamber that is formed on an inner side of the motor stator and that has a fluid suction port and a fluid discharge port, wherein
a pump outer rotor that is able to rotate using an inner periphery of the motor stator as a guide and a pump inner

rotor that is supported for rotation by the unit housing are arranged in the pump chamber,
a permanent magnet holding portion made of synthetic resin is integrally molded on an outer periphery of the pump outer rotor, and
a motor rotor is formed such that a permanent magnet is held by the permanent magnet holding portion.
2. The electric pump unit according to claim 1, wherein a back yoke made of an iron-based material is in-molded in the pump outer rotor.

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