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Oohara

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(54) **MOTOR**

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CPC H02K 1/32; F16C 33/1045; F16C 3/02; F16C 33/6677; F16C 19/54
(Continued)

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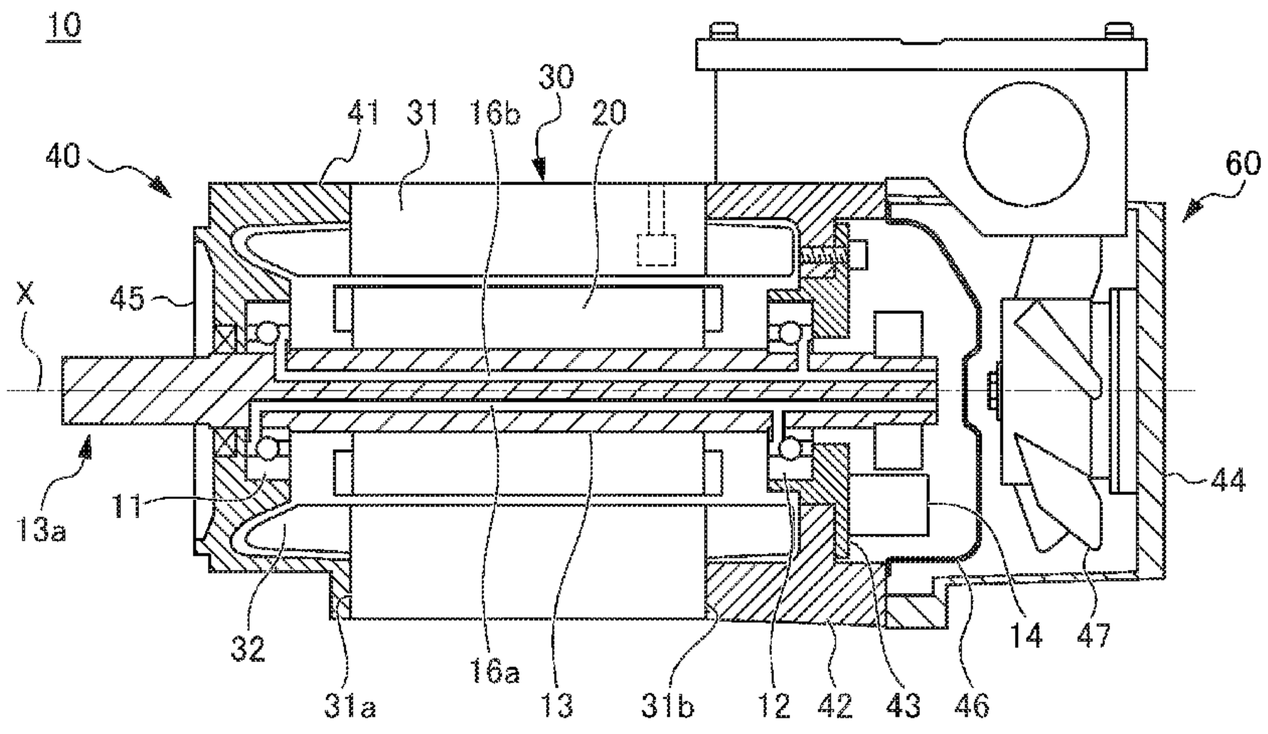
(57) **ABSTRACT**

A motor capable of replacing a lubricant more easily is provided. A motor includes: a rotor supported by an output shaft-side bearing and an anti-output shaft-side bearing; a front housing that supports the output shaft-side bearing; a rear housing that supports the anti-output shaft-side bearing; a stator having both ends attached to the front housing and the rear housing, the stator surrounding the rotor; and a pair of pipelines which has an opening formed in a surface of the rotor close to the rear housing and which is provided inside the rotor, the pipelines communicating with at least one of the output shaft-side bearing and the anti-output shaft-side bearing and capable of circulating a lubricating liquid.

4 Claims, 4 Drawing Sheets



(51) **Int. Cl.**

F16C 33/66	(2006.01)
F16C 3/02	(2006.01)
F16C 33/72	(2006.01)
F16C 19/54	(2006.01)

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(58) **Field of Classification Search**
USPC ..... 310/61, 60 R, 52, 54, 58, 64
See application file for complete search history.

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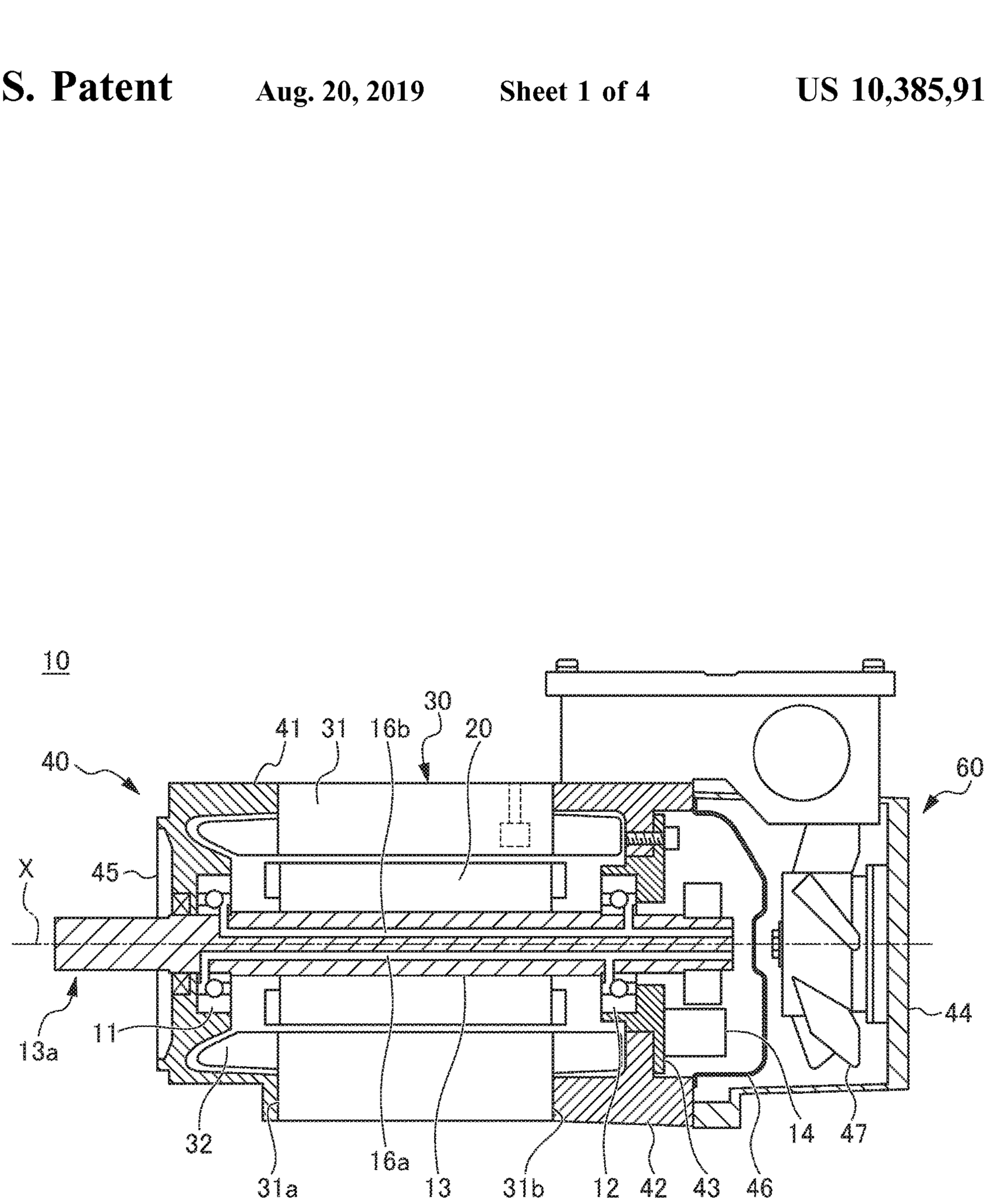
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30
41
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16b
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40
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X
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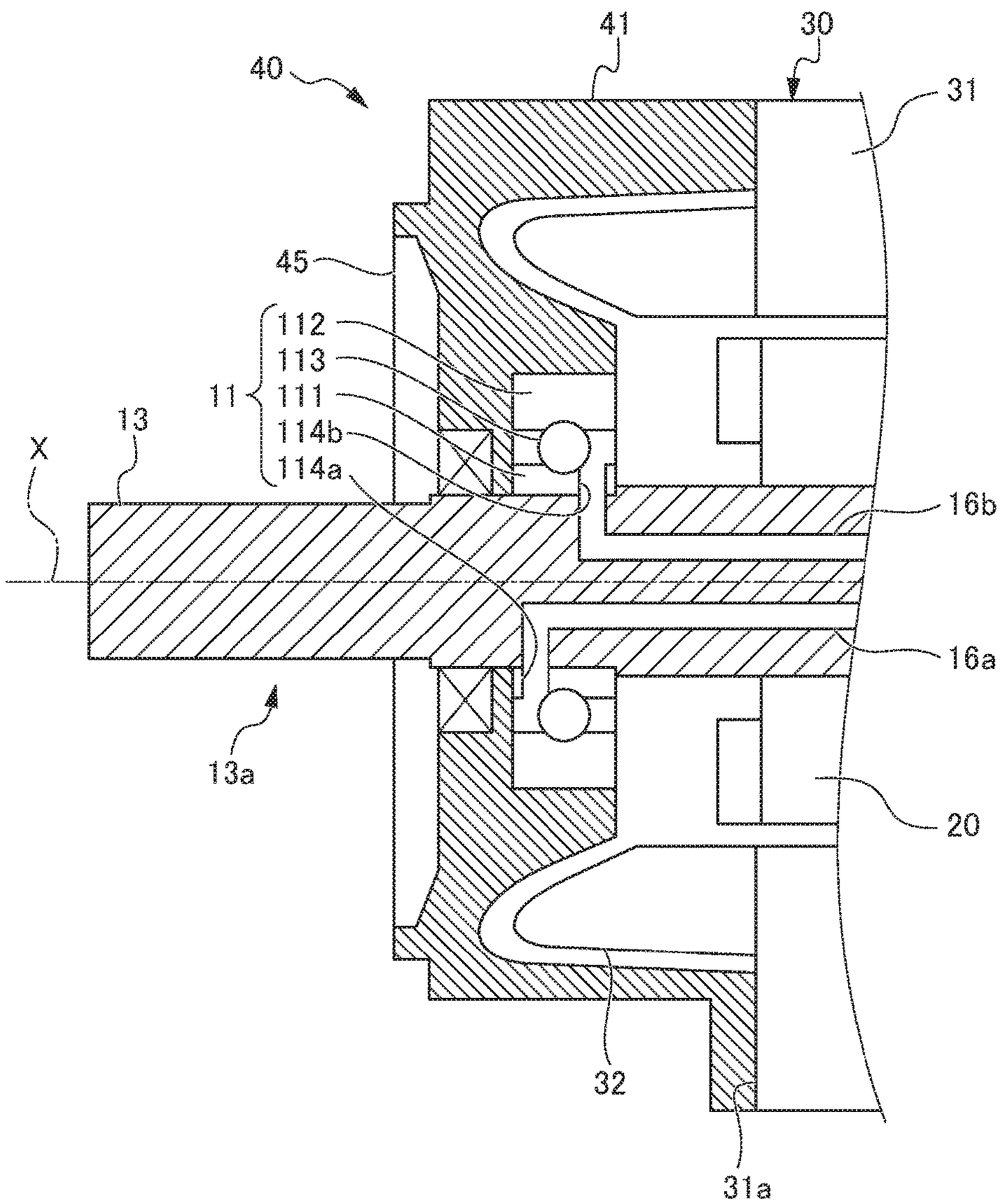
FIG. 1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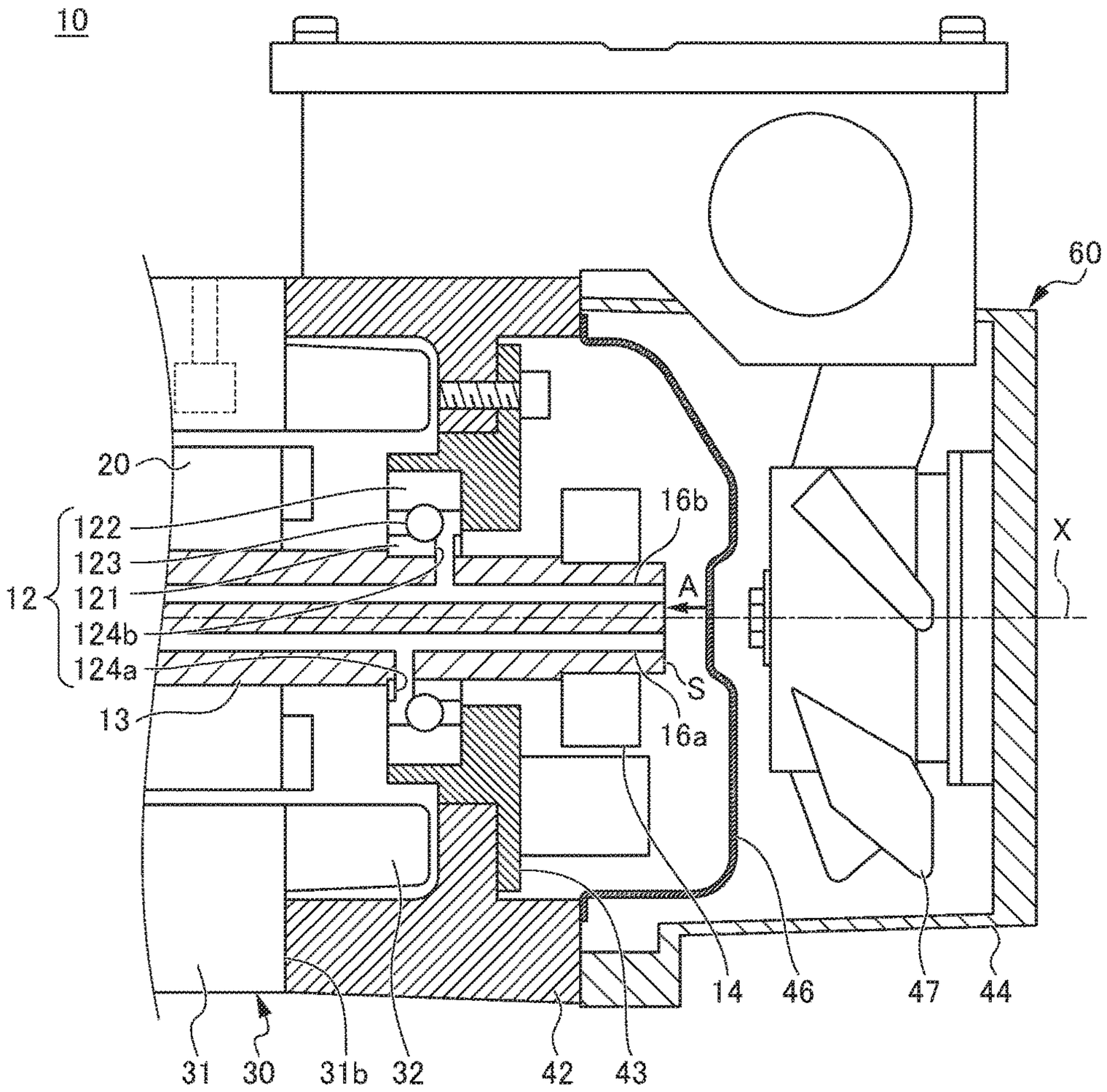
31a

FIG. 2


10
60
20
122
123
121
124b
124a
12
13
16b
16a
A
S
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14
46
47
44
31
30
31b
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42
43

FIG. 3

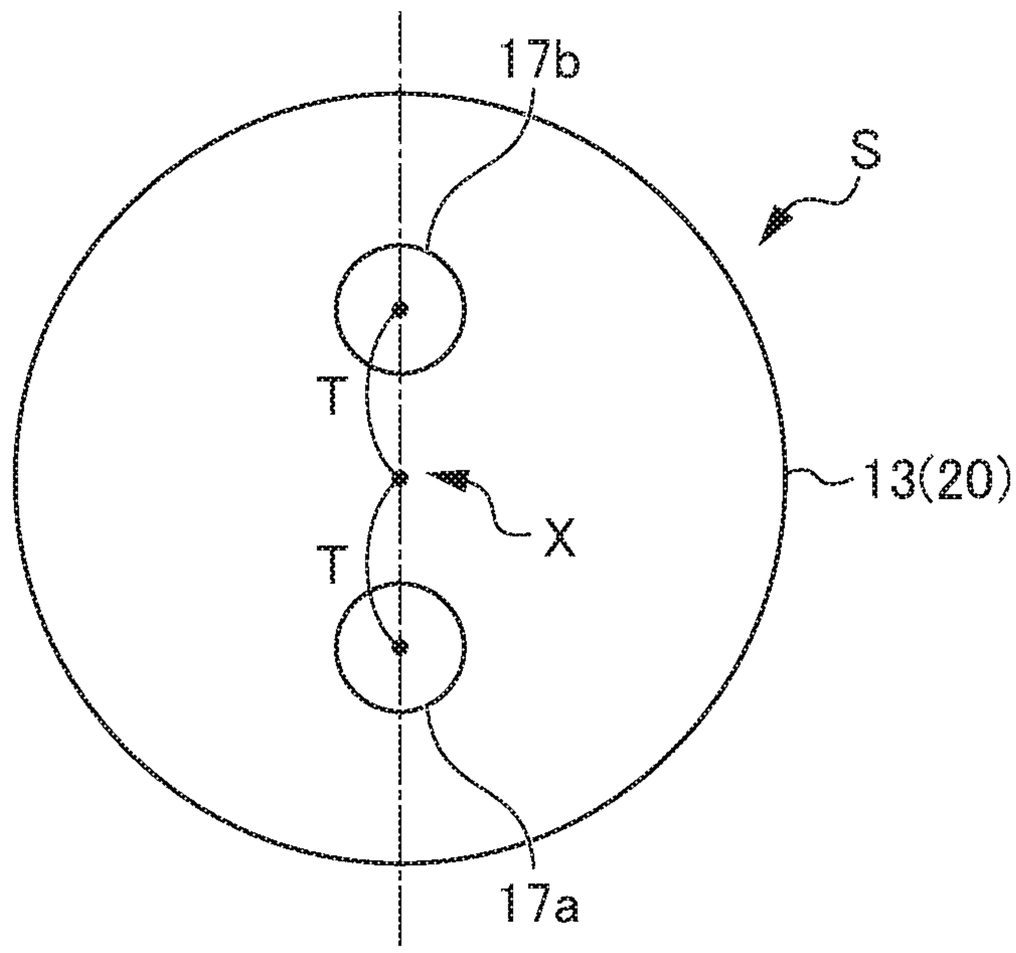

FIG. 4

MOTOR

This application is based on and claims the benefit of priority from Japanese Patent Application No. 2016-234237, filed on 1 Dec. 2016, the content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a motor.

Related Art

From the past, motors that support a rotor using bearings are widely known. In general, bearings are configured to use a lubricant from the view point of reducing friction and wearing and discharging frictional heat. By using a lubricant, it is possible to extend lifespan of the bearings. As a bearing having a lubricant enclosed therein, a water pump in which a hollow portion is formed in a rotation shaft of the water pump, a lubricating oil (the lubricant) is stored in the hollow portion, the lubricating oil (the lubricant) is press-fitted from the hollow portion into a bearing using a communication hole that passes through an outer circumference of the rotation shaft is proposed (for example, see Patent Document

Patent Document 1: Japanese Unexamined Patent Application, Publication No. H10-103289

SUMMARY OF THE INVENTION

However, a lubricant deteriorates with use due to oxidation, contamination, and the like. Since continued use of the deteriorated lubricant leads to damage to the motor, it is preferable to replace the deteriorated lubricant. Since the water pump of Patent Document 1 does not have a mechanism for replacing the lubricant, it is not possible to replace the lubricant.

On the other hand, when bearings are built into a housing or the like during replacement of the lubricant, it is necessary to completely disassemble the motor so that a shaft portion is exposed. Due to this, there is a case in which it is difficult to replace the lubricant and a motor capable of replacing the lubricant more easily is desirable.

An object of the present invention is to provide a motor capable of replacing a lubricant more easily.

(1) A motor (for example, a motor **10** to be described later) of the present invention includes: a rotor (for example, a rotor **20** to be described later) supported by an output shaft-side bearing (for example, an output shaft-side bearing **11** to be described later) and an anti-output shaft-side bearing (for example, an anti-output shaft-side bearing **12** to be described later); a front housing (for example, a front housing **40** to be described later) that supports the output shaft-side bearing; a rear housing (for example, a rear housing **60** to be described later) that supports the anti-output shaft-side bearing; a stator (for example, a stator **30**) having both ends attached to the front housing and the rear housing, the stator surrounding the rotor; and a pair of pipelines (for example, a pair of pipelines **16***a* and **16***b* to be described later) which has an opening (for example, an opening **17***a*, **17***b* to be described later) formed in a surface of the rotor close to the rear housing and which is provided inside the rotor, the pipelines communicating with at least

one of the output shaft-side bearing and the anti-output shaft-side bearing and capable of circulating a lubricating liquid.

(2) In the motor according to (1), it is preferable that the opening is formed in an end surface of the rotor close to the rear housing.

(3) In the motor according to (1) or (2), it is preferable that the pair of pipelines are disposed at positions symmetric about an axis of the rotor.

According to the present invention, it is possible to provide a motor capable of replacing a lubricant more easily.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a longitudinal cross-sectional view schematically illustrating a motor according to an embodiment of the present invention.

FIG. **2** is a partial enlarged view illustrating an output shaft-side portion of the motor illustrated in FIG. **1** at an enlarged scale.

FIG. **3** is a partial enlarged view illustrating an anti-output shaft-side portion of the motor illustrated in FIG. **1** at an enlarged scale.

FIG. **4** is a diagram seen from arrow A in FIG. **3**.

DETAILED DESCRIPTION OF THE INVENTION

An embodiment of a motor according to the present invention will be described with reference to FIGS. **1** to **4**. FIG. **1** is a longitudinal cross-sectional view schematically illustrating a motor according to an embodiment of the present invention. FIG. **2** is a partial enlarged view illustrating an output shaft-side portion of the motor illustrated in FIG. **1** at an enlarged scale. FIG. **3** is a partial enlarged view illustrating an anti-output shaft-side portion of the motor illustrated in FIG. **1** at an enlarged scale. FIG. **4** is a diagram seen from arrow A in FIG. **3**.

A motor **10** of the present embodiment includes, as its main components, a rotor **20** (a rotating member), a stator **30** (a stationary member), a front housing **40**, a rear housing **60**, an output shaft-side bearing **11**, an anti-output shaft-side bearing **12**, and a pair of pipelines **16***a* and **16***b*.

The rotor **20** is supported by an output shaft-side bearing **11** and an anti-output shaft-side bearing **12**. Specifically, the rotor **20** includes a rotation shaft **13**. Both ends of the rotation shaft **13** are supported by the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**. Moreover, the rotation shaft **13** is supported so as to be able to rotate around the axis of rotation X. The rotor **20** rotates integrally with the rotation shaft **13** around the axis of rotation X.

The rotation shaft **13** has a front end **13***a* and a rear end **13***b*. The front end **13***a* is positioned at an end of the rotation shaft **13** close to a side (hereinafter also referred to as an "output shaft-side") of the output shaft-side bearing **11**. The rear end **13***b* is positioned at an end of the rotation shaft **13** close to a side (hereinafter also referred to as an "anti-output shaft-side") of the anti-output shaft-side bearing **12**. An encoder **14** is attached to the rear end **13***b*. The encoder **14** detects a rotation position, a rotation speed, and the like of the rotation shaft **13**.

The stator **30** is a member that surrounds the rotor **20**. Specifically, the stator **30** is an approximately cylindrical member extending along the axis of rotation X so as to surround the rotor **20**. The stator **30** includes a stator core **31** and a winding **32**. The stator core **31** is made up of a number

of stacked electromagnetic steel plates. The winding **32** is wound around a projecting portion (not illustrated) formed on an inner circumferential surface of the stator core **31**.

The stator core **31** has a front end surface **31***a* and a rear end surface **31***b*. The front end surface **31***a* is positioned at the end close to the output shaft-side bearing **11**. The rear end surface **31***b* is positioned at the end close to the anti-output shaft-side bearing **12**.

The winding **32** is fixed to the stator core **31** by a resin or the like. The winding **32** extends along the axis of rotation X so as to protrude from both ends of the stator core **31**. A lead wire (not illustrated) extended from a terminal box **15** (to be described later) is connected to the winding **32**. The winding **32** generates a rotating magnetic field according to current supplied via the lead wire. The rotor **20** rotates integrally with the rotation shaft **13** according to the rotating magnetic field generated by the stator **30**.

The front housing **40** supports the output shaft-side bearing **11**. The rear housing **60** supports the anti-output shaft-side bearing **12**. The front housing **40** has a front housing component **41** and a front cover **45**. Moreover, the rear housing **60** has a rear housing component **42**, a supporting ring **43**, a rear cover **44**, an intermediate cover **46**, and a fan **47**.

The front housing component **41** and the rear housing component **42** surround the winding **32** protruding from the stator core **31**.

The front housing component **41** is fixed to the front end surface **31***a* of the stator core **31** by screws. The front housing component **41** supports the output shaft-side bearing **11**. The front housing component **41** extends from the front end surface **31***a* of the stator core **31** toward the front end **13***a* of the rotation shaft **13**. The front housing component **41** surrounds the output shaft-side bearing **11** and a portion of the rotation shaft **13**. Moreover, the front cover **45** having an approximately ring shape is provided in the front housing component **41**.

The front cover **45** protrudes radially inward toward the rotation shaft **13**. The front end **13***a* of the rotation shaft **13** protrudes from the front cover **45** and the front housing component **41**. The front end **13***a* of the rotation shaft **13** protruding from the front cover **45** and the front housing component **41** functions as an output shaft which is directly or indirectly connected to a main shaft of a machine tool, for example.

The rear housing component **42** is fixed to the rear end surface **31***b* of the stator core **31** by screws. The rear housing component **42** extends from the rear end surface **31***b* of the stator core **31** toward the rear end **13***b* of the rotation shaft **13**. The rear housing component **42** surrounds the anti-output shaft-side bearing **12** and a portion of the rotation shaft **13**.

The supporting ring **43** is fixed to the rear housing component **42** by screws. The supporting ring **43** supports the anti-output shaft-side bearing **12**. The rear cover **44** is provided in the rear housing component **42**. The rear cover **44** surrounds the rear end **13***b* of the rotation shaft **13** protruding from the rear housing component **42**. The terminal box **15** is a member having an inner space. The terminal box **15** is connected to the rear housing component **42**.

The intermediate cover **46** is fixed to the supporting ring **43** by screws. The intermediate cover **46** is disposed between the supporting ring **43** and the rear cover **44**. The fan **47** is fixed to an inner surface of the rear cover **44**. The fan **47** is disposed with its axial center aligned with respect to the rotation shaft **13**.

The output shaft-side bearing **11** is disposed near the front end **13***a* of the rotation shaft **13**. The output shaft-side bearing **11** supports the front end **13***a* of the rotation shaft **13**. The output shaft-side bearing **11** contains a high viscosity lubricant therein. As illustrated in FIG. **2**, the output shaft-side bearing **11** includes an output shaft-side inner ring **111**, an output shaft-side outer ring **112**, an output shaft-side rolling element **113**, and a pair of through-holes **114***a* and **114***b*.

The output shaft-side inner ring **111** is formed in a ring form having such a diameter that the output shaft-side inner ring **111** can engage with the front end **13***a* of the rotation shaft **13**. An inner circumferential surface of the output shaft-side inner ring **111** engages with an outer circumferential surface of the front end **13***a*. A groove extending in a circumferential direction is formed in the outer circumferential surface of the output shaft-side inner ring **111**.

The output shaft-side outer ring **112** is formed in a ring form. The output shaft-side outer ring **112** has a larger inner diameter than the diameter of the output shaft-side inner ring **111**. The output shaft-side outer ring **112** is disposed so that the inner circumferential surface faces the outer circumferential surface of the output shaft-side inner ring **111**. That is, the output shaft-side outer ring **112** is disposed so that the output shaft-side outer ring **112** and the output shaft-side inner ring **111** form a double ring shape. A groove extending in a circumferential direction is formed in the inner circumferential surface of the output shaft-side outer ring **112**. Moreover, a lubricant is contained between the output shaft-side outer ring **112** and the output shaft-side inner ring **111**.

The output shaft-side rolling element **113** is a sphere and is supported by the grooves formed in the output shaft-side inner ring **111** and the output shaft-side outer ring **112** so as to be able to rotate and revolve. A plurality of output shaft-side rolling elements **113** is formed along the groove. The output shaft-side rolling element **113** rotates and revolves to enable rotation of the output shaft-side inner ring **111** in relation to the output shaft-side outer ring **112**.

The pair of through-holes **114***a* and **114***b* pass from the inner circumferential surface of the output shaft-side inner ring **111** to the outer circumferential surface. The pair of through-holes **114***a* and **114***b* are disposed at positions symmetric about the axis (the axis of rotation X) of the rotation shaft **13**. Moreover, one through-hole **114***a* is disposed closer to the front end **13***a* than an axial central position of the output shaft-side inner ring **111**. The other through-hole **114***b* is disposed closer to the rear end **13***b* than the axial central position of the output shaft-side inner ring **111**.

The anti-output shaft-side bearing **12** is disposed close to the rear end **13***b* of the rotation shaft **13**. The anti-output shaft-side bearing **12** supports the rear end **13***b* of the rotation shaft **13**. The anti-output shaft-side bearing **12** contains a high viscosity lubricant therein. As illustrated in FIG. **3**, the output shaft-side bearing **11** includes an anti-output shaft-side inner ring **121**, an anti-output shaft-side outer ring **122**, an anti-output shaft-side rolling element **123**, and a pair of through-holes **124***a* and **124***b*.

The anti-output shaft-side inner ring **121** is formed in a ring form having such a diameter that the anti-output shaft-side inner ring **121** can engage with the rear end **13***b* of the rotation shaft **13**. The inner circumferential surface of the anti-output shaft-side inner ring **121** engages with the outer circumferential surface of the rear end **13***b*. A groove extend-

ing along the circumferential direction is formed in the outer circumferential surface of the anti-output shaft-side inner ring **121**.

The anti-output shaft-side outer ring **122** is formed in a ring form. The anti-output shaft-side outer ring **122** has a larger inner diameter than the diameter of the anti-output shaft-side inner ring **121**. The anti-output shaft-side outer ring **122** is disposed so that the inner circumferential surface faces the outer circumferential surface of the anti-output shaft-side inner ring **121**. That is, the anti-output shaft-side outer ring **122** is disposed so that the anti-output shaft-side outer ring **122** and the anti-output shaft-side inner ring **121** form a double ring shape. A groove extending along the circumferential direction is formed in the inner circumferential surface of the anti-output shaft-side outer ring **122**. Moreover, a lubricant is contained between the anti-output shaft-side outer ring **122** and the anti-output shaft-side inner ring **121**.

The anti-output shaft-side rolling element **123** is a sphere. The anti-output shaft-side rolling element **123** is supported by the grooves formed in the anti-output shaft-side inner ring **121** and the anti-output shaft-side outer ring **122** so as to be able to rotate and revolve. A plurality of anti-output shaft-side rolling elements **123** is formed along the groove. The anti-output shaft-side rolling element **123** rotates and revolves to enable rotation of the anti-output shaft-side inner ring **121** in relation to the anti-output shaft-side outer ring **122**.

The pair of through-holes **124***a* and **124***b* pass from the inner circumferential surface of the anti-output shaft-side inner ring **121** to the outer circumferential surface. The pair of through-holes **124***a* and **124***b* are disposed at positions symmetric about the axis (the axis of rotation X) of the rotation shaft **13**. Moreover, one through-hole **124***a* is disposed closer to the front end **13***a* than an axial central position of the anti-output shaft-side inner ring **121**. The other through-hole **124***b* is disposed closer to the rear end **13***b* than the axial central position of the anti-output shaft-side inner ring **121**.

The pair of pipelines **16***a* and **16***b* are formed inside the rotor **20**. The pair of pipelines **16***a* and **16***b* have openings **17***a* and **17***b* formed in a surface of the rotor **20** close to the rear housing **60**. Specifically, the pair of pipelines **16***a* and **16***b* are formed inside the rotation shaft **13**. The pair of pipelines **16***a* and **16***b* have openings **17***a* and **17***b* formed in a surface of the rotation shaft **13** close to the rear housing **60**. The pair of pipelines **16***a* and **16***b* communicate with at least one of the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**. The pair of pipelines **16***a* and **16***b* are configured so as to be able to circulate a lubricating liquid. The pair of pipelines **16***a* and **16***b* are disposed at positions symmetric about the axis of the rotor **20**. In the present embodiment, the pair of pipelines **16***a* and **16***b* are bifurcated inside the rotation shaft **13**. The pair of pipelines **16***a* and **16***b* communicate with both the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**.

As illustrated in FIG. **4**, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are formed in an end surface S of the rotor **20** (the rotation shaft **13**) close to the rear housing **60**. The openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are disposed at positions symmetric about the axis (the axis of rotation X) of the rotation shaft **13**. Specifically, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are symmetric about the axis (the axis of rotation X) of the rotation shaft **13**. Moreover, the pair of pipelines **16***a* and **16***b* are disposed to be separated by a distance T from the axis (the axis of rotation X). Moreover, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are closed by lids (not illustrated) in a normal time (when the lubricant is not replaced).

One pipeline **16***a* extends linearly along the axial center of the rotation shaft **13** from the opening **17***a* formed in the end surface S of the rotation shaft **13** close to the rear housing **60**. One pipeline **16***a* is bifurcated to communicate with one of the pair of through-holes **114***a* and **114***b* of the output shaft-side bearing **11** and one of the pair of through-holes **124***a* and **124***b* of the anti-output shaft-side bearing **12**. In the present embodiment, one pipeline **16***a* communicates with the through-holes **114***a* and **124***a* positioned closer to the front end **13***a*. Due to this, one pipeline **16***a* functions as a supply path of a lubricant, for example.

The other pipeline **16***b* extends linearly along the axial center of the rotation shaft **13** from the opening **17***b* formed in the end surface S of the rotation shaft **13** close to the rear housing **60**. The other pipeline **16***b* is bifurcated to communicate with the other of the pair of through-holes **114***a* and **114***b* of the output shaft-side bearing **11** and the other of the pair of through-holes **124***a* and **124***b* of the anti-output shaft-side bearing **12**. In the present embodiment, the other pipeline **16***b* communicates with the through-holes **114***b* and **124***b* positioned closer to the rear end **13***b*. Due to this, the pipeline **16** functions as a discharge path of a lubricant, for example.

The lubricant of the motor **10** having such the above-described configuration is replaced in the following manner. First, rotation of the rotor **20** (the rotation shaft **13**) is stopped. Subsequently, the rear cover **44** and the intermediate cover **46** are removed. In this way, a side of the rotor **20** (the rotation shaft **13**) close to the rear housing **60** is exposed to the outside. That is, the end surface S of the rotor **20** (the rotation shaft **13**) close to the rear housing **60** is exposed to the outside. Therefore, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are exposed to the outside.

Subsequently, the lids (not illustrated) are removed from the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b*. Moreover, a lubricant is supplied from the opening **17***a* of one pipeline **16***a*. In this way, the lubricant is injected into the output shaft-side bearing **11** and the anti-output shaft-side bearing **12** via one set of through-holes **114***a* and **124***a*. When the lubricant is injected, an amount of the lubricant (deteriorated lubricant) approximately the same as the injected lubricant, having already been contained in the output shaft-side bearing **11** and the anti-output shaft-side bearing **12** is discharged through the other through-holes **114***b* and **124***b*. The discharged lubricant circulates through the other pipeline **16***b* and is discharged from the opening **17***b*.

Here, the pair of through-holes **114***a* and **114***b* and the pair of through-holes **124***a* and **124***b* are symmetric about the axis (the axis of rotation X) of the rotor **20** (the rotation shaft **13**). Moreover, one set of through-holes **114***a* and **124***a* (the supply side) are positioned closer to the front end **13***a*, and the other set of through-holes **124***a* and **124***b* (the discharge side) are positioned closer to the rear end **13***b*. That is, the pair of through-holes **114***a* and **114***b* are disposed so that a path extending from one through-hole **114***a* to the other through-hole **114***b* is the longest. Moreover, the pair of through-holes **124***a* and **124***b* are disposed so that a path extending from one through-hole **124***a* to the other through-hole **124***b* is the longest. In this way, the lubricant which is already contained in the output shaft-side bearing **11** and the anti-output shaft-side bearing **12** is discharged preferentially.

Moreover, a sufficient amount of the lubricant is supplied, whereby the entire lubricant contained in the output shaft-side bearing **11** and the anti-output shaft-side bearing **12** is replaced with a new lubricant. After replacement of the lubricant ends, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are closed by the lids (not illustrated) again. Moreover, the intermediate cover **46** and the rear cover **44** are attached again. In this way, the end surface S of the rotor **20** (the rotation shaft **13**) close to the rear housing **60** is not exposed to the outside.

According to the motor **10** of the present embodiment, the following advantages are obtained, for example. The motor of the present embodiment includes: the rotor **20** supported by the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**; the front housing **40** that supports the output shaft-side bearing **11**; the rear housing **60** that supports the anti-output shaft-side bearing **12**; the stator **30** having both ends attached to the front housing **40** and the rear housing **60**, the stator surrounding the rotor **20**; and the pair of pipelines **16***a* and **16***b* which has the openings **17***a* and **17***b* formed in the surface of the rotor **20** close to the rear housing **60** and which is provided inside the rotor **20**, the pipelines **16***a* and **16***b* communicating with at least one of the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**. Therefore, even when the output shaft-side bearing **11** and the anti-output shaft-side bearing **12** are surrounded by the front housing **40** and the rear housing **60**, it is possible to expose the openings **17***a* and **17***b* to the outside without completely disassembling the motor. By supplying a lubricant from one opening **17***a*, since a deteriorated lubricant can be discharged from the other opening **17***b* via the pair of pipelines **16***a* and **16***b*, it is possible to replace the lubricant easily.

Moreover, the openings **17***a* and **17***b* are formed in the end surface of the rotor **20** close to the rear housing **60**. Therefore, it is possible to further reduce a portion which is removed to expose the rotor **20** and to replace the lubricant more easily.

Moreover, the pair of pipelines **16***a* and **16***b* are disposed at positions symmetric about the axis (the axis of rotation X) of the rotor **20**. Therefore, in at least one of the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**, a lubricant supply position and a lubricant discharge position are disposed at positions symmetric about the axis (the axis of rotation X) of the rotor **20**. That is, the lubricant supply position and the lubricant discharge position are disposed at the farthest positions. Due to this, when supply of a new lubricant starts from the supply position, discharge of the used lubricant starts from the position farthest from the supply position. The used lubricant can be discharged preferentially until the entire used lubricant is replaced with a new lubricant. In this manner, it is possible to improve lubricant replacement efficiency.

The present invention is not limited to the above-described embodiment but can be changed and modified in various ways. For example, in the embodiment, the openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* are formed in the end surface of the rotor **20** (the rotation shaft **13**) close to the rear housing **60**. However, the present invention is not limited to the embodiment. The openings **17***a* and **17***b* of the pair of pipelines **16***a* and **16***b* may be formed in a circumferential surface closer to the rear housing **60** than the circumferential surface supported by the anti-output shaft-side bearing **12**.

In the embodiment, each of the pair of pipelines **16***a* and **16***b* is bifurcated to communicate with both the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**. However, the present invention is not limited to the embodiment. For example, each of the pair of pipelines **16***a* and **16***b* may be configured to communicate with any one of the output shaft-side bearing **11** and the anti-output shaft-side bearing **12**. Moreover, another pair of pipelines (not illustrated) may be provided inside the rotor **20**. The other pair of pipelines (not illustrated) as well as the pair of pipelines **16***a* and **16***b* may communicate with one pair of through-holes **114***a* and **114***b* of the output shaft-side bearing **11** and one pair of through-holes **124***a* and **124***b* of the anti-output shaft-side bearing **12**. In this case, the openings of the respective pipelines are preferably aligned in a radial direction of the end surface S. An opening of the pipeline as a supply pipe of the output shaft-side bearing **11** and an opening of the pipeline as a discharge side are preferably symmetric about an axis (the axis of rotation X) in the end surface S and are at equal distances from the axis (the axis of rotation X). The opening of the pipeline as a supply pipe of the anti-output shaft-side bearing **12** and the opening of the pipeline as a discharge side are preferably symmetric about the axis (the axis of rotation X) in the end surface S and are at equal distances from the axis (the axis of rotation X).

In the embodiment, the through-hole **114***a* positioned closer to the front end **13***a* among the pair of through-holes **114***a* and **114***b* is a supply side and the through-hole **114***b* positioned closer to the rear end **13***b* is a discharge side. In contrast, the through-hole **114***a* may be the discharge side. In this case, the through-hole **114***b* may be the supply side. Moreover, for example, in the output shaft-side bearing **11**, the through-hole **114***a* positioned closer to the front end **13***a* may be the supply side. In this case, in the anti-output shaft-side bearing **12**, the through-hole **124***b* positioned closer to the rear end **13***b* may be the supply side. That is, the relation between the supply side and the discharge side of the through-holes **114***a* and **114***b* and the relation between the supply side and the discharge side of the through-holes **124***a* and **124***b* may be changed alternately. The pair of pipelines **16***a* and **16***b* may be configured in various combinations as long as one pipeline is the supply side, the other pipeline is the discharge side, and the above-described advantages are obtained.

EXPLANATION OF REFERENCE NUMERALS

10: Motor
11: Output shaft-side bearing
12: Anti-output shaft-side bearing
16: Pipeline
17: Opening
20: Rotor
30: Stator
40: Front housing
60: Rear housing
S: End surface

What is claimed is:

1. A motor comprising:

a rotor supported by an output shaft-side bearing and an anti-output shaft-side bearing;

a front housing that supports the output shaft-side bearing;

a rear housing that supports the anti-output shaft-side bearing;

a stator having both ends attached to the front housing and the rear housing, the stator surrounding the rotor; and

a pair of pipelines which has an opening formed in a surface of the rotor close to the rear housing and which is provided inside the rotor, the pipelines which are

disposed at positions symmetric about an axis of the rotor and communicating with at least one of the output shaft-side bearing and the anti-output shaft-side bearing and capable of circulating a lubricating liquid,

wherein the output shaft-side bearing comprises:

an output shaft-side inner ring which can engage with the front end of the rotor; and

a pair of through-holes which pass from the inner circumferential surface of the output shaft-side inner ring to the outer circumferential surface, the pair of through-holes communicating with each of the pair of pipelines,

wherein one of the through-holes is disposed closer to the front end than an axial central position of the output shaft-side inner ring, and

the other through-hole is disposed closer to the rear end than the axial central position of the output shaft-side inner ring.

2. The motor according to claim **1**, wherein

the opening is formed in an end surface of the rotor close to the rear housing.

3. The motor according to claim **2** further comprising:

a lid which closes the opening of each of the pair of pipelines.

4. The motor according to claim **1** further comprising:

a lid which closes the opening of each of the pair of pipelines.

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