[0006] Furthermore, an inner ring of bearing 104b is fixed to shaft 103 on a side opposite to bearing 104a, and rotor cover 108 is fixed to an outer ring of bearing 104b. Rotor yoke 105 and rotor cover 108 are fixed so that rotor yoke 105 and rotor cover 108 enclose stator core 101, and thus, brushless DC motor 109 is configured.

Citation List

[0007] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2016-63678

SUMMARY ~~OF INVENTION~~

[0008] However, such conventional brushless DC motor has the following problem.

[0009] To realize a ceiling fan having a larger blade-diameter and configured to supply high airflow, a stator core and a magnet that serve as constituents of a motor need to be increased in size. In other words, such ceiling fan can be realized by, for example, making the outer diameter of a stator core larger, increasing the thickness in the direction of stacking, or making a magnet axially longer. However, to newly design each of the constituents of the motor, new equipment and molds and dies are needed, so that development investment costs increase.

[0010] The present disclosure is devised to solve the above-described problem, and ~~an object of the present disclosure is to~~ provide a brushless DC motor capable of reducing investment in new equipment and molds and dies and achieving higher output at low cost and with high driving torque.

[0011] In one~~order to accomplish this object, a brushless DC motor according to an~~ aspect, ~~of~~ the present disclosure includes a brushless DC motor, comprising:

a shaft defining a rotation axis; a first

stator having a cylindrical shape with a top face and a bottom face, wherein a center of a circle of the cylindrical shape is fixed to the shaft; a second stator having a cylindrical shape with a top face and a bottom face and being adjacent to the first stator, wherein a center of a circle of the cylindrical shape is fixed to the shaft; a first rotor yoke including a first flange provided on a face perpendicular to the rotation axis, and rotatably attached to the shaft to face a side face of the first stator; a second rotor yoke including a second flange provided on a face perpendicular to the rotation axis, and rotatably attached to the shaft to face a side face of the second stator; a coupling unit configured to axially couple the first rotor yoke to the second rotor yoke; a wiring board provided on a face of the first stator opposite to a face adjacent to the second stator; and a motor lead line, wherein each of the first stator and the second stator includes: a core including salient poles radially formed from the center; and a connection coil wound around each of the salient poles, the motor lead line is passed through a slit between adjacent salient poles of the salient poles on the first stator from the wiring board to which the connection coil of the first stator is connected, to connect the connection coil of the first stator to the connection coil of the second stator, and the coupling unit is coupled to the first flange and the second flange., ~~a second stator, a first rotor, a second rotor, and a coupling unit. The first stator has a cylindrical shape with a top face and a bottom face, and the center of the circle of the cylindrical shape is fixed to the shaft. The second stator has a cylindrical shape with a top face and a bottom face, and, while the second stator is adjacent to the first stator, the center of the circle of the cylindrical shape is fixed to the shaft. The first rotor includes a first flange in a face perpendicular to the rotation axis, and is rotatably attached to the shaft so as to face a side face of the first stator. The second rotor includes a second flange in a face perpendicular to the rotation axis, and is~~

~~rotatably attached to the shaft so as to face a side face of the second stator. The coupling unit is configured to axially couple the first rotor to the second rotor. The first stator includes a circuit board, a first stator core, and a first driving coil. The circuit board is disposed in a face of the first stator opposite to a face of the first stator adjacent to the second stator. The circuit board is connected to the first stator and the second stator. The first stator core includes a plurality of first salient poles radially formed from the center of the first stator. The first driving coil is connected to the circuit board and wound around each of the first salient poles. The second stator includes a second stator core and a second driving coil. The second stator core includes a plurality of second salient poles radially formed from the center of the second stator. The second driving coil is wound around each of the second salient poles. The first driving coil is connected to the second driving coil via a motor lead wire passing through a gap in the first stator core.~~

[0012] According to the present disclosure, a brushless DC motor capable of achieving high output at low cost can be provided.

BRIEF DESCRIPTION OF DRAWINGS

CLAIMS

1. A brushless DC motor, comprising:

a shaft defining a rotation axis;

a first stator having a cylindrical shape with a top face and a bottom face, wherein a center of a circle of the cylindrical shape is fixed to the shaft;

a second stator having a cylindrical shape with a top face and a bottom face and being adjacent to the first stator, wherein a center of a circle of the cylindrical shape is fixed to the shaft;

a first rotor yoke

including a first flange provided on a face perpendicular to the rotation axis, and

rotatably attached to the shaft to face a side face of the first stator;

a second rotor yoke

including a second flange provided on a face perpendicular to the rotation axis, and

rotatably attached to the shaft to face a side face of the second stator;

a coupling unit configured to axially couple the first rotor yoke to the second rotor yoke;

a wiring board provided on a face of the first stator opposite to a face adjacent to the second stator; and

a motor lead line,

wherein

each of the first stator and the second stator includes:

a core including salient poles radially formed from the center; and

a connection coil wound around each of the salient poles,

the motor lead line is passed through a slit between adjacent salient poles of the salient poles on the first stator from the wiring board to which the connection coil of the first stator is connected, to connect the connection coil of the first stator to the connection coil of the second stator, and

the coupling unit is coupled to the first flange and the second flange.

2. The brushless DC motor according to claim 1, wherein the slit between the adjacent salient poles on the first stator includes an insulating film.

3. The brushless DC motor according to claim 1 or 2, wherein the wiring board includes a movement restriction member configured to restrict movement of the motor lead line in an outer circumferential direction of the first stator.

4. The brushless DC motor according to claim 3, wherein

the movement restriction member includes

a recess through which the motor lead line is passed; and

a protrusion provided to extend in a circumferential direction of the first stator and to be positioned closer to an outer circumferential side of the first stator than the recess is.

5. The brushless DC motor according to any one of claims 1 to 4, wherein

each of the first stator and the second stator includes a core including 3n salient poles radially formed from the center, where n is integer of 1 or more,

the connection coil is a star connection coil including three phase windings and wound around each of the salient poles,

the star connection coil is configured to connect phases of the first stator to phases of the second stator in parallel so that each of the phases of the first stator coincides with a corresponding one of the phases of the second stator, and

the first stator and the second stator are drive-controlled by one motor drive circuit.

6. The brushless DC motor according to any one of claims 1 to 4, wherein

each of the first stator and the second stator includes a core including 3n salient poles radially formed from the center, where n is integer of 1 or more,

the connection coil is a star connection coil including three phase windings and wound around each of the salient poles,

the star connection coil is configured to connect phases of the first stator to phases of the second stator in parallel so that one of the phases of the first stator coincides with a corresponding one of the phases of the second stator and so that remaining two phases of the first stator and remaining two phases of the second stator corresponding to the remaining two phases of the first stator are transposed in phases, and

the first stator and the second stator are drive-controlled by one motor drive circuit.

7. The brushless DC motor according to any one of claims 1 to 6, wherein with directions of magnetization of magnets adjacent to each other between the first rotor yoke and the second rotor yoke being identical to each other, the coupling unit axially couples the first flange to the second flange.

8. The brushless DC motor according to any one of claims 1 to 7, further comprising one temperature detector configured to detect ambient temperatures of both of the first stator and the second stator.

9. The brushless DC motor according to any one of claims 1 to 8, further comprising one position detector configured to detect rotation positions of both of the first rotor yoke and the second rotor yoke.

~~a first rotor~~

~~including a first flange in a face of the first rotor, the face being perpendicular to the rotation axis, and~~

~~rotatably attached to the shaft to face a side face of the first stator;~~

~~a second rotor~~

~~including a second flange in a face of the second rotor, the face being perpendicular to the rotation axis, and~~

~~rotatably attached to the shaft to face a side face of the second stator; and~~

~~a coupling unit configured to couple the first rotor to the second rotor along the rotation axis,~~

~~wherein the first stator includes:~~

~~a circuit board disposed in a face of the first stator, the face being opposite to a face of the first stator adjacent to the second stator, the circuit board being connected to the first stator and the second stator;~~

~~a first stator core including a plurality of first salient poles radially formed from the center of the first stator; and~~

~~a first driving coil connected to the circuit board and wound around each of the first salient poles,~~

the second stator includes:

a second stator core including a plurality of second salient poles radially formed from the center of the second stator; and

a second driving coil wound around each of the second salient poles, and

the first driving coil is connected to the second driving coil via a motor lead wire passing through a gap in the first stator core.

2. The brushless DC motor according to claim 1, further comprising

An insulating film in the gap in the first stator core.

3. The brushless DC motor according to claim 1, wherein

the circuit board includes

a movement inhibiting piece configured to inhibit the motor lead wire from moving toward an outer circumference of the first stator.

4. The brushless DC motor according to claim 3, wherein

the movement inhibiting piece includes:

a recess through which the motor lead wire passes; and

a projection provided on an outer circumferential side of the first stator in the recess and extending in a circumferential direction of the first stator.

5. The brushless DC motor according to claim 1, further comprising

a motor drive circuit connected to the first stator and the second stator and configured to output a driving signal,

wherein the plurality of first salient poles includes 3n salient poles,

~~where n is an integer of 1 or more,~~

~~the first driving coil is a star connection coil including three phase windings,~~

~~the plurality of second salient poles includes 3n salient poles,~~

~~the second driving coil is a star connection coil including three phase windings,~~

~~the first driving coil and the second driving coil are configured to connect phases of the first stator to phases of the second stator in parallel so that each of the phases of the first stator coincides with a corresponding one of the phases of the second stator, and~~

~~the first driving coil and the second driving coil are drive-controlled by the motor drive circuit.~~

~~6. The brushless DC motor according to claim 1, further comprising~~

~~a motor drive circuit connected to the first stator and the second stator and configured to output a driving signal,~~

~~wherein the plurality of first salient poles includes 3n salient poles, where n is an integer of 1 or more,~~

~~the first driving coil is a star connection coil including three phase windings,~~

~~the plurality of second salient poles includes 3n salient poles,~~

~~the second driving coil is a star connection coil including three phase windings,~~

~~the first driving coil and the second driving coil are configured to connect one of phases of the first stator to one of phases of the second stator in parallel, the one of the phases of the first stator coinciding with the one of the phases of the second stator,~~

~~the first driving coil and the second driving coil are configured to exchange other two of the phases of the first stator and other two of the phases of the second stator, the other two of the phases of the first stator coinciding with the other two of the phases of the second stator, and connect the other two of the phases of the first stator and the other two of the phases of the second stator in parallel, and~~

~~the first driving coil and the second driving coil are drive-controlled by the motor drive circuit.~~

~~7. The brushless DC motor according to claim 1, wherein~~

~~the coupling unit is coupled to the first flange and the second flange.~~

~~8. The brushless DC motor according to claim 1, wherein~~

~~the first rotor includes a first magnet,~~

~~the second rotor includes a second magnet, and,~~

~~with a direction of magnetization of the first magnet and a direction of magnetization of the second magnet being identical to each other, the coupling unit couples the first flange to the second flange along the rotation axis, the first magnet and the second magnet being adjacent to each other along the rotation axis between the first rotor and the second rotor.~~

~~9. The brushless DC motor according to claim 1, further comprising~~

~~one temperature detector configured to detect ambient temperatures of both of the first stator and the second stator.~~

~~10. The brushless DC motor according to claim 1, further comprising~~

~~one set of position detectors configured to detect rotation positions of~~

both of the first rotor and the second rotor.

11. A brushless DC motor, comprising:

a shaft defining a rotation axis;

a first stator having a cylindrical shape with a top face and a bottom face, wherein a center of a circle of the cylindrical shape is fixed to the shaft;

a second stator having a cylindrical shape with a top face and a bottom face and being adjacent to the first stator, wherein a center of a circle of the cylindrical shape is fixed to the shaft;

a first rotor

including a first flange in a face of the first rotor, the face being perpendicular to the rotation axis,

including a plurality of first magnets in an inner circumferential face of the first rotor, the inner circumferential face facing a side face of the first stator, and

rotatably attached to the shaft;

a second rotor

including a second flange in a face of the second rotor, the face being perpendicular to the rotation axis,

including a plurality of second magnets in an inner circumferential face of the second rotor, the inner circumferential face facing a side face of the second stator, and

rotatably attached to the shaft; and

a coupling unit configured to couple the first rotor to the second rotor along the rotation axis,

wherein the second rotor includes

a holding ring having a hollow circular shape, the holding ring

holding the second magnets within the second rotor at an end portion of the second rotor on a second flange side, and

the holding ring includes a thread rib which transmits, to the second magnets, a pressure from the coupling unit.

12. The brushless DC motor according to claim 11, wherein

the coupling unit has a hollow disk shape, and an inner diameter of a center opening of the hollow disk shape is larger than an outer diameter of the first stator and larger than an outer diameter of the second stator, and

the thread rib is disposed closer to an outer circumferential side than an inner circumferential edge of a center opening of the holding ring having the hollow circular shape.

13. The brushless DC motor according to claim 11, wherein

the first stator and the second stator are identical components, and

the first rotor and the second rotor are identical components.