

DESCRIPTION

CEILING FAN

5 TECHNICAL FIELD

The present invention relates to a ceiling fan.

BACKGROUND ART

A conventional typical ceiling fan uses a capacitor for adjustment of
10 a rotation speed of blade parts of the ceiling fan (for example, see PTL 1).

This type of ceiling fan is hereinafter described.

The ceiling fan includes a column unit, a motor unit, a support unit,
a plurality of blade parts, and power source lines. The column unit joins
the ceiling fan to a ceiling, and is hollow. The motor unit is disposed below
15 the column unit. The support unit is rotatably provided around a
circumference of the motor unit. The plurality of blade parts are
detachably attached to the support unit. The power source lines extend
from an attic toward the motor unit via a hollow space formed inside the

column unit.

The motor unit includes a stator core, a stator winding, a capacitor, and a rotor. The stator core has a plurality of slot portions as notches arranged in an annular shape. The stator winding is wound between the
5 respective slot portions. The capacitor is electrically connected with the stator winding. The rotor is opposite to a side surface of the stator core, and so attached as to be rotatable relative to the side surface of the stator core.

Citation List

10 Patent Literature

PTL 1: Unexamined Japanese Patent Publication No. 62-48997

SUMMARY OF THE INVENTION

A problem arising from this type of conventional ceiling fan is
15 complicated wiring operation. More specifically, the conventional ceiling fan uses a capacitor for adjustment of a speed of the ceiling fan. In this case, durability of the capacitor deteriorates when a temperature of the capacitor rises with heat generated from the motor unit. For avoiding this

deterioration of durability, the capacitor of the conventional ceiling fan is disposed in such a position that the capacitor is not easily influenced by the heat generated from the motor unit. However, positioning of the capacitor at such a location increases a wiring length, and requires complicated wiring operation. Moreover, a connection between the stator winding and the power source lines becomes difficult.

A ceiling fan according to the present invention includes a hollow column unit that includes a space, a motor unit provided below the column unit, a support unit that rotates around a circumference of the motor unit, a plurality of blade parts detachably attached to the support unit, and power source lines extending toward the motor unit via the space. The motor unit includes a disk-shaped stator core, a plurality of slot portions as notches formed in the stator core and arranged in an annular shape, a stator winding wound between the slot portions, a terminal block that connects a terminal of the stator winding, and a rotor attached in such a position as to be opposite to a side surface of the stator core. The slot portions includes a plurality of outer circumferential slot portions provided on an outer circumference of the stator core, and a plurality of inner circumferential slot

portions provided inside the plurality of outer circumferential slot portions.

The stator winding includes an outer circumferential stator winding wound

between the outer circumferential slot portions, and an inner

circumferential stator winding wound between the inner circumferential

5 slot portions. The inner circumferential stator winding includes a first

inner circumferential stator winding and a second inner circumferential

stator winding. The terminal block includes a first terminal block

positioned above the outer circumferential stator winding and the inner

circumferential stator winding, and a second terminal block positioned

10 above an inner circumferential side of the inner circumferential stator

winding. A terminal of the outer circumferential stator winding passes

through an upper surface of the first terminal block and connects with the

corresponding power source line, while a terminal of the first inner

circumferential stator winding and a terminal of the second inner

15 circumferential stator winding pass through an upper surface of the second

terminal block and connect with the corresponding power source lines.

The ceiling fan thus configured includes the inner circumferential

stator winding including the first inner circumferential stator winding and

the second inner circumferential stator winding. In this case, the ceiling fan performs two types of rotational actions described below, eliminating the necessity of the use of a capacitor for speed adjustment. A first rotational action is performed when voltage is applied to a series connection where the

5 first inner circumferential stator winding is electrically connected in series with the second inner circumferential stator winding, and a parallel connection where the first inner circumferential stator winding and the second inner circumferential stator winding are electrically connected in parallel with the outer circumferential stator winding. A second rotational

10 action is performed when voltage is applied to a series connection where the outer circumferential stator winding is electrically connected in series with the first inner circumferential stator winding, and a parallel connection where the outer circumferential stator winding and the first inner circumferential stator winding are electrically connected in parallel with the

15 second inner circumferential stator winding. The terminal block includes the first terminal block and the second terminal block. The respective terminals of the outer circumferential stator winding, the first inner circumferential stator winding, and the second inner circumferential stator

winding are connected in the manner described above. Accordingly, the connection between the outer circumferential stator winding and the power source line, the connection between the first inner circumferential stator winding and the power source line, and the connection between the second
5 inner circumferential stator winding and the power source line become easier.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front view of a ceiling fan according to an exemplary
10 embodiment of the present invention.

FIG. 2 is a cross-sectional view illustrating a general configuration of the ceiling fan according to the exemplary embodiment.

FIG. 3 is a plan view of a stator of the ceiling fan according to the exemplary embodiment.

15 FIG. 4 is a first perspective view of the stator of the ceiling fan according to the exemplary embodiment.

FIG. 5 is a second perspective view of the stator of the ceiling fan according to the exemplary embodiment.

DESCRIPTION OF EMBODIMENT

An exemplary embodiment according to the present invention is hereinafter described with reference to the drawings.

5 EXEMPLARY EMBODIMENT

FIG. 1 is a front view of a ceiling fan according to an exemplary embodiment of the present invention, and FIG. 2 is a cross-sectional view illustrating a general configuration of the ceiling fan according to the exemplary embodiment. As illustrated in FIGS. 1 and 2, ceiling fan 1
10 includes column unit 2, motor unit 3, support unit 4, a plurality of blade parts 5, and power source lines 6.

Column unit 2 is a hollow and bar-shaped component containing space 2a. Hanging unit 7 as a component capable of engaging with ceiling
20 is disposed above column unit 2. Motor unit 3 is fixed below column
15 unit 2.

FIG. 3 is a plan view of a stator of the ceiling fan according to the exemplary embodiment of the present invention, and FIG. 4 is a first perspective view of the stator of the ceiling fan according to the exemplary

embodiment. As illustrated in FIGS. 3 and 4, motor unit 3 is an outer rotor motor. Motor unit 3 includes stator core 8, stator windings 9, terminal block 10, rotor 11, and slot portions 12.

Disk-shaped stator core 8 includes a plurality of pieces laminated in a vertical direction. Polygonal opening 13 is formed at a center of stator core 8. Column unit 2 is fixed to opening 13. A plurality of slot portions 12 as notches are formed in a circumference of stator core 8 and arranged in an annular shape.

Slot portions 12 include a plurality of outer circumferential slot portions 17, and a plurality of inner circumferential slot portions 18. Each of the plurality of outer circumferential slot portions 17 is provided in an outer circumference of stator core 8. On the other hand, each of the plurality of inner circumferential slot portions 18 is provided inside the plurality of outer circumferential slot portions 17. Each distance between adjoining outer circumferential slot portions 17 is longer than each distance between adjoining inner circumferential slot portions 18. Each of slot portions 12 includes hole 14 having a substantially elliptical shape, and slit 15 extended outward from hole 14.

Stator windings 9 include outer circumferential stator winding 19 wound between outer circumferential slot portions 17, and inner circumferential stator winding 21 wound between inner circumferential slot portions 18. Insulation parts 16 are disposed between stator windings 9 and holes 14.

FIG. 5 is a second perspective view of the stator of the ceiling fan according to the exemplary embodiment of the present invention. As illustrated in FIG. 5, inner circumferential stator winding 21 includes first inner circumferential stator winding 22 and second inner circumferential stator winding 23. Terminal block 10 is fixed to an upper surface of stator core 8. Terminal block 10 connects terminals of stator windings 9 with power source lines 6. In other words, stator windings 9 and power source lines 6 are electrically connected via terminal block 10.

As illustrated in FIG. 4, rotor 11 having an annular shape is opposite to a circumference of motor unit 3, i.e., a side surface of stator core 8, and so attached as to be rotatable relative to the side surface of motor unit 3. Support unit 4 rotates around the circumference of motor unit 3. More specifically, support unit 4 is fixed to rotor 11 and provided in such a

condition as to be rotatable together with rotor 11 relative to motor unit 3.

The plurality of rectangular and flat-plate-shaped blade parts 5 are provided in such a condition that one of shorter sides of each rectangular shape of blade parts 5 is detachably attached to support unit 4.

5 Power source lines 6 illustrated in FIG. 1 extend from an attic toward motor unit 3 via space 2a formed inside column unit 2, so as to electrically connect an alternating current power source provided in the attic with stator windings 9 illustrated in FIG. 3.

 According to the foregoing configuration, voltage is applied to outer
10 circumferential stator winding 19 and inner circumferential stator winding 21 illustrated in FIG. 3 via power source lines 6 illustrated in FIG. 1 with interposition of circuit board 38 illustrated in FIG. 2 between power source lines 6 and outer and inner circumferential stator windings 19 and 21. As a result, rotor 11 illustrated in FIG. 4 performs a rotational action at a
15 speed adjusted in accordance with a resistance of stator windings 9.

 A winding method of inner circumferential stator winding 21 is now described with reference to FIGS. 3 and 5. Inner circumferential stator winding 21 is formed by winding first inner circumferential stator winding

22 at first, and then winding second inner circumferential stator winding 23 after completion of winding of first inner circumferential stator winding 22.

Initially, a first winding operation described below is repeated several times to wind first inner circumferential stator winding 22. In the first winding operation, winding starts, via slits 15, from an inner side of stator core 8 within holes 14 of adjoining inner circumferential slot portions 18, and continues while gradually shifting toward an outer side of stator core 8. When reaching an outermost position of stator core 8 within holes 14 of inner circumferential slot portions 18, winding again continues while shifting toward the inner side. When reaching an innermost position, winding again continues while shifting toward the outer side. These processes are repeated, and winding finally ends at the innermost position. A part thus produced becomes inner circumferential coil part 28 having a winding start. The foregoing processes are executed in the first winding operation.

Thereafter, the first winding operation is again executed for other holes 14 of adjoining inner circumferential slot portions 18. These processes are executed for all holes 14 of inner circumferential slot portions

18. Inner circumferential coil part 28 finally wound becomes inner circumferential coil part 28 having a winding end.

Next, a second winding operation which executes winding over first inner circumferential stator winding 22 is repeated several times to wind
5 second inner circumferential stator winding 23. In the second winding operation, winding starts from holes 14 of inner circumferential slot portions 18 for which winding of first inner circumferential stator winding 22 is executed at first. Similarly to the case of first inner circumferential stator winding 22, winding starts, via slits 15, from the inner side of stator
10 core 8 within holes 14 of adjoining inner circumferential slot portions 18, and continues while gradually shifting toward the outer side of stator core 8. When reaching the outermost position, winding again continues while shifting toward the inner side. When reaching the innermost position, winding again continues while shifting toward the outer side. These
15 processes are repeated to complete winding. In this case, winding may be ended at any one of positions of the innermost position, outermost position, and an intermediate position of stator core 8 within holes 14 of inner circumferential slot portions 18.

A part thus produced becomes inner circumferential coil part 28 having a winding start. The foregoing processes are executed in the second winding operation. Thereafter, the second winding operation is again executed for other holes 14 of adjoining inner circumferential slot portions 18. These processes are executed for all holes 14 of inner circumferential slot portions 18. Inner circumferential coil part 28 finally wound becomes inner circumferential coil part 28 having a winding end. Finally, insulation parts 16 are inserted between stator windings 9 and holes 14.

As apparent from the configuration discussed above, inner circumferential coil part 28 having the winding start of first inner circumferential stator winding 22, and inner circumferential coil part 28 having the winding start of second inner circumferential stator winding 23 become identical inner circumferential coil part 28. Similarly, inner circumferential coil part 28 having the winding end of first inner circumferential stator winding 22, and inner circumferential coil part 28 having the winding end of second inner circumferential stator winding 23 become identical inner circumferential coil part 28.

The ceiling fan according to this exemplary embodiment is

characterized by inner circumferential stator winding 21 and terminal block 10 included in the ceiling fan as illustrated in FIG. 5. More specifically, inner circumferential stator winding 21 including first inner circumferential stator winding 22 and second inner circumferential stator winding 23 performs two types of rotational actions described below, eliminating the necessity of the use of a capacitor for speed adjustment. A first rotational action is performed when voltage is applied to a series connection where first inner circumferential stator winding 22 is electrically connected in series with second inner circumferential stator winding 23, and a parallel connection where first inner circumferential stator winding 22 and second inner circumferential stator winding 23 are electrically connected in parallel with outer circumferential stator winding 19. A second rotational action is performed when voltage is applied to a series connection where outer circumferential stator winding 19 is electrically connected in series with first inner circumferential stator winding 22, and a parallel connection where outer circumferential stator winding 19 and first inner circumferential stator winding 22 are electrically connected in parallel with second inner circumferential stator winding 23. As illustrated in FIG. 4,

terminal block 10 includes first terminal block 24 and second terminal block 25.

First terminal block 24 is positioned above outer circumferential stator winding 19 and inner circumferential stator winding 21. Second terminal block 25 is positioned above an inner circumferential side of inner circumferential stator winding 21. In this case, terminals of outer circumferential stator winding 19 pass through an upper surface of first terminal block 24 to connect with corresponding power source lines 6. In addition, terminals of first inner circumferential stator winding 22 and terminals of second inner circumferential stator winding 23 pass through an upper surface of second terminal block 25 to connect with corresponding power source lines 6 as illustrated in FIG. 5. Accordingly, a connection between outer circumferential stator winding 19 and power source lines 6, a connection between first inner circumferential stator winding 22 and power source lines 6, and a connection between second inner circumferential stator winding 23 and power source lines 6 are facilitated, so that wiring operation becomes easier.

As illustrated in FIG. 5, first terminal block 24 includes first

one-side terminal block 26, and first other-side terminal block 27. Second terminal block 25 is positioned between first one-side terminal block 26 and first other-side terminal block 27. Second terminal block 25, first one-side terminal block 26, and first other-side terminal block 27 are formed integrally with each other. In this case, inner circumferential stator winding 21 is wound between adjoining inner circumferential slot portions 18 to form annular inner circumferential coil parts 28. Inner circumferential coil part 28 having the winding start or the winding end is positioned between first one-side terminal block 26 and first other-side terminal block 27. Accordingly, the winding start or the winding end of inner circumferential coil part 28 is visually recognizable with ease. In addition, a length of a connecting line at the winding start or the winding end of inner circumferential stator winding 21 extending from inner circumferential coil part 28 to second terminal block 25 decreases. Accordingly, inner circumferential stator winding 21 is more easily routed from inner circumferential coil part 28 to second terminal block 25, so that wiring operation becomes easier.

As illustrated in FIG. 5, second terminal block 25 is a

circular-arc-shaped component whose outer circumferential end extends along inner circumferences of inner circumferential coil parts 28 of stator core 8. In this case, inner circumferential coil part 28 having the winding start or the winding end is visible when first terminal block 24 and second terminal block 25 are viewed from above in the vertical direction. Accordingly, wiring operation becomes easier.

The winding start and winding end of first inner circumferential stator winding 22, and the winding start and winding end of second inner circumferential stator winding 23 as illustrated in FIG. 5 are positioned on the inner side of stator core 8 within inner circumferential slot portions 18. This arrangement shortens lengths of respective connecting lines extending to second terminal block 25 from the winding start and winding end of first inner circumferential stator winding 22, and the winding start and winding end of second inner circumferential stator winding 23. Accordingly, inner circumferential stator winding 21 is easily routed from inner circumferential coil part 28 to second terminal block 25, so that wiring operation becomes easier.

Outer circumferential stator winding 19 illustrated in FIG. 5 is

wound between adjoining outer circumferential slot portions 17 to form annular outer circumferential coil parts 29. Outer circumferential coil part 29 having a winding start or a winding end is positioned between first one-side terminal block 26 and first other-side terminal block 27.

5 This arrangement shortens a length of a connecting line extending from the winding start of outer circumferential stator winding 19 to first one-side terminal block 26, and a length of a connection line extending from the winding end of outer circumferential stator winding 19 to first other-side terminal block 27. Accordingly, a connecting line of outer circumferential
10 stator winding 19 is easily routed from outer circumferential stator winding 19 to first terminal block 24, so that winding operation becomes easier.

As illustrated in FIG. 5, first one-side catching portion 36 is formed in an outer portion of first one-side terminal block 26. On the other hand, first other-side catching portion 37 is formed in an outer portion of first
15 other-side terminal block 27. This structure facilitates a connection between power source line 6 and the connecting line extending from the winding start of outer circumferential stator winding 19 to first one-side terminal block 26 via first one-side catching portion 36. This structure

further facilitates a connection between power source line 6 and the connecting line extending from the winding end of outer circumferential stator winding 19 to first other-side terminal block 27 via first other-side catching portion 37.

5 First one-side terminal block 26 includes first one-side terminal block inner end portion 30, and first one-side connecting portion 31. First one-side terminal block inner end portion 30 extends from corresponding inner circumferential slot portion 18 toward the inside. First one-side connecting portion 31 makes such a connection where corresponding power
10 source line 6 and outer circumferential stator winding 19 connect with first one-side terminal block inner end portion 30.

 First other-side terminal block 27 includes first other-side terminal block inner end portion 32, and first other-side connecting portion 33. First other-side terminal block inner end portion 32 extends from corresponding
15 inner circumferential slot portion 18 toward the inside. First other-side connecting portion 33 makes such a connection where corresponding power source line 6 and outer circumferential stator winding 19 connect with first other-side terminal block inner end portion 32.

As illustrated in FIG. 5, second terminal block 25 includes a plurality of second terminal block inner end portions 34, and a plurality of second connecting portions 35. Each of the plurality of second terminal block inner end portions 34 extends from corresponding inner circumferential slot portion 18 toward the inside. Each of the plurality of second connecting portions 35 makes such a connection where corresponding power source line 6 and inner circumferential stator winding 21 connect with corresponding second terminal block inner end portion 34.

According to this structure, first one-side connecting portion 31, first other-side connecting portion 33, and the plurality of second connecting portions 35, as connecting portions 31, 33 and 35 connecting with corresponding power source lines 6, are all positioned inside inner circumferential slot portions 18. This arrangement reduces an influence of temperature increase of inner circumferential stator winding 21 at the respective connecting portions.

First one-side terminal block inner end portion 30, first other-side terminal block inner end portion 32, and each of the plurality of second terminal block inner end portions 34 extend in parallel with each other. In

this case, the connecting lines fixed to these connecting portions also become parallel with each other, so that intervals of the respective connecting lines become uniform.

As illustrated in FIG. 5, first one-side connecting portion 31, first
5 other-side connecting portion 33, and each of the plurality of second
connecting portions 35 are positioned on an identical circumference centered
on column unit 2. This arrangement equalizes respective lengths of power
source lines 6 extended from column unit 2.

10 INDUSTRIAL APPLICABILITY

A ceiling fan according to the present invention improves efficiency
of wiring operation, and thus is suited for ceiling fans for both household use
and office use.

15 REFERENCE MARKS IN THE DRAWINGS

- 1 ceiling fan
- 2 column unit
- 3 motor unit

	4	support unit
	5	blade part
	6	power source line
	7	hanging unit
5	8	stator core
	9	stator winding
	10	terminal block
	11	rotor
	12	slot portion
10	13	opening
	14	hole
	15	slit
	16	insulation part
	17	outer circumferential slot portion
15	18	inner circumferential slot portion
	19	outer circumferential stator winding
	20	ceiling
	21	inner circumferential stator winding

	22	first inner circumferential stator winding
	23	second inner circumferential stator winding
	24	first terminal block
	25	second terminal block
5	26	first one-side terminal block
	27	first other-side terminal block
	28	inner circumferential coil part
	29	outer circumferential coil part
	30	first one-side terminal block inner end portion
10	31	first one-side connecting portion
	32	first other-side terminal block inner end portion
	33	first other-side connecting portion
	34	second terminal block inner end portion
	35	second connecting portion
15	36	first one-side catching portion
	37	first other-side catching portion
	38	circuit board

CLAIMS

1. A ceiling fan comprising:

a hollow column unit that includes a space;

5 a motor unit provided below the column unit;

a support unit that rotates around a circumference of the motor unit;

a plurality of blade parts detachably attached to the support unit;

and

power source lines extending toward the motor unit via the space,

10 wherein the motor unit includes

a disk-shaped stator core,

a plurality of slot portions as notches formed in the stator

core and arranged in an annular shape,

a stator winding wound between the slot portions,

15 a terminal block that connects terminals of the stator

winding, and

a rotor attached in such a position as to be opposite to a side

surface of the stator core,

the slot portions include

a plurality of outer circumferential slot portions provided on
an outer circumference of the stator core, and

a plurality of inner circumferential slot portions provided
5 inside the plurality of outer circumferential slot portions,

the stator winding includes

an outer circumferential stator winding wound between the
outer circumferential slot portions, and

an inner circumferential stator winding wound between the
10 inner circumferential slot portions,

the inner circumferential stator winding includes a first inner
circumferential stator winding and a second inner circumferential stator
winding,

the terminal block includes

15 a first terminal block positioned above the outer
circumferential stator winding and the inner circumferential stator winding,
and

a second terminal block positioned above an inner

circumferential side of the inner circumferential stator winding,

a terminal of the outer circumferential stator winding passes through an upper surface of the first terminal block and connects with the corresponding power source line,

5 a terminal of the first inner circumferential stator winding and a terminal of the second inner circumferential stator winding pass through an upper surface of the second terminal block and connect with the corresponding power source lines.

10 2. The ceiling fan according to claim 1, wherein

the first terminal block includes a first one-side terminal block and a first other-side terminal block,

the second terminal block is positioned between the first one-side terminal block and the first other-side terminal block,

15 the second terminal block, the first one-side terminal block, and the first other-side terminal block are formed integrally with each other,

the inner circumferential stator winding forms annular inner circumferential coil parts, and

the inner circumferential coil part that has a winding start or a winding end is positioned between the first one-side terminal block and the first other-side terminal block.

5 3. The ceiling fan according to claim 2, wherein the second terminal block has a circular-arc shape so formed that an outer circumferential end of the second terminal block extends along an inner circumference of the inner circumferential coil parts on the stator core.

10 4. The ceiling fan according to claim 2, wherein the outer circumferential stator winding forms annular outer circumferential coil parts, and

the outer circumferential coil part that has a winding start or a winding end is positioned between the first one-side terminal block and the
15 first other-side terminal block.

5. The ceiling fan according to claim 2, wherein the first one-side terminal block includes

a first one-side terminal block inner end portion extending
inward from the corresponding inner circumferential slot portion, and

a first one-side connecting portion that connects both of the
corresponding power source line and the outer circumferential stator

5 winding to the first one-side terminal block inner end portion,

the first other-side terminal block includes

a first other-side terminal block inner end portion extending
inward from the corresponding inner circumferential slot portion, and

a first other-side connecting portion that connects both of the
10 corresponding power source line and the outer circumferential stator
winding to the first other-side terminal block inner end portion,

the second terminal block includes

a plurality of second terminal block inner end portions
extending inward from the corresponding inner circumferential slot portions,

15 and

second connecting portions that connects both of the
corresponding power source lines and the inner circumferential stator
winding to the second terminal block inner end portions, and

the first one-side terminal block inner end portion, the first other-side terminal block inner end portion, and the second terminal block inner end portions are parallel with each other.

- 5 6. The ceiling fan according to claim 5, wherein the first one-side connecting portion, the first other-side connecting portion, and the second connecting portions are positioned on an identical circumference centered on the column unit.