

DESCRIPTION

CEILING FAN

TECHNICAL FIELD

[0001] The present disclosure relates to a ceiling fan including a discharge product generator.

BACKGROUND ART

[0002] A conventional ceiling fan includes a strut engageable with a ceiling, a motor unit provided below the strut, a blade part rotated by the motor unit, a controller that controls rotation of the motor unit, a case configured to cover at least a part of the motor unit and the controller, and a discharge product generator. The discharge product generator is provided in a cylinder provided in an upper part of the case (e.g., see PTL 1).

Citation List

Patent Literature

[0003] PTL 1: Unexamined Japanese Patent Publication No. 2007-196144

SUMMARY OF THE INVENTION

[0004] The conventional ceiling fan has a problem of further improvement in design.

[0005] Specifically, the conventional ceiling fan includes the discharge product generator installed outside the case above the blade part, so that the discharge product generator is conspicuous.

[0006] Thus, it is an object of the present disclosure to further improve design of a ceiling fan.

[0007] A ceiling fan of the present disclosure includes a strut engageable with a ceiling, a motor unit disposed in a lower part of the strut, a blade support that is rotated by the motor unit, a plurality of blade parts fixed to the blade support and extending in a lateral direction, an upper cover disposed above the plurality of blade parts and surrounding an upper part of the motor unit, a discharge product generator disposed below the motor unit, and a lower cover having a bowl shape opening upward, disposed below the plurality of blade parts, and covering the discharge product generator. The blade support includes an annular part that is rotated by the motor unit, and a support part to which the plurality of

blade parts extending outward from the annular part are fixed. The blade support is configured to be covered with the lower cover when viewed from below. The lower cover includes an inner cover in a bowl shape opening downward. The discharge product generator is disposed in an annular gap between an outer surface of the inner cover and an inner surface of the lower cover.

[0008] As described above, the ceiling fan of the present disclosure includes the discharge product generator disposed in the lower cover to achieve further improvement in design.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is an external front view of a ceiling fan according to a first exemplary embodiment of the present disclosure.

Fig. 2 is a sectional view of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 3 is a perspective view of a motor unit, a blade support, and a lower cover of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 4 is an external front view of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 5 is a perspective view of an inside of the lower cover of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 6 is a diagram illustrating a discharge product generator of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 7 is a perspective view of the inside of the lower cover of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 8 is a perspective view of an inner cover and the lower cover of the ceiling fan according to the first exemplary embodiment of the present disclosure.

Fig. 9 is a sectional perspective view of an upper cover of the ceiling fan according to the first exemplary embodiment of the present disclosure.

DESCRIPTION OF EMBODIMENT

[0010] Hereinafter, an exemplary embodiment of the present disclosure will be described with reference to the drawings.

[0011] (First exemplary embodiment)

Fig. 1 is a front view illustrating an external appearance of ceiling fan 1 according to a first exemplary embodiment of the present disclosure. Fig. 2 is a sectional view of ceiling fan 1. Fig. 3 is a perspective view of motor unit 3, blade support 4, and lower cover 7 of ceiling fan 1. Fig. 4 is a front view illustrating an external appearance of ceiling fan 1.

[0012] Hereinafter, an up-down direction in Fig. 1 is defined as a vertical up-down direction. Here, an upward direction in the vertical direction, i.e., a direction from ceiling fan 1 toward a ceiling, may be referred to as an “upward direction”, and an upside in the vertical direction may be simply referred to as an “upside” or an “upper part”. Then, a downward direction in the vertical direction, i.e., a direction from the ceiling toward ceiling fan 1, may be referred to as a “downward direction”, and a downside in the vertical direction may be simply referred to as a “downside” or a “lower part”. Additionally, an up-down direction in the vertical direction may be simply referred to as an “up-down direction.”

[0013] As illustrated in Figs. 1 to 4, ceiling fan 1 includes strut 2, motor unit 3, blade support 4, blade part 5, upper cover 6, and lower cover 7.

[0014] Strut 2 has a hollow rod shape extending in the up-down direction. Strut 2 includes an upper part provided with hanging part 9 engageable with hanging metal fitting 8 fixed to the ceiling. Strut 2 includes a lower part to which motor unit 3 is fixed.

[0015] Motor unit 3 is an outer rotor motor, and includes stator core 10, stator winding 11, motor cover 12, and magnet 13. Around stator core 10, stator winding 11 is wound, and motor cover 12 is rotatably provided.

[0016] Motor cover 12 has a bowl shape opening downward. Motor cover 12 includes an upper surface provided with hole 14 through which strut 2 passes. Motor cover 12 includes an inner surface to which a plurality of magnets 13 are fixed. When a current flows through stator winding 11, motor cover 12 rotates about a rotation axis extending in the up-down direction. Blade support 4 is fixed to motor cover 12.

[0017] Blade support 4 includes annular part 17 and support part 18.

[0018] Annular part 17 has a substantially cylindrical shape. Annular part 17 includes an upper end part provided with four screw holes (not illustrated) extending downward. Annular part 17 is fixed to a lower part of motor cover 12 with screw 20.

[0019] Support part 18 includes a plurality of protrusions extending outward (laterally) from annular part 17. Support part 18 rotates clockwise when viewed from above. Support part 18 has a stepped shape in which a front end side in a rotation direction of support part

18 has a larger vertical dimension than a rear end side when viewed from the lateral direction. Support part 18 includes an upper surface to which blade part 5 is fixed. The upper surface of support part 18 is provided with two screw holes 21 extending downward. Annular part 17 and support part 18 are integrally formed and made of metal.

[0020] Blade part 5 includes blade fixing part 22, blade 23, and partition 24.

[0021] Blade fixing part 22 is a part of a member that fixes blade part 5 to support part 18 of blade support 4. Blade fixing part 22 has a substantially plate shape, and is provided with two holes (not illustrated) passing through its upper surface and lower surface. Blade fixing part 22 is fixed to support part 18 by fastening screw 26 to screw hole 21 of support part 18 through the hole while a lower surface of blade fixing part 22 is placed on the upper surface of support part 18.

[0022] Blade 23 blows air in blade part 5. Blade 23 has an elongated plate shape extending in the lateral direction from blade fixing part 22. Blade 23 is inclined with its front end part positioned above its rear end part in a rotation direction of blade part 5.

[0023] Partition 24 is a part of an outer shell of ceiling fan 1, and is provided covering a periphery of support part 18 of blade support 4. Partition 24 has a plate shape with a section in an arc shape when viewed from above, and is provided between blade fixing part 22 and blade 23. A plurality of partitions 24 are disposed concentrically and have a substantially cylindrical shape with a gap between partitions 24 adjacent to each other. Blade fixing part 22, blade 23, and partition 24 are integrally formed and made of resin.

[0024] Upper cover 6 has a cylindrical shape decreasing in diameter from its lower part toward its upper part. Upper cover 6 is provided above blade part 5 and is provided surrounding an upper part of motor unit 3 and a part of strut 2.

[0025] Lower cover 7 is provided below blade part 5 to cover discharge product generator 29 (see Fig. 5) described later. Lower cover 7 has a bowl shape opening upward. Between upper cover 6 and lower cover 7, partition 24 of blade part 5 is provided. Upper cover 6, lower cover 7, and partition 24 constitute the outer shell of ceiling fan 1. Between upper cover 6 and partition 24 of blade part 5, upper gap 27 is provided as a gap. Between lower cover 7 and partition 24 of blade part 5, lower gap 28 is provided as a gap.

[0026] Fig. 5 is a perspective view of the inside of lower cover 7 of ceiling fan 1. Fig. 6 is a diagram illustrating discharge product generator 29 of ceiling fan 1.

[0027] As illustrated in Fig. 2, ceiling fan 1 further includes discharge product generator 29 and controller 30.

[0028] Discharge product generator 29 is provided below motor unit 3 and in lower cover 7. Discharge product generator 29 includes discharge electrode 31 in the shape of a needle, counter electrode 32 disposed opposite to discharge electrode 31, and a Peltier element disposed as cooling part 33 for cooling discharge electrode 31.

[0029] Controller 30 is provided above motor unit 3 to control motor unit 3 and discharge product generator 29. Controller 30 causes a high voltage (-5 KV in the present exemplary embodiment) to be applied between counter electrode 32 and discharge electrode 31, and causes a voltage of about 0.05 V to 0.5 V to be applied to the Peltier element. In the present exemplary embodiment, a side close to discharge electrode 31 is set to a low temperature. When air is cooled around discharge electrode 31 to cause dew condensation, charged fine water particles as a discharge product are generated. The charged fine water particles contain a hydroxyl radical that reacts with an odor to oxidize a substance of the odor, so that the odor can be decomposed.

[0030] The hydroxyl radical is a radical which reacts with a hydroxy group (hydroxyl group). The hydroxyl radical is electrically very unstable because there is only one electron that should normally rotate on an orbit in pairs, and thus tends to deprive a missing electron from surrounding atoms and molecules. For this reason, the hydroxyl radical has very strong oxidizing power, and thus can decompose and remove an odor by an oxidizing action. Besides the charged fine water particles described above, discharge product generator 29 may generate any discharge product that performs sterilization, deodorization, or the like.

[0031] Fig. 7 is a perspective view of the inside of lower cover 7 of ceiling fan 1.

[0032] As illustrated in Figs. 3, 4, 5, and 7, lower cover 7 is internally provided with inner cover 34 in a bowl shape opening downward. Discharge product generator 29 is provided in annular gap 35 between an outer surface of inner cover 34 and an inner surface of lower cover 7. As a result, discharge product generator 29 is provided in lower cover 7, so that further improvement in design can be achieved.

[0033] Blade support 4 is rotated inside lower cover 7 to generate a rotational airflow (arrow in Fig. 7) in annular gap 35 between lower cover 7 and inner cover 34. The generated rotational airflow is induced by an airflow from the inside of lower cover 7 toward upper gap 27 between upper cover 6 and blade part 5, the airflow being generated along an outer surface of upper cover 6 by rotation of blade part 5 of ceiling fan 1. Discharge product generator 29 is provided in annular gap 35 between an outer surface of

inner cover 34 and an inner surface of lower cover 7. Thus, the discharge product is discharged from lower cover 7 toward upper gap 27 between upper cover 6 and blade part 5 by the rotational airflow generated inside lower cover 7, and is discharged into a housing space by an airflow flowing downward along the outer surface of upper cover 6. That is, the discharge product can be prevented from staying inside the lower cover 7 to improve releasability of the discharge product into the housing space.

[0034] Fig. 8 is a perspective view of inner cover 34 and lower cover 7 of ceiling fan 1.

[0035] As illustrated in Figs. 5, 7, and 8, lower cover 7 is in a circular shape when viewed from above. That is, lower cover 7 is in a circular bowl shape opening upward. Inner cover 34 is in a bowl shape opening downward, and includes top plate 36, arcuate side plate 37, and connection side plate 38.

[0036] Top plate 36 is in a shape in which a part (substantially semicircular shape) of a disk shape is missing. The top plate has a peripheral edge in a D-shape when viewed from below. Arcuate side plate 37 has a section in the shape of an arcuate plate when viewed from below. Arcuate side plate 37 extends downward from the peripheral edge in an arcuate shape of top plate 36. Connection side plate 38 is in a plate shape extending downward from a peripheral edge of top plate 36 in which a part of a circle is missing. That is, connection side plate 38 is in the shape of a horizontally elongated plate that connects opposite end parts of arcuate side plate 37 to the peripheral edge of top plate 36 in which the part of the circle is missing. Between arcuate side plate 37 and lower cover 7, a space in an annular shape is provided. Arcuate side plate 37 has a longer length in a rotation direction of blade support 4 than connection side plate 38, so that a rotational airflow easily flows. As a result, the airflow generated by rotation of blade support 4 rotates in a space defined by arcuate side plate 37, connection side plate 38, and lower cover 7.

[0037] The distance between an outer surface of connection side plate 38 of inner cover 34 and the inner surface of lower cover 7 is larger than the distance between an outer surface of the arcuate side plate of inner cover 34 and the inner surface of lower cover 7. Discharge product generator 29 is provided between the outer surface of connection side plate 38 and the inner surface of lower cover 7. This configuration reduces blowing resistance caused by discharge product generator 29, so that the airflow generated by the rotation of blade support 4 easily rotates in the space defined by arcuate side plate 37, connection side plate 38, and lower cover 7. As a result, the discharge product generated

by the discharge product generator can be prevented from staying in a place, where the discharge product is generated, by the rotational airflow passing between the arcuate side plate of inner cover 34 and the lower cover.

[0038] Inner cover 34 includes extension top plate 40 extending from an upstream side in the rotation direction of blade support 4 in an upper part of connection side plate 38 to above discharge product generator 29. Space 41 is disposed between a downstream side of extension top plate 40 in the rotation direction of blade support 4 and connection side plate 38. That is, top plate 36 of inner cover 34 and extension top plate 40 are provided flush with each other, and are in a shape in which a part of a peripheral edge part of a disk is missing when viewed from above. In other words, top plate 36 and extension top plate 40 of inner cover 34 include a cutout in a substantially fan shape in the peripheral edge part of the disk when viewed from above, the cutout serving as space 41.

[0039] Space 41 is disposed downstream in the rotation direction of blade support 4 in extension top plate 40. This configuration causes inner cover 34 to include extension top plate 40 extending to above discharge product generator 29, so that a part of an airflow rotating in the space defined by arcuate side plate 37, connection side plate 38, and lower cover 7 by the rotation of blade support 4 flows along a lower surface of extension top plate 40. As a result, the airflow flowing below lower cover 7 is considered to be rectified to allow the discharge product generated from discharge product generator 29 to easily flow by the rotating airflow.

[0040] Additionally, space 41 is provided between a downstream side of extension top plate 40 in the rotation direction of blade support 4 and connection side plate 38. Thus, the airflow rotating in the space defined by arcuate side plate 37, connection side plate 38, and lower cover 7 by the rotation of blade support 4 can flow upward by space 41 after passing below extension top plate 40. As a result, the discharge product generated from discharge product generator 29 moves toward a downstream side in the rotation direction of blade support 4 to move upward through space 41. Thus, the discharge product is less likely to stagnate in lower cover 7.

[0041] Extension top plate 40 has an outer peripheral edge that is partially provided with extension side surface 42 extending downward. Extension side surface 42 is in an arcuate shape when viewed from above. This configuration causes a part of the airflow rotating in the space defined by arcuate side plate 37, connection side plate 38, and lower cover 7 by the rotation of blade support 4 to flow along an inner surface of extension side surface 42.

As a result, the airflow flowing below lower cover 7 is rectified to allow the airflow generated by the rotation of blade support 4 to easily pass through a space between extension side surface 42 on which discharge product generator 29 is installed and connection side plate 38 as compared with a configuration without extension side surface 42.

[0042] Blade part 5 includes blade fixing part 22 fixed to blade support 4, blade 23 extending in the lateral direction from blade fixing part 22, and partition 24 provided between blade fixing part 22 and blade 23. A plurality of partitions 24 are disposed concentrically. Upper cover 6 has a lower end in a circular shape. Between a lower part of upper cover 6 and upper ends of the plurality of partitions 24, upper gap 27 is provided as a gap. Between an upper part of lower cover 7 and lower ends of the plurality of partitions 24, lower gap 28 is provided as a gap.

[0043] Upper cover 6 is also provided with ring 43 in the shape of an annular plate protruding inward from a lower end of upper cover 6. This configuration causes air flowing upward through space 41 to be induced by rotation of blade 23, thereby being discharged through upper gap 27 to the outside of ceiling fan 1. The air flowing upward through space 41 is blocked from flowing upward from upper cover 6 by ring 43 (see Fig. 2) protruding from the lower end of upper cover 6, and thus is discharged through upper gap 27 to the outside of ceiling fan 1. Controller 30 is disposed above ring 43.

[0044] Fig. 9 is a sectional perspective view of upper cover 6 of ceiling fan 1 according to the first exemplary embodiment of the present disclosure.

[0045] As illustrated in Fig. 9, ring 43 is provided extending downward gradually from its outer peripheral edge toward its inner peripheral edge. As a result, the air blocked by ring 43 from flowing toward upper cover 6 flows along a lower surface of ring 43 to be guided toward upper gap 27, and thus is likely to be discharged through upper gap 27 to the outside.

INDUSTRIAL APPLICABILITY

[0046] The ceiling fan of the present disclosure is useful as a ceiling fan for home use, office use, or the like.

REFERENCE MARKS IN THE DRAWINGS

[0047] 1 ceiling fan

2	strut
3	motor unit
4	blade support
5	blade part
6	upper cover
7	lower cover
8	hanging metal fitting
9	hanging part
10	stator core
11	stator winding
12	motor cover
13	magnet
14	hole
17	annular part
18	support part
20	screw
21	screw hole
22	blade fixing part
23	blade
24	partition
26	screw
27	upper gap
28	lower gap
29	discharge product generator
30	controller
31	discharge electrode
32	counter electrode
33	cooling part
34	inner cover
35	annular gap
36	top plate
37	arcuate side plate
38	connection side plate

40	extension top plate
41	space
42	extension side surface
43	ring

CLAIMS

1. A ceiling fan comprising:
 - a strut engageable with a ceiling;
 - a motor unit disposed in a lower part of the strut;
 - a blade support that is rotated by the motor unit;
 - a plurality of blade parts fixed to the blade support and extending in a lateral direction;
 - an upper cover disposed above the plurality of blade parts and surrounding an upper part of the motor unit;
 - a discharge product generator disposed below the motor unit; and
 - a lower cover having a bowl shape opening upward, the lower cover being disposed below the plurality of blade parts and covering the discharge product generator, wherein
 - the blade support includes an annular part that is rotated by the motor unit, and a support part to which the plurality of blade parts extending outward from the annular part are fixed,
 - the blade support is configured to be covered with the lower cover when viewed from below,
 - the lower cover includes an inner cover in a bowl shape opening downward, and
 - the discharge product generator is disposed in an annular gap between an outer surface of the inner cover and an inner surface of the lower cover.
2. The ceiling fan according to Claim 1, wherein
 - the lower cover is in a circular shape when viewed from above, and
 - the inner cover includes a top plate in a plate shape in which a part of a circle is missing, an arcuate side plate extending downward from an arcuate peripheral edge of the top plate, and a connection side plate extending downward from a peripheral edge of the top plate in which the part of the circle is missing.
3. The ceiling fan according to Claim 2, wherein
 - a distance between an outer surface of the connection side plate of the inner cover and the inner surface of the lower cover is larger than a distance between an outer surface

of the arcuate side plate of the inner cover and the inner surface of the lower cover, and the discharge product generator is disposed between the outer surface of the connection side plate and the inner surface of the lower cover.

4. The ceiling fan according to Claim 3, wherein the inner cover includes an extension top plate extending from an upstream side in a rotation direction of the blade support in an upper part of the connection side plate toward above the discharge product generator, and a space is disposed between a downstream side in the rotation direction of the blade support in the extension top plate and the connection side plate.

5. The ceiling fan according to Claim 4, wherein an extension side surface extending downward is disposed at a part of an outer peripheral edge of the extension top plate, and the extension side surface is in an arcuate shape when viewed from above.

6. The ceiling fan according to any one of Claims 1 to 5, wherein each of the plurality of blades includes:
a blade fixing part fixed to the blade support;
a blade extending in a lateral direction from the blade fixing part; and
a partition disposed between the blade fixing part and the blade,
the partition constituting a plurality of partitions that are disposed concentrically,
the upper cover includes a lower end in a circular shape,
the upper cover includes a lower part and an upper gap is disposed as a gap between the lower part and upper ends of the plurality of partitions,
the lower cover includes an upper part and a lower gap is disposed as a gap between the upper part and lower ends of the plurality of partitions, and
the upper cover includes a ring in an annular plate shape protruding inward from the lower end of the upper cover.

7. The ceiling fan according to Claim 6, wherein the ring is disposed extending downward gradually from an outer peripheral edge of the ring toward an inner peripheral edge of the ring.