

ROTOR, MANUFACTURING METHOD, AND CEILING FAN

Technical Field

[0001] The present disclosure generally relates to rotors, manufacturing methods, and ceiling fans and specifically relates to a rotor to which three vanes are to be attached, a manufacturing method of the rotor, and a ceiling fan including the rotor.

Background Art

[0002] Conventionally, there is a fan configured to be suspended from a ceiling (ceiling fan) (see Patent Literature 1). The ceiling fan of Patent Literature 1 includes a suspending portion configured to be fixed to the ceiling and a body portion configured to be supported by being engaged with the suspending portion. The body portion includes a rotary driving portion and a plurality of vanes. The rotary driving portion includes a rotor configured to rotate when the rotary driving portion is conducted.

Citation List

Patent Literature

[0003] Patent Literature 1: WO 2016/051665 A1

Summary of Invention

[0004] There is a demand for reducing the weight of components of ceiling fans.

[0005] In view of the foregoing, it is an object of the present disclosure to provide a rotor having a reduced weight, a manufacturing method, and a ceiling fan.

[0006] A rotor according to an aspect of the present disclosure is to be used in a ceiling fan, and at least three vanes are to be attached to the rotor. The rotor includes a body, at least three pairs of first and second flanges, and a plurality of spokes. The body has a circular shape centered around a pivot axis around which the at least three vanes are to pivot. The at least three pairs of the first and second flanges correspond to the at least three vanes on a one-to-one basis and protrude along a radial direction of the body to be away from the pivot axis at the body. The plurality of spokes extend from the body toward the pivot axis. Each of the first flanges has a first opening which is open along the pivot axis. Each of the second flanges has a second opening

which is open along the pivot axis.

[0007] A manufacturing method according to an aspect of the present disclosure is a method of manufacturing the rotor. The manufacturing method includes attaching gates to a mold of the rotor at positions corresponding to respective two first flanges of the at least three first flanges corresponding to the at least three vanes on a one-to-one basis. The manufacturing method includes pouring a melted aluminum alloy into the mold through each of the gates to mold the rotor.

[0008] A ceiling fan according to an aspect of the present disclosure includes the rotor and the at least three vanes.

Brief Description of Drawings

[0009] FIG. 1 is a perspective view of a ceiling fan according to an embodiment;

FIG. 2 is an exploded perspective view of the ceiling fan;

FIG. 3 is a perspective view of a rotor included in the ceiling fan;

FIG. 4 is a plan view of the rotor; and

FIG. 5 is a sectional view taken along line X1-X1 of FIG. 4.

Description of Embodiments

[0010] An embodiment and variations described below are mere examples of the present disclosure, and the present disclosure is not limited to the embodiment and variations below. Various modifications may be made to embodiments other than the embodiment and variations below depending on design and the like within the scope of the technical idea of the present disclosure.

[0011] (Embodiment)

A rotor 10 according to the present embodiment and a ceiling fan 1 including the rotor 10 will be described below with reference to FIGS. 1 to 5.

[0012] (1) Overview

The ceiling fan 1 according to the present embodiment is a fan (ceiling fan) to be installed on a ceiling of a building. As shown in FIGS. 1 and 2, the ceiling fan 1 includes the rotor 10. In other words, the rotor 10 is to be used in the ceiling fan 1. To the rotor 10, three vanes 20 are to be attached.

[0013] As shown in FIG. 3, the rotor 10 includes a body 11, three pairs of first and second flanges 12 and 13, and three spokes 14. The body 11 has a circular shape centered around a pivot axis

A1 (see FIG. 3) around which the three vanes 20 are to pivot. The three pairs of first and second flanges 12 and 13 correspond to the three vanes 20 on a one-to-one basis. The three pairs of first and second flanges 12 and 13 protrude along a radial direction of the body 11 to be away from the pivot axis A1 at the body 11. The three spokes 14 extend from the body 11 toward the pivot axis A1. Each of the first flanges 12 has a first opening 121 which is open along the pivot axis A1. Each of the second flanges 13 has a second opening 131 which is open along the pivot axis A1.

[0014] According to this configuration, each of the first flanges 12 and the second flanges 13 of the rotor 10 respectively have the first opening 121 and the second opening 131, thereby achieving a reduction in weight.

[0015] Note that in the following description, unless otherwise indicated, arrows shown in FIG. 3 define up/down directions of the rotor 10. Note that the directions are not intended to define directions in which the rotor 10 is used. Moreover, the arrows shown in FIG. 3 and the like are drawn to simply assist with the description and are intangible.

[0016] (2) Configurations

The configurations of the rotor 10 and the ceiling fan 1 including the rotor 10 will be described in detail.

[0017] As shown in FIGS. 1 and 2, the ceiling fan 1 includes the rotor 10 and three vanes 20. The ceiling fan 1 further includes a cover 30 and a pivot controller including a motor configured to cause the three vanes 20 to pivot. Note that the pivot controller is omitted in the figure.

[0018] The vanes 20 are fixed to the rotor 10 via the cover 30 with, for example, screws (not shown). The vanes 20 are, for example, molded as metal plates. As shown in FIG. 2, each of the vanes 20 has a connector portion 21 and a fan portion 22. The connector portion 21 is a portion which is to be attached to the rotor 10 and the cover 30. Specifically, the connector portion 21 is placed on, and is screwed to, the cover 30. The fan portion 22 is a portion located outside the connector portion 21 in a radial direction of the body 11. Pivoting of the vanes 20 is controlled by the pivot controller such that the vanes 20 pivot around the pivot axis A1, and thereby, the fan portions 22 of the vanes 20 produce a current of air. The fan portions 22 of the vanes 20 are tilted at an angle, appropriate for producing a current of air, with respect to the connector portions 21 of the vanes 20.

[0019] The cover 30 holds the three vanes 20. The cover 30 is disposed between the rotor 10 and the three vanes 20. On the cover 30, the connector portions 21 of the vanes 20 are placed and are fixed to the cover 30 and the first flanges 12 of the rotor with screws (not shown). For example, screws are inserted into through holes formed in the cover 30 and the first flanges 12 of

the rotor 10 and are then tightened. Moreover, the cover 30 houses at least part of the pivot controller between the cover 30 and the rotor 10.

[0020] As shown in FIGS. 3 and 4, the rotor 10 includes the body 11, the three pairs of first and second flanges 12 and 13, and the plurality of (in this embodiment, three) spokes 14. Note that when the three first flanges 12 have to be distinguished from one another, they are referred to as first flanges 12a, 12b, and 12c.

[0021] The rotor 10 is formed by die cast molding. That is, the body 11, the three pairs of first and second flanges 12 and 13, and the three spokes 14 are formed by die cast molding. The rotor 10 is molded from, for example, an aluminum alloy.

[0022] The body 11 has a circular shape centered around the pivot axis A1 (see FIG. 3) around which the three vanes 20 are to pivot. Note that the pivot axis A1 is a virtual axes. The body 11 includes a first body portion 11a, a second body portion 11b, and a third body portion 11c. The first body portion 11a, the second body portion 11b, and the third body portion 11c have a circular shape centered around the pivot axis A1. The second body portion 11b and the third body portion 11c are disposed along the pivot axis A1. The first body portion 11a is disposed to surround an outer perimeter of each of the second body portion 11b and the third body portion 11c and is connected to the second body portion 11b and the third body portion 11c.

[0023] The three pairs of first and second flanges 12 and 13 correspond to the three vanes 20 on a one-to-one basis. Each pair of first and second flanges 12 and 13 protrudes along the radial direction of the body 11 to be away from the pivot axis A1 at the body 11. The three pairs of first and second flanges 12 and 13 support the cover 30 from below.

[0024] Each of the first flanges 12 and each of the second flanges 13 are disposed on the first body portion 11a of the body 11. That is, each of the first flanges 12 and each of the second flanges 13 protrude along the radial direction of the body 11 to be away from the pivot axis A1 at the first body portion 11a.

[0025] Each of the first flanges 12 has the first opening 121 which is open along the pivot axis A1. Each of the second flanges 13 has the second opening 131 which is open along the pivot axis A1.

[0026] As shown in FIG. 4, each of the first flanges 12 includes a first attachment 122, a second attachment 123, a first beam 124, and a second beam 125. Each of the first flanges 12 further includes a first member 126 and a second member 127.

[0027] The first attachment 122 is a portion which is a tip part in the radial direction of the body 11 and to which a corresponding one vane 20 of the three vanes 20 is to be attached. The first

attachment 122 has a first through hole penetrating therethrough along the pivot axis A1. A screw is sequentially inserted into a through hole formed in the vane 20, a through hole formed in the cover 30, and the first through hole formed in the first attachment 122 and is then tightened.

[0028] The second attachment 123 is a portion which is present at a position along a circumferential direction of the body 11 from the first attachment 122 and to which the cover 30 for holding the three vanes 20 is to be attached. The second attachment 123 has a through hole penetrating therethrough along the pivot axis A1. A screw is sequentially inserted into a through hole formed in the cover 30 and the second through hole formed in the second attachment 123 and is then tightened.

[0029] The first beam 124 extends from the first attachment 122 to the body 11. That is, the first beam 124 extends from the first attachment 122 to the first body portion 11a of the body 11. Specifically, the first beam 124 extends from the first attachment 122 to the first body portion 11a such that the first beam 124 intersects a straight line extending from the first attachment 122 along the radial direction of the body 11, and the first beam 124 is connected to the first body portion 11a. The second beam 125 extends from the second attachment 123 to the body 11. That is, the second beam 125 extends from the second attachment 123 to the first body portion 11a of the body 11. Specifically, the second beam 125 extends from the second attachment 123 to the first body portion 11a such that the second beam 125 intersects a straight line extending from the second attachment 123 along the radial direction of the body 11, and the second beam 125 is connected to the first body portion 11a. Here, the first beam 124 and the second beam 125 extend to be apart from each other toward the first body portion 11a.

[0030] The first member 126 is a member extending from the first attachment 122 to the body 11 and is disposed between the first beam 124 and the second beam 125. Specifically, the first member 126 extends from the first attachment 122 to the first body portion 11a such that the first member 126 intersects the straight line extending from the first attachment 122 along the radial direction of the body 11, and the first member 126 is connected to the first body portion 11a. The second member 127 is a member extending from the second attachment 123 to the body 11 and is disposed between the first beam 124 and the second beam 125. Specifically, the second member 127 extends from the second attachment 123 to the first body portion 11a such that the second member 127 intersects the straight line extending from the second attachment 123 along the radial direction of the body 11, and the second member 127 is connected to the first body portion 11a. Here, the first member 126 and the second member 127 extend to be close to each other toward the first body portion 11a.

[0031] The first opening 121 includes a third opening 121a and a fourth opening 121b. The third opening 121a and the fourth opening 121b each have a substantially triangular shape. The third opening 121a is defined by the first beam 124, the first member 126, and a first wall part 111 which is part of the body 11. The first wall part 111 is a portion included in the first body portion 11a and extending from a connection location of the first beam 124 to a connection location of the first member 126. That is, the first wall part 111 is a portion included in the first body portion 11a and located between the first beam 124 and the first member 126 when the first flange 12 is viewed in the radial direction of the body 11. The fourth opening 121b is defined by the second beam 125, the second member 127, and a second wall part 112 included in the body 11 and different from the first wall part 111. The second wall part 112 is a portion included in the first body portion 11a and extending from a connection location of the second beam 125 to a connection location of the second member 127. That is, the second wall part 112 is a portion included in the first body portion 11a and located between the second beam 125 and the second member 127 when the first flange 12 is viewed in the radial direction of the body 11.

[0032] The first opening 121 in the first flange 12c of the three first flanges 12 further includes a fifth opening 121c. The fifth opening 121c has a substantially trapezoidal shape. The fifth opening 121c is defined by the first member 126, the second member 127, a third member 128 connecting the first attachment 122 and the second attachment 123 to each other, and a third wall part 113 which is a portion included in the body 11 and located between the first wall part 111 and the second wall part 112. Each of the first flanges 12a and 12b of the three first flanges 12 further includes a surface part 129. The surface part 129 closes a space defined by the first member 126, the second member 127, the third member 128, and the third wall part 113.

[0033] As shown in FIG. 4, each of the second flanges 13 includes a third attachment 132, a third beam 133, a fourth beam 134, and a fifth beam 135.

[0034] The third attachment 132 is a portion which is a tip part in the radial direction of the body 11 and to which a corresponding one vane 20 of the three vanes 20 is to be attached. Each of the three vanes 20 is held by the first attachment 122 of a corresponding one first flange 12 of the three first flanges 12 and a second flange 13 anticlockwise adjacent to the first attachment 122 when the rotor 10 is viewed from above. For example, a vane 20 corresponding to the first flange 12a is held by the first attachment 122 of the first flange 12a and the second flange 13 anticlockwise adjacent to the first flange 12a.

[0035] The third beam 133 extends from the second attachment 123 to the body 11. That is, the third beam 133 extends from the second attachment 123 to the first body portion 11a of the body

11. Specifically, the third beam 133 extends from the second attachment 123 to the first body portion 11a such that the third beam 133 intersects the straight line extending from the second attachment 123 along the radial direction of the body 11, and the third beam 133 is connected to the first body portion 11a. The fourth beam 134 extends from the second attachment 123 to the body 11. That is, the fourth beam 134 extends from the second attachment 123 to the first body portion 11a of the body 11. Specifically, the fourth beam 134 extends from the second attachment 123 to the first body portion 11a such that the fourth beam 134 intersects the straight line extending from the second attachment 123 along the radial direction of the body 11, and the fourth beam 134 is connected to the first body portion 11a. Here, the third beam 133 and the fourth beam 134 extend to be apart from each other toward the first body portion 11a.

[0036] The fifth beam 135 extends from the second attachment 123 to the first body portion 11a along the radial direction of the body 11 extending from the second attachment 123 between the third beam 133 and the fourth beam 134 and is connected to the first body portion 11a.

[0037] The second opening 131 includes a sixth opening 131a and a seventh opening 131b. The sixth opening 131a and the seventh opening 131b each have a substantially triangular shape. The sixth opening 131a is defined by the third beam 133, the fifth beam 135, and a fourth wall part 114 which is part of the body. The fourth wall part 114 is a portion included in the first body portion 11a and extending from a connection location of the third beam 133 to a connector portion of the fifth beam 135. That is, the fourth wall part 114 is a portion included in the first body portion 11a and located between the third beam 133 and the fifth beam 135 when the second flange 13 is viewed in the radial direction of the body 11. The seventh opening 131b is defined by the fourth beam 134, the fifth beam 135, and a fifth wall part 115 included in the body 11 and different from the fourth wall part 114. The fifth wall part 115 is a portion included in the first body portion 11a and extending from a connection location of the fourth beam 134 to a connection location of the fifth beam 135. That is, the fifth wall part 115 is a portion included in the first body portion 11a and located between the fourth beam 134 and the fifth beam 135 when the second flange 13 is viewed in the radial direction of the body 11.

[0038] The plurality of (in this embodiment, three) spokes 14 extend from the body 11 toward the pivot axis A1. In the present embodiment, the plurality of spokes 14 correspond to the three first flanges 12 on a one-to-one basis. The plurality of spokes 14 are disposed at the body 11 such that each of the spokes 14 overlaps a corresponding one first flange 12 of the three first flanges 12 viewed in the radial direction of the body 11. Specifically, the plurality of spokes 14 are disposed at the second body portion 11b such that each of the spokes 14 overlaps a

corresponding one first flange 12 of the three first flanges 12 viewed in the radial direction of the body 11.

[0039] Each spoke 14 includes a first spoke portion 141 and a second spoke portion 142. The first spoke portion 141 extends downward from the second body portion 11b. The second spoke portion 142 has a plate shape. The second spoke portion 142 extends from a downward extending tip of the first spoke portion 141 along the radial direction of the body 11 toward the pivot axis A1.

[0040] The second spoke portion 142 of each of the spokes 14 is provided with three ribs 143, 144, and 145 along the radial direction of the body 11 such that the three ribs 143, 144, and 145 protrude upward from the second spoke portion 142. The ribs 144 and 145 are provided at both ends in a width direction of the second spoke portion 142. The rib 143 is disposed between the rib 144 and the rib 145.

[0041] In each of the spokes 14, at least one of the width W1 (see FIG. 5) or the thickness H1 (see FIG. 5) of the second spoke portion 142 of the spoke 14 is less than that of a second spoke portion of a comparative example. Here, the premise of the width W1 and the thickness H1 of the second spoke portion 142 of the spoke 14 is that the rotation speed of the motor can be maintained without changing a driving condition for the motor.

[0042] For example, the second spoke portion of the comparative example has a width of 20 mm and a thickness of 2.6 mm. In the present embodiment, both the width W1 and the thickness H1 of the second spoke portion 142 of the spoke 14 are less than those of the second spoke portion of the comparative example. That is, the width W1 and the thickness H1 of the second spoke portion 142 according to the present embodiment are respectively less than 20 mm and less than 2.6 mm. For example, in the present embodiment, the width W1 of the second spoke portion 142 of the spoke 14 is 15 mm, and the thickness H1 of the second spoke portion 142 of the spoke 14 is 1.5 mm. Note that the width W1 of the second spoke portion 142 of the spoke 14 may be 16 mm or may be 17 mm. That is, the width W1 of the second spoke portion 142 of the spoke 14 is preferably greater than or equal to 15 mm and less than 20 mm. Moreover, the thickness H1 of the second spoke portion 142 of the spoke 14 is preferably greater than or equal to 1.5 mm and less than 2.6 mm.

[0043] Note that when only the thickness H1 of the second spoke portion 142 of the spoke 14 is less than that of the second spoke portion of the comparative example, the width W1 of the second spoke portion 142 of the spoke 14 may be 20 mm. Moreover, when only the width W1 of the second spoke portion 142 of the spoke 14 is less than that of the second spoke portion of the comparative example, the thickness H1 of the second spoke portion 142 of the spoke 14 may be

2.6 mm.

[0044] As shown in FIG. 3, the rotor 10 further includes a cylindrical part 15. The cylindrical part 15 has a cylindrical shape centered around the pivot axis A1. That is, the cylindrical part 15 has a through hole 151 extending through the cylindrical part 15 along the pivot axis A1. Note that the diameter of the cylindrical part 15 is smaller than the diameter of the body 11. The second spoke portion 142 extending from the first spoke portion 141 of each of the spokes 14 in the radial direction of the body 11 has a tip connected to a lower end of the cylindrical part 15.

[0045] (3) Manufacturing Method

Here, a manufacturing method of the rotor 10 will be described.

[0046] The rotor 10 is formed by aluminum die cast molding.

[0047] To a mold of the rotor 10, gates are attached at respective positions corresponding to the two first flanges 12a and 12b of the three first flanges 12 corresponding to the three vanes 20 on a one-to-one basis. For example, to the mold, the gates are attached to positions corresponding to the third members 128 of the first flanges 12a and 12b.

[0048] A melted aluminum alloy is poured into (filled in) the mold through each of the gates. After the mold is filled with the melted aluminum alloy, the aluminum alloy in the mold is solidified. When the aluminum alloy in the mold is solidified, the aluminum alloy thus solidified is cut off from each of the gates, and a cast of the aluminum alloy thus solidified, that is, the rotor 10 is taken out of the mold by using a removing device.

[0049] Moreover, the rotor 10 is polished. In particular, a portion of the rotor 10 at which the rotor 10 is cut off from each of the gates, the third member 128 of each of the first flanges 12a and 12b is polished.

[0050] When the melted aluminum alloy is filled, the pressure at an outflow port of each of the gates is higher than pressures at the other locations. The present embodiment includes the surface part 129 provided at each of the first flanges 12a and 12b to which the gates are attached. This can reduce the possibility that the pressure at the outflow port of each of the gates at the time of filling the melted aluminum alloy causes, for example, deformation of molds of the first flanges 12a and 12b.

[0051] Moreover, providing the first opening 121 and the second opening 131 can reduce the number of flow paths of the melted aluminum alloy as compared with the case where neither the first opening 121 nor the second opening 131 is provided. Thus, the melted aluminum alloy easily flows at the time of molding the rotor 10. Therefore, overall applied pressure is substantially uniform at the time of filling the melted aluminum alloy to mold the rotor 10. As a

result, air bubbles produced at the time of molding the rotor 10 are reduced as compared with the case where neither the first opening 121 nor the second opening 131 is provided. Moreover, since the air bubbles are reduced, voids produced after the rotor 10 is solidified are also reduced as compared with the case where neither the first opening 121 nor the second opening 131 is provided.

[0052] (4) Effects

As described above, the rotor 10 according to the embodiment is to be used in the ceiling fan 1, and the three vanes 20 are to be attached to the rotor 10. The rotor 10 includes the body 11, the three pairs of first and second flanges 12 and 13, and the plurality of spokes 14. The body 11 has a circular shape centered around the pivot axis A1 around which the three vanes 20 are to pivot. The three pairs of the first flanges 12 correspond to the three vanes 20 on a one-to-one basis and protrude along a radial direction of the body 11 to be away from the pivot axis A1 at the body 11. The plurality of spokes 14 extend from the body 11 toward the pivot axis A1. Each of the first flanges 12 has a first opening 121 which is open along the pivot axis A1. Each of the second flanges 13 has a second opening 131 which is open along the pivot axis A1.

[0053] According to this configuration, each of the first flanges 12 and the second flanges 13 of the rotor 10 respectively have the first opening 121 and the second opening 131, thereby achieving a reduction in weight.

[0054] Moreover, the ceiling fan 1 of the embodiment includes the rotor 10 and the three vanes 20.

[0055] According to this configuration, each of the first flanges 12 and the second flanges 13 of the rotor 10 respectively have the first opening 121 and the second opening 131, thereby reducing the weight of the ceiling fan 1.

[0056] (5) Variations

Variations will be described below. Note that the variations described below are applicable accordingly in combination with the embodiment described above.

[0057] (5.1) First Variation

In the embodiment, the plurality of spokes 14 are disposed at the body 11 such that each of the spokes 14 overlaps a corresponding one first flange 12 of the three first flanges 12 viewed in the radial direction of the body 11. However, this should not be construed as limiting.

[0058] The plurality of spokes 14 may be disposed at the body 11 such that each of the spokes 14 does not overlap a corresponding one first flange 12 of the three first flanges 12 when viewed in the radial direction of the body 11.

[0059] (5.2) Second Variation

The embodiment includes the three spokes 14, but this should not be construed as limiting. Two spokes may be provided, or four or more spokes may be provided.

[0060] (5.3) Third Variation

In the embodiment, each of the first flanges 12 includes the first attachment 122, the second attachment 123, and the third member 128 connecting the first attachment 122 and the second attachment 123 to each other, but this should not be construed as limiting.

[0061] In the first flange 12, the first attachment 122 and the second attachment 123 do not have to be connected to each other by the third member 128. That is, the first flange 12 may have a configuration including: the first attachment 122, a projection including the first beam 124 and the first member 126; the second attachment 123; and a projection including the second beam 125 and the second member 127. In sum, the first flange 12 may include two projections.

[0062] (5.4) Fourth Variation

The number of vanes of the rotor 10 is three. However, this should not be construed as limiting. Four vanes or five vanes may be provided.

[0063] When the number of vanes is four, the rotor 10 includes four pairs of first and second flanges 12 and 13. Two adjacent first flanges 12 of the four first flanges 12 further include surface parts 129. That is, the two first flanges 12 are first flanges with gates attached at the time of die cast molding. In each of the remaining two first flanges 12 of the four first flanges 12, the first opening 121 includes the fifth opening 121c. That is, the remaining two first flanges 12 are first flanges with no gate attached at the time of the die cast molding.

[0064] When the number of vanes is five, the rotor 10 includes five pairs of first and second flanges 12 and 13. Each of adjacent two first flanges 12 of the five first flanges 12 further includes a surface part 129. That is, the two first flanges 12 are first flanges with gates attached at the time of the die cast molding. In each of the remaining three first flanges 12 of the five first flanges 12, the first opening 121 includes the fifth opening 121c. That is, the remaining three first flanges 12 are first flanges with no gate attached at the time of the die cast molding.

[0065] That is, the number of the vanes is at least three. In this case, the rotor 10 includes at least three pairs of first and second flanges 12 and 13. Each of two adjacent first flanges 12 of the at least three first flanges 12 further has the surface part 129. That is, the two first flanges 12 are first flanges with gates attached at the time of the die cast molding. In the remaining first flange(s) 12 of the at least three first flanges 12, the first opening 121 includes the fifth opening 121c. That is, the remaining first flange(s) 12 is a first flange with no gate attached at the time of the die cast molding.

[0066] (6) Summary

As described above, a rotor (10) of a first aspect is configured to be used in a ceiling fan (1), and at least three vanes (20) are to be attached to the rotor (10). The rotor (10) includes a body (11), at least three pairs of first and second flanges (12) and (13), and a plurality of spokes (14). The body (11) has a circular shape centered around a pivot axis (A1) around which the at least three vanes (20) are to pivot. The at least three pairs of the first flanges (12) correspond to the at least three vanes (20) on a one-to-one basis and protrude along a radial direction of the body (11) to be away from the pivot axis (A1) at the body (11). The plurality of spokes (14) extend from the body (11) toward the pivot axis (A1). Each of the first flanges (12) has a first opening (121) which is open along the pivot axis (A1). Each of the second flanges (13) has a second opening (131) which is open along the pivot axis (A1).

[0067] According to this configuration, each of the first flanges (12) and each of the second flanges (13) of the rotor (10) respectively have the first opening (121) and the second opening (131), thereby achieving a reduction in weight.

[0068] In a rotor (10) of a second aspect referring to the first aspect, each of the first flanges (12) includes a first attachment (122), a second attachment (123), a first beam (124), a second beam (125), a first member (126), and a second member (127). The first attachment (122) is a portion which is a tip part in the radial direction of the body (11) and to which a corresponding one vane (20) of the at least three vanes (20) is to be attached. The second attachment (123) is a portion which is present at a position along a circumferential direction of the body (11) from the first attachment (122) and to which a cover (30) for holding the at least three vanes (20) is to be attached. The first beam (124) extends from the first attachment (122) to the body (11). The second beam (125) extends from the second attachment (123) to the body (11). The first member (126) extends from the first attachment (122) to the body (11) and is disposed between the first beam (124) and the second beam (125). The second member (127) extends from the second attachment (123) to the body (11) and is disposed between the first beam (124) and the first member (126). The first opening (121) includes a third opening (121a) and a fourth opening (121b). The third opening (121a) is defined by the first beam (124), the first member (126), and a first wall part (111) which is part of the body (11). The fourth opening (121b) is defined by the second beam (125), the second member (127), and a second wall part (112) which is part of the body (11) and which is different from the first wall part (111).

[0069] According to this configuration, each of the first flanges (12) of the rotor (10) has the third opening (121a) and the fourth opening (121b), thereby achieving a reduction in weight.

[0070] In a rotor (10) of a third aspect referring to the second aspect, the body (11), each of the first flanges (12), each of the second flanges (13), and each of the plurality of spokes (14) are formed by die cast molding. Each of the first flanges (12) is either a first flange (e.g., a first flange 12a, 12b) with a gate attached at a time of die cast molding or a first flange (e.g., a first flange 12c) with no gate attached at the time of the die cast molding. In the first flange with no gate, the first opening (121) further includes a fifth opening (121c). The fifth opening (121c) is defined by the first member (126), the second member (127), a third member (128) connecting the first attachment (122) and the second attachment (123) to each other, and a third wall part (113) which is a portion included in the body (11) and disposed between the first wall part (111) and the second wall part (112). The first flange with the gate has a surface part (129) closing a space defined by the first member (126), the second member (127), the third member (128), and the third wall part (113).

[0071] According to this configuration, the first flange (first flange 12a, 12b) with the gate has the surface part (129). This can reduce the possibility that the pressure at an outflow port of the gate at the time of filling the melted aluminum alloy causes, for example, deformation of molds of the first flange with the gate. Moreover, the first flange (first flange 12c) with no gate has the fifth opening (121c), thereby achieving a reduction in weight.

[0072] In a rotor (10) of a fourth aspect referring to the third aspect, each of the second flanges (13) has a third attachment (132), a third beam (133), a fourth beam (134), and a fifth beam (135). The third attachment (132) is a portion which is a tip part in the radial direction of the body (11) and to which a corresponding one vane (20) of the at least three vanes (20) is to be attached. The third beam (133), the fourth beam (134), and the fifth beam (135) extend from the third attachment (132) to the body (11). The second opening (131) includes a sixth opening (131a) and a seventh opening (131b). The sixth opening (131a) is defined by the third beam (133), the fifth beam (135), and a fourth wall part (114) which is part of the body (11). The seventh opening (131b) is defined by the fourth beam (134), the fifth beam (135), and a fifth wall part (115) which is part of the body (11) and which is different from the fourth wall part (114).

[0073] According to this configuration, each of the second flanges (13) of the rotor (10) has the sixth opening (131a) and the seventh opening (131b), thereby achieving a reduction in weight.

[0074] In a rotor (10) of a fifth aspect referring to the third or fourth aspect, the plurality of spokes (14) correspond to the at least three first flanges (12) on a one-to-one basis. The plurality of spokes (14) are disposed at the body (11) such that each of the plurality of spokes (14) overlaps a corresponding one first flange (12) of the at least three first flanges (12) when viewed in the radial

direction of the body (11).

[0075] According to this configuration, deformation of the body (11) by a force applied to each of the first flanges (12) is reduced.

[0076] A manufacturing method of a sixth aspect is a manufacturing method for manufacturing the rotor (10) of any one of the first to fifth aspects. The manufacturing method includes attaching gates to a mold of the rotor (10) at respective positions corresponding to two first flanges (12a, 12b) of the at least three first flanges (12) corresponding to the at least three vanes (20) on a one-to-one basis. The manufacturing method includes pouring a melted aluminum alloy through the gates into the mold to form the rotor (10).

[0077] The manufacturing method enables the weight of the rotor (10) to be reduced.

[0078] A ceiling fan (1) of a seventh aspect includes the rotor (10) of any one of the first to fifth aspects and the at least three vanes (20).

[0079] According to this configuration, each of the first flanges (12) and each of the second flanges (13) of the rotor (10) respectively have the first opening (121) and the second opening (131), thereby reducing the weight of the ceiling fan (1).

Reference Signs List

[0080]

1	Ceiling Fan
10	Rotor
11	Body
12, 12a, 12b, 12c	First Flange
13	Second Flange
14	Spoke
20	Vane
30	Cover
111	First Wall Part
112	Second Wall Part
113	Third Wall Part
114	Fourth Wall Part
115	Fifth Wall Part
121	First Opening
121a	Third Opening

121b	Fourth Opening
121c	Fifth Opening
122	First Attachment
123	Second Attachment
124	First Beam
125	Second Beam
126	First Member
127	Second Member
128	Third Member
129	Surface Part
131	Second Opening
131a	Sixth Opening
131b	Seventh Opening
132	Third Attachment
133	Third Beam
134	Fourth Beam
135	Fifth Beam
A1	Pivot Axis

CLAIMS

1. A rotor which is to be used in a ceiling fan and to which at least three vanes are to be attached, the rotor comprising:

a body having a circular shape centered around a pivot axis around which the at least three vanes are to pivot;

at least three pairs of first and second flanges, the at least three pairs corresponding to the at least three vanes on a one-to-one basis and protruding along a radial direction of the body to be away from the pivot axis at the body; and

a plurality of spokes extending from the body toward the pivot axis,

each of the first flanges having a first opening which is open along the pivot axis,

each of the second flanges having a second opening which is open along the pivot axis.

2. The rotor of claim 1, wherein

each of the first flanges includes

a first attachment which is a tip part in the radial direction of the body and to which a corresponding one vane of the at least three vanes is to be attached,

a second attachment which is present at a position along a circumferential direction of the body from the first attachment and to which a cover for holding the at least three vanes is to be attached,

a first beam extending from the first attachment to the body,

a second beam extending from the second attachment to the body,

a first member extending from the first attachment to the body and disposed between the first beam and the second beam, and

a second member extending from the second attachment to the body and disposed between the first beam and the first member,

the first opening includes a third opening and a fourth opening,

the third opening is defined by the first beam, the first member, and a first wall part which is part of the body, and

the fourth opening is defined by the second beam, the second member, and a second wall part which is part of the body and which is different from the first wall part.

3. The rotor of claim 2, wherein

the body, each of the first flanges, each of the second flanges, and each of the plurality of spokes are formed by die cast molding,

each of the first flanges is either

a first flange with a gate attached at a time of die cast molding or

a first flange with no gate attached at the time of the die cast molding,

in the first flange with no gate, the first opening further includes a fifth opening defined by the first member, the second member, a third member connecting the first attachment and the second attachment to each other, and a third wall part which is a portion included in the body and disposed between the first wall part and the second wall part, and

the first flange with the gate has a surface part closing a space defined by the first member, the second member, the third member, and the third wall part.

4. The rotor of claim 3, wherein

each of the second flanges includes

a third attachment which is a tip part in the radial direction of the body and to which a corresponding one vane of the at least three vanes is to be attached and

a third beam, a fourth beam, and a fifth beam which extend from the third attachment to the body,

the second opening includes a sixth opening and a seventh opening,

the sixth opening is defined by the third beam, the fifth beam, and a fourth wall part which is part of the body, and

the seventh opening is defined by the fourth beam, the fifth beam, and a fifth wall part which is part of the body and which is different from the fourth wall part.

5. The rotor of claim 3 or 4, wherein

the plurality of spokes correspond to the at least three first flanges on a one-to-one basis, and

the plurality of spokes are disposed at the body such that each of the plurality of spokes overlaps a corresponding one first flange of the at least three first flanges when viewed in the radial direction of the body.

6. A manufacturing method of manufacturing the rotor of any one of claims 1 to 4, the manufacturing method comprising:

attaching gates to a mold of the rotor at respective positions corresponding to two first flanges of the at least three first flanges corresponding to the at least three vanes on a one-to-one basis; and

pouring a melted aluminum alloy through the gates into the mold to form the rotor.

7. A ceiling fan comprising:
the rotor of any one of claims 1 to 4; and
the at least three vanes.