



(11) **EP 4 050 221 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.08.2022 Bulletin 2022/35

(51) International Patent Classification (IPC):
F04D 29/42^(2006.01)

(21) Application number: **20914498.9**

(52) Cooperative Patent Classification (CPC):
F04D 29/42

(22) Date of filing: **18.06.2020**

(86) International application number:
PCT/CN2020/096821

(87) International publication number:
WO 2021/143044 (22.07.2021 Gazette 2021/29)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **19.01.2020 CN 202010060655**
19.01.2020 CN 202010060619

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(54) **CENTRIFUGAL FAN AND AIR SUPPLY DEVICE**

(57) Disclosed are a centrifugal fan (100) and an air supply device. The centrifugal fan (100) includes a volute (101) having a mounting space (1011) in the volute (101); and a fan wheel (102) arranged in the mounting space (1011), in which the volute (101) is provided with a volute tongue (1012) and a throat (1013), and a distance between the volute tongue (1012) and the fan wheel (102) is greater than a distance between the throat (1013) and the fan wheel (102). The fan can reduce the working noise, slow down the air leakage of the volute and increase the air output volume.

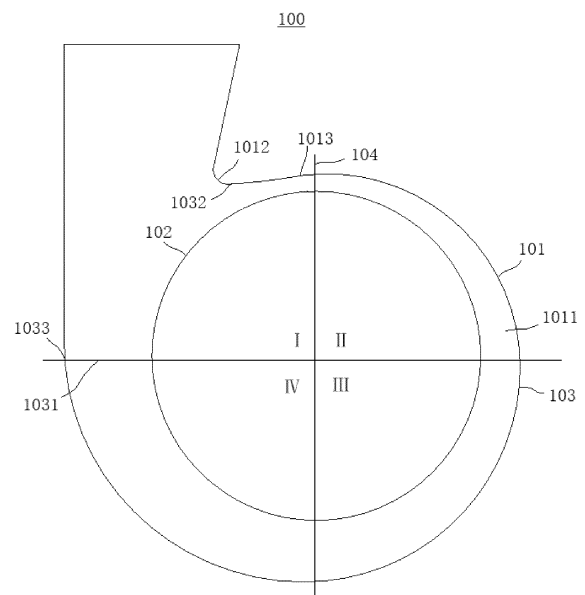


FIG. 2

EP 4 050 221 A1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present disclosure claims priority to Chinese Patent Application Nos. 202010060655.3 and 202010060619.7, titled "Centrifugal Fan and Air Supply Device" and "Centrifugal Fan for Bladeless Air Supply Device" filed on January 19, 2020 by GD MIDEA ENVIRONMENT APPLIANCES MFG CO., LTD. and MIDEA GROUP CO., LTD., the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of household appliances and, more particularly, to a centrifugal fan and an air supply device.

BACKGROUND

[0003] In the related art, air supply devices (bladeless fans) realize air supply in the form of air duct slits, which may cause great resistance in the air duct and require a fan wheel to rotate at high speed to meet air supply requirements of a centrifugal fan. The high-speed rotation of the fan wheel needs a large gap between the fan wheel and a volute, and otherwise the centrifugal fan may generate loud noise during operation. However, the large gap between the fan wheel and the volute will reduce working efficiency of the centrifugal fan and decrease air output of the centrifugal fan.

SUMMARY

[0004] The present disclosure provides a centrifugal fan that can reduce working noise of the centrifugal fan and improve working efficiency of the centrifugal fan.

[0005] The present disclosure further provides an air supply device.

[0006] The centrifugal fan according to the present disclosure includes a volute having a mounting space; and a fan wheel arranged in the mounting space. The volute includes a volute tongue and a throat, and a distance between the volute tongue and the fan wheel is greater than a distance between the throat and the fan wheel.

[0007] For the centrifugal fan according to the present disclosure, since the distance between the volute tongue and the fan wheel is greater than the distance between the throat and the fan wheel, the working noise of the centrifugal fan can be reduced, which can in turn reduce noise pollution to the environment and improve user experience. Moreover, the air leakage of the volute can slow down, the air output of the centrifugal fan can be raised, and the working efficiency of the volute and thus the working efficiency of the centrifugal fan can be improved.

[0008] In some examples of the present disclosure, the

volute includes an Archimedean spiral curved surface that has a start point at the volute tongue and an end point at an ending section of the volute; the throat is between the start point and the end point; and a distance between the Archimedean spiral curved surface and the fan wheel is minimum at the throat.

[0009] In some examples of the present disclosure, the distance between the Archimedes spiral curved surface and the fan wheel decreases progressively from the start point towards the throat, and increases progressively from the throat towards the end point.

[0010] In some examples of the present disclosure, the distance between the volute tongue and the fan wheel is t_1 , and the distance between the throat and the fan wheel is t_2 , t_1 and t_2 satisfying a relationship: $t_1/t_2 < 2$.

[0011] In some examples of the present disclosure, a surface passing through a center of the fan wheel and perpendicular to the ending section is a longitudinal section; and in a coordinate system formed by the longitudinal section and the ending section, a minimum distance between the Archimedean spiral curved surface and the fan wheel is in a first quadrant of the coordinate system.

[0012] In some examples of the present disclosure, a surface passing through a center of the fan wheel and perpendicular to the ending section is a longitudinal section; and in a coordinate system formed by the longitudinal section and the ending section, a minimum distance between the Archimedean spiral curved surface and the fan wheel is in a second quadrant of the coordinate system.

[0013] In some examples of the present disclosure, an outer diameter of the fan wheel is D , in which $t_1 = 0.05D - 0.15D$.

[0014] In some examples of the present disclosure, an outer diameter of the fan wheel is D , in which $t_2 = 0.05D - 0.15D$.

[0015] In some examples of the present disclosure, the centrifugal fan includes a drive motor, the volute has a volute inlet, and the fan wheel is rotatably arranged in the volute; the fan wheel has an outer diameter D of the fan wheel and an inner diameter d of the fan wheel, D and d satisfying a relationship: $0.7 \leq d/D \leq 0.9$; the drive motor is coupled to the fan wheel and is configured to drive the fan wheel to rotate within the volute.

[0016] In some examples of the present disclosure, the volute air inlet includes a first volute air inlet and a second volute air inlet, the first volute air inlet and the second volute air inlet being formed on two axial sides of the volute correspondingly; and the fan wheel includes a fan wheel body and a fan wheel mounting plate arranged within the fan wheel body, and the fan wheel mounting plate divides the fan wheel body into a long fan wheel body and a short fan wheel body along an axial direction of the fan wheel, an axial length of the long fan wheel body being greater than an axial length of the short fan wheel body, the long fan wheel body being arranged corresponding to and adjacent to the first volute inlet, and the short fan wheel body being arranged corresponding

to and adjacent to the second volute inlet; and the drive motor is arranged in the short fan wheel body and coupled to the fan wheel mounting plate.

[0017] In some examples of the present disclosure, a radial dimension of the first volute inlet is larger than a radial dimension of the second volute inlet.

[0018] In some examples of the present disclosure, the axial length of the short fan wheel body is H_1 and the axial length of the long fan wheel body is H_2 , H_2 and H_1 satisfying a relationship: $0.5 \leq H_1/H_2 < 1$.

[0019] In some examples of the present disclosure, the centrifugal fan further includes a motor mounting plate for mounting the drive motor, the motor mounting plate being arranged around the second volute air inlet

[0020] In some examples of the present disclosure, the centrifugal fan further includes an inlet grille arranged at the first volute inlet and/or the second volute inlet.

[0021] In some examples of the present disclosure, the centrifugal fan further includes a plurality of blades spaced apart along a peripheral direction of the fan wheel. The blade has an arc shape, and a chord length of the blade is L , satisfying a relationship: $15 \text{ mm} \leq L \leq 25 \text{ mm}$; and a distance between two adjacent blades is a , satisfying a relationship: $0.3L \leq a \leq 0.7L$.

[0022] In some examples of the present disclosure, a thickness of the blade is t , satisfying a relationship: $1 \text{ mm} \leq t \leq 3 \text{ mm}$.

[0023] In some examples of the present disclosure, an inlet angle of the blade is α , satisfying a relationship: $40^\circ \leq \alpha \leq 90^\circ$.

[0024] In some examples of the present disclosure, an outlet angle of the blade 1025 is θ , satisfying a relationship: $120^\circ \leq \theta \leq 170^\circ$.

[0025] The air supply device according to the present disclosure includes the above centrifugal fan.

[0026] For the air supply device according to the present disclosure, since the distance between the volute tongue and the fan wheel is greater than the distance between the throat and the fan wheel, the working noise of the centrifugal fan can be reduced, which can in turn reduce noise pollution to the environment and improve user experience. Moreover, the air leakage of the volute can slow down, the air output of the centrifugal fan can be raised, and the working efficiency of the volute and thus the working efficiency of the centrifugal fan can be improved.

[0027] Additional aspects and advantages of present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

FIG. 1 is a sectional view of a centrifugal fan according to an embodiment of the present disclosure.

FIG. 2 is a distribution diagram showing a first quadrant, a second quadrant, a third quadrant, and a fourth quadrant of a centrifugal fan according to an embodiment of the present disclosure.

FIG. 3 is an exploded view of a centrifugal fan according to an embodiment of the present disclosure. FIG. 4 is a front view of a fan wheel of a centrifugal fan according to an embodiment of the present disclosure.

FIG. 5 is a side view of a fan wheel of a centrifugal fan according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0029] Embodiments of the present disclosure will be described below in detail, and examples of the embodiments are illustrated in the accompanying drawings, where the same or similar reference numerals throughout the specification refer to the same or similar elements or elements having the same or similar functions. The embodiments described below with reference to the accompanying drawings are exemplary and are intended to explain the present disclosure rather than limit the present disclosure.

[0030] A centrifugal fan 100 according to embodiments of the present disclosure will be described below with reference to FIGS. 1-5.

[0031] As shown in FIGS. 1 and 2, the centrifugal fan 100 according to the embodiments of the present disclosure includes a volute 101 and a fan wheel 102. The volute 101 has a mounting space 1011, and the fan wheel 102 is arranged in the mounting space 1011. The fan wheel 102 is rotatable in the mounting space 1011. The volute 101 includes a volute tongue 1012 and a throat 1013. The volute tongue 1012 is a segment and exhibits an arc shape. A distance between the volute tongue 1012 and the fan wheel 102 is greater than a distance between the throat 1013 and the fan wheel 102. It needs to be explained that FIGS. 1 and 2 illustrate sectional views of the centrifugal fan 100, and sections of the volute 101 and the fan wheel 102 are lines. As shown in FIG. 2, the distance between the volute tongue 1012 and the fan wheel 102 refers to a minimum distance between a surface of the volute tongue 1012 and a surface of the fan wheel 102, and the distance between the throat 1013 and the fan wheel 102 refers to a minimum distance between an inner surface of the throat 1013 and the surface of the fan wheel 102.

[0032] In the related art, the distance between the volute tongue and the fan wheel is a minimum value of a gap between the fan wheel and the volute. For a fan wheel rotating at high speed, such a curve structure of the volute leads to an increase in working noise of the centrifugal fan since the intensity of periodic pulsation between blades on the fan wheel and the volute tongue is increased at the volute tongue. Raising a position of the volute tongue may effectively reduce the noise

caused by the pulsation, but the efficiency of the volute is reduced.

[0033] In the present disclosure, by setting a value of the distance between the volute tongue 1012 and the fan wheel 102 to be smaller than a value of the distance between the throat 1013 and the fan wheel 102, the distance between the volute tongue 1012 and the fan wheel 102 becomes larger compared to the related art, and when the fan wheel 102 rotates at high speed in the mounting space 1011, the noise caused by the increase in pulsation intensity between the blades on the fan wheel 102 and the volute tongue 1012 can be effectively reduced, making the volute 101 adapt to higher speed of the fan wheel 102, reducing a risk of whistling in the volute tongue 1012, and lowering the working noise of the centrifugal fan 100, to reduce noise pollution to the environment and improve user experience. Moreover, too much air backflow due to an excessively large gap at the volute tongue (i.e., the distance between the volute tongue 1012 and the fan wheel 102) can be compensated, slowing down air leakage of the volute 101, raising air output of the centrifugal fan 100, and improving the working efficiency of the volute 101 and thus the working efficiency of the centrifugal fan 100.

[0034] Thus, since the distance between the volute tongue 1012 and the fan wheel 102 is smaller than the distance between the throat 1013 and the fan wheel 102, the working noise of the centrifugal fan 100 can be reduced, which can in turn reduce noise pollution to the environment and improve the user experience. Moreover, the air leakage of the volute 101 can slow down, the air output of the centrifugal fan 100 can be raised, and the working efficiency of the volute 101 and thus the working efficiency of the centrifugal fan 100 can be improved.

[0035] The volute 101 has an Archimedean spiral curved surface 103 that has a start point 1032 at the volute tongue 1012 and an end point 1033 at an ending section 1031 of the volute 101. The throat 1013 is located between the start point 1032 and the end point 1033. A distance between the Archimedean spiral curved surface 103 and the fan wheel 102 is minimum at the throat 1013, which can also be understood in such a way that in a radial direction of the fan wheel 102, a distance between the Archimedean spiral curved surface 103 and an outer diameter of the fan wheel 102 is minimum at the throat section 1013. When the centrifugal fan 100 is working, such an arrangement can better slow down the air leakage of the volute 101, reduce the working noise of the centrifugal fan 100, and raise the air output of the centrifugal fan 100, further improving the working efficiency of the volute 101 and thus the working efficiency of the centrifugal fan 100.

[0036] As shown in FIGS. 1 and 2, the distance between the Archimedes spiral curved surface 103 and the fan wheel 102 decreases progressively from the start point 1032 towards the throat 1013, and the distance between the Archimedes spiral curved surface 103 and the fan wheel 102 increases progressively from the throat

1013 towards the end point 1033. That is, the distance between the Archimedes spiral curved surface 103 and the fan wheel 102 decreases gradually in a direction from the start point 1032 towards the throat 1013, and the distance between the Archimedes spiral curved surface 103 and the fan wheel 102 increases gradually in a direction from the throat 1013 to the end point 1033. When the centrifugal fan 100 is working, such an arrangement can further reduce the noise caused by the increased intensity of the pulsation between the blades on the fan wheel 102 and the volute tongue 1012, lower the working noise of the centrifugal fan 100, and reduce the noise pollution to the environment. Moreover, the air leakage of the volute 101 can further slow down, the air output of the centrifugal fan 100 can be further raised, and the working efficiency of the volute 101 and thus the working efficiency of the centrifugal fan 100 can be further improved.

[0037] The distance between the volute tongue 1012 and the fan wheel 102 is t_1 , and the distance between the throat 1013 and the fan wheel 102 is t_2 , in which t_1 and t_2 satisfy a relationship: $t_1/t_2 < 2$. It should be noted that such an arrangement can ensure the distance between the volute tongue 1012 and the fan wheel 102 to be smaller than the distance between the throat 1013 and the fan wheel 102, which can slow down the air leakage of the volute 101, improve the efficiency of the volute 101, and in turn make the relationship between t_1 and t_2 set in a more reasonable form.

[0038] As shown in FIG. 2, a surface passing through a center of the fan wheel 102 and perpendicular to the ending section 1031 is a longitudinal section 104, and in a coordinate system formed by the longitudinal section 104 and the ending section 1031, a minimum distance between the Archimedean spiral curved surface 103 and the fan wheel 102 is in a first quadrant I of the coordinate system. The coordinate system formed by the longitudinal section 104 and the ending section 1031 has the first quadrant I, a second quadrant II, a third quadrant III, and a fourth quadrant IV. The minimum distance between the Archimedean spiral curved surface 103 and the fan wheel 102 is in the first quadrant I of the coordinate system, that is, the throat 1013 is in the first quadrant I of the coordinate system. Such an arrangement can make the position of the throat 1013 more reasonable, which can slow down the air leakage of the volute 101, improve the working efficiency of the volute 101, and reduce the working noise of the centrifugal fan 100.

[0039] A surface passing through a center of the fan wheel 102 and perpendicular to the ending section 1031 is a longitudinal section 104, and in a coordinate system formed by the longitudinal section 104 and the ending section 1031, a minimum distance between the Archimedean spiral curved surface 103 and the fan wheel 102 is in a second quadrant II of the coordinate system. The coordinate system formed by the longitudinal section 104 and the ending section 1031 has a first quadrant I, the second quadrant II, a third quadrant III, and a fourth quad-

rant IV. The minimum distance between the Archimedean spiral curved surface 103 and the fan wheel 102 is in the second quadrant II of the coordinate system, that is, the throat 1013 is in the second quadrant II of the coordinate system. Such an arrangement can slow down the air leakage of the volute 101, improve the working efficiency of the volute 101, and reduce the working noise of the centrifugal fan 100.

[0040] The outer diameter of the fan wheel 102 is D, in which $t_1 = 0.05D-0.15D$. Such an arrangement can allow for a more suitable distance between the volute tongue 1012 and the fan wheel 102 and enable the volute 101 to adapt to higher speed of the fan wheel 102, reducing the risk of whistling in the volute tongue 1012, and lowering the working noise of the centrifugal fan 100.

[0041] An outer diameter of the fan wheel 102 is D, in which $t_2 = 0.05D-0.15D$. Such an arrangement can allow for a more suitable distance between the throat 1013 and the fan wheel 102 and compensate too much air backflow due to an excessively large gap at the volute tongue (i.e., the distance between the volute tongue 1012 and the fan wheel 102), improving the efficiency of the centrifugal fan 100.

[0042] As shown in FIGS. 3-5, the centrifugal fan 100 includes: a drive motor 105. The volute 101 has a volute inlet 1014, and air from outside the centrifugal fan 100 can flow into the volute 101 through the volute inlet 1014. The fan wheel 102 is rotatably arranged in the volute 101. The fan wheel 102 has an outer diameter D of the fan wheel 102 and an inner diameter d of the fan wheel 102, in which D and d satisfy a relationship: $0.7 \leq d/D \leq 0.9$. The drive motor 105 is coupled to the fan wheel 102, and the drive motor 105 is used to drive the fan wheel 102 to rotate within the volute 101.

[0043] Specifically, the outer diameter D of the fan wheel 102 can be set to 150 mm, the inner diameter d of the fan wheel 102 can be set to 120 mm, in which d/D is 0.8. A rotation speed of the fan wheel 102 may be set to 1500 rpm ~ 3000 rpm. When the centrifugal fan 100 is working, the drive motor 105 drives the fan wheel 102 to rotate, and during the rotation of the fan wheel 102, air pressure in the volute 101 can be raised to overcome air resistance of 100Pa ~ 300Pa in an air duct of an air supply device, improving the working efficiency of the centrifugal fan 100 and thus the working performance of the centrifugal fan 100. Moreover, the centrifugal fan 100 according to the present disclosure has a simple structure, which can reduce the manufacturing cost of the centrifugal fan 100.

[0044] Thus, by making $0.7 \leq d/D \leq 0.9$, the air pressure in the volute 101 can be increased to overcome the air resistance in the air duct of the air supply device, and thus the efficiency of the centrifugal fan 100 can be improved.

[0045] In some embodiments of the present disclosure, as shown in FIGS. 3 and 4, the volute air inlet 1014 may include: a first volute air inlet 1015 and a second volute air inlet 1016. The first volute air inlet 1015 and

the second volute air inlet 1016 are formed on two axial sides of the volute 101. It may also be understood that the first volute air inlet 1015 is arranged on one axial side of the volute 101, and the second volute air inlet 1016 is arranged on the other axial side of the volute 101.

[0046] The fan wheel 102 may include: a fan wheel body 1021 and a fan wheel mounting plate 1022 arranged within the fan wheel body 1021. The fan wheel mounting plate 1022 divides the fan wheel body 1021 into a long fan wheel body 1023 and a short fan wheel body 1024 along an axial direction of the fan wheel 102, the axial direction of the fan wheel 102 being a left-right direction in FIG. 4. An axial length of the long fan wheel body 1023 is greater than an axial length of the short fan wheel body 1024. The long fan wheel body 1023 is arranged corresponding to and adjacent to the first volute inlet 1015, and the short fan wheel body 1024 is arranged corresponding to and adjacent to the second volute inlet 1016. The drive motor 105 may be arranged in the short fan wheel body 1024, and the drive motor 105 is coupled to the fan wheel mounting plate 1022. When the drive motor 105 is in operation, the drive motor 105 can drive the fan wheel mounting plate 1022 to rotate and in turn cause the fan wheel 102 to rotate.

[0047] Moreover, as the drive motor 105 is arranged within the volute 101, the drive motor 105 occupies space inside the volute 101, and when the drive motor 105 is arranged corresponding to the volute air inlet 1014, an air intake effect of the volute air inlet 1014 will be affected. Thus, by arranging the drive motor 105 in the short fan wheel body 1024, it is possible to prevent the drive motor 105 from affecting the air intake volume of the first volute inlet 1015, and guarantee the air intake volume of the centrifugal fan 100, ensuring the working performance of the centrifugal fan 100. Meanwhile, by partitioning the long fan wheel body 1023 from the short fan wheel body 1024 by the fan wheel mounting plate 1022, mutual interference between an airflow in the long fan wheel body 1023 and an airflow in the short fan wheel body 1024 can be avoided, the noise in the centrifugal fan 100 can be lowered, the working efficiency of the centrifugal fan 100 can be improved, and an axial length of the drive motor 105 can be reduced, which is conducive to the dynamic balance of the centrifugal fan 100.

[0048] In some embodiments of the present disclosure, a radial dimension of the first volute inlet 1015 is larger than a radial dimension of the second volute inlet 1016. Such an arrangement can increase the air intake volume of the first volute inlet 1015 per unit time, which can further ensure the air intake volume of the centrifugal fan 100, and further improve the working performance of the centrifugal fan 100.

[0049] In some embodiments of the present disclosure, as shown in FIG. 4, the axial length of the short fan wheel body 1024 is H1 and the axial length of the long fan wheel body 1023 is H2, in which H2 and H1 satisfy a relationship: $0.5 \leq H1/H2 < 1$, H1 may be set to 42mm, and H2 may be set to 75mm. Such an arrangement can

ensure that the axial length of the long fan wheel body 1023 is greater than the axial length of the short fan wheel body 1024, allowing for more suitable axial lengths of the long fan wheel body 1023 and the short fan wheel body 1024, guaranteeing the air intake volume, and ensuring the working efficiency of the centrifugal fan 100.

[0050] In some embodiments of the present disclosure, as shown in FIG. 3, the centrifugal fan 100 may further include: a motor mounting plate 106 for mounting the drive motor 105. The motor mounting plate 106 is arranged around the second volute air inlet 1016. The motor mounting plate 106 may be arranged on an inner surface of the volute 101. After the centrifugal fan 100 has been assembled, the drive motor 105 is mounted on the motor mounting plate 106. Such an arrangement can reliably fix the drive motor 105 to the motor mounting plate 106, and vibration of the drive motor 105 can be reduced when the drive motor 105 is operating, further lowering the working noise of the centrifugal fan 100.

[0051] In some embodiments of the present disclosure, as shown in FIG. 3, the centrifugal fan 100 may also include: an inlet grille 107 that may be arranged at the first volute inlet 1015 and/or the second volute inlet 1016. For example, the inlet grille 107 is arranged at the second volute inlet 1016, so that air can flow gently from the inlet grille 107 to the volute 101, preventing formation of eddy current within the volute 101 and avoiding airflow noise in the volute 101. Moreover, the air inlet grille 107 has a filtering effect and can prevent external objects from being drawn into the volute 101, to ensure the working reliability of the centrifugal fan 100.

[0052] In some embodiments of the present disclosure, as shown in FIG. 5, the fan wheel 102 may include a plurality of blades 1025, for example, forty-one blades 1025. The plurality of blades 1025 are spaced apart along a peripheral direction of the fan wheel 102. The blade 1025 may have an arc shape. A chord length of the blade 1025 is L , which satisfies a relationship: $15\text{ mm} \leq L \leq 25\text{ mm}$. The chord length of the blade 1025 may be set to 18 mm, and a distance between two adjacent blades 1025 is a , which satisfy a relationship: $0.3L \leq a \leq 0.7L$. Moreover, a thickness of the blade 1025 is set to t , which satisfies a relationship: $1\text{ mm} \leq t \leq 3\text{ mm}$, and the thickness of the blade 1025 is preferably set to 1.5 mm.

[0053] Moreover, an inlet angle of the blade 1025 is α , which satisfies a relationship: $40^\circ \leq \alpha \leq 90^\circ$. Preferably, the inlet angle of the blade 1025 is 70° . An outlet angle of the blade 1025 is θ , which satisfies a relationship: $120^\circ \leq \theta \leq 170^\circ$. The outlet angle of the blade 1025 is 165° . It should be noted that the inlet angle of the blade 1025 refers to an angle between a tangent line at an intersection of an inner end of the blade 1025 and the inner diameter of the fan wheel 102 and a tangent line at an intersection of the inner diameter of the fan wheel 102 and the inner end of the blade 1025; and the outlet angle of the blade 1025 refers to an angle between a tangent line at an intersection of an outer end of the blade 1025 and the outer diameter of the fan wheel 102 and a tangent

line at an intersection of the outer diameter of the fan wheel 102 and the outer end of the blade 1025. In addition, a mounting angle of the blade 1025 may be set to be $25^\circ \sim 40^\circ$. Preferably, the mounting angle of the blade 1025 is 32° . The plurality of blades 1025 arranged in the above way can make a flow path between adjacent blades 1025 be an acceleration flow path, with a width of the flow path being decreased in a direction from the inner end of the blade 1025 to the outer end of the blade 1025. After the airflow flows through the fan wheel 102, sufficient high-speed and high-pressure airflow can be formed and enter the air duct, to overcome the resistance in the air duct.

[0054] An air supply device according to embodiments of the present disclosure may be a bladeless fan. The air supply device includes the centrifugal fan 100 in the above embodiments. The centrifugal fan 100 is arranged on the air supply device. The centrifugal fan 100 works with low noise, which can reduce noise pollution to the environment, improving the user experience, and can slow down the air leakage of the volute 101, raising the air output of the centrifugal fan 100, improving the working efficiency of the volute 101, the working efficiency of the centrifugal fan 100 and thus the working efficiency of the air supply device.

[0055] Reference throughout this specification to "an embodiment," "some embodiments," "an exemplary embodiment," "an example," "a specific example" or "some examples" means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

[0056] Although embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes, modifications, alternatives, and variations can be made in the embodiments without departing from principles and purposes of the present disclosure. The scope of the present disclosure is defined by the claims and their equivalents.

Claims

1. A centrifugal fan, comprising:

a volute having a mounting space; and
a fan wheel arranged in the mounting space,
wherein the volute comprises a volute tongue
and a throat, and a distance between the volute
tongue and the fan wheel is greater than a distance
between the throat and the fan wheel.

2. The centrifugal fan according to claim 1, wherein:

the volute comprises an Archimedean spiral curved surface that has a start point at the volute tongue and an end point at an ending section of the volute;
the throat is between the start point and the end point; and
a distance between the Archimedean spiral curved surface and the fan wheel is minimum at the throat.

3. The centrifugal fan according to claim 2, wherein the distance between the Archimedes spiral curved surface and the fan wheel decreases progressively from the start point towards the throat, and increases progressively from the throat towards the end point.

4. The centrifugal fan according to claim 2, wherein the distance between the volute tongue and the fan wheel is t_1 , and the distance between the throat and the fan wheel is t_2 , t_1 and t_2 satisfying a relationship: $t_1/t_2 < 2$.

5. The centrifugal fan according to claim 4, wherein:

a surface passing through a center of the fan wheel and perpendicular to the ending section is a longitudinal section; and
in a coordinate system formed by the longitudinal section and the ending section, a minimum distance between the Archimedean spiral curved surface and the fan wheel is in a first quadrant of the coordinate system.

6. The centrifugal fan according to claim 4, wherein:

a surface passing through a center of the fan wheel and perpendicular to the ending section is a longitudinal section; and
in a coordinate system formed by the longitudinal section and the ending section, a minimum distance between the Archimedean spiral curved surface and the fan wheel is in a second quadrant of the coordinate system.

7. The centrifugal fan according to claim 4, wherein an outer diameter of the fan wheel is D , wherein $t_1 = 0.05D-0.15D$.

8. The centrifugal fan according to claim 4, wherein an outer diameter of the fan wheel is D , wherein $t_2 = 0.05D-0.15D$.

9. The centrifugal fan according to any one of claims 1 to 8, wherein:

the centrifugal fan comprises a drive motor, the

volute has a volute inlet, and the fan wheel is rotatably arranged in the volute;

the fan wheel has an outer diameter D of the fan wheel and an inner diameter d of the fan wheel, wherein D and d satisfy a relationship: $0.7 \leq d/D \leq 0.9$;

the drive motor is coupled to the fan wheel and is configured to drive the fan wheel to rotate within the volute.

10. The centrifugal fan according to claim 9, wherein:

the volute air inlet comprises a first volute air inlet and a second volute air inlet, the first volute air inlet and the second volute air inlet being formed on two axial sides of the volute correspondingly;

the fan wheel comprises a fan wheel body and a fan wheel mounting plate arranged within the fan wheel body, and the fan wheel mounting plate divides the fan wheel body into a long fan wheel body and a short fan wheel body along an axial direction of the fan wheel, an axial length of the long fan wheel body being greater than an axial length of the short fan wheel body, the long fan wheel body being arranged corresponding to and adjacent to the first volute inlet, and the short fan wheel body being arranged corresponding to and adjacent to the second volute inlet; and

the drive motor is arranged in the short fan wheel body and coupled to the fan wheel mounting plate.

11. The centrifugal fan according to claim 10, wherein a radial dimension of the first volute inlet is larger than a radial dimension of the second volute inlet.

12. The centrifugal fan according to claim 10, wherein the axial length of the short fan wheel body is H_1 and the axial length of the long fan wheel body is H_2 , wherein H_2 and H_1 satisfy a relationship: $0.5 \leq H_1/H_2 < 1$.

13. The centrifugal fan according to claim 10, further comprising a motor mounting plate for mounting the drive motor, the motor mounting plate being arranged around the second volute air inlet.

14. The centrifugal fan according to claim 10, further comprising an inlet grille arranged at the first volute inlet and/or the second volute inlet.

15. The centrifugal fan according to claim 9, further comprising a plurality of blades spaced apart along a peripheral direction of the fan wheel,

wherein the blade has an arc shape, and a chord

length of the blade is L , satisfying a relationship:
 $15\text{ mm} \leq L \leq 25\text{ mm}$; and
a distance between two adjacent blades is a ,
satisfying a relationship: $0.3L \leq a \leq 0.7L$.

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16. The centrifugal fan according to claim 15, wherein a thickness of the blade is t , satisfying a relationship: $1\text{ mm} \leq t \leq 3\text{ mm}$.

17. The centrifugal fan according to claim 15, wherein an inlet angle of the blade is α , satisfying a relationship: $40^\circ \leq \alpha \leq 90^\circ$. 10

18. The centrifugal fan according to claim 15, wherein an outlet angle of the blade 1025 is θ , satisfying a relationship: $120^\circ \leq \theta \leq 170^\circ$. 15

19. An air supply device, comprising the centrifugal fan according to any one of claims 1 to 18.

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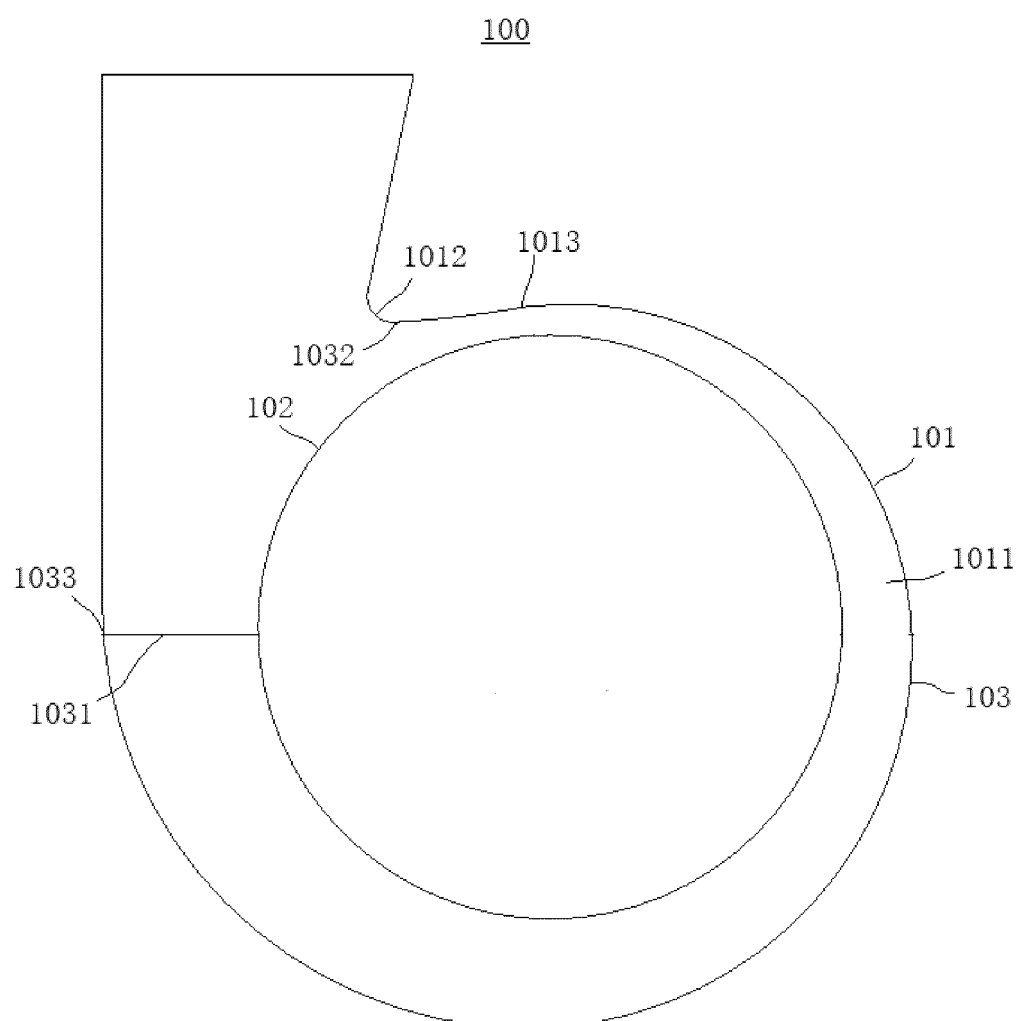


FIG. 1

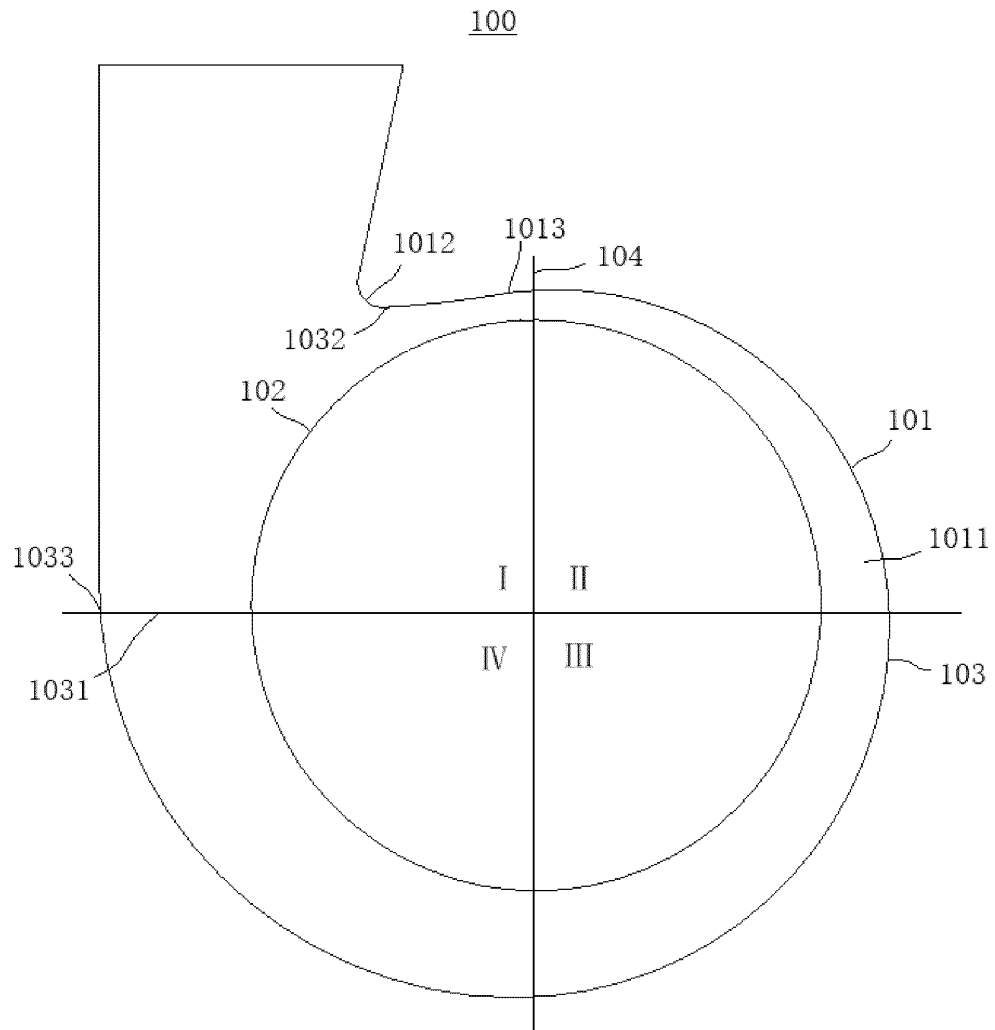


FIG. 2

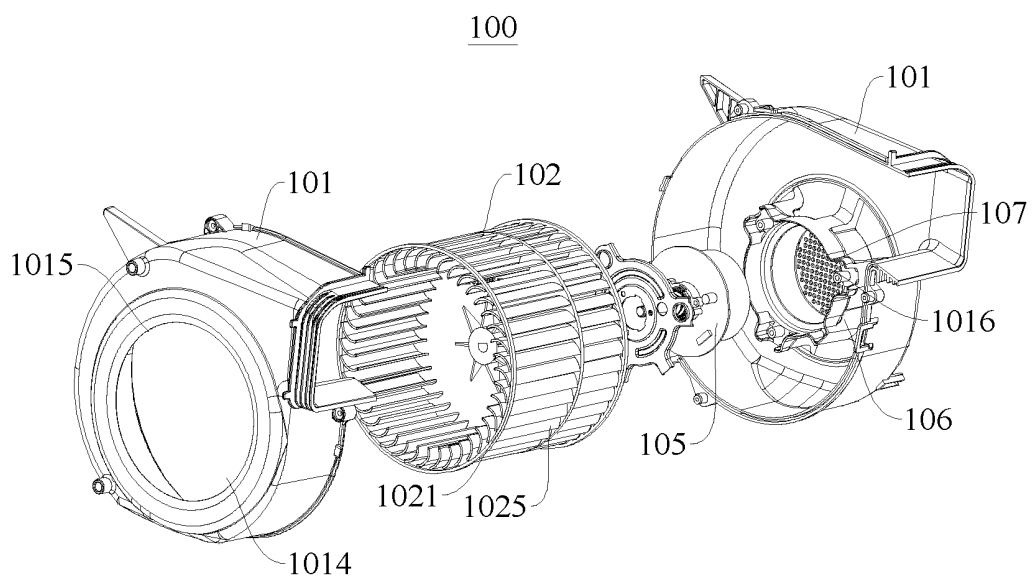


FIG. 3

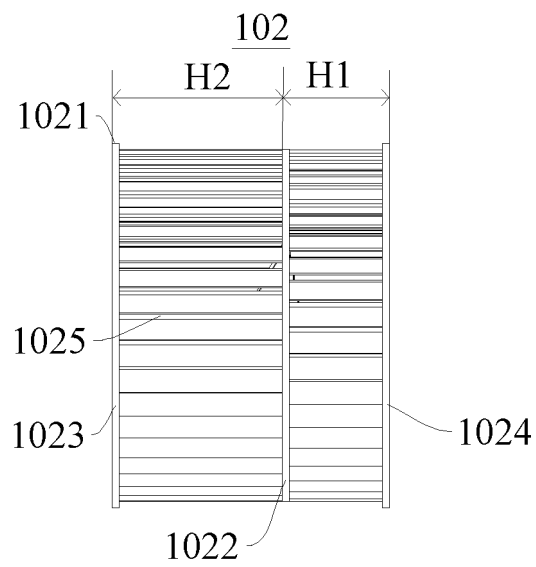


FIG. 4

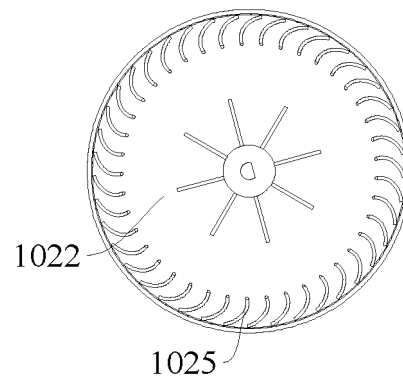


FIG. 5

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/096821

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A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/42(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN, CNABS, CNKI, CNTXT: 风机, 蜗舌, 蜗喉, 喉部, 距离, 间隙, 间距, volute, tongue, distance

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 110145493 A (NINGBO FOTILE KITCHEN WARE CO., LTD.) 20 August 2019 (2019-08-20) description, specific embodiments, and figures 1-3	1-9, 15-19
Y	CN 110145493 A (NINGBO FOTILE KITCHEN WARE CO., LTD.) 20 August 2019 (2019-08-20) description, specific embodiments, and figures 1-3	10-14
Y	CN 207145321 U (GUANGDONG MEDIA REFRIGERATION EQUIPMENT CO., LTD.) 27 March 2018 (2018-03-27) description, specific embodiments, and figures 1-7	10-14
X	CN 109973438 A (NINGBO FOTILE KITCHEN WARE CO., LTD.) 05 July 2019 (2019-07-05) description, specific embodiments, and figures 1-3	1-9, 15-19
A	WO 2015048231 A1 (BORGWARNER INC. et al.) 02 April 2015 (2015-04-02) entire document	1-19
A	US 5286162 A (US ARMY) 15 February 1994 (1994-02-15) entire document	1-19

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☐ Further documents are listed in the continuation of Box C.
☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

30 August 2020

Date of mailing of the international search report

17 September 2020

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/096821

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	110145493	A	20 August 2019	None			
CN	207145321	U	27 March 2018	None			
CN	109973438	A	05 July 2019	None			
WO	2015048231	A1	02 April 2015	US	2016230651	A1	11 August 2016
				US	10480398	B2	19 November 2019
				DE	112014004513	T5	28 July 2016
US	5286162	A	15 February 1994	None			

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202010060655 [0001]
- CN 202010060619 [0001]