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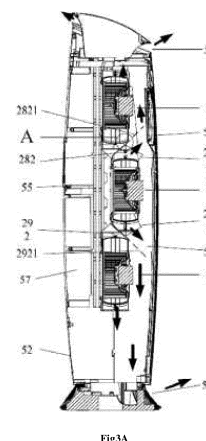
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(54) **VOLUTE FAN ASSEMBLY STRUCTURE AND FLOOR-STANDING AIR CONDITIONER**

(57) A volute fan combination structure, comprises a mounting plate (4) and at least two adjacent volute fans mounted on the mounting plate (4), one volute fan of the two adjacent volute fans has an intermediate inclined air outlet that located between the two adjacent volute fans, the intermediate inclined air outlet extending such as to be inclined towards a direction away from said mounting plate (4). The volute fan combination structure is capable of allowing that the air outlet of a second volute fan (2) is staggered from a first volute fan (1) and a third volute fan (3), so as to reduce disturbance. There is further provided with a vertical air conditioner having the aforementioned volute fan combination structure.



Description

[0001] The present application claims the priority right of the Chinese patent application No. 201510579262.2 submitted to the Chinese Patent Office on Sep. 11, 2015, the invention title of which application is "a volute fan combination structure and a vertical air conditioner", all the content of which is incorporated into the present application by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of an air blowing mechanism, and specifically relates to a volute fan combination structure and a vertical air conditioner.

BACKGROUND OF THE INVENTION

[0003] At present, the air conditioning device in the market may sometimes be provided with two volute fans to blow towards two opposite directions, when there is a demand for bidirectional blowing. However, limited by the power and volume of a volute fan, upon application on a very large air conditioning device, for example a vertical air conditioner, there may be a problem of insufficient air volume. If the power of a volute fan is raised, the volume of the volute fan may also be increased along therewith, so that it is further necessary to enlarge an overall volume of the vertical air conditioner, in particular to enlarge a width and/or thickness of the vertical air conditioner, and to increase a transversely occupied space by the vertical air conditioner. These are all unfavorable for installation, use and transportation of the vertical air conditioner.

SUMMARY OF THE INVENTION

[0004] In view of this, the present invention provides a volute fan combination structure capable of reducing the influence on the air blowing of an intermediate volute fan by a volute of the volute fans at both sides in an air blower device having multiple volute fans.

[0005] In order to achieve the object, the present invention uses the following technical solution:

[0006] A volute fan combination structure comprises: a mounting plate; at least two adjacent volute fans mounted on said mounting plate; wherein one volute fan of the two adjacent volute fans has an intermediate inclined air outlet located between the two adjacent volute fans, said intermediate inclined air outlet extending along a direction away from said mounting plate.

[0007] Preferably, in the aforementioned volute fan combination structure, the inner surface adjacent to said mounting plate of said intermediate inclined air outlet representing a slope or camber, an extension of said slope or an extension of a tangent plane of said camber not intersecting with a volute of another volute fan adjacent

to said intermediate inclined air outlet.

[0008] Preferably, in the aforementioned volute fan combination structure, there comprise three volute fans having a third volute fan, a second volute fan and a first volute fan provided in an upward sequence; said second volute fan comprising second volute fan air outlets blowing air upwards and/or blowing air downwards, said second volute fan air outlets extending along a direction away from said mounting plate.

[0009] Preferably, in the aforementioned volute fan combination structure, the inner surface adjacent to said mounting plate of said second volute fan air outlets representing a slope or camber, an extension of a corresponding slope or an extension of a tangent plane of an camber not intersecting with a volute of the first volute fan or the third volute fan opposite to said second volute fan said air outlets

[0010] Preferably, in the aforementioned volute fan combination structure, said first volute fan comprising a first volute fan air outlet blowing air upwards; and said third volute fan comprising a third volute fan air outlet blowing air downwards.

[0011] Preferably, in the aforementioned volute fan combination structure, said second volute fan air outlet comprising a second volute fan first air outlet blowing air upwards and a second volute fan second air outlet (29) blowing air downwards.

[0012] Preferably, in the aforementioned volute fan combination structure, the inner surface adjacent to said mounting plate of said second volute fan first air outlet representing a slope or camber, an extension of said slope or an extension of a tangent plane of the camber not intersecting with a volute of the first volute fan; and the inner surface adjacent to said mounting plate of said second volute fan second air outlet representing a slope or camber, an extension of said slope or an extension of a tangent plane of the camber not intersecting with a volute of the third volute fan.

[0013] Preferably, in the aforementioned volute fan combination structure, a first deflector parallel to said mounting plate provided at least on a wall away from said mounting plate of said second volute fan first air outlet; and/or a second deflector parallel to said mounting plate provided at least on a wall away from said mounting plate of second volute fan second air outlet.

[0014] Preferably, in the aforementioned volute fan combination structure, said first deflector comprising a sleeve extending upwards, and said second deflector comprising a sleeve extending downwards.

[0015] Preferably, in the aforementioned volute fan combination structure, said second volute fan is located forward of said first volute fan and said third volute fan along a front-and-rear direction.

[0016] Preferably, in the aforementioned volute fan combination structure, said mounting plate is provided with a first fan mounting portion, a second fan mounting portion and a third volute fan mounting portion for respectively mounting the first volute fan, the second volute fan

and the third volute fan correspondingly, and wherein said second fan mounting portion is disposed such as to project towards the front of said mounting plate and forward of said first fan mounting portion and said third fan mounting portion.

[0017] Another object of the present invention is to provide a vertical air conditioner, which specifically uses the following solution:

[0018] A vertical air conditioner, comprises a housing provided with a top air outlet located at a top thereof and a bottom air outlet located at a bottom thereof; a main body air duct provided within the housing, said main body air duct respectively communicating with said top air outlet and said bottom air outlet, and said volute fan combination structure according to claim 1, said volute fan combination structure is provided within said housing and blows air towards said top air outlet and/or said bottom air outlet through said main body air duct.

[0019] The advantageous effects of the present invention are as follows:

1. For a combination of a plurality of volute fans arranged sequentially, one volute fan in two adjacent volute fans has an inclined air outlet located between two adjacent volute fans, which inclined air outlet extends such as to be inclined from rear to front towards a direction away from a volute of said one volute fan, such that said one volute fan is capable of inclinedly blowing air in an air blowing direction that can avoid disturbance by adjacent volute fans, and at the same time the volute fans as a whole may also be arranged on a plane, with slight variation in volume.

2. For a combination structure of three volute fans, two air outlets of the second volute fan are inclinedly provided such as to reduce a size of second volute fan projecting out of the first volute fan and the third volute fan, so that it is possible to reduce the influence on the overall size of a vertical air conditioner in a thickness and/or thickness direction.

3. The intermediate second volute fan is capable of bidirectionally blowing air such as to increase an overall air blowing volume under the circumstance that there is no need to make any change to the original volute fans.

4. Further, it is also possible to allow that the second volute fan is located forward than the first volute fan and the third volute fan in a front-and-rear direction, such as to reduce an inclined extent of an inclined air outlet of the second volute fan, so that the air blowing of the second volute fan is more smooth.

5. With a slight influence on the overall size of an air conditioning device for example a vertical air conditioner, the volute fan uses such a combined manner that the inclined air outlet and the volute fan are staggeringly disposed, which results in less increase in thickness, so that it is only necessary to adjust a height of the vertical air conditioner such as to satisfy

the variation requirement in space. As the overall size of a vertical air conditioner is generally very high, the adjustment in height affects less the design of the overall size.

6. A deflector for adjusting an air direction of an air outlet is provided at the inclined air outlet of the second volute fan, such that air blowing of the air outlet is delivered in a direction substantially parallel to the mounting plate after avoiding the first volute fan and the third volute fan. When the air conditioning device is provided to blow air unidirectionally, the influence on reciprocal air flow may be reduced by reflection air of the front panel.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0020] The aforementioned as well as other objects, features and advantages of the present invention will be more clear, by means of the following descriptions of the embodiments of the present invention with reference to the drawings, in which drawings:

Figure 1 is an exterior view of the air conditioning device of the present invention.

Figure 2 is a schematic view of mounting the volute combination structure within the air conditioning device.

Figure 3A is a schematic view of an air flow of the air conditioning device of the present invention in such a state that the upper and lower air outlets are both opened.

Figure 3B is a schematic view of an air flow of the air conditioning device of the present invention in such a state that the lower air outlet is closed and the upper air outlet is opened.

Figure 4 is a locally enlarged view of the portion A in Figure 3A.

Figure 5 is a front view of the volute fan combination structure.

Figure 6 is a side view of the volute fan combination structure.

Figure 7 is an exploded schematic view of a volute fan and a mounting plate of the volute fan combination structure.

Figure 8 is a front view and a side view of the mounting plate provided with a second volute half.

Figure 8B is an enlarged view of the portion B in Figure 8.

Figure 9 is a schematic view of assembling a first half provided with an impeller and a motor and a mounting plate with a second half.

Figure 10 is a side view of the second volute fan.

Figure 11 is a sectional view of the second volute fan.

Figure 12 is a sectional view of another embodiment of the second volute fan.

Figure 13 is an exploded sectional view of the first volute fan.

Figure 14 is an exterior view of the first volute fan.
 Figure 15 is a sectional view of a mounting structure of the first volute fan.
 Figure 16 is a locally enlarged view of the area D in Figure 15.
 Figure 17 is a locally enlarged view of the area E in Figure 15.
 Figure 18 is a locally enlarged view of the area F in Figure 15..

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] The present invention is described as follows on the basis of the embodiments, but the present invention is not only limited to such embodiments. Several specific detailed portions are described in detail in the following detailed descriptions of the present invention. For a person skilled in the art, the present invention may also be fully understood without descriptions of such detailed portions. In order to avoid confusion of the essence of the present invention, detailed narrations are not made to the commonly known methods, processes, flow procedures, and elements.

[0022] In the present application, the definition of the direction is shown in Figures 1, 2, wherein the front-and-rear direction is defined to be along a direction perpendicular to the mounting plate 4, in which the front panel 51 is located at the front, and the rear panel is located at the rear; the longitudinal direction is defined to be along a direction parallel to the mounting plate, in which the top air outlet 53 is located above, and the lower air outlet 54 is located below. The latitudinal direction is defined to be along a direction parallel to the mounting plate and perpendicular to the longitudinal direction, wherein the left hand direction in Figure 1 is a left side, and the right hand direction is a right side. The side perpendicular to a principal plane direction and proximate to an observer is a left side, and the side opposite to the left side is a right side.

[0023] The present application designs a volute fan combination structure of an air conditioning device, which comprises a mounting plate 4 and a plurality of volute fans. The air conditioning device specifically refers to an electrical appliance device such as a vertical air conditioner, a fan and an air filter, which has an air blowing function and is capable of adjusting indoor air parameters. As shown in Figures 1-3, the air conditioning device has a housing 5, above which a top air outlet 53 is provided preferably at the top; below which a bottom air outlet 54 is provided preferably on a seat at the bottom of the housing 5. The housing comprises a front panel 51 and a rear panel 55, between which a hollow chamber is enclosed. The hollow chamber is internally provided with a volute fan combination structure, which mainly consists of a mounting plate 4 and a plurality of volute fans. Its specific structure will be described in detail later. The volute fan combination structure is arranged within

said hollow chamber along a longitudinal direction, and the volute is provided in front of the mounting plate 4 and opposite to a position of the front panel 51. The mounting plate 4 divides the hollow chamber into two independent parts, and a space between a rear side of the mounting plate 4 and the rear panel 55 is formed with an air intake duct 57 which communicates with an air intake grill located on the rear panel 55. As a preferable solution, the air intake duct 57 is further internally provided with a heat exchange mechanism such as an evaporator. The space between a front side of the mounting plate 4 and the front panel 51 forms a main body air duct 56 of the air conditioning device, which main body air duct 56 respectively communicates with the top air outlet 53 and the bottom air outlet 54. At a position corresponding to a volute mounting position, the mounting plate 4 is provided with a mounting plate air inlet, a position of which is opposite to that of the volute air inlet. The air outlet of the volute communicates with the main body air duct 56. When the air conditioning device operates, air enters the air intake duct 57 after passing through the air intake grill on the rear panel 55, then enters the volute air outlet through a mounting plate air inlet, is conveyed to the main body air duct 56 through the volute air outlet after being accelerated by a centrifugal fan of the volute fan, then may move downwards within the main body 56 such as to be blown out by the bottom air outlet 54, and/or move upwards such as to be blown out by the top air outlet 53.

[0024] The volute fan combination structure of the present application, comprises a mounting plate and at least three volute fans mounted on a front side face of the mounting plate, the at least three volute fans comprises an upper volute fan located above and provided with an air outlet blowing air upwards, and a lower volute fan located below and provided with an air outlet blowing air downwards, and further comprises at least one intermediate volute fan between the upper volute fan and the lower volute fan. The at least one intermediate fan comprises at least one bidirectional volute fan having a bidirectional air outlet capable of blowing air upwards and downwards at the same time, and said bidirectional air outlet and the volute fan adjacent to said bidirectional volute fan are staggeringly disposed in a front-and-rear direction. The at least one intermediate volute fan may be a combination of a bidirectional volute fan and a unidirectionally blowing volute fan, and may also be fully bidirectional volute fans. The specific manner that the bidirectional air blower and the volute fan adjacent to said bidirectional volute fan are staggered in a front-and-rear direction may use staggering the volute fans in a front-and-rear direction, providing the bidirectional air outlet to blow air inclinedly, as well as a combination of the aforementioned two manners. The specific structure may be described in detail below.

[0025] Next, detailed explanations are made to the volute fan combination structure of the present application by taking Figures 3-18 for example. As shown in Figures 5-7, the volute fan combination structure comprises a

mounting plate 4, as well as three volute fans (hereinafter referred to as fans for short). The three volute fans comprise a first volute fan 1 provided at an upper side of the mounting plate 4, a third volute fan 3 located a lower side of the mounting plate 4, as well as a second volute fan 2 provided on the mounting plate 4 and located between the first volute fan 1 and the third volute fan 3. Among them, the first volute fan 1 has a first volute fan air outlet 18 blowing air upwards; the third volute fan is provided with a third volute fan air outlet 39 blowing air downwards; the second volute fan has two air outlets, in which the second volute fan first air outlet 28 is provided to blow air upwards, and the second volute fan second air outlet 29 is provided to blow air downwards. It is necessary to explain that, although the mounting plate in the present embodiment is provided in a longitudinal direction, and the three volute fans are also arranged in a longitudinal direction, the technical solution of the present application should not be limited in a mounting plate structure provided in a longitudinal direction. It is both possible that the mounting plate uses a horizontal arrangement or an inclined arrangement. The longitudinal, latitudinal and front-and-rear definitions mentioned in the present text are all relative directions with respect to the mounting plate.

[0026] The second volute fan 2 is disposed between the first volute fan 1 and the third volute fan 3, and the air outlet is provided in such a manner as to blow air longitudinally. If three fans are mounted on the same plane according to a conventional manner, the volute of the first volute fan 1 and the volute of the third volute fan 3 may form a barrier for the air blowing of the second volute fan, which impedes air blown by the second volute fan 2 from smoothly entering the main body air duct 56. Accordingly, the three fans are provided to present a staggered structure in space, such that the second volute fan first air outlet 28 and the second volute fan second air outlet 29 are staggered in space from positions of the first volute fan 1 and the third volute fan 3. The influence on the air blowing of the second volute fan 2 by the first volute fan 1 and the third volute fan 3 is reduced to minimum as much as possible, for example the three fans are staggeringly disposed in a front-and-rear direction and/or a latitudinal direction.

[0027] As a preferred embodiment, as shown in Figure 6, it uses such a manner that the three fans are staggeringly disposed back and forth. Specifically, a mounting position of the second volute fan 2 on the mounting plate 4 is disposed at a front side of a mounting position of the third and third volute fans, i.e. the second volute fan 2 is disposed at a position that is closer to the main body air duct 56 than a position at which the first volute fan 1 and the third volute fan 3 are disposed, such that the air blown by the second volute fan 2 in a longitudinal direction may at least partially avoid disturbance of a volute of the first volute fan 1 and a volute of the third volute fan 3, so that it is conveyed through the main body air duct 56 more smoothly. Preferably, it is effectuated that a mounting

position of the second volute fan 2 on the mounting plate 4 is disposed at a front side of mounting positions of the second and third volute fans by changing a shape of the mounting plate 4. As shown in Figure 6-8, the mounting plate has a first fan mounting portion 41, a second fan mounting portion 42 and a third fan mounting portion 43, in which steps are formed between the second fan mounting portion 42 and the first fan mounting portion 41/third fan mounting portion 43, such that the second fan mounting portion 42 projects in a forward direction towards the front panel 51 relative to the first fan mounting portion 41 and the third fan mounting portion 43. In this way, under the circumstance without changing a shape of the three fans, it is possible to allow that a mounting position of the second volute fan 2 on the mounting plate 4 is located at a front side of mounting positions of the first and third volute fans when the three fans are mounted on the mounting plate 4. The advantage of staggered arrangement back and forth is only to increase a thickness in a front-and-rear direction for certain extent, without increasing a thickness of the volute fan assembly in a latitudinal direction, so that there is a very slight influence on the overall size of the air conditioning device. As a preferred manner, the rear walls of the second volute fan first air outlet 28 and the second volute fan second air outlet 29 have an inner surface which may present a plane parallel to the mounting plate, and the extension of the plane does not intersect with the volutes of the first volute fan 1 and the third volute fan 3 respectively. In this way, it may allow that the air blown by the second volute fan 2 may not be blown onto the volutes of the first volute fan 1 and the third volute fan 3, and the influence on the air blowing of the second volute fan 2 by the first volute fan 1 and the third volute fan 3 is reduced to minimum.

[0028] It is also possible to use such a manner that the three fans are staggered in a latitudinal direction (not shown in the drawings), i.e. the second volute fan 2 is arranged at a left side or a right side of the first volute fan 1 and the third volute fan 3, which may also effectuate reducing disturbance of the air blowing of the second volute fan by the first volute fan 1 and the third volute fan 3. However, such manner may significantly increase a width of the volute fan assembly in a latitudinal direction, which is unfavorable for the overall layout of the air conditioning device.

[0029] As another preferred embodiment, the second volute fan first air outlet 28 and the second volute fan second air outlet 29 of the second volute fan 2 may also be inclinedly disposed relative to the volute of the second volute fan 2. Take Figures 3-6 for example, in an actual installation state, the volute of the second volute fan 2 is mounted in such a manner as to be substantially parallel to a plane of the second volute fan mounting portion 42 of the mounting plate 4. As shown in Figure 3, the volute plane of the second volute fan 2 extends substantially along a longitudinal direction. The second volute fan first air outlet 28 and the second volute fan second air outlet 29 are disposed such as to extend in a direction from the

mounting plate 4 to the front panel 51 (i.e. a front-and-rear direction) towards a direction away from the volute. Specifically, the second volute fan first air outlet 28 is disposed to blow air in a forwardly upward direction, and the second volute fan second air outlet 29 is disposed to blow air in a forwardly downward direction. With reference to Figures 6, 10, 11, the second volute fan first air outlet 28 comprises an inner surface 282 of a rear wall of the second volute fan first air outlet proximate to the second fan mounting portion 42 and an inner surface 281 of a front wall of the second volute fan first air outlet proximate to the front panel 51, the inner surface 281 of a front wall of the second volute fan first air outlet may present a slope or an camber, and the extension 2811 of the tangent of the slope or camber and the plane of the mounting plate 4 present a first inclination θ_1 ; the inner surface 282 of a rear wall of the second volute fan first air outlet may present a slope or an camber, and the extension 2821 of the slope or camber and the plane of the mounting plate 4 present a second inclination θ_2 . The first inclination θ_1 may be the same as or different from the second inclination θ_2 in size. The second volute fan second air outlet 29 has an inner surface 292 of a rear wall of the second volute fan second air outlet proximate to the second fan mounting portion 42 and an inner surface 291 of a front wall of the second volute fan second air outlet proximate to the front panel 51, the inner surface 291 of a front wall of the second volute fan first air outlet may present a slope or an camber, and the tangent direction 2911 of the slope or camber and the plane of the mounting plate 4 present a third inclination θ_3 ; the inner surface 292 of a rear wall of the second volute fan second air outlet may present a slope or an camber, and the tangent direction 2921 of the camber and the plane of the mounting plate 4 present a fourth inclination θ_4 . The third inclination θ_3 may be the same as or different from the fourth inclination θ_4 in size. As a preferred manner, the extension of the slope or the extension 2821 of the tangent of the camber of the inner surface 282 of the rear wall of the second volute fan first air outlet does not intersect with the volute of the first volute fan 1, as shown in Figure 4. The extension of the slope or the extension 2921 of the tangent of the camber of the inner surface 292 of the rear wall of the second volute fan second air outlet does not intersect with the volute of the third volute fan 1 (not shown in the drawings). The meaning of not intersecting is specifically signified that, the portion on the extension of the slope or the extension 2821 of the tangent of the camber which overlaps with a projection of the volute on the positioning plate is located in front of the volute in a front-and-rear direction. By means of such configuration, it is possible to allow that the air blown by the second volute fan first air outlet 28 and the second volute fan second air outlet 29 may not be blown onto the volutes of the first volute fan 1 and the third volute fan 3, such as to reduce the disturbance of the air blowing of the second volute fan 2 by the volutes of the first volute fan 1 and the third volute fan 3.

[0030] As another preferred embodiment, it uses a combination of the aforementioned staggered manners. As shown in Figure 3-7, the mounting plate has a first fan mounting portion 41, a second fan mounting portion 42 and a third volute fan mounting portion 43, in which steps are formed between the second volute fan mounting portion 42 and the first fan mounting portion 41/third fan mounting portion 43, such that the second fan mounting portion 42 projects in a forward direction towards the front panel 51 relative to the first fan mounting portion 41 and the third fan mounting portion 43. At the same time, the second volute fan first air outlet 28 and the second volute fan second air outlet 29 are provided to be disposed inclinedly relative to the volute, i.e. extending in a direction from the mounting plate 4 to the front panel 51 (i.e. a front-and-rear direction) towards a direction away from the volute. Preferably, an extension of the slope or an extension 2821 of the tangent of the camber of the inner surface 282 of the rear wall of the second volute fan first air outlet does not intersect with the volute of the first volute fan 1, as shown in Figure 4. An extension of the slope or an extension 2921 of the tangent of the camber of the inner surface 292 of the rear wall of the second volute fan second air outlet does not intersect with the volute of the third volute fan 3. Such combination of staggered manners may reduce an increase in a thickness (a front-and-rear direction) of the volute fan combination structure resulting from staggering in a front-and-rear direction, and at the same time may also avoid that the inclined angles of the second volute fan first air outlet 28 and the second volute fan second air outlet 29 relative to the volute is so large as to affect the air blowing of the volute fan, ensure that there is no significant increase of size in both a thickness (a front-and-rear direction) and width (a latitudinal direction) of the volute fan combination structure, and facilitate an optimized design of the overall structure of the air conditioning device. At the same time, the disturbance of the air blowing of the second volute fan by of the first volute fan and the third volute fan is also very low, such that the air blown by the three fans is capable of moving smoothly within the main body air duct 56.

[0031] As another preferred manner, a deflector may be provided at a second volute fan first air outlet 28 and/or second volute fan second air outlet 29 inclinedly disposed at the second volute fan. As shown in Figure 12, an upper deflector 280 is provided at the second volute fan first air outlet 28, and a lower deflector 290 is provided at the second volute fan second air outlet 29. The upper deflector 280 is at least disposed at a front wall of the second volute fan first air outlet 28, i.e. at a position proximate to the front panel 51; the lower deflector 290 is at least disposed at a front wall of the second volute fan second air outlet 29, i.e. at a position proximate to the front panel 51. The upper deflector 280 and the lower deflector 290 extend substantially in such a manner as to be parallel to the mounting plate 4 and/or front panel 51, i.e. along a longitudinal direction. Preferably, the upper deflector

280 and the lower deflector 290 have a structure of a sleeve which is provided at the second volute fan first air outlet 28 and the second volute fan second air outlet 29, and which extends along a substantially longitudinal direction. In this way, air blown by the upper air outlet 28 and the lower air outlet 29 may enter the main body air duct 56 in a manner of a heading substantially parallel to the main body air duct 56, to reduce disturbance of air stream within the main body air duct 56 by reflection air flow of the front panel 51, so as to make a more smooth air flow within the main body air duct 56, and reduce the energy loss. At the same time, if one of the top air outlet 53 or the bottom air outlet 54 is closed, as shown in Figure 3B, for instance the bottom air outlet 54 is closed. At this time, air blown downwards by the second volute fan second air outlet 29 and the third volute fan air outlet 39 returns after moving to a lower end of the main body air duct 56, and moves towards the top air outlet 53 through the third volute fan 3 as well as a passage formed between the volute and the front panel 51 of the second volute fan 2. Due to presence of the lower deflector, air blown downwards by the lower air outlet 29 is substantially parallel to the main body air duct 56, the lower reciprocal air when passing through the passage between the volute and the front panel 51 of the second volute fan 2 may not be disturbed by air blown by the lower air outlet 29, so as to able to smoothly move upwards. If the lower deflector 290 is not provided, the air blown by the lower air outlet 29 which is inclined forwardly downwards may cause a barrier for the lower reciprocal air, so that the reciprocal air cannot smoothly move upwards. Similarly, it applies to the upper deflector 280 in a way such that the effect produced by the upper deflector 280 is the same as the effect produced by the lower deflector 290 when the top air outlet 53 is closed.

[0032] Next, the specific installation manner of the volute fan assembly is explained by referring to the structures shown in Figures 7-9. The mounting plate has a first fan mounting portion 41, a second fan mounting portion 42 and a third fan mounting portion 43, which are respectively provided with a first fan mounting face, a second fan mounting face and a third fan mounting face (not shown in the drawings). Among them, the second fan mounting face is disposed to project in a direction towards the front panel relative to the first fan mounting face and the third fan mounting face. An enclosure provided at an edge of the first fan mounting face and the third fan mounting face may reinforce the overall strength of the mounting plate, and at the same time allow that the first fan mounting portion 41 and the third fan mounting portion 43 form a depression, as shown in Figure 8. The first fan mounting face, the second fan mounting face and the third fan mounting face are respectively formed with a first mounting plate air inlet 411, a second mounting plate air inlet 421 and a third mounting plate air inlet 431, as shown in Figure 8. The volute of the fan consists of two halves, which possess substantially the same thickness. Preferably, the two halves are formed by sectioning

the volute from a centerline perpendicular to an axis of the volute, so that such configuration facilitates the manufacture of halves. Specifically, the first volute fan 1 includes a first fan rear half 15, a first fan front half 13, a first motor 11, and a first impeller 14. The first fan rear half 15 and the first fan front half 13 constitute the first volute, the first volute fan rear half 15 is opened with a first volute air inlet, and the first motor 11 and the first impeller 14 are mounted on the first fan front half 13. The second volute fan 2 includes a second fan rear half 25, a second fan front half 23, a second motor 21, and a second impeller 24. The second fan rear half 25 and the second fan front half 23 constitute the second volute, the second fan rear half 25 is opened with a second volute air inlet, and the second motor 21 and the second impeller 24 are mounted on the second fan front half 23. The third volute fan 3 includes a third fan rear half 35, a third fan front half 33, a third motor 31, and a third impeller 34. The third fan rear half 35 and the third fan front half 33 constitute the third volute, the third fan rear half 35 is opened with a third volute air inlet, and the third motor 31 and the third impeller 34 are mounted on the third fan front half 33, specifically as shown in Figure 9.

[0033] When the first volute fan 1, the second volute fan 2, and the third volute fan 3 are respectively mounted to the first fan mounting portion 41, the second fan mounting portion 42 and the third fan mounting portion 43, the first fan rear half 15, the second fan rear half 25 and the third fan rear half 35 are respectively fixed to a first fan mounting face, a second fan mounting face and a third fan mounting face of the first fan mounting portion 41, the second fan mounting portion 42 and the third fan mounting portion 43 by means of a connection piece which may be a screw, a bolt, a rivet and the like. As shown in Figure 8B, it uses a manner of a screw 91. The first volute air inlet, the second volute air inlet and the third volute air inlet are respectively opposite to the first mounting plate air inlet 411, the second mounting plate air inlet 421 and the third mounting plate air inlet 431. As the first fan mounting portion 41 and the third fan mounting portion 43 form a depression, said first fan rear half 15 and said third fan rear half 35 are embedded into said depression, and the fan rear half 25 is located on the second fan mounting portion 42 by projecting out of the mounting plate 4. The first fan front half 13, the second fan front half 23 and the third fan front half 33 after the corresponding motor and impeller are mounted, are integrally connected to the first fan rear half 15, the second fan rear half 25 and the third fan rear half 35 respectively, such as to further constitute the whole volute fan combination structure, as shown in Figure 9. Compared to a conventional manner of mounting a motor to a mounting plate, the motor of the present application is mounted on a volute, and the motor and the impeller may be removable together with the volute, without requiring to remove the mounting plate, thereby improving the convenience and the maintainability in the whole assembly. The specific structure of the volute motor will be described in de-

tail later.

[0034] Next, the mounting structure of the volute motor is described in detail by taking the first motor 1 and the mounting plate 4 for example, as shown in Figures 13-18. In the following descriptions, the axial direction is defined to be a direction parallel to an axis of the motor, the radial direction is defined to be a direction perpendicular to an axis of the motor, the circumferential direction is defined to be a direction rotating about an axis of the motor. The term "side" is concerned relative to an axis direction of the motor. For example in Figure 13, the first half 13 (a first fan front half) is located at one side, the second half 15 (a first fan rear half) is located at the other side, and the impeller 14 is located between the first half 13 and the second half 15.

[0035] As shown in Figure 15, when said volute is viewed from an axial cross section obtained by cutting the volute from a plane containing an axis 111 of the motor, a distance from a peripheral wall of the volute proximate to a centerline of the volute in a direction of said axis to said axis is greater than a distance from a peripheral wall of the volute at both sides in the axis to said axis 111, and the distance is a distance from a centerline of the peripheral wall to the axis 144 of the impeller, with a different of H. Preferably, a distance from an outer wall of a peripheral wall of the volute proximate to a centerline 139 of the volute in a direction of said axis 111 to said axis 111 is greater than a distance from an outer wall of a peripheral wall of the volute at both sides in the axis 111 to said axis 111, with a different of H1 (not shown in the drawings). Preferably, the outer wall of a peripheral wall of the volute has a cross section which may be an arc, a trapezoid, a trimmed arc, a triangle, or other polygons. Preferably, a distance from an outer wall of a peripheral wall of the volute proximate to a centerline 139 of the volute in a direction of said axis 111 to said axis 111 is greater than a distance from an outer wall of a peripheral wall of the volute at both sides in the axis 111 to said axis 111, with a different of H1 (not shown in the drawings). Preferably, the outer wall of a peripheral wall of the volute has a cross section which may be an arc, a trapezoid, a trimmed arc, a triangle, or other polygons. By designing an outer wall of a peripheral wall of the volute to be an intermediately projecting structure, it may be adapted to different vertical air conditioner structures for example having a curved housing. Further, as the peripheral wall of the volute usually has a uniform thickness, the projection of the outer wall of the peripheral wall may allow that the inner wall of the peripheral wall also presents a projecting structure. By comparing the volutes of which the peripheral wall is perpendicular to the sidewall, it is possible to increase a volume inside the volute, and improve the air sending capability of the volute fan.

[0036] In order to facilitate the manufacture, the volute may be provided in a divided structure. As shown in Figures 13-15, the volute comprises a first half 13 and a second half 15, the first half 13 comprises a first half

peripheral wall 131 and a first half sidewall 132, the second half comprises a second half peripheral wall 151 and a second half sidewall 152, and the first half peripheral wall 131 and the second half peripheral wall 151 are bent in such a manner as to surround a periphery of the impeller 14. The first half peripheral wall 131 comprises a fixed end connected to an edge portion of the first half sidewall 132 and a first connection end away from the first half sidewall 132. The second half peripheral wall 151 comprises a fixed end connected to an edge portion of the second half sidewall 152 and a second connection end away from the second half sidewall 152. The first connection end 1311 of the first half peripheral wall 131 is connected to the second connection end 1511 of the second half peripheral wall 151, so that an accommodating cavity is formed inside the first half 13 and the second half 15 for accommodating the impeller 14, and formed in a cylindrical shape with a radius increasing along a rotation direction of the impeller 14 relative to the axis 111 of the motor.

[0037] The motor 11 of the volute motor in the present embodiment comprises a motor main body 117 and a rotary shaft 112. The impeller 14 which is mounted within the accommodating cavity, presents a cylindrical shape formed in a way such that a plurality of blades 141 elongately formed in an axial direction of the axis 111 of the motor present a radiating shape and are configured at specified gaps. One end of the blades 141 is mounted to an outer edge portion of a rotary circular plate 142 in a substantially circular shape, and the other end of the blades 141 is mounted to a support ring 143 in an annular shape and internally formed with an impeller air inlet. The rotary circular plate 142 is centrally fixed at the rotary shaft 112 of the motor, and under the drive of the motor 11, the impeller 14 rotates with the rotation shaft 112 as a center. The first half 13 is provided with a motor mounting port 133, adjacent to which the rotary circular plate 142 of the impeller is disposed. The rotary shaft 112 of the motor 11 passes through the motor mounting port and is connected to the rotary circular plate 142 of the impeller 14, such as to drive rotation of the rotary circular plate 142. The second half 15 is provided with a volute air inlet 153 which corresponds to the impeller air inlet in position for guiding air towards inside the impeller 14. The motor main body 117 is supported by the first half 13. A first damping means is provided between the motor main body 117 and the first half 13, and the structure and the specific mounting manner of the first damping means will be described in detail as follows.

[0038] As the volute is usually made from a plastic material with poor overall strength, by directly mounting the motor main body 117 to the first half 13, it may result in inadequate strength of the first half 13 to support power of the motor, which results in that the first half 13 is deformed or damaged. Accordingly, as a preferred embodiment, there comprises a support disk 12 which is made from a metal material. The support disk 12 is fixed on the first half 13, and preferably fixed on an outer wall of the

first half sidewall 132 of the first half 13, and the motor main body 117 is fixed on the support disk 12. Preferably, the motor main body 117 is fixed on a lateral face of the support disk 12 away from the first half 13. By providing the support disk 12, it is possible to allow that the motor main body 117 can be provided on the volute and supported by the volute, and at the same time may not deform or damage the volute.

[0039] When a support disk 12 is provided, the first damping means may be disposed between the support disk 12 and the motor main body 117. The outer wall of the peripheral wall of the motor main body 117 is provided with a flange 133, which is fixed to the support disk 12, and the first damping means is disposed between the flange 133 and the support disk 12. Preferably, the first damping means is preferably a first damping washer disposed between the flange 133 and the support disk 12. As a preferred solution, as shown in Figure 13, the first damping washer 114 is provided in a columnar shape, the outer periphery of the first damping washer 114 in a columnar shape is provided with a socket, and the flange 133 which is sheet-like is inserted into inside the first damping washer 114 from said socket. The first damping washer 114 is provided with a through hole communicating with a mounting hole of the flange 133. The connection piece such as a screw and a bolt after passing through a through hole of the first damping washer 114 and a mounting hole of the flange 133 is connected to the support disk 12 such as to be fix the motor main body 117. The first damping washer 113 preferably uses a rubber support. When a support disc 12 is not provided, the motor 11 may also be directly connected to the first half 13 through the aforementioned damping means in a manner of replacing the support disc 12 by the first half 13.

[0040] The first half periphery 131 extends from a fixed end to a first connection end 1311 in a radial direction towards a direction away from the axis 111 of the motor, and the second half periphery 151 extends from a fixed end to a second connection end 1511 in a radial direction towards a direction away from the axis 111 of the motor. Preferably, the connection of the first connection end 1311 of the first half peripheral wall 131 and the second connection end 1511 of the second half peripheral wall 151 is proximate to the centerline 139 of the volute perpendicular to the axis 111 of the motor, or overlaps with the centerline 139 of the volute perpendicular to the axis 111 of the motor.

[0041] In order to enhance the air-tightness of the volute, a sealing structure may be provided at the connection of the half 13 and the second half 15. Preferably, the sealing structure comprises a rib provided on one of the first connection end 1311 of the first half peripheral wall 131 and the second connection end 1511 of the second half peripheral wall 151 and a groove provided on the other thereof. Preferably, as shown in Figure 15, the first connection end of the first half peripheral wall 131 is provided with a rib 1312 extending towards the second half

15, and the second half peripheral wall 151 is provided with a groove 1512 corresponding to the rib 1312. When the first half 13 is connected to the second half 15, the rib 1312 is embedded into the groove 1512, so that it is possible to improve the sealing property of the half and avoid air leakage of the peripheral wall of the volute to reduce the efficiency of the volute fan. The structure of the rib 1312 and the groove 1512 may be provided in a single manner and may also be provided in a plural manner.

[0042] The sealing structure may also use a form of a sealing ring by providing a flange on one of the first half 13 and the second half 15, and providing a groove on the other thereof. The flange abuts against the groove and presses the sealing ring within the groove to effectuate the sealing. The sealing ring may also use rubber or other soft materials. The sealing structure may be provided radially outside or radially inside the peripheral wall of the volute.

[0043] As a preferred embodiment, as shown in Figure 15, the rotary circular plate 142 is disposed in such a manner as to project towards an interior of the impeller 14 in a direction from the edge to an axis center of the rotary circular plate 142. The rotary circular plate 142 presents substantially a cup shape or a tapered shape, and the radial inside of the rotary circular plate 142 forms a motor accommodating space. The rotary shaft 112 of the motor passes through the volute into the volute, and a portion of the motor main body 117 may be located within the motor accommodating space. By doing so, there are advantages of reducing a length of the motor 11 projecting out of an exterior of the volute, reducing a mounting length of the volute motor in an axial direction, and allowing the overall structure of the volute fan to be more compact. Further, the first half sidewall 132 of the first half 13 is correspondingly formed with an inner recess 1321, the center of which is provided with a motor mounting port 133. The inner recess 1321 is further disposed to project towards an interior of the impeller 14 in a direction from the edge to the axis center of the motor mounting port 133.

[0044] In order to further reduce vibration between the motor and the support disk, as shown in Figure 17, preferably, the outer wall of the peripheral wall of the motor main body 117 is provided with a flange 133, which is fixed to the support disk 12, and a first damping structure is provided between the flange 133 and the support disk 12. Preferably, the first damping structure is preferably a first damping washer disposed between the flange 133 and the support disk 12. As a preferred solution, as shown in Figure 17, the first damping washer 114 is provided in a columnar shape, the outer periphery of the first damping washer 114 in a columnar shape is provided with a socket, and the flange 133 which is sheet-like is inserted into inside the first damping washer 114 from said socket. The first damping washer 114 is provided with a through hole communicating with a mounting hole of the flange 133. The connection piece such as a screw and a bolt

after passing through a through hole of the first damping washer 114 and a mounting hole of the flange 133 is connected to the support disk 12 such as to be fix the motor 11. The first damping washer 113 preferably uses a rubber support.

[0045] In order to further reduce vibration between the motor 11 and the impeller 14, as shown in Figure 18, a second damper structure is provided between the rotary shaft 112 of the motor and the rotary circular plate 142 of the impeller 13. Preferably, the second damping structure comprises a rubber sleeve 115 and a metal collar 116; the rubber sleeve 115 is fixed at an outer periphery of the rotary shaft 112 of the motor to rotate synchronously with the motor shaft 11. The outer periphery of the metal collar is connected to the rotary circular plate 142, and the inner periphery is connected to the rubber sleeve 115. The power of the rotary shaft 112 of the motor is transferred to the rotary circular plate 142 to further drive rotation of the impeller 14, and the presence of the rubber 115 may effectively reduce vibration transferred by the motor 11 to the impeller 13 and effectively reduce the noise.

[0046] Preferably, in order to reduce vibration transferred by the motor main body 117 to the volute 13, a cylindrical support 134 is provided at an edge of the motor mounting port 133 of the first half 13, and the cylindrical support 134 is internally provided with a through hole communicating with the motor mounting port 133. As shown in Figure 17, the fixed end of the cylindrical support 134 is connected to the edge of the motor mounting port 133, and the free end of the cylindrical support 134 extends in an axis towards a direction away from a center of the volute. At least a portion of the motor main body 117 is located within the cylindrical support 134 such that the rotary shaft 112 of the motor passes through the motor mounting port 133 and is connected to the impeller 14. A third damping structure is provided between the cylindrical support 134 and an outer wall of the cylindrical wall of the motor main body 117. Preferably, the third damping structure is a second sealing ring 135 provided at an end or an inner wall of the cylindrical support 134. When the motor 11 is located inside the cylindrical support 134, an elastic fit is formed between the second sealing ring 135 and the outer wall of the peripheral wall of the motor main body 117, such as to reduce vibration transferred by the motor to the volute. At the same time, it is also possible to form a sealing fit to close the motor mounting port 133, so as to effectuate sealing at the motor mounting port 133 and prevent that the efficiency of the volute motor is reduced by air leakage at the motor mounting port. The second sealing ring 135 may be mounted on the cylindrical support 134, and may also be mounted at an outer periphery of the motor main body 117. Preferably, as shown in Figure 17, the second sealing ring 135 is provided to be an annular structure having a U cross section, the opening of which is directed towards a free end of the cylindrical support 134 and mounted at a free end of the cylindrical support 134. The inner

peripheral wall of the second sealing ring 135 abuts against the outer wall of the peripheral wall of the motor main body 117. Preferably, the inner periphery of the second sealing ring which is provided with a sealing lip extending towards the motor, may abut against the outer wall of the peripheral wall of the motor main body 117. Preferably, the volute 13 is provided with a mounting seat 136, and the support disk 12 is connected to the mounting disk 136 such as to be mounted to the first half 13. The lateral face of the support disc 12 opposite to the cylindrical seat 134 is pressed against the second sealing ring 135 to sandwich the second sealing ring between the support disk 12 and the cylindrical support 134, so as to better fix the second sealing ring 135.

[0047] Next, explanations are made to the mounting structure of the volute motor of the present embodiment. As shown in Figure 14, the mounting structure of the volute motor of the present embodiment comprises the aforementioned volute fan and mounting plate 4, in which the volute fan is mounted on the mounting plate 4, and the mounting plate is provided with a mounting plate air inlet 41. The second half 15 is fixedly connected to the mounting plate 4 through a fastener such as a screw, a bolt and a rivet, the volute air inlet 153 on the second half 15 is opposite to the mounting plate air inlet 41 on the mounting plate 4 in position, and the motor 11 and the impeller 14 are both mounted to the first half 14. The first half 13 mounted with the motor 11 and the impeller 14 is connected to the second half 15 such as to mount the volute fan to the mounting plate 4.

[0048] Next, detailed explanations are made to the specific assembling manner of the aforementioned volute fan and mounting plate 4.

[0049] When the volute fan is fixed to the mounting plate 4, there comprise the following steps:

Step I:

The second half 15 is connected to the mounting plate 4. Preferably, the second half sidewall 152 is connected to the mounting plate 4 through a fastener, and the second half peripheral wall 151 is located at one side of the second half sidewall 152 away from the mounting plate 4. The fastener may use a connection piece such as a screw and a rivet.

Step II: the motor 11 and the impeller 14 are connected to the first half 13. There specifically comprise two manners:

Manner 1:

The support disk 12 is fixed to the first half 13; the rotary shaft 112 of the motor 11 passes through the motor mounting port 133 on the first half 13 and fixes the motor 11 on the support disk 12 so as to fix the motor 11 to the first half 13; and the rotary circular plate 142 of the impeller 14 is connected to the rotary shaft 112 of the motor 11 so as to connect the impeller 14 and the motor.

Or manner 2:

The motor 11 is connected to the support disk 12; the support disk 12 together with the motor 11 are fixed to the first half 13, and the rotary shaft 112 of the motor 11 passes through the motor mounting port 133 on the first half 13; the rotary circular plate 142 of the impeller 14 is connected to the rotary shaft 112 of the motor 11 so as to connect the impeller 14 and the motor 11.

Step III, the first half 13 mounted with the motor 11 and the impeller 14 is connected to the second half 15, so as to integrally mount the volute fan to the mounting plate 4.

[0050] Among them, the sequence of the step I and the step II may be interchanged and may also be performed at the same time.

[0051] Compared to the current volute fan structure, the motor 11 and the impeller 14 of the volute fan of the embodiment I are fully mounted on the first half 13, and integrally mounted with the first half 13 upon installation, so that the installation is more convenient. When it is necessary to perform such operations as repair, maintenance and replacement of the motor 11 or the impeller 14, it is only necessary to remove the first half 13 together with the motor 11 and the impeller 14 as a whole as well as the second half 15. It is necessary to remove the second volute 15, and it is also necessary to remove the mounting plate 4 so that there is a better overall maintenance.

[0052] Further, a common person skilled in the art should understand that, the drawings provided herein are for the purpose of description, and that the drawings are not necessarily delineated according to the scale.

[0053] At the same time, it should be understood that, the exemplary embodiments are provided, so that the present disclosure is comprehensive, and its scope is adequately delivered to a person skilled in the art. Many specify details (for example examples of a specific member, device and method) are offered to provide a comprehensive understanding of the present disclosure. A person skilled in the art will understand that, it is necessary to use specific details, the embodiments may be implemented in many different forms, and the exemplary embodiments should not be understood to limit the scope of the present disclosure. In several exemplary embodiments, there are no detailed descriptions of the commonly known device structure and the commonly known art.

[0054] When an element or layer is mentioned to be "on", "engaged to", "connected to" another element or layer, or "coupled to" another element or layer, it may be directly on another element or layer, directly engaged to, connected to or coupled to another element or layer, or may be present with an intermediate element or layer. By contrast, when an element is mentioned to be "direct-

ly" "on" another element or layer, "directly engaged to", "directly connected to" or "directly coupled to" another element or layer, there may not be present with an intermediate element or layer. Other expressions for describing relations among the elements may be explained in similar manners (for example "between" and "directly between", "adjacent to" and "directly adjacent to", and the like). As used herein, the term "and/or" comprises any one or all combinations of one or more related items as listed.

[0055] Although the terms "first, second, third and the like" herein may be used to describe each element, member, area, layer and/or segment, such elements, parts, areas, layers and/or segments should not be limited by such terms. Such terms may only be used for differentiating an element, member, area, layer or segment from another element, area, layer or segment. The terms such as "first" and "second" and other value terms when used herein do not mean an order or sequence unless specifically specified in the context. Accordingly, the first element, member, area, layer or segment discussed below may be called as a second element, member, area, layer or segment, without departing from the teaching of the exemplary embodiments. Further, in the descriptions of the present invention, unless otherwise explained, the meaning of "a plurality of" is two or more.

[0056] In order to facilitate the description, the relevant terms of space such as "within", "outside", "under", "below", "lower", "above" and "upper" herein are used to elaborate a relation between an element or feature and another element or feature as exemplified in the drawings. It will be understood that, the relevant terms of space may be intended to contain different orientations of the device in use or operation other than those illustrated in the drawings. For example, if the device in the drawings is overturned, the element described to be "below" or "under" other elements or features will be positioned "over" other elements or features. Thus, the exemplary term "below" can contain orientations both above and below. The device may be oriented in other manners (rotated by 90 degrees or located at other orientations), and the relevant description words of space used herein should be correspondingly explained.

[0057] The foregoing is intended only as a preferred embodiment of the present invention, but is not used for limiting the present invention, and for a person skilled in the art, the present invention may have various modifications and variations. Any amendment, equivalent replacement, improvement, and the like within the spirit and principles of the present invention should all be contained within the protection scope of the present invention.

Claims

1. A volute fan combination structure, comprising:

- a mounting plate (4);
 at least two adjacent volute fans mounted on
 said mounting plate (4); and
 wherein one volute fan of the two adjacent volute
 fans has an intermediate inclined air outlet lo-
 cated between the two adjacent volute fans, said
 intermediate inclined air outlet extending along
 a direction away from said mounting plate (4).
2. The volute fan combination structure according to
 claim 1, wherein the inner surface adjacent to said
 mounting plate (4) of said intermediate inclined air
 outlet representing a slope or camber, an extension
 of said slope or an extension of a tangent plane of
 said camber not intersecting with a volute of another
 volute fan adjacent to said intermediate inclined air
 outlet.
3. The volute fan combination structure according to
 claim 1, comprising three volute fans (1, 2, 3) having
 a third volute fan (3), a second volute fan (2) and a
 first volute fan (1) provided in an upward sequence;
 said second volute fan (2) comprising second volute
 fan air outlets (28, 29) blowing air upwards and/ or
 blowing air downwards, said second volute fan air
 outlets (28, 29) extending along a direction away
 from said mounting plate (4).
4. The volute fan combination structure according to
 claim 3, wherein the inner surface adjacent to said
 mounting plate (4) of said second volute fan air out-
 lets (28,29) representing a slope or camber, an ex-
 tension of a corresponding slope or an extension of
 a tangent plane of an camber not intersecting with a
 volute of the first volute fan or the third volute fan
 opposite to said second volute fan said air outlets
 (28,29).
5. The volute fan combination structure according to
 claim 3, wherein,
 said first volute fan (1) comprising a first volute fan
 air outlet (18) blowing air upwards;
 said third volute fan (3) comprising a third volute fan
 air outlet (39) blowing air downwards; and
 said second volute fan air outlet comprising a second
 volute fan first air outlet (28) blowing air upwards and
 a second volute fan second air outlet (29) blowing
 air downwards.
6. The volute fan combination structure according to
 claim 5, wherein,
 the inner surface (282) adjacent to said mounting
 plate (4) of said second volute fan first air outlet (28)
 representing a slope or camber, an extension of said
 slope or an extension (2821) of a tangent plane of
 the camber not intersecting with a volute of the first
 volute fan (1); and
 the inner surface (292) adjacent to said mounting
- plate (4) of said second volute fan second air outlet
 (29) representing a slope or camber, an extension
 of said slope or an extension (2921) of a tangent
 plane of the camber not intersecting with a volute of
 the third volute fan (3).
7. The volute fan combination structure according to
 claim 6, wherein,
 a first deflector (280) parallel to said mounting plate
 (4) provided at least on a wall away from said mount-
 ing plate (4) of said second volute fan first air outlet
 (28); and/or
 a second deflector (290) parallel to said mounting
 plate (4) provided at least on a wall away from said
 mounting plate (4) of second volute fan second air
 outlet (29).
8. The volute fan combination structure according to
 claim 7, wherein said first deflector (280) comprising
 a sleeve extending upwards, and said second de-
 flector (290) comprising a sleeve extending down-
 wards.
9. The volute fan combination structure according to
 claim 3, wherein said second volute fan (2) is further
 away from said mounting plate (4) than said first vo-
 lute fan (1) and said third volute fan (3) .
10. The volute fan combination structure according to
 claim 9, wherein said mounting plate (4) is provided
 with a first fan mounting portion (41), a second fan
 mounting portion (42) and a third volute fan mounting
 portion (43) for respectively mounting the first volute
 fan (1), the second volute fan (2) and the third volute
 fan (3) correspondingly, and
 wherein said second fan mounting portion is dis-
 posed such as to project towards the front of said
 mounting plate (4) and forward of said first fan mount-
 ing portion (41) and said third fan mounting portion
 (43).
11. A vertical air conditioner, comprising:
 a housing provided with a top air outlet located
 at a top thereof and a bottom air outlet located
 at a bottom thereof;
 a main body air duct provided within the housing,
 said main body air duct respectively communi-
 cating with said top air outlet and said bottom
 air outlet, and
 said volute fan combination structure according
 to claim 1, said volute fan combination structure
 is provided within said housing and blows air
 towards said top air outlet and/or said bottom air
 outlet through said main body air duct.

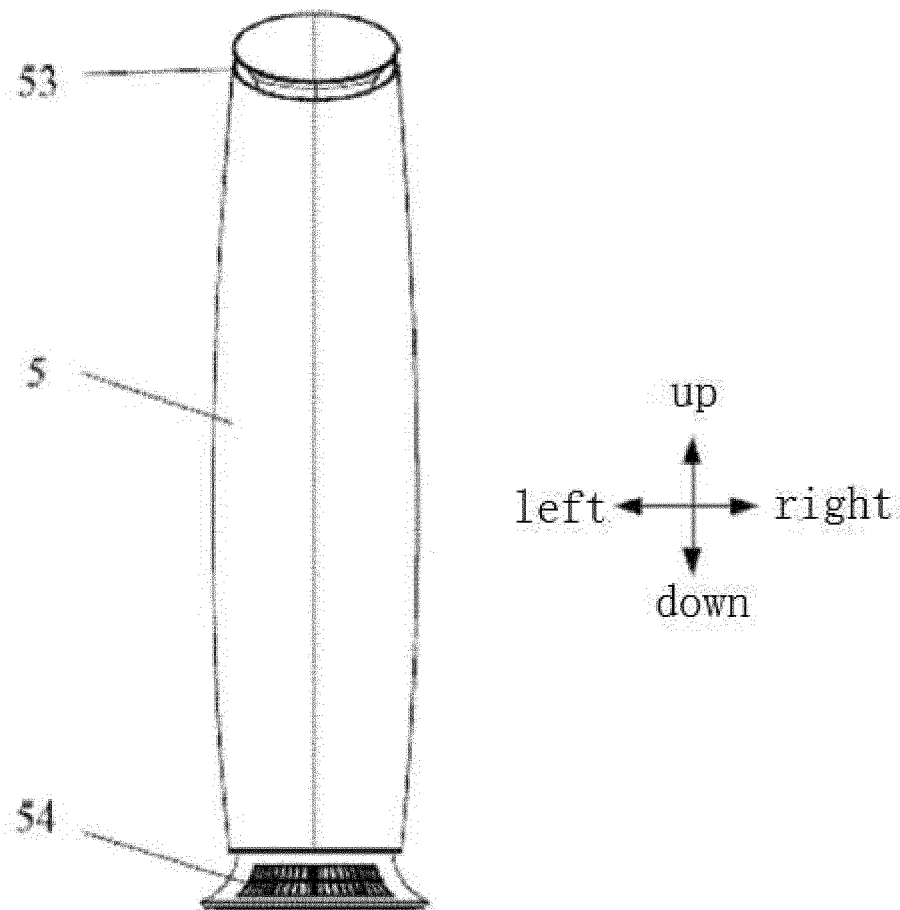


Fig1

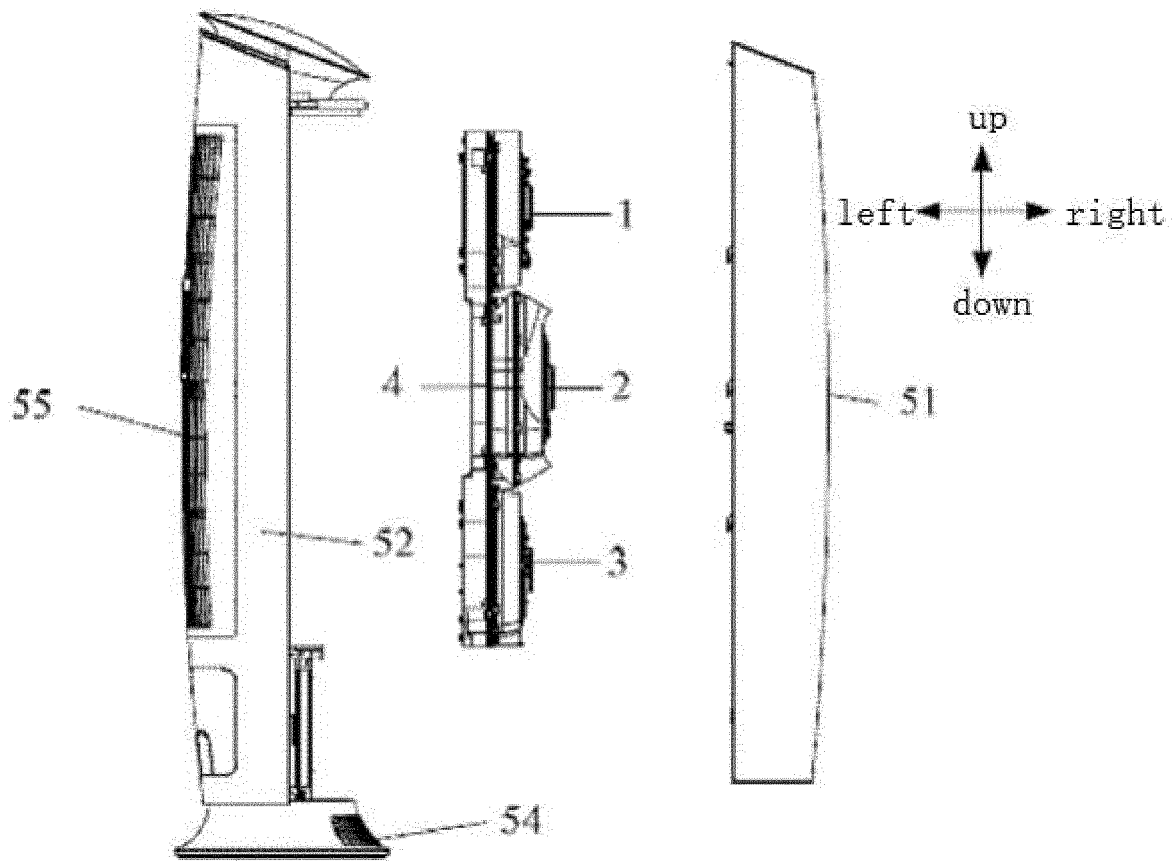


Fig2

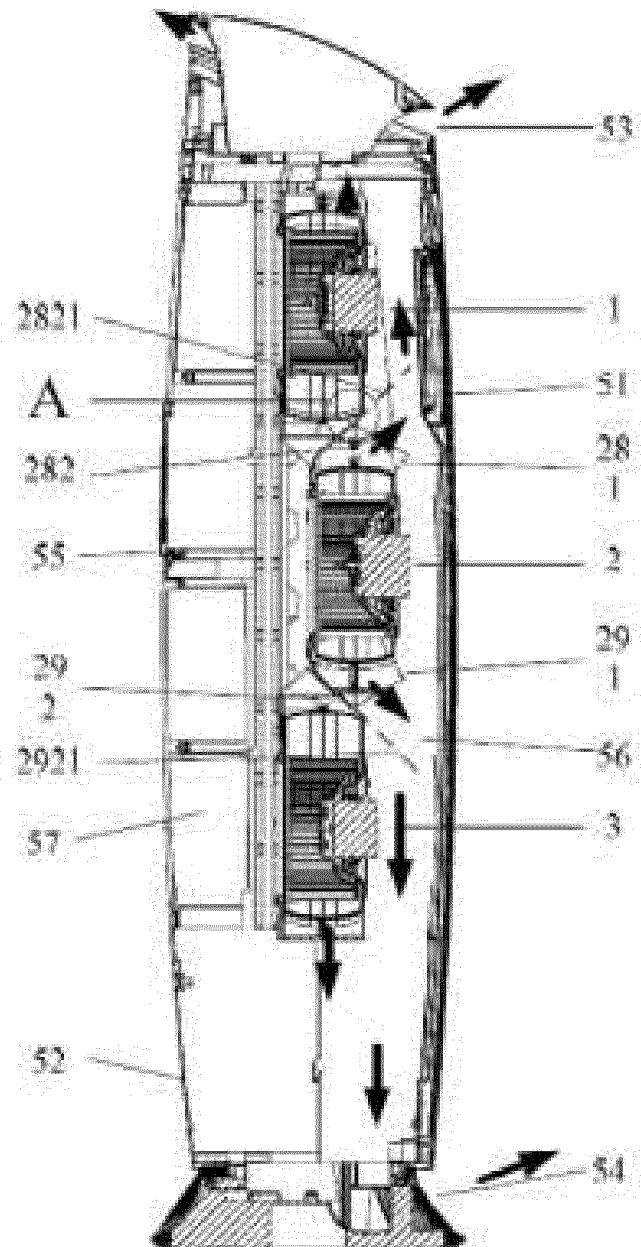


Fig3A

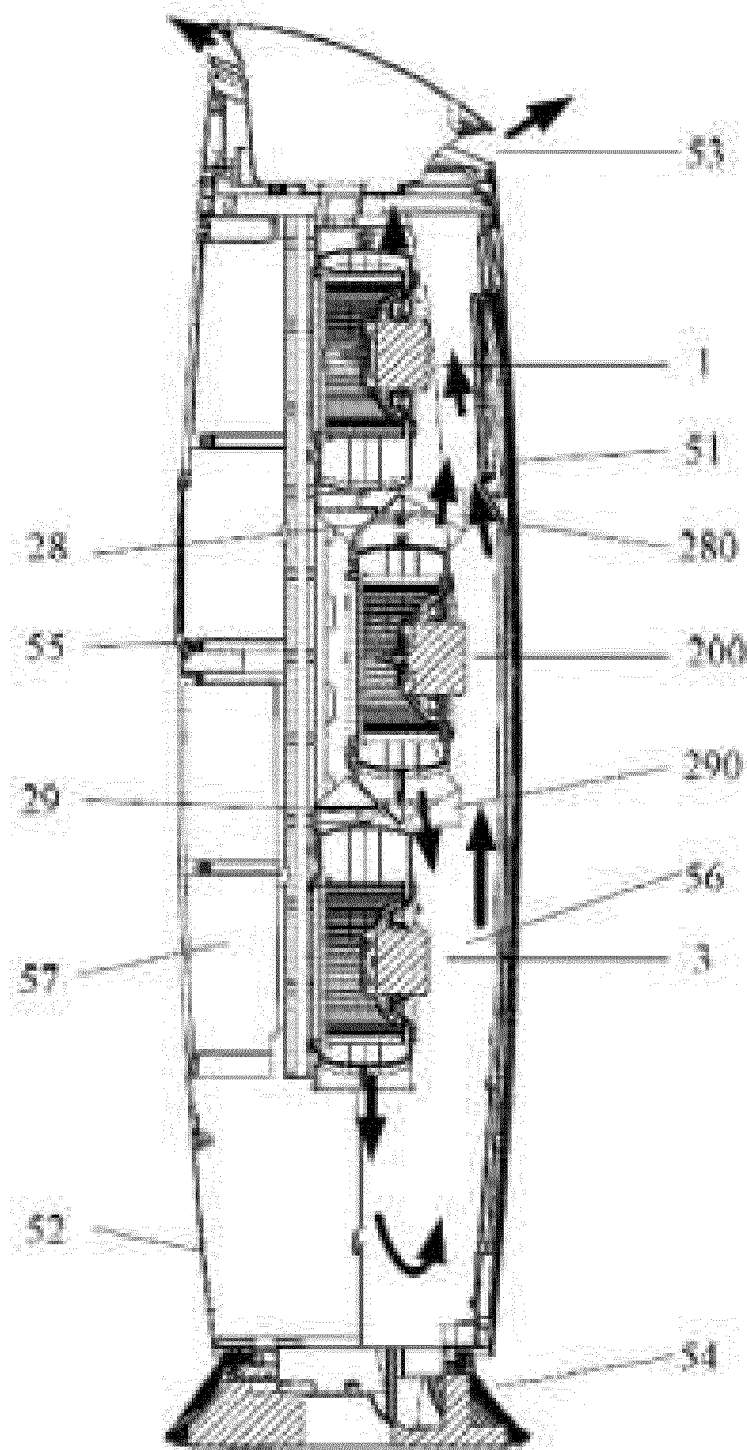


Fig3B

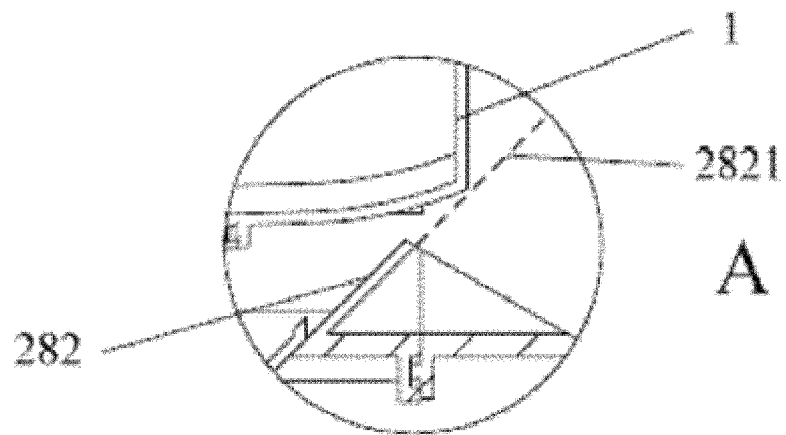


Fig4

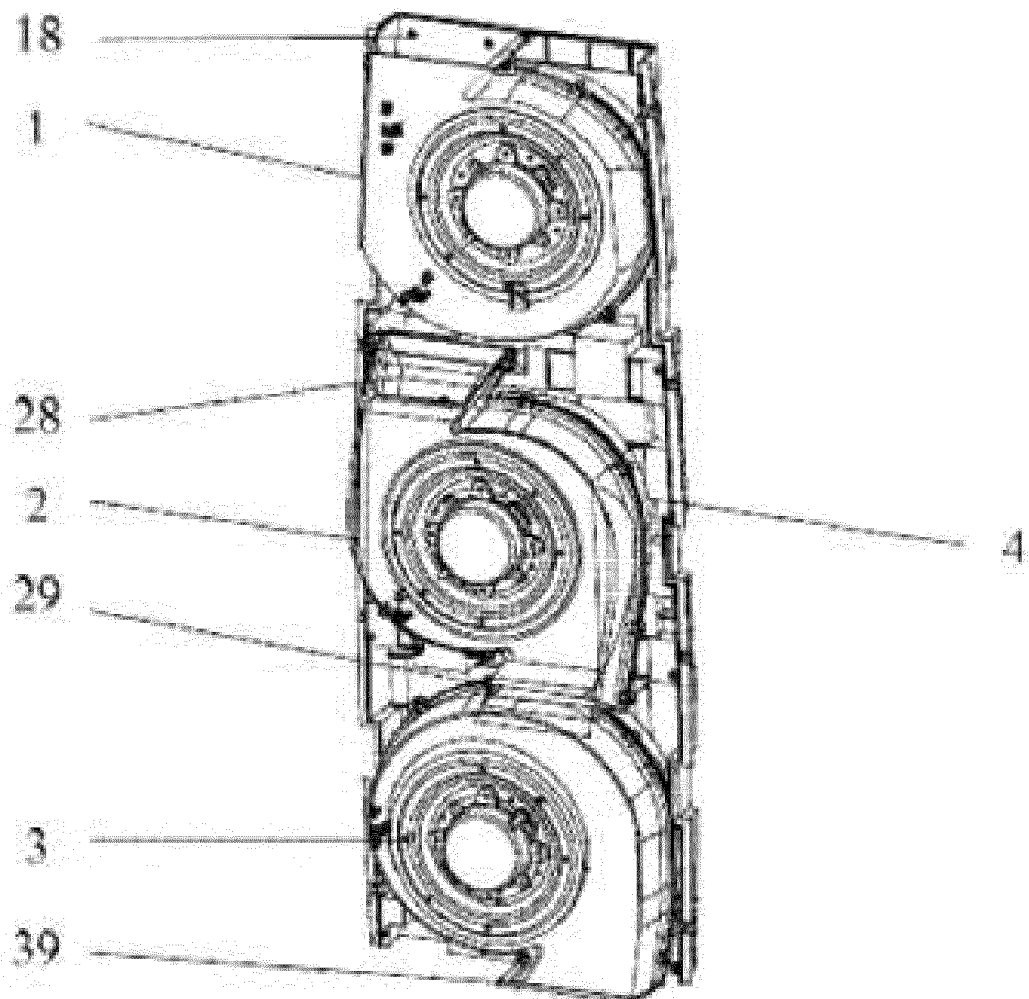


Fig5

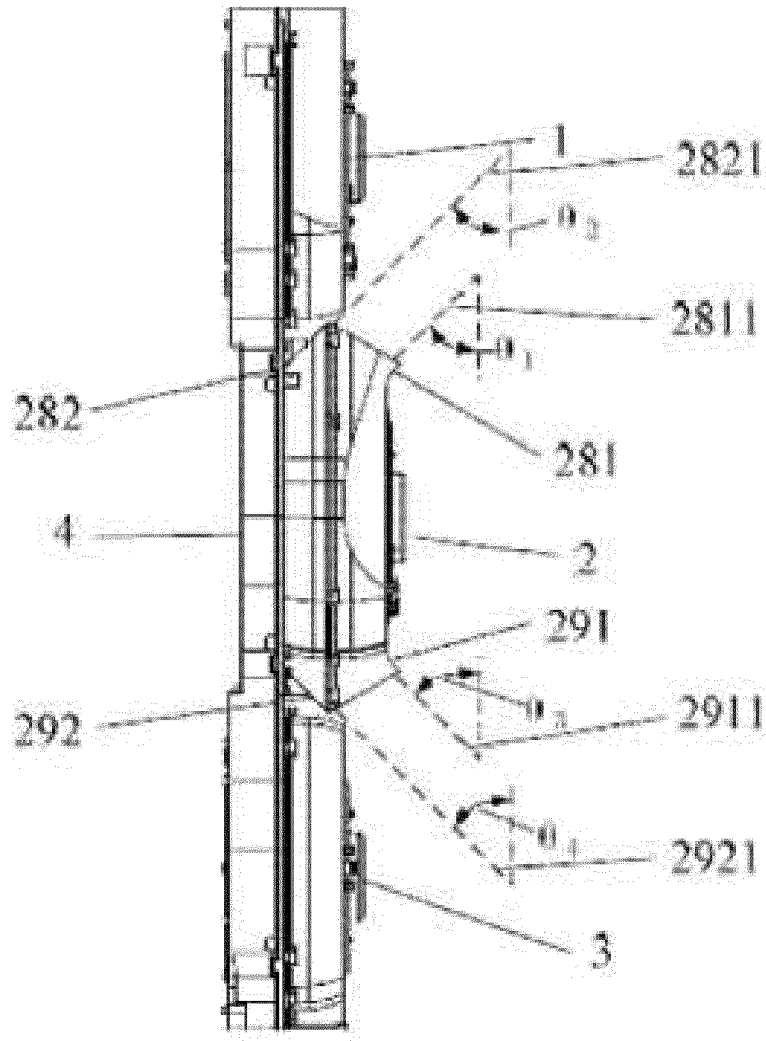


Fig6

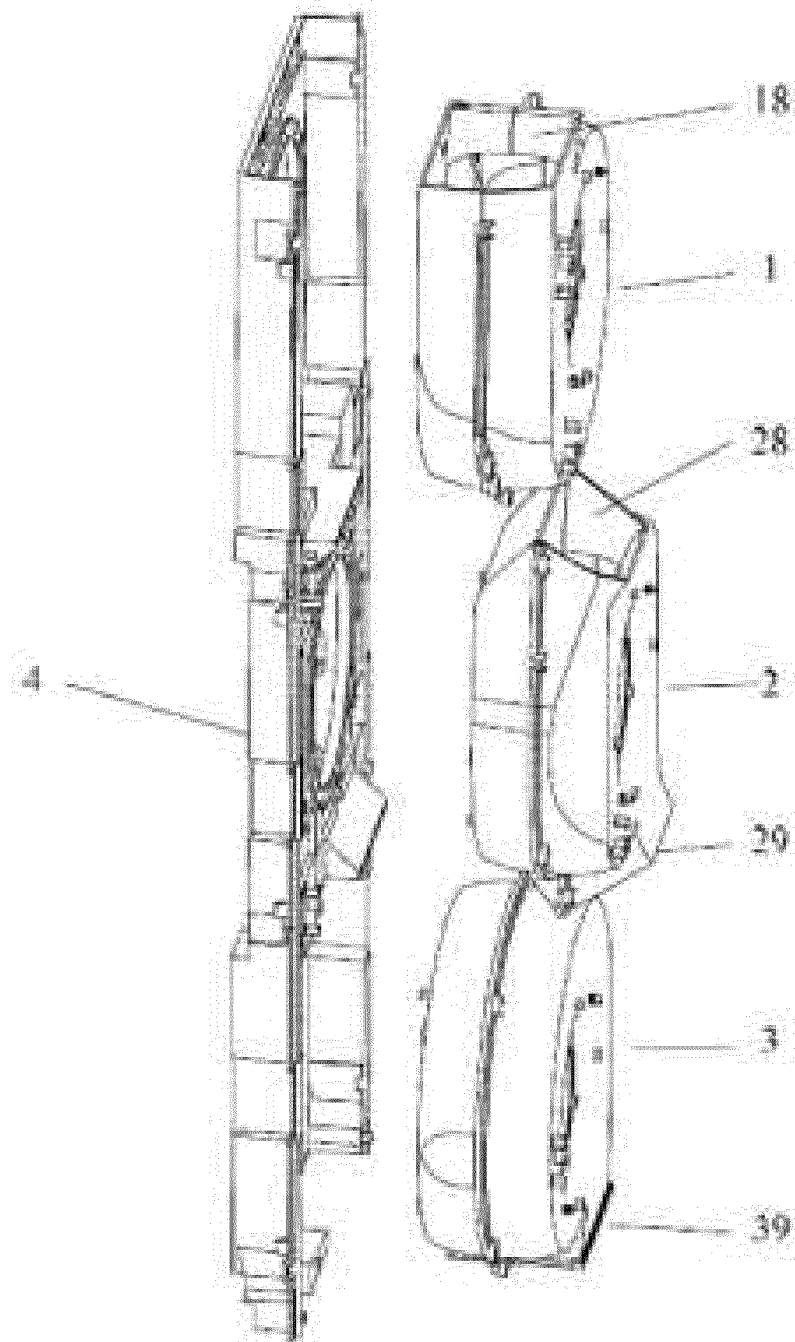


Fig7

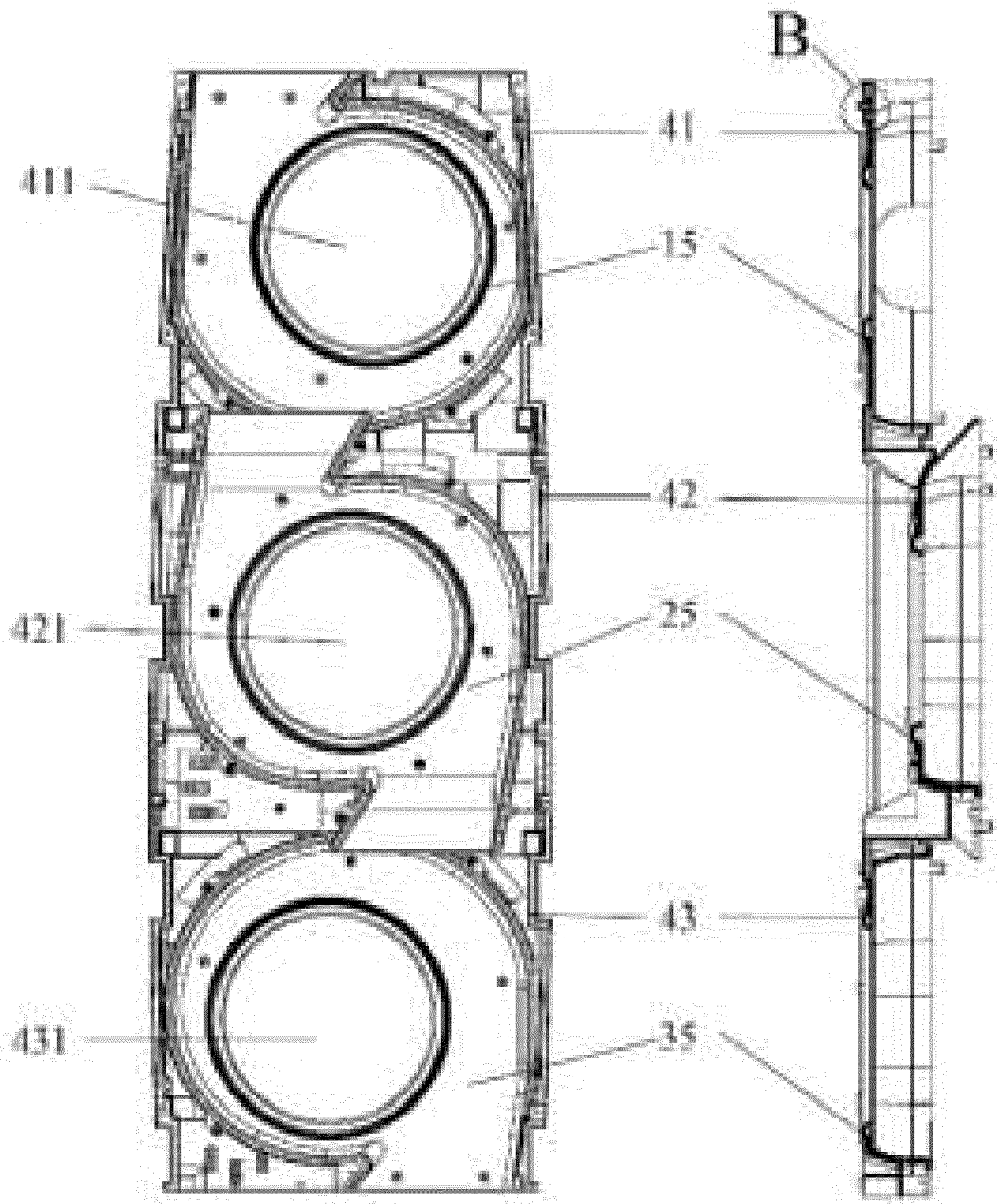


Fig8

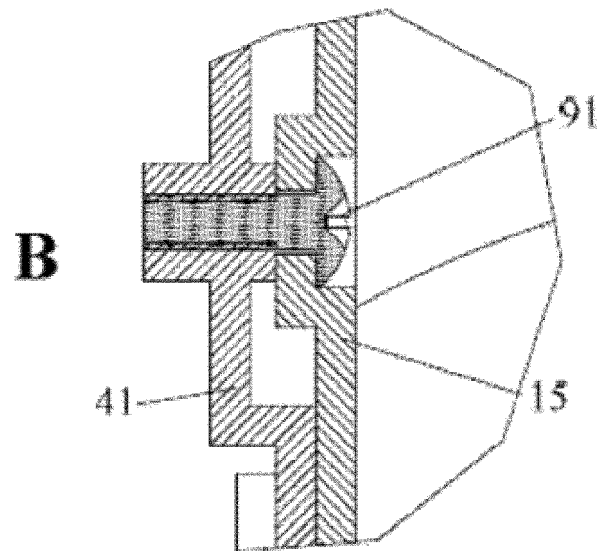


Fig8B

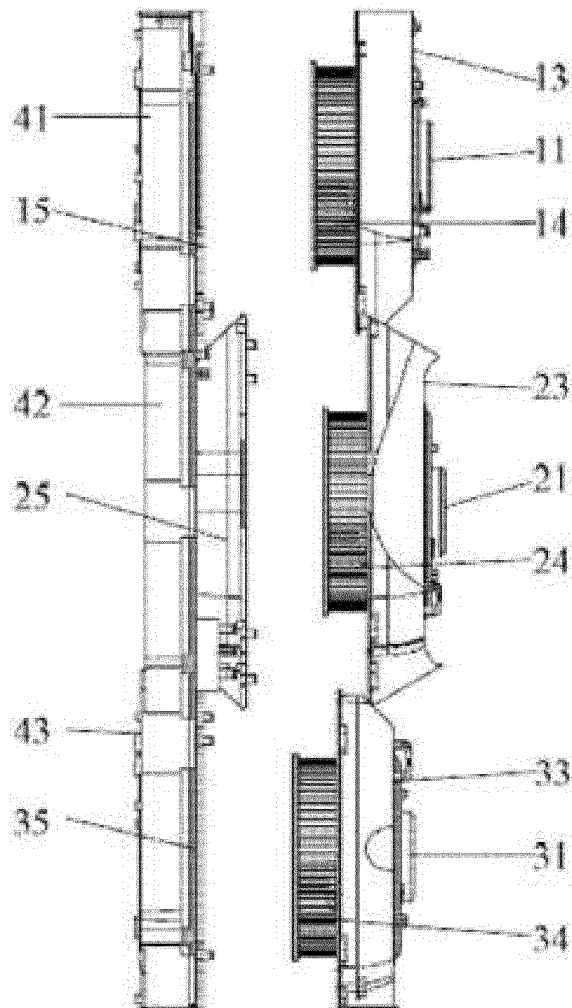


Fig9

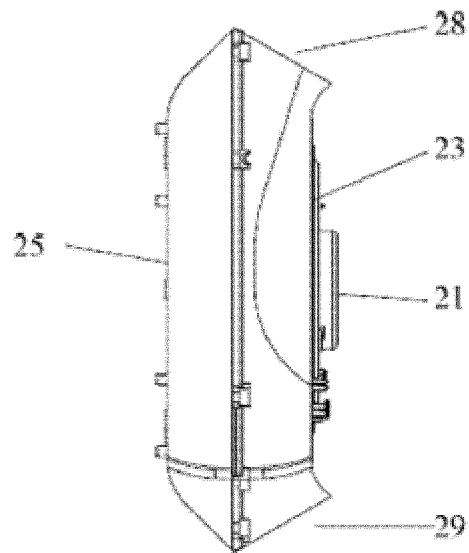


Fig10

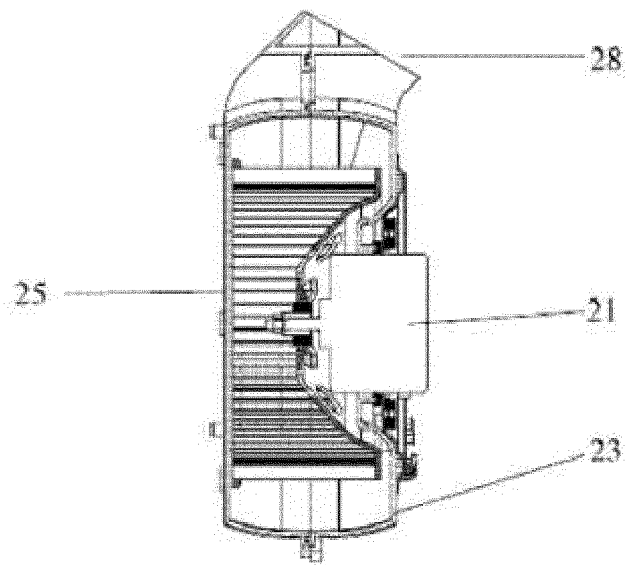


Fig11

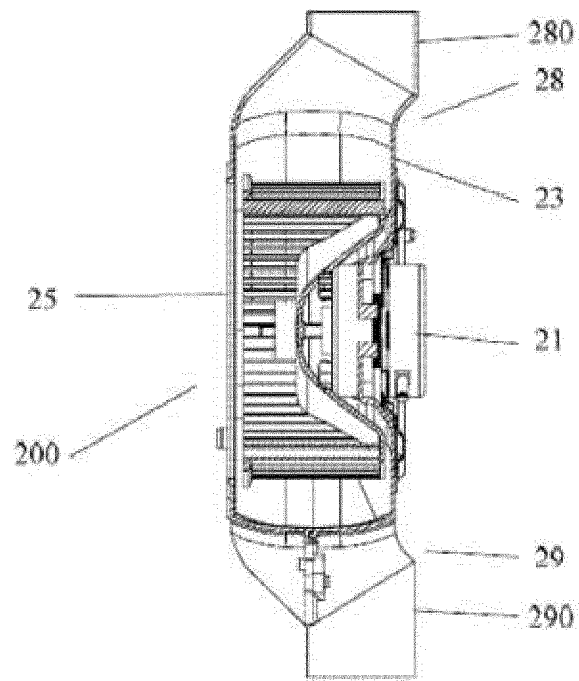


Fig12

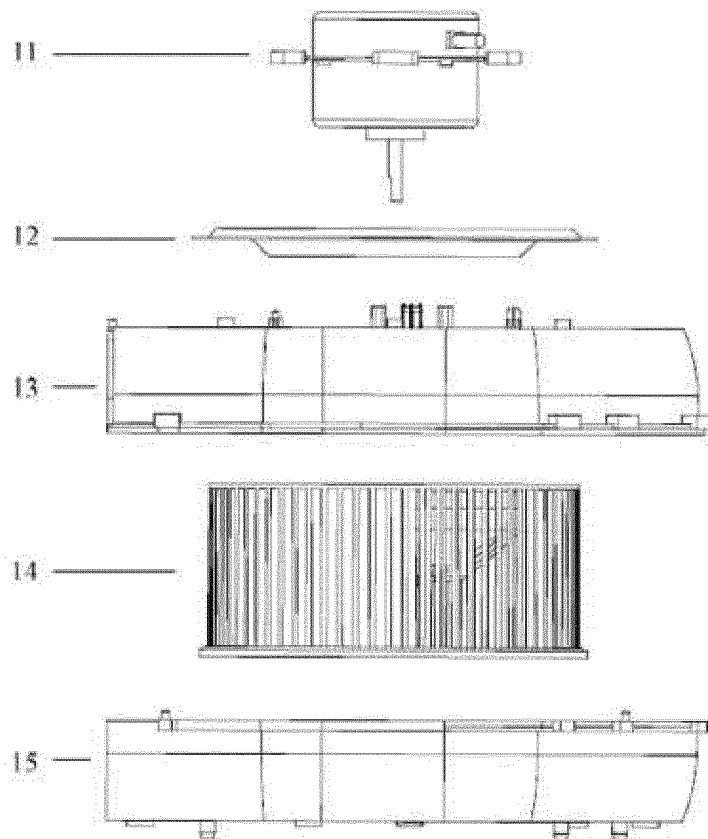


Fig13

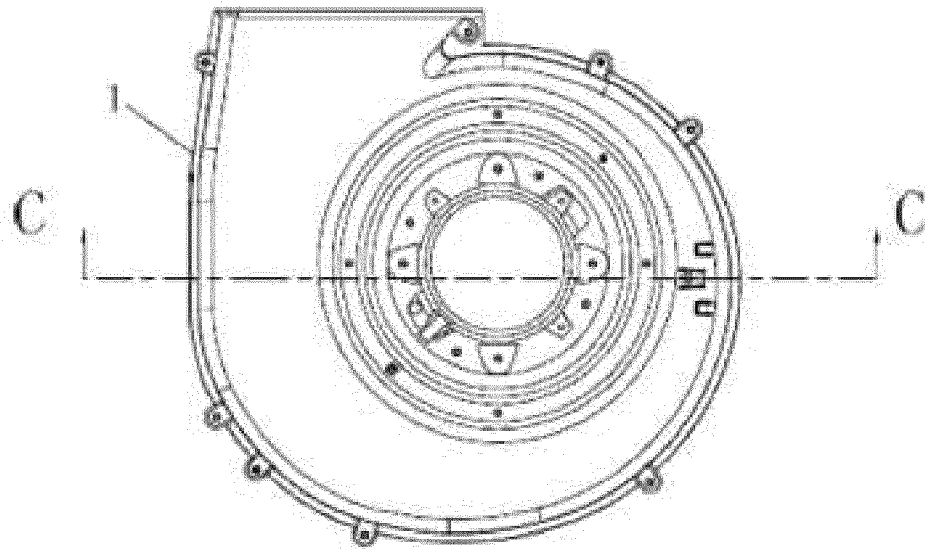


Fig14

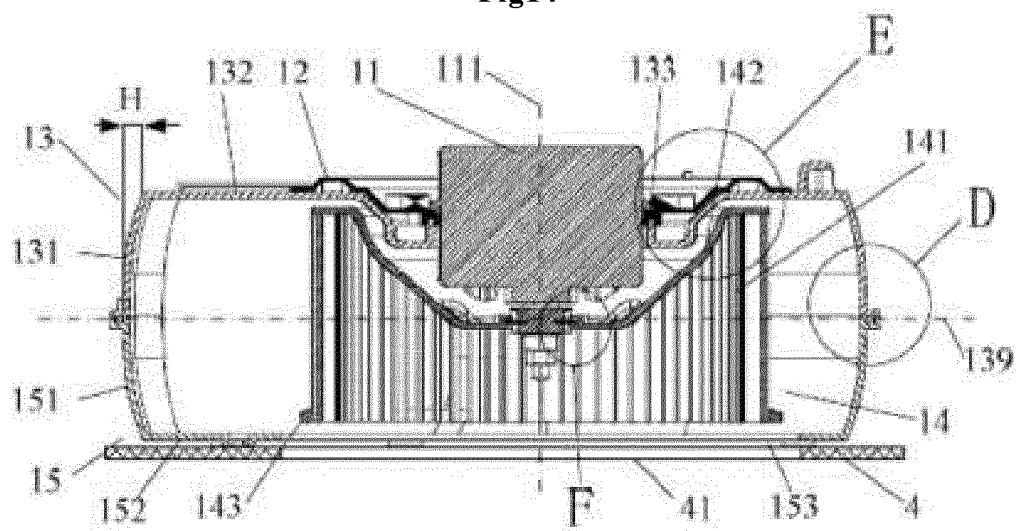


Fig15

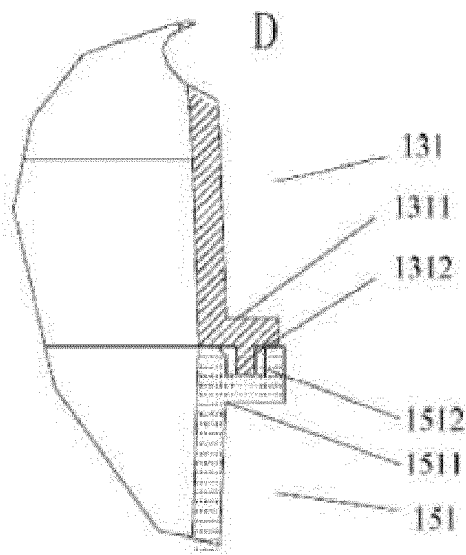


Fig16

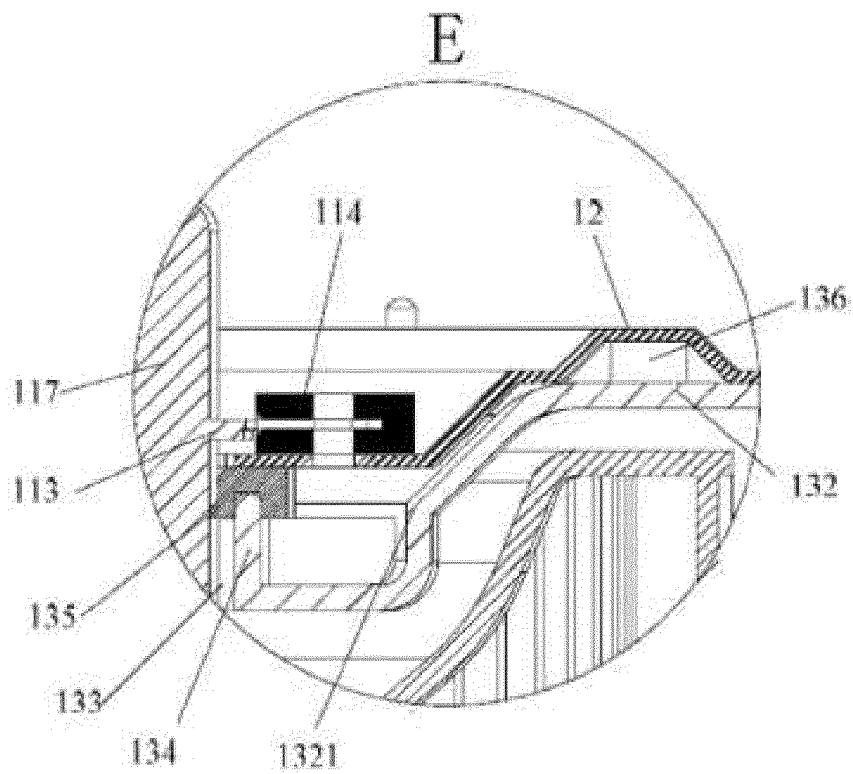


Fig17

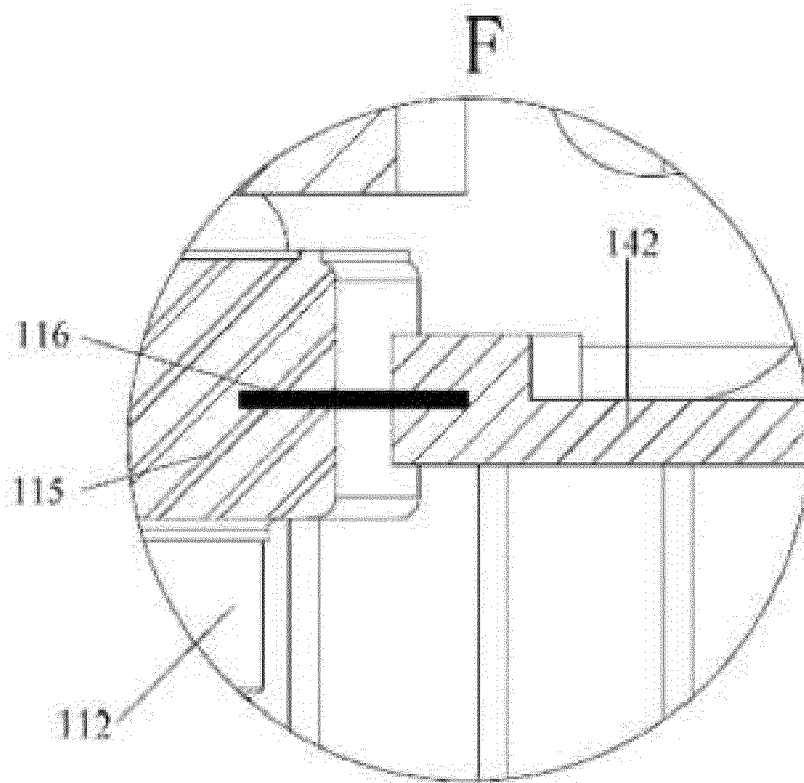


Fig18

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/098203

A. CLASSIFICATION OF SUBJECT MATTER

F04D 25/08 (2006.01) i; F04D 25/16 (2006.01) i; F04D 29/42 (2006.01) i; F04D 29/44 (2006.01) i; F04D 29/66 (2006.01) i; F24F 1/00 (2011.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04D, F24F

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)

CNABS; SIPOABS; CNTXT; VEN: volute, dislocation, stagger, protrude, scroll, fan, incline, disturb+, offset, protrus+, tower

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011308777 A1 (O'CONNOR, J.F. et al.), 22 December 2011 (22.12.2011), description, paragraph 0031, and figure 6	1, 10
PX	CN 105156345 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 16 December 2015 (16.12.2015), claims 1-10, and figures 1-18	1-10
PX	CN 205047468 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 24 February 2016 (24.02.2016), description, paragraphs 0046-0086, and figures 1-18	1-10
PX	CN 105156344 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 16 December 2015 (16.12.2015), description, paragraphs 0046-0087, and figures 1-18	1-10
PX	CN 205047467 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 24 February 2016 (24.02.2016), description, paragraphs 0046-0086, and figures 1-18	1-10
PX	CN 105179273 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 23 December 2015 (23.12.2015), description, paragraphs 0046-0086, and figures 1-18	1-10
PX	CN 205089654 U (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI), 16 March 2016 (16.03.2016), description, paragraphs 0046-0086, and figures 1-18	1-10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 17 November 2016 (17.11.2016)	Date of mailing of the international search report 12 December 2016 (12.12.2016)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer CHEN, Lili Telephone No.: (86-10) 62085258

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/098203

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101813096 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 25 August 2010 (25.08.2010), the whole document	1-10
A	CN 101929712 A (LG ELECTRONICS (TIANJIN) APPLIANCES CO., LTD.), 29 December 2010 (29.12.2010), the whole document	1-10
A	US 7059826 B2 (LASKO HOLDINGS INC.), 13 June 2006 (13.06.2006), the whole document	1-10
A	US 6830433 B2 (KAZ INC.), 14 December 2004 (14.12.2004), the whole document	1-10
A	CN 104612990 A (ZHEJIANG SCI-TECH UNIVERSITY), 13 May 2015 (13.05.2015), the whole document	1-10

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/098203

5	Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
	US 2011308777 A1	22 December 2011	WO 2011160047 A1	22 December 2011
			DE 112011102067 T5	02 May 2013
10	CN 105156345 A	16 December 2015	None	
	CN 205047468 U	24 February 2016	None	
	CN 105156344 A	16 December 2015	None	
	CN 205047467 U	24 February 2016	None	
15	CN 105179273 A	23 December 2015	None	
	CN 205089654 U	16 March 2016	None	
	CN 101813096 A	25 August 2010	None	
	CN 101929712 A	29 December 2010	None	
20	US 7059826 B2	13 June 2006	US 2005019155 A1	27 January 2005
	US 6830433 B2	14 December 2004	US 2004022631 A1	05 February 2004
	CN 104612990 A	13 May 2015	None	
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201510579262 [0001]