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(54) AIR CONDITIONER OUTDOOR UNIT

(57) An air conditioner outdoor unit, comprising a housing (1), a heat exchanger (2), a fan wheel (33), an electric motor (32) and a support (31), wherein the housing (1) is provided with a first cavity (11) and an air outlet (12) in communication with the first cavity (11); the heat exchanger (2) is arranged in the first cavity (11) and connected to the housing (1); in a horizontal direction, the heat exchanger (2) comprises a first portion (21) and a second portion (22) which are opposite each other, a minimum distance S being provided between the first portion (21) and the second portion (22); the support (31) is arranged in the first cavity (11), is connected to the housing (1), and is located above the heat exchanger (2); the electric motor (32) is in the first cavity (11) and is arranged on the support (31); the fan wheel (33) is in the first cavity (11), is connected to the electric motor (32), and has a diameter of D; and a first portion (311) of the support (31) is opposite the heat exchanger (2) in a vertical direction, the minimum distance between the first portion (311) and the heat exchanger (2) in the vertical direction is L1, and when $S < D$, $0 \leq L1 \leq 0.15D$. By means of the structure, air volume loss and aerodynamic noise caused by improper matching between the heat exchanger (2) and the support (31) can be reduced, such that the heat exchange performance is improved.

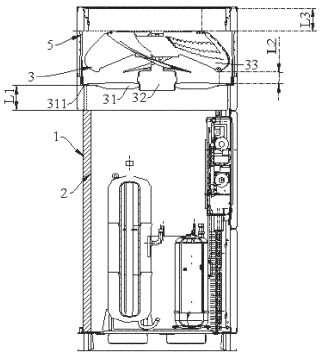

Fig. 2

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and benefits of Chinese Patent Application Serial No. 202022893868.2 filed on December 3, 2020, the entire content of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of heat exchange of air conditioners, and more particularly, to an air conditioner outdoor unit.

BACKGROUND

[0003] In the related art, for an air conditioner outdoor unit, a fan module is arranged above a heat exchanger and includes a fan wheel, a motor, a bracket, and an air guide ring, and a mesh cover is mounted at an upper opening of a housing of the air conditioner outdoor unit to ensure the safety of the fan module.

[0004] The air conditioner outdoor unit is required to maintain low operating noise and high aerodynamic efficiency while ensuring high air volume. However, improper designs of heat exchangers, fan wheels, motors, brackets, air guide rings and mesh covers in the related art may easily lead to air volume loss and aerodynamic noise.

SUMMARY

[0005] The present disclosure seeks to solve at least one of the problems existing in the related art at least to a certain extent.

[0006] To this end, embodiments of the present disclosure propose an air conditioner outdoor unit, which can reduce air volume loss and aerodynamic noise caused by improper coordination among heat exchangers, fan wheels, motors, brackets, air guide rings and mesh covers, and improve heat transfer performance.

[0007] An air conditioner outdoor unit according to embodiments of the present disclosure includes: a housing including a first cavity and an air outlet in communication with the first cavity; a heat exchanger in the first cavity, in which in a horizontal direction, the heat exchanger includes a first portion and a second portion opposite to each other, and a minimum distance between the first portion and the second portion is S; and a fan assembly. The fan assembly includes: a bracket arranged in the first cavity and above the heat exchanger, and connected to the housing; a motor in the first cavity and on the bracket; and a fan wheel arranged in the first cavity and connected to the motor, and having a diameter of D. A first part of the bracket is opposite to the heat exchanger in an up-down direction, a minimum distance between the first part of the bracket and the heat exchanger in the up-down direction is L1 that satisfies: $0 \le L1 \le 0.15D$ when $S < D$.

[0008] The air conditioner outdoor unit according to embodiments of the present disclosure includes the housing, the heat exchanger and the fan assembly. Both the heat exchanger and the fan assembly are arranged in the housing. The heat exchanger includes the first portion and a second portion opposite to each other in the horizontal direction, and there is the minimum distance S between the first portion and the second portion. The fan assembly includes the bracket, the motor on the bracket, and the fan wheel connected to the motor. The diameter of the fan wheel is D. A part of the bracket is right above the heat exchanger, and a minimum distance between this part of the bracket and a top end of the heat exchanger is L1 that satisfies: $0 \le L1 \le 0.15D$ when $S < D$. When the minimum distance L1 between this part of the bracket and the top end of the heat exchanger satisfies: $0 \le L1 \le 0.15D$, cold air in the housing will not be subject to speed loss when flowing to the outside. As a result, the air exhaust volume and efficiency of the fan wheel can be improved, and the noise of the fan wheel can be reduced.

[0009] In some embodiments, L1 satisfies $0 \le L1 \le 0.05D$ when $S \ge D$. 3. The air conditioner outdoor unit according to claim 1, in which a minimum distance between the fan wheel and the bracket in the up-down direction is L2 that satisfies $A1 \le L2 \le A1 + 50$ mm, in which A1 is a first preset value.

[0010] In some embodiments, 20 mm $\le$ A1 $\le$ 55 mm.

[0011] In some embodiments, the air conditioner outdoor unit further includes a mesh cover. The air outlet is at an upper end of the housing, the fan wheel is opposite to the air outlet in the up-down direction, the mesh cover is arranged at the air outlet and connected to the housing, and a blockage ratio σ of the mesh cover satisfies: $0.12 \le \sigma \le 0.15$.

[0012] In some embodiments, σ satisfies: $0.133 \le \sigma \le 0.137$; and the fan cover includes: a plurality of first ribs, a plurality of second ribs, a plurality of third ribs, and a plurality of fourth ribs. The plurality of first ribs are parallel to each other and spaced apart along a first horizontal direction. The plurality of second ribs are parallel to each other and spaced apart along a second horizontal direction. Each of the plurality of first ribs is perpendicular to each of the plurality of second ribs, and each of the plurality of first ribs and each of the plurality of second ribs cross and form a grid. Each of the plurality of third ribs are between two adjacent first ribs in the first horizontal direction, and each of the plurality of third ribs are parallel to each of the plurality of first ribs and perpendicular to each of the plurality of second ribs. Each of the plurality of fourth ribs are between two adjacent second ribs in the second horizontal direction, and each of the plurality of fourth ribs is parallel to each of the plurality of second ribs and perpendicular to each of the plurality of first ribs. Each of the first ribs and the second ribs has a diameter greater than or equal to 5 mm and less than 7 mm, and

each of the third ribs and the fourth ribs has a diameter greater than or equal to 2 mm and less than 3 mm.

[0013] In some embodiments, a minimum distance between the fan wheel and the mesh cover in the up-down direction is L3 that satisfies $A2 \leq L3 \leq 150$ mm, in which A2 is a second preset value.

[0014] In some embodiments, $A2 \geq 90$ mm.

[0015] In some embodiments, the air conditioner outdoor unit further includes an air guide ring in the first cavity. The air guide ring is connected to the housing and is fitted over the fan wheel, an upper end of the air guide ring is above an upper end of the fan wheel, and a minimum distance between the air guide ring and the fan wheel in a radial direction of the fan wheel is L4 that satisfies: $0 < L4 \leq 0.02D$.

[0016] In some embodiments, L4 satisfies: $0.013D \leq L4 \leq 0.017D$.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

Fig. 1 is a perspective view of an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 2 is a front view of an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 3 is a top view of an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 4 is another top view of an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 5 is a perspective view of a heat exchanger in an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 6 is a schematic view of a mesh cover in an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 7 is a schematic view of a mesh cover in an air conditioner outdoor unit according to another embodiment of the present disclosure.

Fig. 8 illustrates a linear relationship between L1 and an air exhaust volume in an air conditioner outdoor unit according to an embodiment of the present disclosure.

Fig. 9 illustrates a linear relationship between L1 and noise in an air conditioner outdoor unit according to an embodiment of the present disclosure.

Reference numerals:

[0018] air conditioner outdoor unit 100, housing 1, heat exchanger 2, first portion 21, second portion 22, third portion 23, fan assembly 3, bracket 31, first part 311, motor 32, fan wheel 33, mesh cover 4, first rib 41, second rib 42, third rib 43, fourth rib 44, air guide ring 5.

DETAILED DESCRIPTION

[0019] Embodiments of the present disclosure will be described below in detail, and examples of the embodiments are illustrated in the accompanying drawings. 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. In the specification of the present disclosure, it is to be understood that terms such as "central," "longitudinal," "transverse," "length," "width," "thickness," "upper," "lower," "front," "rear," "left," "right," "vertical," "horizontal," "top," "bottom," "inner," "outer," "clockwise," "counterclockwise," "axial," "radial," "circumferential" and the like should be construed to refer to orientations or positions as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not indicate or imply that the device or element referred to must have a particular orientation or be constructed or operated in a particular orientation. Thus, these terms shall not be construed as limitations on the present disclosure.

[0020] As shown in Figs. 1-7, an air conditioner outdoor unit 100 according to embodiments of the present disclosure includes a housing 1, a heat exchanger 2, and a fan assembly 3. The housing 1 includes a first cavity 11 and an air outlet 12 in communication with the first cavity 11.

[0021] The heat exchanger 2 is arranged in the first cavity 11, and the heat exchanger 2 is connected to a peripheral wall and a bottom plate of the housing 1. In a horizontal direction, the heat exchanger 2 includes a first portion 21 (e.g., a left portion of the heat exchanger 2 in Fig. 5) and a second portion 22 (e.g., a right portion of the heat exchanger 2 in Fig. 5) opposite to each other, and a minimum distance between the first portion 21 and the second portion 22 is denoted as S.

[0022] The fan assembly 3 includes a fan wheel 33, a motor 32 and a bracket 31. The bracket 31 is arranged in the first cavity 11 and connected to the housing 1; the bracket 31 is above the heat exchanger 2; the motor 32 is in the first cavity 11 and is arranged on the bracket 31; and the fan wheel 33 is in the first cavity 11 and is connected to the motor 32, and a diameter of the fan wheel 33 is denoted as D.

[0023] A first part 311 of the bracket 31 is opposite to the heat exchanger 2 in an up-down direction, that is, the first part 311 of the bracket 31 is right above the heat exchanger 2. A minimum distance between the first part 311 of the bracket 31 and the heat exchanger 2 in the up-down direction is denoted as L1 that satisfies $0 \leq L1 \leq 0.15D$ when $S < D$.

[0024] The minimum distance S is a minimum value among all distances from any point on the first portion 21 to any point on the second portion 22. The minimum distance L1 is a minimum value among all distances from any point on the heat exchanger 2 to any point on the first part 311 of the bracket 31.

[0025] Outside air exchanges heat with the heat exchanger 2 after entering the first cavity 11. The air is discharged from the first cavity 11 under the action of the fan wheel 33, after undergoing heat exchange. The air conditioner outdoor unit 100 according to the embodiments of the present disclosure makes $0 \leq L1 \leq 0.15D$, so that the air after the heat exchange does not suffer from speed loss when flowing through the fan wheel 33 and the bracket 31 (the fan assembly 3), allowing for high air exhaust volume and efficiency of the fan wheel 33, and effectively reducing the noise of the fan wheel 33.

[0026] Therefore, the air conditioner outdoor unit 100 according to the embodiments of the present disclosure has the advantages of high air exhaust volume and low noise.

[0027] As shown in Figs. 1-7, the air conditioner outdoor unit 100 includes a housing 1, a heat exchanger 2, and a fan assembly 3.

[0028] As shown in Fig. 1, the housing 1 is substantially shaped as a rectangular parallelepiped, and the housing 1 includes a bottom plate, a top plate, a left plate, a right plate, a front plate and a rear plate. A cross section of the first cavity 11 is substantially square. The heat exchanger 2 is substantially U-shaped, and the heat exchanger 2 includes a first portion 21, a second portion 22 and a third portion 23. The first portion 21 and the second portion 22 are opposite to each other in a left-right direction, and the third portion 23 is connected between the first portion 21 and the second portion 22. The heat exchanger 2 is arranged in the first cavity 11. The first portion 21 is connected to the left plate of the housing 1, the second portion 22 is connected to the right plate of the housing 1, and the third portion 23 is connected to the front plate (or the rear plate) of the housing 1. Respective lower ends of the first portion 21, the second portion 22, and the third portion 23 are all connected to the bottom plate of the housing 1.

[0029] An inner surface of the first portion 21 and an inner surface of the second portion 22 are substantially parallel, and a minimum distance between the inner surface of the first portion 21 and the inner surface of the second portion 22 is S. The inner surface of the first portion 21 refers to a surface of the first portion 21 adjacent to a middle part of the first cavity 11, that is, the inner surface of the first portion 21 refers to a surface of the first portion 21 adjacent to the second portion 22 in the horizontal direction. The inner surface of the second portion 22 refers to a surface of the second portion 22 adjacent to the middle part of the first cavity 11, that is, the inner surface of the second portion 22 refers to a surface of the second portion 22 adjacent to the first portion 21 in the horizontal direction.

[0030] For example, when the first portion 21 is opposite to the second portion 22 in the right-left direction, the inner surface of the first portion 21 is a right surface of the first portion 21, and the inner surface of the second portion 22 is a left surface of the second portion 22.

[0031] It can be understood that the cross section of the first cavity 11 is substantially square, and an inner surface of the third portion 23 refers to a surface of the third portion 23 adjacent to the middle part of the first cavity 11. The inner surface of the third portion 23 is substantially parallel to a front surface (or a rear surface) of the housing 1, and a minimum distance between the inner surface of the third portion 23 and the front surface (or the rear surface) of the housing 1 is denoted as Sa. That is, Sa is greater than S, and the minimum distance Sa is a minimum value among all distances from any point on the third portion 23 to any point on the front surface of the housing 1.

[0032] In the air conditioner outdoor unit 100 of the present disclosure, the peripheral wall of the housing, which is connected to the heat exchanger 2, includes a ventilation hole, and hot air from the outside enters the housing 1 through the ventilation hole on the housing 1 and exchanges heat with the heat exchanger 2. The air after the heat exchange flows upward to the fan assembly 3 and is discharged out of the first cavity 11 under the action of the fan wheel 33.

[0033] The bracket 31 is substantially square, and the bracket 31 is arranged in the first cavity 11 and above the heat exchanger 2. The first part 311 of the bracket 31 (i.e., an edge part of the bracket 31) is right above the heat exchanger 2, and a minimum distance between the first part 311 of the bracket 31 and a top end of the heat exchanger 2 is L1 that satisfies $0 \leq L1 \leq 0.15D$ when $S < D$.

[0034] The outside air exchanges heat with the heat exchanger 2 after entering the first cavity 11. The air is discharged from the first cavity 11 under the action of the fan wheel 33, after undergoing the heat exchange. The air conditioner outdoor unit 100 according to the embodiments of the present disclosure makes $0 \leq L1 \leq 0.15D$, so that the air after the heat exchange does not suffer from speed loss when flowing through the fan wheel 33 and the bracket 31 (the fan assembly 3), allowing for high air exhaust volume and efficiency of the fan wheel 33, and effectively reducing the noise of the fan wheel 33.

[0035] In some embodiments, as shown in Fig. 2, L1 satisfies $0 \leq L1 \leq 0.05D$ when $S \geq D$, and the air outside enters the first cavity 11 and exchanges heat with the heat exchanger 2. The air is discharged from the first cavity 11 under the action of the fan wheel 33, after undergoing the heat exchange. The air conditioner outdoor unit 100 according to the embodiments of the present disclosure makes $0 \leq L1 \leq 0.05D$, so that the air after the heat exchange does not suffer from speed loss when flowing through the fan wheel 33 and the bracket 31 (the fan assembly 3), allowing for high air exhaust volume and efficiency of the fan wheel 33, and effectively reducing the noise of the fan wheel 33.

[0036] As shown in Figs. 8-9, in the outdoor unit 100 according to a specific embodiment, the relationship between L1 and the air exhaust volume and noise is as follows:

The air exhaust volume gradually increases and the noise gradually decreases, as L1 gradually increases.

[0037] In some embodiments, as shown in Fig. 2, a minimum distance between the fan wheel 33 and the bracket 31 in the up-down direction is L2, and the minimum distance L2 is a minimum value among all distances from any point on the fan wheel 33 to any point on the bracket 31. L2 satisfies: A1≤L2≤A1+50 mm, in which A1 is a first preset value. As a result, there is enough space for an airflow between the fan wheel 33 and the bracket 31 to dissipate, that is, there is enough space between the fan wheel 33 and the bracket 31 for the air after the heat exchange to dissipate, thereby effectively reducing the noise generated by interaction between the airflow and the fan wheel 33. Meanwhile, a gap between the fan wheel 33 and the bracket 31 is also conducive to improving the air exhaust volume of the fan wheel 33, so that even if the fan wheel 33 vibrates or deflects during rotation, the fan wheel 33 will not collide with the bracket 31, which ensures the safe operation of the fan wheel 33.

[0038] In some embodiments, 20 mm≤A1≤55 mm.

[0039] When A1= 20 mm, 20 mm≤L2≤70 mm. That is, the minimum distance from the fan wheel 33 to the bracket 31 is 20 mm, so that even if the fan wheel 33 vibrates and deflects during the rotation, the fan wheel 33 will not collide with the bracket 31, which ensures the safer operation of the fan wheel 33. In the up-down direction, a maximum vertical distance from the lowest point on the fan wheel 33 to the bracket 31 is 70 mm, such that an overall height of the motor assembly 3 is effectively reduced, an installation space for the motor assembly 3 is saved, and the production cost of the air conditioner outdoor unit 100 is lowered, while the safe operation of the fan wheel 33 is ensured.

[0040] When A1= 55 mm, 55 mm≤L2≤125 mm. That is, the minimum vertical distance from the lowest point on the fan wheel 33 to the bracket 31 is 55 mm, so that there is enough space for the airflow between the fan wheel 33 and the bracket 31 to dissipate, and the noise generated by the interaction between the airflow and the fan wheel 33 is effectively reduced.

[0041] Preferably, a cross section of the bracket 31 in the up-down direction may be designed as a circle, an ellipse, a semi-circle or an arc, in which an arc portion protrudes downward, that is, an arc surface corresponds to a discharge direction of cold air. Consequently, the blockage of the cold air by the bracket 31 can be reduced, and the flow speed of the cold air remains unchanged, which helps to improve the air exhaust efficiency of the air conditioner outdoor unit 100.

[0042] In some embodiments, as shown in Figs. 1-7, the air conditioner outdoor unit 100 further includes a mesh cover 4; the air outlet 12 is at an upper end of the housing 1, for example, at a top plate of the housing 1; the fan wheel 33 is opposite to the air outlet 12 in the up-down direction, that is, the fan wheel 33 is in the first cavity 11, and the fan wheel 33 is right below the air outlet 12.

[0043] The mesh cover 4 is arranged at the air outlet 12 and connected to the housing 1, a blockage ratio of the mesh cover 4 is σ that satisfies: $0.12 \leq \sigma \leq 0.15$, in which σ is defined as $\sigma = (S1 - S2) \div S1$, in which S1 represents a frame area of the mesh cover 4, and S2 represents a hole area in the mesh cover 4. Consequently, the blockage ratio of the mesh cover 4 is σ, that is, a ratio of the hole area on the mesh cover 4 to the frame area of the mesh cover 4 is $1-\sigma$. The frame area S1 is an area of a region enclosed by a frame of the mesh cover 4.

[0044] Further, the smaller the value of σ is, the larger the hole area on the mesh cover 4 and the better the ventilation effect, but the lower the structural strength of the mesh cover 4. Conversely, the larger the value of σ, the higher the structural strength of the mesh cover 4, but the smaller the hole area on the mesh cover 4 is and the poorer the ventilation effect. Therefore, when the blockage ratio σ of the mesh cover 4 is set, it is necessary to ensure both the structural strength of the mesh cover 4 and the ventilation effect of the mesh cover 4. When $0.12 \leq \sigma \leq 0.15$, the mesh cover 4 ensures the structural strength, prolongs the service life of the mesh cover 4, ensures the ventilation effect, improves the air exhaust efficiency of the air conditioner outdoor unit 100, and enhances the heat exchange effect.

[0045] In some embodiments, σ satisfies: $0.133 \leq \sigma \leq 0.137$, and the structural strength and ventilation effect of the mesh cover 4 are better.

[0046] In some embodiments, as shown in Fig. 6, the fan cover 4 includes a plurality of first ribs 41, a plurality of second ribs 42, a plurality of third ribs 43, and a plurality of fourth ribs 44.

[0047] The plurality of first ribs 41 are parallel to each other and spaced apart along a first horizontal direction (e.g., the left-right direction in Fig. 6), and the plurality of second ribs 42 are parallel to each other and spaced apart along a second horizontal direction (e.g., a front-rear direction in Fig. 6). Each first rib 41 is perpendicular to each second rib 42, and each first rib 41 and each second rib 42 cross to form a grid.

[0048] Each third rib 43 is between two adjacent first ribs 41 in the first horizontal direction. Specifically, the plurality of third ribs 43 may be arranged between two first ribs 41, that is, the plurality of third ribs 43 equally divide a gap between the two first ribs 41. Each third rib 43 is parallel to each first rib 41, and each third rib 43 is perpendicular to each second rib 42.

[0049] Each fourth rib 44 is between two adjacent second ribs 42 in the second horizontal direction. Specifically, the plurality of fourth ribs 44 may be arranged between two second ribs 42, that is, the plurality of fourth ribs 44 equally divide a gap between the two second ribs 42. Each fourth rib 44 is parallel to each second rib 42, and each fourth rib 44 is perpendicular to each first rib 41.

[0050] Each of the first rib 41 and the second rib 42 has a diameter greater than or equal to 5 mm and less than 7 mm, and each of the third rib 43 and the fourth rib 44 has a diameter greater than or equal to 2 mm and less than 3 mm. Preferably, the first rib 41 and the second rib 42 have the same diameter, and the third rib 43 and the

fourth rib 44 have the same diameter.

[0051] It can be understood that the first ribs 41 and the second ribs 42 are thick ribs compared with the third ribs 43 and the fourth ribs 44. The first ribs 41 and the second ribs 42 cross each other vertically, and the first ribs 41 and the second ribs 42 form a skeleton of the mesh cover 4. The third ribs 43 and the fourth ribs 44 cross each other vertically, the third ribs 43 are arranged between adjacent first ribs 41, and the fourth ribs 44 are arranged between adjacent second ribs 42. In such a way, the grid of the mesh cover 4 is further subdivided by the third ribs 43 and the fourth ribs 44, making the size of holes in the mesh cover 4 smaller, and preventing external debris from entering the housing 1 through the mesh cover 4, to ensure the safe operation of the fan wheel 33 and reduce safety accidents.

[0052] Meanwhile, the thick ribs (the first rib 41 and the second rib 42) effectively improve the structural strength of the mesh cover 4, and the thin ribs (the third ribs 43 and the fourth ribs 44) effectively reduce the blockage ratio σ of the mesh cover 4 and increase the hole area on the mesh cover 4, which helps to improve the ventilation effect of the mesh cover 4.

[0053] In other embodiments, as shown in Fig. 7, the fan cover 4 may also be circular; the first rib 41 and the second rib 42 are arranged crosswise along a radial direction of the fan cover 4; and the third ribs 43 are circular and connected to the first rib 41 and the second rib 42. The fourth ribs 44 are arranged along the radial direction of the fan cover 4 and connected to the plurality of third ribs 43.

[0054] In some embodiments, as shown in Fig. 2, a minimum distance between the fan wheel 33 and the mesh cover 4 in the up-down direction is L3, and the minimum distance L3 is a minimum value among all distances from any point on the fan wheel 33 to any point on the mesh cover 4. L3 satisfies: $A2 \leq L3 \leq 150$ mm, in which A2 is a second preset value. In such a way, the mesh cover 4 can protect the fan wheel 33 and prevent external debris from entering the housing 1 and colliding with the fan wheel 33.

[0055] In some embodiments, $A2 \geq 90$ mm. When A2 = 90 mm, $90\ \text{mm} \leq L3 \leq 150$ mm, the fan wheel 33 will not affect the outside of the mesh cover 4 and the housing 1.

[0056] In some embodiments, as shown in Figs. 1-7, the air conditioner outdoor unit 100 further includes an air guide ring 5 arranged in the first cavity 11. The air guide ring 5 is connected to the housing 1 and fitted over the fan wheel 33, and an upper end of the air guide ring 5 is above an upper end of the fan wheel 33, in which a minimum distance between the air guide ring 5 and the fan wheel 33 in a radial direction of the fan wheel 33 is L4, and L4 satisfies: $0 < L4 \leq 0.02D$.

[0057] It can be understood that on a horizontal plane, an outermost side of the fan wheel 33 is approximately shaped as a circle, an inner surface of the air guide ring 5 is also shaped as a circle, and the two circles are concentric, with a radius difference of the two concentric circles as the minimum distance L4.

[0058] Specifically, there is no air guide ring 5, the cross section of the first cavity 11 is substantially square, and the fan wheel 33 is in the first cavity 11. In such a case, when the fan wheel 33 is rotating, a distance between the outermost side of the fan wheel 31 and an inner surface of the housing 1 is varied. The airflow driven by the fan wheel 33 has different directions in a flowing process since the distance between the outermost side of the fan wheel 33 and the inner surface of the shell 1 is different. That is, the airflow driven by the fan wheel 33 interferes with each other, resulting in noise, and diminishing the stability of the fan wheel 33.

[0059] When there is the air guide ring 5, the air guide ring 5 is substantially annular, the air guide ring 5 is arranged in the first cavity 11, and the air guide ring 5 is fitted over and arranged coaxially with the fan wheel 33. In such a case, in the radial direction of the fan wheel 33, a distance from each point on the outermost side of the fan wheel 33 to the inner surface of the air guide ring 5 is equal. That is, the airflow driven by the fan wheel 33 has a consistent flow direction, and the airflow will not interfere with each other. As a result, the noise of the air conditioner outdoor unit 100 is reduced, and the stability of the fan wheel 33 is improved.

[0060] When $0 < L4 \leq 0.02D$, the airflow creates almost no backflow or vortex in the fan wheel 33 and the air guide ring 5, allowing the airflow to be discharged out of the housing 1 more quickly.

[0061] In some embodiments, L4 satisfies: $0.013D \leq L4 \leq 0.017D$. In such a way, the airflow driven by the fan wheel 33 creates almost no backflow or vortex between the air guide ring 5 and the fan wheel 33, making the cooperation between the air guide ring 5 and the fan wheel 33 better.

[0062] Reference throughout this specification to "an embodiment," "some embodiments," "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 in various places 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. Furthermore, those skilled in the art may combine and unite different embodiments or examples as well as features of different embodiments or examples described in this specification, in the case of no mutual contradiction.

[0063] Although some embodiments of the present disclosure have been shown and described, it should be understood that the above embodiments are exemplary and should not be construed as limitations on the present disclosure. Those skilled in the art may make changes,

modifications, alternatives, and variations in the embodiments within the scope of the present disclosure.

Claims

1. An air conditioner outdoor unit, comprising:

a housing comprising a first cavity and an air outlet in communication with the first cavity;
a heat exchanger in the first cavity, wherein in a horizontal direction, the heat exchanger comprises a first portion and a second portion opposite to each other, and a minimum distance between the first portion and the second portion is S; and
a fan assembly comprising:

a bracket arranged in the first cavity and above the heat exchanger, and connected to the housing;
a motor in the first cavity and on the bracket; and
a fan wheel arranged in the first cavity and connected to the motor, and having a diameter of D;

wherein a first part of the bracket is opposite to the heat exchanger in an up-down direction, a minimum distance between the first part of the bracket and the heat exchanger in the up-down direction is L1 that satisfies: $0 \le L1 \le 0.15D$ when $S < D$.

2. The air conditioner outdoor unit according to claim 1, wherein L1 satisfies $0 \le L1 \le 0.05D$ when $S \ge D$.

3. The air conditioner outdoor unit according to claim 1, wherein a minimum distance between the fan wheel and the bracket in the up-down direction is L2 that satisfies $A1 \le L2 \le A1 + 50$ mm, wherein A1 is a first preset value.

4. The air conditioner outdoor unit according to claim 3, wherein 20 mm $\le A1 \le$ 55 mm.

5. The air conditioner outdoor unit according to any one of claims 1-4, further comprising a mesh cover,
wherein the air outlet is at an upper end of the housing, the fan wheel is opposite to the air outlet in the up-down direction, the mesh cover is arranged at the air outlet and connected to the housing, and a blockage ratio σ of the mesh cover satisfies: $0.12 \le \sigma \le 0.15$.

6. The air conditioner outdoor unit according to claim 5, wherein:
σ satisfies: $0.133 \le \sigma \le 0.137$;
the fan cover comprises:

a plurality of first ribs parallel to each other and spaced apart along a first horizontal direction;
a plurality of second ribs parallel to each other and spaced apart along a second horizontal direction, wherein each of the plurality of first ribs is perpendicular to each of the plurality of second ribs, and each of the plurality of first ribs and each of the plurality of second ribs cross and form a grid;
a plurality of third ribs, wherein each of the plurality of third ribs is between two adjacent first ribs in the first horizontal direction, and each of the plurality of third ribs is parallel to each of the plurality of first ribs and perpendicular to each of the plurality of second ribs; and
a plurality of fourth ribs, wherein each of the plurality of fourth ribs is between two adjacent second ribs in the second horizontal direction, and each of the plurality of fourth ribs is parallel to each of the plurality of second ribs and perpendicular to each of the plurality of first ribs,

wherein each of the first ribs and the second ribs has a diameter greater than or equal to 5 mm and less than 7 mm, and each of the third ribs and the fourth ribs has a diameter greater than or equal to 2 mm and less than 3 mm.

7. The air conditioner outdoor unit according to claim 6, wherein a minimum distance between the fan wheel and the mesh cover in the up-down direction is L3 that satisfies $A2 \le L3 \le 150$ mm, wherein A2 is a second preset value.

8. The air conditioner outdoor unit according to claim 7, wherein $A2 \ge 90$ mm.

9. The air conditioner outdoor unit according to any one of claims 5-8, further comprising an air guide ring in the first cavity, wherein the air guide ring is connected to the housing and is fitted over the fan wheel, an upper end of the air guide ring is above an upper end of the fan wheel, and a minimum distance between the air guide ring and the fan wheel in a radial direction of the fan wheel is L4 that satisfies: $0 < L4 \le 0.02D$.

10. The air conditioner outdoor unit according to claim 9, wherein L4 satisfies: $0.013D \le L4 \le 0.017D$.

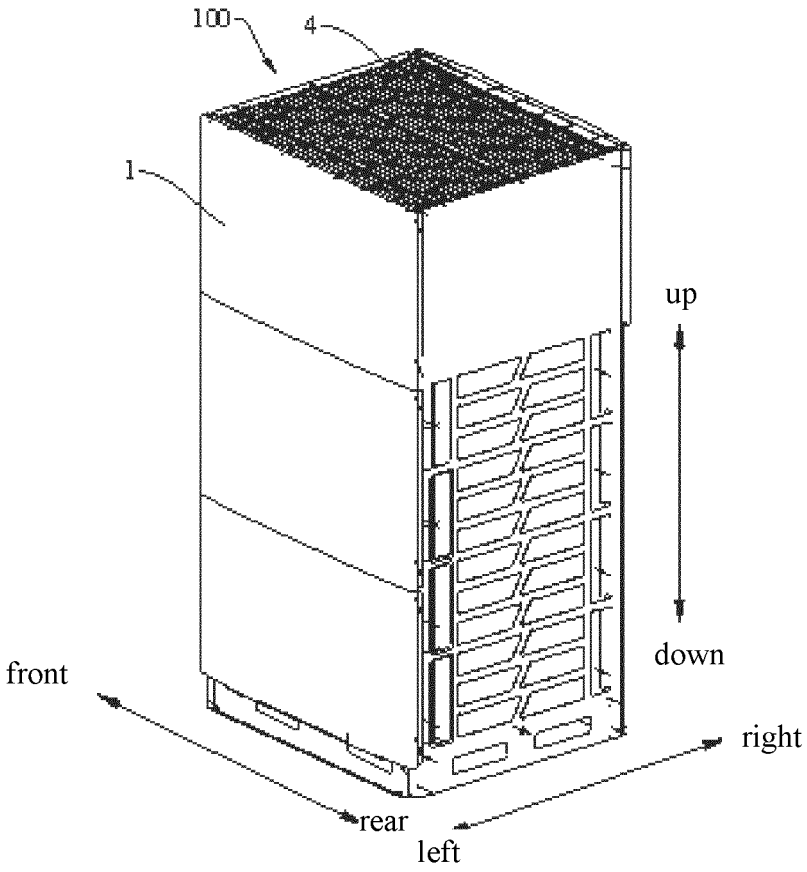


Fig. 1

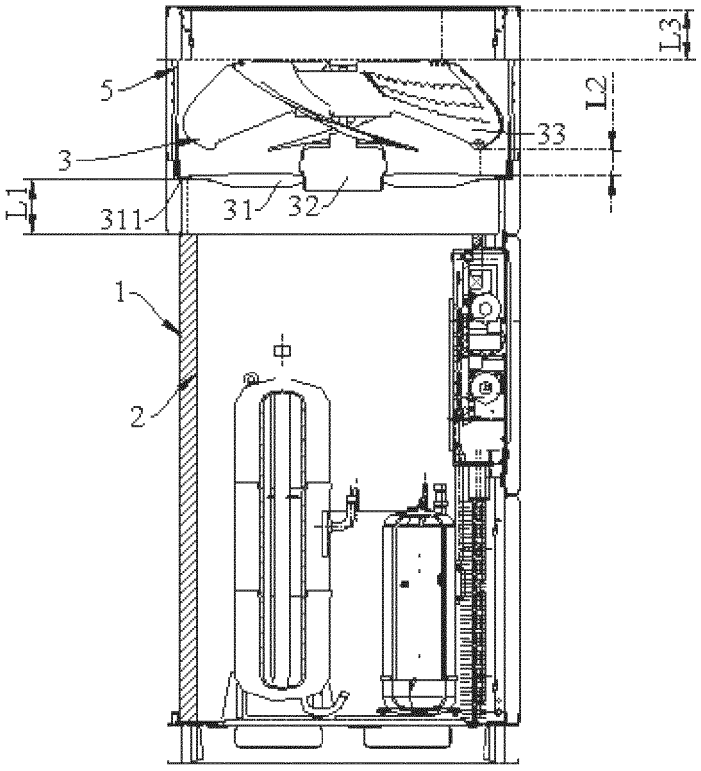


Fig. 2

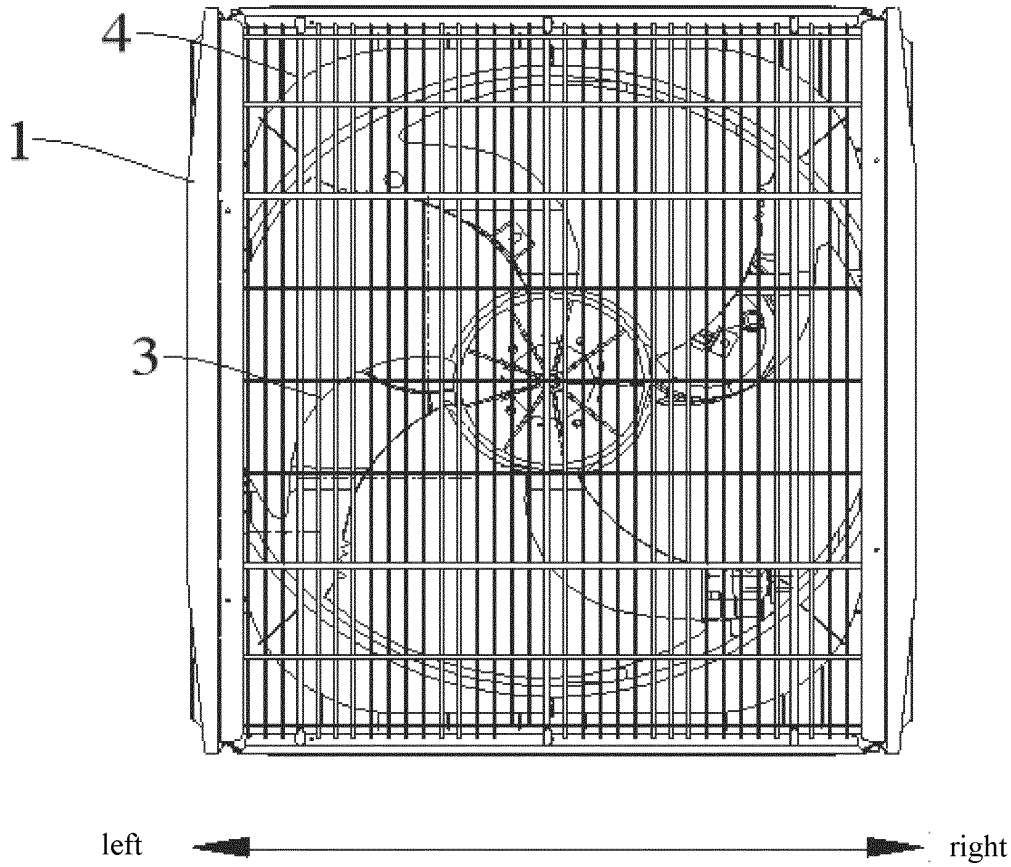


Fig. 3

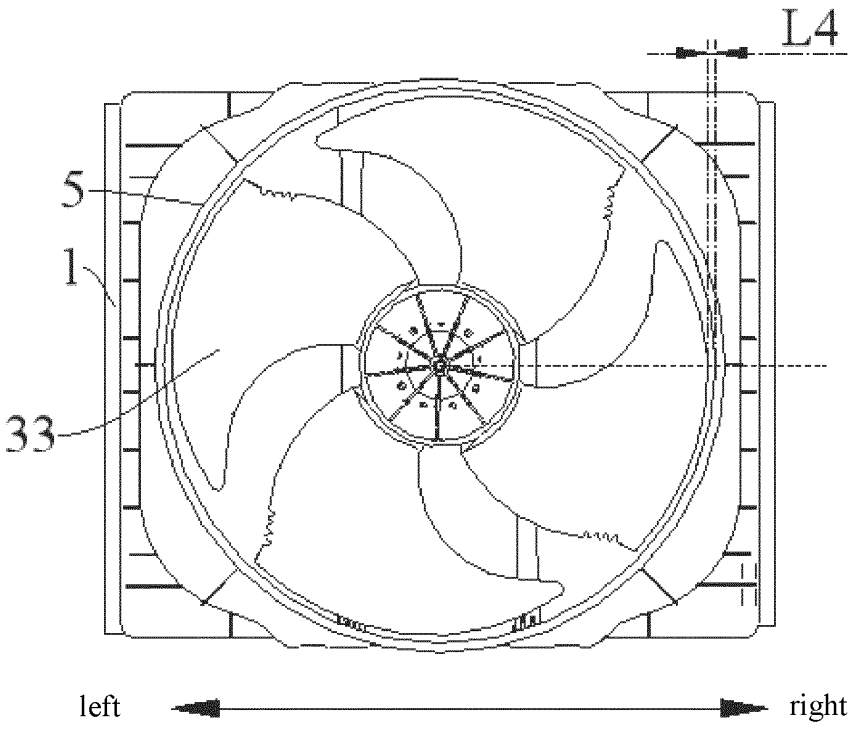


Fig. 4

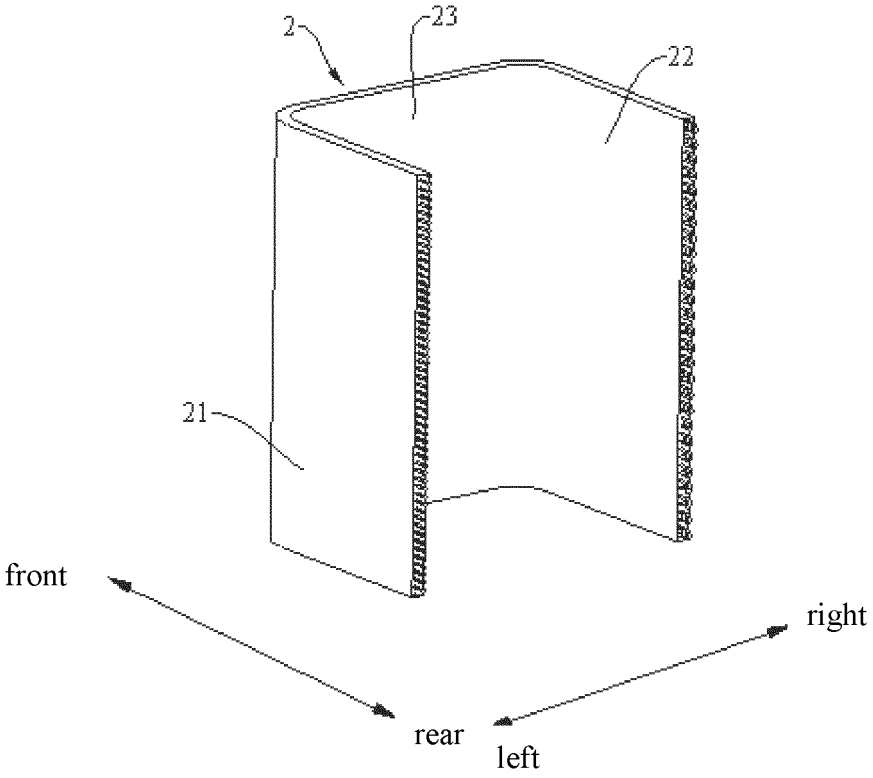


Fig. 5

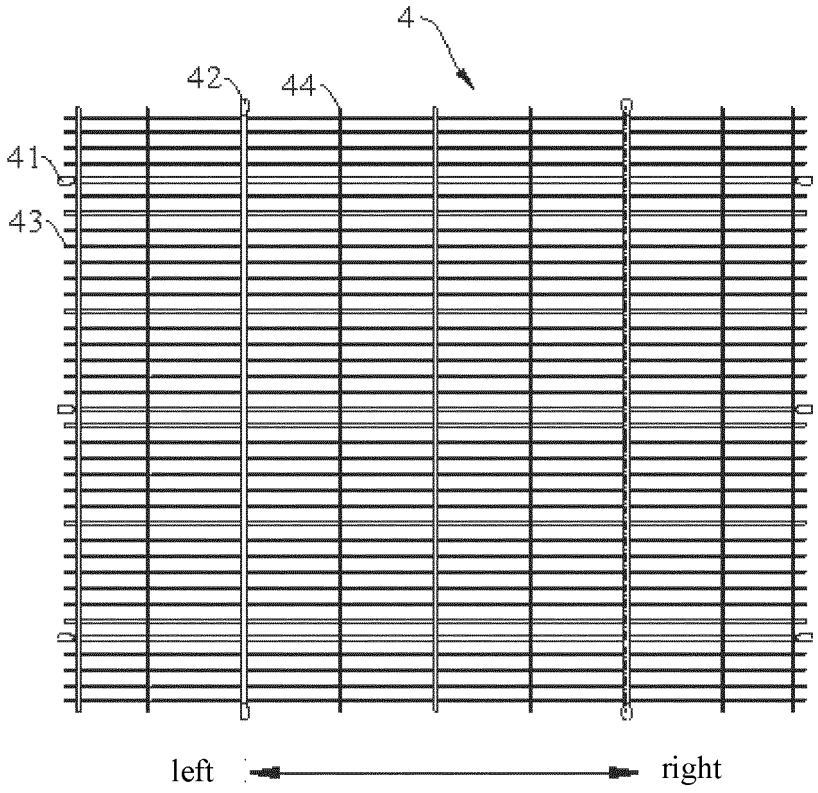
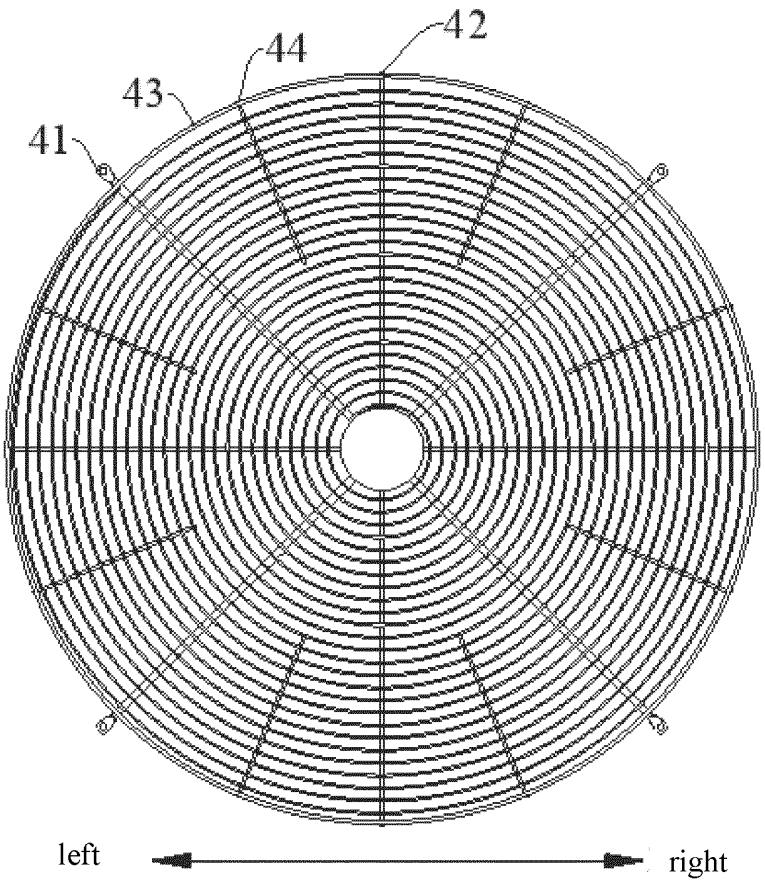


Fig. 6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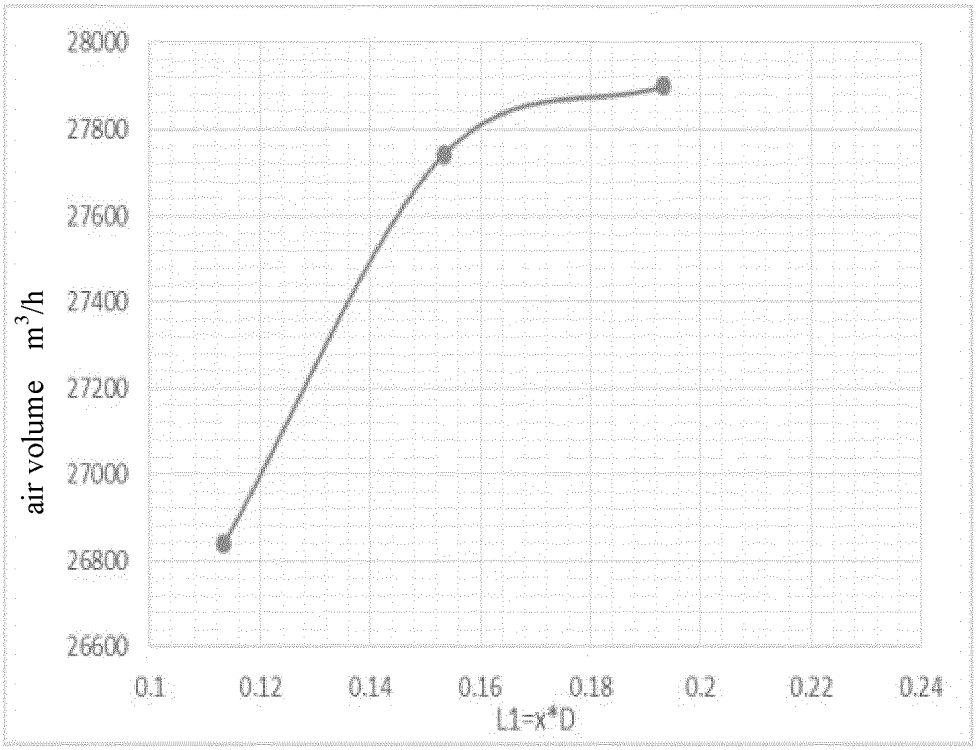
44
43
41
left
right

Fig. 7


28000
27800
27600
27400
27200
27000
26800
26600
air volume m3/h
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0.12
0.14
0.16
0.18
0.2
0.22
0.24
L1=x*D

Fig. 8

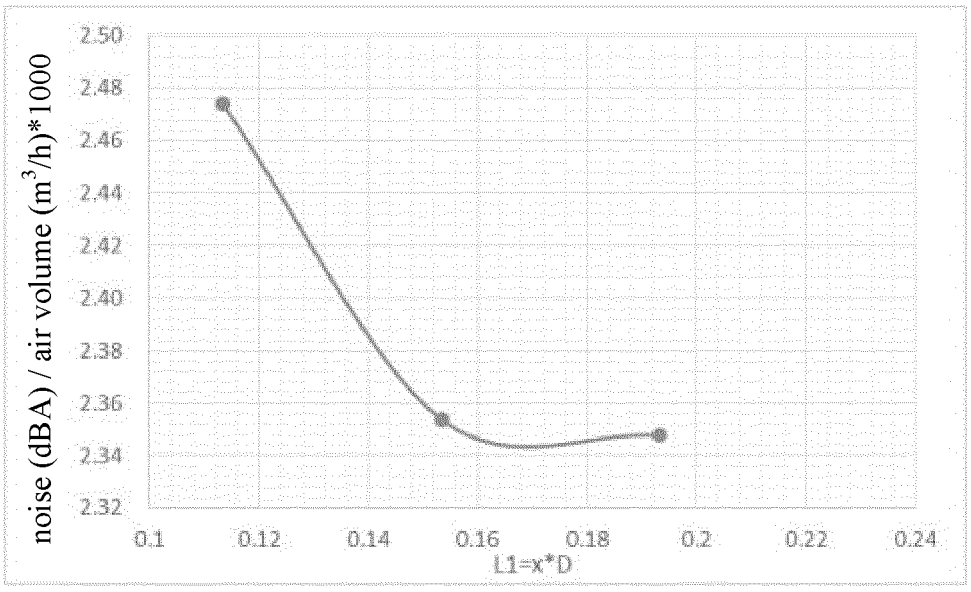
noise (dBA) / air volume (m3/h)*1000
2.50
2.48
2.46
2.44
2.42
2.40
2.38
2.36
2.34
2.32
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
L1=x*D

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/115715

A. CLASSIFICATION OF SUBJECT MATTER

F24F 1/06(2011.01)i; F24F 1/50(2011.01)i; F24F 1/16(2011.01)i; F24F 1/40(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)

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)

DWPI, CJFD, CNABS, SIPOABS, CNTXT, USTXT, 美的, 刘乃桐, 陈维涛, 詹镇江, 余东东, 李跃飞, 空调, 室外机, 换热器, 热交换器, 冷凝器, 蒸发器, U型, 距离, 间距, 长度, 直径, 尺寸, 风轮, 风机, 叶轮, 风叶, 电机, 电动机, 马达, 导风圈, 风罩, 网罩; MEDE, MIDEA, air 1d condition+, outdoor, outside, heat 1d exchang+, evaporat+, condenser?, type, distanc+, dimension, length, longness, size?, diameter?, fan?, rorator?, blade?, blower?, ventilator?, motor, モータ, guid+, direct+, ring+, circle+, cover+, lid

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2016121856 A (DAIKIN INDUSTRIES, LTD.) 07 July 2016 (2016-07-07) description, paragraphs 0023-0101, figures 1-10	1-10
A	JP 2014105901 A (HITACHI APPLIANCES INC.) 09 June 2014 (2014-06-09) entire document	1-10
A	KR 20190141479 A (LG ELECTRONICS INC.) 24 December 2019 (2019-12-24) entire document	1-10
A	US 2014154095 A1 (PLASTICOS Y ALAMBRES S.A. DE C.V.) 05 June 2014 (2014-06-05) entire document	1-10
A	WO 2013183145 A1 (MITSUBISHI ELECTRIC CORP. et al.) 12 December 2013 (2013-12-12) entire document	1-10
A	CN 111486516 A (QINGDAO HISENSE HITACHI AIR-CONDITIONING SYSTEMS CO., LTD.) 04 August 2020 (2020-08-04) entire document	1-10

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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)
"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 November 2021	**25 November 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/115715

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 102141275 A (SANYO ELECTRIC CO., LTD.) 03 August 2011 (2011-08-03) entire document	1-10

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/115715

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JP	2016121856	A	07 July 2016	None			
JP	2014105901	A	09 June 2014	None			
KR	20190141479	A	24 December 2019	None			
US	2014154095	A1	05 June 2014	US	9347465	B2	24 May 2016
				MX	2012013974	A	02 June 2014
				MX	346109	B	07 March 2017
WO	2013183145	A1	12 December 2013	CN	104334974	A	04 February 2015
				US	2015184871	A1	02 July 2015
				US	9702571	B2	11 July 2017
				WO	2013183710	A1	12 December 2013
				EP	2889543	A1	01 July 2015
				JP	5868502	B2	24 February 2016
				CN	104334974	B	22 September 2017
CN	111486516	A	04 August 2020	None			
CN	102141275	A	03 August 2011	JP	2011158108	A	18 August 2011
				JP	5496697	B2	21 May 2014
				CN	102141275	B	07 May 2014
				CN	102141272	A	03 August 2011
				CN	102141271	A	03 August 2011
				CN	102141271	B	08 January 2014
				JP	5611605	B2	21 May 2014
				EP	2354683	A2	10 August 2011
				CN	102141272	B	16 July 2014
				JP	5461213	B2	02 April 2014
				JP	2011153806	A	11 August 2011
				JP	2011158149	A	18 August 2011

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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