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(54) CENTRIFUGAL WIND WHEEL AND AIR TREATMENT DEVICE HAVING SAME

(57) A centrifugal wind wheel (100) and an air treatment device having same. The centrifugal wind wheel (100) comprises a hub (1) and blades (2), wherein a plurality of air input holes (10) are formed in the hub (1), the plurality of air input holes (10) are arranged at intervals in the circumferential direction of the hub (1), and each air input hole (10) penetrates the hub (1); and a plurality of blades (2) are provided, the plurality of blades (2) are all arranged on the hub (1), the plurality of blades (2) are arranged at intervals in the circumferential direction of the hub (1) and are arranged at intervals on the radial outer side of the plurality of air input holes (10), the number of blades (2) is equal to the number of air input holes (10), and each blade (2) is arranged opposite a corresponding air input hole (10) in the radial direction of the hub (1).

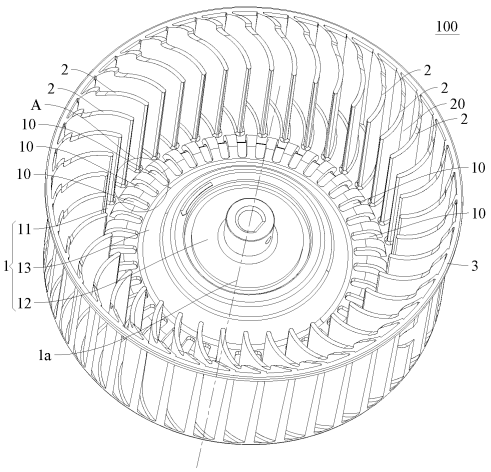

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims priorities to Chinese Patent Applications No. 202011044953.X and No. 202022179591.7 that are both filed on September 28, 2020, the entire disclosure of which are incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of air treatment device technologies, and more particularly, to a centrifugal wind wheel and an air treatment device having same.

BACKGROUND

[0003] Centrifugal wind wheels are rotatable by means of inputted mechanical energy to increase a gas pressure and discharge a gas. In the related art, the centrifugal wind wheels provide low air volumes and have low air exchange efficiency.

SUMMARY

[0004] The present disclosure aims to solve at least one of the technical problems in the related art. To this end, the present disclosure provides a centrifugal wind wheel. The centrifugal wind wheel can provide a greater air exchange volume and higher air exchange efficiency, and has good sound quality.

[0005] The present disclosure further provides an air treatment device having the above-mentioned centrifugal wind wheel.

[0006] According to embodiments in a first aspect of the present disclosure, a centrifugal wind wheel is provided. The centrifugal wind wheel includes a hub and a plurality of blades. The hub has a plurality of air inlet holes. The plurality of air inlet holes is arranged at intervals in a circumferential direction of the hub, and each of the plurality of air inlet holes penetrates the hub. The plurality of blades is disposed on the hub. The plurality of blades is arranged at intervals in the circumferential direction of the hub at a radially outer side of the plurality of air inlet holes. A number of the plurality of blades is equal to a number of the plurality of air inlet holes. Each of the plurality of blades is opposite to a corresponding one of the plurality of air inlet holes in a radial direction of the hub.

[0007] In the centrifugal wind wheel according to the embodiments of the present disclosure, the plurality of air inlet holes is defined on the hub, the number of the plurality of air inlet holes is equal to the number of the plurality of blades, and each air inlet hole is opposite to the corresponding blade in the radial direction of the hub. Thus, it is possible to effectively improve an air exchange volume and air exchange efficiency of the centrifugal wind wheel while ensuring structural strength of the centrifugal wind wheel, and ensure stability of a flow field of the centrifugal wind wheel to provide a good sound quality for the centrifugal wind wheel.

[0008] In some embodiments, each of the plurality of air inlet holes extends in the radial direction of the hub and has a contour line extending in the radial direction of the hub. Each of the plurality of blades has a skeleton line extending in the radial direction of the hub. In a cross section of the hub, an orthographic projection of a central axis of the hub, a radially outermost endpoint of an orthographic projection of the contour line, and a radially innermost endpoint of an orthographic projection of the corresponding skeleton line are located on a same straight line.

[0009] In some embodiments, the contour line is a straight line. In the cross section of the hub, the orthographic projection of the central axis of the hub, the radially outermost endpoint of the orthographic projection of the contour line, a radially innermost endpoint of the orthographic projection of the contour line, and the radially innermost endpoint of the orthographic projection of the corresponding skeleton line are located on a same straight line.

[0010] In some embodiments, in a cross section of the hub, a first straight line and a second straight line are defined by connecting a radially innermost endpoint of an orthographic projection of the skeleton line with two endpoints of an orthographic projection of an outer contour of a corresponding air inlet hole in the circumferential direction of the hub, respectively. An angle formed between the first straight line and the second straight line is defined as α and faces towards the corresponding air inlet hole, and the angle α satisfies $120° \leq \alpha \leq 135°$.

[0011] In some embodiments, in the radial direction of the hub, a distance L_0 between a radially innermost endpoint of a contour line and a central axis of the hub satisfies $L_0 \geq 0.3R$, where R represents a radius of the centrifugal wind wheel.

[0012] In some embodiments, in the radial direction of the hub, a length L_1 of a contour line satisfies $0.3L \leq L_1 \leq 0.2R$, where L represents a length of each of the blades in the radial direction of the hub, and R represents a radius of the centrifugal wind wheel.

[0013] In some embodiments, in the radial direction of the hub, a distance L_2 between a radially outermost endpoint of a contour line and a radially innermost endpoint of a corresponding skeleton line satisfies 1 mm$\leq L_2 \leq$0.3L, where L represents a length of the blade in the radial direction of the hub.

[0014] In some embodiments, the centrifugal wind wheel further includes a reinforcing ring spaced apart from the hub in an axial direction of the hub and located at both ends of a length of the blade, respectively.

[0015] According to embodiments in a second aspect of the present disclosure, an air treatment device is provided. The air treatment device includes the centrifugal wind wheel according to the embodiments in the above-mentioned first aspect of the present disclosure.

[0016] In the air treatment device according to the embodiments of the present disclosure, by using the above-mentioned centrifugal wind wheel, an air volume of the air treatment device can be effectively improved while a sound quality of the air treatment device can be ensured.

[0017] In some embodiments, the air treatment device is an air conditioner and includes a fresh air duct. The centrifugal wind wheel is disposed in the fresh air duct.

[0018] Additional aspects and advantages of the present disclosure will be provided at least in part in the following description, or will become apparent at least in part from the following description, or can be learned from practicing of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above and/or additional aspects and advantages of the present disclosure will become more apparent and more understandable from the following description of embodiments taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic view of a centrifugal wind wheel according to an embodiment of the present disclosure.
FIG. 2 is an enlarged view of a circled part A illustrated in FIG. 1.
FIG. 3 is another schematic view of the centrifugal wind wheel illustrated in FIG. 1.
FIG. 4 is another schematic view of the centrifugal wind wheel illustrated in FIG. 3.
FIG. 5 is an enlarged view of a circled part B illustrated in FIG. 4.
FIG. 6 is a schematic view of an air flow movement of a centrifugal wind wheel in the related art.

[0020] Reference numerals of the accompanying drawings:

centrifugal wind wheel 100, first straight line Q3, second straight line Q4,
hub 1, central axis 1a,
air inlet hole 10, contour line Ω1,
base plate portion 11, shaft core portion 12, connection portion 13,
blade 2, centrifugal air duct 20, skeleton line Q2,
reinforcing ring 3.

DETAILED DESCRIPTION

[0021] Embodiments of the present disclosure will be described in detail below with reference to examples thereof as illustrated in the accompanying drawings, throughout which same or similar elements, or elements having same or similar functions, are denoted by same or similar reference numerals. The embodiments described below with reference to the drawings are illustrative only, and are intended to explain, rather than limiting, the present disclosure.

[0022] Various embodiments or examples for implementing different structures of the present disclosure are provided below. In order to simplify the description of the present disclosure, components and arrangements of specific examples are described herein. These specific examples are merely for the purpose of illustration, rather than limiting the present disclosure. Further, the same reference numerals and/or reference letters may appear in different examples of the present disclosure for the purpose of simplicity and clarity, instead of indicating a relationship between different embodiments and/or the discussed arrangements. In addition, the present disclosure provides examples of various specific processes and materials. However, applicability of other processes and/or the use of other materials are conceivable for those of ordinary skill in the art.

[0023] A centrifugal wind wheel 100 according to an embodiment in a first aspect of the present disclosure will be described below with reference to the accompanying drawings.

[0024] As illustrated in FIG. 1, the centrifugal wind wheel 100 includes a hub 1 and a blade 2. The hub 1 has a plurality of air inlet holes 10. The plurality of air inlet holes 10 is arranged at intervals in a circumferential direction of the hub 1. Each air inlet hole 10 penetrates the hub 1. A plurality of blades 2 is provided. Each of the plurality of blades 2 is disposed

on the hub 1. The plurality of blades 2 is arranged at intervals in the circumferential direction of the hub 1. A centrifugal air duct 20 is defined between every two adjacent blades 2. The centrifugal air duct 20 is in communication with the corresponding air inlet hole 10. The plurality of blades 2 is radially arranged at intervals outside the plurality of air inlet holes 10. Therefore, in a radial direction of the hub 1, the plurality of air inlet holes 10 is located at an inner side of the plurality of blades 2.

[0025] In this way, when the centrifugal wind wheel 100 rotates, some of airflow flow to the inner side of the plurality of blades 2 through the plurality of air inlet holes 10, and some of the airflow flow to the inner side of the plurality of blades 2 through ends of the corresponding blades 2 away from the hub 1, and all the airflow flow out through each centrifugal air duct 20. Thus, an air inlet area of the centrifugal wind wheel 100 can be increased to effectively increase an air exchange volume of the centrifugal wind wheel 100. Therefore, air exchange efficiency of the centrifugal wind wheel 100 can be improved. In addition, the hub 1 is adapted to be connected to a motor. As a result, the airflow flowing to the inner side of the plurality of blades 2 through the plurality of air inlet holes 10 can also effectively dissipate heat from the motor to cool the motor. In the description of the present disclosure, "plurality of" means two or more.

[0026] As illustrated in FIG. 3 and FIG. 4, a number of the plurality of blades 2 is equal to a number of the plurality of air inlet holes 10. In this way, each blade 2 corresponds to one air inlet hole 10, and each air inlet hole 10 corresponds to one blade 2. As a result, the plurality of air inlet holes 10 and the plurality of blades 2 are arranged in one-to-one correspondence. Each blade 2 is opposite to a corresponding one of the plurality of air inlet holes 10 in the radial direction of the hub 1. As a result, in the radial direction of the hub 1, each blade 2 is disposed at an outer side of the corresponding air inlet hole 10. In addition, since the centrifugal wind wheel 100 is a rotatable member, the airflow flowing out of the plurality of air inlet holes 10 can flow more mildly into the centrifugal air duct 20 for acceleration, avoiding generation of a unstable flow field of the centrifugal wind wheel 100 due to an arrangement of the plurality of air inlet holes 10 and generation of abnormal noises. In this way, stability of the flow field of the centrifugal wind wheel 100 can be ensured to ensure that no other abnormal noise is generated during a rotation of the centrifugal wind wheel 100. Thus, the centrifugal wind wheel 100 has good sound quality and good user experience.

[0027] It should be noted that a direction "outer" refers to a direction, in the radial direction of the hub 1, away from a central axis 1a of the hub 1, an opposite direction of which is defined as "inner".

[0028] With the centrifugal wind wheel 100 of the embodiments of the present disclosure, the plurality of air inlet holes 10 is formed on the hub 1, the number of the plurality of air inlet holes 10 is equal to the number of the plurality of blades 2, and each air inlet hole 10 is arranged opposite to the corresponding blade 2 in the radial direction of the hub 1. Therefore, an air exchange volume and air exchange efficiency of the centrifugal wind wheel 100 can be effectively improved while structural strength of the centrifugal wind wheel 100 is ensured. Further, stability of the flow field of the centrifugal wind wheel 100 can be ensured to provide good sound quality for the centrifugal wind wheel 100. Therefore, the present disclosure can improve the air exchange efficiency and stability of the centrifugal wind wheel 100 without changing overall structural dimensions of the centrifugal wind wheel 100, which facilitates an implementation of good applicability and practicality of the centrifugal wind wheel 100.

[0029] By comparing the centrifugal wind wheel 100 according to the embodiments of the present disclosure with a centrifugal wind wheel without any air inlet hole in the related art in an experiment, the inventor of this application obtained that, at a same rotational speed, the centrifugal wind wheel 100 in the present disclosure has a significantly improved air volume by up to 10% compared with the centrifugal wind wheel in the related art. In addition, it is verified that for the centrifugal wind wheel 100 in the present disclosure, no abnormal noises are generated during its operation, no abnormalities are found in a frequency spectrum or in a sense of hearing, and requirements for dropping are satisfied without safety hazards. Therefore, the centrifugal wind wheel 100 can provide good use reliability.

[0030] In addition, in some techniques, for reasons of heat dissipation or weight reduction of the motor, openings are defined in a contour of the centrifugal wind wheel. The openings are defined in a random manner without any basis. For example, regardless of the structure of the centrifugal wind wheel, six openings are often defined in the hub, which limits an increase in the air volume of the centrifugal wind wheel. In the present disclosure, the number of the air inlet holes 10 is set equal to the number of the blades 2, and each inlet hole 10 is arranged opposite to the corresponding blade 2 in the radial direction of the hub 1, which can ensure the structural strength of the centrifugal wind wheel 100 while further improving the air volume. Thus, the centrifugal wind wheel 100 has the stable flow field to avoid generation of other abnormal noises in the centrifugal wind wheel 100.

[0031] For example, a difference in a flow state of a centrifugal wind wheel with six openings defined in the hub in some techniques is illustrated in FIG. 6. In the centrifugal wind wheel with the six openings, each opening has a greater dimension. Suppose that a region formed between two adjacent blades is regarded as one air duct, the greater dimension can lead to excessive differences in flow directions of an incoming gas within a single air duct. A deflection angle ($\beta 2$-$\beta 1$) (where $\beta 2$ represents an air flow exit angle and $\beta 1$ represents an air flow entry angle) of the airflow is often around 75° throughout the entire air duct. Such a great variation in flow directions of the airflow can lead to more significant flow losses for an airflow with great differences in flow directions, which may offset energy of the airflow introduced by the great-dimension openings, and make it impossible to effectively increase the air volume. However, in the present dis-

closure, the airflow flowing into the air inlet holes 10 can gradually flow in a direction of contour lines Ω1 of the blades 2. According to Coanda effect of fluids, stability of a flow state of the airflow is increased, and a flow loss of the airflow is decreased, and thus working efficiency of the single blade 2 is improved, which provides a greater air volume.

[0032] In addition, for the centrifugal wind wheel operating at a high rotational speed, e.g., the centrifugal wind wheel with a diameter of 0.1 m and operating at a rotational speed of 2,400 rpm, the centrifugal wind wheel is subjected to a pulling force of approximately 3,000 times its own mass. In this context, the solution in which six openings are provided in the above-mentioned technique is even less valid, because a strength of the blade is far from being sufficient for high-speed operation. In contrast, with a ratio of 1: 1 of number of the air inlet holes 10 to the number of the blades 2, the structural strength of the centrifugal wind wheel 100 has been experimentally verified to be fully satisfactory.

[0033] The inventor of this application conducted the following experimental verification. A centrifugal wind wheel with a diameter of 0.13 m was selected. Experimental items are illustrated in Table 1 below, in which "related technique I" refers to a centrifugal wind wheel without any air inlet hole, and "related technique II" refers to a centrifugal wind wheel with six openings. It is clear from the table that, at a same rotational speed, the centrifugal wind wheel 100 of the present disclosure has a significant increase in the air volume and is free from abnormal noises and safety hazards. Compared with the centrifugal wind wheel without any air inlet hole and the centrifugal wind wheel with six openings, the centrifugal wind wheel 100 of the present disclosure has obvious technical advantages.

Table 1 Comparison of experimental validation results of the present disclosure and the related techniques

Test items	Related technique I	Related technique II	The present disclosure
Air volume	53m^3/h	55m^3/h	60m^3/h
Noise	49dB	49.2dB	49.2dB
Strength	No breakage at 2,400 rpm	Breakage at 2,400 rpm	No breakage at 2,400 rpm

[0034] For example, in the examples of FIG. 1 and FIG. 3, the hub 1 includes a base plate portion 11, a shaft core portion 12, and a connection portion 13. The base plate portion 11 is formed as an annular structure. The base plate portion 11 is sleeved over a radial outer side of the shaft core portion 12, and is spaced apart from the shaft core portion 12 in the radial direction of the hub 1. The connection portion 13 is connected between the base plate portion 11 and the shaft core portion 12. A radial outer edge of the connection portion 13 is connected to the base plate portion 11, and a radial inner edge of the connection portion 13 is connected to the shaft core portion 12. The shaft core portion 12 is adapted to be connected to a motor to be driven by the motor for a rotation of the centrifugal wind wheel 100. The plurality of blades 2 is disposed on the base plate portion 11. The plurality of air inlet holes 10 is formed on the connection portion 13. Therefore, the plurality of air inlet holes 10 are located between the shaft core portion 12 and the plurality of blades 2 in the radial direction of the hub 1.

[0035] In some embodiments, as illustrated in FIG. 2, FIG. 4, and FIG. 5, each of the plurality of air inlet holes 10 extends in the radial direction of the hub 1, and has a contour line Ω1 extending in the radial direction of the hub 1. Each of the plurality of blades 2 has a skeleton line Q2 extending in the radial direction of the hub 1. In a cross section of the hub 1, an orthographic projection of the central axis 1a of the hub 1, a radial outermost endpoint of an orthographic projection of the contour line Q1, and a radial innermost endpoint of an orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. That is, in the cross section of the hub 1, the orthographic projection of the central axis 1a of the hub 1, the radial outermost endpoint of the orthographic projection of each contour line Q1, and the radial innermost endpoint of the orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. For example, in the example of FIG. 5, in the cross section of the hub 1, an orthographic projection O_1 of the central axis 1a of the hub 1, a radial outermost endpoint O_3 of the orthographic projection of the contour line Q1, and a radially innermost endpoint O_2 of the orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. That is, in the cross section of the hub 1, an orthographic projection of an axis of a column surface on which the plurality of blades 2 is located, the radial outermost endpoint of the orthographic projection of the contour line Q1, and the radial innermost endpoint of the orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. In this way, the plurality of air inlet holes 10 is reasonably provided, which is conducive to further ensuring the structural strength and flow field stability of the centrifugal wind wheel 100, and avoids the generation of abnormal noises and safety hazards during the rotation of the centrifugal wind wheel 100. Therefore, the sound quality and safety of use of the centrifugal wind wheel 100 can be ensured.

[0036] It should be noted that the contour line S21 of the air inlet hole 10 may be understood as a midline of a shape of an outer contour of an orthographic projection of the air inlet hole 10 on the cross section of the hub 1, and the skeleton line Q2 of the blade 2 may be understood as a midline of a shape of a cross section of the blade 2 in a streamline direction. The cross section of the hub 1 is perpendicular to the central axis 1a of the hub 1.

[0037] In some embodiments, as illustrated in FIG. 2, FIG. 4, and FIG. 5, the contour line Ω1 is formed as a straight line. The outer contour of the orthographic projection of the air inlet hole 10 on the cross section of the hub 1 may be symmetrical about the contour line Ω1. In the cross section of the hub 1, the orthographic projection of the central axis 1a of the hub 1, the radially outermost endpoint of the orthographic projection of the contour line Q1, the radially innermost endpoint of the orthographic projection of the contour line Q1, and the radially innermost endpoint of the orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. For example, in the example of FIG. 5, in the cross section of hub 1, the orthographic projection O_1 of the central axis 1a of the hub 1, the radially outermost endpoint O_3 of the orthographic projection of the contour line Q1, a radially innermost endpoint O_4 of the orthographic projection of the contour line Q1, and the radially innermost endpoint O_2 of the orthographic projection of the corresponding skeleton line Q2 are located on a same straight line. Therefore, in the cross section of hub 1, a straight line formed by connecting the orthographic projection of the central axis 1a of the hub 1 with the radially innermost endpoint of the orthographic projection of the skeleton line Q2 is co-linear with the orthographic projection of the contour line Q1, which simplifies a structure of the air inlet hole 10 and facilitates processing. Further, it is possible to weaken an influence of the air inlet hole 10 on the structural strength of the centrifugal wind wheel 100 to ensure reliable use of the centrifugal wind wheel 100.

[0038] In addition, since the inventor of this application has found through research and experimental verification that a width of an outer end of the air inlet hole 10 in the circumferential direction of the hub 1 would affect the air volume of the centrifugal wind wheel 100, and the air inlet holes 10 are thus arranged rationally. In some embodiments, as illustrated in FIG. 5, in the cross section of the hub 1, a first straight line Q3 and a second straight line Q4 are defined by connecting the radially innermost endpoint of the orthographic projection of the skeleton line Q2 with two endpoints of an orthographic projection of the outer contour of the corresponding air inlet hole 10 in the circumferential direction of the hub 1, respectively. For example, the radially innermost endpoint O_2 of the orthographic projection of the skeleton line Q2 is connected with one endpoint A_1 of the orthographic projection of the outer contour of the corresponding air inlet hole 10 in the circumferential direction of the hub 1 to form the first straight line Q3, and the radially innermost endpoint O_2 of the orthographic projection of the skeleton line Q2 is connected with the other endpoint A_2 of the orthographic projection of the outer contour of the corresponding air inlet hole 10 in the circumferential direction of the hub 1 to form the second straight line Q4. An angle α facing towards the corresponding air inlet hole 10 is formed between the first straight line Q3 and the second straight line Q4, and satisfies $120°\leq\alpha\leq135°$. Accordingly, an angle α facing away from the corresponding air inlet hole 10 is also formed between the first straight line Q3 and the second straight line Q4. In this way, by forming the angle α, the air inlet hole 10 may be designed more reasonably, which can effectively improve the air volume of the centrifugal wind wheel 100. In addition, the inventor of this application has experimentally verified that the too large or too small angle α does not significantly increase the air volume of the centrifugal wind wheel 100.

[0039] In some embodiments, the angle α formed between the first straight line Q3 and the second straight line Q4 and facing towards the corresponding air inlet hole 10 satisfies $120°\leq\alpha\leq135°$. For example, α may be 125°, 129°, 130°, or 133°, etc.

[0040] In some embodiments, as illustrated in FIG. 4 and FIG. 5, in the radial direction of the hub 1, a distance between a radially innermost endpoint of the contour line Ω1 and the central axis 1a of the hub 1 is defined as L_0. For example, in the example of FIG. 5, in the radial direction of the hub 1, the distance L_0 between the radially innermost endpoint O_4 of the contour line Ω1 and the central axis 1a of the hub 1 satisfies $L_0\geq0.3R$, where R represents a radius of the centrifugal wind wheel 100. That is, L_0 is greater than or equal to 30% of the radius of the centrifugal wind wheel 100. In this way, it is possible to prevent the structural strength of the centrifugal wind wheel 100 from being weakened due to a large number of air inlet holes 10, which can effectively ensure the structural strength of the centrifugal wind wheel 100 during its rotation.

[0041] In some embodiments, in the radial direction of the hub 1, the distance L_0 between the radially innermost endpoint of the contour line Ω1 and the central axis 1a of the hub 1 is greater than 30% of the radius of the centrifugal wind wheel 100. For example, the distance L_0 may be 0.33R, or 0.35R, etc.

[0042] It should be understood that when the centrifugal wind wheel 100 includes a reinforcing ring 3, as illustrated in FIG. 4, the radius of the centrifugal wind wheel 100 may be a radius of an outer edge of the reinforcing ring 3. In addition, when the centrifugal wind wheel 100 includes no reinforcing ring 3, the radius of the centrifugal wind wheel 100 may be the radius of the hub 1. However, the radius of the centrifugal wind wheel 100 is not limited to any of these examples.

[0043] In some embodiments, as illustrated in FIG. 4 and FIG. 5, the contour line Ω1 has a length L_1 in the radial direction of the hub 1. The length of the contour line S21 may be a radial distance between the radially innermost endpoint O_4 of the contour line Ω1 and the radially outermost endpoint O_3 of the contour line Q1, i.e., a length of the air inlet hole 10 in the radial direction of the hub 1. Further, L_1 satisfies $0.3L\leq L_1\leq0.2R$, where L represents a length of the blade 2 in the radial direction of the hub 1, and R represents the radius of the centrifugal wind wheel 100. That is, L_1 is greater than or equal to 30% of a radial length of the blade 2, which can effectively increase the air volume of the centrifugal wind wheel 100. In addition, L_1 is smaller than or equal to 20% of the radius of the centrifugal wind wheel 100, which can ensure the structural strength of the centrifugal wind wheel 100.

[0044] In some embodiments, in the radial direction of the hub 1, the length L_1 of the contour line S21 satisfies $0.3L<L_1<0.2R$ to effectively increase the air volume of the centrifugal wind wheel 100 while maintaining the structure of the centrifugal wind wheel 100.

[0045] In some embodiments, as illustrated in FIG. 4 and FIG. 5, a distance between the radially outermost endpoint of the contour line Ω1 and the radially innermost endpoint of the corresponding skeleton line Q2 in the radial direction of the hub 1 is defined as L_2. For example, in the example of FIG. 5, a distance between the radially outermost endpoint O_3 of the contour line Ω1 and the radially innermost endpoint O_2 of the corresponding skeleton line Q2 in the radial direction of the hub 1 is defined as L_2. Therefore, the distance L_2 is a shortest radial distance between the air inlet hole 10 and the corresponding blade 2, and L_2 satisfies $1\ mm\leq L_2\leq 0.3L$, where L represents a length of the blade 2 in the radial direction of the hub 1. That is, L_2 is greater than or equal to 1 mm and smaller than or equal to 30% of the radial length of the blade 2, which can ensure power of the centrifugal wind wheel 100 and provide the centrifugal wind wheel 100 with a good rotational work effect.

[0046] In some embodiments, the distance L_2 between the radially outermost endpoint of the contour line Ω1 and the radially innermost endpoint of the corresponding skeleton line Q2 in the radial direction of the hub 1 satisfies $1\ mm<L_2<0.3L$.

[0047] In some embodiments, as illustrated in FIG. 1 and FIG. 3, the centrifugal wind wheel 100 further includes a reinforcing ring 3. The reinforcing ring 3 and the hub 1 are spaced apart from each other in an axial direction of the hub 1 and located at both ends of the blade 2 in a length direction thereof, respectively. Each blade 2 is connected between the hub 1 and the reinforcing ring 3. That is, one end of the blade 2 in the length direction thereof is connected to the hub 1, and the other end of the blade 2 in the length direction thereof is connected to the reinforcing ring 3. Therefore, it is possible to enhance the structural strength of the centrifugal wind wheel 100.

[0048] According to embodiments in a second aspect of the present disclosure, an air treatment device is provided. The air treatment device includes the centrifugal wind wheel 100 according to the embodiments in the above-mentioned first aspect of the present disclosure. The air treatment device may be an air conditioner, a dehumidifier, a humidifier, or an air purifier, etc. Of course, the air treatment device may be a combination of at least two of these devices.

[0049] According to the air treatment device of the embodiments of the present disclosure, by using the above-mentioned centrifugal wind wheel 100, an air volume of the air treatment device can be effectively improved while a sound quality of the air treatment device can be ensured.

[0050] In some embodiments, the air treatment device is the air conditioner and includes a fresh air duct. The fresh air duct may introduce fresh outdoor air into an indoor room to achieve indoor-outdoor air circulation. The centrifugal wind wheel 100 is disposed in the fresh air duct. For example, the air conditioner includes a fresh air module. Limited by factors such as a size and mechanism strength of the fresh air module, the centrifugal wind wheel 100 can effectively improve an air exchange volume and air exchange efficiency of the air conditioner, which is reliable in use and ensures good sound quality of the air conditioner.

[0051] It should be understood that no heat exchanger may not be provided for the fresh air duct, in which case the fresh air duct does not have a heat exchange function and is not involved in cooling or heating. Of course, the fresh air duct may be provided with the heat exchanger, in which case the fresh air duct not only has a fresh air function, but also has the heat exchange function.

[0052] Other compositions and operations of the air treatment device according to the embodiments of the present disclosure are known to those skilled in the art, and thus the description thereof in detail will be omitted herein.

[0053] It should be understood that in the description of the present disclosure, the orientation or position relationship indicated by the terms "center", "transverse", "length", "width", "thickness", "inner", "outer", "axial", "radial", "circumferential" etc., is based on the orientation or position relationship shown in the drawings, and is merely for the convenience of describing the present disclosure and simplifying the description, rather than indicating or implying that the associated device or element must have a specific orientation, or be constructed and operated in a specific orientation, and cannot be construed as limiting the present disclosure.

[0054] It should be noted that in the description of the present disclosure, terms such as "installed", "mounted", "connected", "coupled" and the like should be understood in a broad sense, unless otherwise clearly specified and limited. For example, it may be a fixed connection or a detachable connection or an integrated connection; mechanical connection or electrical connection; direct connection or indirect connection through an intermediate; or internal communication of two components. For those of ordinary skill in the art, the specific meaning of the above-mentioned terms in the present disclosure can be understood according to specific circumstances.

[0055] In the description of this specification, descriptions with reference to the terms "an embodiment", "some embodiments", "example embodiments", "examples", "specific examples", or "some examples" etc. mean that specific features, structure, materials, or characteristics described in conjunction with the embodiment or example are included in at least one embodiment or example of the present disclosure. In this specification, the schematic representations of the above terms do not necessarily refer to the same embodiment or example. Moreover, the described specific features, structures, materials, or characteristics may be combined in any one or more embodiments or examples in a suitable

manner.

[0056] Although embodiments of the present disclosure have been illustrated and described, it is conceivable for those of ordinary skill in the art that various changes, modifications, replacements, and variations can be made to these embodiments without departing from the principles and ideas of the present disclosure. The scope of the present disclosure shall be defined by the claims and their equivalents.

Claims

1. A centrifugal wind wheel, comprising:

   a hub having a plurality of air inlet holes, the plurality of air inlet holes being arranged at intervals in a circumferential direction of the hub, and each of the plurality of air inlet holes penetrating the hub; and
   a plurality of blades disposed on the hub, the plurality of blades being arranged at intervals in the circumferential direction of the hub at a radially outer side of the plurality of air inlet holes, wherein:

      a number of the plurality of blades is equal to a number of the plurality of air inlet holes; and
      each of the plurality of blades is opposite to a corresponding one of the plurality of air inlet holes in a radial direction of the hub.

2. The centrifugal wind wheel according to claim 1, wherein:

   each of the plurality of air inlet holes extends in the radial direction of the hub and has a contour line extending in the radial direction of the hub;
   each of the plurality of blades has a skeleton line extending in the radial direction of the hub; and
   in a cross section of the hub, an orthographic projection of a central axis of the hub, a radially outermost endpoint of an orthographic projection of the contour line, and a radially innermost endpoint of an orthographic projection of the corresponding skeleton line are located on a same straight line.

3. The centrifugal wind wheel according to claim 2, wherein:

   the contour line is a straight line; and
   in the cross section of the hub, the orthographic projection of the central axis of the hub, the radially outermost endpoint of the orthographic projection of the contour line, a radially innermost endpoint of the orthographic projection of the contour line, and the radially innermost endpoint of the orthographic projection of the corresponding skeleton line are located on a same straight line.

4. The centrifugal wind wheel according to any one of claims 1 to 3, wherein:

   in a cross section of the hub, a first straight line and a second straight line are defined by connecting a radially innermost endpoint of an orthographic projection of the skeleton line with two endpoints of an orthographic projection of an outer contour of a corresponding air inlet hole in the circumferential direction of the hub, respectively; and
   an angle formed between the first straight line and the second straight line is defined as α and faces towards the corresponding air inlet hole, the angle α satisfying $120° \leq \alpha \leq 135°$.

5. The centrifugal wind wheel according to any one of claims 1 to 4, wherein in the radial direction of the hub, a distance L_0 between a radially innermost endpoint of a contour line and a central axis of the hub satisfies $L_0 \geq 0.3R$, where R represents a radius of the centrifugal wind wheel.

6. The centrifugal wind wheel according to any one of claims 1 to 5, wherein in the radial direction of the hub, a length L_1 of a contour line satisfies $0.3L \leq L_1 \leq 0.2R$, where L represents a length of each of the blades in the radial direction of the hub, and R represents a radius of the centrifugal wind wheel.

7. The centrifugal wind wheel according to any one of claims 1 to 6, wherein in the radial direction of the hub, a distance L_2 between a radially outermost endpoint of a contour line and a radially innermost endpoint of a corresponding skeleton line satisfies $1\ mm \leq L_2 \leq 0.3L$, where L represents a length of the blade in the radial direction of the hub.

8. The centrifugal wind wheel according to any one of claims 1 to 7, further comprising:
a reinforcing ring spaced apart from the hub in an axial direction of the hub and located at both ends of a length of the blade, respectively.

9. An air treatment device, comprising the centrifugal wind wheel according to any one of claims 1 to 8.

10. The air treatment device according to claim 9, wherein the air treatment device is an air conditioner and comprises a fresh air duct, the centrifugal wind wheel being disposed in the fresh air duct.

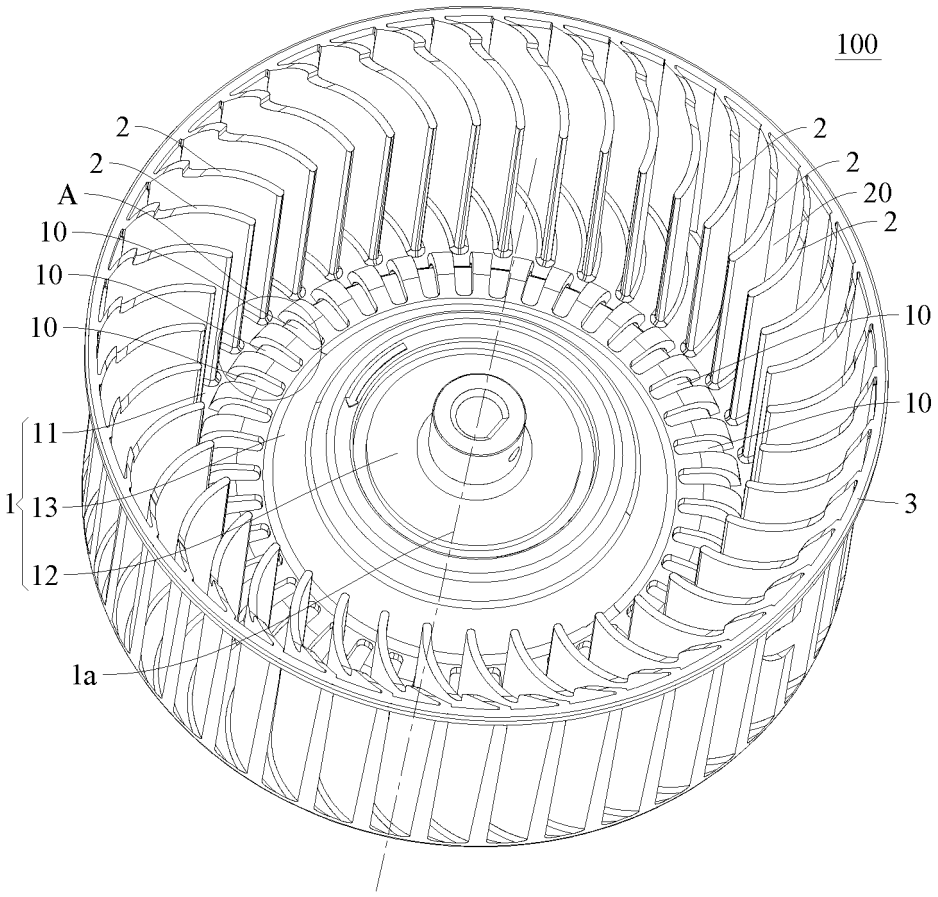
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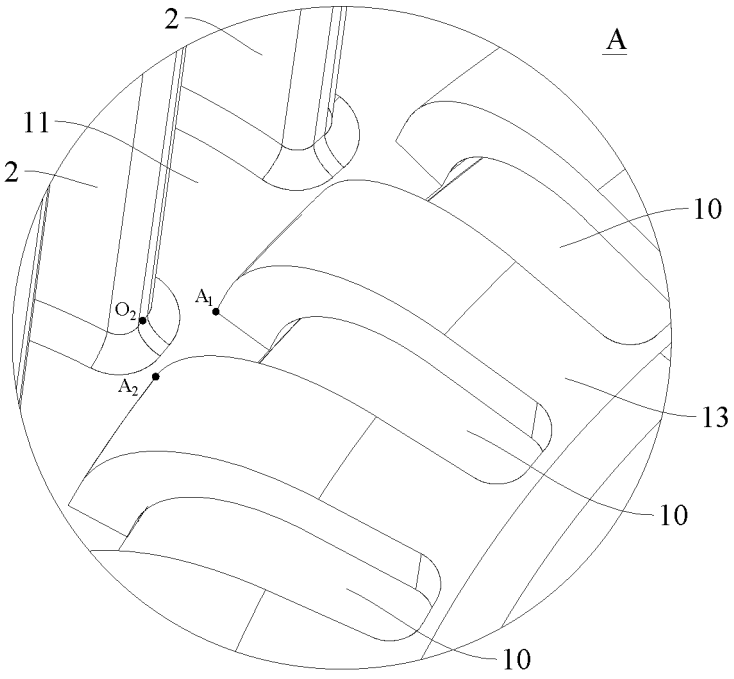
FIG. 1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A_2
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FIG. 2

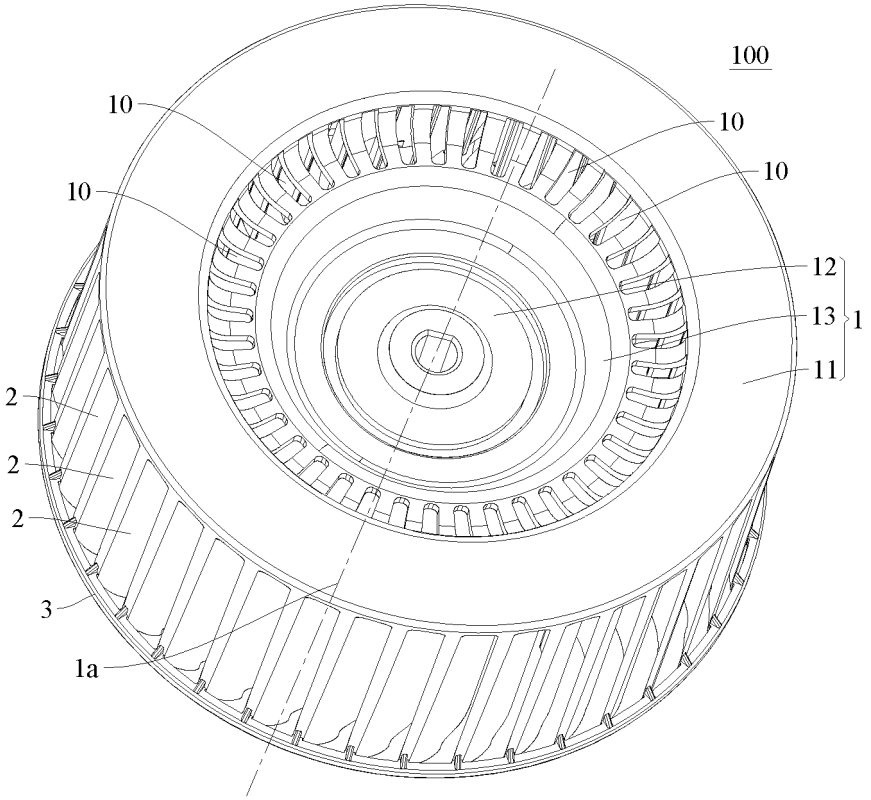

FIG. 3

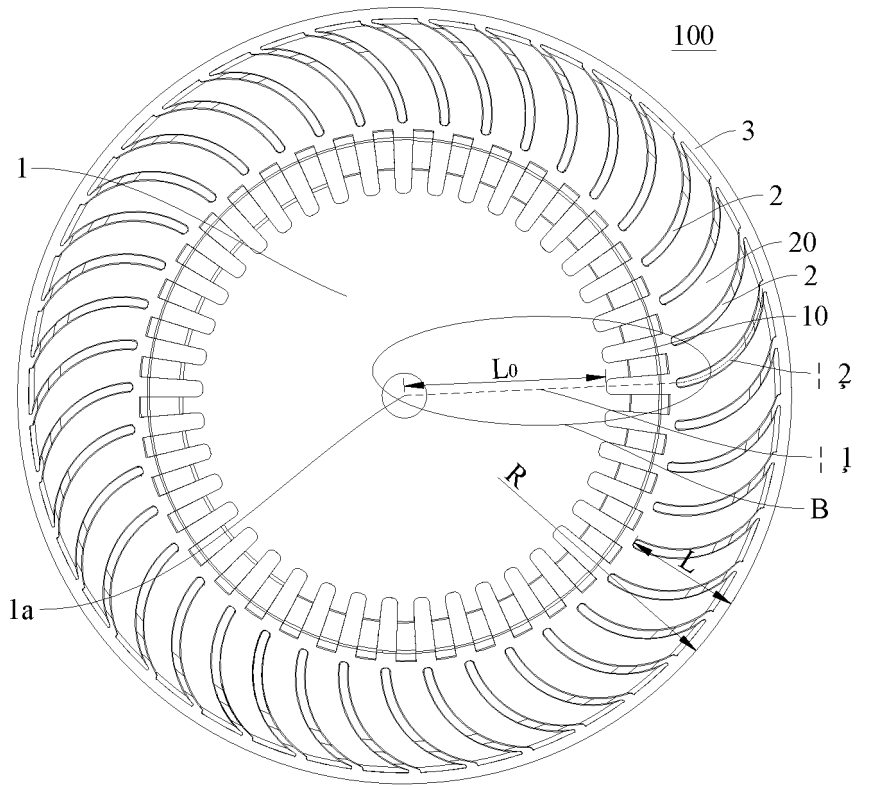

FIG. 4

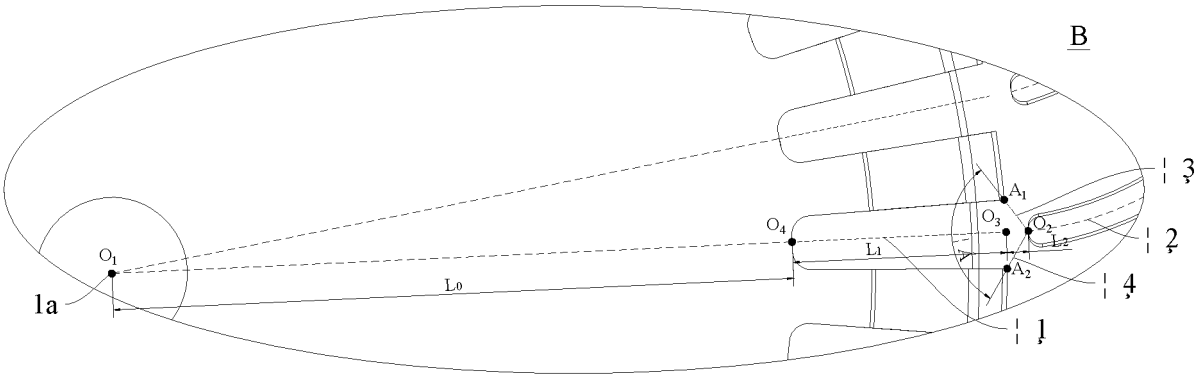

FIG. 5

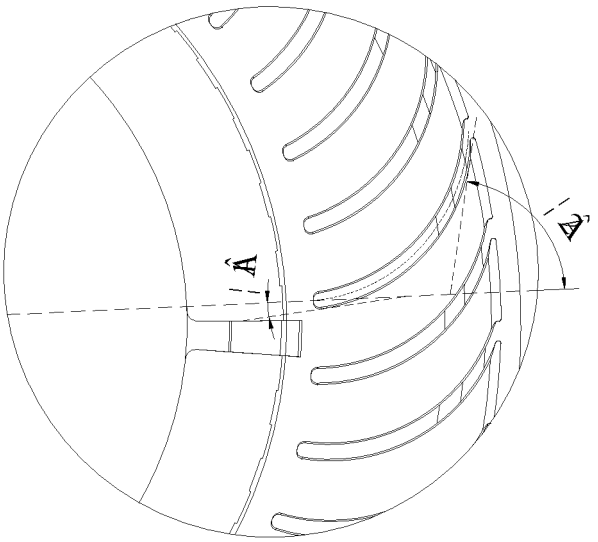

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/128977

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/28(2006.01)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

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)

CNPAT, EPODOC, WPI, CNKI: 广东美的制冷设备有限公司, 付裕, 离心, 风轮, 轮毂, 叶片, 进风, 孔, 投影, 直线, 半径, 空气, 处理, 装置, centrifugate, wind, wheel, hub, blade, inlet, hole, projection, straight, line, radius, air, handle, device

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 209744584 U (YOOWO CO., LIMITED) 06 December 2019 (2019-12-06) description, paragraphs 35-39, and figures 4-6	1-10
A	CN 207673439 U (SHENZHEN HUAYANG LASER TECHNOLOGY CO., LTD.) 31 July 2018 (2018-07-31) entire document	1-10
A	EP 3181911 A1 (EBM-PAPST MULFINGEN G.M.B.H.& CO., KG.) 21 June 2017 (2017-06-21) entire document	1-10
A	CN 205841322 U (HUNAN TYEN MACHINERY CO., LTD.) 28 December 2016 (2016-12-28) entire document	1-10
A	CN 110360150 A (GREE ELECTRIC APPLIANCES, INC. OF ZHUHAI) 22 October 2019 (2019-10-22) entire document	1-10
A	CN 105841236 A (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO., LTD. et al.) 10 August 2016 (2016-08-10) entire document	1-10

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

* Special categories of cited documents:
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"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
12 June 2021	**28 June 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**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/128977

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 209744584 U	06 December 2019	US 2020224892 A1	16 July 2020
CN 207673439 U	31 July 2018	None	
EP 3181911 A1	21 June 2017	DE 102015122132 A1	22 June 2017
		CN 205806012 U	14 December 2016
		US 2017175777 A1	22 June 2017
CN 205841322 U	28 December 2016	None	
CN 110360150 A	22 October 2019	None	
CN 105841236 A	10 August 2016	None	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202011044953X **[0001]**
- CN 202022179591 **[0001]**