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(54) **CROSS-FLOW WIND TURBINE AND FAN HEATER**

(57) Disclosed are a cross-flow wind turbine and a fan heater applying the cross-flow wind turbine, in which the cross-flow wind turbine includes two fixing plates oppositely disposed and a plurality of blades connected between the two fixing plates, the plurality of blades being disposed at intervals along an outer edge of the fixing plate, wherein the blades are disposed twisted along an axial direction of the cross-flow wind turbine, and a relative twisting angle at both ends of one of the blades is no less than 5° and no more than 40°. The technical solution of the present disclosure can reduce the working noise of the fan heater and improve the comfortability for users.

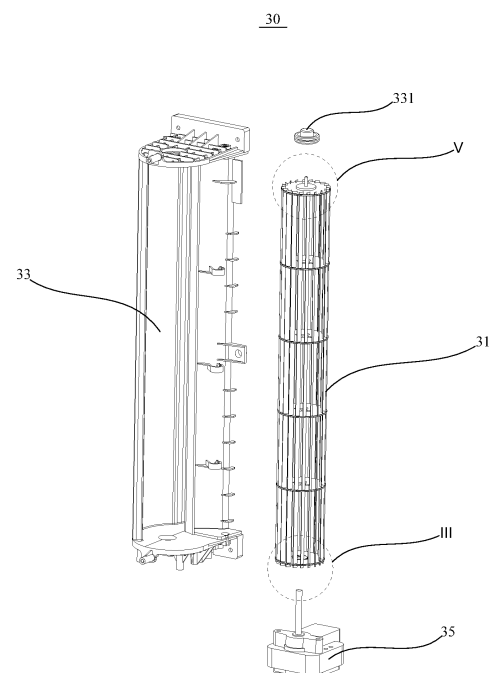


Fig. 2

Description**TECHNICAL FIELD**

- 5 **[0001]** The present disclosure relates to the technical field of fan heaters, in particular to a cross-flow wind turbine and a fan heater applying the cross-flow wind turbine.

BACKGROUND

- 10 **[0002]** Fan heater, as a novel heating equipment, has been widely used due to its convenient use and simple operation. However, the noise of the related fan heater is typically unavoidable, which affects the comfortability for users.

SUMMARY

- 15 **[0003]** The present disclosure is to propose a cross-flow wind turbine, aiming at reducing noise of a fan heater at work and improving the comfortability for users.

- 20 **[0004]** In order to achieve the above object, the cross-flow wind turbine proposed by the present disclosure includes two fixing plates oppositely disposed and a plurality of blades connected between the two fixing plates, the plurality of blades being disposed at intervals along an outer edge of the fixing plate, in which the blades are disposed twisted along an axial direction of the cross-flow wind turbine, and a relative twisting angle at both ends of the blades is no less than 5° and no more than 40°.

[0005] Optionally, the blades are obliquely disposed between the two fixing plates along the axial direction of the cross-flow wind turbine, and an inclined angle θ formed between the blades and the fixing plates, is no less than 85° and no more than 88°.

- 25 **[0006]** Optionally, a cross section of one of the blades has an arc shape with a chord length 6mm to 8mm.

[0007] Optionally, a thickness of one of the blades ranges from 0.3mm to 0.5mm.

[0008] Optionally, an outer diameter D of the cross-flow wind turbine ranges from 30mm to 100mm, and/or a length of the cross-flow wind turbine ranges from 150mm to 600mm.

[0009] Optionally, the cross-flow wind turbine includes no less than 18 and no more than 25 blades.

- 30 **[0010]** Optionally, a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.

[0011] Optionally, the cross-flow wind turbine includes a plurality of first blades and a plurality of second blades, in which one of the first blades and one of the second blades are alternately disposed, and a width of the one of the first blades is greater than a width of the one of the second blades; and/or, a distance between two of the first blades and the second blades is alternately changed.

- 35 **[0012]** The present disclosure further proposes a fan heater, which includes two fixing plates oppositely disposed and a plurality of blades connected between the two fixing plates, the plurality of blades being disposed at intervals along an outer edge of the fixing plate, in which the blades are disposed twisted along an axial direction of the cross-flow wind turbine, and a relative twisting angle at both ends of the blades is no less than 5° and no more than 40°. The cross-flow wind turbine is disposed in the volute.

- 40 **[0013]** Optionally, a rotating shaft is disposed at a first end of the cross-flow wind turbine; a bearing sleeve is disposed on the volute to accommodate the rotating shaft.

[0014] Optionally, a shaft sleeve is disposed at a second end of the cross-flow wind turbine; the air passage assembly further includes a motor disposed in the volute; the shaft sleeve is sleeved on an output shaft of the motor.

- 45 **[0015]** Optionally, the blades are obliquely disposed between the two fixing plates along the axial direction of the cross-flow wind turbine, and an inclined angle θ formed between the blades and the fixing plates, is no less than 85° and no more than 88°.

[0016] Optionally, a cross section of one of the blades has an arc shape with a chord length 6mm to 8mm.

[0017] Optionally, a thickness of one of the blades ranges from 0.3mm to 0.5mm.

- 50 **[0018]** Optionally, an outer diameter D of the cross-flow wind turbine ranges from 30mm to 100mm, and/or a length of the cross-flow wind turbine ranges from 150mm to 600mm.

[0019] Optionally, the cross-flow wind turbine includes no less than 18 and no more than 25 blades.

[0020] Optionally, a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.

- 55 **[0021]** Optionally, the cross-flow wind turbine includes a plurality of first blades and a plurality of second blades, in which one of the first blades and one of the second blades are alternately disposed, and a width of the one of the first blades is greater than a width of the one of the second blades; and/or,

[0022] a distance between two of the first blades and the second blades is alternately changed.

[0023] According to the technical solution of the present disclosure, each blade of the cross-flow wind turbine is disposed twisted along the axial direction of the cross-flow wind turbine, and the relative twisting angle at the two ends

of each blade no less than 5° and no more than 40°, so that when the cross-flow wind turbine works, each part on the same blade can pass through the minimum gap between the cross-flow wind turbine and the volute at different time points, diversifying the types and frequencies of noises generated at each part on the same blade. Thus, the resonance peak caused by noise superposition of a same type and frequency is avoided, i.e. the noise frequency has been less concentrated, with the noise intensity reduced. the working noise of the fan heater is thereby reduced, and the use comfortability of users has been improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] In order to explain the embodiment of the present application or the technical solution of the prior art more clearly, the following will briefly introduce the drawings necessary in the description of the embodiments or the prior art. Obviously, the drawings in the following description are only some embodiments of the present application. For those ordinary skill in the art, other drawings can be obtained according to the structure shown in these drawings without any creative effort.

Fig. 1 is an exploded view of a fan heater according to an embodiment of the present disclosure;
 Fig. 2 is an exploded view of the air passage assembly in Fig. 1;
 Fig. 3 is an enlarged structural schematic view at portion III in Fig. 2;
 Fig. 4 is a top view of the cross-flow wind turbine in Fig. 2;
 Fig. 5 is an enlarged structural schematic view at portion V in Fig. 2;
 Fig. 6 is a top view of a cross-flow wind turbine according to another embodiment of the present disclosure.

Description of reference numerals

Reference Numeral	Name	Reference Numeral	Name
100	Fan heater	315b	Second blade
10	Base	33	Volute
30	Air passage assembly	331	Bearing sleeve
31	Cross-flow wind turbine	35	Motor
311	Fixing plate	351	Output shaft
3111	Rotating shaft	50	Shell
3113	Shaft sleeve	51	Front shell
315	Blade	53	Rear shell
315a	First blade		

[0025] The implementation, functional features and advantages of the present application will be further described with reference to the accompanying drawings with the embodiments.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] As following, the technical solution in the embodiments of the present disclosure will be described clearly and completely with reference to the drawings in the embodiment of the present application. Obviously, the described embodiment is only a part of the embodiment of the present application, not all of the embodiments. Based on the embodiments in the present application, all other embodiments perceived by those ordinary skills in the art without creative effort should be fallen within the protection scope of the present application.

[0027] It should be noted that all directional indicators (such as upper, lower, left, right, front, rear, etc.) in the embodiment of the present application are only used to explain the relative positional relationship, movement, etc. between various components under a certain specific posture (as shown in the drawings). If the specific posture changes, the directional indicator will also change accordingly.

[0028] In addition, the descriptions related to "first", "second" and the like in the present application are for descriptive purposes only and cannot be understood as indicating or implying its relative importance or implicitly indicating a number of technical features indicated. Thus, features defining "first" and "second" may explicitly or implicitly include at least one of the features. In the description of the present application, the meaning of "plural" is at least two, such as two,

three, etc., otherwise specifically defined.

[0029] In the present application, the terms "connected" and "fixed" etc. should be understood in a broad sense, otherwise specified and defined. For example, "fixed" can be a fixed connection, a detachable connection, or an forming a part integrally; It can be a mechanical connection or an electrical connection; It can be a direct connection or an indirect connection through an intermediate medium; and it can be the communication between interior of two elements or the interaction between two elements, otherwise specifically defined. For those ordinary skilled in the art, the specific meanings of the aforementioned terms in the present application can be understood according to practical conditions.

[0030] In addition, the technical solutions between the various embodiments may be combined with each other, but must be based on what one of ordinary skill in the art can achieve. When the combination of technical solutions is contradictory or impossible to achieve, it should be considered that the combination of such technical solutions does not exist and is not within the protection scope required by the present application.

[0031] The present disclosure proposes a cross-flow wind turbine 31.

[0032] As shown in Figs. 1 and 2, the cross-flow wind turbine 31 of the present disclosure which is applied to a fan heater 100, includes:

- a base 10;
- a shell 50 disposed on the base 10.

[0033] Specifically, the shell 50 includes a front shell 51 and a rear shell 53 connected to the front shell 51. The front shell 51 and the rear shell 53 are enclosed to form an accommodating cavity (not shown) for accommodating the air passage assembly 30, the heating assembly (not shown) and the like of the fan heater 100. The front shell 51 is provided with an air outlet (not shown), and the rear shell 53 is provided with an air inlet (not shown). Air flow enters into the accommodating cavity in the shell 50 from the air inlet of the rear shell 53, then sequentially passes through the air passage assembly 30 for acceleration and the heating assembly for heating, and finally blows out from the air outlet of the front shell 51.

[0034] The air passage assembly 30 of the fan heater 100 includes a volute 33 and a cross-flow wind turbine 31 provided in the volute 33.

[0035] Specifically, as shown in Figs. 2, 3, and 5, in at least one embodiment of the present disclosure, the cross-flow wind turbine 31 includes two fixing plates 311 oppositely disposed and a plurality of blades 315 connected between the two fixing plates 311, the plurality of blades 315 being disposed at intervals along an outer edge of the fixing plate 311, in which the blades 315 are disposed twisted along an axial direction of the cross-flow wind turbine 31, and a relative twisting angle at both ends of the blades 315 is no less than 5° and no more than 40°.

[0036] The fan heater 100 being placed horizontally is describe hereinafter as an example.

[0037] In the present embodiment, each fixing plate 311 is circular and is placed in the horizontal plane, and the two fixing plates 311 are disposed in the vertical direction and two plate surfaces are disposed in parallel. Two ends of each blade 315 are respectively connected to the two fixing plates 311, and the end of each blade 315 is located at the outer edge of the fixing plate 311. As such, the cross-flow wind turbine 31 is substantially cylindrical, with its axis extending in the vertical direction. In addition, between the two fixing plates 311, a plurality of reinforcing plates (not shown) are provided, which are parallel to each other and disposed at intervals. The plurality of reinforcing plates pass through each blade 315, to strengthen the structural strength of the cross-flow wind turbine 31.

[0038] Specifically, as shown in Fig. 2, the blades 315 are twisted by a certain angle along the circumferential direction of the cross-flow wind turbine 31 for every certain distance rise along the axial direction of the cross-flow wind turbine 31. The twisting starts from the lower end to the upper end, so that the relative twisting angles of the upper and lower ends of each blade 315 (i.e., the two ends respectively close to the two fixing plates 311) is no less than 5° and no more than 40° (i.e., between 5° and 40°). As such, when the cross-flow wind turbine 31 is in operation, each part on a same blade 315 may pass through the minimum gap between the cross-flow wind turbine 31 and the volute 33 at a different time point, diversifying the types and frequencies of noise generated at each part on the same blade 315.

[0039] As such, it should be understood that according to the technical solution of the present disclosure, each blade 315 of the cross-flow wind turbine 31 is disposed twisted along the axial direction of the cross-flow wind turbine 31, and the relative twisting angle at the two ends of each blade 315 no less than 5° and no more than 40°, so that when the cross-flow wind turbine 31 works, each part on the same blade 315 can pass through the minimum gap between the cross-flow wind turbine 31 and the volute 33 at different time points, diversifying the types and frequencies of noises generated at each part on the same blade. Thus, the resonance peak caused by noise superposition of a same type and frequency is avoided, i.e. the noise frequency has been less concentrated, with the noise intensity reduced. the working noise of the fan heater 100 is thereby reduced, and the use comfortability for users has been improved.

[0040] As shown in Fig. 3, the blades 315 are obliquely disposed between the two fixing plates 311 along the axial direction of the cross-flow wind turbine 31, and an inclined angle θ formed between the blades 315 and the fixing plates 311, is no less than 85° and no more than 88°.

[0041] Specifically, each blade 315 has an elongated shape, and each blade 315 is an inclined blade 315 or a spiral blade 315 obliquely disposed along the axial direction of the cross-flow wind turbine 31 (i.e., the vertical direction, i.e., the up-down direction). Namely, the extending direction of each blade 315 is not parallel to the axial direction of the cross-flow wind turbine 31, and the included angle θ between each blade 315 and the fixed plate 311 is no less than 85° and no more than 88°. As such, compared with the vertical blades (i.e., the blades 315 disposed perpendicularly to the fixed plate 311), it firstly further ensures that each part on a same blade 315 may pass through the minimum gap between the cross-flow wind turbine 31 and the volute 33 at a different time point, thus further avoiding the generation and superposition of noise of a same type and frequency, avoiding the frequency concentrated noise and reducing the noise intensity. Further, such arrangement can also enable each blade 315 in the circumferential direction of the cross-flow wind turbine 31 to pass through the minimum gap between the cross-flow wind turbine 31 and the volute 33 at a different time point, thus avoiding the noise of a same type and frequency generated by each blade 315, further avoiding the superposition of the noise of the same type and frequency generated by each blade 315, and further reducing the noise intensity.

[0042] As shown in Fig. 4, the cross section of the blade 315 is arc, and the chord length of the arc ranges from 6mm to 8mm.

[0043] Specifically, the cross-section of the blade 315 in the horizontal plane perpendicular to the axis of the cross-flow wind turbine 31 is approximately arc-shaped, and the chord length of the arc ranges from 6mm to 8mm.

[0044] The thickness of the blade 315 ranges from 0.3mm to 0.5mm.

[0045] The outer diameter D of the cross-flow wind turbine 31 ranges from 30mm to 100mm, and/or the length of the cross-flow wind turbine ranges from 150mm to 600mm.

[0046] The wheel diameter ratio d/D of the cross-flow wind turbine 31 ranges from 0.7 to 0.85.

[0047] Specifically, further referring to Fig. 4, the side of each blade 315 close to the axis of the cross-flow wind turbine 31 is approximately located on circumference of a same circle, and the ratio d/D regarding the diameter d of the circle to the outer diameter D of the cross-flow wind turbine 31 ranges from 0.7 to 0.85.

[0048] Through such setting of the above parameters, the air volume of the cross-flow wind turbine 31 can be effectively increased, bringing less material consumption and a lighter weight, thus effectively reducing the load of the driving motor 35 at a fixed air volume, and further reducing the working noise of the fan heater 100.

[0049] As shown in Fig. 4, the number of blades 315 of the cross-flow wind turbine 31 ranges from 18 to 25. Such arrangement enables the air intake and sweeping of the blades 315, so that the cross-flow wind turbine 31 can generate a larger air volume. Thereby the load of the motor 35 is reduced under a certain air volume condition, further reducing the working noise of the fan heater 100.

[0050] As shown in Fig. 6, in at least another embodiment of the cross-flow wind turbine 31 of the present disclosure, the cross-flow wind turbine 31 includes a plurality of first blades 315a and a plurality of second blades 315b, the width of the first blades 315a is greater than the width of the second blades 315b, and the plurality of first blades 315a and the plurality of second blades 315b are alternately disposed.

[0051] Specifically, the chord length of the first blade 315a is set to 7.4mm, and its wheel diameter ratio is set to 0.79; while the chord length of the second blade 315b is set to 7.0mm, with a wheel diameter ratio being set to 0.78.

[0052] As such, the large and small blades are alternately disposed, which not only can maintain a higher air volume, but also can utilize the large and small blades to alternately perform the air sweeping, effectively disperses the noise frequency due to the air sweeping by the blades 315, and reduces the howling sound induced by excessively strong noise at the same frequency band, thereby effectively reducing the working noise of the fan heater 100.

[0053] In addition, in at least yet another embodiment of the cross-flow wind turbine 31 of the present disclosure, a distance between two of the first blades and the second blades is alternately changed. Specifically, the blades 315 can be alternately disposed at an alternatively changed intervals at 5.0mm and 5.3mm. As such, the noise intensity can also be dispersed to alleviate noise.

[0054] The present disclosure further proposes a fan heater 100, which includes a shell 50 and an air passage assembly 30 disposed in the shell 50, in which the air passage assembly 30 includes a volute 33 and a cross-flow wind turbine 31 as described above. Since the fan heater 100 takes all the technical solutions of the aforementioned embodiments, it has at least all the beneficial effects brought by the technical solutions of these embodiments, which will thus not be described in detail herein. The cross-flow wind turbine 31 is disposed in the volute 33.

[0055] As shown in Figs. 2 and 5, one end of the cross-flow wind turbine 31 is provided with a rotating shaft 3111, the volute 33 is provided with a bearing sleeve 331, and the rotating shaft 3111 is accommodated in the bearing sleeve 331.

[0056] In the present embodiment, a rotating shaft 3111 is fixedly disposed on a fixing plate 311 positioned at the upper end of the cross-flow wind turbine 31, the rotating shaft 3111 is protruded on the surface of the fixing plate 311 facing the volute 33. Correspondingly, a bearing sleeve 331 is fixedly disposed at the position of the volute 33 facing the rotating shaft 3111, and a bearing is fixedly disposed in the bearing sleeve 331. The rotating shaft 3111 is accommodated in the bearing sleeve 331 and inserted into the inner ring of the bearing. Specifically, the bearing sleeve 331 may be a rubber bearing sleeve.

[0057] As such, the vibration in the rotation of the cross-flow wind turbine 31 can be effectively reduced, which enables the rotation of the cross-flow wind turbine 31 and the structure of the fan heater 100 more stable. Further, the reduction in vibration as well as the more stable structure would lead to the alleviation of the noise of the fan heater 100.

[0058] As shown in Figs. 2 and 3, a shaft sleeve 3113 is disposed at an end of the cross-flow wind turbine 31 where the rotating shaft 3111 is not disposed. The air passage assembly 30 further includes a motor 35 disposed in the volute 33; the shaft sleeve 3113 is sleeved on an output shaft 351 of the motor 35.

[0059] In the present embodiment, the fixing plate 311 located at one end of the cross-flow wind turbine 31 where the rotating shaft 3111 is not disposed. The shaft sleeve 3113 is sleeved and fit on the output shaft 351 of the motor 35. As such, as the motor 35 rotates, the output shaft 351 of the motor 35 drives the shaft sleeve 3113 to rotate. Then the shaft sleeve 3113 fixed on the fixed plate drives the cross-flow wind turbine 31 to rotate. The rotating shaft 3111 at the other end then rotates in the bearing sleeve 331. Specifically, the sleeve 3113 can be a silicone sleeve, and is connected with the output shaft 351 of the motor 35 in an interference fit without screws, and the assembly is simple and convenient. Further, the saving of parts and components reduces the vibration between these parts and components and also alleviate the load of the motor 35 on the other hand, effectively alleviating the noise of the fan heater 100.

[0060] The above is only the preferred embodiment of the present application and is not therefore limiting the scope of the present application. Any equivalent structure or process change made by using the contents of the present specification and drawings, or directly or indirectly applied in other related technical fields, shall be included in the protection scope of the present application.

Claims

1. A cross-flow wind turbine applied to a fan heater, comprising two fixing plates oppositely disposed, and a plurality of blades connected between the two fixing plates, the plurality of blades being disposed at intervals along an outer edge of each fixing plate, wherein the blades are twisted along an axial direction of the cross-flow wind turbine, and a relative twisting angle at both ends of one of the blades is no less than 5° and no more than 40°.
2. The cross-flow wind turbine of claim 1, wherein the blades are obliquely disposed between the two fixing plates along the axial direction of the cross-flow wind turbine, and wherein an included angle θ formed between one of the blades and one of the fixing plates, is no less than 85° and no more than 88°.
3. The cross-flow wind turbine of claim 1, wherein a cross section of one of the blades has an arc shape with a chord length 6 mm to 8 mm.
4. The cross-flow wind turbine of claim 3, wherein a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.
5. The cross-flow wind turbine of claim 1, wherein a thickness of one of the blades ranges from 0.3 mm to 0.5 mm.
6. The cross-flow wind turbine of claim 1, wherein an outer diameter D of the cross-flow wind turbine ranges from 30 mm to 100 mm, and/or wherein a length of the cross-flow wind turbine ranges from 150 mm to 600 mm.
7. The cross-flow wind turbine of claim 1, wherein the cross-flow wind turbine comprises no less than 18 and no more than 25 blades.
8. The cross-flow wind turbine of claim 1, wherein a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.
9. The cross-flow wind turbine of claim 1, wherein the cross-flow wind turbine comprises a plurality of first blades and a plurality of second blades, wherein one of the first blades and one of the second blades are alternately disposed; a width of the one of the first blades is greater than a width of the one of the second blades; and/or,

wherein distances between two of the first blades and the second blades are alternately changed.

10. A fan heater, comprising
a shell, and

an air passage assembly disposed in the shell and comprising a volute and a cross-flow wind turbine as claimed in claim 1, the cross-flow wind turbine (31) is disposed in the volute.

11. The fan heater of claim 10, further comprising:

a rotating shaft disposed at a first end of the cross-flow wind turbine, and
a bearing sleeve disposed on the volute to accommodate the rotating shaft.

12. The fan heater of claim 11,

wherein a shaft sleeve is disposed at a second end of the cross-flow wind turbine, and
wherein the air passage assembly further comprises a motor disposed in the volute; the shaft sleeve is sleeved on an output shaft of the motor.

13. The fan heater of claim 10, wherein

the blades are obliquely disposed between the two fixing plates along the axial direction of the cross-flow wind turbine, wherein
an inclined angle θ formed between the blades and the fixing plates, is no less than 85° and no more than 88° .

14. The fan heater of claim 10, wherein

a cross section of one of the blades has an arc shape with a chord length 6 mm to 8 mm.

15. The fan heater of claim 14, wherein

a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.

16. The fan heater of claim 10, wherein

a thickness of one of the blades ranges from 0.3 mm to 0.5 mm.

17. The fan heater of claim 10, wherein

an outer diameter D of the cross-flow wind turbine ranges from 30mm to 100mm, and/or a length of the cross-flow wind turbine ranges from 150mm to 600mm.

18. The fan heater of claim 10, wherein

the cross-flow wind turbine comprises no less than 18 and no more than 25 blades.

19. The fan heater of claim 10, wherein

a wheel diameter ratio d/D of the cross-flow wind turbine ranges from 0.7 to 0.85.

20. The fan heater of claim 10, wherein

the cross-flow wind turbine comprises
a plurality of first blades and a plurality of second blades, wherein
one of the first blades and one of the second blades are alternately disposed; a width of the one of the first blades is greater than a width of the one of the second blades; and/or,
a distance between two of the first blades and the second blades is alternately changed.

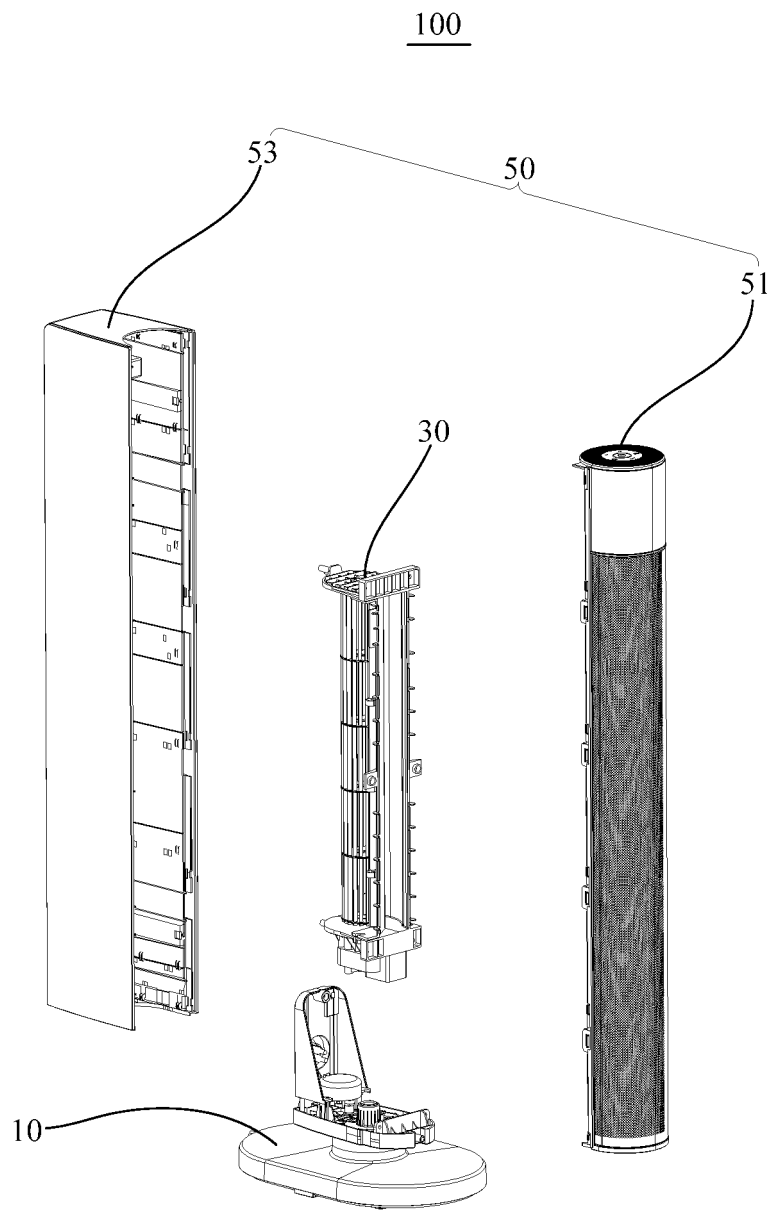


Fig. 1

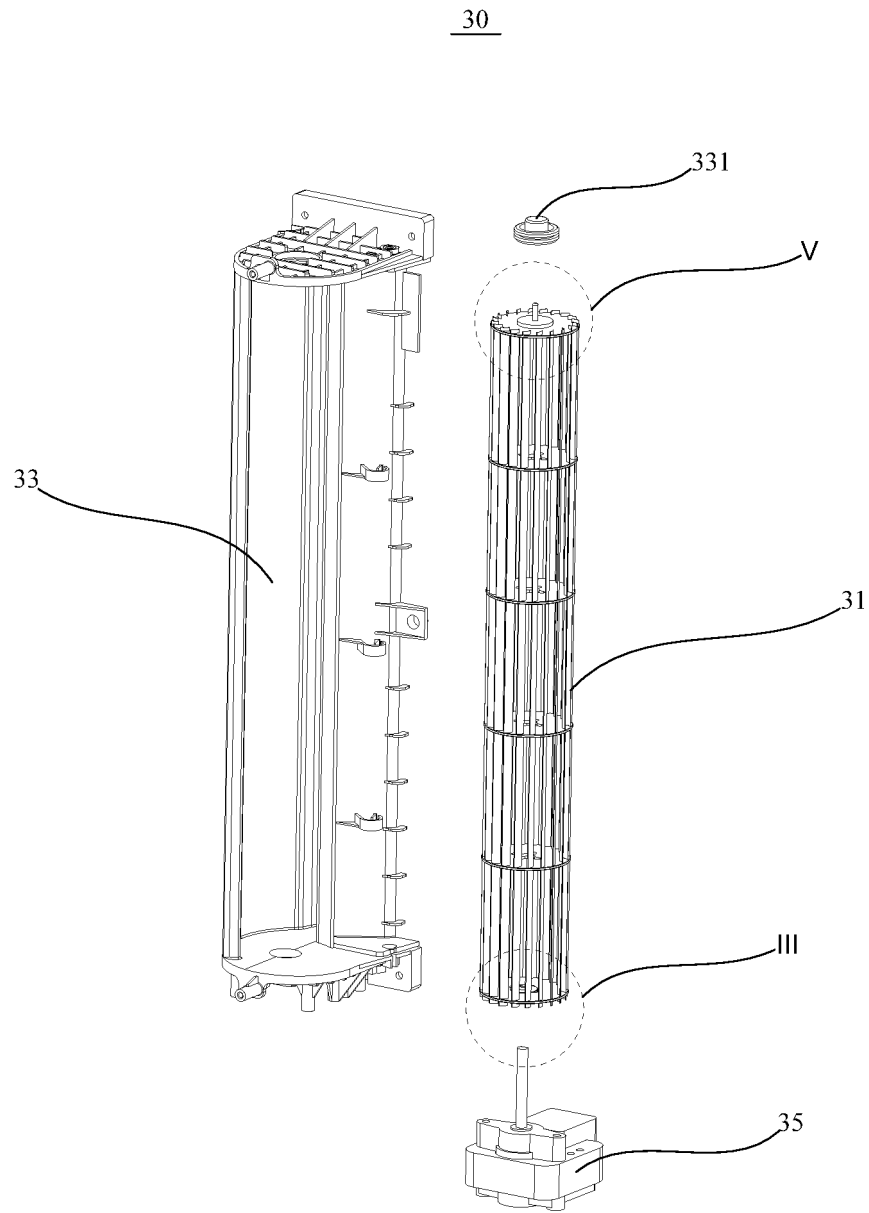


Fig. 2

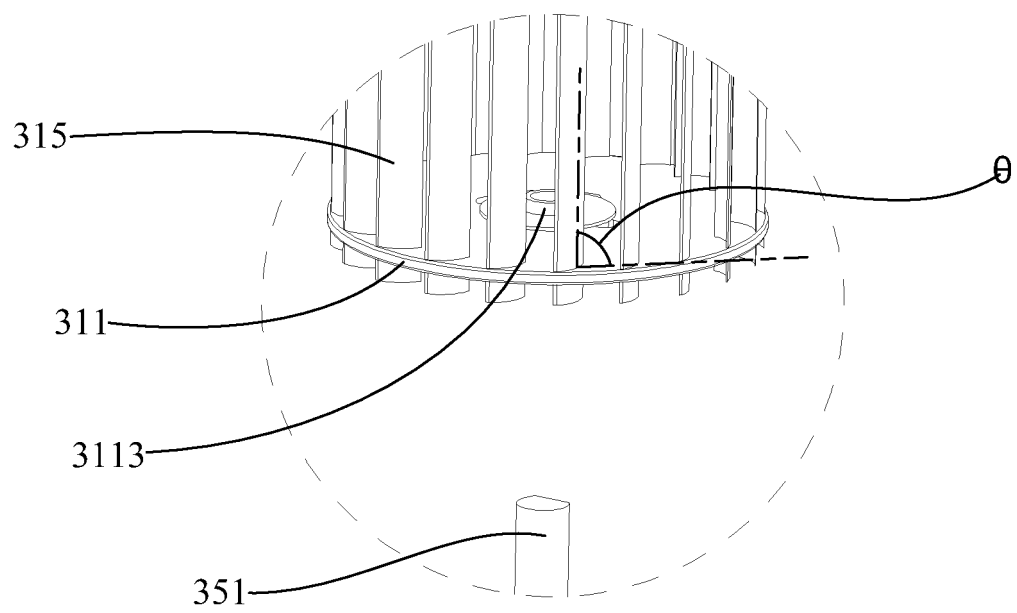


Fig. 3

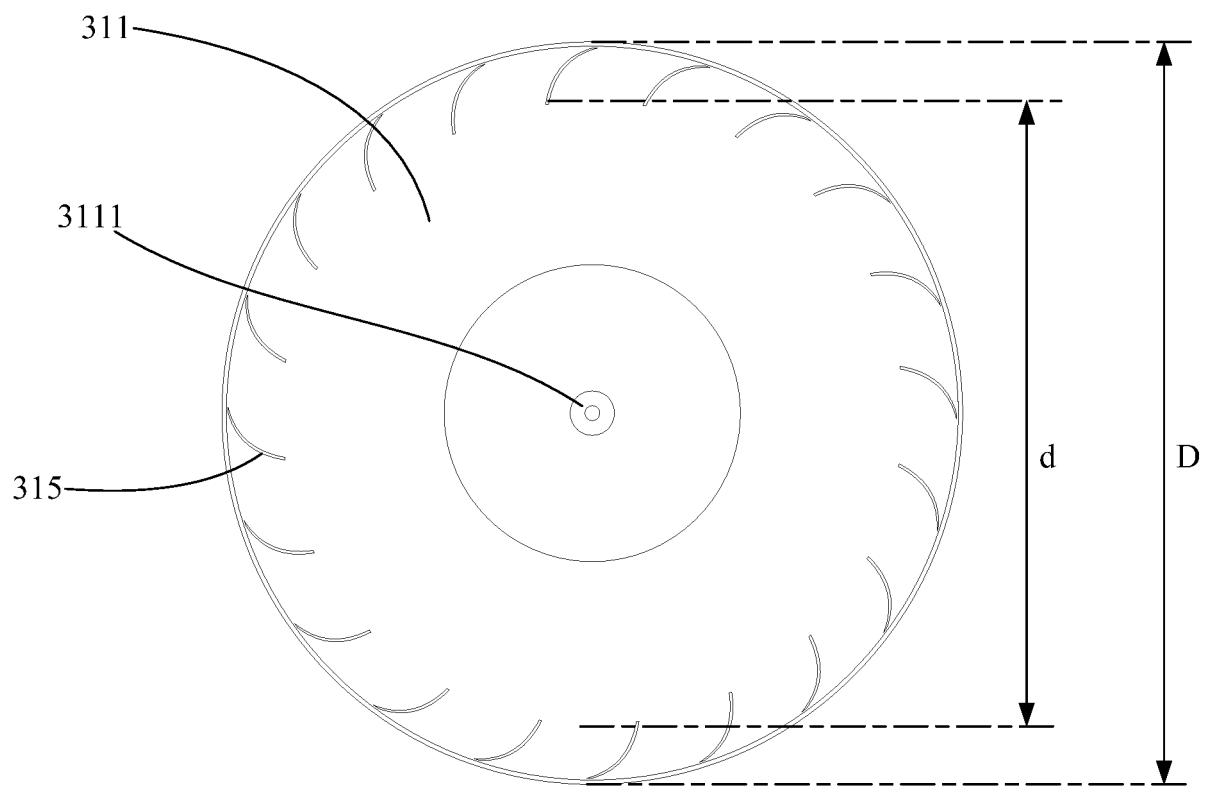


Fig. 4

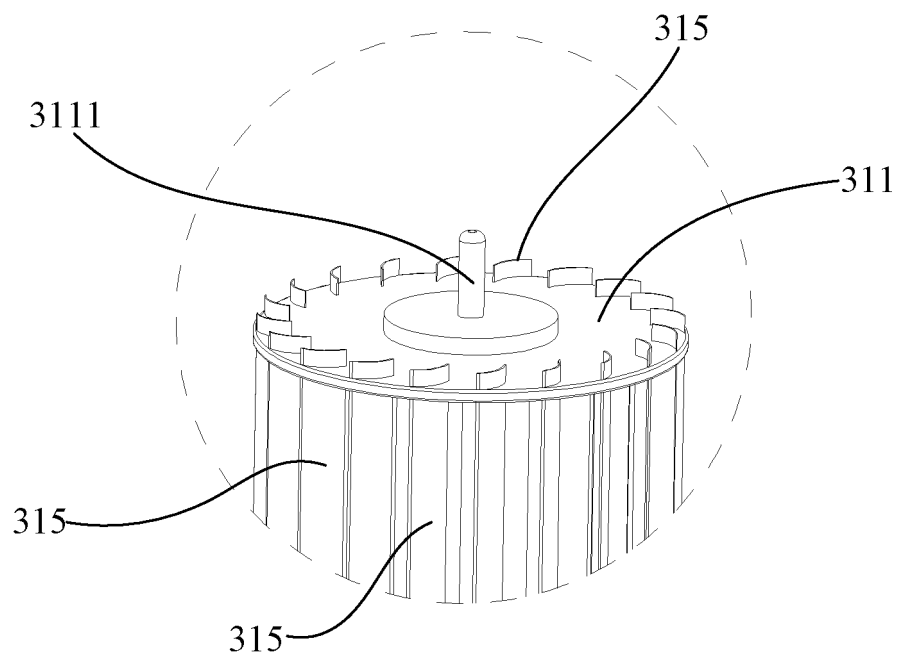


Fig. 5

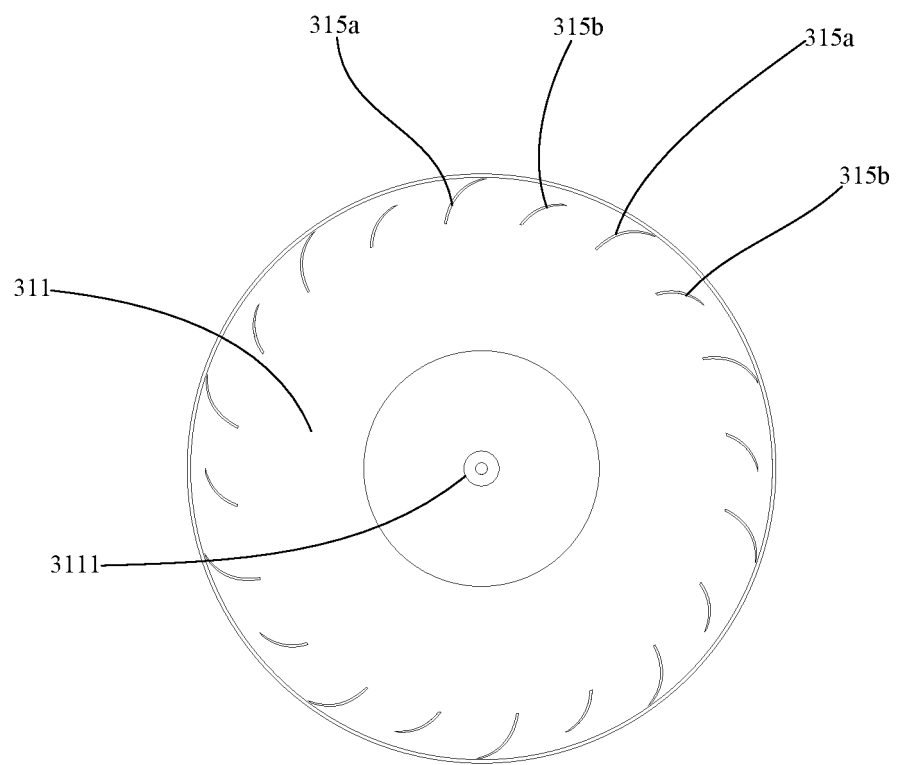


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/083795

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/28 (2006.01) i; F04D 29/30 (2006.01) i; F04D 29/66 (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; 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)

CNKI; CNABS; VEN:横流, 横向, 贯流, 风机, 电扇, 叶轮, 风轮, 风叶, 风扇, 角度, 度数, 夹角, 扭, 扇叶, 叶片, 大, 小, 主, 副, 第一, 第二, 长, 短, big, small, first, second, main, assistant, vice+, long, short, paddle?, leaf, leaves, blade?, vane?, flow+, cross, cross-flow+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 206917925 U (GUANGDONG MIDEA ENVIRONMENT APPLIANCES MFG CO., LTD. et al.) 23 January 2018 (23.01.2018), claims 1-11, description, paragraphs [0032]-[0062], and figures 1-6	1-20
X	CN 206111665 U (FOSHAN DONGLI PLASTIC CO., LTD.) 19 April 2017 (19.04.2017), description, paragraphs [0002] and [0017]-[0022], and figures 1-5	1-8, 10-19
X	CN 201221497 Y (LI, Gongchuan et al.) 15 April 2009 (15.04.2009), description, specific embodiment, and figure 5	1-8, 10-19
A	CN 104061176 A (SAMSUNG ELECTRONICS CO., LTD.) 24 September 2014 (24.09.2014), entire document	1-20

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

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“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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/083795

5	C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
10	A	JP 4687675 B2 (MITSUBISHI ELECTRIC CORPORATION) 25 May 2011 (25.05.2011), entire document	1-20
	A	JP 2013079617 A (HITACHI APPLIANCES INC.) 02 May 2013 (02.05.2013), entire document	1-20
15			
20			
25			
30			
35			
40			
45			
50			
55			

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2018/083795

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 206917925 U	23 January 2018	None	
CN 206111665 U	19 April 2017	None	
CN 201221497 Y	15 April 2009	None	
CN 104061176 A	24 September 2014	KR 20140115192 A	30 September 2014
		RU 2636909 C2	28 November 2017
		US 2014286800 A1	25 September 2014
		US 9624932 B2	18 April 2017
		EP 2781761 A1	24 September 2014
		AU 2014238673 B2	04 August 2016
		RU 2015139892 A	23 March 2017
		WO 2014148793 A1	25 September 2014
		AU 2014238673 A1	06 August 2015
JP 4687675 B2	25 May 2011	JP 2008241188 A	09 October 2008
JP 2013079617 A	02 May 2013	WO 2013051297 A1	11 April 2013