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(54) **AIR-OUTLET PROTECTION STRUCTURE, OUTDOOR UNIT OF AIR CONDITIONER AND METHOD FOR DESIGNING AIR-OUTLET PROTECTION STRUCTURE**

(57) The invention discloses an air outlet protection structure, an outdoor unit of an air conditioner and a method for designing an air outlet protection structure. The air outlet protection structure comprises: a central circular disk (10); and a radiating rib (20), extending from an outer edge of the central circular disk (10) to a direction away from the central circular disk (10). An included angle between a first side surface (21) of the radiating rib (20) and a central axis of the central circular disk (10) is α , as formula (I), where V_r is a flowing velocity of an airflow in a rotation direction of a blade, V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface (21) of each radiating rib (20) to the central axis of the central circular disk (10), and f is a rotation frequency of the blade shaft. The air outlet protection structure, the outdoor unit of the air conditioner and the method for designing an air outlet protection structure are determined according to the characteristics of a flow field of an air duct, and can reduce the hindering effect of an air outlet protection apparatus on a fluid as far as possible, thereby improving

the air output volume of a fan and reducing the noise of the entire outdoor unit of the air conditioner.

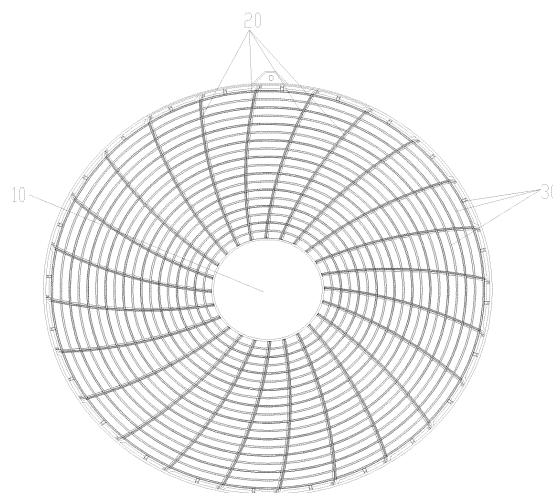


Fig. 1

Description

Technical field of the invention

[0001] The invention relates to the technical field of air conditioners, and in particular to an air outlet protection structure, an outdoor unit of an air conditioner and a method for designing an air outlet protection structure.

Background of the invention

[0002] In order to improve the heat exchange effect of a heat exchanger of an outdoor unit of an air conditioner, an air duct system will be designed in front of the heat exchanger generally. By means of forced convection, the heat exchange amount of the system is improved. A majority of fan systems of conventional outdoor units adopt axial flow fans which have the advantages of large air volume, low power consumption and the like and are widely applied to the industry of air conditioners.

[0003] Since the fan systems belong to rotation machinery structures and are relatively high in rotation velocity, it is necessary to satisfy a basic safety standard such as GB/T 4208-2008. In order to prevent a person from touching a running fan blade structure, it is necessary to perform a pointing test. A higher requirement is made for the strength and clearance of a protection grid structure.

[0004] In order to satisfy basic running safety, a protection grid structure will be mounted at an air outlet of each fan system. However, after the protection structure is added, the resistance of an air duct will be increased so as to bring negative effects to the system. For example, generally, the air volume will be reduced, and the noise will be increased, thereby reducing the overall performance of the fan system.

[0005] The conventional protection structure only satisfies electrical safety standards and structural strength generally, and a basic structural form adopts criss-crossed ribs. In order to facilitate structural design, the overall effects of the protection structure on the fan system are not much considered, that is, a flow field of an air duct is not considered, thereby reducing the performance of the fan system.

[0006] By looking up and analyzing relevant patents, it is determined that various air outlet protection structures pay less attention to improvement of an air outlet flow field currently. It is shown as follows.

1) In order to facilitate mould stripping, mould drawing is performed only in an axial direction (identical to a mould stripping direction) of a fan blade. For example, a crisscrossed Chinese character "田"-shaped structure is adopted, and mould drawing is performed on an upper end and a lower end.

2) The angles of ribs at a windward opening are changed into acute angles, thereby reducing the air

resistance. For example, according to a patent called air outlet mesh enclosure for outdoor unit of air conditioner (CN200910161676.8), angles of radial ribs in the axial direction are changed into acute angles, thereby reducing the air resistance and increasing the air output volume.

[0007] The analysis of the conventional patent is established on the basis of qualitative analysis, and actual distribution of a flow field inside a fan is not monitored, so that the air outlet protection structure of the entire outdoor unit of the air conditioner is high in resistance and high in noise, and the performance of the fan system cannot be optimized.

Summary of the invention

[0008] The invention aims to provide an air outlet protection structure, an outdoor unit of an air conditioner and a method for designing an air outlet protection structure, which are intended to solve the problems in the conventional art that the outdoor unit of the air conditioner is high in resistance and high in noise.

[0009] In order to solve the technical problems, according to one aspect of the invention, an air outlet protection structure is provided, which may comprise: a central circular disk; and a radiating rib, extending from an outer edge of the central circular disk to a direction away from the central circular disk. An included angle between a first side surface of the radiating rib and a central axis of

the central circular disk is α , $\alpha = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}$, where

V_r is a flowing velocity of an airflow in a rotation direction of a blade, V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface of the radiating rib to the central axis of the central circular disk, and f is a rotation frequency of the blade shaft.

[0010] Furthermore, there may be a plurality of radiating ribs which are uniformly arranged along the periphery of the central circular disk. When the air outlet protection structure is horizontally placed, projections of the radiating ribs on a horizontal plane may be cambered.

[0011] Furthermore, the air outlet protection structure further comprises: a plurality of circumferential ribs, an interval between every two adjacent circumferential ribs being increased gradually in the direction away from the central circular disk, and the circumferential ribs and the radiating ribs being intersected to form a net structure.

[0012] Furthermore, a protrusion provided in a length direction of the radiating rib may be provided on a side, opposite to the first side surface, of the radiating rib, a protrusion direction of the protrusion is opposite to a flowing direction of the airflow, and the thickness of the radiating rib is decreased gradually in a width direction of the radiating rib from the top of the corresponding protrusion.

[0013] According to another aspect of the invention, an outdoor unit of an air conditioner is provided, which comprises a fan. The fan comprises an air outlet protection structure which refers to an above-mentioned air outlet protection structure.

[0014] According to another aspect of the invention, a method for designing an air outlet protection structure is provided. The air outlet protection structure comprises a central circular disk and a radiating rib extending from an outer edge of the central circular disk to a direction away from the central circular disk. An included angle a between a first side surface of the radiating rib and a central axis of the central circular disk is determined by a formula

$$a = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}, \text{ where } V_r \text{ is a flowing velocity of an}$$

airflow in a rotation direction of a blade, V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface of the radiating rib to the central axis of the central circular disk, and f is a rotation frequency of the blade shaft.

[0015] Furthermore, after the included angle a is determined, the method further comprises that: a plurality of circumferential ribs are provided at the periphery of the central circular disk, such that an interval between every two adjacent circumferential ribs is increased gradually, and the circumferential ribs and the radiating ribs are intersected to form a net structure.

[0016] Furthermore, a protrusion disposed in a length direction of the radiating rib may be provided on a side, opposite to the first side surface, of the radiating rib, a protrusion direction of the protrusion may be opposite to a flowing direction of the airflow, and the thickness of the radiating rib may be decreased gradually in a width direction of the radiating rib from the top of the corresponding protrusion.

[0017] By means of the technical solutions of the invention, the air outlet protection structure comprises the central circular disk and the radiating rib, the radiating rib extend from the outer edge of the central circular disk to the direction away from the central circular disk, the included angle between the first side surface of the radiating rib and the central axis of the central circular disk is

$$a, a = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}, \text{ where } V_r \text{ is the flowing velocity of}$$

the airflow in the rotation direction of the blade, V_z is the flowing velocity of the airflow in the axial direction of the blade shaft, l is the distance from the point on the first side surface of the radiating rib to the central axis of the central circular disk, and f is the rotation frequency of the blade shaft. The air outlet protection structure is determined according to the characteristics of a flow field of an air duct, and can reduce the hindering effect of an air outlet protection apparatus on a fluid as far as possible, thereby improving the air output volume of a fan and reducing the noise of the entire outdoor unit of the air conditioner.

Brief description of the drawings

[0018] The drawings forming a part of the invention are intended to provide further understanding of the invention. The schematic embodiments and descriptions of the invention are intended to explain the invention, and do not form improper limits to the invention. In the drawings:

Fig. 1 schematically shows a top view of an air outlet protection structure in the invention;

Fig. 2 schematically shows a front view of an air outlet protection structure in the invention;

Fig. 3 schematically shows a first part section view of an air outlet protection structure in the invention;

Fig. 4 schematically shows a velocity diagram of a fluid;

Fig. 5 schematically shows a second part section view of an air outlet protection structure in the invention;

Fig. 6 schematically shows a front view of a fan when an air outlet protection structure is not provided in the invention; and

Fig. 7 schematically shows a section view of an outdoor unit of an air conditioner in the invention.

[0019] Drawing mark descriptions: 10, central circular disk; 20, radiating rib; 21, first side surface; 22, protrusion; 30, circumferential rib; 40, blade; 50, motor; 60, heat exchanger; 70, flow guiding ring; 80, mounting portion; and 100, fan.

Detailed description of the embodiments

[0020] The embodiments of the invention are described below in detail with reference to the drawings. However, the invention can be implemented in multiple different modes limited and covered by claims.

[0021] As shown in Fig. 1 to Fig. 7, according to a first embodiment of the invention, an air outlet protection structure is provided, which comprises a central circular disk 10 and a radiating rib 20. The radiating rib 20 extend from an outer edge of the central circular disk 10 to a direction away from the central circular disk 10. An included angle between a first side surface 21 of the radiating rib 20 and a central axis of the central circular disk

10 is $a, a = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}$, where V_r is a flowing velocity

of an airflow in a rotation direction of a blade 40, V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface 21 of the radiating rib 20 to the central axis of the central circular disk 10, and f is a rotation frequency of the blade shaft. According to the embodiment, by means of the central circular disk 10, the strength of the entire air outlet protection structure can be improved, structures such as the blade 40 protected by the air outlet protection

structure are prevented from being damaged by deformation of the air outlet protection structure due to accidental impacts from the outside, and the airflow outside an air outlet structure can be prevented from returning. In addition, in the field of air conditioners, since a fan protected by the air outlet protection structure is an axial flow fan generally, the axial flow fan adopts a propeller-type axial flow blade, the rotation of the blade 40 acts on the airflow to blow the airflow out, and an actual flowing velocity of the airflow can be divided into the flowing velocity V_r of the airflow in the rotation direction of the blade 40 under the rotation of the blade 40 and the flowing velocity V_z of the airflow in the axial direction of the blade shaft. According to the knowledge regarding rotation machinery, in case of a certain rotation velocity of the fan, a distribution rule of the rotation velocity of the blade 40 is as follows:

$$V_r = 2\pi f l'$$

where, V_r is the flowing velocity of the airflow in the rotation direction of the blade 40, l' is a distance from a point on the blade 40 to a central axis of the blade shaft, and f is the rotation frequency of the blade shaft.

[0022] Meanwhile, in case of a certain rotation velocity of the fan, the velocity of the blade shaft remains unchanged. As shown in Fig. 4, at this time, an actual air outlet angle of a fluid can be defined as

$$a' = \frac{V_r}{V_z} = \frac{2\pi f l'}{V_z}, \text{ and according to the analysis, it can}$$

be known that the size of the air outlet angle of the fluid is in direct proportion to the distance from the point on the blade 40 to the blade shaft.

[0023] After the air outlet protection structure is provided on an outer surface of the fan, l' is equal to l , and the distribution situation of flowing of the fluid on the air outlet protection structure is consistent with that of flowing of the fluid on the blade 40. In the embodiment, as long as the included angle a between the first side surface 21 of each radiating rib 20 and the central axis of the central circular disk 10 is equal to the actual air outlet angle a' of the fluid, when the fluid flows through the air outlet protection structure, the hindering effect of the air outlet protection apparatus on the fluid can be reduced as far as possible, thereby improving the air output volume of the fan and reducing the noise of the entire fan.

[0024] In the embodiment, there are a plurality of radiating ribs 20 which are uniformly arranged along the periphery of the central circular disk 10. Thus, at a place close to the central circular disk 10, the flowing area of the fluid is small, and at a place away from the central circular disk 10, the air outlet area of the fluid is large. According to the embodiment, the air outlet area between every two adjacent radiating ribs 20 is increased gradually. According to fluid mechanics, it can be known that

in order to reduce the velocity ($V=Q/S$, where Q is air volume and S is flowing area) of the fluid, in case of the air volume to be determined, it is necessary to increase the flowing area of the fluid, thereby aiding in reducing an impact velocity of the airflow on the air outlet protection structure so as to reduce the noise. Obviously, an arrangement mode of the radiating ribs 20 in the embodiment is exactly consistent with the flowing velocity distribution of the fluid, so that the hindering effect of the air outlet protection structure on the fluid can be further reduced. It is important to note that each first side surface 21 in the embodiment is a side surface, forming a flowing channel of the fluid, of the corresponding radiating rib 20. Moreover, when the air outlet protection structure is horizontally placed, as shown in Fig. 2, projections of the radiating ribs 20 on a horizontal plane are cambered. Namely, the radiating ribs 20 are arranged along the periphery of the central circular disk 10 by means of a cambered structure. The arrangement mode of the radiating ribs 20 is consistent with an air outlet mode of an air duct, and therefore the resistance of the air outlet protection structure to air flowing out of an air outlet mechanism can be further reduced, thereby reducing the noise of the entire air outlet structure.

[0025] Preferably, the air outlet protection structure further comprises a plurality of circumferential ribs 30, an interval between every two adjacent circumferential ribs 30 is increased gradually in the direction away from the central circular disk 10, and the circumferential ribs 30 and the radiating ribs 20 are intersected to form a net structure. The air outlet structure such as the blade of the fan is protected from being damaged by the outside, thereby reducing potential safety hazards of the air outlet structure in a running process. In addition, the interval between every two adjacent circumferential ribs 30 is increased gradually, and is consistent with the air force distribution of air output from the fan, so that the noise can be well reduced.

[0026] Preferably, the circumferential ribs 30 have an annular structure, a central axis of the annular structure is overlapped with that of the central circular disk 10, and radiuses of the circumferential ribs 30 are uniformly increased in the direction away from the central circular disk 10, thereby enhancing the strength of the entire air outlet protection structure as shown in Fig. 1.

[0027] Preferably, a protrusion 22 in a length direction of each radiating rib 20 is provided on a side, opposite to the first side surface 21, of the radiating rib 20, a protrusion direction of each protrusion 22 is opposite to a flowing direction of the airflow, and the thickness of each radiating rib 20 is decreased gradually in a width direction of the radiating rib 20 from the top of the corresponding protrusion 22. In the embodiment, each protrusion 22 is provided on the side opposite to the corresponding first side surface 21. By means of each protrusion 22, the middle of the corresponding radiating rib 20 can be thick while the edge can be thin, so that the strength of each radiating rib 20 is ensured, the windward side of the ra-

diating rib 20 can be reduced, and the hindering effect of the radiating rib 20 on the fluid is reduced as far as possible. The arrangement mode of the protrusions 22 is shown in Fig. 3.

[0028] As shown in Fig. 2, the air outlet protection structure according to the embodiment further comprises a mounting portion 80, and the mounting portion 80 is provided at the outer edge of the air outlet protection structure and is configured to mount the outlet protection structure on a protected structure. In the embodiment, the mounting portion 80 is a hook fixedly provided at the outer edge of the outlet protection structure. As shown in Fig. 6, an arrow in Fig. 6 represents the rotation direction of the fan, and a clamping groove (unmarked in Fig. 6) matched with the hook is disposed on the fan 100.

[0029] According to another embodiment of the invention, an outdoor unit of an air conditioner is provided, which comprises a fan 100 and a heat exchanger 60. The fan 100 comprises a flow guiding ring 70 provided therein and a motor 50 driving a blade shaft to rotate. A specific link relationship is shown in Fig. 7, an area A in Fig. 7 is an airflow return area, and an area B is an air outlet flow line. In the embodiment, the fan 100 further comprises an air outlet protection structure. The air outlet protection structure is an air outlet protection structure in the above-mentioned embodiment.

[0030] According to another embodiment of the invention, a method for designing an air outlet protection structure is provided. In the embodiment, the air outlet protection structure comprises a central circular disk 10 and a radiating rib 20 extending from an outer edge of the central circular disk 10 to a direction away from the central circular disk 10. An included angle α between a first side surface 21 of the radiating rib 20 and a central axis of the central circular disk 10 is determined by a formula

$$\alpha = \frac{V_r}{V_z} = \frac{2\pi fl}{V_z}, \text{ where } V_r \text{ is a flowing velocity of an}$$

airflow in a rotation direction of a blade 40, V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface 21 of the radiating rib 20 to the central axis of the central circular disk 10, and f is a rotation frequency of the blade shaft. Like the first embodiment, by means of the central circular disk 10, the strength of the entire air outlet protection structure can be improved, structures such as the blade 40 protected by the air outlet protection structure are prevented from being damaged by deformation of the air outlet protection structure due to accidental impacts from the outside, and the airflow outside the air outlet structure can be prevented from returning. According to the deduction of the first embodiment, it can be known that the included angle α between the first side surface 21 of the radiating rib 20 of the air outlet protection structure and the central axis of the central circular disk 10 is determined according to the characteristics of a flow field of an air duct, and the hindering effect of an air outlet protection apparatus on the fluid can be reduced as far as

possible, thereby improving the air output volume of a fan and reducing the noise of the entire fan.

[0031] After the included angle α is determined, the method for designing an air outlet protection structure according to the embodiment further comprises that: a plurality of circumferential ribs 30 are provided at the periphery of the central circular disk 10, so that an interval between every two adjacent circumferential ribs 30 is increased gradually, and the circumferential ribs 30 and the radiating ribs 20 are intersected to form a net structure. An air outlet structure such as the blade of the fan is protected from being damaged by the outside, thereby reducing potential safety hazards of the air outlet structure in a running process. In addition, the interval between every two adjacent circumferential ribs 30 is increased gradually, and is consistent with the air force distribution of air output from the fan, so that the noise can be well reduced.

[0032] Preferably, the circumferential ribs 30 have an annular structure, a central axis of the annular structure is overlapped with that of the central circular disk 10, and radiuses of the circumferential ribs 30 are uniformly increased in the direction away from the central circular disk 10, thereby enhancing the strength of the entire air outlet protection structure.

[0033] Preferably, a protrusion 22 in a length direction of each radiating rib 20 is provided on a side, opposite to the first side surface 21, of the radiating rib 20, a protrusion direction of each protrusion 22 is opposite to a flowing direction of the airflow, and the thickness of each radiating rib 20 is decreased gradually in a width direction of the radiating rib 20 from the top of the corresponding protrusion 22. In the embodiment, each protrusion 22 is provided on the side opposite to the corresponding first side surface 21. By means of each protrusion 22, the middle of the corresponding radiating rib 20 can be thick while the edge can be thin, so that the strength of each radiating rib 20 is ensured, the windward side of the radiating rib 20 can be reduced, and the hindering effect of the radiating rib 20 on the fluid is reduced as far as possible.

[0034] From the above descriptions, it can be seen that the embodiments of the invention achieve the technical effects as follow. According to the air outlet protection structure, the outdoor unit of the air conditioner and the method for designing an air outlet protection structure in the invention, the hindering effect of the air outlet protection apparatus on the fluid can be reduced as far as possible, thereby improving the air output volume of the fan and reducing the noise of the entire outdoor unit of the air conditioner.

[0035] The above is only the preferred embodiments of the invention, and is not intended to limit the invention. There can be various modifications and variations in the invention for those skilled in the art. Any modifications, equivalent replacements, improvements and the like within the spirit and principle of the invention shall fall within the protection scope of the invention.

Claims

1. An air outlet protection structure, comprising:

a central circular disk (10); and
a radiating rib (20), extending from an outer edge of the central circular disk (10) to a direction away from the central circular disk (10);
an included angle between a first side surface (21) of the radiating rib (20) and a central axis of the central circular disk (10) is a ,

$$a = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}, \text{ where } V_r \text{ is a flowing velocity}$$

of an airflow in a rotation direction of a blade (40), V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface (21) of the radiating rib (20) to the central axis of the central circular disk (10), and f is a rotation frequency of the blade shaft.

2. The air outlet protection structure according to claim 1, wherein there are a plurality of radiating ribs (20) which are uniformly arranged along the periphery of the central circular disk (10), and when the air outlet protection structure is horizontally placed, projections of the radiating ribs (20) on a horizontal plane are cambered.

3. The air outlet protection structure according to claim 1, further comprising:

a plurality of circumferential ribs (30), an interval between every two adjacent circumferential ribs (30) being increased gradually in the direction away from the central circular disk (10), and the circumferential ribs (30) and the radiating ribs (20) being intersected to form a net structure.

4. The air outlet protection structure according to claim 1, wherein a protrusion (22) provided in a length direction of the radiating rib (20) is provided on a side, opposite to the first side surface (21), of the radiating rib (20), a protrusion direction of the protrusion (22) is opposite to a flowing direction of the airflow, and the thickness of the radiating rib (20) is decreased gradually in a width direction of the radiating rib (20) from the top of the corresponding protrusion (22).

5. An outdoor unit of an air conditioner, comprising a fan (100), the fan (100) comprising an air outlet protection structure which refers to an air outlet protection structure according to any one of claims 1 to 4.

6. A method for designing an air outlet protection structure, wherein the air outlet protection structure comprises a central circular disk (10) and a radiating rib

(20) extending from an outer edge of the central circular disk (10) to a direction away from the central circular disk (10), an included angle a between a first side surface (21) of the radiating rib (20) and a central axis of the central circular disk (10) is determined by a formula $a = \frac{V_r}{V_z} = \frac{2\pi f l}{V_z}$ where V_r is a flowing velocity of an airflow in a rotation direction of a blade (40), V_z is a flowing velocity of the airflow in an axial direction of a blade shaft, l is a distance from a point on the first side surface (21) of the radiating rib (20) to the central axis of the central circular disk (10), and f is a rotation frequency of the blade shaft.

7. The method for designing an air outlet protection structure according to claim 6, wherein after the included angle a is determined, the method further comprises: a plurality of circumferential ribs (30) are provided at the periphery of the central circular disk (10), such that an interval between every two adjacent circumferential ribs (30) is increased gradually, and the circumferential ribs (30) and the radiating ribs (20) are intersected to form a net structure.

8. The method for designing an air outlet protection structure according to claim 6 or 7, wherein a protrusion (22) disposed in a length direction of each radiating rib (20) is provided on a side, opposite to the first side surface (21), of the radiating rib (20), a protrusion direction of the protrusion (22) is opposite to a flowing direction of the airflow, and the thickness of the radiating rib (20) is decreased gradually in a width direction of the radiating rib (20) from the top of the corresponding protrusion (22).

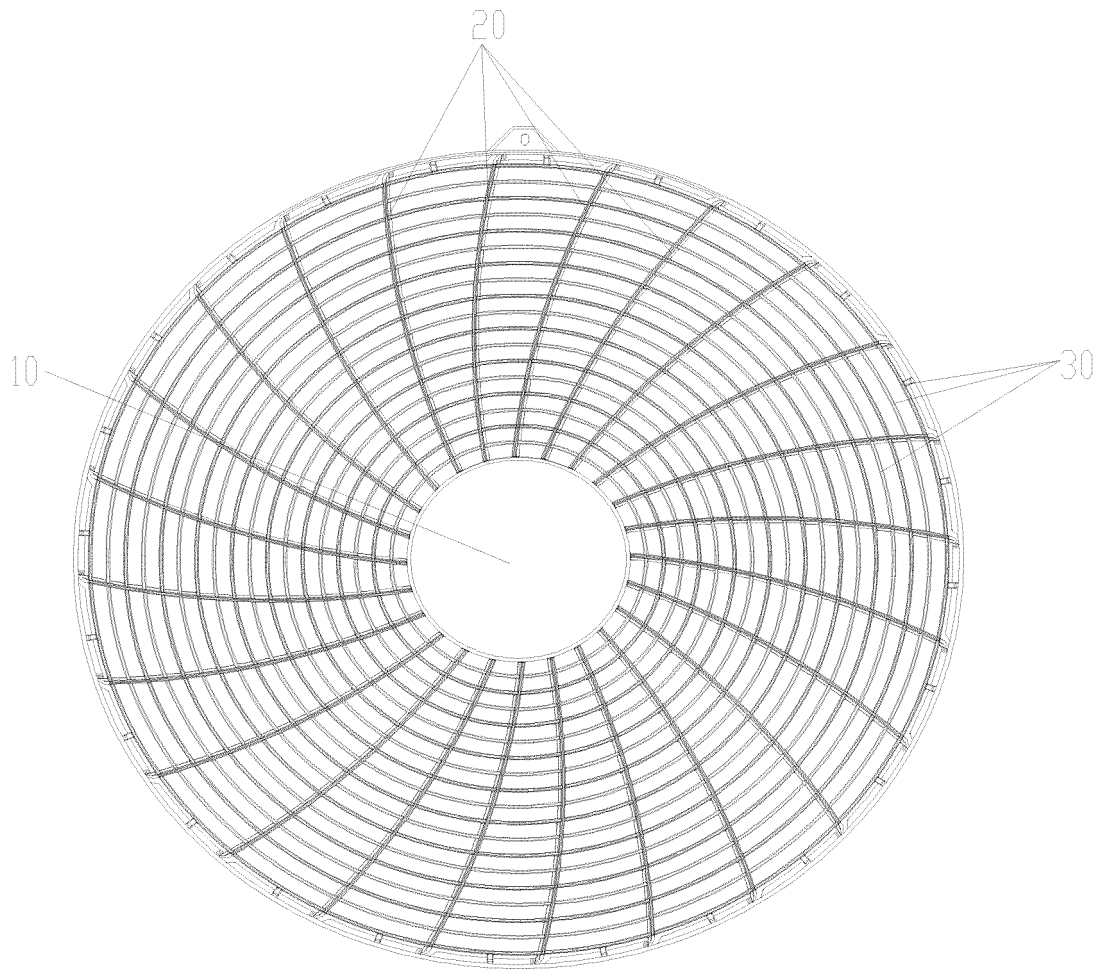


Fig. 1

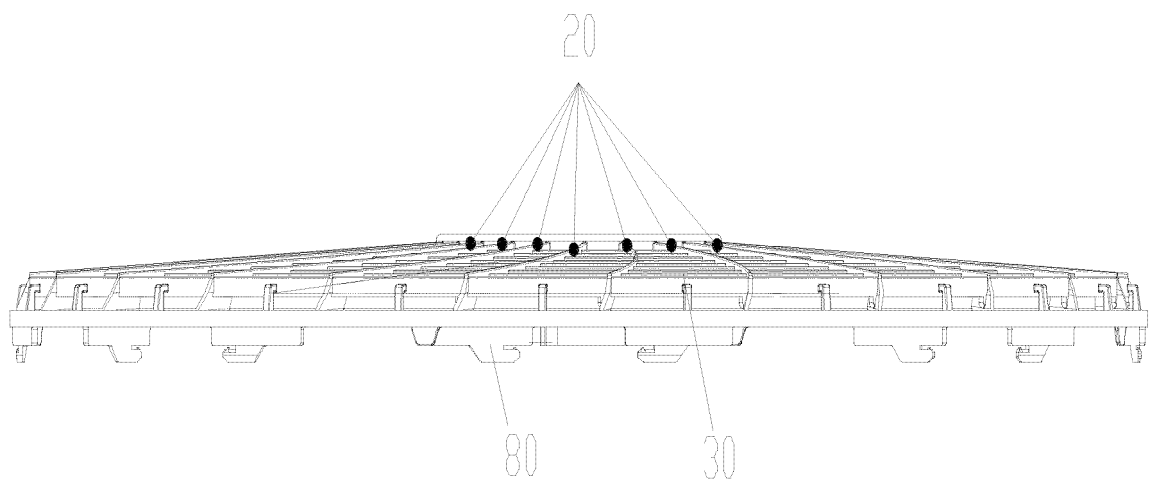


Fig. 2

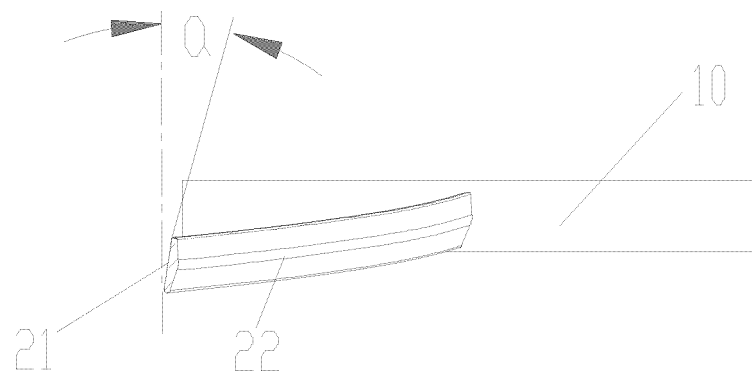


Fig. 3

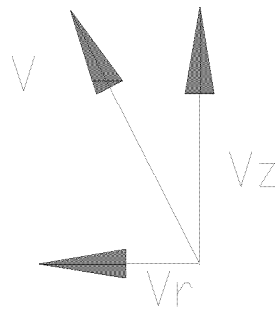


Fig. 4

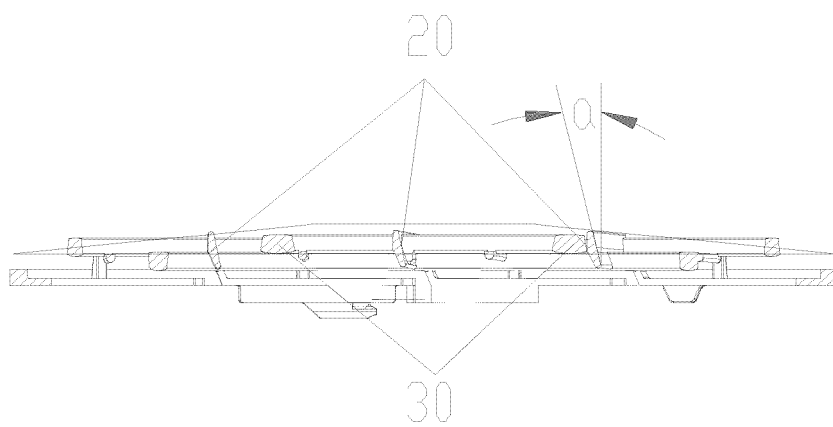


Fig. 5

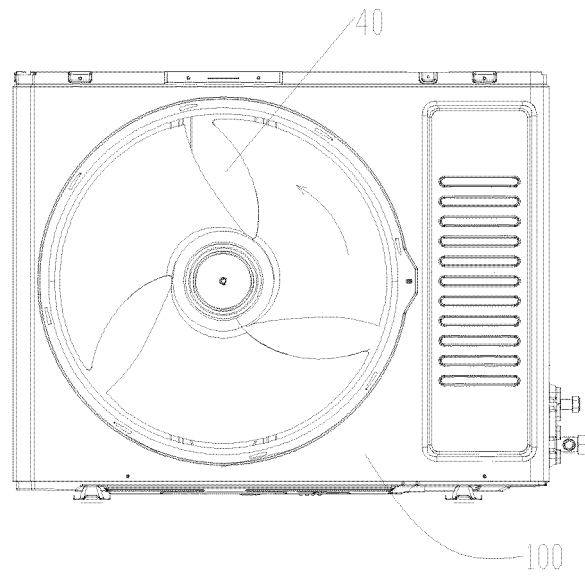


Fig. 6

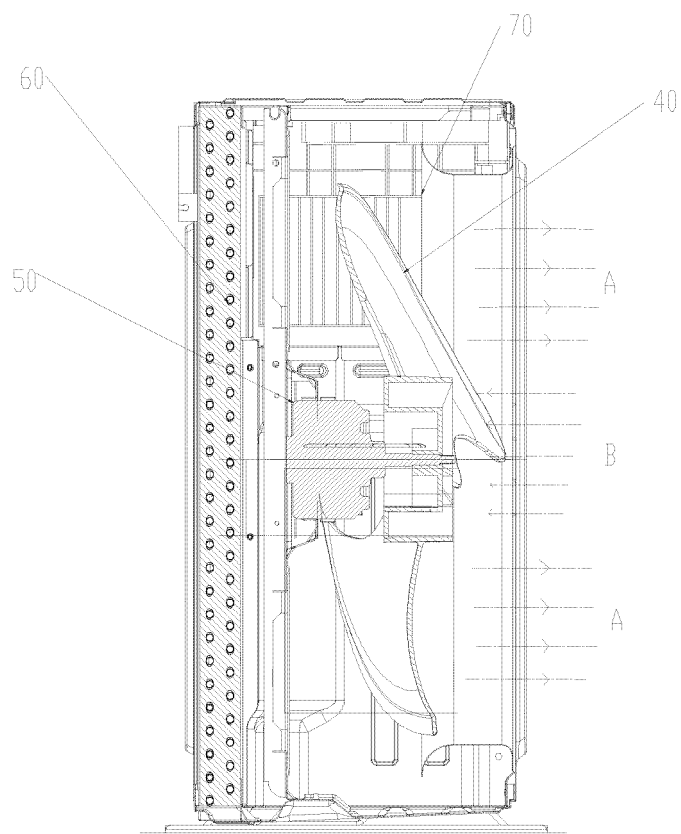


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/094423

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/52 (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)

F24F; 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, CNKI, EPODOC, WPI: fan, blower, cover, casing, shell, rib, strip?, angle, arc

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 203797829 U (ZHUHAI GREE ELECTRIC APPLIANCES INC.) 27 August 2014 (27.08.2014) claims 1 to 5, description, pages 3 to 5, and figures 1 to 7	1-8
A	CN 203384114 U (KAIPING YONGQIANG FAN MFG CO., LTD.) 08 January 2014 (08.01.2014) description, pages 1 and 2, and figure 1	1-8
A	CN 103307027 A (KAIPING YONGQIANG FAN MFG CO., LTD.) 18 September 2013 (18.09.2013) the whole document	1-8
A	US 2007268665 A1 (DELTA ELECTRONICS INC et al.) 22 November 2007 (22.11.2007)	1-8

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
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Date of the actual completion of the international search 30 January 2015	Date of mailing of the international search report 11 March 2015
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International application No.

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