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(54) **FAN AND MOBILE TERMINAL**

(57) This application provides a fan and a mobile terminal. The fan includes a housing and a centrifugal impeller disposed inside the housing and rotatable relative to the housing, where the centrifugal impeller includes a plurality of blades, at least one of the plurality of blades is provided with a plurality of grooves arranged along a radial direction of the blade, and the grooves are inclined at an angle relative to a normal direction of a radial tangent of the blade. In use, movement of an airflow relative to the blade is a combination of velocity along a tangential direction of the blade and velocity relative to a radius of the centrifugal impeller, that is, final relative velocity is not parallel to the normal direction (a direction perpendicular to the radial tangent of the blade) of the blade. Therefore, to enable air to flow through the grooves more smoothly, the grooves disposed in embodiments of this application are inclined relative to the radial direction, so that a length direction of the grooves is the same as a direction of the relative velocity as much as possible, thereby improving passage of the air through the grooves, further improving a passing effect, and reducing noise caused by the fan.

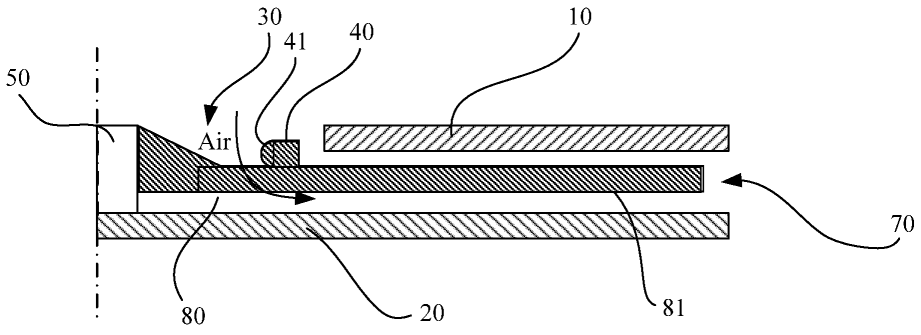

FIG. 2

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Description

TECHNICAL FIELD

[0001] This application relates to the field of mobile terminal technologies, and in particular, to a fan and a mobile terminal.

BACKGROUND

[0002] Due to thinness and lightness requirements of users, terminal products such as a notebook computer and a tablet computer need to be thinner and lighter, and need to have good heat dissipation performance, to achieve relatively good temperature experience. In addition, to improve mute experience of a user, a fan needs to have relatively low noise. In this case, a cooling fan needs to have a relatively high air volume and relatively low noise while having a smallest possible size.

[0003] Due to reduction in a size of a conventional fan, a flow field of an air inlet area of an inlet easily deteriorates, reducing an air volume, and affecting an air supply effect of the fan.

SUMMARY

[0004] This application provides a fan and a mobile terminal, to improve an air supply volume of the fan.

[0005] According to a first aspect, this application provides a fan. The fan includes a housing, the housing is provided with an air inlet and an air outlet, a centrifugal impeller is disposed inside the housing, and the centrifugal impeller may rotate relative to the housing, to transmit air from the air inlet to the air outlet. In a specific disposition, the centrifugal impeller includes a plurality of blades, and the plurality of blades are disposed around a drive shaft of the centrifugal impeller. To improve an air intake effect, at least one of the plurality of blades is provided with a plurality of grooves, the plurality of grooves are arranged along a radial direction of the blade, and the grooves are inclined at an angle relative to a normal direction of a radial tangent of the blade. The radial direction of the blade is an extending direction of the blade gradually away from the drive shaft.

[0006] In use, movement of an airflow relative to the blade is a combination of velocity along a tangential direction of the blade and velocity relative to a radius of the centrifugal impeller, that is, final relative velocity is not parallel to the normal direction (a direction perpendicular to a direction of the radial tangent of the blade) of the blade. Therefore, to enable air to flow through the grooves more smoothly, the grooves disposed in embodiments of this application are inclined relative to the radial direction, so that a length direction of the grooves is the same as a direction of the relative velocity as much as possible, thereby improving passage of the air through the grooves, further improving a passing effect, and reducing noise caused by the fan.

[0007] In a specific disposition of the grooves, the grooves may be formed in different manners, and the manners are separately described below.

[0008] In a specific implementation, the groove is a first groove inclined in a single direction, and an angle between a length direction of the first groove and the normal direction of the radial tangent of the blade is an acute angle. The acute angle may be any angle between 3° and 75°, so that the first groove can better match the relative velocity, thereby improving the passage of the air.

[0009] A plurality of first grooves may be specifically provided on different surfaces of the blade. For example, when the blade has a top surface and a bottom surface opposite to each other, the top surface and the bottom surface each may be provided a first groove, or the top surface or the bottom surface is provided with a first groove. When the blade has opposite side surfaces, the side surfaces of the blade each may also be provided with a first groove. In addition, when the first grooves are provided on the surfaces of the blade, the plurality of first grooves may be arranged periodically or non-periodically.

[0010] In addition, the first groove may be of different shapes. Specifically, a cross section of the first groove may be rectangular or triangular, or streamlined and elliptical, or of another shape.

[0011] A height of a single first groove is measured along a height direction of the blade, and ranges between 0.1% and 25% of a total height of the blade. A width of the first groove is measured along a radial length direction of the blade, and ranges between 0.1% and 25% of a total length of the blade.

[0012] In another specific implementation, the groove is a second groove of a herringbone shape. Specifically, the second groove includes a first groove body and a second groove body inclined relative to each other, and the first groove body and the second groove body each form an acute angle with the normal direction of the radial tangent of the blade. The acute angle may be any angle between 3° and 75°. In addition, for surfaces on which second grooves are specifically provided and periodicity of arrangement of the second grooves, refer to the foregoing description of the first groove.

[0013] To further improve an air supply effect, an outer end face of the blade is provided with a third groove, further improving a ventilation effect.

[0014] In addition to the foregoing grooves, an air intake effect of the fan may further be improved by adding a guide ring. Specifically, the drive shaft of the centrifugal impeller is exposed outside the air inlet, the guide ring is fixedly connected to the plurality of blades, and a surface of the guide ring facing the drive shaft is a guide surface. During air intake, air flowing in from the air inlet is guided by the guide surface of the guide ring, thereby improving an effect of air steering, reducing vortices, improving air circulation, and further improving an air intake effect. In specific use, the guide ring may be used independently, or may be used in combination with the grooves, thereby

further improving the air supply effect.

[0015] In a specific disposition, the guide ring may be a complete ring, or may be segmented. In this case, the guide ring includes a plurality of alternately disposed arc segments.

[0016] In addition, the guide ring may be specifically disposed inside the housing, or may be exposed outside the air inlet. In a specific implementation solution, the guide ring is exposed outside the air inlet.

[0017] A cross section of the guide ring may be of different shapes. For example, the cross section of the guide ring is of different shapes, such as circular, elliptical, or bullet-shaped.

[0018] According to a second aspect, a fan is provided. The fan includes a housing, the housing is provided with an air inlet and an air outlet, a centrifugal impeller is disposed inside the housing, and the centrifugal impeller may rotate relative to the housing, to transmit air from the air inlet to the air outlet. In a specific disposition, the centrifugal impeller includes a plurality of blades, and the plurality of blades are disposed around a drive shaft of the centrifugal impeller. To improve an air intake effect, a guide ring is further included, the guide ring is fixedly connected to the plurality of blades, and a surface of the guide ring facing the drive shaft is a guide surface.

[0019] In use, during air intake, air flowing in from the air inlet is guided by the guide surface of the guide ring, thereby improving an effect of air steering, reducing vortices, improving air circulation, and further improving an air intake effect.

[0020] In a specific disposition, the guide ring may be a complete ring, or may be segmented. For example, the guide ring includes a plurality of alternately disposed arc segments.

[0021] In addition, the guide ring may be specifically disposed inside the housing, or may be exposed outside the air inlet. In a specific implementation solution, the guide ring is exposed outside the air inlet.

[0022] A cross section of the guide ring may be of different shapes. For example, the cross section of the guide ring is of different shapes, such as circular, elliptical, or bullet-shaped.

[0023] According to a third aspect, this application further provides a mobile terminal. The mobile terminal includes a housing and any one of the foregoing fans disposed inside the housing. A guide ring is added to the fan, or a groove is added to the fan, or both a groove and a guide ring are added to the fan, to improve an air supply volume of the fan and reduce noise of the fan.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

FIG. 1 is a schematic structural diagram of a fan according to an embodiment of this application;

FIG. 2 is a cross-sectional view of a fan according to an embodiment of this application;

FIG. 3 is a schematic structural diagram of a centrifugal impeller according to an embodiment of this application;

FIG. 4 to FIG. 8 are each a schematic diagram of a cross section of a guide ring according to an embodiment of this application;

FIG. 9 is a schematic diagram of dimensions of a fan according to an embodiment of this application;

FIG. 10 is a schematic diagram of dimensions of a cross section of a guide ring according to an embodiment of this application;

FIG. 11 is a schematic structural diagram of another centrifugal impeller according to an embodiment of this application;

FIG. 12 is a schematic structural diagram of a blade according to an embodiment of this application;

FIG. 13 is a schematic structural diagram of another blade according to an embodiment of this application;

FIG. 14 is a schematic structural diagram of another blade according to an embodiment of this application;

FIG. 15 is a schematic diagram of an internal flow field direction of a centrifugal impeller according to an embodiment of this application;

FIG. 16 is a schematic diagram of an internal flow field direction of the blade shown in FIG. 13;

FIG. 17 is a schematic diagram of an internal flow field direction of the blade shown in FIG. 14; and

FIG. 18 is a schematic structural diagram of a mobile terminal according to an embodiment of this application.

DESCRIPTION OF EMBODIMENTS

[0025] To make the objectives, technical solutions, and advantages of the present invention clearer, the following further describes the present invention in detail with reference to the accompanying drawings. It is clear that the described embodiments are merely some rather than all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0026] In the prior art, a mobile terminal is becoming thinner, and therefore, a fan in the mobile terminal in the prior art is also becoming smaller to match the mobile terminal, causing a decrease in an air supply volume. To improve the air supply volume, an embodiment of this application provides a fan. A structure of the fan provided in this embodiment of this application is improved, to increase the air supply volume of the fan. To help understand the fan provided in this embodiment of this application, the following describes in detail the fan with reference to the accompanying drawings and specific embodiments.

[0027] First, it should be noted that, the fan provided

in this embodiment of this application is a centrifugal fan, and the centrifugal fan includes a housing and a centrifugal impeller disposed inside the housing. The centrifugal impeller is rotatably connected to the housing through a drive shaft. An axis of the drive shaft is also an axis of the centrifugal impeller. The housing is provided with an air inlet and an air outlet. In a specific disposition, there may be one air inlet or two air inlets. When there is one air inlet, the air inlet is located on one side of the centrifugal impeller. In this case, the fan is a single-side air intake fan. When there are two air inlets, the two air inlets are provided opposite to each other on two sides of the centrifugal impeller. In this case, the fan is a two-side air intake fan.

[0028] For ease of description, in this embodiment of this application, a single-side air intake fan is used as an example for description. FIG. 1 is a schematic structural diagram of a fan, and FIG. 2 is a cross-sectional view of a fan. It can be learned from FIG. 2 that, a housing includes a top cover 10 and a bottom cover 20 disposed opposite to each other, and the top cover 10 and the bottom cover 20 are connected by using a side wall. An air inlet is provided on the top cover 10, and an air outlet 70 is provided on the side wall. In use, air entering from the top cover 10 is transmitted to the air outlet 70 on the side wall through a centrifugal impeller 80, and then enters a mobile terminal. Specifically, referring to a line with an arrow in FIG. 2, the line with the arrow indicates a flow direction of the air. It can be learned from FIG. 2 that, during air circulation, the flow direction of the air inside the housing is bent at approximately ninety degrees. Due to a relatively small thickness of the top cover 10 at the air inlet, and a relatively small gap between the top cover and an inner wall surface of a system in which the top cover is located, the air has a relatively large bend at an edge of the air inlet, easily causing a vortex, and affecting an air supply volume of the air in the fan. To reduce loss of the air at the air inlet during bending, the centrifugal impeller 80 provided in this embodiment of this application is provided with a guide ring 40. FIG. 3 shows a manner of disposing the guide ring 40 on the centrifugal impeller 80. In a specific disposition, the guide ring 40 is annular, and a center of the guide ring 40 is located on an axis of the centrifugal impeller 80, to ensure that during rotation, the guide ring 40 can synchronously rotate with the centrifugal impeller 80, and can be stationary relative to the centrifugal impeller 80. As shown in FIG. 3, the guide ring 40 divides an area on the centrifugal impeller 80 into two areas: an area I and an area II. The area I is an area corresponding to the air inlet. During air intake, the air enters from the area I, flows through a blade 81 after being guided by the guide ring 40, and is guided into the area II through the blade 81. In addition, in addition to being annular, the guide ring 40 may further be of another shape, for example, a ring shape enclosed by a plurality of discontinuous arc segments, or a ring shape with a notch, or other different shapes.

[0029] Refer to FIG. 1 and FIG. 3 together. FIG. 1 is a schematic diagram of a cross section of the guide ring 40. It can be learned from a structure shown in FIG. 1 that, the guide ring 40 has a guide surface 41, and the guide surface 41 is an inner side surface of the guide ring 40. In addition, during mounting of the centrifugal impeller 80, the guide surface 41 faces an axis of the centrifugal impeller 80. When the centrifugal impeller 80 rotates, the air flows through the guide surface 41, and is bent along the guide surface 41. To improve a flow effect of the air during bending, the guide surface 41 is an arc-shaped guide surface. An arc of an edge of the guide surface 41 shown in FIG. 1 may be a different streamline arc such as a circular arc or an elliptical arc. The edge of the guide surface 41 may alternatively not be an arc, or may be non-streamlined. In addition, in a specific implementation, it only needs to be ensured that the guide surface 41 of the guide ring 40 has a particular arc, so that the flow effect of the air during bending can be improved. The guide ring has two functions. One is to use a streamlined design to reduce air resistance, and the other function is to reduce vortices generated by a fluid flowing through the cover 10. Therefore, the guide surface 41 still has a partial effect even if the guide surface 41 is not streamlined. Therefore, a specific shape of the cross section of the guide ring 40 is not limited herein. FIG. 4 to FIG. 8 show different shapes of the cross section of the guide ring 40. It can be learned from FIG. 4 to FIG. 8 that, the cross section of the guide ring 40 provided in this embodiment may be of different shapes, such as circular, elliptical, bullet-shaped, or runway-shaped. In a specific disposition of the guide ring 40, the cross section of the guide ring 40 may be of different shapes, such as a regular shape, an irregular shape, a symmetrical shape, an asymmetrical shape, or the like.

[0030] The following describes a structure of the guide ring 40 disposed on the centrifugal fan by using an example in which the cross section is that of the guide ring 40 shown in FIG. 4. Referring to FIG. 9 and FIG. 10, for ease of description, meanings of letters in FIG. 9 and FIG. 10 are described first: r1 is a radius of a drive shaft 50, r2 is an outer diameter of the top cover 10, r3 is a radius of a center point of the cross section of the guide ring 40, r4 is a radius of an air inlet 30, a is a distance from an upper surface of the guide ring 40 to an upper surface of the top cover 10, b is a width of the cross section of the guide ring 40, c is a thickness of the top cover 10, d is a distance from an outer side surface of the guide ring 40 to an inner side surface of the top cover 10, and h is a height of the guide ring 40. In a specific set, as shown in FIG. 9, the guide ring 40 is located between the drive shaft 50 and the outer diameter of the top cover 10, that is, $r1 \leq r3 \leq r2$. In the foregoing disposition manner, the guide ring 40 may be located on an inner side of the top cover 10 (located inside the air inlet 30) in the radial direction. In this case, $r1 \leq r3 \leq r4$. In the foregoing disposition manner, $d \geq 0$. When $d = 0$, it indicates that an end face of the guide ring 40 away from the drive shaft 50 is in contact with the inner side surface of

the top cover 10. Alternatively, a structure in which the guide ring 40 is embedded in the top cover 10 may be used. In this case, $r4 \leq r3 \leq r2$, and $d < 0$. In this case, the guide ring 40 is located outside the air inlet 30, and between the top cover 10 and the blade 81. When two different disposition manners are used, a has different values. When the guide ring 40 is located inside the air inlet 30, $-3\ mm \leq a \leq +3\ mm$. A negative dimension indicates that the upper surface of the guide ring 40 is higher than the upper surface of the top cover 10. A positive distance indicates that the upper surface of the guide ring 40 is lower than the upper surface of the top cover 10. A dimension of 0 indicates that the guide ring 40 and the top cover 10 are flush. When the guide ring 40 is located outside the air inlet 30, $a \geq c$. That is, a height from the upper surface of the guide ring 40 to the upper surface of the top cover 10 is greater than the thickness of the top cover 10. That is, the height of the guide ring 40 is less than a gap between blade 81 and the top cover 10. In a specific implementation solution, the guide ring 40 is located at the air inlet 30, that is, the guide surface 41 of the guide ring 40 is closer to the drive shaft 50 than the inner side surface of the top cover 10, so that an effect of air steering at the air inlet 30 can be improved by using the guide surface 41.

[0031] FIG. 10 shows dimensions of the guide ring 40. A height h of the guide ring 40 ranges between 0.01 mm and 5 mm. A width b of the guide ring 40 ranges between 0.01 mm and 15 mm. There are different dimensions, for example, h = 0.02 mm, and b = 0.05 mm; or h = 0.05 mm, and b = 0.08 mm; or h = 0.5 mm, and b = 1 mm; or h = 2 mm, and b = 5 mm; or h = 4 mm, b = 10 mm.

[0032] In addition, when the guide ring 40 is specifically fixed to the centrifugal impeller 80, the guide ring 40 may be fixed to the blade 81 of the centrifugal impeller 80 in different manners such as bonding, welding, or by using a connection member. In addition, the guide ring 40 and the centrifugal impeller 80 may alternatively be prepared integrally. Either the foregoing connection or preparation manner may be applied to the fan provided in this embodiment of this application.

[0033] In addition to the effect of air steering mentioned in the foregoing description, the guide ring 40 provided in this embodiment of this application further has the following effect: Because the guide ring 40 and the blade 81 are relatively fixed, when the centrifugal impeller 80 rotates, relative positions of the impeller 80 and the guide ring 40 are fixed, and during air circulation, the blade 81 and the guide ring 40 on both sides of the air are relatively fixed, facilitating the air circulation. In the prior art, when the centrifugal impeller rotates and the top cover rotates relative to the blade, and during air circulation, there is relative movement between the blade and the top cover on both sides of the air. Therefore, some disturbances are caused to the flow of the air. It can be learned from the foregoing description that, in the fan provided in this embodiment of this application, the impeller 80 and the guide ring 40 are relatively fixed to each other, so that an effect of air circulation can be further improved, thereby increasing an air supply volume.

[0034] In this embodiment of this application, in addition to the foregoing embodiment in which the air supply volume is improved by using the guide ring 40, the air supply volume may further be improved by improving another structure on the centrifugal impeller 80. FIG. 11 shows another structure of a fan according to an embodiment of this application. In the structure shown in FIG. 11, an air supply volume is improved by improving a structure of the blade 81 on the centrifugal impeller 80. Referring to FIG. 11, in this embodiment of this application, the air supply volume is improved by providing a groove 811 on the impeller 80 along a radial direction of the blade 81. The radial direction of the blade 81 is an extending direction of the blade 81 gradually away from the drive shaft. In a specific implementation, a rectangular blade is used for description. For ease of description of a structure and a disposition position of the groove 811, surfaces of the blade 81 are respectively named. As shown in FIG. 11, five surfaces of the blade 81 are respectively a top surface 812, a bottom surface (a surface opposite to the top surface 812), a left side surface 813, a right side surface (a surface opposite to the left side surface 813), and an outer end face 814. The top surface 812 and the bottom surface are two surfaces perpendicular to the axis of the centrifugal impeller 80. The left side surface 813, the right side surface, and the outer end face 814 are three side surfaces between the top surface 812 and the bottom surface. The outer end face 814 is an end face of the blade 81 away from the axis. The left side surface 813 and the right side surface are respectively side surfaces on both sides of the outer end face 814. In addition, along the direction of the blade 81, a direction from the axis of the centrifugal impeller 80 to the outer end face 814 of the blade 81 is the radial direction of the blade 81.

[0035] Referring to FIG. 11, to improve an air intake effect of the fan, in the fan provided in this embodiment of this application, at least one blade 81 is provided with a plurality of grooves 811, the plurality of grooves 811 are arranged along the radial direction of the blade 81, and the grooves 811 are inclined at an angle relative to a normal direction of a radial tangent of the blade 81. For each groove 811, as shown in FIG. 12 and FIG. 14, the groove 811 is inclined relative to the radial direction of the blade 81, both ends of the groove 811 are open, and there is a specified angle between a length direction of the groove 811 and the normal direction of the radial tangent of the blade 81. The length direction of the groove 811 is a direction from one opening of the groove 811 to the other opening of the groove 811. A direction of the radial tangent of the blade 81 is the radial direction of the blade 81 when the blade 81 is a straight blade, and is a tangent direction of an arc line on the blade 81 when the blade 81 is a curved blade.

[0036] Referring to FIG. 12 first, a part of the blade 81 of the fan provided in this embodiment of this application is provided with a first groove 815, the first groove 815

is provided on the top surface 812 of the blade 81. In a specific disposition, the length direction of the first groove 815 is inclined relative to the normal direction of the radial tangent of the blade 81, and an angle between the length direction of the first groove 815 and the normal direction of the tangent of the blade 81 is an acute angle. As shown in FIG. 12, an angle between the length direction of the first groove 815 and the radial direction of the blade 81 is α, where α ranges between 3° and 75°, such as 10°, 20°, 30°, 40°, 50°, or other different angles. In addition, a height of a single first groove 815 is measured along a height direction of the blade 81, and ranges between 0.1% and 25% of a total height of the blade 81. A width of the first groove 815 is measured along a radial length direction of the blade 81, and ranges between 0.1% and 25% of a total length of the blade 81. In addition, when a plurality of first grooves 815 are specifically provided, the plurality of first grooves 815 may be periodically or non-periodically distributed, and a plurality of grooves 811 may be arranged at equal intervals or at non-equal intervals. In addition, the first grooves 815 may further be provided on different surfaces of the blade 81. As shown in FIG. 13, the first grooves 815 are provided on the top surface 812 and the bottom surface of the blade 81. In addition, the outer end face 814 may be provided with a third groove 817, to further improve air passage. Similarly, the first groove 815 may alternatively be provided on the left side surface 813, the right side surface, and the outer end face 814 of the blade 81, and the groove located on the outer end face 814 is the third groove 817. Examples are not shown herein one by one. When first grooves 815 are respectively provided on the different surfaces of the blade 81, the first grooves 815 on the different surfaces may be arranged in different manners. For example, first grooves 815 located on the top surface 812 are periodically arranged, and first grooves 815 located on the bottom surface are non-periodically arranged. Alternatively, first grooves 815 on both surfaces are periodically arranged or non-periodically arranged, and both may be applied to this embodiment of this application.

[0037] In addition, a cross section of the first groove 815 may be of different shapes. First grooves 815 shown in FIG. 13 include streamlined and elliptical first grooves 815, or regular rectangular and triangular first grooves 815. Certainly, the shape of the first groove 815 is not limited to the shapes of the grooves 811 listed above. In addition, in a specific disposition, first grooves 815 provided on a same surface may be grooves 811 whose cross sections are of a same shape, or may be grooves 811 whose cross sections are of different shapes.

[0038] Referring to FIG. 14, in addition to including the first groove 815 described above, the groove 811 provided in this embodiment of this application may also be a second groove 816. The second groove 816 includes two parts, forming a herringbone-shaped groove. Specifically, the second groove 816 includes a first groove body 8161 and a second groove body 8162. The first groove body 8161 and the second groove body 8162 are inclined relative to each other, and a length direction of each of the first groove body 8161 and the second groove body 8162 forms a specified angle with the normal direction of the tangent of the blade 81. In a specific disposition, for shapes of cross sections and sizes of the first groove body 8161 and the second groove body 8162 in the second groove 816, refer to the shape of the cross section and the size of the first groove 815 shown in FIG. 12. Details are not described herein again.

[0039] In addition, in a specific disposition of the first groove 815 and the second groove 816, the first groove 815 or the second groove 816 may be located on all blades 81 of the fan, or may be located on several blades 81 of the fan. The blades 81 having features of the grooves 811 may be periodically distributed, or may be non-periodically distributed. Several consecutive blades 81 may have the features of the grooves 811, or non-consecutive blades 81 may have the features of the grooves 811. Distribution of the grooves 811 needs to be determined based on an actually measured air volume and noise spectral characteristics.

[0040] For ease of understanding of the groove 811 provided in this embodiment of this application, the following describes the groove 811 in detail with reference to a principle of the groove 811. As shown in FIG. 15, relative rotation occurs between the centrifugal impeller 80 of the fan and the top cover 10, and the top surface and the bottom surface of the blade 81 each maintain a particular gap with the top cover 10 and the bottom cover 20. Relative movement of an airflow between the top cover 10 and the blade 81 is shown in FIG. 15: Movement of the airflow relative to the blade 81 is a combination of velocity Vt along a tangential direction of the blade 81 of the centrifugal impeller 80 and velocity Vr relative to a radius of the centrifugal impeller 80, that is, final relative velocity is Va at a particular point of the blade 81. A direction of Va varies with magnitude of the radius of the blade 81. It can be learned from FIG. 15 that, the combined velocity Va of the relative movement is not parallel to the normal direction of the blade 81 (a direction perpendicular to the radial direction of the blade 81). Therefore, to allow air between the centrifugal impeller 80 and the top cover 10 to flow through the groove 811 more smoothly, a direction of the groove 811 provided in this embodiment of this application should be the same as the direction of Va as much as possible, thereby improving passage of the air through the groove 811.

[0041] The direction of Va varies geometrically with the magnitude of the radius of the blade 81, and varies in movement with a rotation speed of the centrifugal impeller 80. Therefore, there is a suitable angle selection based on a radial position of the groove 811 on the blade 81 and a rotation speed of the centrifugal impeller 80 at a common working point. Usually, an angle ranges between 3° and 75°. In a structure shown in FIG. 16, the length direction of the first groove 815 is set to be parallel to the combined Va as much as possible. In addition, to

disperse large vortices to a greater extent, a herringbone-shaped groove 811 of the blade 81 may be used. For details, refer to FIG. 17. As shown in FIG. 16 and FIG. 17, the inclined groove 811 can enable the air to flow through the groove 811 more smoothly, thereby improving a flow effect of the air.

[0042] It can be learned from the foregoing description that, when the grooves 811 are used, the features of the grooves on the surfaces of the blade 81 forcefully divide the large vortices flowing through the surfaces of the blade 81 into small vortices, thereby making energy of the vortices distributed in a wider frequency band range, and reducing concentration of energy of noise. In addition, the division of the large vortices reduces a possibility of air blocking a flow path. Particularly, in a non-design condition, an air flow status deteriorates, thereby helping the air flow more smoothly through a flow path between blades and increasing an air volume.

[0043] In a specific implementation, because a mobile terminal device such as a notebook computer or a tablet computer is becoming thinner, a size of a fan is also becoming thinner, resulting in a great limitation on a height and a thickness of a blade. To make maximum use of the features of the grooves, in the fan provided in this embodiment of this application, an inclined groove or a groove of a herringbone shape is formed on top of the blade. In addition, grooves of adjacent blades may be staggered, to maximally divide the large vortices, thereby improving an air intake effect of the fan, and reducing noise.

[0044] The guide ring 40 and the groove 811 provided in the foregoing embodiment may be used alone to improve the air intake effect of the fan, to increase the air supply volume of the fan. Alternatively, the guide ring 40 and the groove 811 provided in the foregoing embodiment may be combined to improve the air supply volume of the fan. In this case, the blade 81 of the centrifugal impeller 80 is provided with the first groove 815, or the second groove 816, or both the first groove 815 and the second groove 816, and the centrifugal impeller 80 is provided with the guide ring 40. The guide ring 40 is disposed at a position in a manner described in the foregoing embodiment. The guide ring 40 divides an area on the centrifugal impeller 80 into two areas: an area I and an area II, and the first groove 815 or the second groove 816 is provided on the area II. When the structure including the guide ring 40 and the groove 811 is used, the fan has both the guide ring 40 to improve a flow effect of air during bending, and the groove 811 to improve an effect of the air flowing through the blade 81, thereby effectively improving the air supply volume of the fan.

[0045] As shown in FIG. 18, an embodiment of this application further provides a mobile terminal. The mobile terminal includes any one of the foregoing fans 100. In a specific disposition, the mobile terminal is a common mobile terminal such as a notebook computer or a tablet computer. As shown in FIG. 18, the fan 100 is disposed inside a housing 200 of the mobile terminal. A guide ring is added to the fan 100, or a groove is added to the fan 100, or both a groove and a guide ring are added to the fan 100, to improve an air supply volume of the fan 100 and reduce noise of the fan 100.

[0046] The foregoing descriptions are merely specific implementations of the present invention, but are not intended to limit the protection scope of the present invention. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in the present invention shall fall within the protection scope of the present invention. Therefore, the protection scope of the present invention shall be subject to the protection scope of the claims.

Claims

1. A fan, comprising a housing and a centrifugal impeller disposed inside the housing and rotatable relative to the housing, wherein the centrifugal impeller comprises a plurality of blades, at least one of the plurality of blades is provided with a plurality of grooves arranged along a radial direction of the blade, and the grooves are inclined at an angle relative to a normal direction of a radial tangent of the blade.

2. The fan according to claim 1, wherein the groove is a first groove inclined in a single direction, and an angle between a length direction of the first groove and the normal direction of the radial tangent of the blade is an acute angle.

3. The fan according to claim 2, wherein the blade has a top surface and a bottom surface disposed opposite to each other, wherein the top surface and/or the bottom surface is provided with the first groove.

4. The fan according to claim 2, wherein a cross section of the first groove is rectangular or triangular.

5. The fan according to claim 1, wherein the groove is a second groove of a herringbone shape, the second groove comprises a first groove body and a second groove body inclined relative to each other, and the first groove body and the second groove body each form an angle with the normal direction of the radial tangent of the blade.

6. The fan according to any one of claims 2 to 5, wherein the blade has an outer end face, and the outer end face is provided with a third groove.

7. The fan according to any one of claims 1 to 6, wherein the fan has an air inlet, wherein a drive shaft of the centrifugal impeller is exposed outside the air inlet; and
further comprises a guide ring, wherein the guide ring is fixedly connected to the plurality of blades,

and a surface of the guide ring facing the drive shaft is a guide surface.

8. The fan according to claim 7, wherein the guide ring comprises a plurality of arc segments arranged at intervals.

9. The fan according to claim 7, wherein the guide ring is exposed outside the air inlet.

10. The fan according to claim 7, wherein a cross section of the guide ring is circular, elliptical, or bullet-shaped.

11. A fan, comprising a housing and a centrifugal impeller disposed inside the housing and rotatable relative to the housing, wherein the centrifugal impeller comprises a drive shaft and a plurality of blades connected to the drive shaft; and
further comprising a guide ring, wherein the guide ring is fixedly connected to the plurality of blades, and a surface of the guide ring facing the drive shaft is a guide surface.

12. The fan according to claim 11, wherein the guide ring comprises a plurality of arc segments arranged at intervals.

13. The fan according to claim 11, wherein the guide ring is exposed outside the air inlet.

14. The fan according to claim 11, wherein a cross section of the guide ring is circular, elliptical, or bullet-shaped.

15. A mobile terminal, comprising the fan according to any one of claims 1 to 14.

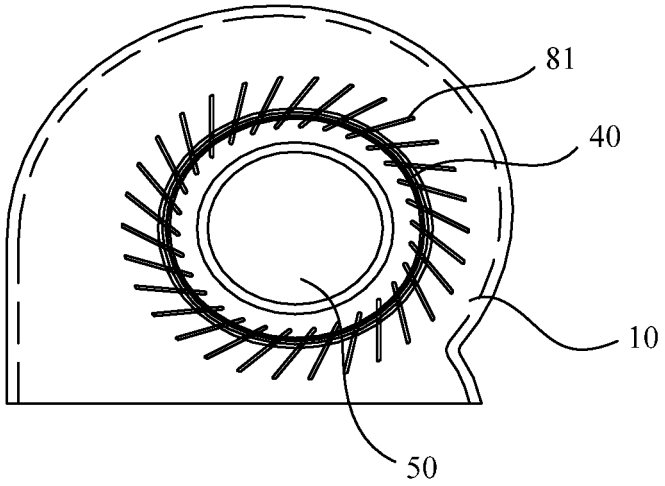

FIG. 1

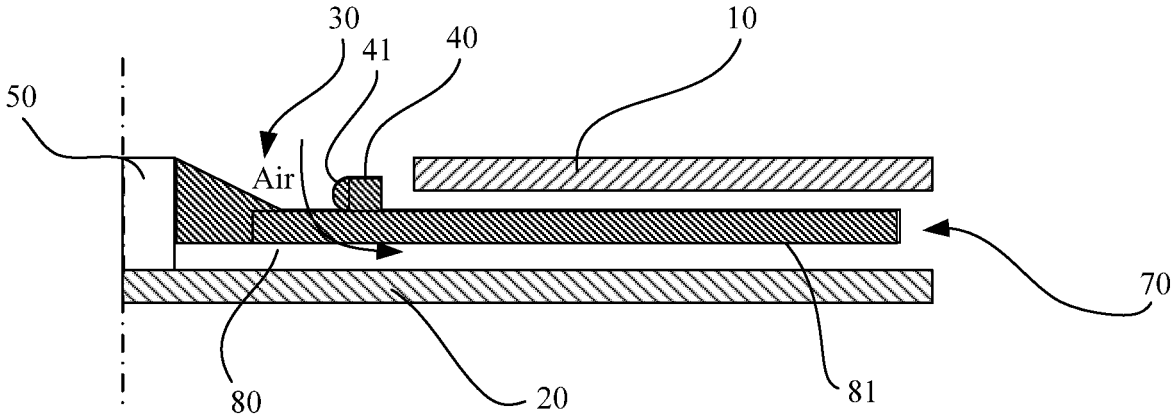

FIG. 2

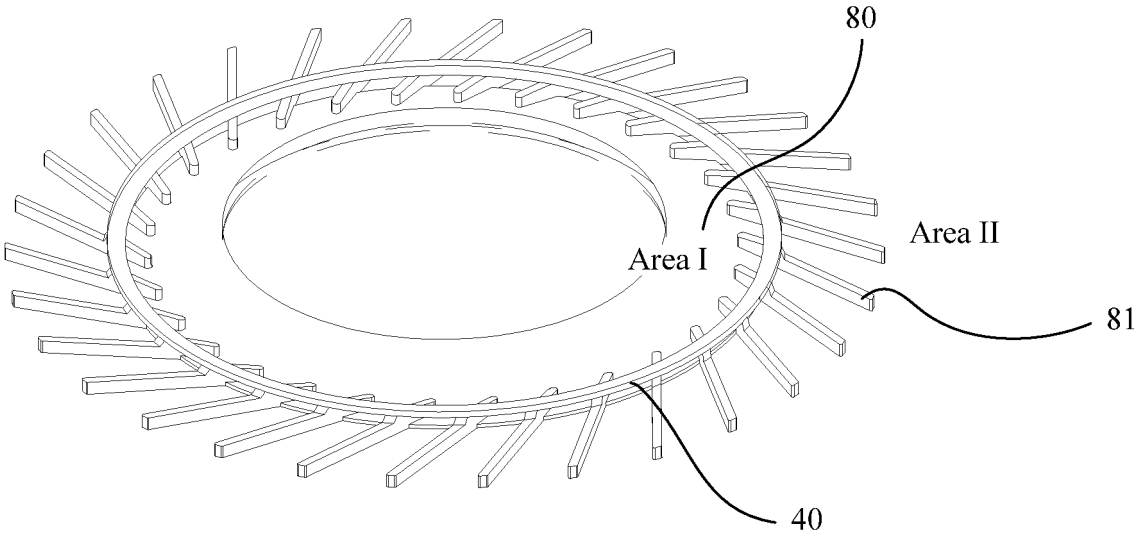

FIG. 3

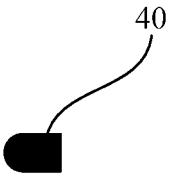

FIG. 4

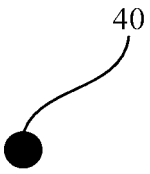

FIG. 5

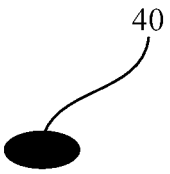

FIG. 6

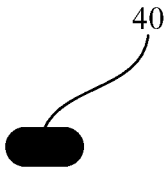

FIG. 7

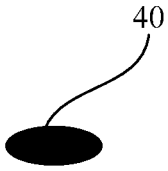

FIG. 8

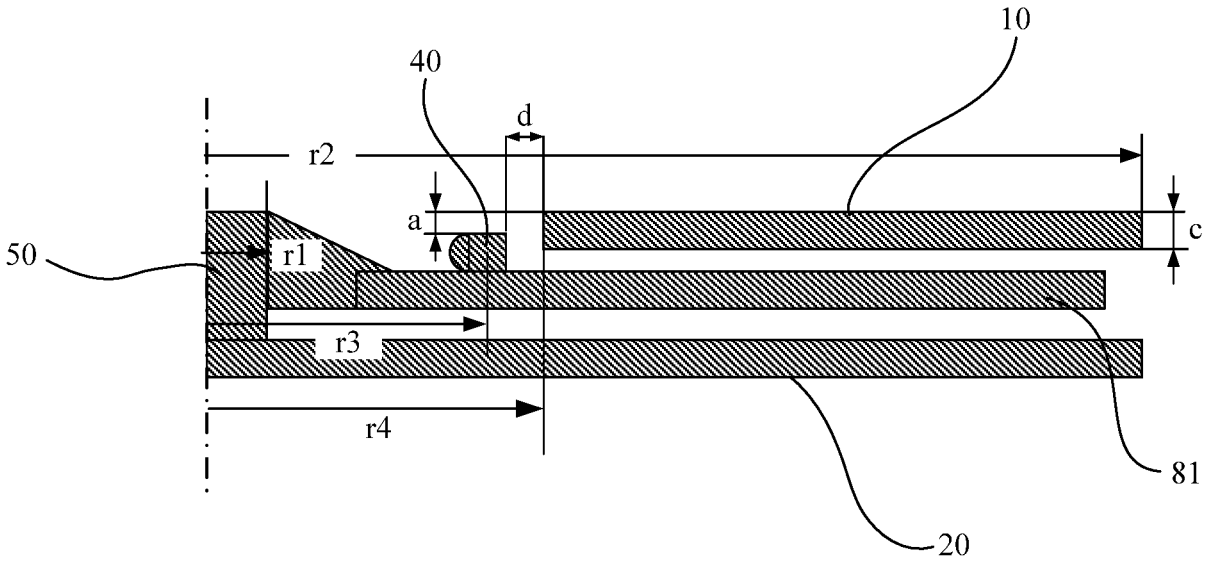

FIG. 9

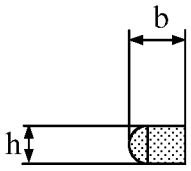

FIG. 10

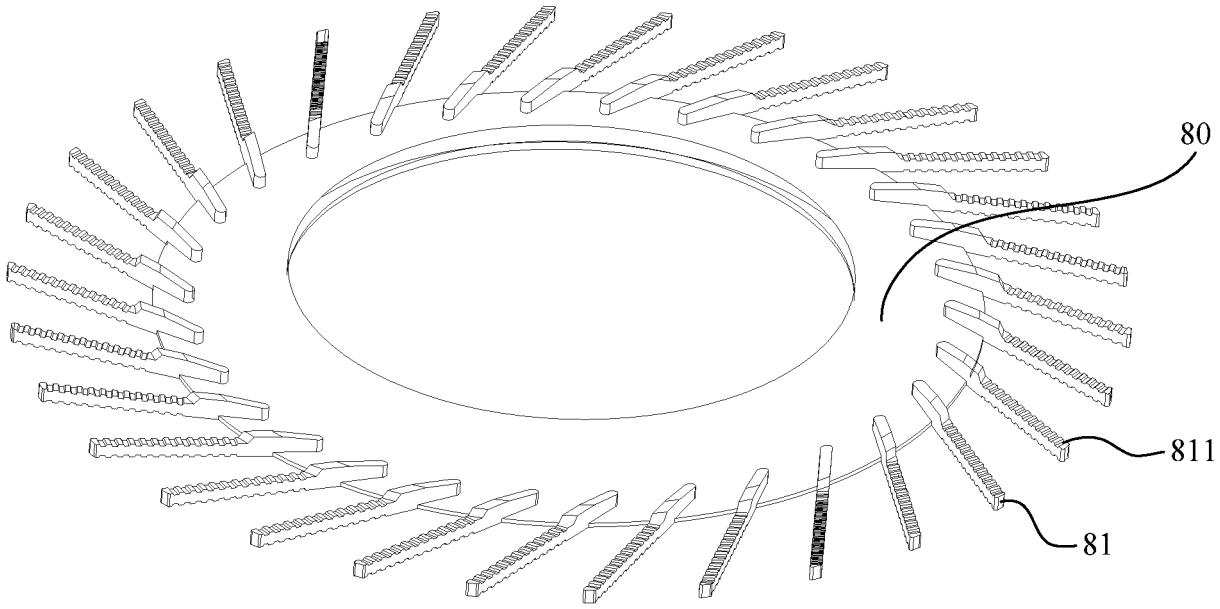

FIG. 11

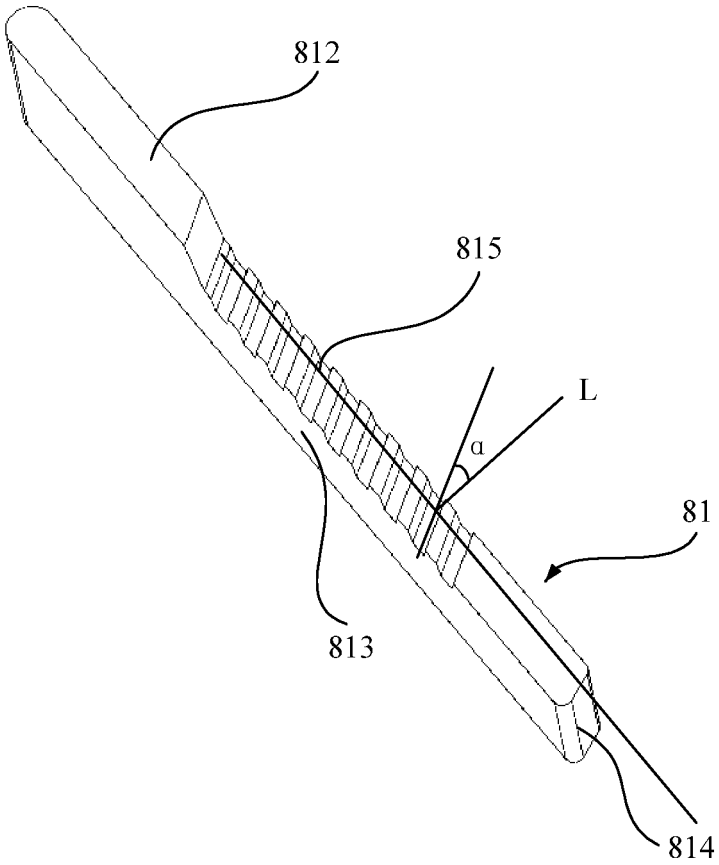

FIG. 12

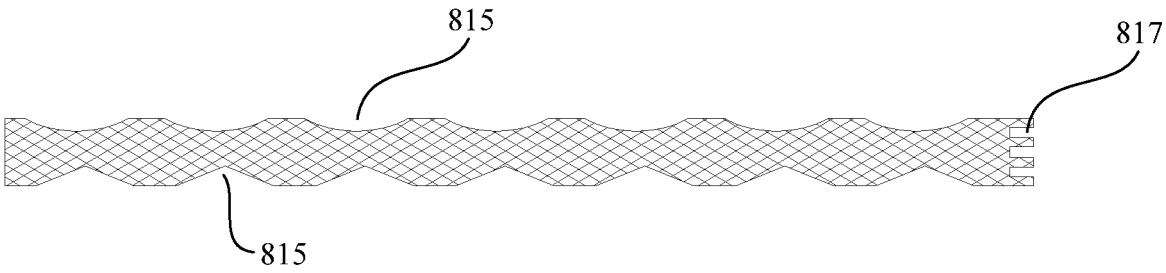

FIG. 13

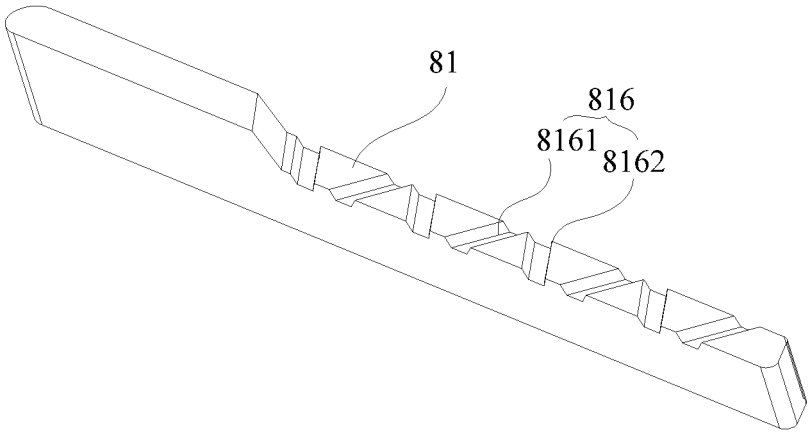

FIG. 14

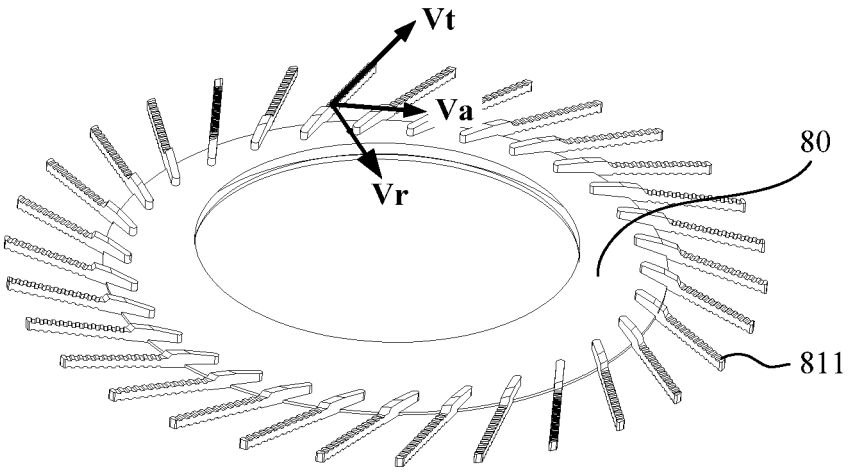

FIG. 15

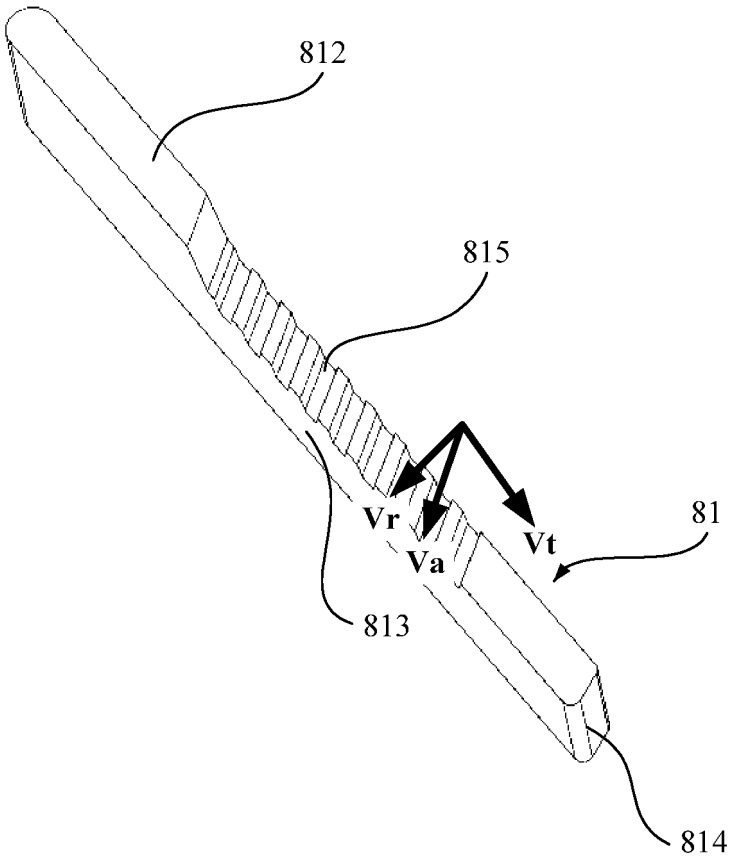

FIG. 16

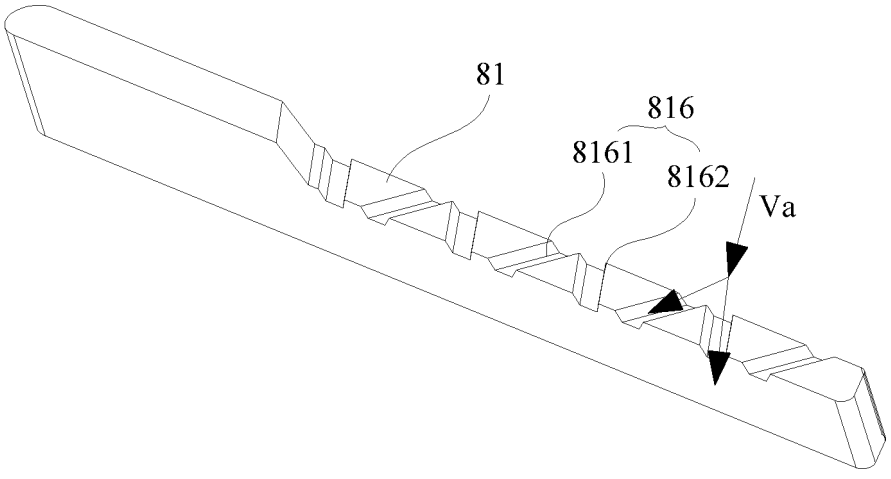

FIG. 17

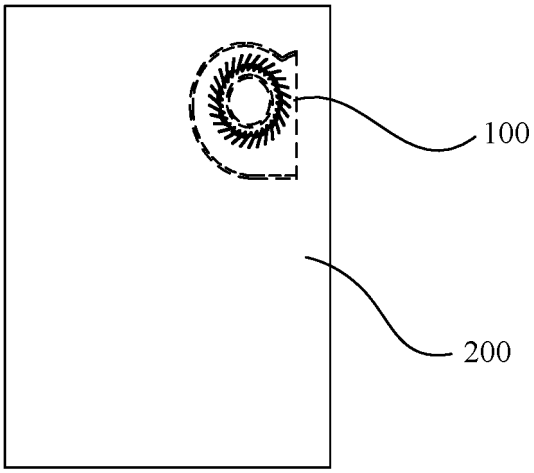

FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2018/075171

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/30(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)

WPI; EPODOC; CNPAT; CNKI; CNTXT: 噪声, 降噪, 去噪, 减少, 降低, 扇, 偏心轮, 扇叶, 叶片, 叶轮, 斜, 沟, 槽, 移动终端, 电子, 手机, reduc+, noise, fan, air, groove, blade, inpeller, phone

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 101498317 A (FUZHUN PRECISION INDUSTRY SHENZHEN CO., LTD. ET AL.) 05 August 2009 (2009-08-05) description, page 4, paragraph 5 to page 5, paragraph 2, and figures 1-3	1-15
A	CN 102478020 A (DELTA ELECTRONICS, INC.) 30 May 2012 (2012-05-30) see entire document	1-15
A	CN 201560981 U (EVERFLOW PRECISION ELECTRONICS (DONGGUAN) CO., LTD. ET AL.) 25 August 2010 (2010-08-25) see entire document	1-15
A	CN 101463831 A (FUZHUN PRECISION INDUSTRY SHENZHEN CO., LTD. ET AL.) 24 June 2009 (2009-06-24) see entire document	1-15
A	CN 202056098 U (ZHONGDA ELECTRONIC COMPONENTS (WUJIANG) CO., LTD.) 30 November 2011 (2011-11-30) see entire document	1-15
A	US 2013105124 A1 (FOXCONN TECHNOLOGY CO., LTD.) 02 May 2013 (2013-05-02) see entire document	1-15

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
29 September 2018	**25 October 2018**
Name and mailing address of the ISA/CN **State Intellectual Property Office of the P. R. China (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2018/075171

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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CN 201560981 U	25 August 2010	None	
CN 101463831 A	24 June 2009	US 2009162210 A1	25 June 2009
CN 202056098 U	30 November 2011	None	
US 2013105124 A1	02 May 2013	TW 201317464 A	01 May 2013

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