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(54) **FAN AND MOBILE TERMINAL**

LÜFTER UND MOBILES ENDGERÄT

VENTILATEUR ET TERMINAL MOBILE

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(56) References cited:

CN-A- 101 463 831 CN-A- 101 498 317

CN-A- 102 478 020 CN-A- 104 929 977

CN-A- 106 151 111 CN-B- 103 967 808

CN-U- 201 560 981 CN-U- 202 056 098

DE-A1-102009 028 125 GB-A- 754 055

US-A1- 2013 105 124

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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.

[0004] For example, DE 102009 028 125 A1 refers to an ingress geometry of fan wheel. Further, GP 754055 refers to a centrifugal fan wheel. Further, CN 106151111A refers to a cooling blower.

SUMMARY

[0005] This application provides a fan and a mobile terminal, to improve an air supply volume of the fan. The above mentioned problem is solved by the subject matter of the independent claim. Further implementation forms are provided in the dependent claims.

[0006] 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. According to the invention, 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.

[0007] 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.

[0008] In a specific disposition of the grooves, the grooves may be formed in different manners, and the manners are separately described below.

[0009] In a specific implementation not belonging to the invention, 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.

[0010] 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. According to the invention a plurality of first grooves are provided on the surfaces of the blade, the plurality of first grooves may be arranged periodically or non-periodically.

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] In addition to the foregoing grooves, according to the invention an air intake effect of the fan is further 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 not belonging to the present invention, the guide ring may be used independently, or according to the invention is used in combination with the grooves, thereby further improving the air supply effect.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] According to a second aspect not belonging to the present invention, 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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, according to the

invention, 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.

5 BRIEF DESCRIPTION OF DRAWINGS

[0025]

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

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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: r_1 is a radius of a drive shaft 50, r_2 is an outer diameter of the top cover 10, r_3 is a radius of a center point of the cross section of the guide ring 40, r_4 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 be-

tween 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, $-3 \text{ mm} \leq a \leq +3 \text{ mm}$. 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.

[0032] 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, $h = 0.02 \text{ mm}$, and $b = 0.05 \text{ mm}$; or $h = 0.05 \text{ mm}$, and $b = 0.08 \text{ mm}$; or $h = 0.5 \text{ mm}$, and $b = 1 \text{ mm}$; or $h = 2 \text{ mm}$, and $b = 5 \text{ mm}$; or $h = 4 \text{ mm}$, $b = 10 \text{ mm}$.

[0033] 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.

[0034] 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.

[0035] According to the present invention, in addition to the foregoing embodiment in which the air supply volume is improved by using the guide ring 40, the air supply volume is further 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.

[0036] 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.

[0037] 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. According to the invention, 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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 V_t along a tangential direction of the blade 81 of the centrifugal impeller 80 and velocity V_r relative to a radius of the centrifugal impeller 80, that is, final relative velocity is V_a at a particular point of the blade 81. A direction of V_a varies with magnitude of the radius of the blade 81. It can be learned from FIG. 15 that, the combined velocity V_a 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 V_a as much as possible, thereby improving passage of the air through the groove 811.

[0042] The direction of V_a 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.

[0043] 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.

[0044] 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.

[0045] According to embodiments not belonging to the present invention, 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. According to the invention, the guide ring 40 and the groove 811 provided in the foregoing embodiment are 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.

[0046] 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, according to the invention, 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.

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 (80) comprises a plurality of blades (81), wherein:
 - each blade among the plurality of blades (81) has a top surface and a bottom surface disposed opposite to each other,
 - at least one of the plurality of blades (81) is provided with a plurality of grooves (811) arranged along a radial direction on the top surface and/or the bottom surface of the blade, and the plurality of grooves (811) extend in a direction, which is inclined at an angle relative to a normal direction of a radial tangent of the blade, a direction of the radial tangent of the blade being the radial direction of the blade when the blade is a straight blade, and is a tangent direction of an arc line on the blade when the blade is a curved blade,
 - the fan has an air inlet (30), wherein a drive shaft (50) of the centrifugal impeller (80) is exposed outside the air inlet (30),
 - the fan further comprises a guide ring (40), wherein the guide ring (40) is fixedly connected to the plurality of blades (81), and a surface of the guide ring (40) facing the drive shaft (50) is a guide surface (41), and **characterized in that** the guide ring (40) divides an area on the centrifugal impeller (80) into two areas, an area I closer to the drive shaft (50) and an area II further away from the drive shaft (50), wherein the plurality of grooves (811) is provided in the area II.
2. The fan according to claim 1, wherein each groove among the plurality of grooves is inclined in a single direction, and an angle between a length direction of the groove and the normal direction of the radial tangent of the blade is an acute angle.

3. The fan according to claim 1, wherein a cross section of the groove is rectangular or triangular.
4. The fan according to claim 1, wherein each groove among the plurality of grooves is of a herringbone shape, the 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.
5. The fan according to any one of claims 2 to 4, wherein the blade has an outer end face, and the outer end face is provided with a further groove (817).
6. The fan according to any one of claims 1 - 5, wherein the guide ring comprises a plurality of arc segments arranged at intervals.
7. The fan according to any one of claims 1 - 5, wherein the guide ring is exposed outside the air inlet.
8. The fan according to any one of claims 1 - 5, wherein a cross section of the guide ring is circular, elliptical, or bullet-shaped.

Patentansprüche

1. Lüfter, umfassend ein Gehäuse und ein Zentrifugallaufrad, angeordnet im Inneren des Gehäuses und relativ zum Gehäuse drehbar, wobei das Zentrifugallaufrad (80) mehrere Flügel (81) umfasst, wobei:
 - jeder Flügel unter den mehreren Flügeln (81) eine obere Oberfläche und eine untere Oberfläche aufweist, die einander gegenüberliegend angeordnet sind,
 - zumindest einer der mehreren Flügel (81) mit mehreren Nuten (811) versehen ist, die entlang einer radialen Richtung auf der oberen Oberfläche und/oder der unteren Oberfläche des Flügels angeordnet sind, und wobei sich die mehreren Nuten (811) in eine Richtung erstrecken, die in einem Winkel relativ zu einer Normalenrichtung einer radialen Tangente des Flügels geneigt ist, wobei eine Richtung der radialen Tangente des Flügels die radiale Richtung des Flügels ist, wenn der Flügel ein gerader Flügel ist, und eine Tangentenrichtung einer Bogenlinie am Flügel ist, wenn der Flügel ein gekrümmter Flügel ist,
 - der Lüfter einen Lufteinlass (30) aufweist, wobei eine Antriebswelle (50) des Zentrifugallaufrads (80) außerhalb des Lufteinlasses (30) freiliegt,
 - der Lüfter ferner einen Führungsring (40) umfasst, wobei der Führungsring (40) fest mit den

mehreren Flügeln (81) verbunden ist, und wobei eine Oberfläche des Führungsrings (40), die zur Antriebswelle (50) zeigt, eine Führungsfläche (41) ist, und **dadurch gekennzeichnet, dass** der Führungsring (40) eine Fläche am Zentrifugallaufrad (80) in zwei Flächen teilt, eine Fläche I näher an der Antriebswelle (50) und eine Fläche II weiter entfernt von der Antriebswelle (50), wobei die mehreren Nuten (811) in der Fläche II bereitgestellt sind.

2. Lüfter nach Anspruch 1, wobei jede Nut unter den mehreren Nuten in eine einzelne Richtung geneigt ist, und wobei ein Winkel zwischen einer Längsrichtung der Nut und der Normalenrichtung der radialen Tangente des Flügels ein spitzer Winkel ist.
3. Lüfter nach Anspruch 1, wobei ein Querschnitt der Nut rechteckig oder dreieckig ist.
4. Lüfter nach Anspruch 1, wobei jede Nut unter den mehreren Nuten eine Fischgrätenform hat, wobei die Nut einen ersten Nutkörper und einen zweiten Nutkörper umfasst, die relativ zueinander geneigt sind, und wobei der erste Nutkörper und der zweite Nutkörper jeweils einen Winkel mit der Normalenrichtung der radialen Tangente des Flügels bilden.
5. Lüfter nach einem der Ansprüche 2 bis 4, wobei der Flügel eine äußere Endfläche aufweist und die äußere Endfläche mit einer weiteren Nut (817) versehen ist.
6. Lüfter nach einem der Ansprüche 1-5, wobei der Führungsring mehrere Bogensegmente umfasst, die in Intervallen angeordnet sind.
7. Lüfter nach einem der Ansprüche 1-5, wobei der Führungsring außerhalb des Lufteinlasses freiliegt.
8. Lüfter nach einem der Ansprüche 1-5, wobei ein Querschnitt des Führungsrings kreisförmig, elliptisch oder konisch ist.

Revendications

1. Ventilateur comprenant un logement et un rouet centrifuge disposé à l'intérieur du logement et pouvant tourner relativement au logement, le rouet centrifuge (80) comprenant une pluralité de pales (81), dans lequel :
 - chaque pale parmi la pluralité de pales (81) a une surface supérieure et une surface inférieure disposées à l'opposé l'une de l'autre,
 - au moins une pale parmi la pluralité de pales (81) est pourvue d'une pluralité de rainures

- (811) agencées le long d'une direction radiale sur la surface supérieure et/ou la surface inférieure de la pale, et la pluralité de rainures (811) s'étendent dans une direction, qui est inclinée à un angle relativement à une direction normale d'une tangente radiale de la pale, une direction de la tangente radiale de la pale étant la direction radiale de la pale lorsque la pale est une pale droite, et est une direction tangente d'une ligne d'arc sur la pale lorsque la pale est une pale incurvée,
- le ventilateur a une entrée d'air (30), un arbre d'entraînement (50) du rouet centrifuge (80) étant exposé à l'extérieur de l'entrée d'air (30),
 - le ventilateur comprend en outre une bague de guidage (40), la bague de guidage (40) étant raccordée de façon fixe à la pluralité de pales (81), et une surface de la bague de guidage (40) faisant face à l'arbre d'entraînement (50) étant une surface de guidage (41), et **caractérisé en ce que** la bague de guidage (40) divise une zone sur le rouet centrifuge (80) en deux zones, une zone I plus proche de l'arbre d'entraînement (50) et une zone II plus éloignée de l'arbre d'entraînement (50), la pluralité de rainures (811) étant disposées dans la zone II.
2. Ventilateur selon la revendication 1, dans lequel chaque rainure parmi la pluralité de rainures est inclinée dans une seule direction, et un angle entre une direction de longueur de la rainure et la direction normale de la tangente radiale de la pale est un angle aigu.
 3. Ventilateur selon la revendication 1, dans lequel une section transversale de la rainure est rectangulaire ou triangulaire.
 4. Ventilateur selon la revendication 1, dans lequel chaque rainure parmi la pluralité de rainures a une forme en arêtes de poisson, la rainure comprend un premier corps de rainure et un deuxième corps de rainure inclinés l'un relativement à l'autre, et le premier corps de rainure et le deuxième corps de rainure forment chacun un angle avec la direction normale de la tangente radiale de la pale.
 5. Ventilateur selon l'une quelconque des revendications 2 à 4, dans lequel la pale a une face d'extrémité externe, et la face d'extrémité externe est pourvue d'une autre rainure (817).
 6. Ventilateur selon l'une quelconque des revendications 1 à 5, dans lequel la bague de guidage comprend une pluralité de segments d'arc agencés à intervalles.
 7. Ventilateur selon l'une quelconque des revendications 1 à 5, dans lequel la bague de guidage est exposée à l'extérieur de l'entrée d'air.
 8. Ventilateur selon l'une quelconque des revendications 1 à 5, dans lequel une section transversale de la bague de guidage est circulaire, elliptique, ou en forme de balle.

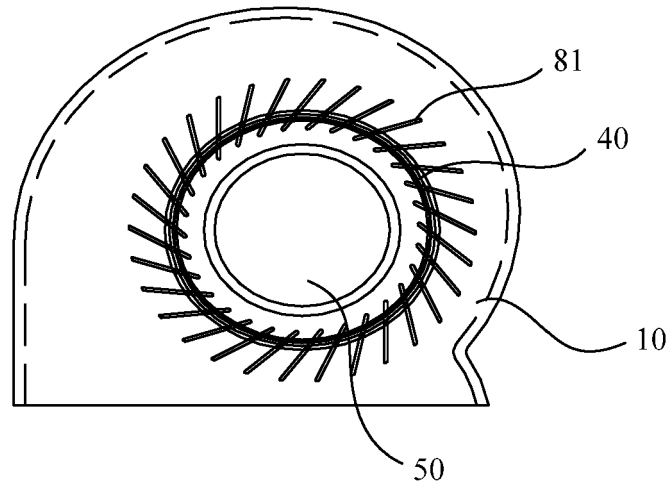


FIG. 1

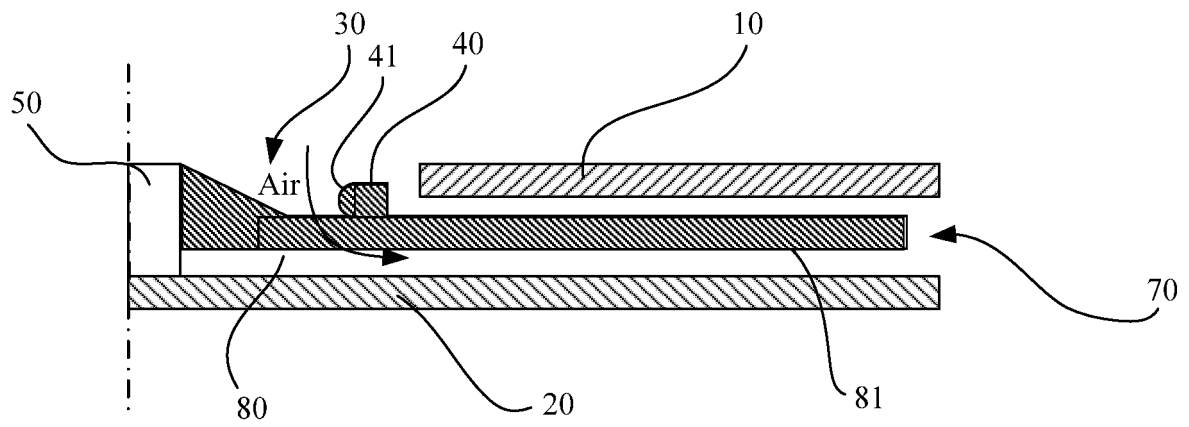


FIG. 2

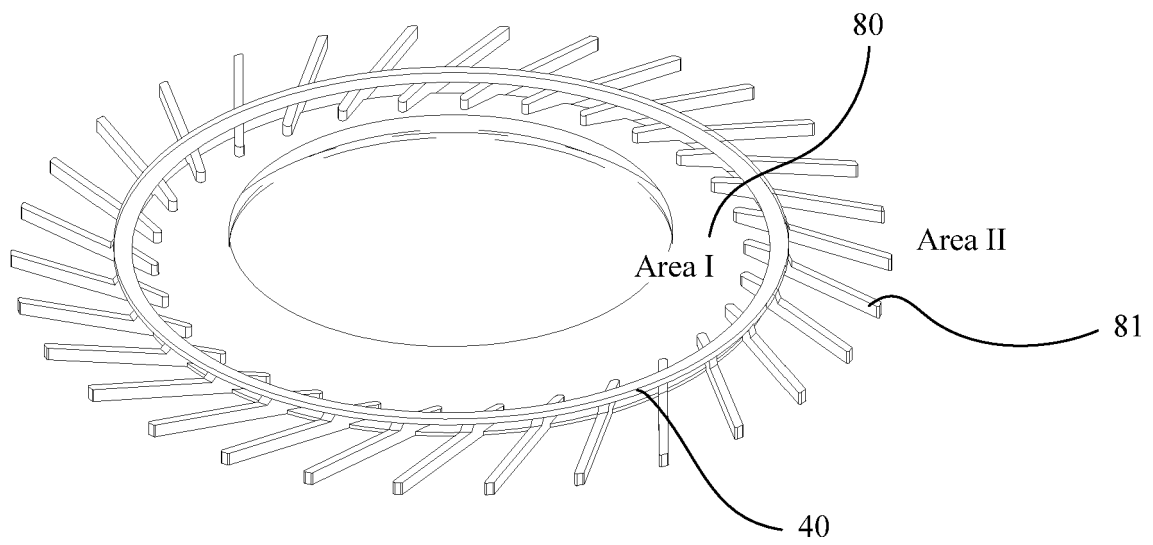


FIG. 3

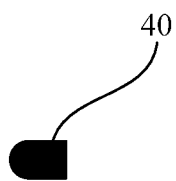


FIG. 4

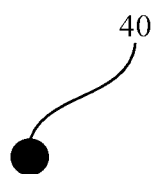


FIG. 5

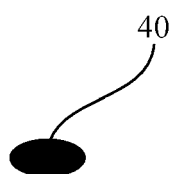


FIG. 6

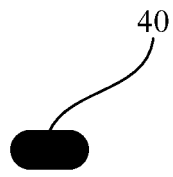


FIG. 7

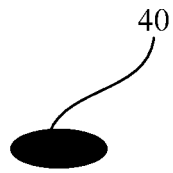


FIG. 8

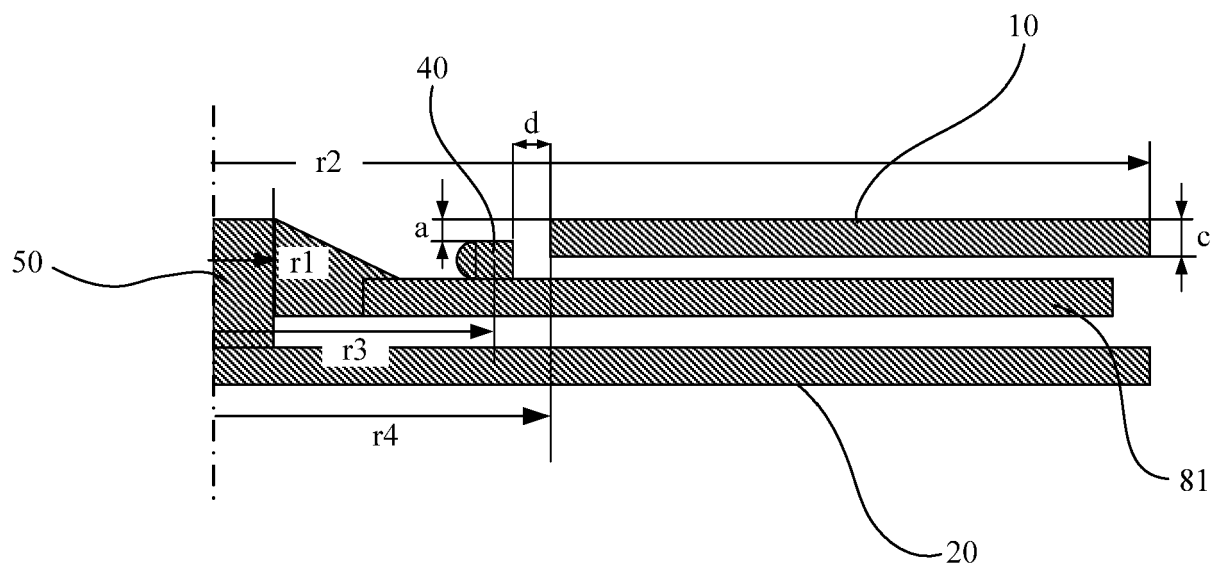


FIG. 9

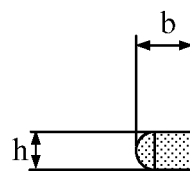


FIG. 10

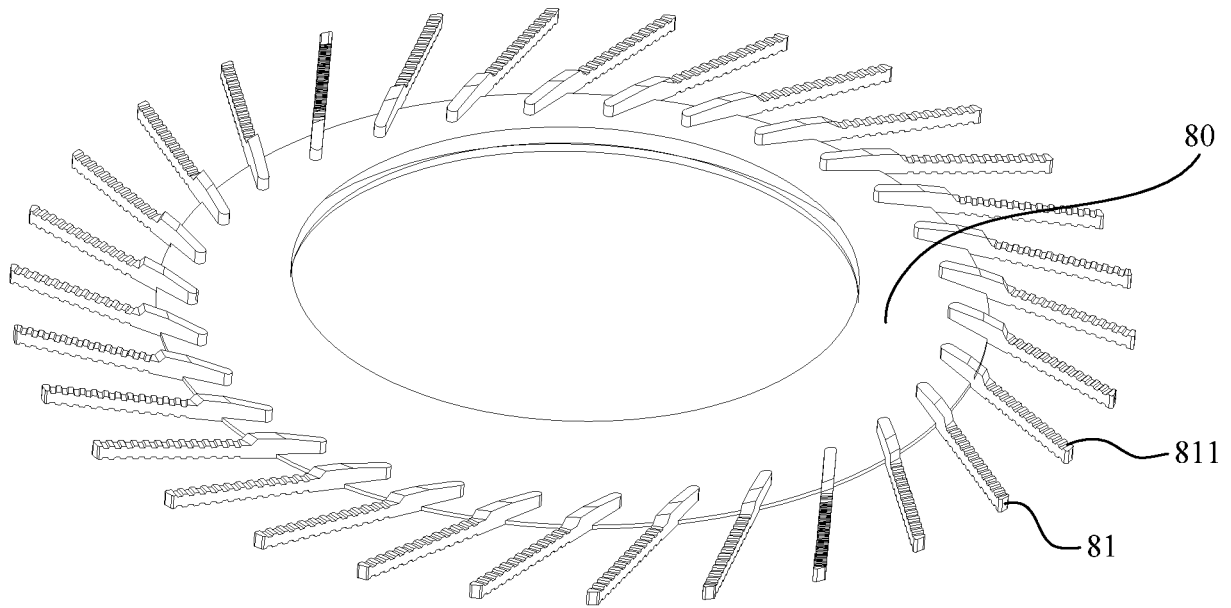


FIG. 11

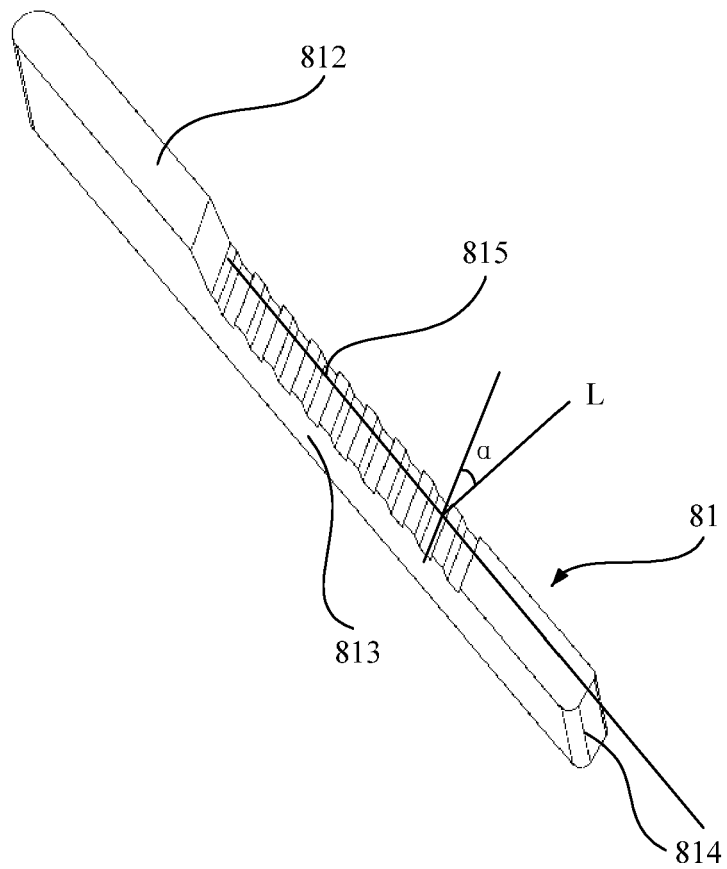


FIG. 12

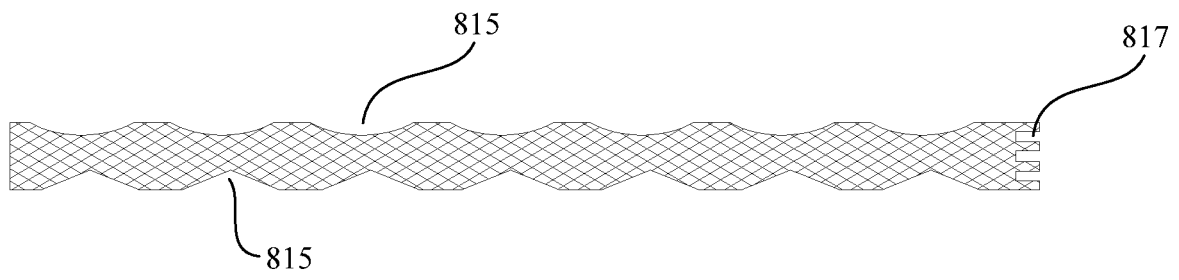


FIG. 13

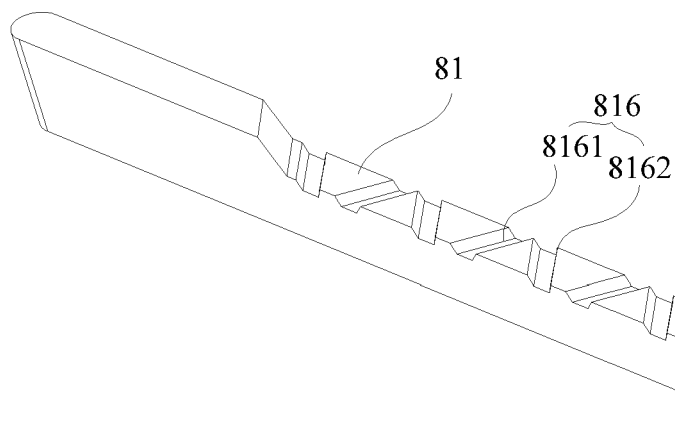


FIG. 14

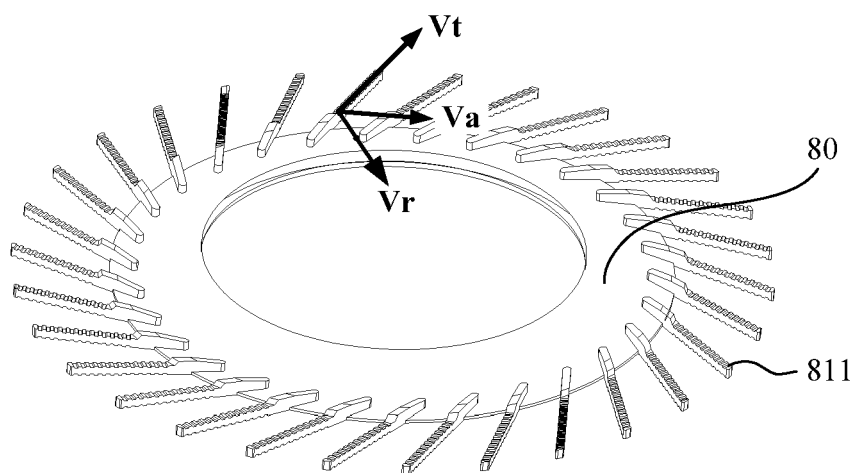


FIG. 15

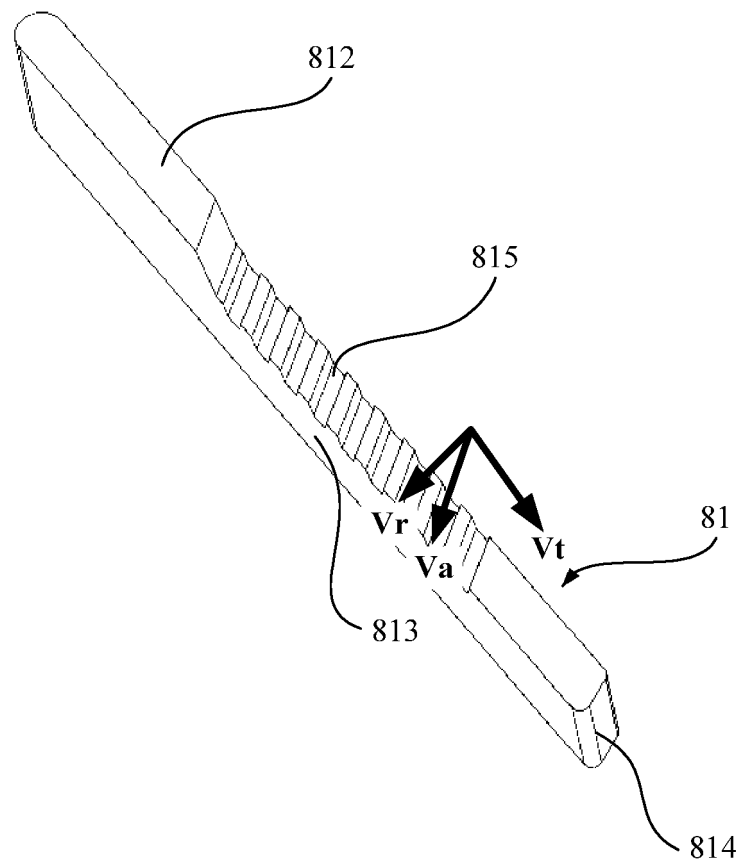


FIG. 16

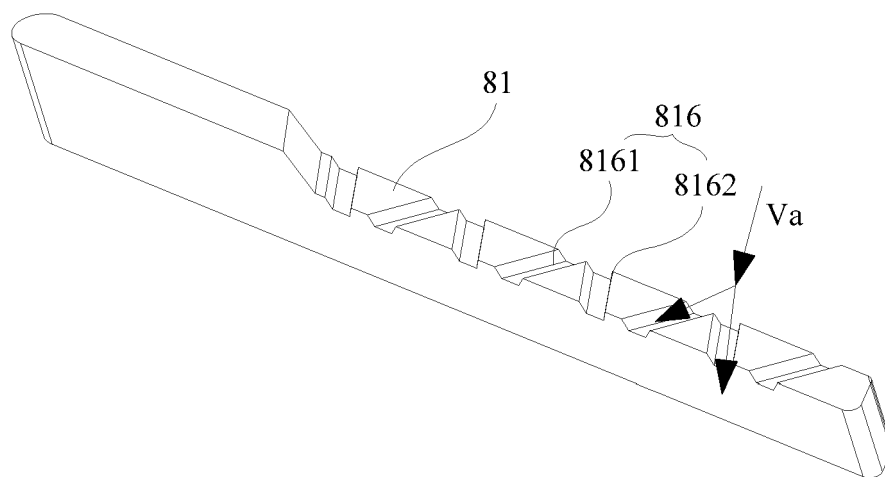


FIG. 17

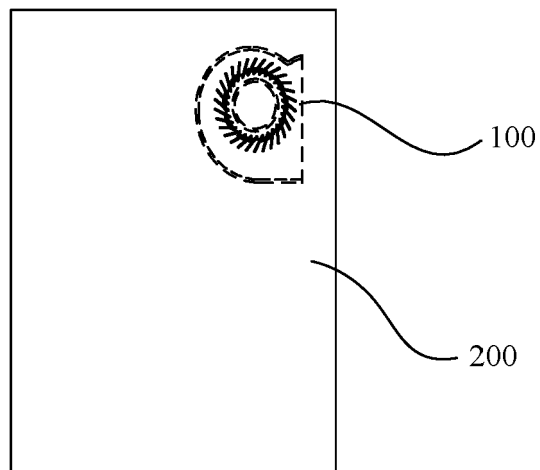


FIG. 18

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 102009028125 A1 [0004]
- CN 106151111 A [0004]