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(54) HAIRDRYER IMPELLER AND MOTOR

(57) Provided is a high-speed high-pressure hairdryer motor and impeller, including a central shaft and a motor, where an impeller hub is fixedly mounted on the central shaft, a plurality of blades are fixedly mounted on the impeller hub, and both leading and trailing edges of the impeller hub are linear. A blade surface formed by a blade tip contour and a blade root contour of the blade is defined as a first blade surface, and the first blade surface is characterized by a straight transition. An airflow-guiding housing is arranged outside the blades, and a distance between points on a blade tip cambered surface and a bottom of the impeller hub conforms to a logarithmic function y(A)=a-b*ln(r). A curve of the impeller hub is a Bezier curve. Operational efficiency of the blades can be enhanced by improving smoothness of an airflow channel for the blades.

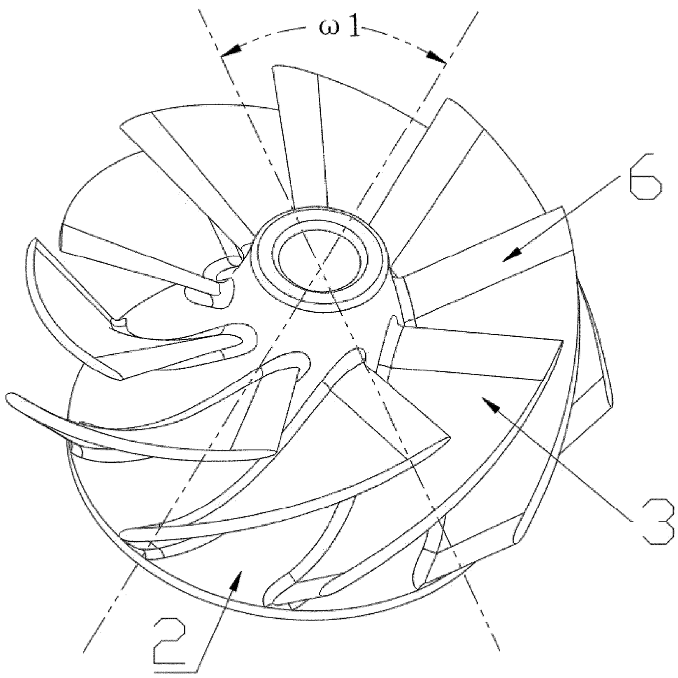

FIG. 3

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Description

[0001] The present invention relates to the technical field of hairdryers, and specifically relates to a high-speed high-pressure hairdryer motor and impeller.

[0002] A high-speed hairdryer is a novel hairdryer that mainly relies on a motor to provide a powerful driving force, and a rotational speed of the motor usually exceeds 100,000 rpm. The motor drives a rotor to rotate blades, air is sucked from an air inlet when the blades rotate, and a resultant discharged airflow is then blown out through a front nozzle of a barrel of the hairdryer. As a result, a high-speed forceful airflow is generated, and the high-speed airflow rapidly blows away moisture from hair, thereby achieving the purpose of air drying. In contrast, a traditional hairdryer mainly relies on high temperatures to dry hair, and therefore the blades of the hairdryer are particularly important.

[0003] The Chinese patent CN214711022U discloses a hairdryer blade, including a central shaft. An impeller hub is sleeved outside the central shaft, blades are arranged outside the impeller hub, an air outlet cutting plane is arranged on one side of each of the blades, and an air inlet cutting plane is arranged on the other side thereof, where the air inlet cutting plane and the air outlet cutting plane are parallel to each other in a top view direction. The number of the blades is six, and the air inlet cutting plane and the air outlet cutting plane are in a parabolic shape and high in middles and low at both ends. An extended line of the air inlet cutting plane in the top view direction intersects the impeller hub at a point C, the point C is connected to a central axis, a connecting line is denoted as B, and the connecting line B forms an angle β together with the extended line of the air inlet cutting plane in the top view direction. Designs that the air inlet cutting plane and the air outlet cutting plane of each of the blades are parallel to each other in the top view direction and the air inlet cutting plane and the air outlet cutting plane are in the parabolic shape significantly enhance overall airflow performance of the hairdryer.

[0004] However, the technical solution of the patent has the following defects:

1. The designs that the air inlet cutting plane and the air outlet cutting plane of each of the blades are parallel to each other in the top view direction and the air inlet cutting plane and the air outlet cutting plane are in the parabolic shape enhance the overall airflow performance of the hairdryer, but a current-carrying cross-sectional area is restricted by a core size of the central shaft during high-speed blowing, such that airflow velocity cannot be continuously enhanced by increasing the rotational speed. To solve the above problems, those skilled in the art provide a high-speed high-pressure hairdryer motor and impeller.

[0005] An objective of the present invention is to provide a high-speed high-pressure hairdryer motor and impeller, so as to at least partially solve the problems mentioned in the above background art.

[0006] To achieve the above objective, the present invention provides an impellor and a motor according to the independent claims. Embodiments thereof are specified in the dependent claims and the subsequent disclosure. Dependencies of the dependent claims does not limit the combination of features listed in the claims or the specification.

[0007] To achieve the above objective, the present invention provides the following technical solution:
a high-speed high-pressure hairdryer (motor and) impeller, including a central shaft and a motor, the central shaft is the rotational axis of the impeller, where an impeller hub is fixedly mounted on an upper side of the central shaft, a plurality of blades are fixedly mounted on an external side of the impeller hub, and both leading and trailing edges of the impeller hub are linear.

[0008] Further, a blade surface may be formed by a blade tip contour and a blade root contour of the blade is defined as a first blade surface, and the first blade surface is characterized by a straight transition, which facilitates 5-axis CNC machining and improves machining efficiency.

[0009] Furthermore, an airflow-guiding housing may be arranged outside the blades, and a distance between points on a blade tip cambered surface and a bottom of the impeller hub conforms to a logarithmic function $y(A) = a-b*\ln(r)$, where a is in a range of 0-0.5 mm, a is a gap between the blades and an inner wall of the airflow-guiding housing of the hairdryer, and r is a distance from a point on the blade tip cambered surface to a rotational axis.

[0010] Furthermore, a curve of the impeller hub may be a Bezier curve, and an angle α between the curve of the impeller hub and a horizontal plane is 30-60°.

[0011] Furthermore, an angle β between the blade tip contour of the blade and the horizontal plane may be 20-50°.

[0012] Furthermore, the first blade surface may a curved surface, an angle δ between the first blade surface and a vertical plane is gradually decreasing from the leading edge to the trailing edge of the first blade surface, with a value of 80-10.

[0013] Furthermore, an inlet diameter D1 of the impeller may be the diameter of the maximum circle formed by its leading edge rotating around the axis, a outlet diameter D2 of the impeller is the diameter of the maximum circle formed by its trailing edge rotating around the axis, a outlet diameter D3 of the airflow-guiding housing is the diameter of its maximum air outlet cross-section, where D1/D2 as a ratio between D1 and D2 is in a range of 0.4-0.75, and D2/D3 as a ratio between D2 and D3 is in a range of 0.7-0.9, such that a blade airflow channel is smoother, with more efficient energy conversion and better performance.

[0014] Furthermore, an outlet area of the blades may be greater than an inlet area, when S2/S1>1 (where S1 denotes the inlet area of the blades and S2 denotes the outlet area of the blades) and S2/S1 increases, airflow output from the blades is greater, and when S2/S1 decreases (approximating 1), a vacuum degree created by the blades is higher.

[0015] Furthermore, curved leading edge surfaces of the blades may be all below an upper end surface of the impeller hub for easy installation and positioning, and along the axial direction, a leading edge blade tip of the blade is slightly higher than a blade root thereof, an angle $\theta 1$ formed between a leading edge contour of the blade and a rotational axis of the impeller is in a range of 70-90°, and in some cases, $\theta 1$ can also be set to 90°, to reduce a load on the impeller and enhance operational performance of the impeller.

[0016] Furthermore, a wrap angle $\omega 1$ of a blade root portion of the impeller may be within a first preset range, and a wrap angle $\omega 2$ of a blade tip portion is within a second preset range, where $60° \leq \omega 2 < \omega 1 \leq 90°$.

[0017] Furthermore, an angle $\theta 2$ formed between a trailing edge contour of the blade and the rotational axis of the impeller is in a range of 20-60°.

[0018] Furthermore, the motor may employ a two-stage pressure-boosting guide vane design, a rotor of the motor may be of a single-bar structure for simple assembly, which allows safe and reliable high-speed or ultra-high-speed rotation, a lower side of the central shaft may be fixedly mounted on an output shaft of the motor, and the airflow-guiding housing may be fixedly mounted on an upper side of the motor.

[0019] Compared with the prior art, the present invention has one or more of the beneficial effects as follows:

1. in the present invention, a reasonable ratio range exists between the inlet diameter D1 of the impeller, the outlet diameter D2 of the impeller, and the outlet diameter D3 of the airflow-guiding housing,, where D1/D2 is in a range of 0.4-0.75, and D2/D3 is in a range of 0.7-0.9, such that the blade airflow channel is smoother, with more efficient energy conversion; and the blades are in clearance fit with the inner wall of the airflow-guiding housing of the hairdryer, where a gap a therebetween is in a range of 0-0.5 mm, which avoids airflow leakage losses, enhances operational efficiency of the high-speed hairdryer motor, enables high-speed and high-pressure operation of the hairdryer, and reduces airflow noise; and
2. by using a two-stage pressure-boosting guide vane design in the motor, the circumferential (radial) kinetic energy of the high-speed airflow discharged by the blades can be converted into axial static pressure, which enhances pressure resistance of the motor, thereby enhancing the capability of airflow delivery under high air pressure or ultra-high air pressure conditions.

[0020] The attached figures are schematic and illustrate only embodiments of the invention and help to understand the technical background as well.

FIG. 1 is a schematic diagram of a three-dimensional structure of the present invention.
FIG. 2 is a front view of the present invention.
FIG. 3 is a structural schematic diagram I of an impeller of the present invention.
FIG. 4 is a structural schematic diagram II of an impeller of the present invention.
FIG. 5 is a structural schematic diagram III of an impeller of the present invention.
FIG. 6 is a top view of an impeller of the present invention.
FIG. 7 is a sectional view of A-A in FIG. 5.
FIG. 8 is a sectional of sectional view I of an impeller of the present invention.
FIG. 9 is a structural schematic diagram IV of an impeller of the present invention.
FIG. 10 is a structural of sectional view II of an impeller of the present invention.

[0021] Reference numerals in the figures: 1. central shaft; 2. impeller hub; 3. blade; 4. motor; 5. airflow-guiding housing; and 6. blade tip cambered surface.

[0022] The technical solutions in the examples of the present invention will be clearly and completely described below in combination with the accompanying drawings in the examples of the present invention. Apparently, the examples described are merely some rather than all of the examples of the present invention. Based on the examples of the present invention, all other examples obtained by those of ordinary skill in the art without making creative efforts shall fall within the protection scope of the present invention.

[0023] In the following description, the terms such as "left", "right", "front", "rear", "upper" and "lower" are oriented from the perspective direction of the front view.

[0024] In some examples, as illustrated in FIGs. 1-10 of the specification, a high-speed high-pressure hairdryer motor and impeller, including a central shaft 1 and a motor 4, the central shaft 1 is the rotational axis of the impeller, where an impeller hub 2 is fixedly mounted on an upper side of the central shaft 1, a plurality of blades 3 are fixedly mounted on an external side of the impeller hub 2, and both leading and trailing edges of the impeller hub 2 are linear; and a blade surface formed by a blade tip contour and a blade root contour of the blade 3 is defined as a first blade surface, and the first blade surface is characterized by a straight transition, which facilitates 5-axis CNC machining and improves machining efficiency.

[0025] An airflow-guiding housing 5 is arranged outside the blades 3, and a distance between points on a blade tip cambered surface 6 and a bottom of the impeller hub 2 conforms to a logarithmic function $y(A)=a-b*\ln(r)$, where a is in a range of 0-0.5 mm, a is a gap between the blades 3 and an inner wall of the airflow-guiding housing 5 of the hairdryer, and r is a distance from a point on the blade tip cambered surface 6 to the central shaft 1.

[0026] The blades 3 are in clearance fit with the inner wall of the airflow-guiding housing 5 of the hairdryer, which avoids airflow leakage losses, enhances operational efficiency of the high-speed hairdryer motor 4, enables high-speed and high-pressure operation of the hairdryer, and reduces airflow noise.

[0027] A curve of the impeller hub 2 is a Bezier curve, and an angle α between the curve of the impeller hub 2 and a horizontal plane is 30-60°.

[0028] The first blade surface is a curved surface, an angle δ between the first blade surface and a vertical plane is gradually decreasing from the leading edge to the trailing edge of the first blade surface, with a value of 80-10° .

[0029] The blades 3 and the impeller hub 2 are in cooperation with each other, which is not restricted by a core size of the central shaft 1, and an airflow volume can be continuously increased by improving the rotational speed.

[0030] An inlet diameter D1 of the impeller is the diameter of the maximum circle formed by its leading edge rotating around the axis, a outlet diameter D2 of the impeller is the diameter of the maximum circle formed by its trailing edge rotating around the axis, a outlet diameter D3 of the airflow-guiding housing 5 is the diameter of its maximum air outlet cross-section, where D1/D2 as a ratio between D1 and D2 is in a range of 0.4-0.75, and D2/D3 as a ratio between D2 and D3 is in a range of 0.7-0.9, such that an airflow channel of the blades 3 is smoother, with more efficient energy conversion and better performance.

[0031] An outlet area of the blades 3 is greater than an inlet area, when S2/S1>1 (where S1 denotes the inlet area of the blades 3 and S2 denotes the outlet area of the blades 3) and S2/S1 increases, airflow output from the blades 3 is greater, and when S2/S1 decreases (approximating 1), a vacuum degree created by the blades 3 is higher. Curved leading edge surfaces of the blades 3 are all below an upper end surface of the impeller hub 2 for easy installation and positioning, and along the axial direction, a leading edge blade tip of the blade 3 is slightly higher than a blade root thereof, an angle $\theta 1$ formed between a leading edge contour of the blade 3 and a rotational axis of the impeller is in a range of 70-90°, and in some cases, $\theta 1$ can also be set to 90°, to reduce a load on the impeller and enhance operational performance of the impeller.

[0032] A wrap angle $\omega 1$ of a blade root portion of the impeller is within a first preset range, and a wrap angle $\omega 2$ of a blade tip portion is within a second preset range, where $60° \leq \omega 2 < \omega 1 \leq 90°$.

[0033] An angle $\theta 2$ formed between a trailing edge contour of the blade 3 and the rotational axis of the impeller is in a range of 20-60°.

[0034] In some examples, as illustrated in FIGs. 1-7, as a preferred example of the present invention, the motor 4 employs a two-stage pressure-boosting guide vane design, a rotor of the motor 4 is of a single-bar structure for simple assembly, which allows safe and reliable high-speed or ultra-high-speed rotation, a lower side of the central shaft 1 **is fixedly** mounted on an output shaft of the motor 4, and the airflow-guiding housing 5 is fixedly mounted on an upper side of the motor 4.

[0035] By using a two-stage pressure-boosting guide vane design in the motor, the circumferential (radial) kinetic energy of the high-speed airflow discharged by the blades 3 can be converted into axial static pressure, which enhances pressure resistance of the motor 4, thereby enhancing the capability of airflow delivery under high air pressure or ultra-high air pressure conditions.

[0036] ln(r) in the above logarithmic function y(A)=a-b*ln(r) is a monotonically increasing function, when the coefficient b> 0, -bln(r) decreases monotonically and y(A) =a-b*ln(r) also decreases monotonically, and when b< 0, -bln(r) monotonically increases, and y(A)=a-b*ln(r) also monotonically increases. According to an actual physical model of the blades, when y(A) needs to decrease as r increases, b > 0; and conversely, when y(A) needs to increase as r increases, b < 0. Normally, in a meridian plane model of the blades, it may be expected that as r increases, the distance y(A) between the point on the blade tip cambered surface and the bottom of the impeller decreases, and therefore b > 0 is usually possible.

[0037] A range of values of the logarithmic function is restricted: since $a \in (0, 0.5\text{ mm})$ and r is the distance from the point on the blade tip cambered surface to the rotational axis, and a range of values thereof is also limited, assuming $r \in [r_{min}, r_{max}]$. To ensure that a value of y(A) meets requirements for an actual size and structure of the blades, a value of b must ensure that y(A) remains within a reasonable range. For example, when $r = r_{min}$, y(A) cannot exceed a maximum value allowed by an internal structure of the hairdryer; and when $r=r_{max}$, y(A) cannot be less than a minimum safe distance from the bottom of the impeller to other components, etc.

[0038] Based on physical principles and actual working conditions, from an aerodynamic perspective, to achieve the desired effects of promoting air flow through the blades more effectively and blowing in a more concentrated manner and at a higher speed, y(A) may need to vary according to certain rules, thereby imposing certain requirements on the value of b. For example, to create a specific airflow velocity distribution at the blade tip, b maybe needs to be adjusted to ensure y(A) satisfies corresponding aerodynamic equation requirements.

[0039] In general hairdryer blade designs, the value of b roughly ranges from 0.5 mm to 3 mm. In practical designs, methods such as detailed computational fluid dynamics analysis and experimental testing are required to accurately determine the value of b. The above examples are merely intended for describing the technical solutions of the present invention rather than limiting same. Although the present invention has been described in detail with reference to the foregoing examples, those of ordinary skill in the art should understand that: the technical solutions described in the foregoing examples can still be modified, or some technical features thereof can be equivalently replaced; and these modifications or replacements do not make the essence of the corresponding technical solutions deviate from the spirit and scope of the technical solutions of the examples of the present invention.

Claims

1. A high-speed high-pressure hairdryer impeller, **characterized by** comprising a central shaft (1) and a motor, the central shaft (1) is the rotational axis of the impeller, wherein an impeller hub (2) is fixedly mounted on an upper side of the central shaft (1), a plurality of blades (3) are fixedly mounted on an external side of the impeller hub (2), and both leading and trailing edges of the impeller hub (2) are linear.

2. The high-speed high-pressure hairdryer impeller according to claim 1, **characterized in that** a blade surface formed by a blade tip contour and a blade root contour of the blade (3) is defined as a first blade surface, and the first blade surface is **characterized by** a straight transition.

3. The high-speed high-pressure hairdryer impeller according to claim 2, **characterized in that** an airflow-guiding housing (5) is arranged outside the blades (3), and a distance between points on a blade tip cambered surface (6) and a bottom of the impeller hub (2) conforms to a logarithmic function $y(A)=a-b*\ln(r)$, wherein a is in a range of 0-0.5 mm, a is a gap between the blades (3) and an inner wall of the airflow-guiding housing (5) of the hairdryer, and r is a distance from a point on the blade tip cambered surface (6) to the central shaft (1).

4. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** a curve of the impeller hub (2) is a Bezier curve, and an angle α between the curve of the impeller hub (2) and a horizontal plane is 30-60°.

5. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** an angle β between the blade tip contour of the blade (3) and the horizontal plane is 20-50°.

6. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** the first blade surface is a curved surface, an angle δ between the first blade surface and a vertical plane is gradually decreasing from the leading edge to the trailing edge of the first blade surface, with a value of (80-10°).

7. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** an inlet diameter D1 of the impeller is the diameter of the maximum circle formed by its leading edge rotating around the axis, a outlet diameter D2 of the impeller is the diameter of the maximum circle formed by its trailing edge rotating around the axis, a outlet diameter D3 of the airflow-guiding housing (5) is the diameter of its maximum air outlet cross-section, where D1/D2 as a ratio between D1 and D2 is in a range of 0.4-0.75, and D2/D3 as a ratio between D2 and D3 is in a range of 0.7-0.9.

8. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** an outlet area of the blades (3) is greater than an inlet area, and $S2/S1>1$, wherein S1 denotes the inlet area of the blades (3) and S2 denotes the outlet area of the blades (3).

9. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** curved leading edge surfaces of the blades (3) are all below an upper end surface of the impeller hub (2), and along the axial direction, a leading edge blade tip of the blade (3) is slightly higher than a blade root thereof.

10. The high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** an angle $\theta 1$ formed between a leading edge contour of the blade (3) and a rotational axis of the impeller is in a range of 70-90°.

11. The high-speed high-pressure hairdryer impeller according to any one of claims 1-10, **characterized in that** a wrap angle $\omega 1$ of a blade root portion of the impeller is within a first preset range, and a wrap angle $\omega 2$ of a blade tip portion is within a second preset range, where $60° \leq \omega 2 < \omega 1 \leq 90°$.

12. The high-speed high-pressure hairdryer impeller according to any one of claims 1-11, **characterized in that** an angle $\theta 2$ formed between a trailing edge contour of the blade (3) and the rotational axis of the impeller is in a range of 20-60°.

13. A motor of the high-speed high-pressure hairdryer impeller according to any of the preceding claims, **characterized in that** the motor (4) employs a two-stage pressure-boosting guide vane design, a rotor of the motor (4) is of a single-bar structure, a lower side of the central shaft (1) is fixedly mounted on an output shaft of the motor (4), and the airflow-guiding housing (5) is fixedly mounted on an upper side of the motor (4).

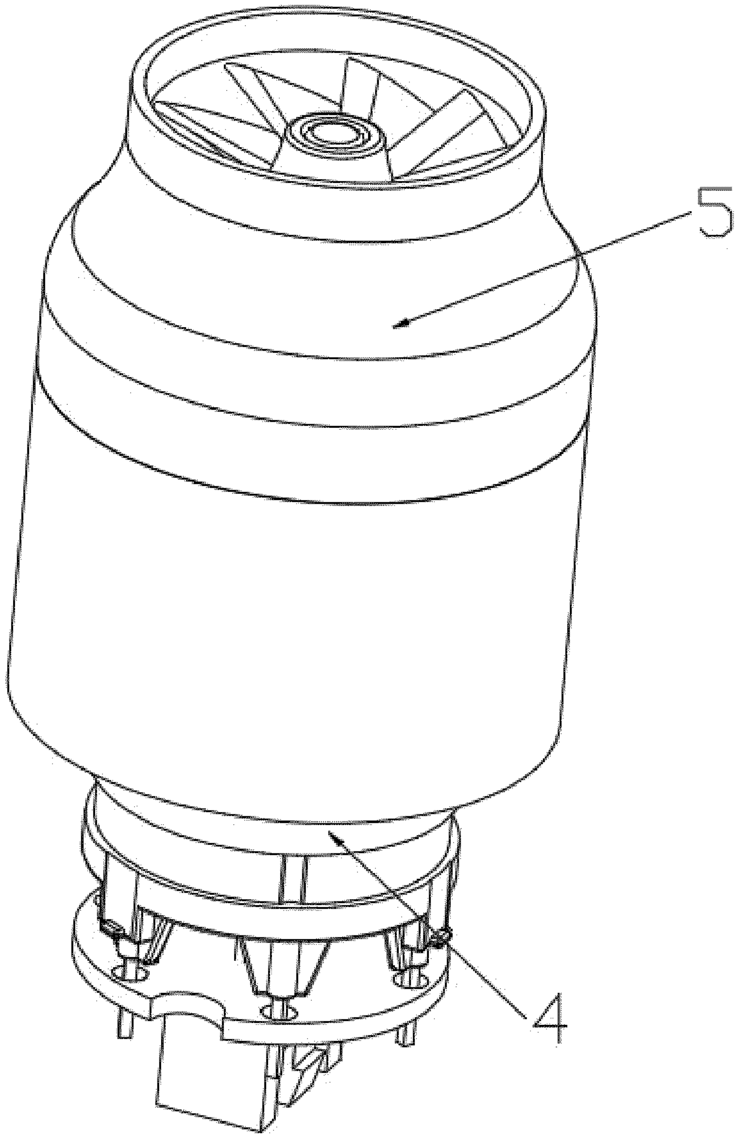

FIG. 1

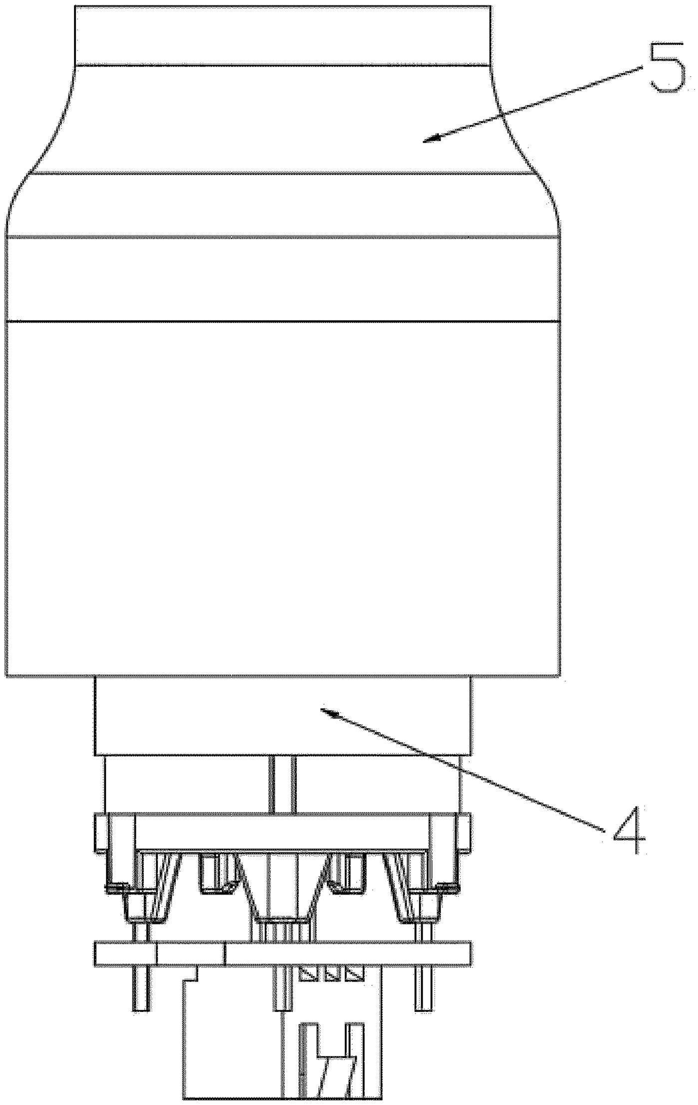

FIG. 2

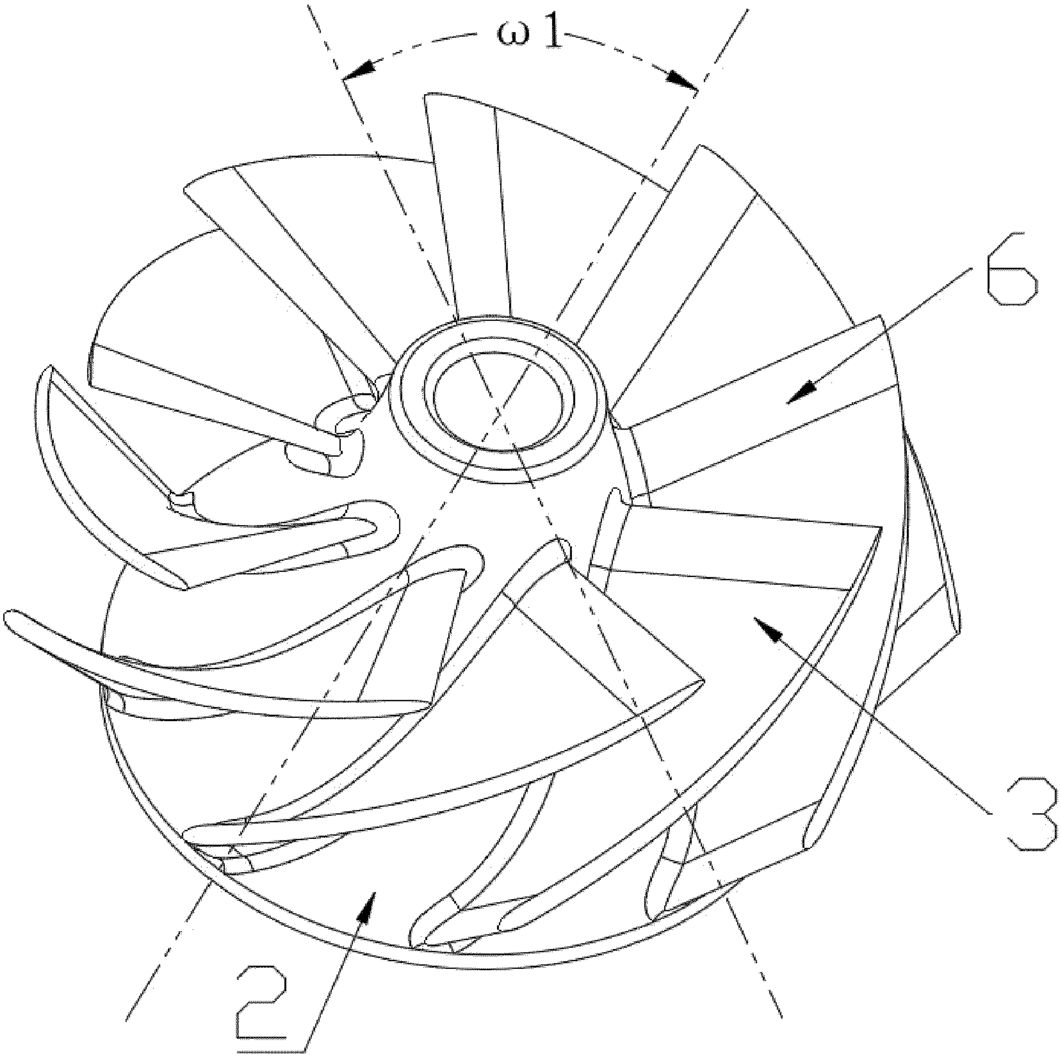

FIG. 3

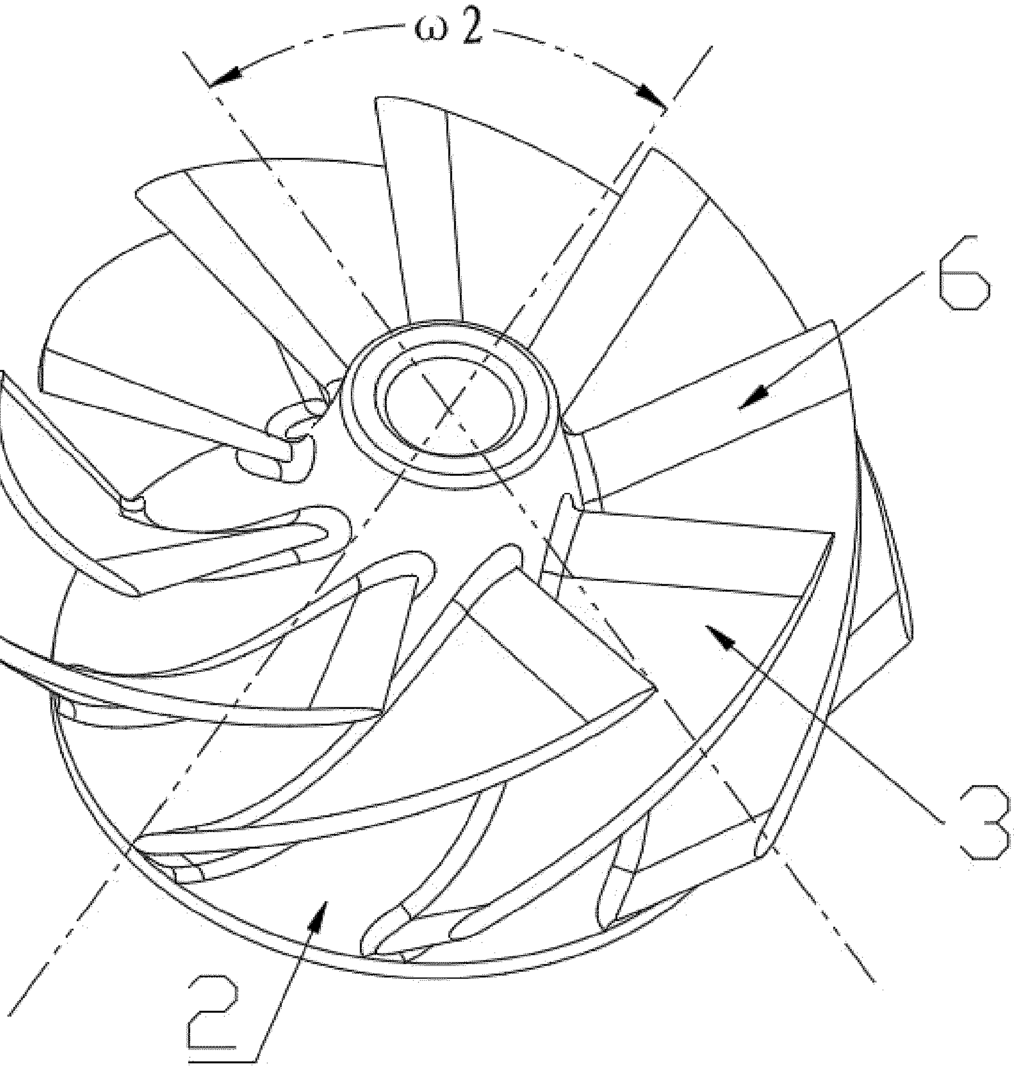

FIG. 4

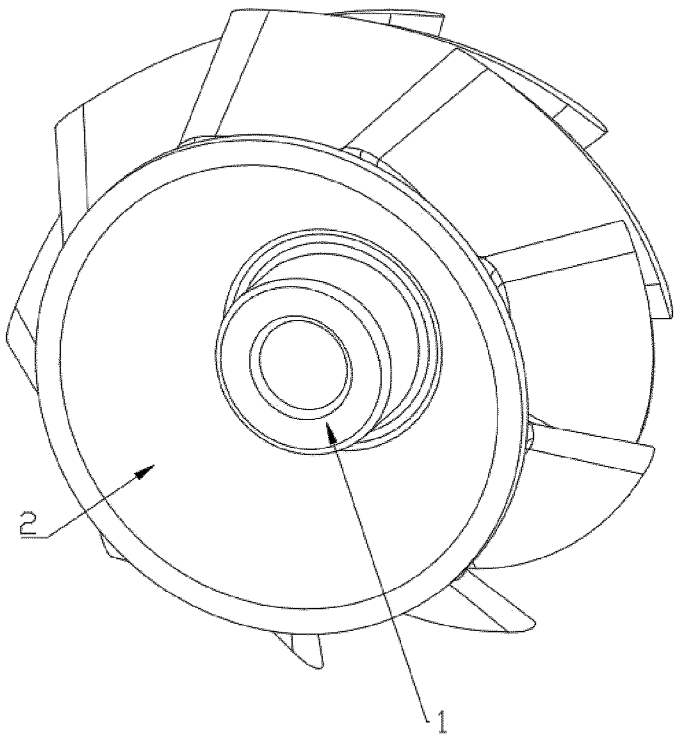

FIG. 5

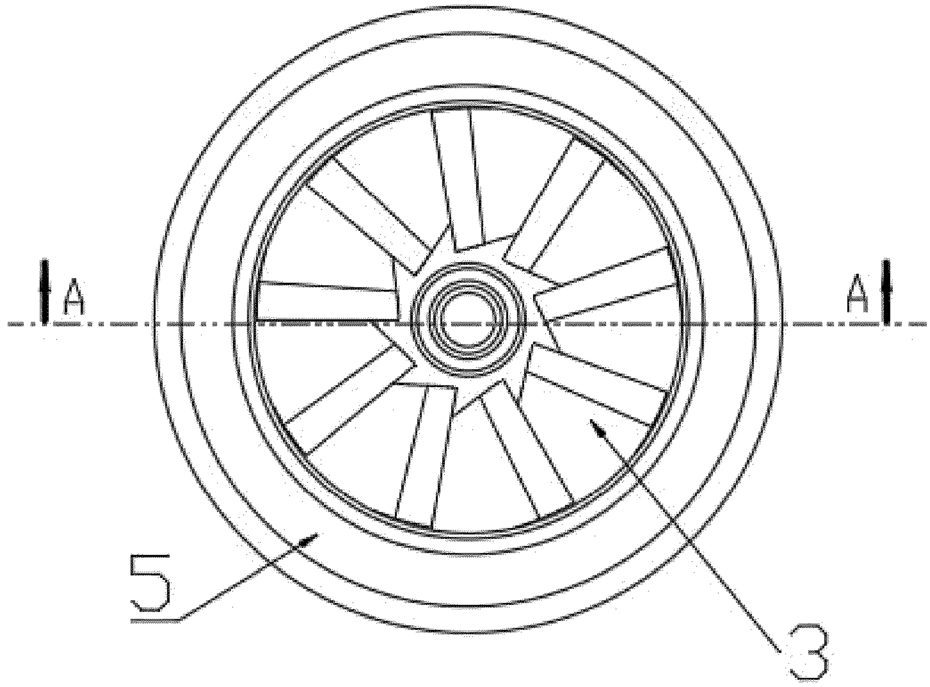

FIG. 6

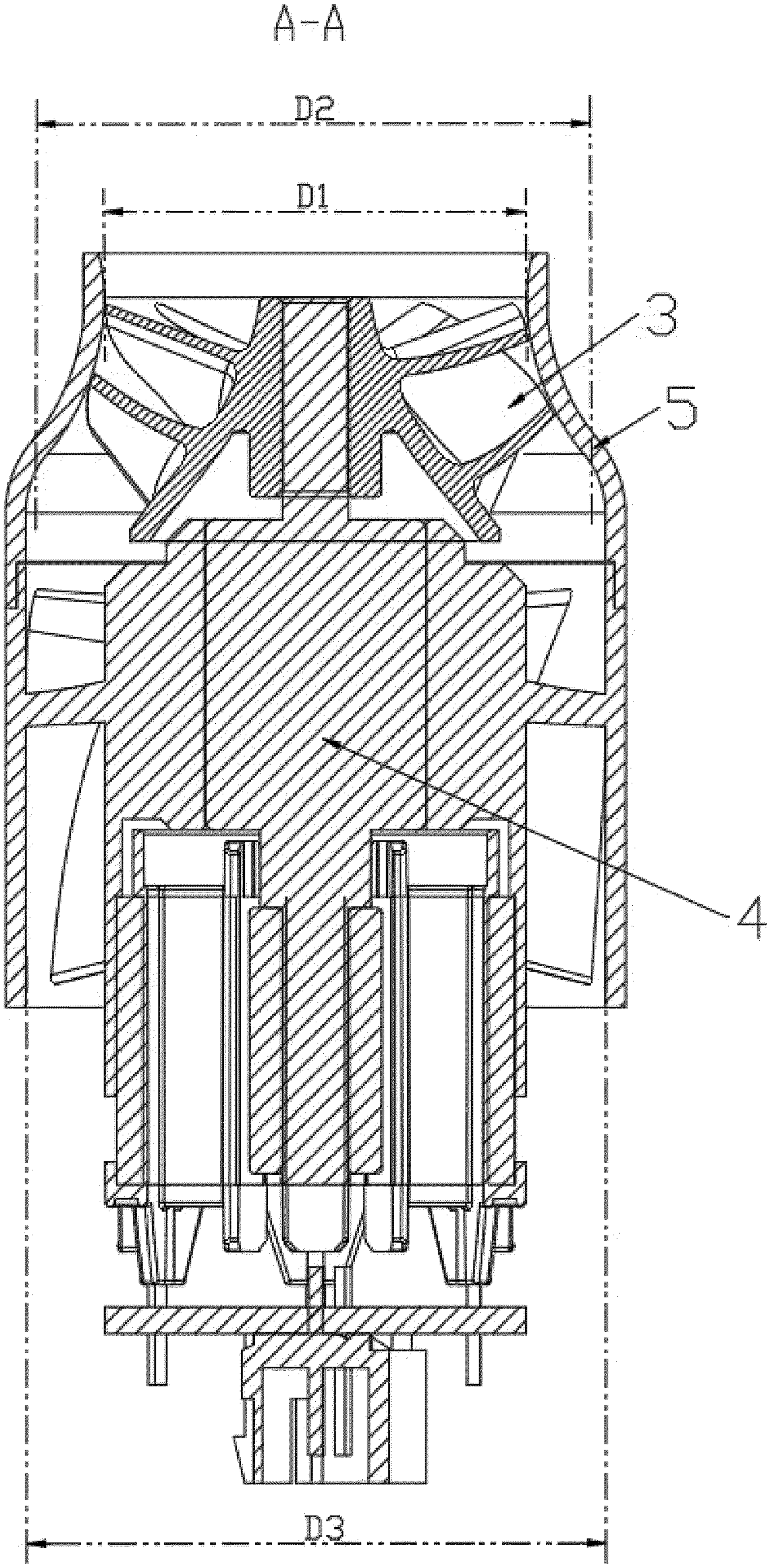

FIG. 7

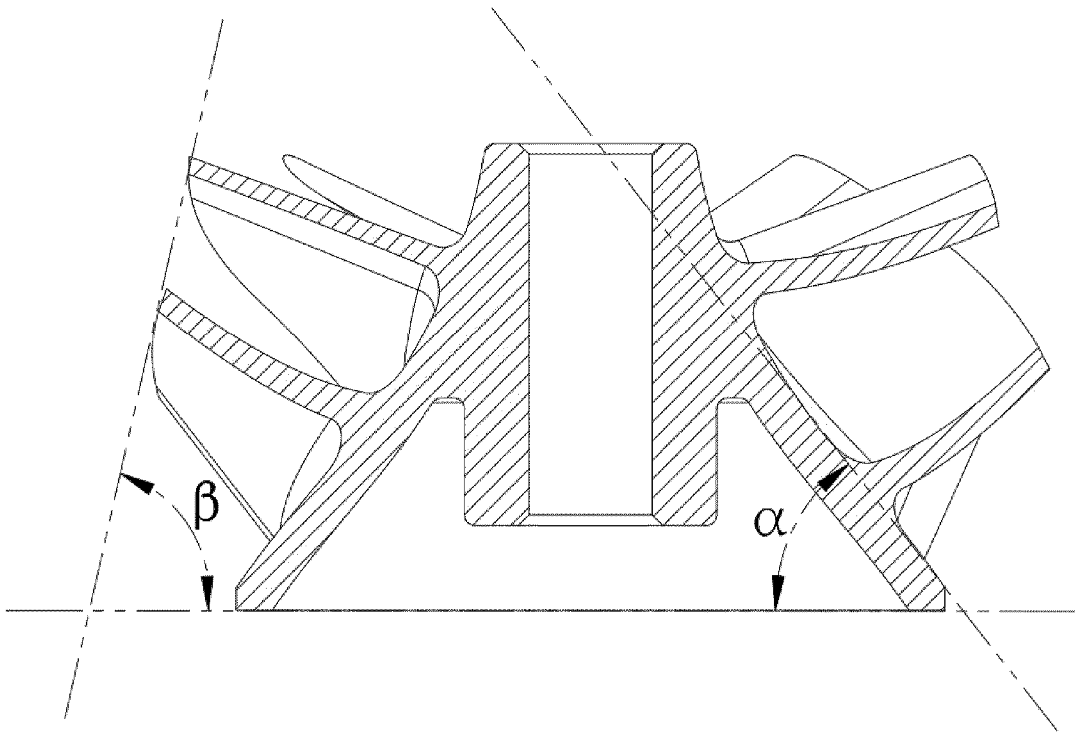

FIG. 8

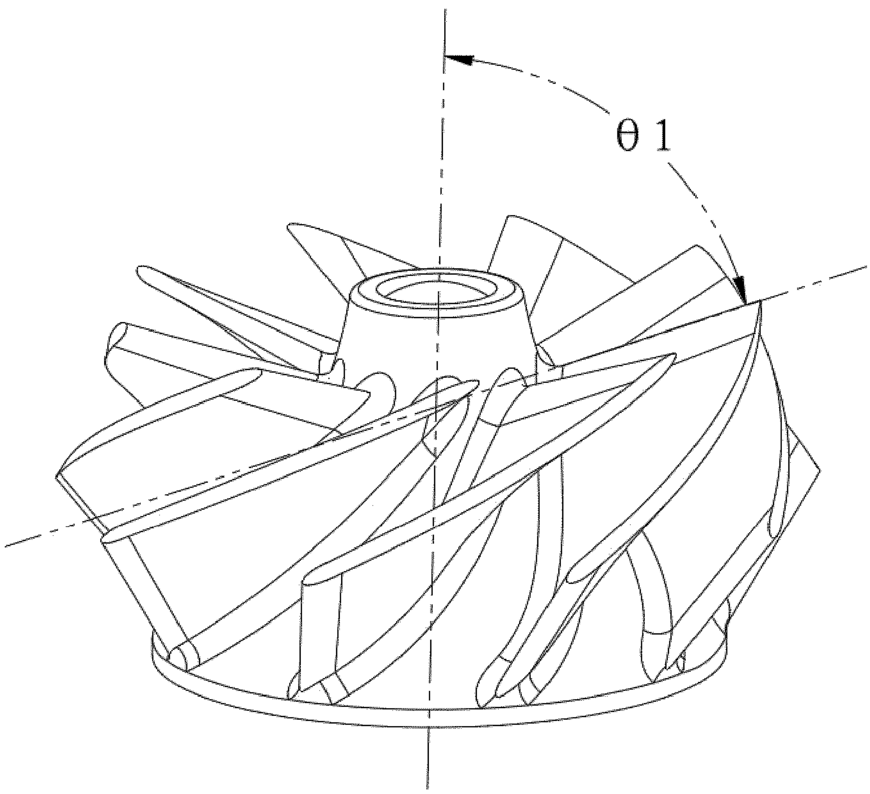

FIG. 9

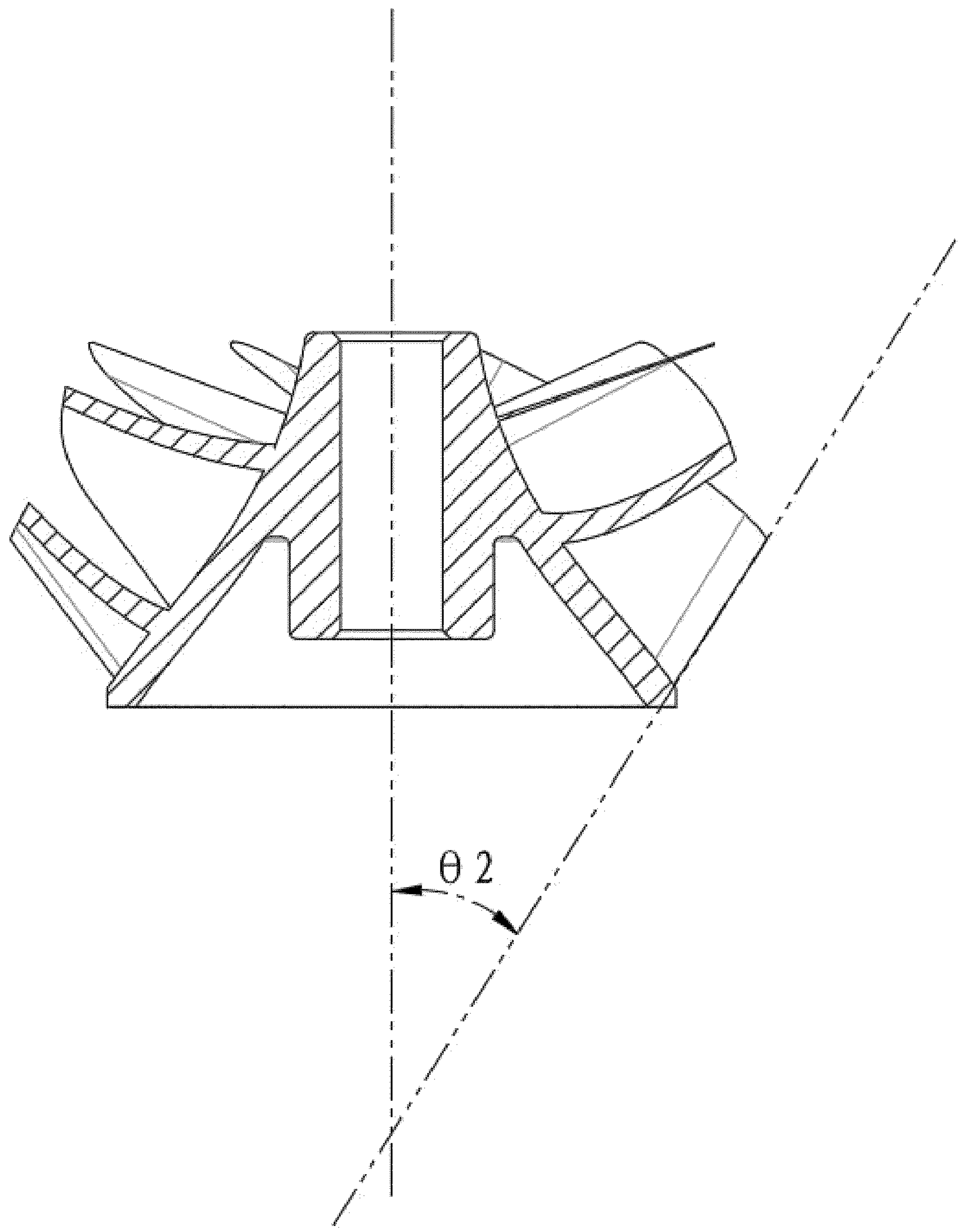

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 25 16 7512

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	CN 216 518 820 U (FORAGING SCIENCE AND TECH SUZHOU LIMITED COMPANY) 13 May 2022 (2022-05-13) * paragraphs [0014], [0016]; figures * -----	1-12 13	INV. A45D20/12 F04D29/28
A	CN 112 780 606 A (CHANGSHA TUANLIU TECH CO LTD) 11 May 2021 (2021-05-11) * paragraphs [0064] - [0076]; figures * -----	1-13	
A	CN 210 290 259 U (MIDEA WELLING MOTOR TECH SHANGHAI CO LTD) 10 April 2020 (2020-04-10) * figures * -----	1-13	
A	US 2010/189557 A1 (BROOM COLIN [GB]) 29 July 2010 (2010-07-29) * paragraphs [0020], [0041]; figures * -----	1-13	
A	CN 110 966 250 A (GUANGDONG WELLING MOTOR MFG CO ET AL.) 7 April 2020 (2020-04-07) * figures * -----	1-13	TECHNICAL FIELDS SEARCHED (IPC)
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A	JP 3 959995 B2 (MATSUSHITA ELECTRIC WORKS LTD) 15 August 2007 (2007-08-15) * figures * -----	1-13	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	4 September 2025	Zattoni, Federico

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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04-09-2025

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