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(54) CENTRIFUGAL FAN

(57) A centrifugal fan includes a casing (1) and an impeller module (2). The casing (1) defines an accommodating space (100) having an air inlet (101) and an air outlet (102). The impeller module (2) is mounted in the accommodating space (100) and is rotatable about an axis for allowing air flow to enter from the air inlet (101) and then exit from the air outlet (102) . The impeller module (2) includes a body (20) and a plurality of blade units (21) connected to and annularly distributed along a circumference of the body (20). Each of the blade units (21) has a plurality of blades (211) that are equi-angularly arranged along the circumference of the body (20). A blade spacing which is defined between each adjacent pair of the blades (211) of one of the blade units (21) is different from a blade spacing which is defined between each adjacent pair of the blades (211) of another one of the blade units (21).

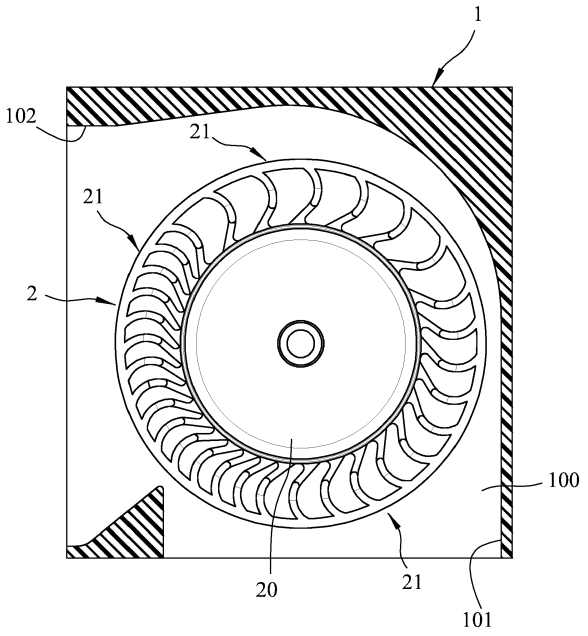

FIG.2

EP 3 623 637 A1

Description

[0001] The disclosure relates to a cooling fan, and particularly to a centrifugal fan.

[0002] The centrifugal fan is one of the commonly used heat dissipating devices, the characteristics of the air entering the fan casing from an axial inlet opening near the shaft of the impeller and being displaced from a radial outlet opening at one side of the casing are particularly advantageous for the heat dissipation of miniaturized electronic products. However, the periodic changes in air pressure will occur in operation of the centrifugal fan and lead to a source of noise. These periodic changes in pressure are directly related to the number of fan blades, the shape of fan blades, the distribution of fan blades, and even the rotation speed of the impeller. In particular, when the shape of the respective blades is the same and the distribution of blade pitch is uniform, the noise from resonance of the fan blades causing troubles in use.

[0003] Referring to Figure 1, an impeller of a conventional centrifugal fan 9 is shown to include a hub 90, a ring member 91 surrounding the hub 90, and a plurality of blades 92 radially extending from the ring member 91. The arc distances (D) between each two adjacent blades 92, with the same imaginary circular line as a reference, are designed to exhibit continuous variations according to the requirement of reducing noise. In the clockwise direction (R) as depicted in Figure 1, the arc distances (D) between each two adjacent blades 92 gradually decrease from the 12 o'clock position and then gradually increase from the 6 o'clock position. That is, any two adjacent arc distances (D) of these blades 92 in the same imaginary circular line are different, such that the blades 92 to be rendered by unequal spacing arrangement, thereby reducing the resonance of blades 92 and the noise generated during rotation of the centrifugal fan 9.

[0004] However, in this way of design, if the running test result of the centrifugal fan is not as expected, it must be re-adjusted the appropriate spacing variation or spacing ratio variation one by one for each blade 92, so that not only the time and cost of the design are huge, but also relatively precise processes are required for actual manufacturing in considering accurately matching the design data, therefore, the costs of design and manufacturing are bound to be high.

[0005] Therefore, the object of the disclosure is to provide a centrifugal fan capable of reducing noise with reduced design and manufacturing costs.

[0006] According to the disclosure, a centrifugal fan includes a casing and an impeller module. The casing defines an accommodating space having an air inlet and an air outlet. The impeller module is mounted in the accommodating space and is rotatable about an axis for allowing air flow to enter from the air inlet and exit from the air outlet. The impeller module includes a body and a plurality of blade units connected to and annularly distributed along a circumference of the body. Each of the blade units has a plurality of blades that are equi-angularly arranged along the circumference of the body. A blade spacing which is defined between each adjacent pair of the blades of one of the blade units is different from a blade spacing which is defined between each adjacent pair of the blades of another one of the blade units.

[0007] Further, the present disclosure is to provide a variation of the centrifugal fan capable of reducing noise with reduced design and manufacturing costs.

[0008] Accordingly, this variation of the disclosed centrifugal fan includes a casing and an impeller module. The casing defines an accommodation space having an air inlet and an air outlet. The impeller module is mounted in the accommodating space and is rotatable about an axis for allowing air flow to enter from the air inlet and exit from the outlet. The impeller module includes a body and a plurality of blade units connected to and angularly distributed in a rotational direction along a circumference of the body. Each of the blade units has a plurality of blades with a blade spacing being defined between each adjacent pair of the blades. For each of the blade units, the blade spacings among the blades are different, and the blades are arranged in a manner that the blade spacings increases in the rotational direction.

[0009] Other features and advantages of the disclosure will become apparent in the following detailed description of the embodiments with reference to the accompanying drawings, of which:

Figure 1 is a top view illustrating an impeller of a conventional centrifugal fan;

Figure 2 is a partly cross-sectional view illustrating a first embodiment of a centrifugal fan according to the present disclosure,

Figure 3 is a top view of an impeller module of the first embodiment;

Figure 4 is a top view of an impeller module of a second embodiment of the centrifugal fan according to the present disclosure; and

Figure 5 is a top view of an impeller module of a third embodiment of the centrifugal fan according to the present disclosure.

[0010] Before the present disclosure is described in greater detail, it should be noted that where considered appropriate, reference numerals or terminal portions of reference numerals have been repeated among the figures to indicate corresponding or analogous elements, which may optionally have similar characteristics.

[0011] As shown in Figures 2 and 3, the first embodiment of a centrifugal fan according to the present disclosure includes a casing 1 which defines an accommodating space 100 having an air inlet 101 and an outlet 102, and an impeller module 2 which is mounted in the accommodating space 100 and which is rotatable about an axis for allowing air flow to enter from the air inlet 101 and then exit from the outlet 102.

[0012] In this embodiment, the impeller module 2 includes a body 20, and three blade units 21 connected to

the body 20 and annularly distributed along a circumference of the body 20. Each of the blade units 21 has a plurality of blades 211 extending from the body 20 away from the axis, and are equi-angularly arranged along the circumference of the body 20. In this embodiment, each adjacent pair of the blades 211 of one of the blade units 21 defines a blade spacing (X1) therebetween, each adjacent pair of the blades 211 of another one of the blade units 21 defines a blade spacing (X2) therebetween, and each adjacent pair of the blades 211 of the last one of the blade units 21 defines a blade spacing (X3) therebetween. The blade spacings (X1, X2, X3) among the blade units 21 are of different sizes, and the three blade units 21 are arranged in the order of size of the predetermined blade spacings (X1, X2, X3). With the full circle around the body 20 as a reference, a blade unit 21 is formed every 120 degrees, with the blade spacings of the three blade units 21 varied from (X1) to (X2) and then to (X3), thereby providing asymmetrically distributed blades 211 as a whole for the impeller module 2 of the first embodiment.

[0013] Since the blades 211 of the impeller module 2 in the first embodiment are asymmetrically distributed, the noise from resonance during rotation of the impeller module 2 can be reduced. Further, in the design of the first embodiment, it is only needed to provide three blade units 21 with different blade spacings (X1, X2, X3), thus obviating the necessity of adjusting the continuous spacing variation between each adjacent blades 92 as illustrated in Figure 1. Therefore, it can effectively reduce the costs of design and testing. In addition, because the design is relatively simple, high-precision processes are not required, thereby reducing the cost incurred in manufacturing.

[0014] It should be particularly noted that the first embodiment is described by taking the form of three blade unit 21 as an example. In actual implementation, for the consideration of other requirements, four to six blade units 21 may be designed for an impeller module 2 without excessive difficulty. This can also provide an impeller module 2 with asymmetrically distributed blades 211 in terms of the blade spacing, and achieve the effect of reducing the costs of design and manufacturing.

[0015] As shown in Figure 4, the second embodiment of a centrifugal fan of the present disclosure has a structure similar to that of the first embodiment. The main difference between this embodiment and the first embodiment resides in the following. The impeller module 2 in this embodiment includes four blade units 21. The four blade units 21 includes two first blade units 2101 with one blade spacing (X4), and two second blade units 2102 with a different blade spacing (X5). The first and second blade units 2101, 2102 are arranged in alternate. In the second embodiment, since only two different spacings (X4, X5) are used in the four blade units 21, the resonance of blades 211 can be prevented in a simpler design to achieve the purpose of reducing noise during operation.

[0016] As shown in Figure 5, the third embodiment has a structure similar to that of the first embodiment. The main difference between this embodiment and the first embodiment resides in the following. The blade unit 21 in this embodiment are annularly distributed in a rotational direction (R1) along the circumference of the body 20. Each of the blade units 21 has four blades 211 with the blade spacings among the blades 211 being different. Specifically, each of the blade units 21 has three blade spacings (Y1, Y2, Y3), and the four blades 211 are arranged in a manner that the blade spacings (Y1, Y2, Y3) increases in the rotational direction (R1). Given that each blade unit 21 has four blades 211 with three different spacings (Y1, Y2, Y3), in the design of the third embodiment, it is only needed to configure the three blade spacings (Y1, Y2, Y3) rather than to adjust the continuous spacing variation between each adjacent blades 92 as illustrated in Figure 1, so that the cost of design and testing can be effectively reduced as in the first embodiment, which in turn reducing the cost incurred in manufacturing.

[0017] To be particularly noted that the third embodiment is described with respect to the blade units 21 with four blades 211 as an example, this embodeiment may be implemented depending on the actual requirements with appropriate adjustments. For example, each blade unit 21 has only three blades 211, or has five blades 211, the intended effect of this disclosure can still be achieved without unduly raising the design difficulty.

[0018] In summary, the impeller module 2 of the centrifugal fan 2 of the present disclosure is designed in a relatively simple manner to prevent the resonance of blades, thereby reducing the noise during operation, and effectively reducing the costs of design, testing, and manufacturing.

[0019] In the description above, for the purposes of explanation, numerous specific details have been set forth in order to provide a thorough understanding of the embodiments. It will be apparent, however, to one skilled in the art, that one or more other embodiments may be practiced without some of these specific details. It should also be appreciated that reference throughout this specification to "one embodiment," "an embodiment," an embodiment with an indication of an ordinal number and so forth means that a particular feature, structure, or characteristic may be included in the practice of the disclosure. It should be further appreciated that in the description, various features are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of various inventive aspects, and that one or more features or specific details from one embodiment may be practiced together with one or more features or specific details from another embodiment, where appropriate, in the practice of the disclosure.

Claims

1. A centrifugal fan including:

a casing (1) defining an accommodatng space (100) having an air inlet (101) and an air outlet (102); and
an impeller module (2) mounted in said accommodating space (100) and rotatable about an axis for allowing air flow to enter from said air inlet (101) and exit from said air outlet (102), said impeller module (2) including a body (20) and a plurality of blade units (21) connected to and annularly distributed along a circumference of said body (20), **characterized in that**:
each of said blade units (21) has a plurality of blades (211) that are equi-angularly arranged along said circumference of said body (20), a blade spacing which is defined between each adjacent pair of said blades (211) of one of said blade units (21) being different from a blade spacing which is defined between each adjacent pair of said blades (211) of another one of said blade units (21).

2. The centrifugal fan as claimed in claim 1, **characterized in that**:

said plurality of blade units (21) includes at least three blade units (21);
the blade spacings among said blade units (21) are different; and
said blade units (21) are arranged in the order of size of the blade spacings.

3. The centrifugal fan as claimed in any one of claims 1 and 2, **characterized in that** said impeller module (2) includes exactly three blade units (21).

4. The centrifugal fan as claimed in claim 1, **characterized in that** said impeller module (2) includes exactly four blade units (21).

5. The centrifugal fan as claimed in claim 4, **characterized in that** said four blade units (21) includes two first blade units with one blade spacing and two second blade units with a different blade spacing, said first and second blade units being arranged in alternate.

6. A centrifugal fan including:

a casing (1) defining an accommodation space (100) having an air inlet (101) and an air outlet (102); and
an impeller module (2) mounted in said accommodating space (100) and rotatable about an axis for allowing air flow to enter from said air inlet (101) and exit from said air outlet (102), said impeller module (2) including a body (20) and a plurality of blade units (21) connected to and annularly distributed in a rotational direction along a circumference of said body (20), each of said blade units (21) having a plurality of blades (211) with a blade spacing being defined between each adjacent pair of said blades (211); **characterized in that**, for each of said blade units (21), the blade spacings among said blades (211) being different, and said blades (211) being arranged in a manner that the blade spacings increases in the rotational direction.

7. The centrifugal fan as claimed in claim 6, **characterized in that** each blade unit (21) has four blades (211).

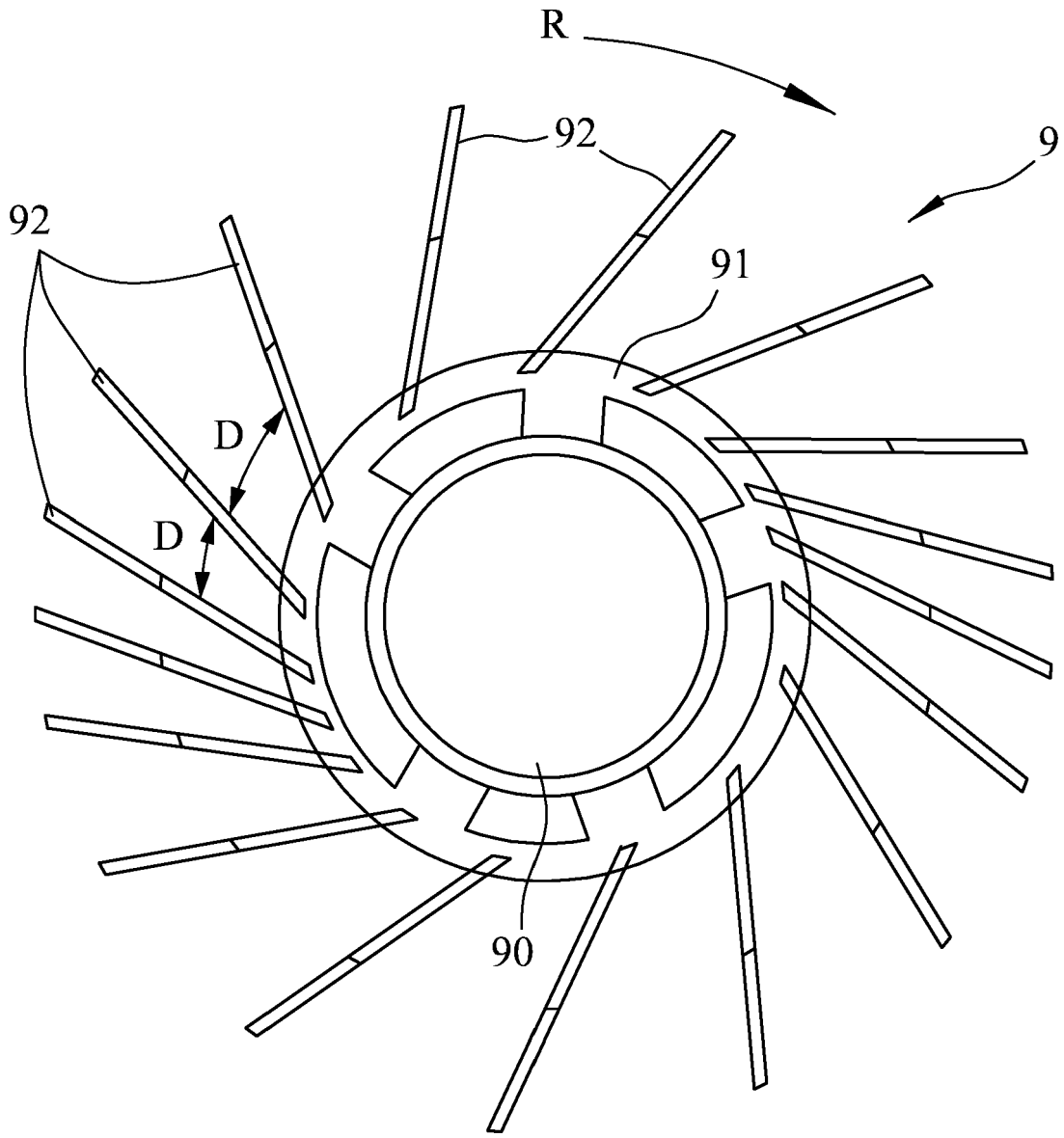

FIG.1
PRIOR ART

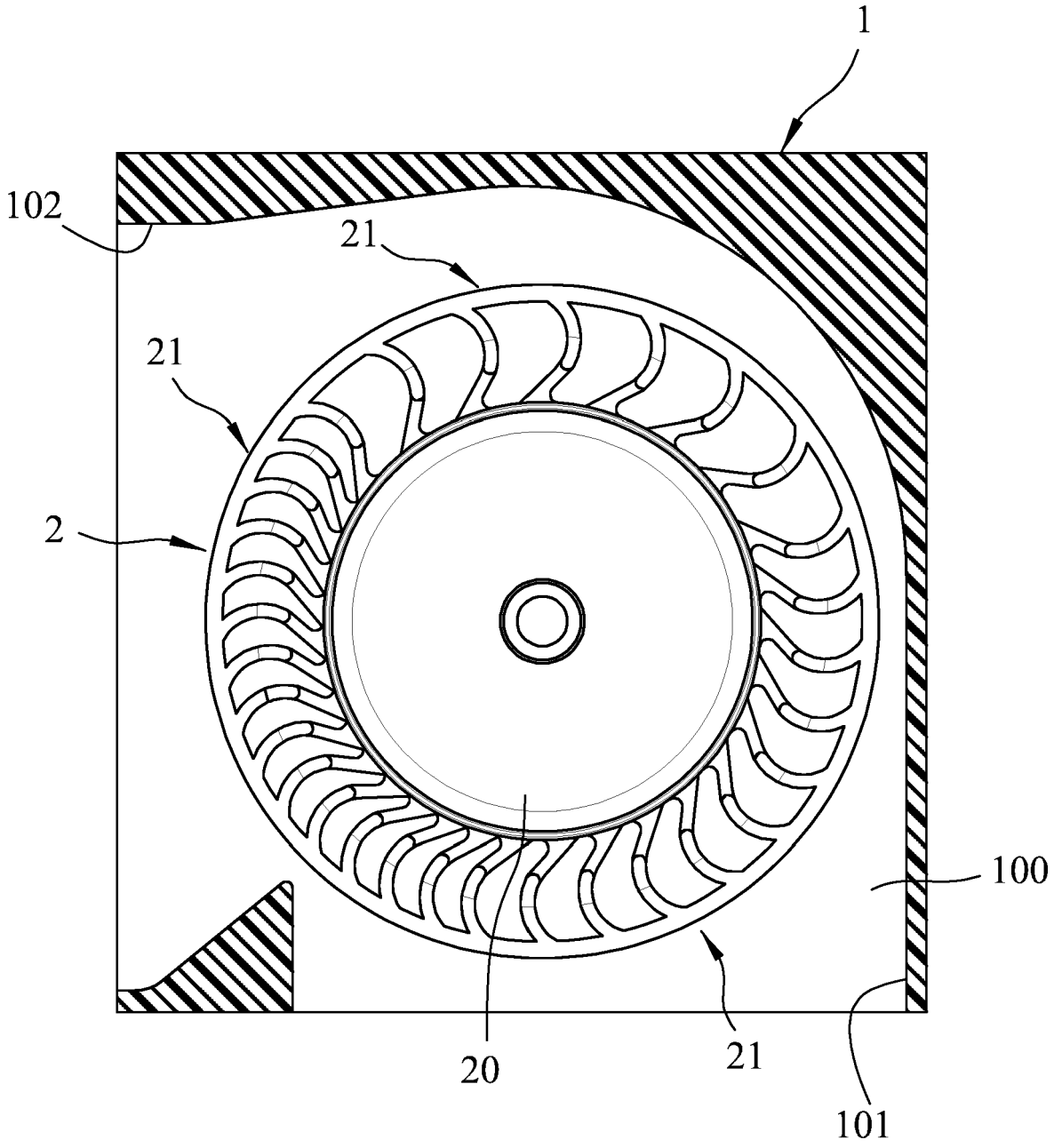

FIG.2

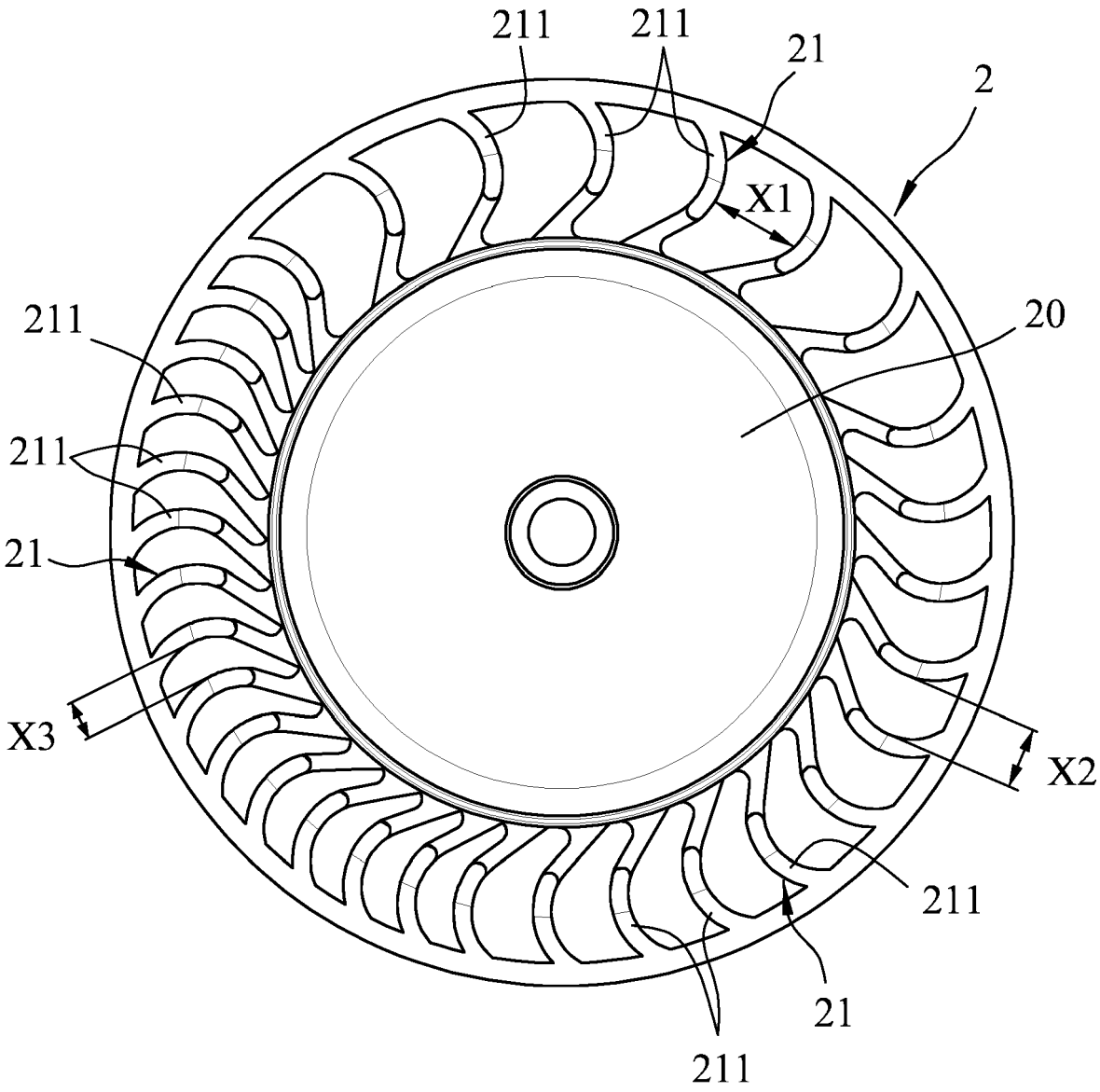

FIG.3

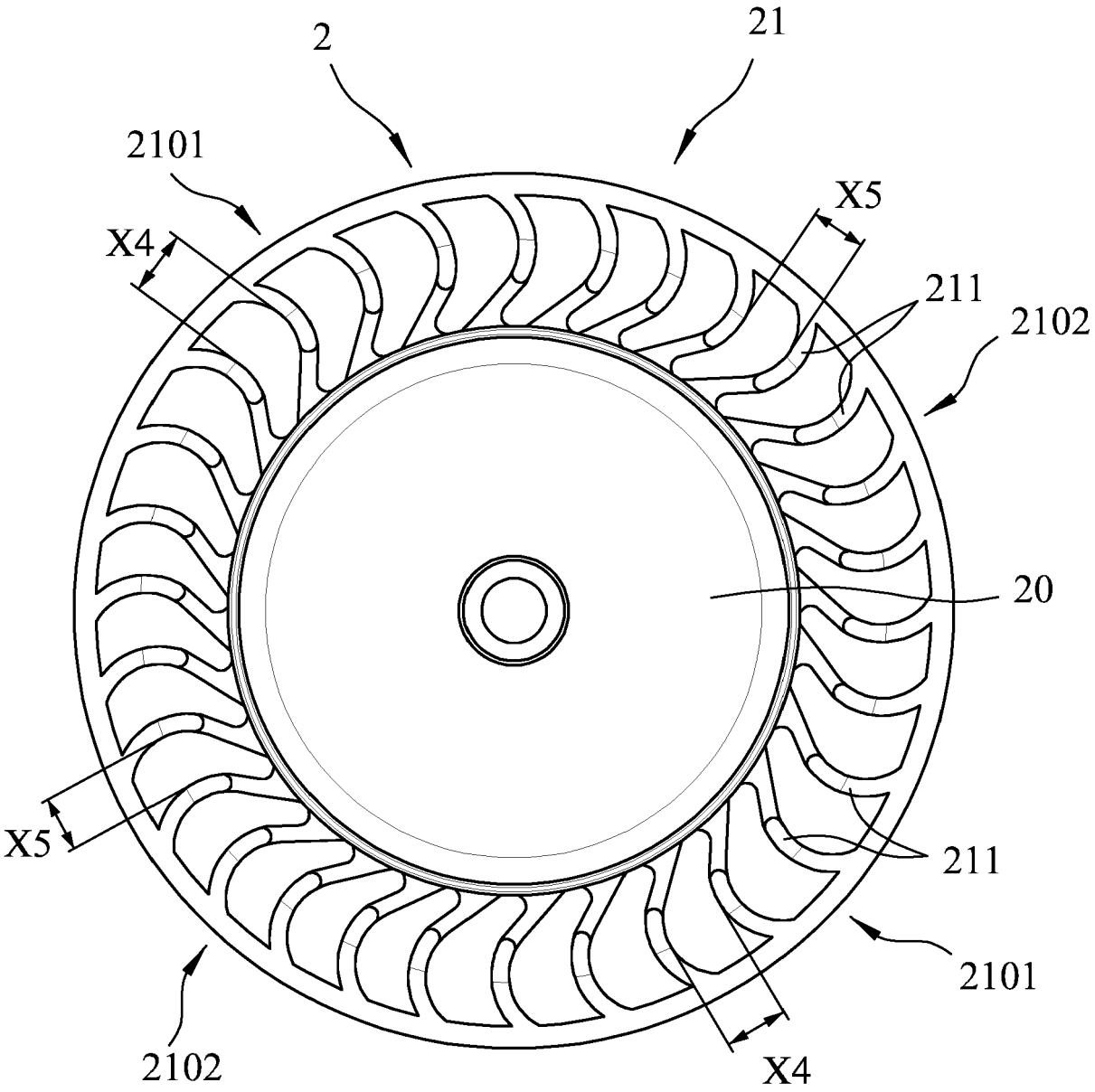

FIG.4

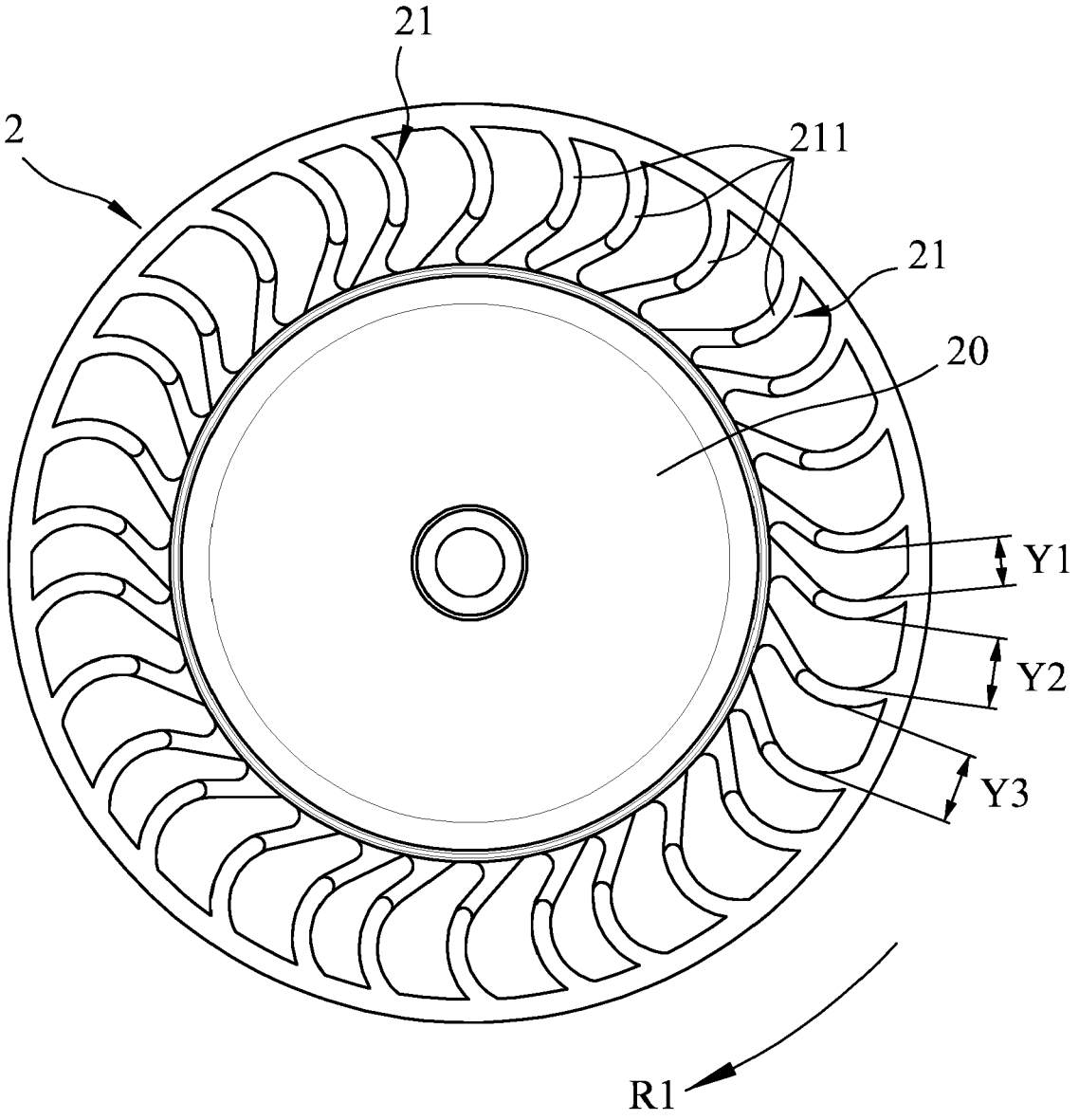

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 19 6942

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC) F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 January 2020	Lovergine, A

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 19 6942

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28-01-2020

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