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(54) **POLISHING DEVICE AND MANUFACTURING METHOD**

(57) A polishing device includes a plurality of elastic thin teeth (2), a substrate (1) having an annular structure, and a pressing plate (3). The plurality of elastic thin teeth (2) is sequentially spliced and stacked to form the annular structure. Every two adjacent elastic thin teeth (2) are closely abutted. An upper end face or an annular side surface of the annular structure is a grinding working surface (4). The grinding working surface (4) is of an annular saw-toothed structure. A manufacturing method of the polishing device includes: S1, manufacturing a plurality of elastic thin teeth (2) according to a set structure, and sequentially splicing and stacking the plurality of elastic thin teeth (2) to form an annular structure, so that every two adjacent elastic thin teeth (2) are closely abutted; and S2, rotating the annular structure, and shaping and sharpening a grinding working surface (4) of the annular structure, so that the grinding working surface (4) is of an annular saw-toothed structure.

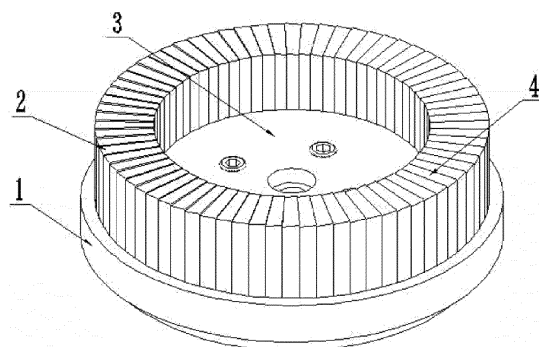


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of abrasive tools, and in particular to a polishing device for edge polishing and a manufacturing method thereof.

BACKGROUND

[0002] Polishing wheels mainly use resin bonds and rubber bonds for edge polishing. Resin-bonded abrasive tools have high strength, good elasticity, poor heat resistance, and good self-drive property, but are small in porosity, easy to block, quick to wear, and can easily lose their profiles. Rubber-bonded abrasive tools have higher strength and elasticity, low porosity and poor heat resistance. The above-mentioned bonds have poor temperature resistance, and the bond strength will drop sharply with temperature increase, and is easy to suffer from changes such as softening, melting and carbonization, which destroy the structures, directly resulting in the failures of the performances of the abrasive tools, such as abrasive shedding, sharpness reduction, bond softening and melting to block pores, etc. Therefore, heat dissipation of working abrasive tools is a key to ensure their normal use. In many occasions, coolants such as water and emulsions are used to cool the abrasive tools. However, the existing methods for cooling abrasive tools still have some problems. The coolant has a poor cooling effect on abrasive tools with a temperature resistance of less than 200°C when used for cooling. For situations where the contact area for grinding is relatively large, for example, the contact surface of a cup-shaped polishing wheel is relatively large when grinding, the coolant cannot smoothly enter a working surface, resulting in poor cooling effect. A bonding material is a poor heat conductor, such that local high temperature generated by the abrasive in the grinding process cannot be quickly transferred out to form a heat dissipation effect. Therefore, the local high temperature will greatly affect the transition zone properties of the abrasive and the bond, such that the poor combination of the abrasive and the bond directly leads to a sharp decline in the performance of the abrasive tool. In high-speed and high-efficiency machining, it is necessary to improve the grinding ability, which requires improved ability to hold the abrasive and better cooling. Increased elasticity and porosity are not conducive to the service life and rigidity. The various factors restrict one another, thus limiting the application of high-speed and high-efficiency machining.

SUMMARY

[0003] The objects of the present invention are to provide a polishing device for edge polishing with a simple structure, reliable manufacturing process, low manufac-

turing cost, high efficiency, energy saving and safety, and a manufacturing method thereof.

[0004] The technical solutions of the present invention to solve the above technical problems are as follows: a polishing device including a plurality of elastic thin teeth, wherein the plurality of elastic thin teeth is sequentially spliced and stacked to form an annular structure, and every two adjacent elastic thin teeth are closely abutted; and an upper end face or an annular side surface of the annular structure is a grinding working surface, and the grinding working surface is of an annular saw-toothed structure.

[0005] Further, upper parts or side walls of the plurality of elastic thin teeth are made of an abrasive layer; the plurality of elastic thin teeth includes a plurality of elastic thin teeth A and a plurality of elastic thin teeth B, and the plurality of elastic thin teeth A and the plurality of elastic thin teeth B are arranged in a staggered manner; or the plurality of elastic thin teeth A and one elastic thin teeth B are arranged in a staggered manner; or the plurality of elastic thin teeth A constitutes a group of elastic thin teeth A, the plurality of elastic thin teeth B constitutes a group of elastic thin teeth B, and the group of elastic thin teeth A and the group of elastic thin teeth B are arranged in a staggered manner; and upper parts of the plurality of elastic thin teeth A and upper parts of the plurality of elastic thin teeth B form the annular saw-toothed structure.

[0006] Further, the elastic thin teeth A are made of a first bond and a first abrasive, and the elastic thin teeth B are made of a second bond and a second abrasive.

[0007] Further, the polishing device also includes a substrate having an annular structure, and a pressing plate, wherein the annular structure formed by the plurality of elastic thin teeth is fixed on the substrate; and the pressing plate is placed in the annular structure, is connected to the substrate by a bolt, and squeezes the plurality of elastic thin teeth.

[0008] Further, the substrate is provided with a limiting groove arranged along an inner edge of the substrate; and lower parts of the plurality of elastic thin teeth are embedded in the limiting groove.

[0009] Further, an end surface of the pressing plate close to the elastic thin teeth is inclined, and is matched and close to end surfaces of the elastic thin teeth to limit the plurality of elastic thin teeth.

[0010] Further, the plurality of elastic thin teeth is displaced from a radial direction of the annular structure.

[0011] Further, every two adjacent elastic thin teeth are fixedly connected by gluing and/or by a fastener.

[0012] Another technical solution of the present invention to solve the above technical problems is as follows. A manufacturing method of a polishing device includes the following steps:

S 1. manufacturing a plurality of elastic thin teeth according to a set structure, and sequentially splicing and stacking the plurality of elastic thin teeth to form

an annular structure, so that every two adjacent elastic thin teeth are closely abutted; and
 S2. rotating the annular structure, and shaping and sharpening a grinding working surface of the annular structure, so that the grinding working surface is of an annular saw-toothed structure.

[0013] Further, a ratio of an average radial length of each elastic thin tooth to an average circumferential width thereof in step S1 is greater than 3 times.

[0014] The beneficial effects of the present invention are summarized as follows.

1. Under the same physical volume condition of the abrasive working layer, the narrower and the more the elastic thin teeth are, the easier the elastic thin teeth will be deflected and displaced by forces including a centrifugal force. Then a gap is formed, which is conducive to the penetration of cooling water through the grinding area and can provide better cooling effect.

2. The more the elastic thin teeth, the narrower a circumferential width of the abrasive teeth, the shorter a chip discharge path, the smaller the accumulation of chips, and the smaller the amount of bond friction on the abrasive body. Thus, relatively low grinding heat is generated, which is conducive to high-speed and high-efficiency machining and can expand the application of formulas that are not resistant to high temperatures.

3. In view of a large number of elastic thin teeth, short chip discharge path, small accumulation of chips and small friction resistance of the chips, the required chip space is small, and the requirement for the exposure height of the abrasive is low. This feature is also conducive to the use of relative finer abrasives to obtain high-quality machining. This feature is also conducive to the use of relatively faster speed or greater engagement to obtain high-efficiency machining.

4. The elastic thin teeth profile polishing device that is difficult to be machined as a whole can be easily realized by breaking down into individual thin tooth and splicing and stacking and consolidating the teeth.

5. The polishing device can be applied to non-annular abrasive tools such as grinding discs and grinding blocks.

6. The polishing device provides better chip holding and cooling functions, and transfers the functions required by the original abrasive tool body to structural functions. Therefore, for the elastic abrasive tool with the organic bond, under the condition of meeting the self-sharpening properties, the porosity and elasticity of the abrasive tool can be moderately reduced to enhance the ability to hold the abrasive, which is conducive to prolonging the service life of the abrasive tool, and expanding the application of

high-speed and high-efficiency machining.

7. The polishing device and the manufacturing method thereof can effectively reduce the power consumption, save energy and reduce the cost, and is environment-friendly.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a front view of a polishing device and a manufacturing method of the present invention with respect to Embodiment 1;

FIG. 2 is a cross-sectional view of a polishing device and a manufacturing method of the present invention with respect to Embodiment 1;

FIG. 3 is a partial enlarged view of a polishing device and a manufacturing method of the present invention with respect to a grinding working surface in Embodiment 1;

FIG. 4 is a schematic diagram showing the implementation of a polishing device and a manufacturing method of the present invention when a grinding part of an elastic thin teeth is in contact with a workpiece in Embodiment 1;

FIG. 5 is a partial enlarged view of a polishing device and a manufacturing method of the present invention when a grinding part of an elastic thin teeth is in contact with a workpiece in Embodiment 1;

FIG. 6 is a schematic diagram showing the implementation of a polishing device and a manufacturing method of the present invention when all the grinding part of a single elastic thin tooth is in contact with a workpiece in Embodiment 1;

FIG. 7 is a partial enlarged view of a polishing device and a manufacturing method of the present invention when the entire grinding part of a single elastic thin tooth is in contact with a workpiece in Embodiment 1; FIG. 8 is a schematic diagram of a polishing device and a manufacturing method of the present invention with respect to the improvement of Embodiment 1; FIG. 9 is a front view of a polishing device and a manufacturing method of the present invention with respect to Embodiment 2;

FIG. 10 is a schematic diagram showing the implementation of a polishing device and a manufacturing method of the present invention with respect to Embodiment 2;

FIG. 11 is a partial enlarged view showing the implementation of a polishing device and a manufacturing method of the present invention with respect to Embodiment 2.

[0016] In the drawings, the list of components represented by various symbols is as follows:

[0017] 1. substrate; 2. elastic thin teeth; elastic thin teeth A; elastic thin teeth B; 3. pressing plate; 4. grinding working surface; 5. limiting groove; 6. workpiece; 7. first

gap; 8. second gap.

DESCRIPTION OF EMBODIMENTS

[0018] The principles and features of the present invention will be described below with reference to the accompanying drawings. The embodiments set forth herein are only intended to explain the present invention, rather than limit the scope of the present invention.

[0019] The technical solution of a polishing device can also be applied to various forms of polishing machining such as grinding blocks and grinding discs. The polishing device is a polishing wheel or a wool wheel.

Embodiment 1:

[0020] As shown in FIGs. 1 to 8, a polishing device includes a plurality of elastic thin teeth 2. The plurality of elastic thin teeth 2 is sequentially spliced and stacked to form an annular structure. Every two adjacent elastic thin teeth 2 are closely abutted. An upper end face of the annular structure is a grinding working surface 4. The grinding working surface 4 is of an annular saw-toothed structure. The polishing device also includes a substrate 1 having an annular structure and a pressing plate 3. The annular structure formed by the plurality of elastic thin teeth 2 is fixed on the substrate 1. The pressing plate 3 is placed in the annular structure, is connected to the substrate 1 by a bolt, and squeezes the plurality of elastic thin teeth 2.

[0021] The substrate 1 is provided with a limiting groove 5 arranged along an inner edge of the substrate 1. Lower parts of the plurality of elastic thin teeth 2 are embedded in the limiting groove 5. An end surface of the pressing plate 3 close to the elastic thin teeth 2 is inclined, and is matched and close to end surfaces of the elastic thin teeth 2 to limit the plurality of elastic thin teeth 2.

[0022] The plurality of elastic thin teeth 2 is displaced from a radial direction of the annular structure.

[0023] Every two adjacent elastic thin teeth 2 are fixedly connected by gluing and/or by a fastener. The plurality of elastic thin teeth 2 is made of a rubber bond polyurethane material.

[0024] The size of the polishing device in this embodiment is as follows. The diameter of the polishing device is 150 mm. The inner diameter of the polishing device is 102 mm. The annular width of the polishing device is 24 mm. The height of the polishing device is 40 mm. The height of each elastic thin tooth 2 is 40 mm. The height of the upper part of each elastic thin tooth 2 is 28 mm. The height of the lower part of each elastic thin tooth 2 is 12 mm. The number of the elastic thin teeth 2 is specifically 72. The average circumferential tooth width of each elastic thin tooth 2 is: $(150\pi/72+102\pi/72)/2=5.498$ mm. A ratio of the radial length of 24 mm of each elastic thin tooth 2 to the average circumferential tooth width of 5.498 mm of each elastic thin tooth 2 is 4.365 times.

[0025] Upper parts or side walls of the plurality of elas-

tic thin teeth 2 are made of an abrasive layer. The plurality of elastic thin teeth 2 includes a plurality of elastic thin teeth A and a plurality of elastic thin teeth B. The plurality of elastic thin teeth A and the plurality of elastic thin teeth B are arranged in a staggered manner. Alternatively, the plurality of elastic thin teeth A and one elastic thin teeth B are arranged in a staggered manner. Alternatively, the plurality of elastic thin teeth A constitutes a group of elastic thin teeth A, the plurality of elastic thin teeth B constitutes a group of elastic thin teeth B, and the group of elastic thin teeth A and the group of elastic thin teeth B are arranged in a staggered manner. Upper parts of the plurality of elastic thin teeth A and upper parts of the plurality of elastic thin teeth B form an annular saw-toothed structure. The elastic thin teeth A are made of a first bond and a first abrasive. The elastic thin teeth B are made of a second bond and a second abrasive. The elastic thin teeth A made of the first bond and the first abrasive have high hardness and long service life. The elastic thin teeth B made of the second bond and the second abrasive are highly elastic and easy to deform. The comprehensive effect can meet the cooling requirements of high-pressure machining. Meanwhile, the polishing device has a longer service life.

[0026] The mechanism of the annular saw-toothed structure is as follows. A plurality of elastic thin teeth 2 is sequentially spliced and stacked to form an annular structure. The annular structure is rotated and the grinding working surface 4 of the annular structure is shaped and sharpened. When the grinding working surface 4 is shaped and sharpened, the grinding working surface 4 is elastically deformed and the elastic thin teeth 2 are deflected and displaced by forces, so that the working surface of a single elastic thin tooth is inclined, and the grinding working surface 4 shows an annular saw-toothed structure.

[0027] The working principle is as follows. When the polishing device is working, the engagement is small. The height of the tip to the root of each elastic thin tooth 2 is generally much greater than the engagement. When the grinding part of each elastic thin tooth 2 is only partly in contact with a workpiece 6, the tips of the plurality of elastic thin teeth 2 constitute a small amount of intermittent grinding, that is, impact grinding. A first gap 7 appears between the workpiece 6 and the grinding part of each elastic thin tooth 2 that has not yet contacted the workpiece 6. Cooling water penetrates through the first gap 7 under a centrifugal force, which improves the timely cooling of the grinding working surface 4.

[0028] When the grinding part of the single elastic thin tooth 2 has all contacted the workpiece 6, the single elastic thin tooth 2 is subjected to a grinding positive force and tangential force. The position and size of the single elastic thin tooth 2 when it is stressed and the area and pressure when it is in contact with the workpiece 6 are constantly changing. As a result, the single elastic thin tooth 2 is slightly deflected and displaced, but the amounts of change of adjacent elastic thin teeth 2 are

different. In this case, a second gap 8 appears between the stressed elastic thin teeth 2. Cooling water penetrates through the second gap 8 under a centrifugal force, which improves the timely cooling of the grinding working surface 4. Thus, intermittent grinding machining of the polishing device is realized, and good machining quality and high efficiency are achieved.

[0029] Compared with existing technical solutions, the present invention has the following advantages.

[0030] The polishing device using the polyurethane material bond in the prior art is annular as a whole. When high-speed and high-efficiency polishing is performed, the temperature of a grinding area is greatly increased. The temperature resistance of the polyurethane material bond is poor, and the bond strength will decrease sharply as the temperature increases and will easily cause changes such as softening, melting and carbonization, which destroy the structures, directly resulting in the failures in the performances of an abrasive tool, such as abrasive shedding, decreased sharpness, and bond softening and melting to block pores. Even if a workpiece can withstand the influence of temperature, the polishing device needs to improve the grinding ability, which requires better ability to hold the abrasive and better cooling. Increased elasticity and porosity are not conducive to the service life and rigidity. Various factors are contradictory and restrict each other, thus limiting the application of high-speed and high-efficiency machining.

[0031] This embodiment provides better chip holding and cooling functions, and transfers the functions required by the original polishing wheel body to structural functions. While meeting the self-sharpening properties, the porosity and elasticity of the abrasive tool can be appropriately reduced, and the ability to hold the abrasive can be improved, which can help prolong the service life of the abrasive tool and expand the application of high-speed and high-efficiency machining. The difficulty of product manufacturing process is also reduced, and fast chip removal, good cooling, easy manufacturing, and greatly improved performance are achieved.

Embodiment 2:

[0032] As shown in FIGs. 9 to 11, a polishing device includes a plurality of elastic thin teeth 2. The plurality of elastic thin teeth 2 is sequentially spliced and stacked to form an annular structure. Every two adjacent elastic thin teeth 2 are closely abutted. An annular side surface of the annular structure is a grinding working surface 4. The grinding working surface 4 is of an annular saw-toothed structure. The polishing device also includes a substrate 1 having an annular structure, and a pressing plate 3. The annular structure formed by the plurality of elastic thin teeth 2 is fixed on the substrate 1. The pressing plate 3 is placed in the annular structure, is connected to the substrate 1 by a bolt, and squeezes the plurality of elastic thin teeth 2. The plurality of elastic thin teeth 2 is fixed on the substrate 1 using auxiliary parts or adhesives.

[0033] The substrate 1 is provided with a limiting groove 5 arranged along an inner edge of the substrate 1. Lower parts of the plurality of elastic thin teeth 2 are embedded in the limiting groove 5. An end surface of the pressing plate 3 close to the elastic thin teeth 2 is inclined, and is matched and close to end surfaces of the elastic thin teeth 2 to limit the plurality of elastic thin teeth 2 and prevent the plurality of elastic thin teeth 2 from flying out during the grinding process.

[0034] The plurality of elastic thin teeth 2 is displaced from a radial direction of the annular structure.

[0035] The two adjacent elastic thin teeth 2 are fixedly connected by gluing and/or by a fastener.

[0036] The size of the polishing device of this embodiment is as follows. The diameter of the polishing device is 150 mm. The annular width of the effective annular structure of the polishing device is 40 mm. The thickness of the polishing device is 12 mm, which is suitable for machining a workpiece 6 with a shaped edge of a maximum thickness of 10 mm. The polishing device post-processes an opening shape with an appropriate thickness. The number of teeth of the polishing device is 60 teeth. The average circumferential tooth working width is: $(150\pi/60+70\pi/60)/2=1.833$ mm. A ratio of the effective radial length of 40 mm of each elastic thin tooth 2 to the average circumferential tooth width of 1.833 mm of each elastic thin tooth 2 is 21.8 times.

[0037] The working principle is as follows. Within a certain range, when the pressure becomes larger, the elastic thin teeth 2 will deflect and displace and a second gap 8 that appears between the elastic thin teeth 2 is also large. Cooling water penetrates through the second gap 8 under a centrifugal force, which improves the timely cooling of the grinding working surface 4 of the polishing device. When the pressure is small, a first gap 7 is formed between the workpiece 6 and a grinding part of the elastic thin tooth 2 that has not yet contacted the workpiece 6. Cooling water penetrates through the first gap 7 under a centrifugal force, which improves the timely cooling of the grinding working surface 4.

[0038] When the grinding part of each elastic thin tooth 2 is in contact with the workpiece 6, the tips of the plurality of elastic thin teeth 2 constitute a small amount of intermittent grinding, and the elastic thin teeth 2 is subjected to a grinding positive force and tangential force. The position and size of a single elastic thin tooth 2 when it is stressed and the area and pressure when it is in contact with the workpiece 6 are constantly changing. As a result, the single elastic thin tooth 2 is slightly deflected and displaced, but the amounts of changes of adjacent elastic thin teeth 2 are different, such that the first gap 7 and the second gap 8 continue to appear. The polishing device achieves intermittent grinding machining, good machining quality and high efficiency.

[0039] Compared with prior art products, the present invention has the following advantages.

[0040] The technical solution of this embodiment simplifies the manufacturing process, realizes the overall

presetting of the elastic thin teeth 2 that are difficult to manufacture, realizes a narrow tooth structure that greatly shortens the chip discharge path, and achieves the structural functions of the first gap 7 and the second gap 8 for rapid cooling. Dense internal water cooling in a grinding area is realized, and the product performance of the polishing device is greatly improved.

[0041] The present invention also relates to a manufacturing method of a polishing device, including the following steps.

S1. A plurality of elastic thin teeth 2 is manufactured according to a set structure, and the plurality of elastic thin teeth 2 is sequentially spliced and stacked to form an annular structure, so that every two adjacent elastic thin teeth 2 are closely abutted.

S2. The annular structure is rotated, and a grinding working surface 4 of the annular structure is shaped and sharpened, so that the grinding working surface 4 has an annular saw-teeth structure.

[0042] In the above embodiment, a ratio of an average radial length of each elastic thin tooth 2 to an average circumferential width thereof in step S1 is greater than 3 times.

[0043] The foregoing are merely preferred embodiments of the present invention, which are not intended to limit the present invention. Any modifications, equivalent replacements and improvements made within the spirits and principles of the present invention shall all fall in the protection scope of the present invention.

Claims

1. A polishing device, comprising: a plurality of elastic thin teeth (2), wherein the plurality of elastic thin teeth (2) is sequentially spliced and stacked to form an annular structure, and every two adjacent elastic thin teeth (2) are closely abutted; and an upper end face or an annular side surface of the annular structure is a grinding working surface (4), and the grinding working surface (4) is of an annular saw-toothed structure.
2. The polishing device according to claim 1, wherein upper parts or side walls of the plurality of elastic thin teeth (2) are made of an abrasive layer; the plurality of elastic thin teeth (2) comprises a plurality of elastic thin teeth A and a plurality of elastic thin teeth B, and the plurality of elastic thin teeth A and the plurality of elastic thin teeth B are arranged in a staggered manner; or the plurality of elastic thin teeth A and one elastic thin teeth B are arranged in a staggered manner; or the plurality of elastic thin teeth A constitutes a group of elastic thin teeth A, the plurality of elastic thin teeth B constitutes a group of elastic thin teeth B, and the group of elastic thin teeth A and the

group of elastic thin teeth B are arranged in a staggered manner; and upper parts of the plurality of elastic thin teeth A and upper parts of the plurality of elastic thin teeth B form the annular saw-toothed structure.

3. The polishing device according to claim 2, wherein the elastic thin teeth A are made of a first bond and a first abrasive, and the elastic thin teeth B are made of a second bond and a second abrasive.

4. The polishing device according to claim 2 or 3, further comprising a substrate (1) having an annular structure, and a pressing plate (3), wherein the annular structure formed by the plurality of elastic thin teeth (2) is fixed on the substrate (1); and the pressing plate (3) is placed in the annular structure, is connected to the substrate (1) by a bolt, and squeezes the plurality of elastic thin teeth (2).

5. The polishing device according to claim 4, wherein the substrate (1) is provided with a limiting groove (5) arranged along an inner edge of the substrate (1); and lower parts of the plurality of elastic thin teeth (2) are embedded in the limiting groove (5).

6. The polishing device according to claim 5, wherein an end surface of the pressing plate (3) close to the elastic thin teeth (2) is inclined, and is matched and close to end surfaces of the elastic thin teeth (2) to limit the plurality of elastic thin teeth (2).

7. The polishing device according to claim 1, wherein the plurality of elastic thin teeth (2) is displaced from a radial direction of the annular structure.

8. The polishing device according to claim 1, wherein every two adjacent elastic thin teeth (2) are fixedly connected by gluing and/or by a fastener.

9. A manufacturing method of a polishing device, comprising the following steps:

S1. manufacturing a plurality of elastic thin teeth (2) according to a set structure, and sequentially splicing and stacking the plurality of elastic thin teeth (2) to form an annular structure, so that every two adjacent elastic thin teeth (2) are closely abutted; and

S2. rotating the annular structure, and shaping and sharpening a grinding working surface (4) of the annular structure, so that the grinding working surface (4) is of an annular saw-toothed structure.

10. The manufacturing method of the polishing device according to claim 9, wherein a ratio of an average radial length of each elastic thin tooth (2) to an av-

erage circumferential width thereof in step S1 is greater than 3 times.

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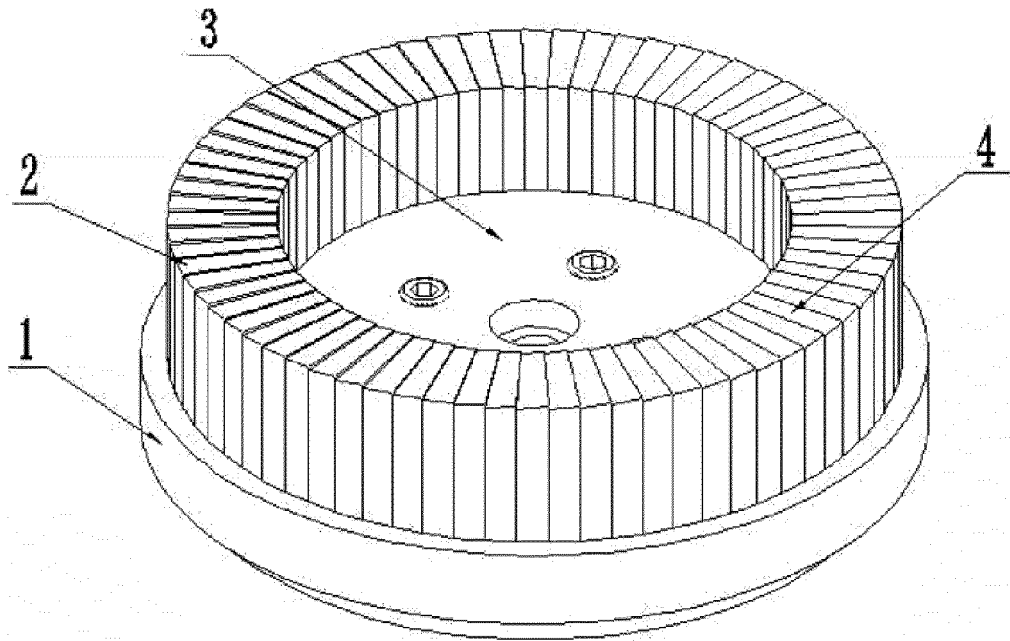


FIG. 1

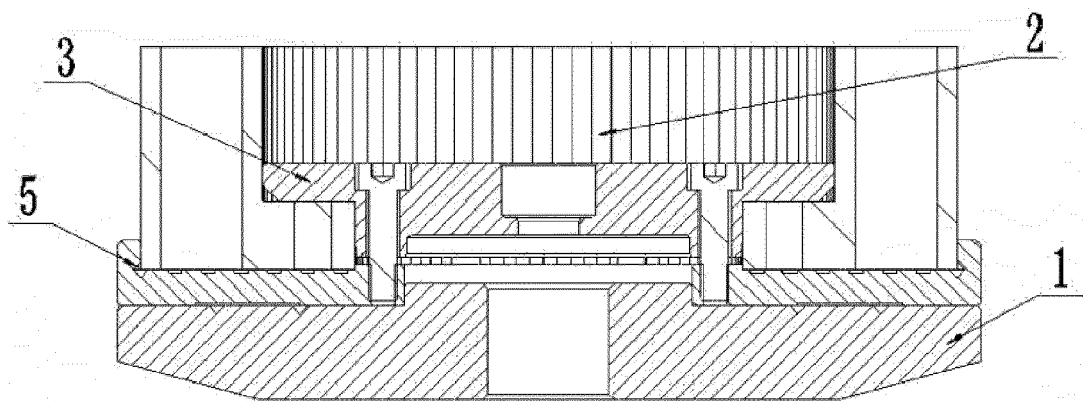


FIG. 2

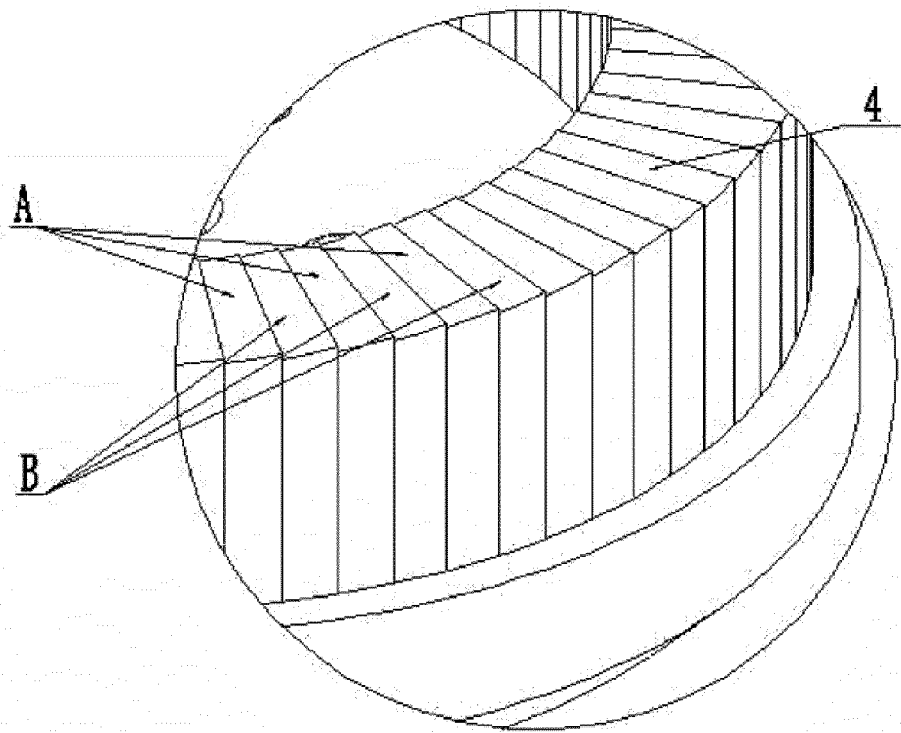


FIG. 3

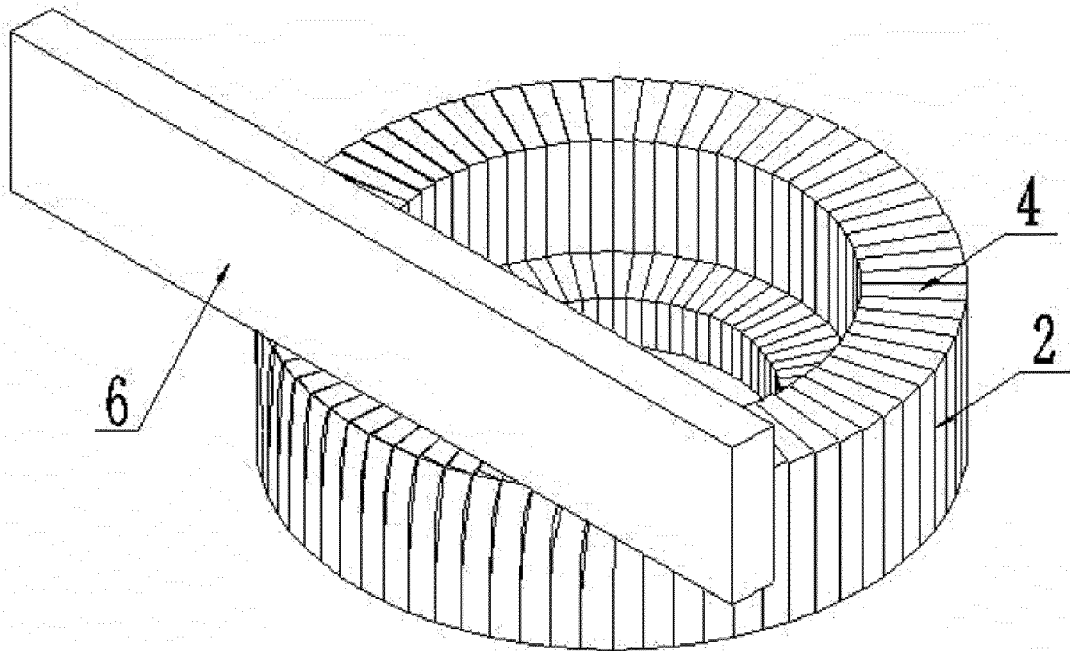


FIG. 4

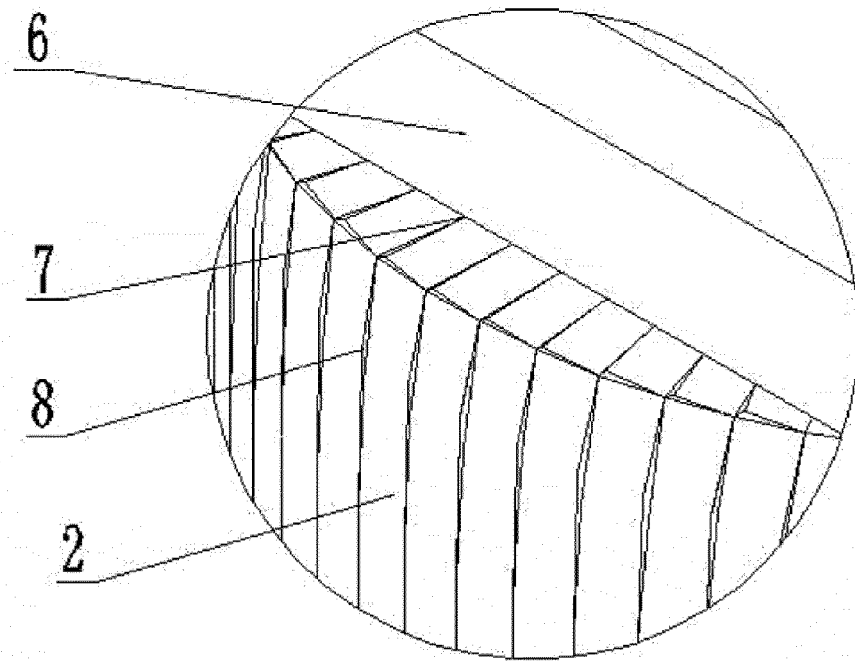


FIG. 5

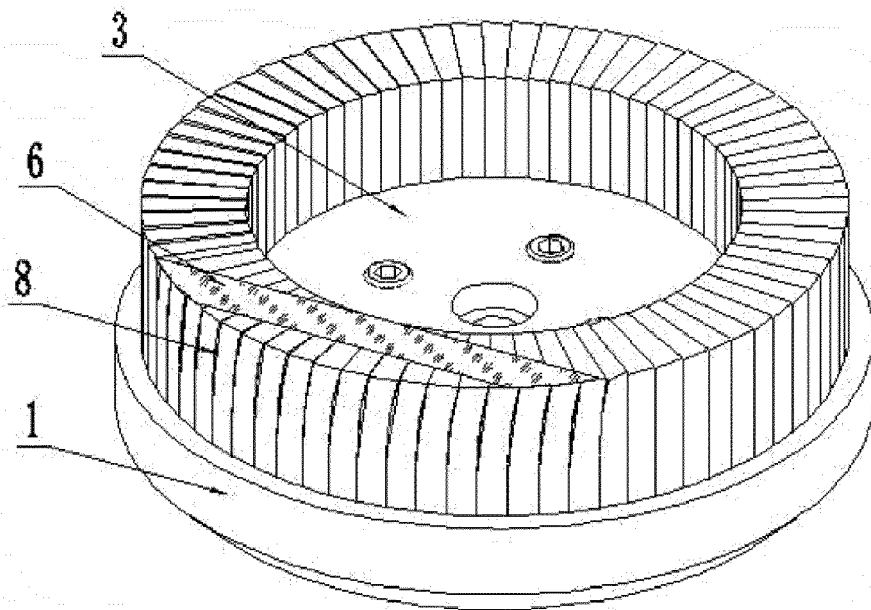


FIG. 6

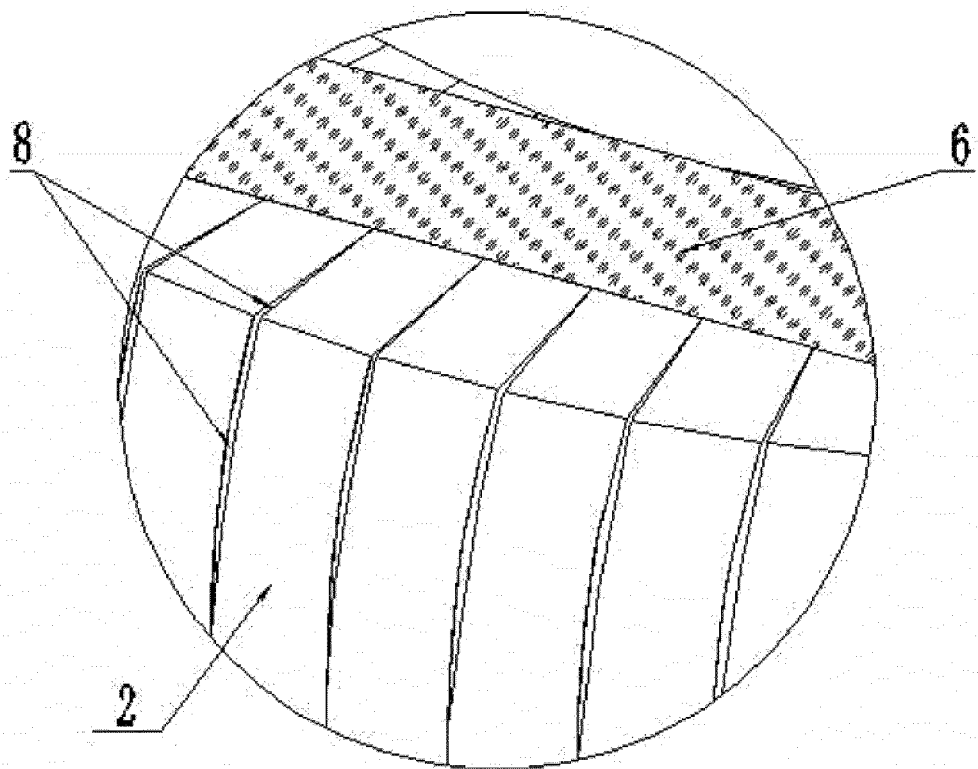


FIG. 7

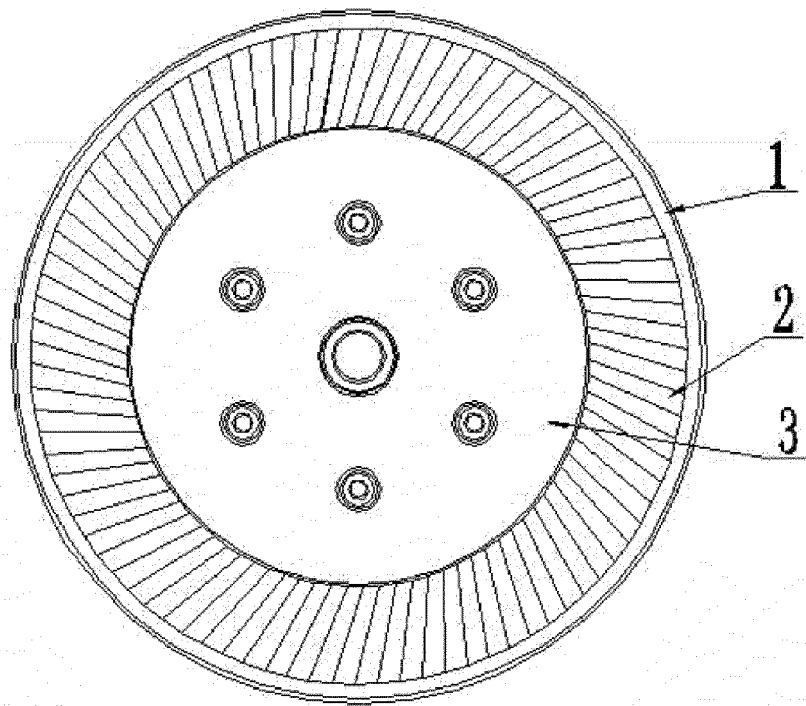


FIG. 8

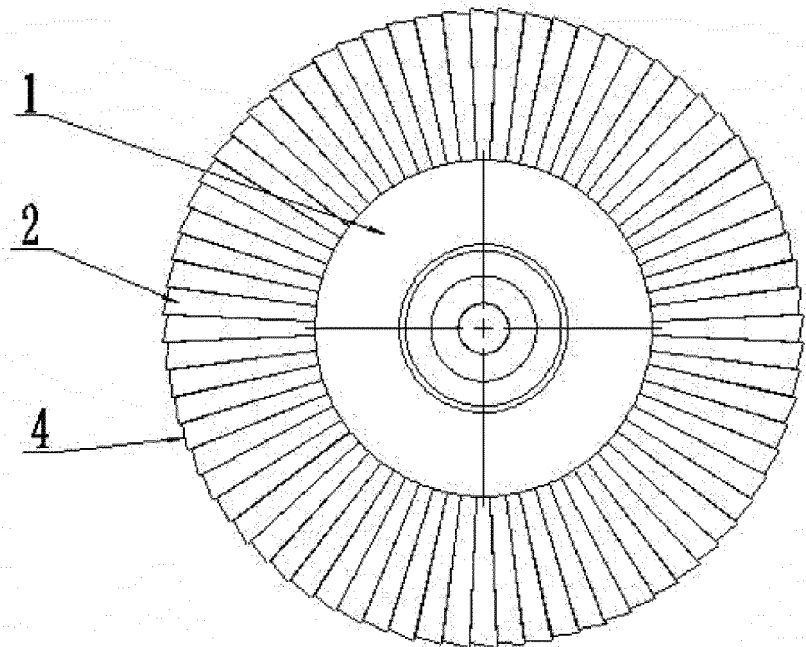


FIG. 9

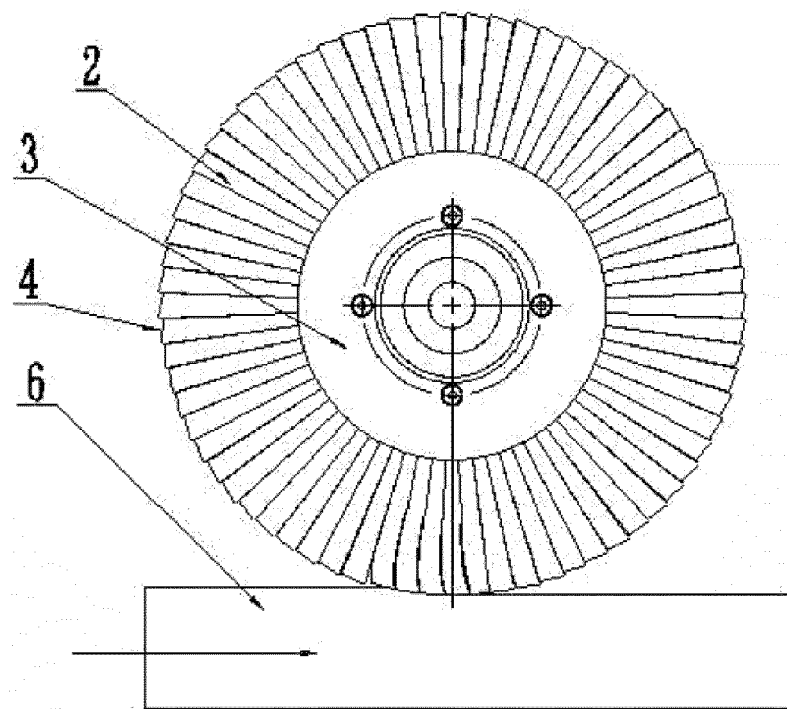


FIG. 10

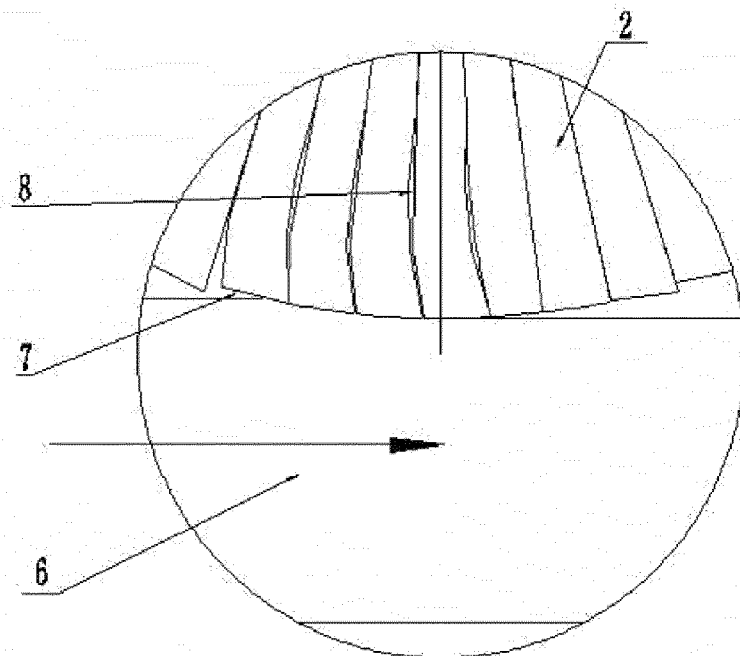


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/077871

A. CLASSIFICATION OF SUBJECT MATTER

B24D 7/10(2006.01)i; B24D 18/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B24D13; B24D7; B24D18

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNABS, VEN: 片, 齿, 环, 圈, 弹性, slice, laminate, lamella, flake, chip, ring, elastic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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