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(72) Inventors:
• **SONG, Jingxin**
Guilin, Guangxi 541004 (CN)
• **CAI, Yuanpei**
Guilin, Guangxi 541004 (CN)
• **GUO, Xinling**
Guilin, Guangxi 541004 (CN)

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(74) Representative: **Zaboliene, Reda**
Metida
Business center Vertas
Gyneju str. 16
01109 Vilnius (LT)

(71) Applicant: **Guilin Champion Union Diamond Co., Ltd.**
Guilin, Guangxi 541004 (CN)

(54) **ABRASIVE TOOL AND FABRICATION METHOD THEREFOR**

(57) A grinding tool and a manufacturing method thereof are disclosed. The grinding tool includes a plurality of thin teeth (2) which are sequentially spliced and stacked to form an annular structure, wherein every two adjacent thin teeth (2) are fixedly connected, and a groove body (4) is formed between every two adjacent thin teeth (2). The narrower and the more the groove

bodies of the grinding tool are, the better the cooling effect is, thus the better the chip-removal effect is. Meanwhile, the manufacturing method for the grinding tool features a machining process having low difficulty and is easy for mass production, thereby facilitating the high-speed and high-efficiency machining of grinding tools with an organic bond and an inorganic bond.

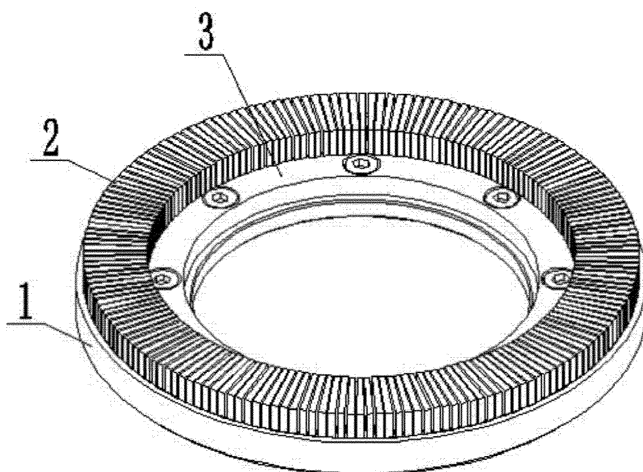


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of grinding tools, and in particular to a grinding tool and a manufacturing method thereof.

BACKGROUND

[0002] Metal bond diamond grinding wheels are generally manufactured by a powder metallurgy sintering process.

[0003] In order to improve the sharpness of the diamond grinding wheel during machining, it is necessary to improve the chip holding, chip-removal and cooling capabilities of the diamond grinding wheel during the working process. An effective way is to use a toothed grinding wheel with groove bodies and use an intermittent (impact) grinding function to enhance the grinding efficiency. The usual method is to set some groove body structures which are beneficial for chip-removal (chip-holding) and water-passing (water-holding) on a diamond working layer and are typically implemented by one-time molding through a preset mold. Then, a tooth-shaped diamond grinding wheel with groove bodies is manufactured.

[0004] The powder metallurgy process requires hot pressing and sintering through a mold. Therefore, the requirement for the hot strength of the mold is high. Each groove body is usually formed by presetting a gate block made of graphite, cast iron, an alloy and other materials in the mold and removing (pulling out) the gate block after hot pressing and sintering.

[0005] It is necessary for gate blocks made of ordinary metals or alloys to not be easily deformed and not be easily broken when a mold is removed (pulled out). A graphite gate block is fragile. In order to meet the strength requirements, a gate block needs to have sufficient solid cross-sectional areas in all directions, especially on a main pressure bearing surface. Thus, the gate block inevitably has a large volume which causes a large interval between diamond teeth (i.e., the width of each groove body is large). A large width of the groove body is advantageous for the cooling of a material to be machined, but plays a very limited role in the cooling effect on the diamond working layer. Therefore, in the intermittent grinding, the grinding wheel is manifested by a large impact force and a large beating amplitude, thereby increasing the surface roughness of the workpiece.

[0006] In the case that the grinding wheel is constrained in geometric dimension, the greater the volume occupied by each groove body is, and the larger the amount of the groove bodies is, the smaller the volume of the diamond working layer is. Thus, when the volume of the gate block cannot be too small under the constraints of manufacturing process conditions such as the strength. However, in order to ensure that the diamond

working layer has a sufficient amount of volume (i.e., to ensure a sufficient life), the number of the provided groove bodies is limited objectively, which in turn restricts diamond working teeth from having a space in a circumferential direction to be thinner. In this way, a long circumferential chip-removal path, large accumulation amount of chips and large heat generation of the grinding wheel in working are caused. These situations are even worse in fast or high-speed feed machining! Generally, it is necessary to increase a particle size of diamond to improve the chip holding space and alleviate the above situations, but the increase of the particle size is not conducive to the reduction of the surface roughness of the workpiece.

[0007] The wider the slot, the less quantity of it, the smaller the outer surface area (including a grinding surface and a non-grinding surface) of the working section entity of the grinding wheel is, that is, the smaller the area acted by cooling water is, the worse the cooling effect is.

[0008] Metal bond diamond grinding wheels are generally manufactured by a powder metallurgy technology. In the high-temperature and high-pressure manufacturing process, the fluidity of metal powder (bond) is relatively poor. If a mold structure is too complex, the pressure transmission will be affected, resulting in uneven compaction of the diamond grinding wheels and performance deviations. Therefore, some complex structures cannot be manufactured by the powder metallurgy technology. For some special structures, such as flimsy, pointed, long, thin or mesh-like teeth, under the condition of hot pressing, the performances of a mold material cannot meet process requirements, so that the manufacture cannot be completed by the way of preset molds or in an economical manner.

[0009] Diamond grinding wheel products manufactured by the prior art process can realize a small amount of groove bodies and a larger volume occupied by the groove bodies through mold presetting, but causes simple and thick shapes of diamond teeth, and thus take a very limited effect. If a post-machining method is adopted, it is usually difficult to machine, resulting in increased cost.

[0010] With the continuous development of technology, high-quality, high-speed, and high-efficiency machining is inevitable, and it is difficult for products in the prior art to follow the development.

[0011] The conditions described in the above-mentioned technical background not only exist in metal bond grinding wheels, but also in ceramic bond, resin bond, rubber bond, organic bond diamond grinding wheels or ordinary abrasive grinding wheels or polishing wheels. Similar problems will happen to these wheels whatever they are provided with base bodies or not provided with base bodies. The ceramic bond grinding wheel has good heat resistance, but the cooling of workpieces is limited during high-speed and high-efficiency machining with a large grinding contact area. The resin bond and rubber bond grinding wheels (including polishing wheels) have

poor heat resistance, and needs an increased grinding ability during high-speed and high-efficiency machining, which requires better ability to hold an abrasive, and at the same time, better cooling is required. However, large elasticity and porosity are not conducive to the life and rigidity. Various factors restrict each other, thus limiting the application of high-speed and high-efficiency machining.

SUMMARY

[0012] The present invention is directed to provide a grinding tool which is reliable in manufacturing process, optionally complex and simple in structure, feasible in function implementation, low in manufacturing cost, high in efficiency, energy-saving and safe, and a manufacturing method thereof.

[0013] The technical solution of the present invention to solve the above-mentioned technical problems is summarized as follows: a grinding tool comprises a plurality of thin teeth which are sequentially spliced and stacked to form an annular structure, wherein every two adjacent thin teeth are fixedly connected; and a groove body is formed between every two adjacent thin teeth.

[0014] Further, the grinding tool further includes a substrate in a annular structure, and a pressing plate, wherein the annular structure formed by the plurality of the thin teeth is fixed on the substrate, the pressing plate has a ring-shaped structure, and the pressing plate is connected with the substrate by a bolt and presses the plurality of the thin teeth .

[0015] Further, the plurality of thin teeth include a plurality of thin teeth A and a plurality of thin teeth B, wherein the plurality of thin teeth A and the plurality of thin teeth B are arranged in a staggered manner; or a plurality of elastic thin teeth A and one elastic thin tooth B are arranged in a staggered manner; or a plurality of elastic thin teeth A constitute groups of elastic thin teeth A, and a plurality of elastic thin teeth B constitute groups of elastic thin teeth B, and the groups of elastic thin teeth A and the groups of elastic thin teeth B are arranged in a staggered manner; when the thin tooth A and the thin tooth B are combined adjacently, the lower portion of the thin tooth A and the lower portion of the thin tooth B constitute an interlocking structure.

[0016] 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.

[0017] Further, the substrate is provided with a limiting groove arranged along the inner annular edge of the substrate; the lower portions of the plurality of thin teeth are embedded in the limiting groove, and upper portions of the plurality of thin teeth are all made of an abrasive layer.

[0018] Further, the abrasive layer is made of diamond.

[0019] Further, an end face of the pressing plate close to the thin teeth is inclined and is matched and close to end faces of the thin tooth, and a filler embedded in the pressing plate is arranged at a position of the pressing

plate close to an annular end face of each thin tooth.

[0020] Further, the plurality of the groove bodies is arranged in an annular shape along the annular structure, and each of the groove bodies is displaced from a radial direction of the annular structure.

[0021] Further, at an end of each thin tooth away from the inner annular side of the substrate, a first bump in connection with the end is arranged at one side of the end.

[0022] Further, a plurality of first convex textures is connected to the side wall of each thin tooth close to another thin tooth.

[0023] Further, a plurality of second bumps is connected to the side wall of each thin tooth.

[0024] Further, the plurality of the thin teeth includes a plurality of thin teeth C and a plurality of thin teeth D, wherein several thin teeth C are continuously spliced and stacked to form a first abrasive body, several thin teeth D are continuously spliced and stacked to form a second abrasive body, and a plurality of first abrasive bodies and a plurality of second abrasive bodies are spliced in a staggered manner to form an annular structure on the substrate; the width of the one end of each thin tooth C close to the inside of the substrate is greater than that of the other end of the thin tooth C, and the width of one end of each thin tooth D close to the inside of the substrate is smaller than that of the other end of the thin tooth D.

[0025] Further, the end face of the annular structure is tightly attached to the edge of the substrate; the pressing plate is in an annular shape and is placed on the upper end of the substrate;

[0026] a meshing position is provided on the side wall of one end of each thin tooth close to the inner annular side of the substrate, every two adjacent thin teeth engage with each other through the meshing position, and the lower end face of the pressing plate is inclined downward from the inner annular side to the outer annular side of the pressing plate to limit the plurality of thin teeth; one end of each of the thin teeth away from the inner annular side of the substrate is provided with a grinding structure.

[0027] Further, an arc length of each point of the grinding structure on the thin tooth in an axial direction is in a positive relationship with a machining amount at this point.

[0028] Further, the upper end of each thin tooth is provided with a plurality of grooves in a radial direction of the annular structure, and the plurality of grooves form a net structure with the plurality of groove bodies to form a net grinding surface.

[0029] Further, every two adjacent thin teeth are fixedly connected by gluing and/or by a fastener.

[0030] Further, the bond for the plurality of thin teeth is an organic bond, an inorganic bond, or a composite bond.

[0031] Further, the grinding tool is a thin-tooth spliced diamond grinding wheel.

[0032] A manufacturing method for the grinding tool includes the following steps:

S1. manufacturing thin teeth according to a set structure, so that a ratio of an average radial length of each thin tooth to an average circumferential width thereof is greater than 2.5;

S2. manufacturing a main pressing surface of each thin tooth as a non-grinding working surface, wherein the main pressing surface is a surface with the largest area of the thin tooth; and

S3. splicing and stacking and fixedly connecting the main pressing surfaces of the plurality of thin teeth to form an annular structure.

[0033] Further, the manufacturing method further includes step S4: consolidating the plurality of thin teeth to a substrate through the pressing plate and bolts.

[0034] The beneficial effects of the present invention are summarized as follows.

1. Under the condition that the entity volume of the abrasive working layer is not affected, the narrower and the more the groove bodies are, the larger the external surface area (including the grinding surface and the non-grinding surface) of the working layer entity of the grinding wheel is, the larger the area acted by cooling water is, the better the cooling effect is.

2. The more the groove bodies are, and the narrower the circumferential width of each abrasive tooth is, the shorter the chip removal path. The smaller the accumulation amount of chips is, the smaller the amount of their frictions to the bonds of the abrasive bodies is. In this way, the grinding heat is relatively low, which is conducive to high-speed and high-efficiency machining and is conducive to expanding the application of formulas that are not resistant to high temperatures.

3. In view of a large number of groove bodies, short chip removal path, small accumulation amount of chips and small friction resistance of the chips, the required chip space is small, and the requirement for the height of abrasive exposure is low. This feature is also beneficial for obtaining high-quality machining by using relatively finer abrasives, and further for obtaining high-efficiency machining by using relatively faster running speed or greater engagement.

4. By the structural machining on the thin teeth, it is easy to realize that, in the use of the abrasive layer, the grinding surface is locally worn quickly to form a circumferential broached groove, the broached groove forms a new groove body on the grinding surface, and the new groove body forms a net groove body on the grinding surface together with the groove body obtained by splicing and stacking, thereby forming a net grinding surface, which shortens the radial removal path of the chips, increases the pressure intensity of the grinding surface during grinding, and improves the sharpness and life of the grinding

wheel.

5. The grinding tool is conducive to dry grinding machining.

6. As the characteristics of the manufacturing process, it is easy to achieve a similar orderly arrangement structure of the abrasive layers, which can improve the sharpness and life of the grinding wheel and is more suitable for rough grinding machining.

7. The grinding tool presents a structural function of double rings or multiple rings, which can exert or surpass the technical effect of the prior art.

8. The thin-tooth-shaped grinding wheel that is difficult to be machined as a whole can be easily realized by breaking it into individual thin teeth and splicing and stacking and consolidating them.

9. By arranging a plurality of densely packed bosses on the pressed surface, every two adjacent thin teeth support each other, thereby facilitating achieving increased strength of the thin teeth against stressed fracture, displacement and vibration when the thin teeth becomes thinner in a circumferential direction, and ensuring the rigidity required by the entire working surface of the grinding wheel.

10. A structural fly-out prevention structure is formed by arranging the plurality of bosses on the pressed surface to engage and interlock with the corresponding limiting grooves.

11. The circumferential arc length of each thin tooth is short. The thin teeth are adapted to be spliced and stacked with a variety of structures having a diameter as the same as an annular width and an annular height, without being produced by manufacturing corresponding molds one by one according to diameters, thereby greatly reducing the difficulty of feeding and the difficulty of machining the molds, and being conducive to the implementation of automated mass production.

12. Dense internal water-cooling in a grinding area is realized.

13. The retention of cooling water between the teeth of the working layer is realized, and a cooling effect is improved.

14. The cooling water between the thin teeth penetrates integrally and is communicated with a cooling water source, thereby achieving the capacity, cooling and chip holding effects that are difficult to be achieved by pores of the grinding wheel or artificial holes.

15. Using the above principles, the grinding tool can also be applied to non-annular grinding tools such as grinding discs and grinding blocks.

16. Using the above principles, the grinding tool can also be applied to other grinding tools such as grinding wheels or grinding discs, and grinding block, with inorganic bonds such as metal bonds, ceramic bonds or magnesite bond, and organic bonds such as resin bonds or rubber bonds.

17. Using the above principles, the grinding tool pro-

vides better chip holding and cooling functions, and transfers functions required by the original grinding tool itself to structural functions. Therefore, for the elastic grinding tool with an organic bond, the porosity and elasticity of the grinding tool can be appropriately reduced and the ability to hold abrasives can be enhanced under the condition that the self-sharpening property is satisfied, which is conducive to prolonging the life of the grinding tool and expanding the application of high-speed and efficient machining.

18. Using the above principles, a product machining load is reduced compared to the same period. Therefore, the grinding tool can effectively reduce the power consumption and the cost, and is energy-saving and environment-friendly.

BRIEF DESCRIPTION OF DRAWINGS

[0035]

FIG. 1 is a front view of a grinding tool according to Embodiment 1 of the present invention;

FIG. 2 is a sectional view of the grinding tool according to Embodiment 1 of the present invention;

FIG. 3 is a top view showing the arrangement of lower portions of a plurality of thin teeth in the grinding tool according to Embodiment 1 of the present invention;

FIG. 4 is a top view of a thin tooth A in the grinding tool according to Embodiment 1 of the present invention;

FIG. 5 is a top view of a thin tooth B in the grinding tool according to Embodiment 1 of the present invention;

FIG. 6 is a schematic structural diagram of a part of the thin teeth in the grinding tool according to Embodiment 1 of the present invention;

FIG. 7 is a front view of a thin tooth in the grinding tool according to Embodiment 1 of the present invention;

FIG. 8 is a front view of a grinding tool according to Embodiment 2 of the present invention;

FIG. 9 is a schematic structural diagram of a part of thin teeth in the grinding tool according to Embodiment 2 of the present invention;

FIG. 10 is a schematic diagram of an improvement of the grinding tool according to Embodiment 2 of the present invention;

FIG. 11 is a front view of a grinding tool according to Embodiment 3 of the present invention;

FIG. 12 is a schematic structural diagram of a part of thin teeth in the grinding tool according to Embodiment 3 of the present invention;

FIG. 13 is a front view of a thin tooth in the grinding tool according to Embodiment 3 of the present invention;

FIG. 14 is a schematic diagram of an improvement of the grinding tool according to Embodiment 3 of

the present invention;

FIG. 15 is a front view of a grinding tool according to Embodiment 4 of the present invention;

FIG. 16 is a schematic structural diagram of a part of thin teeth in the grinding tool according to Embodiment 4 of the present invention;

FIG. 17 is a front view of a thin tooth in the grinding tool according to Embodiment 4 of the present invention;

FIG. 18 is a front view of a grinding tool according to Embodiment 5 of the present invention;

FIG. 19 is a front view of a part of first abrasive bodies and second abrasive bodies in the grinding tool according to Embodiment 5 of the present invention;

FIG. 20 is a top view of a part of the first abrasive body and the second abrasive body in the grinding tool according to Embodiment 5 of the present invention;

FIG. 21 is a schematic structural diagram of a grinding tool according to Embodiment 6 of the present invention;

FIG. 22 is a sectional view of the grinding tool according to Embodiment 6 of the present invention;

FIG. 23 is a schematic structural diagram of a part of thin teeth in the grinding tool according to Embodiment 6 of the present invention;

FIG. 24 is a front view of a thin tooth in the grinding tool according to Embodiment 6 of the present invention;

FIG. 25 is a schematic structural diagram of a grinding tool according to Embodiment 7 of the present invention;

FIG. 26 is a sectional view of the grinding tool according to Embodiment 7 of the present invention;

FIG. 27 is a front view of a thin tooth in the grinding tool according to Embodiment 7 of the present invention;

FIG. 28 is a front view of a grinding tool according to Embodiment 8 of the present invention;

FIG. 29 is a sectional view of the grinding tool according to Embodiment 8 of the present invention;

FIG. 30 is a schematic structural diagram of an annular structure in the grinding tool according to Embodiment 8 of the present invention;

FIG. 31 is a top diagram of the annular structure in the grinding tool according to Embodiment 8 of the present invention;

FIG. 32 is another schematic diagram of the annular structure in the grinding tool according to Embodiment 8 of the present invention;

FIG. 33 is a schematic structural diagram of thin tooth in the grinding tool according to Embodiment 8 of the present invention;

FIG. 34 is a front view of a grinding tool according to Embodiment 9 of the present invention;

FIG. 35 is a sectional view of the grinding tool according to Embodiment 9 of the present invention;

FIG. 36 is a schematic structural diagram of the

grinding tool according to Embodiment 9 of the present invention;

FIG. 37 is a front view of a grinding tool according to Embodiment 10 of the present invention;

FIG. 38 is a schematic structural diagram of the grinding tool according to Embodiment 10 of the present invention;

FIG. 39 is a schematic structural diagram of an annular structure in the grinding tool according to Embodiment 10 of the present invention.

[0036] In the drawings, the list of components indicated by individual reference symbols is as follows:

1. substrate; 2. thin tooth; thin tooth A; thin tooth B; thin tooth C; thin tooth D; thin tooth E; thin tooth F; 3. pressing plate; 4. groove body; 5. limiting groove; 6. filler; 7. first bump; 8. first convex texture; 9. groove; 10. second bump; 11. first abrasive body; 12. second abrasive body; 13. meshing position; 14. grinding structure; 15. concave texture structure; 16. mounting bottom plate; 17. fly-out prevention structure; 18. third bump; 19. fourth bump.

DESCRIPTION OF EMBODIMENTS

[0037] The principles and features of the present invention will be described below with reference to the accompanying drawings. The examples provided are only used to explain the present invention, but not to limit the scope of the present invention.

[0038] Grinding tools are tools for grinding, milling, and polishing, including diamond grinding wheels, ordinary abrasive grinding wheels and polishing grinding wheels. The grinding tools may also be in various forms such as grinding blocks and grinding discs. The technical solution for thin-tooth spliced diamond grinding wheels may also be applied to diamond grinding wheels, ordinary abrasive grinding wheels and polishing grinding wheels.

Embodiment 1:

[0039] As shown in FIGs. 1 to 7, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The substrate 1 is provided with limiting grooves 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. The pressing plate 3 is in an annular structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2. Upper portions of the plurality of the thin teeth 2 are made of an abrasive layer. The abrasive layer is made of diamond.

[0040] A plurality of individual thin teeth 2 are spliced and stacked and consolidated into an abrasive body which has an annular structure.

[0041] The groove body 4 is a functional groove such as a water groove for circulating cooling water, a chip-holding groove, or a chip-removal groove or an air flow groove. The groove body 4 is of a radial, axial, oblique, circumferential, grid or composite type.

[0042] Each surface of each thin tooth 2 may be a flat surface or a curved surface, and may also be a composite surface with convex textures or concave textures, or a combination of both convex and concave textures; or a surface with perforations.

[0043] In each embodiment, the concave and convex textures on the surface of each thin tooth 2 are set in a dot, block, line, strip, or grid type, or a composite of dot, block, line, strip and grid types. The groove body 4 in each embodiment is composed of plain textures, concave textures, convex textures, or a composite of concave and convex textures on two adjacent thin teeth 2.

[0044] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 152 mm, the inner diameter of the grinding wheel is 118 mm, the annular width of the grinding wheel is 17 mm, and the height of the grinding wheel is 20 mm. The height of each thin tooth 2 is 14 mm, wherein the height of the upper portion of each thin tooth 2 is 8 mm, and the height of the lower portion of each thin tooth 2 is 6 mm.

[0045] The number of the plurality of the thin teeth 2 is specifically 180, the width of the groove body 4 is 0.5 mm, and the average tooth width of each thin teeth 2 is: $((152\pi - 180 \times 0.5) / 180 + (118\pi - 180 \times 0.5) / 180) / 2 = 1.856$ mm.

[0046] The end face area of the grinding wheel is 7210 mm², the area of the groove body 4 is 1530 mm², and the proportion of the groove body 4 on the end face is 21.2%.

[0047] The thin teeth 2 are made by a powder metallurgy technology. A feeding direction surface and a main pressing surface of each thin tooth 2 are the same surfaces with the largest area. Since the average thickness of each thin teeth 2 is only 1.856 mm, simple one-way pressing is sufficient. In comparison to the existing overall mold presetting manufacturing technology which requires two-way pressing, the mold height is greatly reduced, and the feeding is simple and easy.

[0048] As shown in FIGs. 2 to 7, the thin teeth 2 can be easily assembled and consolidated owing to their shapes. The thin teeth 2 are spliced and stacked and consolidated to form the annular structure on the substrate 1. After the plurality of the thin teeth 2 are spliced and stacked, a groove body 4 is formed between upper portions of every two adjacent thin teeth 2, and the width of the groove body 4 is 0.5 mm.

[0049] The plurality of thin teeth 2 includes a plurality of thin teeth A and a plurality of thin teeth B. The plurality of thin teeth A and the plurality of thin teeth B are arranged in a staggered manner. Alternatively, a plurality of elastic thin teeth A and one elastic thin tooth B are arranged in a staggered manner. Alternatively, a plurality of elastic thin teeth A constitute groups of elastic thin teeth A, and

a plurality of elastic thin teeth B constitute groups of elastic thin teeth B, and the groups of elastic thin teeth A and the groups of elastic thin teeth B are arranged in a staggered manner. When the thin tooth A and the thin tooth B are combined adjacently, the lower portion of the thin tooth A and the lower portion of the thin tooth B constitute an interlocking structure.

[0050] 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 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 may meet the cooling requirements during high-pressure machining. At the same time, a polishing device has a long service life.

[0051] The end face of the pressing plate 3 close to each thin tooth 2 is inclined and is matched and close to end faces of the thin teeth 2. A filler 6 embedded in the pressing plate 3 is arranged at a position of the pressing plate 3 close to the annular end face of each thin teeth 2. The filler 6 has a plastic deformation ability, and is made of an aluminum alloy, a copper alloy and other materials. The pressing plate 3 is consolidated on the substrate 1 by a bolt or glue. The grinding wheel is subjected to post-machining, such as shaping and sharpening to form a finished product.

[0052] The existing technical solutions are compared with the product of the present embodiment.

[0053] In the existing technical solution 1: in a good level of the existing overall mold presetting manufacturing technology and under economic conditions, the average width of the groove body 4 may be controlled at about 1.5 mm, the number of teeth is 64, and the average tooth width is: $((152\pi-64*1.5)/64+(118\pi-64*1.5)/64)/2 = 5.127$ mm; the area of the end face of the grinding wheel is 7210 square mm, the area of the groove body 4 is 1632 mm², and the proportion of the groove body 4 on the end face is 22.6%.

[0054] In the existing technical solution 2: if the number of teeth in the existing technical solution is increased to 120, the average tooth width is: $((152\pi-120*1.5)/120+(118\pi-120*1.5)/120)/2 = 2.034$ mm; the area of the end face of the grinding wheel is 7,210 mm², the area of the groove body 4 is 1,632 mm², and the proportion of the groove body 4 on the end face is 42.4%. Obviously, in the existing technical solution 2, due to the limitation by the manufacturing difficulty in the width of the groove body 4, if only the number of teeth is increased, the proportion of the groove body 4 is increased to occupy the entity space of the abrasive layer, such that the service life of the tool will be affected directly.

[0055] A comparison description is made:

A ratio of the tooth width in the existing technical solution 1 to the tooth width in the present embodiment is $5.127/1.856 = 2.76$ times, i.e., a chip-removal path in the existing technical solution 1 is 2.76 times of the chip-

removal path in the present embodiment. A ratio of the number of teeth in the present embodiment to the number of teeth in the existing technical solution is $1: 180/64 = 2.81$ times, i.e., a circumferential cooling area of the teeth in the present embodiment is 2.81 times of a circumferential cooling area of the teeth in the existing technical solution 1.

[0056] The manufacturing process of the product of the present embodiment turns difficulty into simplicity, which achieves fast chip-removal, good cooling effect, easy manufacturing, and greatly improved performances. As shown in FIG. 8, there is no local support structure on the surface of each thin tooth 2 of the product of the present invention, so the grinding tool of the present invention is more suitable for a grinding wheel has a small amount of grinding and low strength requirements for the thin teeth 2.

Embodiment 2:

[0057] As shown in FIGs. 8 to 10, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 are spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. The pressing plate 3 has an annular structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2. Upper portions of the plurality of the thin teeth 2 are made of an abrasive layer. The abrasive layer is made of diamond.

[0058] At an end of each thin tooth 2 away from the inner annular side of the substrate 1, a first bump 7 in connection with the end is arranged at one side of the end.

[0059] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 152 mm, the inner diameter of the grinding wheel is 118 mm, the annular width of the grinding wheel is 17 mm, and the height of the grinding wheel is 20 mm. The radial width of the first bump 7 is 2 mm, the raised height of the first bump 7 is 0.5 mm, and the first bump 7 serves to locally support every adjacent two thin teeth 2; the number of the thin teeth 2 is 180, and the width of the groove body 4 is 0.5 mm.

[0060] The thin teeth 2 are made by a powder metallurgy technology. A feeding direction surface and a main pressing surface of each thin tooth 2 are the same surfaces with the largest area, and the simple one-way pressing is adopted. The thin teeth 2 can be easily assembled and consolidated owing to their shapes. The thin teeth 2 are spliced and stacked and consolidated to form the annular structure on the substrate 1. After the plurality of the thin teeth 2 is spliced and stacked, they

are consolidated onto the substrate 1 and subjected to post-machining, such as shaping and sharpening to form a finished tool product.

[0061] A comparison description is made:

In technical solutions of the embodiments of the present invention, as compared to the technical solution of Embodiment 1, the first bump 7 forms a local support structure for the corresponding two adjacent thin teeth 2, which is equivalent to a continuous tooth structure, thereby eliminating the bounce and impact caused by intermittent grinding. The local support structure is located at the outer diameter of the annular structure formed by the plurality of thin teeth 2. During machining, a part of the grinding wheel of the present embodiment close to the outer diameter will firstly contact a workpiece. Therefore, the strength of the thin teeth 2 against the impact at the outer diameter is greatly enhanced, which is beneficial for rough grinding and powerful machining.

[0062] According to the technical solution of the embodiment of the present invention, the groove bodies 4 are formed to form an internal tooth structure when the plurality of thin teeth 2 are spliced and stacked. Cooling water is more likely to stay in the groove bodies 4 to achieve a better cooling effect.

Embodiment 3:

[0063] As shown in FIGs. 11 to 14, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 are spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. The pressing plate 3 has an annular structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2. Upper portions of the plurality of the thin teeth 2 are made of an abrasive layer. The abrasive layer is made of diamond. A plurality of first convex textures 8 is connected to the side wall of each thin tooth 2 close to another thin tooth 2.

[0064] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 152 mm, the inner diameter of the grinding wheel is 118 mm, the annular width of the grinding wheel is 17 mm, and the height of the grinding wheel is 20 mm; each first convex texture 8 is a vertical triangle texture, the raised height of the triangle texture is 0.6 mm, and a distance between a plane formed by the vertex of a triangular texture projection of each thin tooth 2 and a circumferential plane of the adjacent thin tooth 2 is 0.3 mm; the number of the thin tooth 2 is 180, and the width of the narrowest portion of the groove body 4 is 0.3 mm.

[0065] The upper end portion of each thin tooth 2 is

provided with a plurality of grooves 9. Each of the grooves 9 passes through two end faces of the corresponding thin tooth 2. The grooves on the plurality of the thin teeth 2 are arranged along different circumferential radii to form a plurality of circular through grooves. The plurality of circular through grooves and the plurality of groove bodies 4 intersect to form a net structure, thereby forming a net grinding surface.

[0066] In the annular structure formed by splicing and stacking and consolidating the plurality of thin teeth 2, on the circumference of each point in a radial direction, the cumulative total circumferential length of the abrasive layer of the upper portions of the thin teeth 2 contained therein is uneven and fluctuating. The shorter the cumulative total circumferential length of the abrasive layer, the easier it is to wear first. Each thin tooth 2 is formed with grooves 9 at the upper end of the thin tooth 2 due to fast abrasion on the circumference of each point in the radial direction of the annular structure. The grooves 9 may not only drain water but also shorten the removal path of chips in the radial direction. The grooves 9 and the adjacent groove bodies 4 form a net structure to form a net grinding surface, thereby improving cooling and chip-removal effects. Once formed, the grooves 9 remain there until the abrasive layer is completely consumed. The plurality of grooves 9 may have the same diameter and form an annular structure. The plurality of grooves 9 may also have different diameters and are distributed in sections on a part of the annular shape to serve for axial micro-frequency vibration grinding.

[0067] A comparison description is made:

compared with the prior art, the net grinding surface, formed from the net structure which is formed by the grooves 9 due to the abrasion, avoids the influence caused by circumferential groove bodies fabricated in the prior art through overall molding of molds on the strength of thin teeth, maintains the strength of the thin teeth 2 and greatly improves the heat dissipation capacity of the grinding wheel, thereby making the grinding wheel more suitable for high-speed machining. This structure is of great significance for the development of grinding machining tools without cooling water, and has a structural principle suitable for the application of grinding blocks on grinding discs with various abrasives.

Embodiment 4:

[0068] As shown in FIGs. 15 to 17, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. The pressing plate 3 has

an annular structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2. Upper portions of the plurality of the thin teeth 2 are made of an abrasive layer. The abrasive layer is made of diamond. A plurality of second bumps 10 which is circular or semi-circular is connected to a side wall of each thin tooth 2.

[0069] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 152 mm, the inner diameter of the grinding wheel is 118 mm, the annular width of the grinding wheel is 17 mm, and the height of the grinding wheel is 20 mm; the raised height of the second bump 10 is 0.4 mm, and the diameter of the second bump 10 is 1 mm. The vertex of the raised height of the plurality of second bumps 10 of each thin tooth 2 contacts the adjacent thin teeth 2, and every two adjacent thin teeth 2 support with each other by the plurality of second bumps 10.

[0070] The number of teeth of each thin teeth 2 is 240, the widest portion of the groove body 4 is 0.4 mm, and the average tooth width is: $((152\pi - 240 \cdot 0.4)/240 + (118\pi - 240 \cdot 0.4)/240) / 2 = 1.367$ mm.

[0071] The area of the end face of the grinding wheel is 7,210 mm², the area of the groove body 4 is about 1,632 mm², and the proportion of the groove body 4 on the end face of the grinding wheel is 22.6%.

[0072] The aforementioned technical products are compared with the product of the present embodiment.

[0073] In the existing technical solution 1: in a good level of the existing overall mold presetting manufacturing technology and under economic conditions, the average width of the groove body 4 may be controlled at about 1.5 mm, the number of teeth is 64, and the average tooth width is: $((152\pi - 64 \cdot 1.5)/64 + (118\pi - 64 \cdot 1.5)/64) / 2 = 5.127$ mm; the end face area of the grinding wheel is 7210 mm², the area of the groove body 4 is about 1632 mm², and the proportion of the groove body 4 on the end face is 22.6%.

[0074] A ratio of the tooth width in the existing technical solution 1 to the tooth width of the present embodiment is $5.127/1.367 = 3.75$ times, i.e., a chip-removal path in the existing technical solution 1 is 3.75 times of a chip-removal path in the present embodiment, wherein the chip-removal path is just the groove body 4. A ratio of the number of teeth in the present embodiment to the number of teeth in the existing technical solution 1 is $240/64 = 3.75$ times, i.e., a circumferential cooling area of the teeth in the present embodiment is 3.75 times of a circumferential cooling area of the teeth in the existing technical solution 1.

[0075] The average thickness of each thin teeth 2 in the present embodiment is 1.367 mm, and each thin tooth 2 is in contact with the plane of the adjacent thin teeth 2 through the corresponding second bump 10 to support each other, so that the rigidity of the grinding wheel is greatly improved. The present embodiment may adopt a variety of bumps or grooves, or a composite structure of the bumps and the grooves.

[0076] Compared with Embodiment 1, the chip-removal path in the technical solution of the present embodiment is calculated to be reduced by 26.4%. The circumferential cooling surface area in the technical solution of the present embodiment is calculated to be increased by 33.3%. The diameter of the grinding wheel is 152 mm, the number of teeth of each thin teeth 2 is 240, and the width of the groove body 4 is 0.4 mm, which is difficult to accomplish with the existing overall manufacturing technology. Due to the above advantages, the present embodiment greatly expands the application space and application fields of fine-particle abrasive grinding wheels.

Embodiment 5:

[0077] As shown in FIGs. 18 to FIG. 20, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. The pressing plate 3 has an annular structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2. Upper portions of the plurality of the thin teeth 2 are made of an abrasive layer. The abrasive layer is made of diamond.

[0078] The plurality of thin teeth 2 includes a plurality of thin teeth C and a plurality of thin teeth D, wherein several thin teeth C are continuously spliced and stacked to form a first abrasive body 11, and several thin teeth D are continuously stacked to form a second abrasive body 12. A plurality of first abrasive bodies 11 and a plurality of second abrasive bodies 12 are spliced in a staggered manner to form the annular structure on the substrate 1. The width of one end of each thin tooth C close to the inside of the substrate 1 is greater than that of the other end of the thin tooth C, and the width of one end of each thin tooth D close to the inside of the substrate 1 is smaller than that of the other end of the thin tooth D.

[0079] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 152 mm, the inner diameter of the grinding wheel is 118 mm, the annular width of the grinding wheel is 17 mm, and the height of the grinding wheel is 20 mm.

[0080] The number of teeth of each thin teeth 2 is 180, the width of the widest portion of the groove body 4 is 1 mm, and the width of the narrowest portion of the groove body is 0.5 mm; 5 thin teeth C are continuously spliced and stacked to constitute a first abrasive body 11, 5 thin teeth D are continuously stacked to constitute a second abrasive body 12. 18 first abrasive bodies 11 and 18 second abrasive bodies 12 are spliced in a staggered manner to form the annular structure on the substrate 1.

[0081] The aforementioned technical products are compared with the product in the present embodiment.

[0082] In the technical solution of the present invention, several thin teeth C are continuously spliced and stacked to form a first abrasive body 11, several thin teeth D are continuously spliced and stacked to form a second abrasive body 12, and a plurality of first abrasive bodies 11 and a plurality of second abrasive bodies 12 are spliced in a staggered manner to form the annular structure on the substrate 1 to form a composite grinding ring, thereby achieving an explicit or implicit double-ring or multi-ring structure.

[0083] The shapes of grinding surfaces of the first abrasive body 11 and the second abrasive body 12 may be different, the areas of an inner annular portion and an outer annular portion of each segment of the composite grinding ring may be different, and the pressure intensities and abrasions of the individual first abrasive bodies 11 or second abrasive bodies 12 during working may be different, so that the grinding surface of the composite grinding annular has an explicit difference in height and shape. If different bonds are used for the thin teeth C and the thin teeth D at the same time, the difference in performance of the inner annular portion and the outer annular portion of each segment of the composite grinding ring will cause different forces during grinding. The grinding surface of the composite grinding ring will have an implicit difference in force strength. Both the height difference and the strength difference form radial and axial frequency vibration grinding, thereby presenting a structural function of double rings or multiple rings, and exerting or surpassing the technical effect of the existing technical solutions.

Embodiment 6:

[0084] As shown in FIGs. 21 to 24, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, a plurality of thin teeth 2 and a pressing plate 3. The plurality of the thin teeth 2 is spliced and stacked along the substrate 1 to form the annular structure on the substrate 1. The abrasive end face of the annular structure is closely attached to the edge of the substrate 1. A groove body 4 is formed in the middle between every two adjacent thin teeth 2. An arc length of each point of a grinding structure 14 on each thin tooth 2 in an axial direction is in a positive relationship with the machining amount at this point. The greater the machining amount at that point is, the greater the wear amount at this point is, the more likely the wear and deformation happen. Therefore, the circumferential arc length at this point should be set to be relatively longer. The smaller the machining amount at this point is, the shorter the circumferential arc length set for this point is. Therefore, relatively balanced wear is achieved to improve the ability to resist the deformation. The pressing plate 3 is in an annular shape and is placed on the upper end of the substrate 1. The pressing plate 3 is connected to the

substrate 1 by a bolt and presses the plurality of the thin teeth 2.

[0085] The size of the grinding wheel in the present embodiment is as follows: the diameter of the grinding wheel is 150 mm; the annular width of the annular structure of the grinding wheel is 10 mm; the width of an opening of the grinding wheel is 12 mm, which is suitable for machining workpieces of 10 mm; and the height of the grinding wheel is 23 mm.

[0086] When the grinding wheel is in contact with a workpiece, the width of the narrowest portion of the groove body 4 is 0.2 mm.

[0087] The number of teeth of the grinding wheel is 276, and the average circumferential working width of the teeth is: $((150\pi - 276 \times 0.2) / 276 + (130\pi - 276 \times 0.2) / 276) / 2 = 1.394$ mm.

[0088] The thin teeth 2 are made by a powder metal-lurgy technology. A feeding direction surface and a main pressing surface of each thin tooth 2 are the same surfaces with the largest area. Since the average thickness of each thin teeth 2 is only 1.394 mm, simple one-way pressing is sufficient. In comparison to the existing overall mold presetting manufacturing technology which requires two-way pressing, the mold height is greatly reduced, and the feeding is simple and easy. The thin teeth 2 can be easily assembled and consolidated owing to their shapes. After the plurality of the thin teeth 2 are spliced and stacked, a groove body 4 is formed in the middle between every two adjacent thin teeth 2. The width of the narrowest portion of the groove body 4 is 0.2 mm when contacting a workpiece. A meshing position 13 is provided on the side wall of one end of each thin tooth 2 close to the inner annular side of the substrate 1, and the corresponding two adjacent thin teeth 2 engage with each other through the meshing position 13. The lower end face of the pressing plate 3 is inclined downward from the inner annular side to the outer annular side of the pressing plate 3 to limit the plurality of thin teeth 2, thereby preventing the plurality of thin teeth 2 from flying out during the grinding process. With the aid of filling bodies 6, the plurality of thin teeth 2 are consolidated on the substrate 1 by using auxiliary members, adhesives, etc. A finished tool product is formed after post-machining such as shaping and sharpening, etc.

[0089] A grinding structure 14 is arranged at one end of each thin tooth 2 away from the inner annular side of the substrate 1. When a corresponding workpiece to be ground has a concave surface, the end face of each thin tooth 2 close to another thin tooth 2 has a convex texture structure. When a corresponding workpiece to be ground has a convex surface, the end face of each thin tooth 2 close to another thin tooth 2 has a concave texture structure 15. The grinding structure 14 may be a concave texture, a convex texture or a concave-convex composite texture.

[0090] The prior art products are compared with the product in the present embodiments: according to the manufacturing process of the technical

solution in the present embodiment, the difficulty is turned into simplicity, the thin teeth 2 that are difficult to fabricate by overall presetting can be fabricated, a narrow tooth structure that greatly shortens the chip-removal path and the groove bodies 4 for rapid cooling can be achieved. Therefore, dense internal water-cooling in a grinding area can be achieved conveniently, and the performances of the grinding wheel product are greatly improved.

Embodiment 7:

[0091] As shown in FIGs. 25 to 27, in the present embodiment, a grinding tool further includes a substrate 1 in an annular structure, and a pressing plate 3. The annular structure formed by the plurality of thin teeth 2 is fixed on the substrate 1. The pressing plate 3 has a ring-shaped structure. The pressing plate 3 is connected to the substrate 1 by a bolt and presses the plurality of the thin teeth 2.

[0092] A plurality of groove bodies 4 is arranged in an annular shape along the annular structure. Each of the groove bodies 4 is displaced from a radial direction the annular structure.

Embodiment 8:

[0093] As shown in FIGs. 28 to 33, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure and a plurality of thin teeth 2. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form the annular structure on the substrate 1. Lower portions of the plurality of thin teeth 2 are embedded in the limiting groove 5 and are bonded to the substrate 1 by glue. A groove body 4 is formed between upper portions of every two adjacent thin teeth 2. When in use, the grinding tool is pressed on a mounting bottom plate 16 by a pressing plate, is connected to a flange plate on a motor shaft by a bolt and presses the plurality of the thin teeth 2. The upper portions of the plurality of thin teeth 2 are made of an abrasive layer.

[0094] The abrasive layer is made of an organic bond, an inorganic bond or a composite bond and an abrasive. Different amounts of porosity are set in the abrasive layer. The abrasive layer is also a working layer. The inorganic bond is metal, ceramic or magnesite. The organic bond is resin or rubber. The composite bond is ceramic resin.

[0095] At an end of each thin tooth 2 away from the annular structure, a third bump 18 in connection with the end is arranged at one side of the end. A plurality of fourth bumps 19 which are circular or semicircular is connected to a side wall of each thin tooth 2. Every two adjacent thin teeth 2 are pressed tightly with each other by the plurality of fourth bumps 19 to achieve mutual support.

[0096] In the present embodiment, a variety of bumps or groove, or a composite structure of the bumps and the

grooves may be used to form a mutual support structure or a fly-out prevention structure 17.

[0097] The thin teeth 2 are made of an organic bond. A feeding direction surface and a main pressing surface of each thin tooth 2 are the same surfaces with the largest area, such that simple one-way pressing is adopted. The thin teeth 2 can be easily assembled and consolidated owing to their shapes. The plurality of thin teeth 2 are spliced and stacked and consolidated to form the annular structure on the substrate 1. A finished tool product is formed after pose-machining such as shaping.

[0098] Every two adjacent thin teeth 2 are coupled by gluing with the aid of an adhesive.

[0099] A comparison description is made:

in the technical solution of the embodiment of the present invention, when a plurality of thin teeth 2 is spliced and stacked, the groove bodies 4 are formed to form an internal tooth structure, such that cooling water is more likely to stay in the groove bodies 4 to achieve a better cooling effect.

[0100] In the technical solution of the embodiment of the present invention, a mutual pressed support is achieved by the plurality of fourth bumps 19, so that the rigidity of a polishing wheel with an organic bond is satisfied to solve the problem in the prior art that the polishing wheel has a poor rigidity and is easy to deform after being provided with grooves and pores.

[0101] In the technical solution in the embodiment of the present invention, the overall elasticity of the product can be adjusted to a certain extent by adjusting the structure shape, number, and size of the fourth bumps 19.

[0102] In the technical solution of the embodiment of the present invention, the overall heat resistance of the product is improved through structural functions. A part of the pore structure that originally needs to be placed inside the bond may be replaced, such that the porosity is reduced, the ability to hold abrasives is improved, and the high-speed and high-efficiency machining capacity is greatly improved.

Embodiment 9:

[0103] As shown in FIGs. 34 to 36, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure 1, and a plurality of teeth thin 2. The thin tooth 2 includes thin teeth E and thin teeth F. A plurality of the thin teeth E and a plurality of thin teeth F are arranged in a staggered manner. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form an annular structure. A groove body 4 is formed between every two adjacent thin teeth 2, i.e., the groove body 4 is formed between each thin tooth E and the corresponding thin tooth F. The lower end portion of the annular structure is provided with a fly-out prevention structure 17. The limiting groove 5 of the substrate 1 engages with the fly-out prevention structure 17 on the an-

nular structure. The annular structure is clamped and consolidated by the substrate 1 and the pressing plate 3. The pressing plate 3 presses the plurality of the thin teeth 2. The plurality of the thin teeth 2 is made of an abrasive layer. The thin teeth E are flat thin teeth, and the thin teeth F are wavy thin teeth. Each thin tooth E and each thin tooth F have the same circumferential thickness at each point in the axial direction, that is, cumulative total circumferential arc lengths of the thin tooth E and the thin tooth F are the same in the respective points in the axial direction, so that a grinding surface of the grinding wheel has good resistance to deformation in grooving machining.

Embodiment 10:

[0104] As shown in FIGs. 37 to 39, in the present embodiment, a grinding tool includes a substrate 1 in an annular structure, and a plurality of thin teeth 2. The substrate 1 is provided with a limiting groove 5 arranged along the inner annular edge of the substrate 1. The plurality of the thin teeth 2 is spliced and stacked in a radial direction of the substrate 1 to form an annular structure. The annular structure is glued by an adhesive. A groove body 4 is formed between every two adjacent thin teeth 2. A fly-out prevention structure 17 is provided on the end face of the annular structure. The annular structure is clamped and consolidated by the substrate 1 and the pressing plate 3. The limit groove 5 of the substrate 1 engages with the fly-out structure 17 on the annular structure. The plurality of the thin teeth 2 is pressed by the pressing plate 3. The plurality of the thin teeth 2 are all made of an abrasive layer.

[0105] The present invention also relates to a manufacturing method for a grinding tool, which includes the following steps:

in step S1: thin teeth 2 are fabricated according to a set structure, so that a ratio of an average radial length of the thin teeth 2 to an average circumferential width of the thin teeth 2 is greater than 2.5;
in step S2: a main pressing surface of each thin tooth is fabricated as a non-grinding working surface, wherein the main pressing surface is a surface with the largest area of the thin tooth; and
in step S3: the main pressing surface of the plurality of thin teeth 2 are spliced and stacked and fixedly connected to form an annular structure.

[0106] In the above-mentioned embodiment, the manufacturing method may further include a step S4: the plurality of thin teeth 2 are consolidated to the substrate 1 through the pressing plate 3 and bolts.

[0107] The above descriptions only relate to preferred embodiments of the present invention and are not intended to limit the present invention. Any modification, equivalent replacement, improvement, etc. made within the spirit and principle of the present invention shall be in-

cluded within the scope of protection of the present invention.

5 Claims

1. A grinding tool, comprising a plurality of thin teeth (2) which is sequentially spliced and stacked to form an annular structure, wherein every two adjacent thin teeth (2) are fixedly connected; and a groove body (4) is formed between every two adjacent thin teeth (2).
2. The grinding tool according to claim 1, further comprising a substrate (1) in an annular structure, and a pressing plate (3), wherein the annular structure formed by the plurality of the thin teeth (2) is fixed on the substrate (1), the pressing plate (3) has a ring-shaped structure, and the pressing plate (3) is connected with the substrate (1) by a bolt and presses the plurality of the thin teeth (2).
3. The grinding tool according to claim 2, wherein the plurality of thin teeth (2) comprise a plurality of thin teeth A and a plurality of thin teeth B, and the plurality of thin teeth A and the plurality of thin teeth B are arranged in a staggered manner; or a plurality of elastic thin teeth A and one elastic thin tooth B are arranged in a staggered manner; or a plurality of elastic thin teeth A constitute groups of elastic thin teeth A, a plurality of elastic thin teeth B constitute groups of elastic thin teeth B, and the groups of elastic thin teeth A and the groups of elastic thin teeth B are arranged in a staggered manner; when the thin tooth A and the thin tooth B are combined adjacently, the lower portion of the thin tooth A and the lower portion of the thin tooth B constitute an interlocking structure.
4. The grinding tool according to claim 3, 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.
5. The grinding tool according to claim 2, wherein the substrate (1) is provided with a limiting groove (5) arranged along the inner annular edge of the substrate (1); the lower portions of the plurality of thin teeth (2) are embedded in the limiting groove (5), and upper portions of the plurality of thin teeth (2) are all made of an abrasive layer.
6. The grinding tool according to claim 5, wherein the abrasive layer is made of diamond.
7. The grinding tool according to claim 2, wherein an end face of the pressing plate (3) close to the thin teeth (2) is inclined and is matched and close to end

faces of the thin teeth (2), and a filler (6) embedded in the pressing plate (3) is arranged at a position of the pressing plate (3) close to an annular end face of each thin tooth (2).

8. The grinding tool according to claim 1 or 2, wherein a plurality of groove bodies (4) is arranged in an annular shape along the annular structure, and each of the groove bodies (4) is displaced from a radial direction of the annular structure. 5
9. The grinding tool according to any one of claims 2 to 7, wherein at an end of each thin tooth (2) away from the inner annular side of the substrate (1), a first bump (7) in connection with the end is arranged at one side of the end. 10
10. The grinding tool according to any one of claims 2 to 7, wherein a plurality of first convex textures (8) is connected to a side wall of each thin tooth (2) close to another thin tooth (2). 15
11. The grinding tool according to any one of claims 2 to 7, wherein a plurality of second bumps (10) is connected to a side wall of each thin tooth (2). 20
12. The grinding tool according to any one of claims 2, 5, 6 and 7, wherein the plurality of the thin teeth (2) comprises a plurality of thin teeth C and a plurality of thin teeth D, several thin teeth C are continuously spliced and stacked to form a first abrasive body (11), several thin teeth D are continuously spliced and stacked to form a second abrasive body (12), and a plurality of first abrasive bodies (11) and a plurality of second abrasive bodies (12) are spliced in a staggered manner to form the annular structure on the substrate (1); the width of the one end of each thin tooth C close to the inside of the substrate (1) is greater than that of the other end of the thin tooth C, and the width of one end of each thin tooth D close to the inside of the substrate (1) is smaller than that of the other end of the thin tooth D. 25
13. The grinding tool according to claim 2, wherein the end face of the annular structure is tightly attached to the edge of the substrate (1); the pressing plate (3) is in an annular shape and is placed on the upper end of the substrate (1); a meshing position (13) is provided on the side wall of one end of each thin tooth (2) close to the inner annular side of the substrate (1), every two adjacent thin teeth (2) engage with each other through the meshing position (13), and the lower end face of the pressing plate (3) is inclined downward from the inner annular side to the outer annular side of the pressing plate (3) to limit the plurality of thin teeth (2); one end of each of the thin teeth (2) away from the inner annular side of the substrate (1) is provided 30

with a grinding structure (14).

14. The grinding tool according to claim 13, wherein an arc length of each point of the grinding structure (14) on each thin tooth (2) in an axial direction is in a positive relationship with the machining amount at this point. 35
15. The grinding tool according to claim 1, wherein the upper end of each thin tooth (2) is provided with a plurality of grooves (9) in a radial direction of the annular structure, and the plurality of grooves (9) forms a net structure with the plurality of groove bodies (4) to form a net grinding surface. 40
16. The grinding tool according to claim 1, wherein every two adjacent thin teeth (2) are fixedly connected by gluing and/or a fastener. 45
17. The grinding tool according to claim 1, wherein the bond for the plurality of thin teeth (2) is an organic bond, an inorganic bond, or a composite bond. 50
18. The grinding tool according to any one of claims 1 to 7, and 13 to 17, wherein the grinding tool is a thin-tooth spliced diamond grinding wheel. 55
19. A manufacturing method for a grinding tool, comprising the following steps:
S 1. manufacturing thin teeth (2) according to a set structure, so that a ratio of an average radial length of each thin tooth (2) to an average circumferential width thereof is greater than 2.5;
S2. manufacturing a main pressing surface of each thin tooth as a non-grinding working surface, wherein the main pressing surface is a surface with the largest area of the thin tooth; and
S3. splicing and stacking and fixedly connecting the main pressing surfaces of the plurality of thin teeth (2) to form an annular structure.
20. The manufacturing method for the grinding tool according to claim 19, further comprising step S4: consolidating the plurality of thin teeth (2) to the substrate (1) through a pressing plate (3) and bolts.

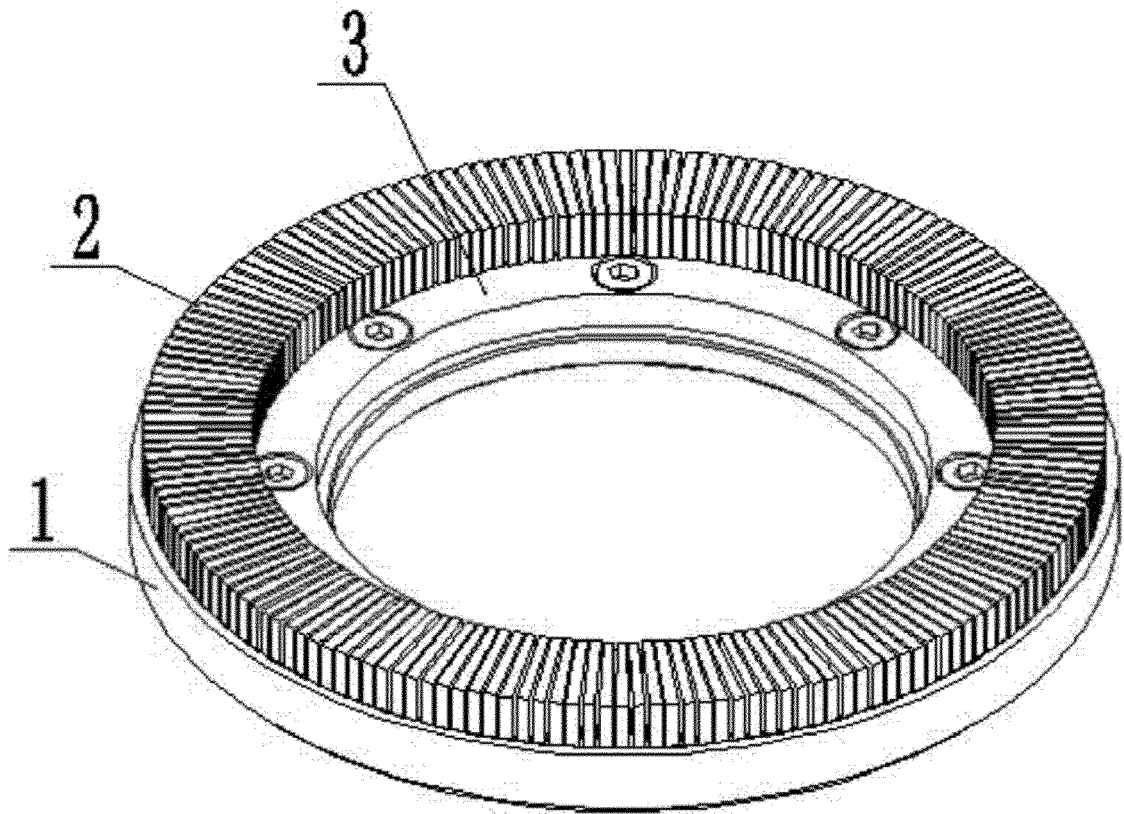


FIG. 1

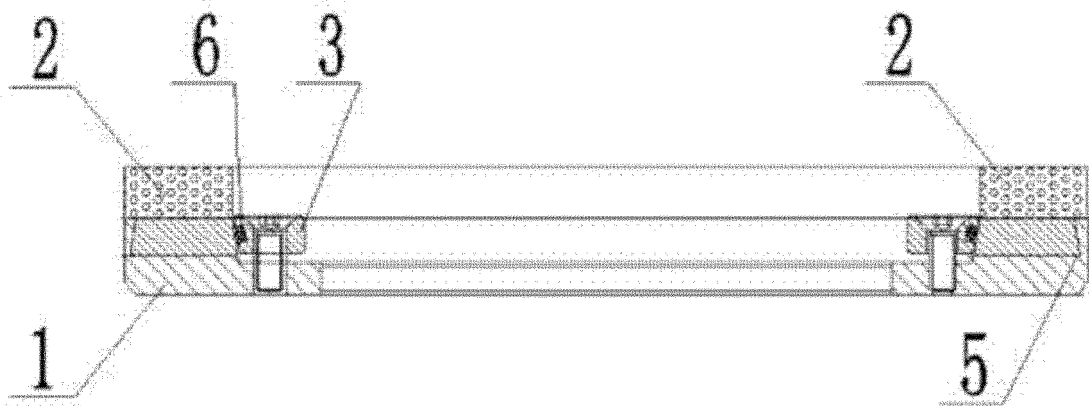


FIG. 2

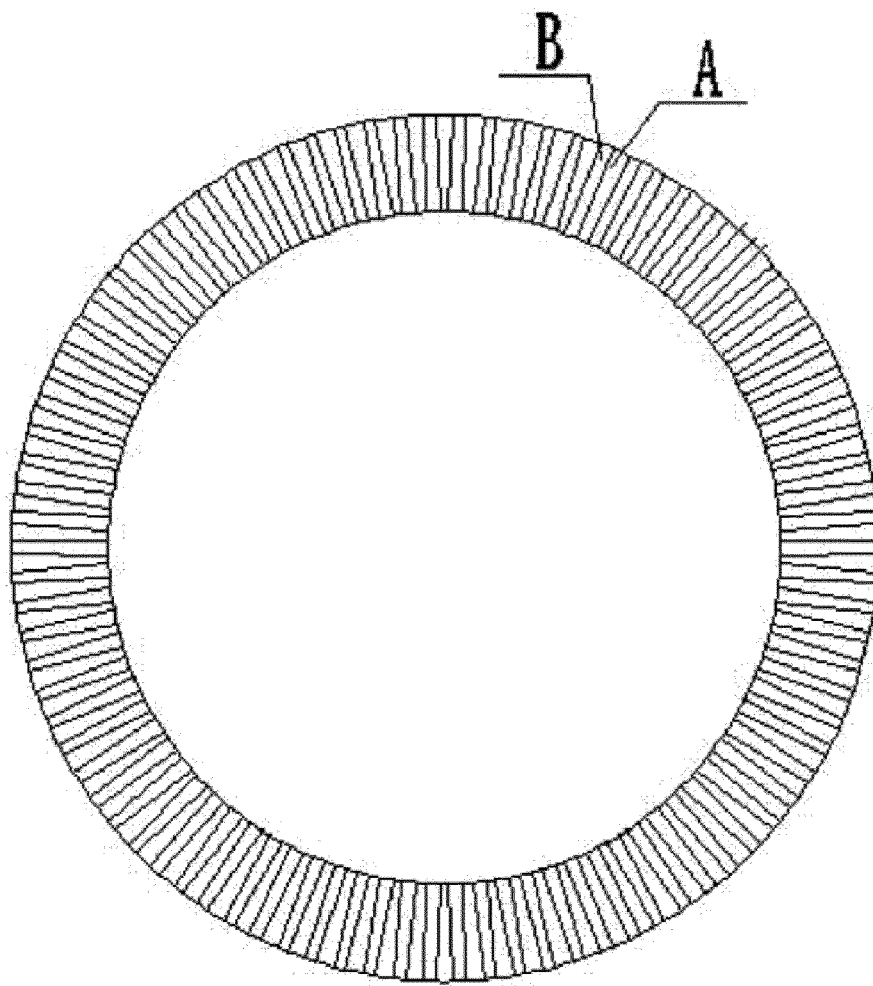


FIG. 3



FIG. 4

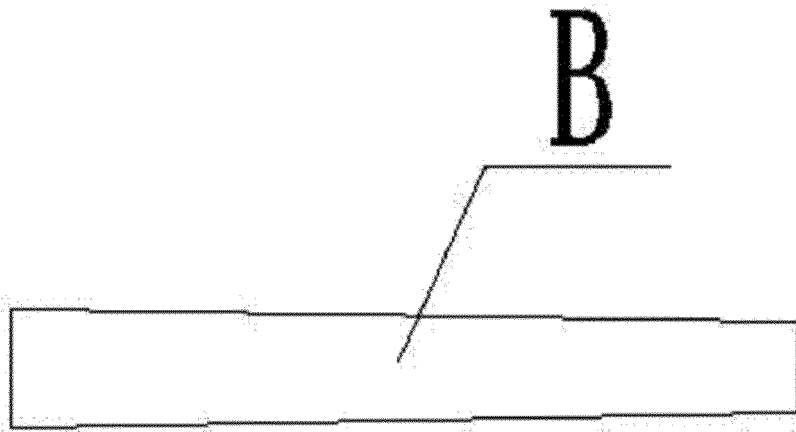


FIG. 5

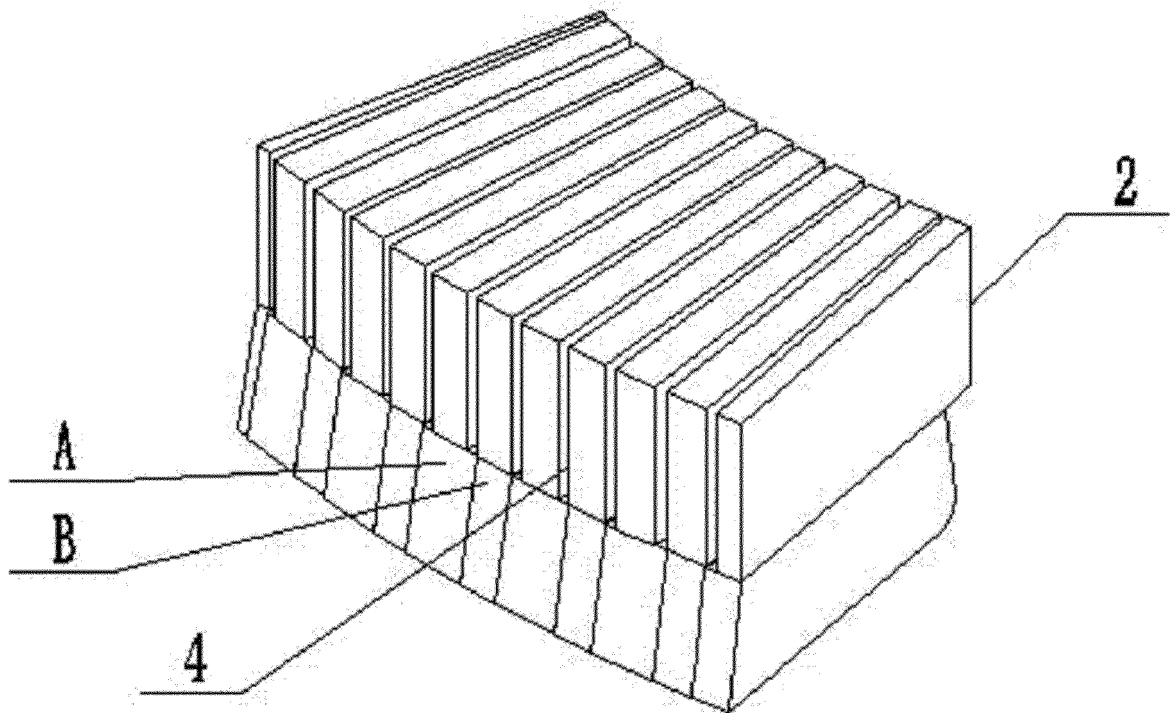


FIG. 6

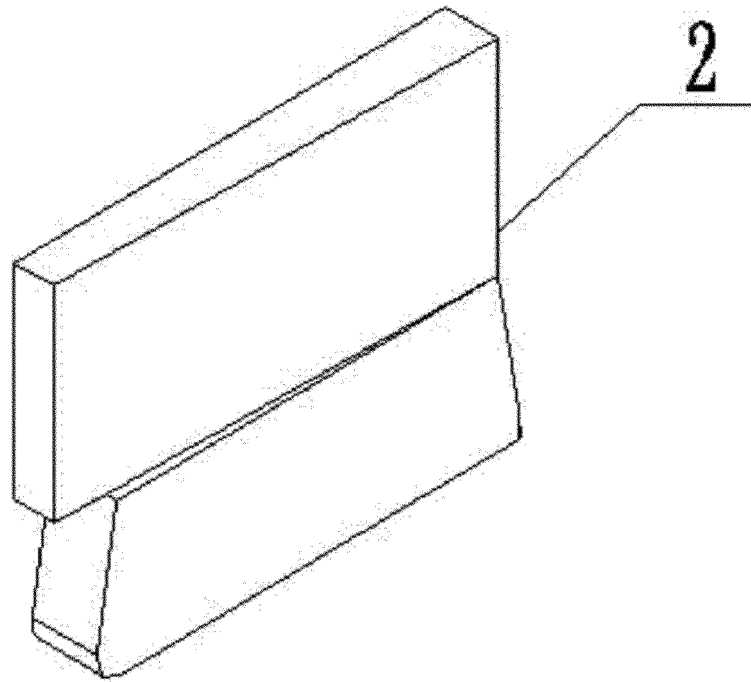


FIG. 7

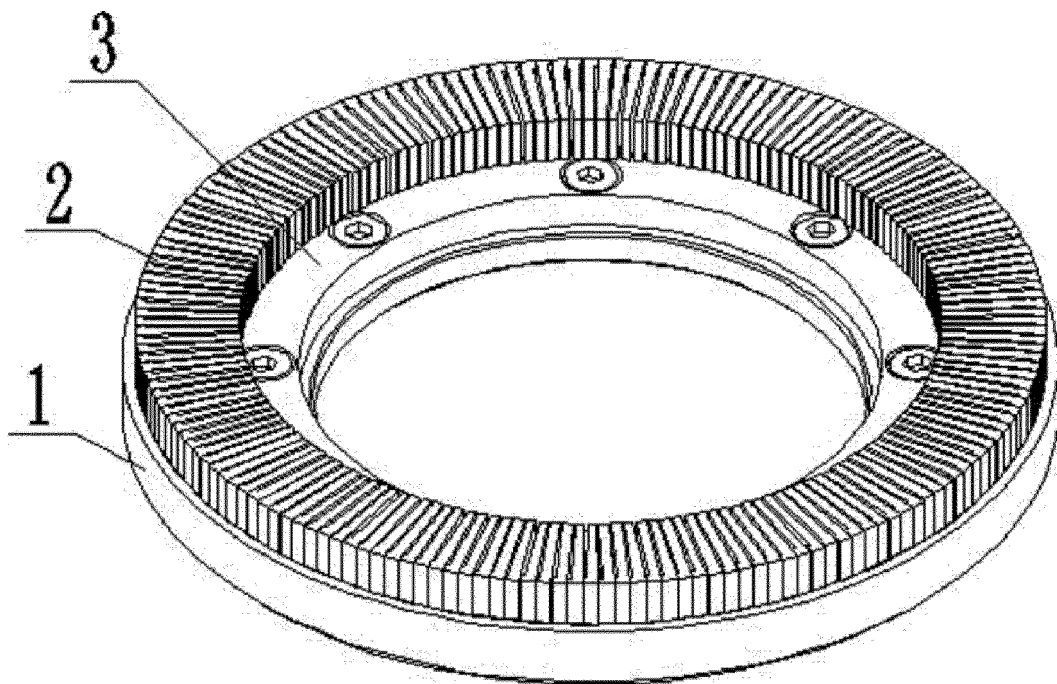


FIG. 8

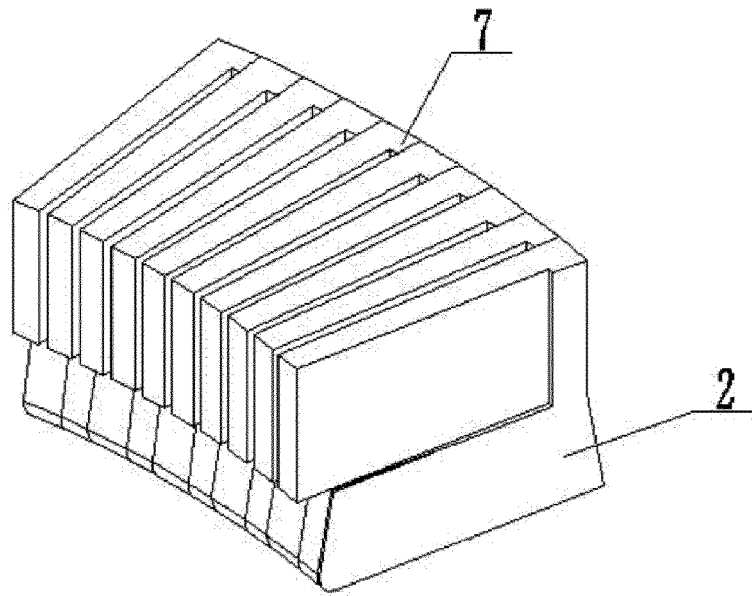


FIG. 9

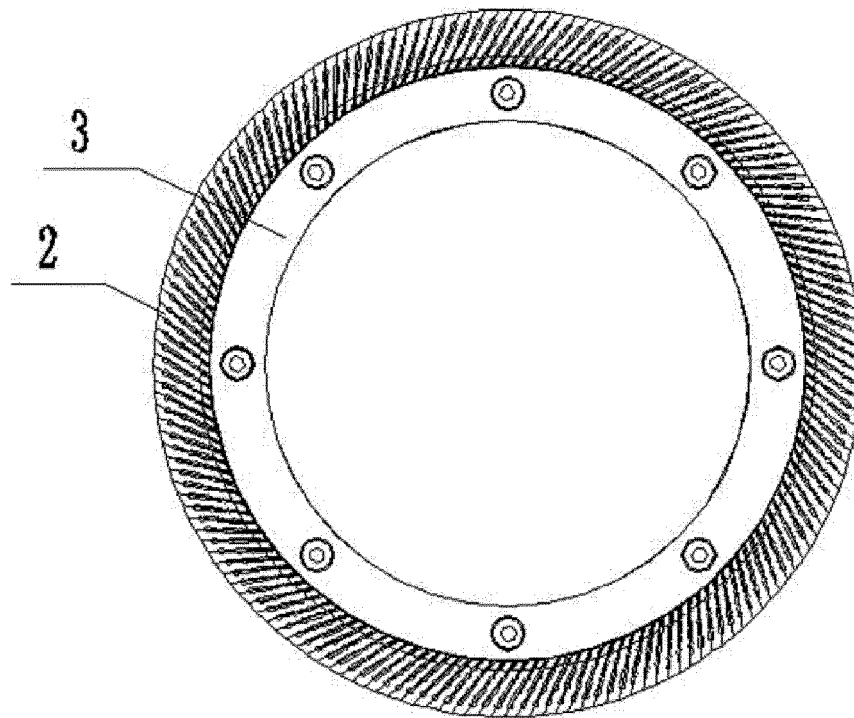


FIG. 10

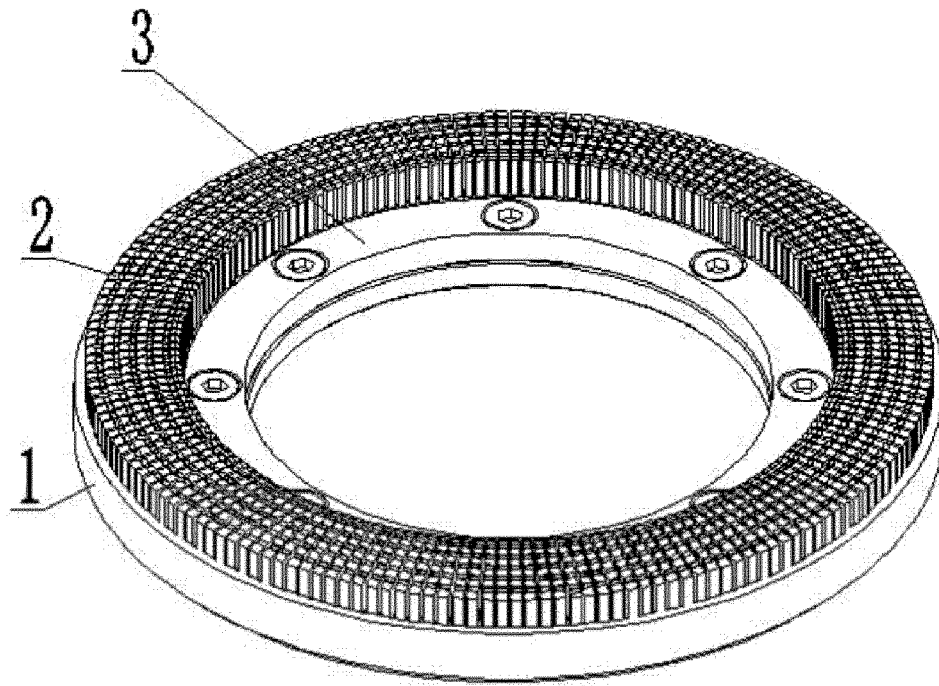


FIG. 11

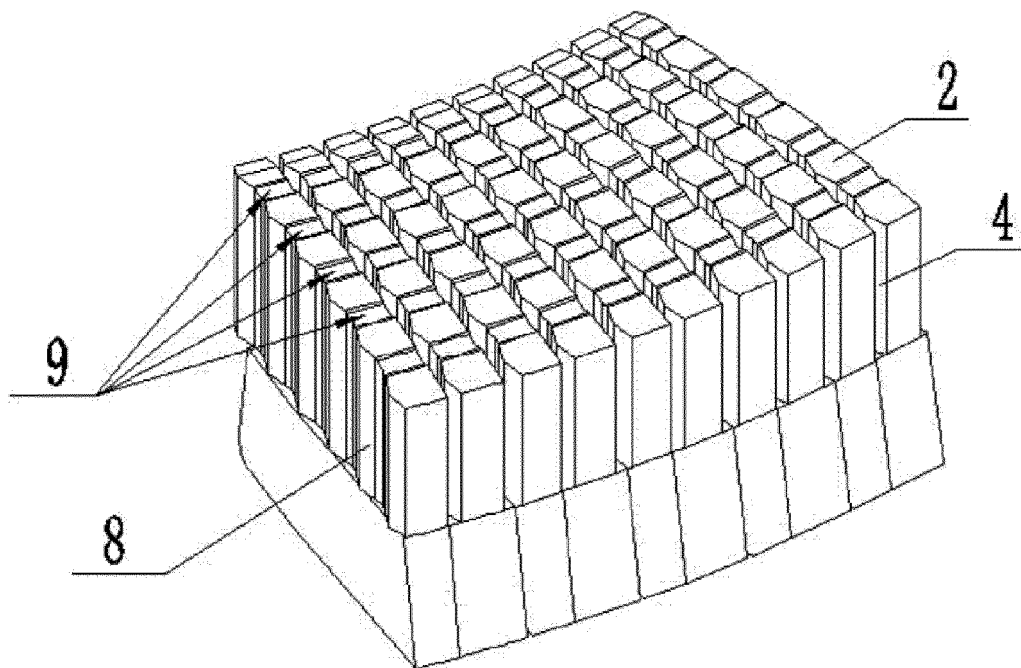


FIG. 12

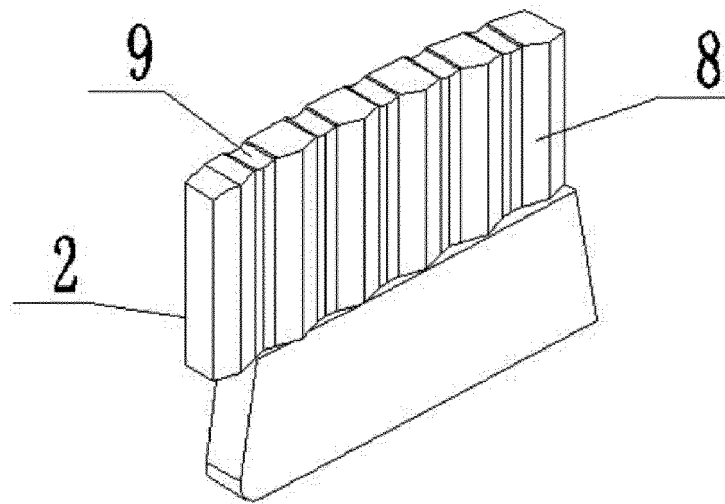


FIG. 13

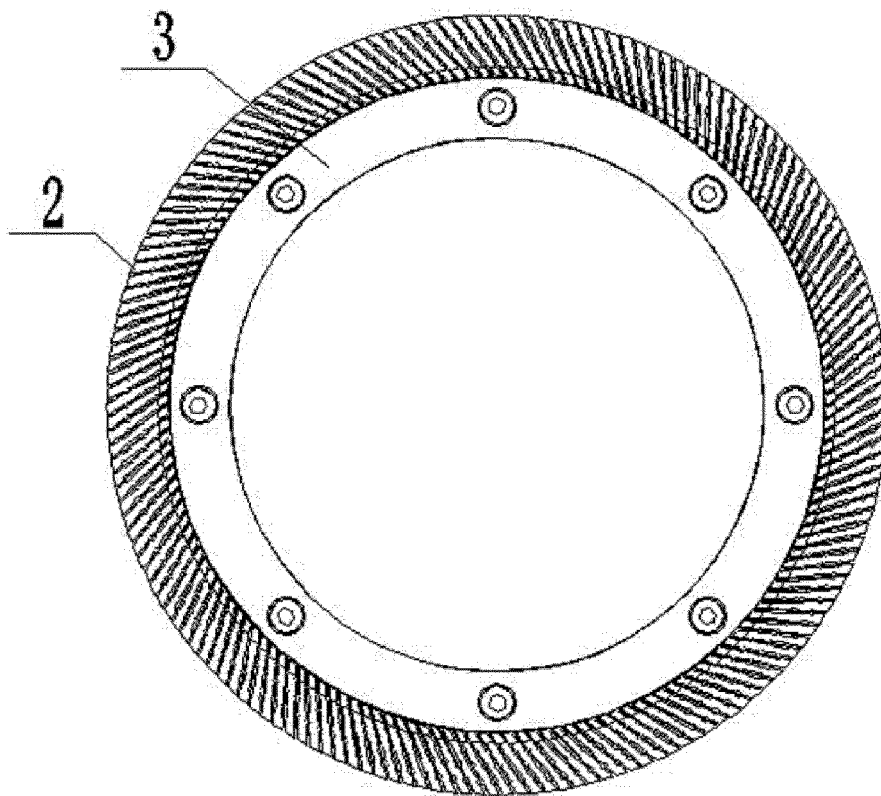


FIG. 14

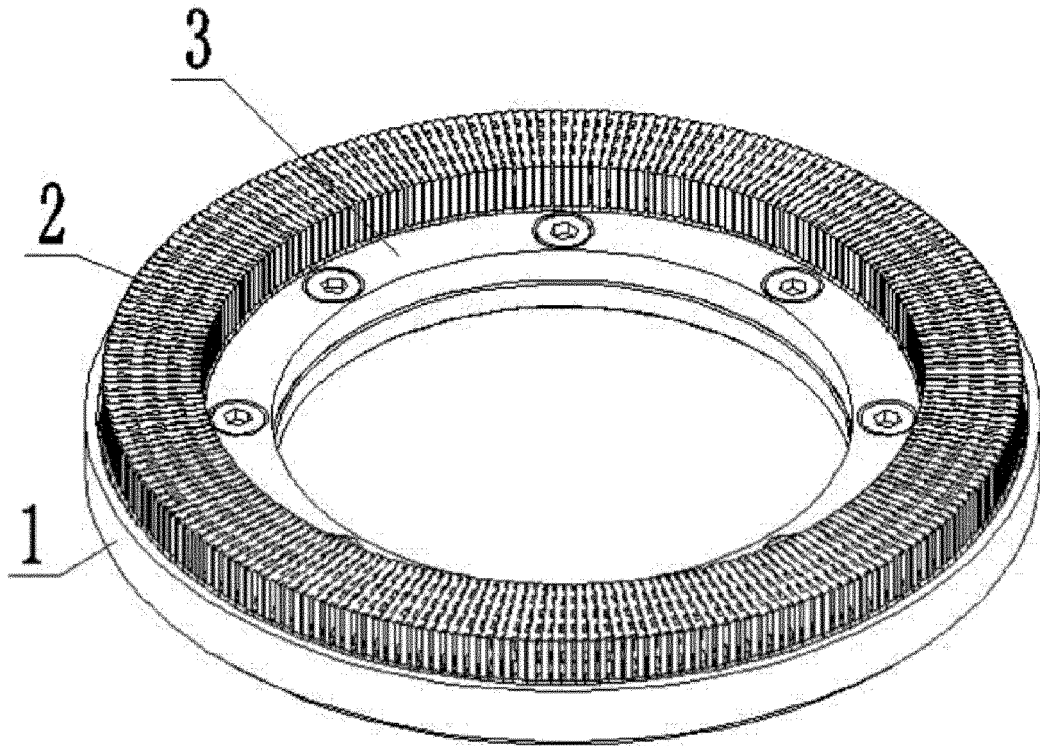


FIG. 15

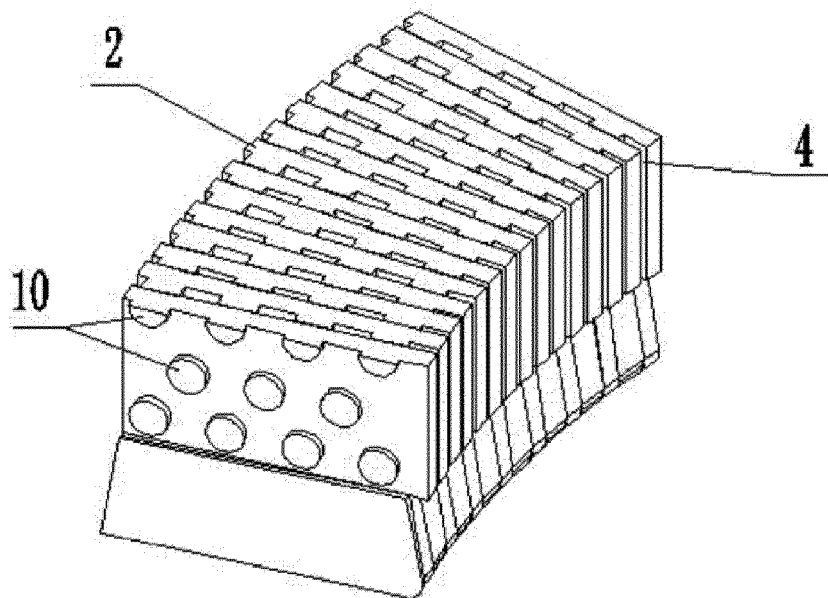


FIG. 16

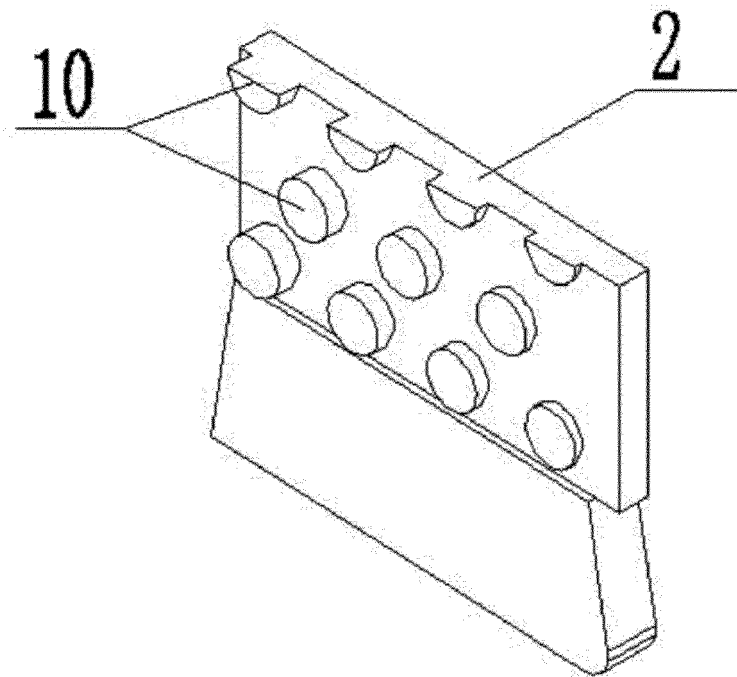


FIG. 17

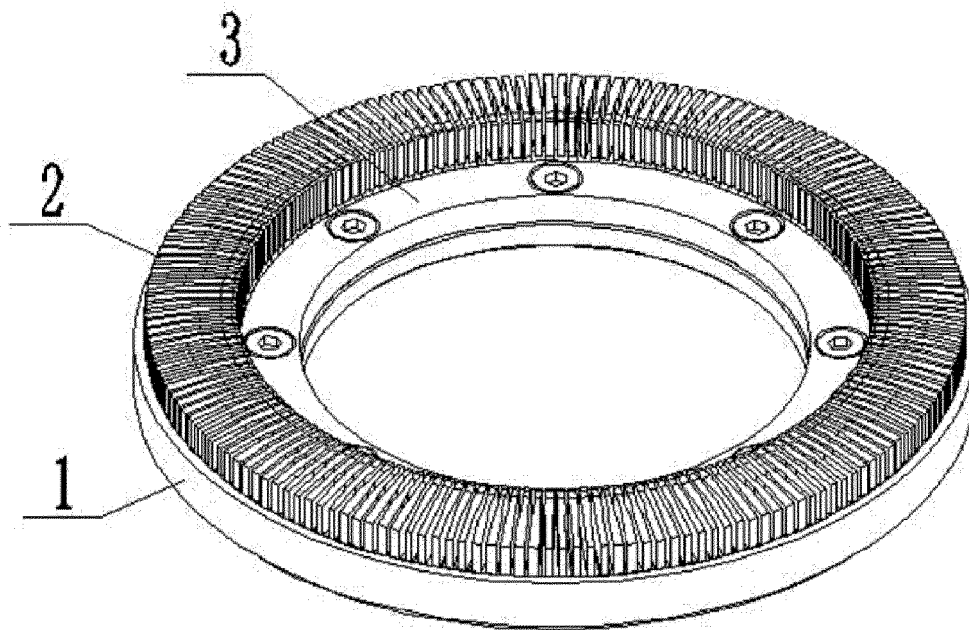


FIG. 18

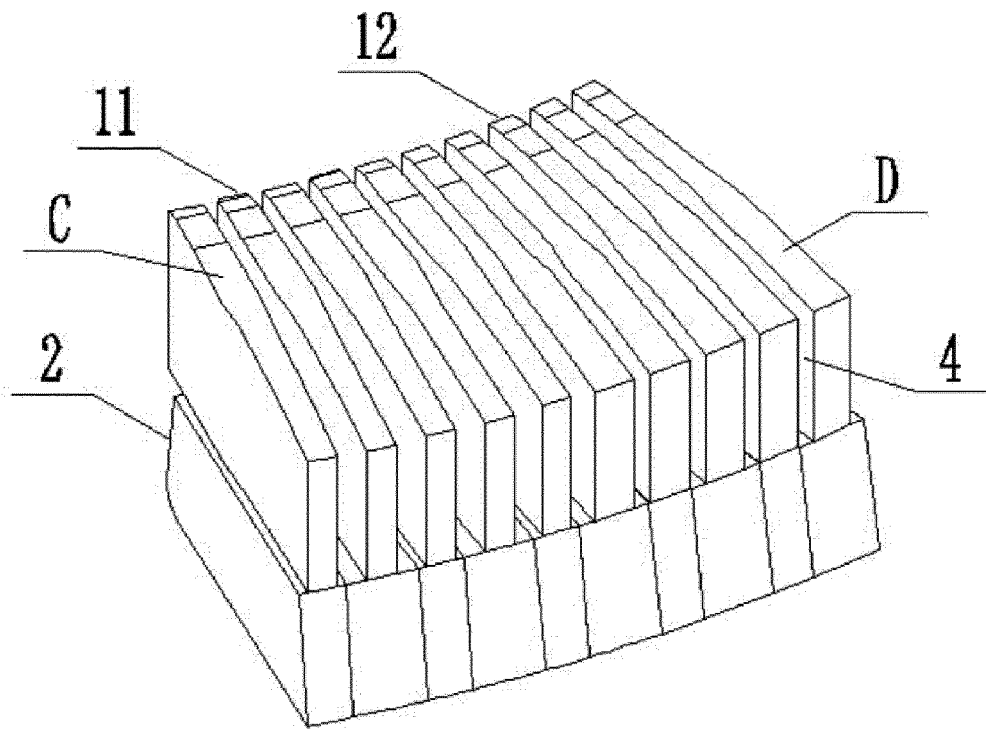


FIG. 19

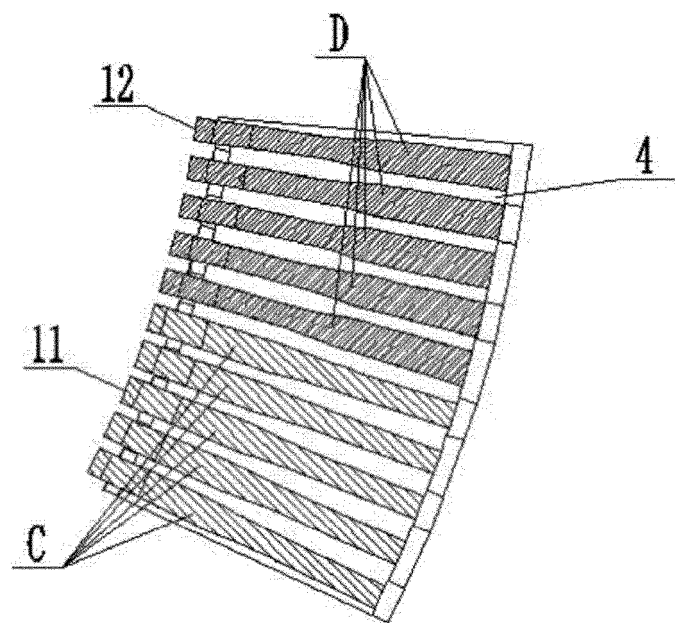


FIG. 20

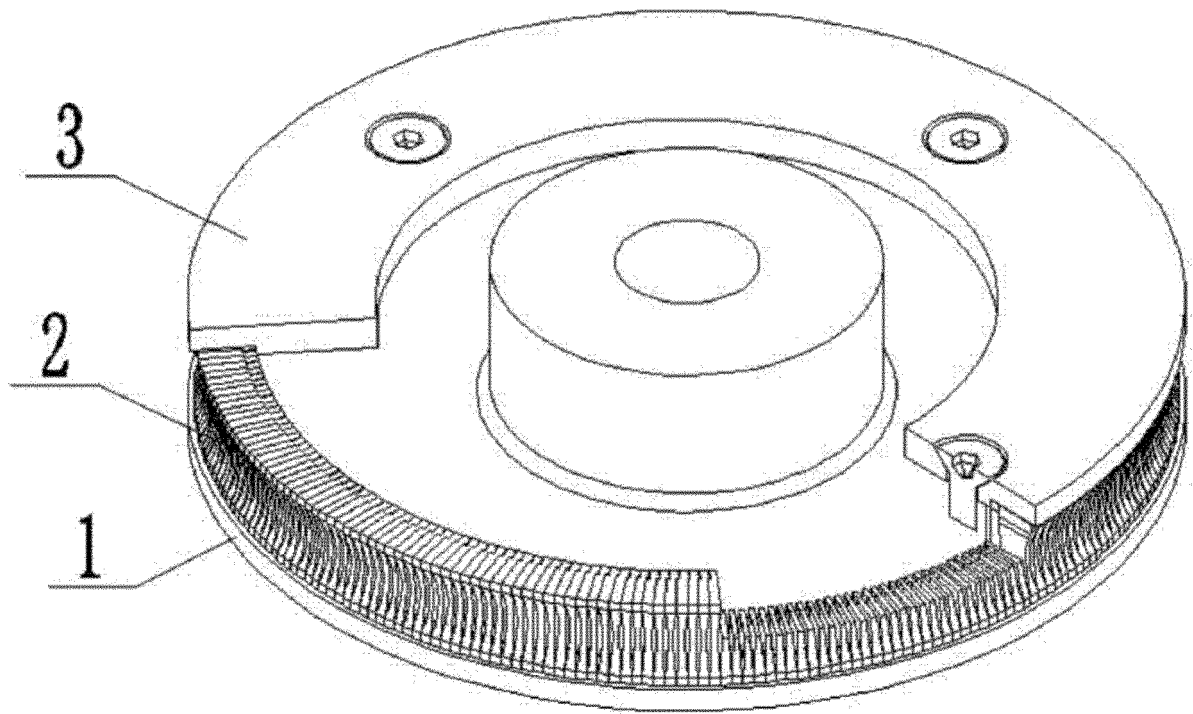


FIG. 21

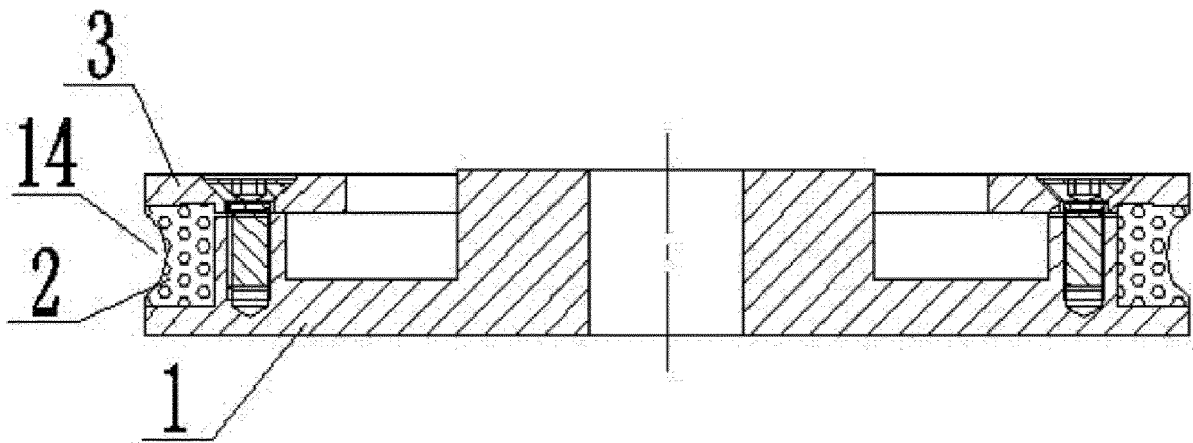


FIG. 22

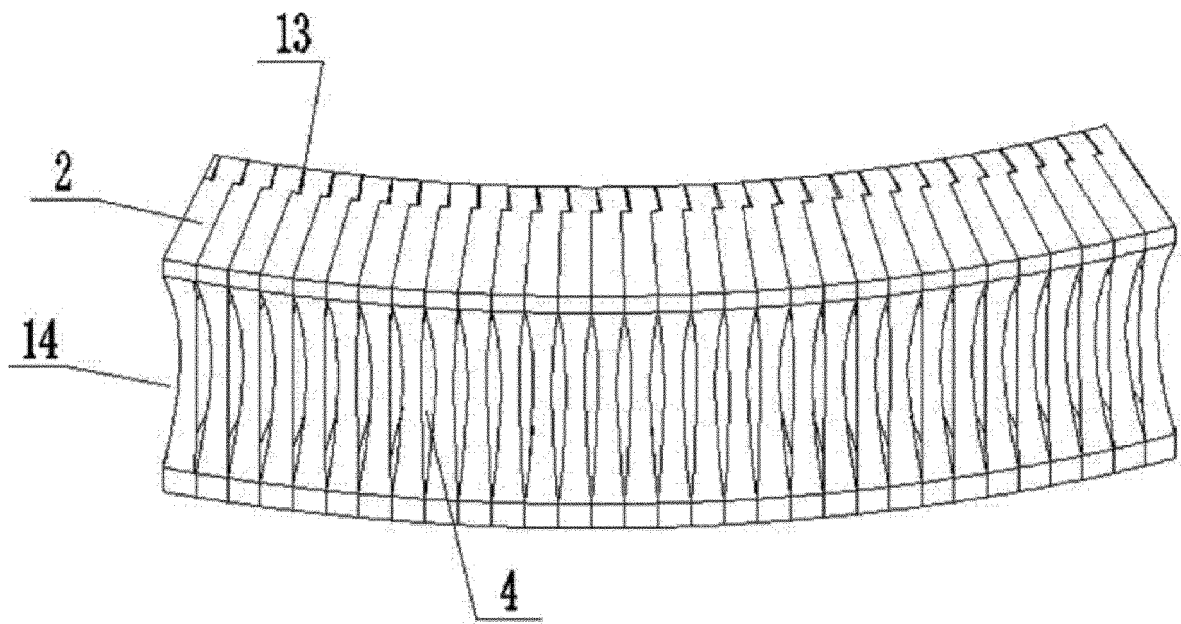


FIG. 23

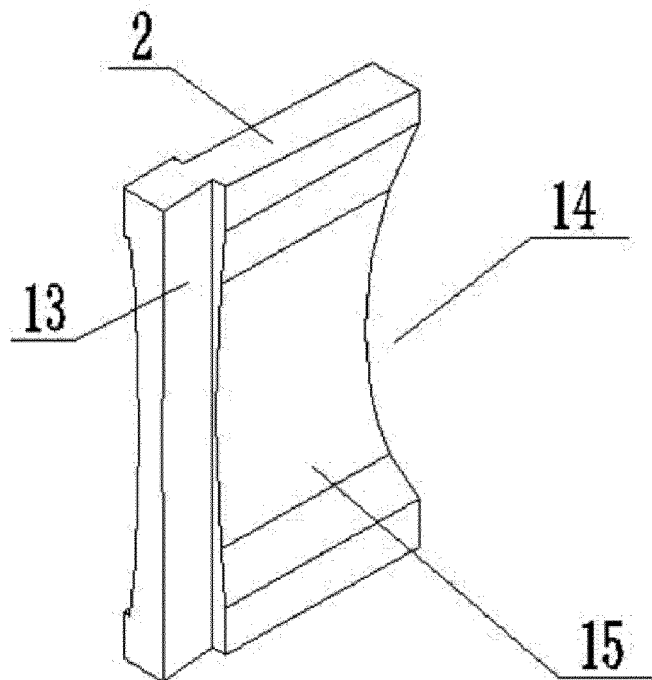


FIG. 24

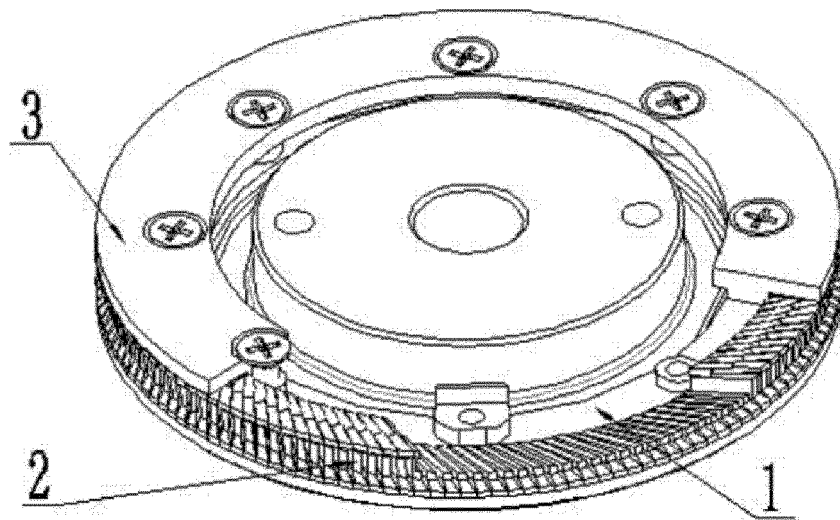


FIG. 25

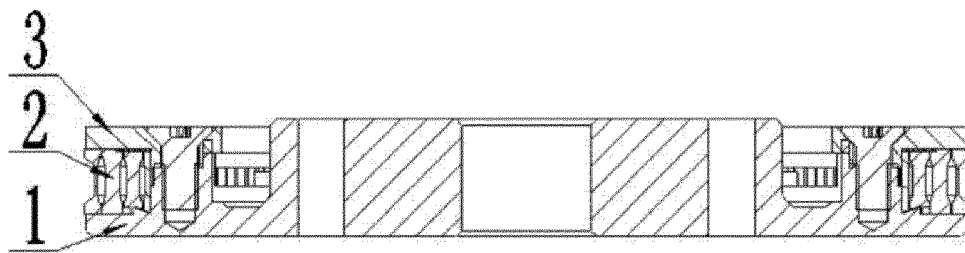


FIG. 26

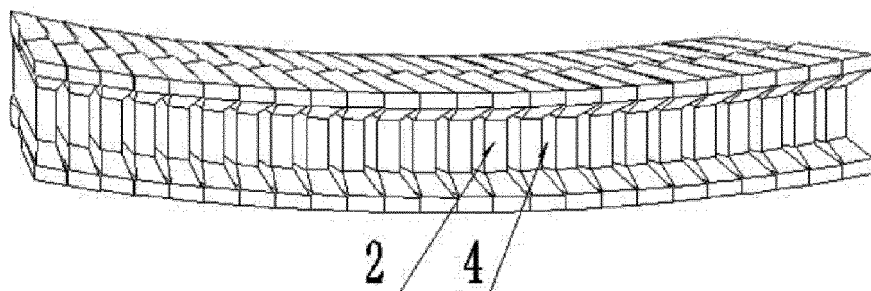


FIG. 27

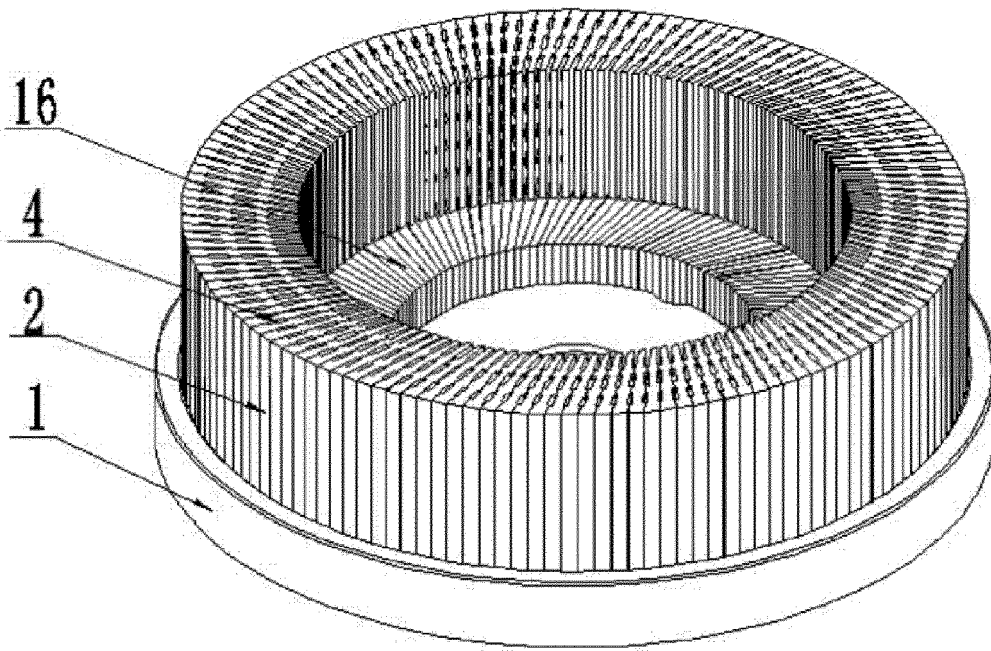


FIG. 28

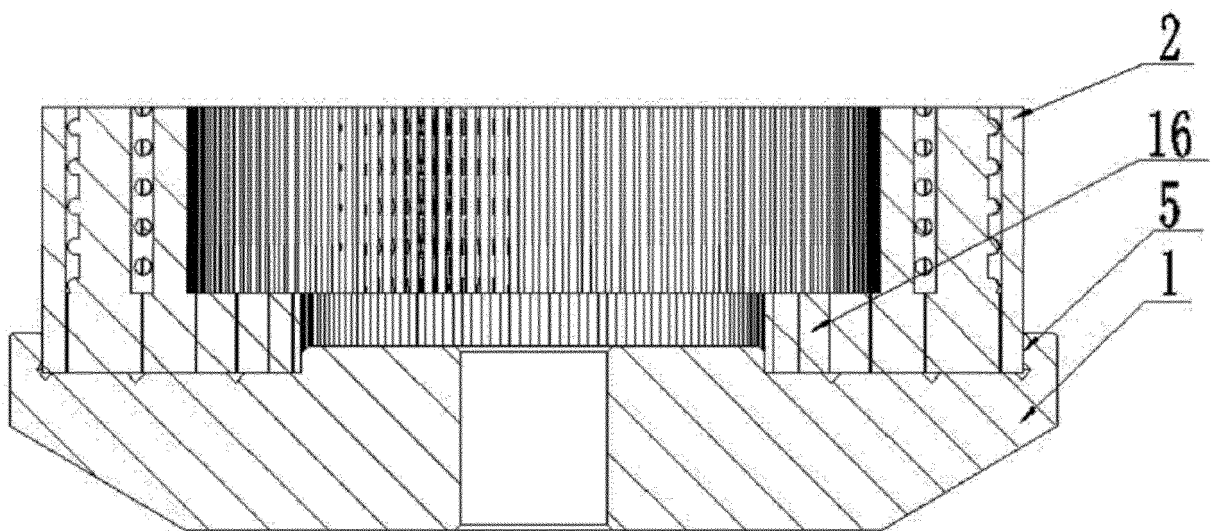


FIG. 29

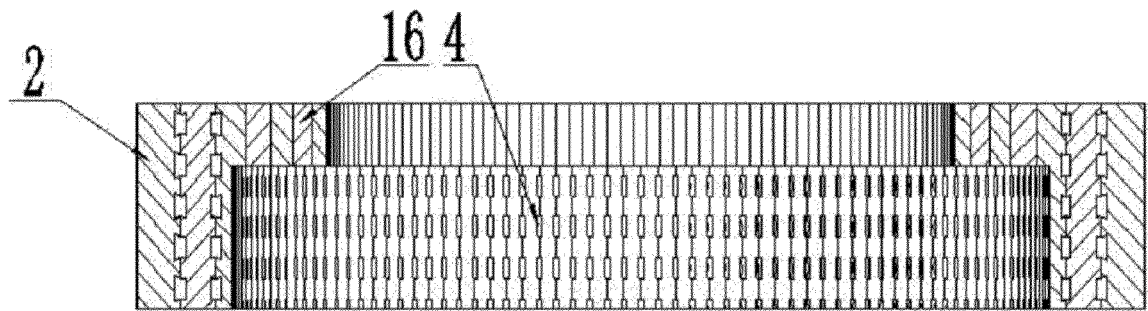


FIG. 30

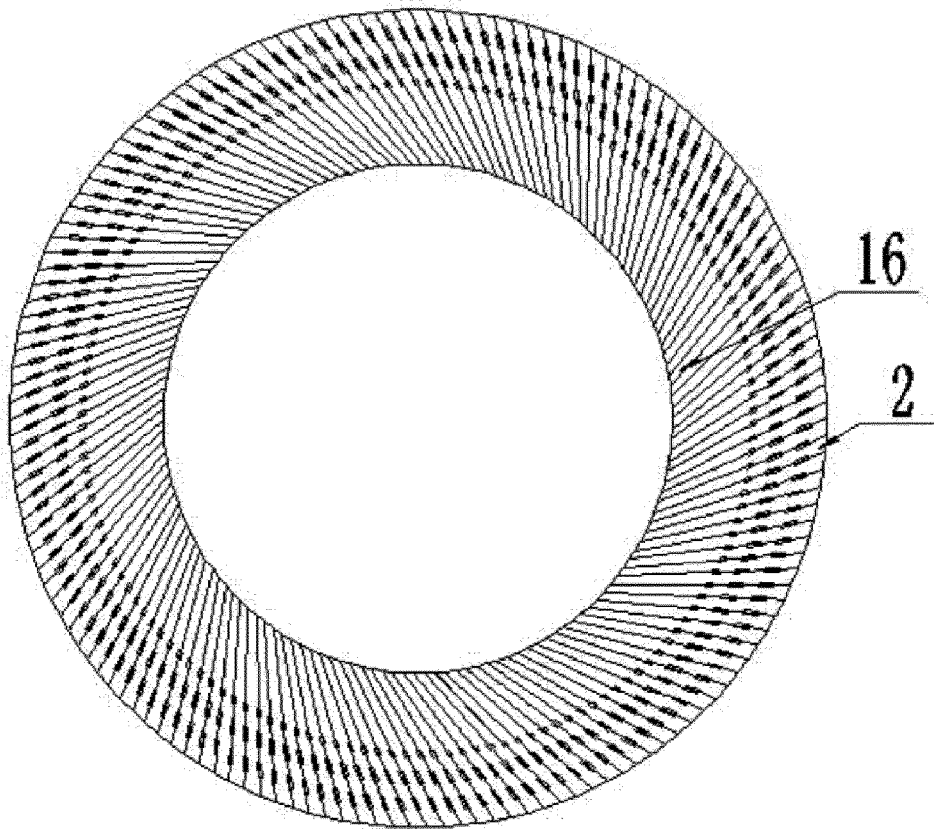


FIG. 31

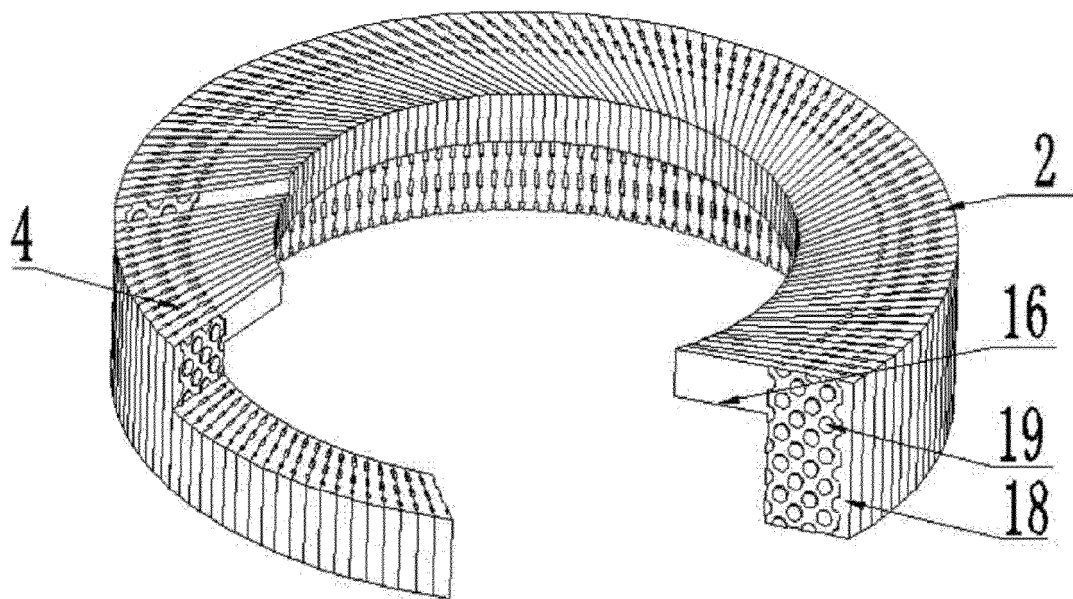


FIG. 32

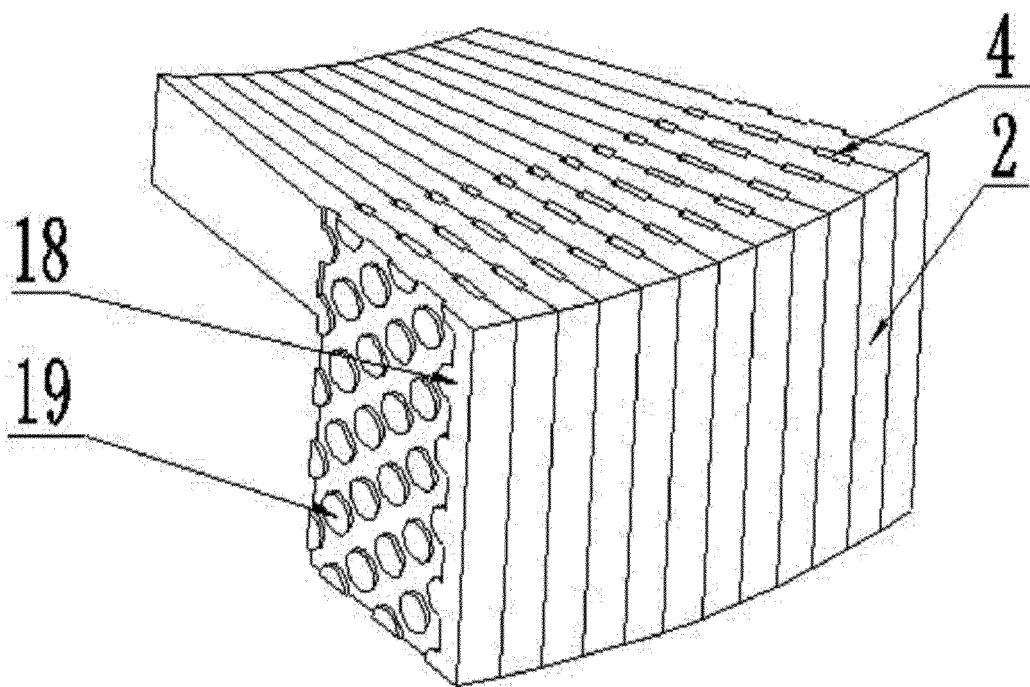


FIG. 33

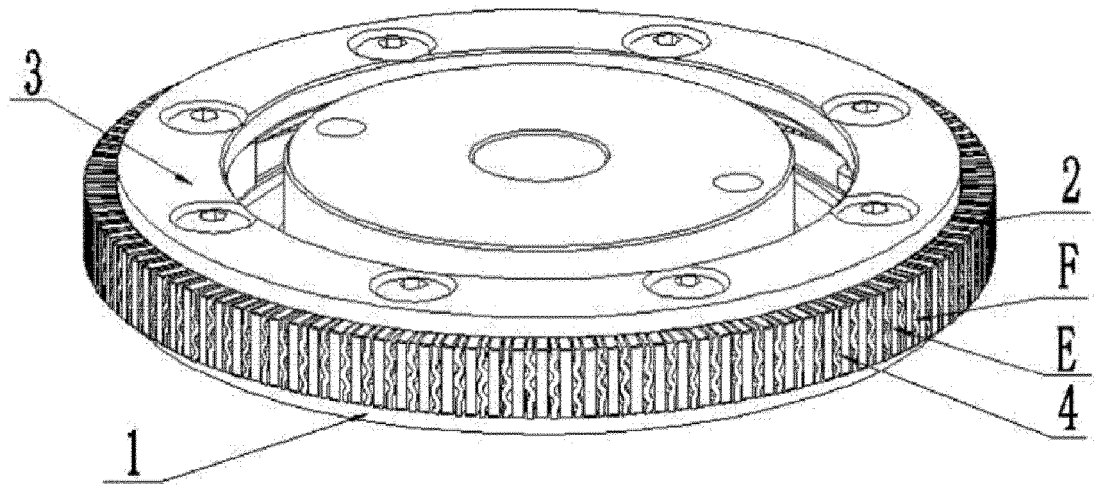


FIG. 34

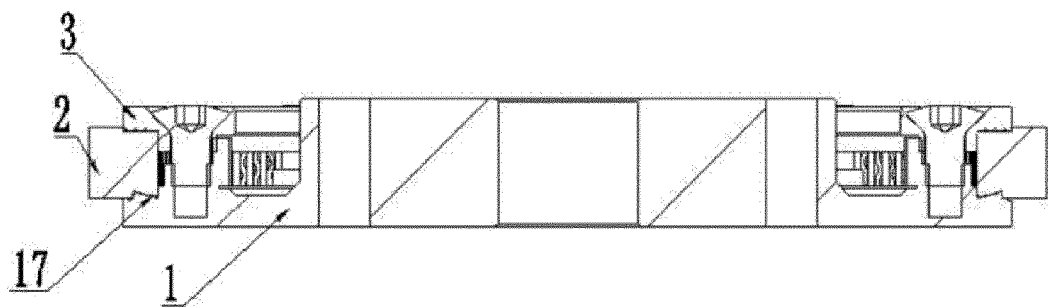


FIG. 35

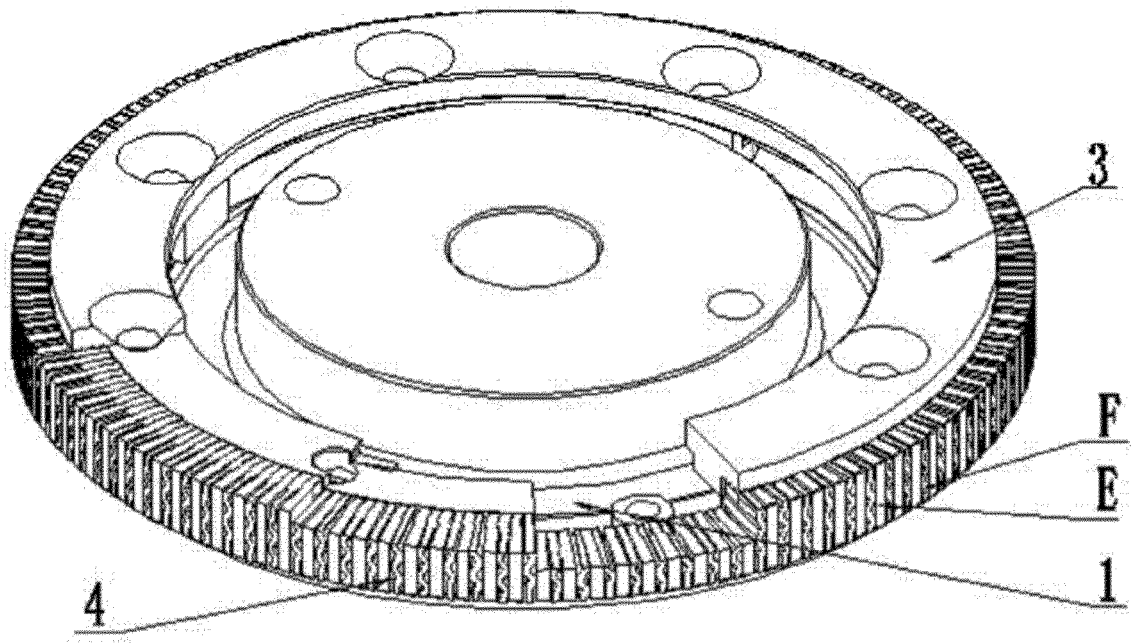


FIG. 36

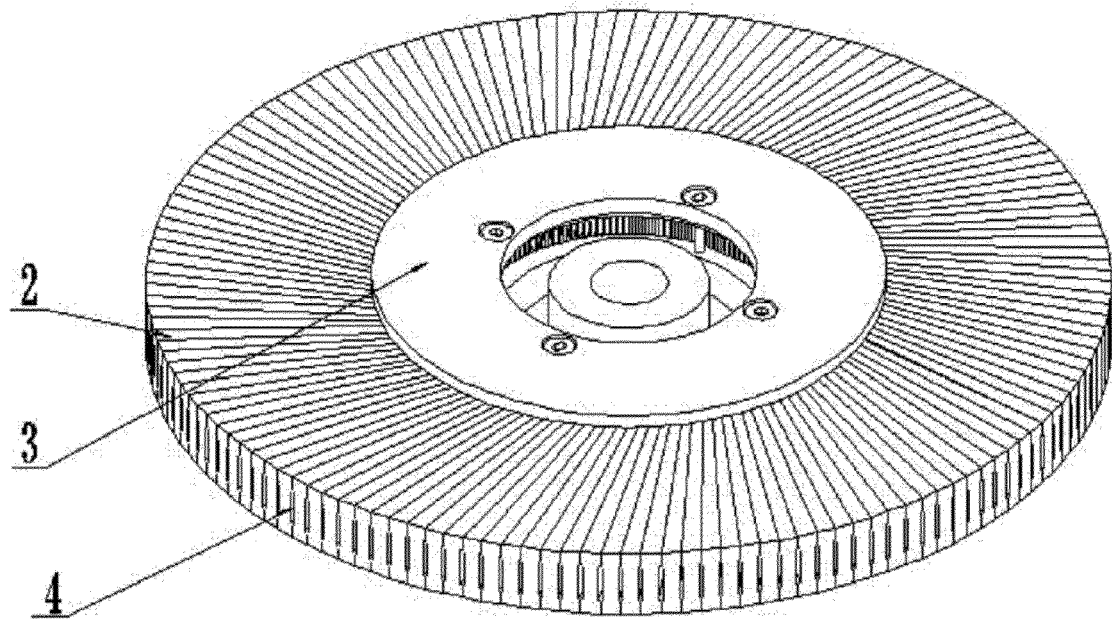


FIG. 37

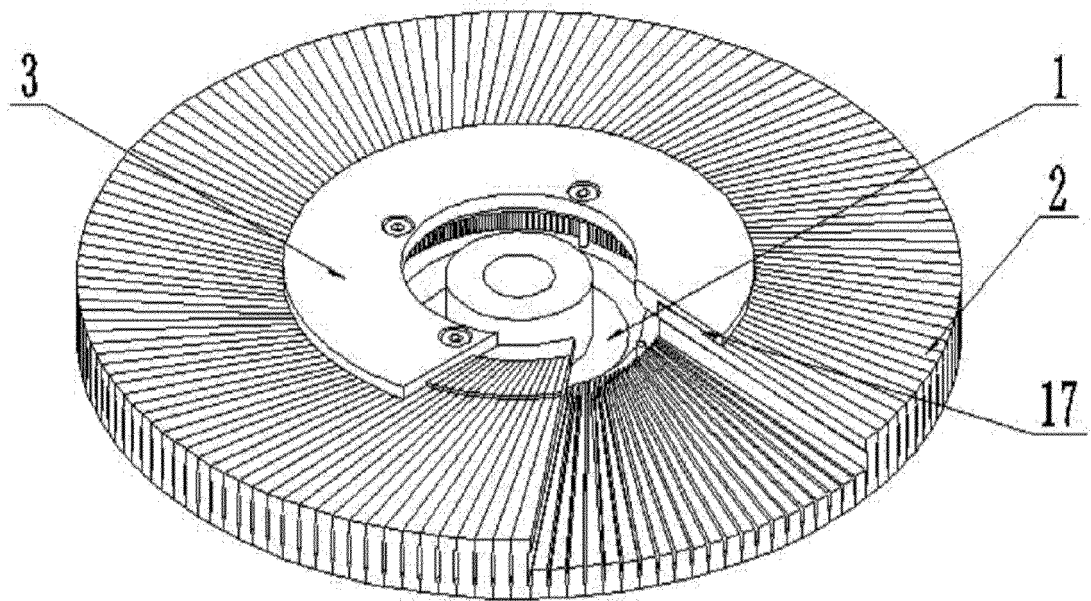


FIG. 38

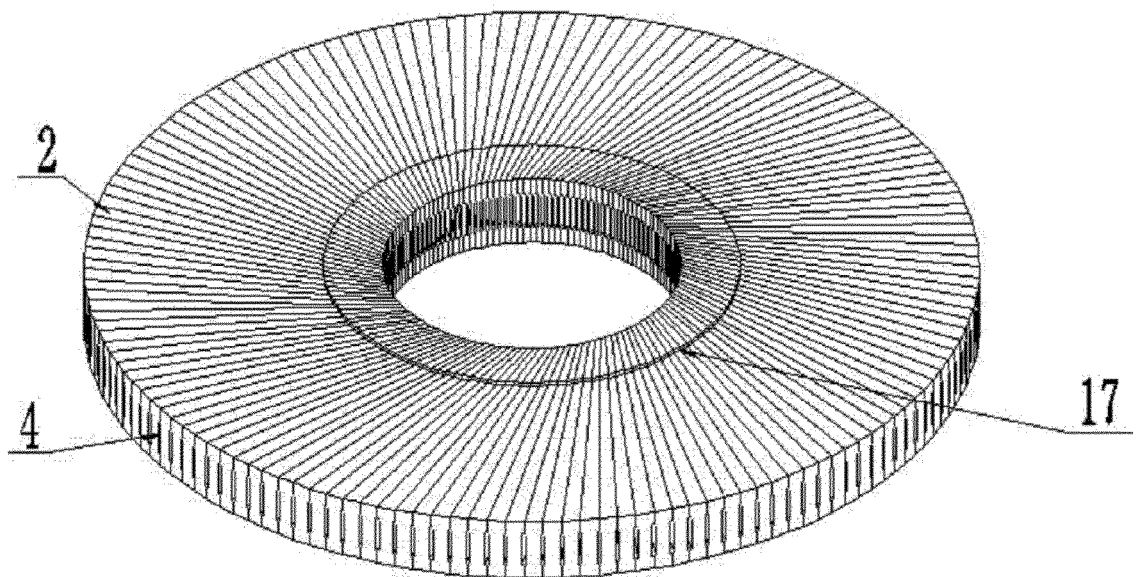


FIG. 39

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2019/077870

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) B24D		
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) CNABS, CNKI, VEN: 磨, 齿, 槽, 冷却, 交错, 交叉, grind+, teeth, sheet, groove, slot, cool+, interlace, interleave		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 108188945 A (GUILIN CHAMPION UNION DIAMOND CO., LTD.) 22 June 2018 (2018-06-22) claims 1-11	1-20
PX	CN 207629869 U (GUILIN CHAMPION UNION DIAMOND CO., LTD.) 20 July 2018 (2018-07-20) claims 1-10	1-18
X	CN 104907943 A (ZHUHAI STRENGTH DIAMOND TOOLS MANUFACTURE CO., LTD.) 16 September 2015 (2015-09-16) description, paragraphs [0003] and [0020]-[0023], and figures 2-4 and 6	1, 8, 15-18
Y	CN 104907943 A (ZHUHAI STRENGTH DIAMOND TOOLS MANUFACTURE CO., LTD.) 16 September 2015 (2015-09-16) description, paragraphs [0003] and [0020]-[0023], and figures 2-4 and 6	2, 5-7, 9-11, 19-20
Y	CN 103223647 A (GUILIN CHAMPION UNION DIAMOND CO., LTD.) 31 July 2013 (2013-07-31) description, paragraphs [0012]-[0015] and [0038]-[0042], and figures 1-3	2, 5-7, 9-11, 19-20
Y	CN 102672629 A (GUILIN CHAMPION UNION DIAMOND CO., LTD.) 19 September 2012 (2012-09-19) description, paragraphs [0012]-[0015], and figure 1	5-6, 9-11
☒ Further documents are listed in the continuation of Box C.	☒ See patent family annex.	
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Date of the actual completion of the international search 10 April 2019	Date of mailing of the international search report 26 April 2019	
Name and mailing address of the ISA/CN National Intellectual Property Administration, PRC No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.	

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/077870

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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A	JP 2000094342 A (OKAMOTO MACHINE TOOL WORKS) 04 April 2000 (2000-04-04) entire document	1-20

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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