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(54) **HIGH-SPEED CUP-SHAPED WHEEL COOLING STRUCTURE**

BECHERFÖRMIGE HOCHGESCHWINDIGKEITS-RADKÜHLSTRUKTUR

STRUCTURE DE REFROIDISSEMENT DE ROUE CUPULIFORME À GRANDE VITESSE

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(56) References cited:

CN-A- 111 438 643 CN-A- 111 958 508

CN-A- 112 828 782 CN-U- 203 738 615

CN-U- 205 588 162 DE-A1- 19 704 746

JP-A- 2018 130 791 JP-A- 2020 093 338

KR-A- 20110 060 380

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of cup-shaped wheel technologies, and in particular to a cooling structure of a high-speed cup-shaped wheel (cf. CN 205 588 162 U forming the basis for the preamble of claim 1).

BACKGROUND

[0002] A cup-shaped wheel mainly works in three major modes. In the first mode, as shown in FIG. 1 and FIG. 2, a front ring works, and this mode is characterized in that an axial height at an outer circle of a working surface of a blade ring is lower than an axial height at an inner circle of the working surface of the blade ring, and the inner circle of the working surface of the blade ring is finally in contact with a workpiece. In the second mode, as shown in FIG. 3 and FIG. 4, a back ring works, and this mode is characterized in that the axial height at the outer circle of the working surface of the blade ring is higher than the axial height at the inner circle of the working surface of the blade ring, and the outer circle of the working surface of the blade ring is finally in contact with the workpiece. In a third mode, as shown in FIG. 5, both the front ring and the back ring work, and this mode is characterized in that the axial height at the outer circle of the working surface of the blade ring is lower than the axial height at the inner circle of the working surface of the blade ring, and the inner circle of the working surface of the blade ring is finally in contact with the workpiece. After the running-in of the grinding surface of the blade ring in the three modes, with small variation in depth-of-cut and normal abrasion, an axial height difference between an outer diameter and an inner diameter of the grinding surface shows a curved surface form associated with the depth-of-cut.

[0003] In a through-blade ring-type cup-shaped grinding wheel of the prior art, two adjacent blades are spaced apart to form a water passage channel capable of delivering cooling water to a working surface, and the water passage channel has a through structure in a radial direction of a blade ring. When the cup-shaped grinding wheel rotates at a high speed, most of the cooling water entering the blade ring via an inner radial cavity will be thrown out toward the outer circle side of the blade ring via the water passage channel under a centrifugal force since the water passage channel has a through structure in the radial direction of the blade ring, such that the cooling effect on the working surface is extremely poor. Moreover, the amount of cooling water flowing along the inner circle sidewall of the blade ring to the working surface of the blade ring is very small, and the water in a bundle state is easily atomized into small water droplets by an "airflow barrier", which attenuates the cooling effect. Therefore, a region of the working surface close to the inner circle of the blade ring has no cooling water or insufficient cooling water, failing to achieve sufficient

cooling.

[0004] In an inner blade ring-type cup-shaped grinding wheel of the prior art, the outer side of a blade ring is blocked, that is, an end of a water passage channel close to an outer circle of the blade ring is blocked. When the cup-shaped grinding wheel rotates at a high speed, most of the cooling water entering an inner circle of the blade ring via an inner radial cavity will tend to gather at the end of the water passage channel close to the outer circle of the blade ring under a centrifugal force, and be thrown out from a region of the working surface close to the outer circle of the blade ring, and the region of the working surface close to the outer circle of the blade ring can be sufficiently cooled at this time. However, the region of the working surface close to the inner circle of the blade ring has no cooling water or insufficient cooling water, failing to achieve sufficient cooling.

SUMMARY

[0005] The present invention is intended to solve one of the above-mentioned technical problems in the prior art to some extent. To this end, an object of the present invention is to provide a cooling structure of a high-speed cup-shaped wheel, in order to improve the cooling efficiency and the utilization efficiency of cooling water and advantageously improve the grinding stability and grinding quality.

[0006] The technical solution for the present invention to solve the above-mentioned technical problems is as follows. A cooling structure of a high-speed cup-shaped wheel includes a base and a blade ring, wherein the blade ring is arranged on the base and is fixedly connected to the base; the blade ring is provided with a plurality of water channel groups, which is sequentially arranged at intervals in a circumferential direction of the blade ring; and each of the water channel groups includes two or more inner water channels, which are sequentially arranged at intervals in the circumferential direction of the blade ring, the width of each of the two or more inner water channels in a radial direction of the blade ring being gradually increased.

[0007] The present invention has the following beneficial effects: the cooling water flowing out of the two or more inner water channels different in width can cover the entire working surface, thereby improving the cooling efficiency for the working surface and avoiding the failure of sufficient cooling on some regions of the working surface; the cooling water covers the entire working surface, such that the utilization efficiency of the cooling water can be effectively improved; the influences from machining parameters can also be reduced to advantageously improve the grinding stability and grinding quality; and the cooling water covering the entire working surface can also allow the cup-shaped wheel to adapt to high-speed grinding.

[0008] On the basis of the above-mentioned technical

solution, the present invention can implement further improvements as described below.

[0009] Further, a number of the inner water channels in each of the water channel groups has a directly proportional relationship with a depth-of-cut of the blade ring.

[0010] The beneficial effect of adopting the above-mentioned further solution is that, with more inner water channels in each water channel group, the outflow uniformity of the cooling water is improved to ensure that the cooling water completely covers the entire working surface, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0011] Further, a width difference between two adjacent inner water channels in each of the water channel groups in the radial direction of the blade ring has an inversely proportional relationship with the number of the inner water channels.

[0012] The beneficial effect of adopting the above-mentioned further solution is that when the cooling water is allowed to flow through the two or more inner water channels, the outer or inner circle edge of the blade ring can be covered with the cooling water to ensure that the cooling water completely covers the entire working surface, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0013] Further, the larger the width of each of the inner water channels in each of the water channel groups in the radial direction of the blade ring, the larger a circumferential spacing between the inner water channel and the adjacent inner water channel thereof.

[0014] The beneficial effect of adopting the above-mentioned further solution is that with larger circumferential spacing between adjacent inner water channels, the strength of the working surface corresponding to a region between two adjacent inner water channels is ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0015] Further, a spacing between the inner water channel, having a maximum width in the radial direction of the blade ring, in each of the water channel groups and the adjacent inner water channel thereof is $W1$; a spacing between the inner water channel, having a minimum width in the radial direction of the blade ring, in the water channel group and the adjacent inner water channel thereof is $W2$; a spacing between the inner water channel, having the minimum width in the radial direction of the blade ring, in the water channel group and the inner water channel, having the maximum width in the radial direction of the blade ring, in the adjacent water channel group thereof is $W3$; and $W1 > W3 > W2$.

[0016] The beneficial effect of adopting the above-mentioned further solution is that ensuring the strength of the working surface corresponding to the region between two adjacent inner water channels can further ensure the strength of the working surface corresponding to a region between two adjacent water channel groups,

such that the cup-shaped wheel can adapt to high-speed grinding.

[0017] Further, a cooling coverage area between the inner water channel, having the maximum width in the radial direction of the blade ring, in each of the water channel groups and the adjacent inner water channel thereof is $S1$; a cooling coverage area between the inner water channel, having the minimum width in the radial direction of the blade ring, in the water channel group and the adjacent inner water channel thereof is $S2$; a cooling coverage area between the inner water channel, having the minimum width in the radial direction of the blade ring, in the water channel group and the inner water channel, having the maximum width in the radial direction of the blade ring, in the adjacent water channel group thereof is $S3$; and $S1 > S3 > S2$.

[0018] The beneficial effect of adopting the above-mentioned further solution is that ensuring the strength of the working surface corresponding to the region between two adjacent inner water channels can further ensure the strength of the working surface corresponding to a region between two adjacent water channel groups, such that the cup-shaped wheel can adapt to high-speed grinding.

[0019] Further, the inner water channel, having the maximum width in the radial direction of the blade ring, in each of the water channel groups is close to an outer circle edge of the blade ring.

[0020] The beneficial effect of adopting the above-mentioned further solution is that the cooling water flowing out of the inner water channel having the maximum width in the radial direction of the blade ring can cover the outer circle edge of the blade ring to improve the cooling efficiency.

[0021] Further, the two or more inner water channels each have a roundabout structure, and an axis of each of the two or more inner water channels deviates from a circle center of the blade ring.

[0022] Further, each of the water channel groups includes a water passage channel, which is arranged at a side of the inner water channel, having the largest length in the radial direction of the blade ring, in the water channel group.

[0023] The beneficial effect of adopting the above-mentioned further solution is that the cooling water is thrown out via the water passage channels towards the outer circle of the blade ring, in order to cover the outer circle region of the blade ring, thereby improving the cooling efficiency of the blade ring.

[0024] Further, the water passage channel has a roundabout structure, and has an axis deviating from the circle center of the blade ring.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a first schematic implementation diagram of

a cup-shaped wheel in the prior art in a mode where a front ring works;

FIG. 2 is a second schematic implementation diagram of the cup-shaped wheel in the prior art in a mode where the front ring works;

FIG. 3 is a first schematic implementation diagram of the cup-shaped wheel in the prior art in a mode where a back ring works;

FIG. 4 is a second schematic implementation diagram of the cup-shaped wheel in the prior art in a mode where the back ring works;

FIG. 5 is a schematic implementation diagram of the cup-shaped wheel of the prior art in a mode where both the front ring and the back ring work;

FIG. 6 is a front view of a cup-shaped wheel with respect to Embodiment 1 according to the present invention;

FIG. 7 is a schematic enlarged view of Part A in FIG. 6;

FIG. 8 is a front view of a cup-shaped wheel with respect to Embodiment 2 according to the present invention; and

FIG. 9 is a schematic enlarged view of Part B in FIG. 8.

[0026] In the accompanying drawings, components represented by respective reference numerals are listed below:

- 1, base;
- 2, blade ring; 2.1, working surface;
- 3, water channel group; 3.1, inner water channel;
- 3.2, water passage channel; and
- 4, workpiece.

DETAILED DESCRIPTION

[0027] The principles and features of the present invention will be described below in conjunction with the accompanying drawings. The examples are only used to explain the present invention only, and are not intended to limit the scope of the present invention.

Embodiment 1:

[0028] As shown in FIG. 6 and FIG. 7, a cooling structure of a high-speed cup-shaped wheel includes a base 1 and a blade ring 2. The blade ring 2 is arranged on the base 1 and fixedly connected to the base 1. The blade ring 2 is provided with a plurality of water channel groups 3, which is sequentially arranged at intervals in a circumferential direction of the blade ring 2.

[0029] Each of the water channel groups 3 includes two or more inner water channels 3.1, which are sequentially arranged at intervals in the circumferential direction of the blade ring 2. The width of each of the two or more inner water channels 3.1 in a radial direction of the blade ring 2 is gradually increased.

[0030] Cooling water is introduced at the center of the base 1 and enters the inner water channels 3.1. Under the action of a centrifugal force, the cooling water flows from the end of each inner water channel 3.1 close to the inner circle of the blade ring 2 to the end of the inner water channel 3.1 close to the outer circle of the blade ring 2. Because the end of the inner water channel 3.1 close to the outer circle of the blade ring 2 is blocked, the cooling water flows out to a working surface 2.1 of the blade ring 2, and flows on the working surface 2.1 along a tangential direction of the inner water channel 3.1, such that the cooling water cools a partial region of the working surface 2.1.

[0031] The width of each of the two or more inner water channels 3.1 in the radial direction of the blade ring 2 increases gradually, and the cooling water flowing out of the inner water channels 3.1 different in width can cover the entire working surface 2.1, thereby improving the cooling efficiency for the working surface 2.1 and avoiding the failure of sufficient cooling on some regions of the working surface 2.1; the cooling water covers the entire working surface 2.1, such that the utilization efficiency of the cooling water can be effectively improved; the influences from machining parameters can also be reduced to advantageously improve the grinding stability and grinding quality; and the cooling water covering the entire working surface 2.1 can also allow the cup-shaped wheel to adapt to high-speed grinding.

[0032] One end of the inner water channel 3.1 is communicated to the inner circle of the blade ring 2, and the other end of the inner water channel 3.1 is close to the outer circle of the blade ring 2 and is blocked. The cooling structure is simple and is convenient to machine, and the cost can be effectively reduced.

[0033] In the above-mentioned embodiment, the number of the inner water channels 3.1 in each of the water channel groups 3 has a directly proportional relationship with a depth-of-cut of the blade ring 2.

[0034] That is, the larger the depth-of-cut of the blade ring 2 of the cup-shaped wheel, the more the inner water channels 3.1 in each of the water channel groups 3, such that the outflow uniformity of the cooling water is improved to ensure that the cooling water completely covers the entire working surface 2.1, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0035] In the above-mentioned embodiment, a width difference between two adjacent inner water channels 3.1 in each of the water channel groups 3 in the radial direction of the blade ring 2 has an inversely proportional relationship with the number of the inner water channels 3.1.

[0036] That is, when the depth-of-cut of the blade ring 2 of the cup-shaped wheel becomes larger, the more the inner water channels 3.1 in each of the water channel groups 3, the smaller the width difference, in the radial direction of the blade ring 2, between two adjacent inner

water channels 3.1. However, the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in each of the water channel groups 3 is smaller. That is, the width of each inner water channel 3.1 in the radial direction of the blade ring 2 decreases with the increase of the depth-of-cut of the blade ring 2.

[0037] When the cooling water is allowed to flow through two or more inner water channels 3.1, the outer or inner circle edge of the blade ring 2 can be covered with the cooling water to ensure that the cooling water completely covers the entire working surface 2.1, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0038] In the above-mentioned embodiment, the larger the width of each of the inner water channels 3.1 in each of the water channel groups 3 in the radial direction of the blade ring 2, the larger a circumferential spacing between the inner water channel and the adjacent inner water channel 3.1 thereof.

[0039] With a larger circumferential spacing between adjacent inner water channels 3.1, the strength of the working surface 2.1 corresponding to the region between the two adjacent inner water channels 3.1 is ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0040] In the above-mentioned embodiment, a spacing between the inner water channel 3.1, having a maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 and the adjacent inner water channel 3.1 thereof is W1; a spacing between the inner water channel 3.1, having a minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the adjacent inner water channel 3.1 thereof is W2; a spacing between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in the adjacent water channel group 3 thereof is W3; and $W1 > W3 > W2$.

[0041] W1 is also a circumferential distance between the inner water channel 3.1 having the maximum width in the radial direction of the blade ring 2 and the adjacent inner water channel 3.1 thereof; W2 is also a circumferential distance between the inner water channel 3.1 having the minimum width in the radial direction of the blade ring 2 and the adjacent inner water channel 3.1; and W3 is also a circumferential distance between the inner water channel 3.1 having the minimum width in the radial direction of the blade ring 2 and the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in the adjacent water channel group 3.

[0042] By setting $W1 > W3 > W2$, the strength of the working surface 2.1 corresponding to a region between the two adjacent inner water channels 3.1 is ensured, and the strength of the working surface 2.1 corresponding to a

region between the two adjacent channel groups 3 is also ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0043] In the above-mentioned embodiment, a cooling coverage area between the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 and the adjacent inner water channel 3.1 thereof is S1; a cooling coverage area between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the adjacent inner water channel 3.1 thereof is S2; a cooling coverage area between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in the adjacent water channel group 3 thereof is S3; and $S1 > S3 > S2$.

[0044] By setting $S1 > S3 > S2$, the strength of the working surface 2.1 corresponding to the region between the two adjacent inner water channels 3.1 is ensured, and the strength of the working surface 2.1 corresponding to the region between the two adjacent channel groups 3 is also ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0045] In the above-mentioned embodiment, the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 is close to an outer circle edge of the blade ring 2.

[0046] The end of the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, close to the outer circle edge of the blade ring 2 is infinitely close to the outer circle edge of the blade ring 2 to allow that a spacing between the inner water channel 3.1 and the outer circle edge of the blade ring 2 is infinitely close to zero, such that the cooling water flowing out from the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, can cover the outer circle edge of the blade ring 2, thereby improving the cooling efficiency.

[0047] In the above-mentioned embodiment, the two or more inner water channels 3.1 each have a roundabout structure, and an axis of each of the two or more inner water channels 3.1 deviates from a circle center of the blade ring 2.

[0048] As shown in FIG. 6, when the cooling structure of the high-speed cup-shaped wheel in this embodiment rotates counterclockwise, the strength of the blade ring 2 can be improved favorably; and when the cooling structure of the high-speed cup-shaped wheel rotates clockwise, the utilization ratio of the cooling water can be increased favorably.

Embodiment 2:

[0049] As shown in FIG. 8 and FIG. 9, a cooling structure of a high-speed cup-shaped wheel includes a base 1

and a blade ring 2. The blade ring 2 is arranged on the base 1 and fixedly connected to the base 1. The blade ring 2 is provided with a plurality of water channel groups 3, which is sequentially arranged at intervals in a circumferential direction of the blade ring 2.

[0050] Each of the water channel groups 3 includes two or more inner water channels 3.1, which are sequentially arranged at intervals in the circumferential direction of the blade ring 2. The width of each of the two or more inner water channels 3.1 in a radial direction of the blade ring 2 is gradually increased.

[0051] Cooling water is introduced at the center of the base 1 and enters the inner water channels 3.1. Under the action of a centrifugal force, the cooling water flows from the end of each inner water channel 3.1 close to the inner circle of the blade ring 2 to the end of the inner water channel 3.1 close to the outer circle of the blade ring 2. Because the end of the inner water channel 3.1 close to the outer circle of the blade ring 2 is blocked, the cooling water flows out to a working surface 2.1 of the blade ring 2, and flows on the working surface 2.1 along a tangential direction of the inner water channel 3.1, such that the cooling water cools a partial region on the working surface 2.1.

[0052] The width of each of the two or more inner water channels 3.1 in the radial direction of the blade ring 2 increases gradually, and the cooling water flowing out of the inner water channels 3.1 different in width can cover the entire working surface 2.1, thereby improving the cooling efficiency for the working surface 2.1 and avoiding the failure of sufficient cooling on some regions of the working surface 2.1; the cooling water covers the entire working surface 2.1, such that the utilization efficiency of the cooling water can be effectively improved; the influences from machining parameters can also be reduced to advantageously improve the grinding stability and grinding quality; and the cooling water covering the entire working surface 2.1 can also allow the cup-shaped wheel to adapt to high-speed grinding.

[0053] One end of the inner water channel 3.1 is communicated to the inner circle of the blade ring 2, and the other end of the inner water channel 3.1 is close to the outer circle of the blade ring 2 and is blocked. The cooling structure is simple and is convenient to machine, and the cost can be effectively reduced.

[0054] In the above-mentioned embodiment, the number of the inner water channels 3.1 in each of the water channel groups 3 has a directly proportional relationship with a depth-of-cut of the blade ring 2.

[0055] That is, the larger the depth-of-cut of the blade ring 2 of the cup-shaped wheel, the more the inner water channels 3.1 in each of the water channel groups 3, such that the outflow uniformity of the cooling water is improved to ensure that the cooling water completely covers the entire working surface 2.1, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0056] In the above-mentioned embodiment, a width difference between two adjacent inner water channels 3.1 in each of the water channel groups 3 in the radial direction of the blade ring 2 has an inversely proportional relationship with the number of the inner water channels 3.1.

[0057] That is, when the depth-of-cut of the blade ring 2 of the cup-shaped wheel becomes larger, the more the inner water channels 3.1 in each of the water channel groups 3, the smaller the width difference, in the radial direction of the blade ring 2, between two adjacent inner water channels 3.1. However, the width of the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in each of the water channel groups 3 is smaller. That is, the width of each inner water channel 3.1 in the radial direction of the blade ring 2 decreases with the increase of the depth-of-cut of the blade ring 2.

[0058] When the cooling water is allowed to flow through two or more inner water channels 3.1, the outer or inner circle edge of the blade ring 2 can be covered with the cooling water to ensure that the cooling water completely covers the entire working surface 2.1, thereby meeting the requirement of the cup-shaped wheel for high-speed machining and improving the cooling efficiency and cooling completeness.

[0059] In the above-mentioned embodiment, the larger the width of each of the inner water channels 3.1 in each of the water channel groups 3 in the radial direction of the blade ring 2, the larger a circumferential spacing between the inner water channel and the adjacent inner water channel 3.1 thereof.

[0060] With a larger circumferential spacing between adjacent inner water channels 3.1, the strength of the working surface 2.1 corresponding to a region between the two adjacent inner water channels 3.1 is ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0061] In the above-mentioned embodiment, a spacing between the inner water channel 3.1, having a maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 and the adjacent inner water channel 3.1 thereof is $W1$; a spacing between the inner water channel 3.1, having a minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the adjacent inner water channel 3.1 thereof is $W2$; a spacing between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in the adjacent water channel group 3 thereof is $W3$; and $W1 > W3 > W2$.

[0062] By setting $W1 > W3 > W2$, the strength of the working surface 2.1 corresponding to the region between the two adjacent inner water channels 3.1 is ensured, and the strength of the working surface 2.1 corresponding to the region between the two adjacent channel groups 3 is

also ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0063] In the above-mentioned embodiment, a cooling coverage area between the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 and the adjacent inner water channel 3.1 thereof is S1; a cooling coverage area between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the adjacent inner water channel 3.1 thereof is S2; a cooling coverage area between the inner water channel 3.1, having the minimum width in the radial direction of the blade ring 2, in the water channel group 3 and the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in the adjacent water channel group 3 thereof is S3; and $S1 > S3 > S2$.

[0064] By setting $S1 > S3 > S2$, the strength of the working surface 2.1 corresponding to the region between the two adjacent inner water channels 3.1 is ensured, and the strength of the working surface 2.1 corresponding to the region between the two adjacent channel groups 3 is also ensured, such that the cup-shaped wheel can adapt to high-speed grinding.

[0065] In the above-mentioned embodiment, the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, in each of the water channel groups 3 is close to an outer circle edge of the blade ring 2.

[0066] The end of the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, close to the outer circle edge of the blade ring 2 is infinitely close to the outer circle edge of the blade ring 2 to allow that a spacing between the inner water channel 3.1 and the outer circle edge of the blade ring 2 is infinitely close to zero, such that the cooling water flowing out from the inner water channel 3.1, having the maximum width in the radial direction of the blade ring 2, can cover the outer circle edge of the blade ring 2, thereby improving the cooling efficiency.

[0067] In the above-mentioned embodiment, each of the water channel groups 3 includes a water passage channel 3.2, which is arranged at a side of the inner water channel 3.1, having the largest length in the radial direction of the blade ring 2, in the water channel group 3.

[0068] The cooling water is introduced at the center of the base 1 and enters the water passage channels 3.2. Under the action of a centrifugal force, the cooling water is thrown out towards the outer circle side of the blade ring 2 to cover the outer circle region of the blade ring 2, thereby improving the cooling efficiency of the blade ring 2.

[0069] In the above-mentioned embodiment, the two or more inner water channels 3.1 each have a roundabout structure, and an axis of each of the two or more inner water channels 3.1 deviates from a circle center of the blade ring 2; and the water passage channel 3.2 has a roundabout structure, and has an axis deviating from the

circle center of the blade ring 2.

[0070] The two or more inner water channels 3.1 and the water passage channels 3.2 each have a roundabout structure, and an axis of each of the two or more inner water channels 3.1 and the water passage channels 3.2 deviates from the circle center of the blade ring 2.

[0071] Described above are merely preferred embodiments of the present invention, which are not intended to limit the present invention. The scope of protection is determined by the appended claims.

Claims

1. A cooling structure of a high-speed cup-shaped wheel, comprising a base (1) and a blade ring (2), the blade ring (2) being arranged on the base (1) and fixedly connected to the base (1), wherein the blade ring (2) is provided with a plurality of water channel groups (3), which is sequentially arranged at intervals in a circumferential direction of the blade ring (2); and **characterised in that** each of the water channel groups (3) comprises two or more inner water channels (3.1), which are sequentially arranged at intervals in the circumferential direction of the blade ring (2), the width of each of the two or more inner water channels (3.1) in a radial direction of the blade ring (2) being gradually increased.
2. The cooling structure of the high-speed cup-shaped wheel according to claim 1, wherein a number of the inner water channels (3.1) in each of the water channel groups (3) has a directly proportional relationship with a depth-of-cut of the blade ring (2).
3. The cooling structure of the high-speed cup-shaped wheel according to claim 2, wherein a width difference between two adjacent inner water channels (3.1) in each of the water channel groups (3) in the radial direction of the blade ring (2) has an inversely proportional relationship with the number of the inner water channels (3.1).
4. The cooling structure of the high-speed cup-shaped wheel according to claim 3, wherein the larger the width of each of the inner water channels (3.1) in each of the water channel groups (3) in the radial direction of the blade ring (2), the larger a circumferential spacing between the inner water channel (3.1) and the adjacent inner water channel (3.1) thereof.
5. The cooling structure of the high-speed cup-shaped wheel according to claim 4, wherein a spacing between the inner water channel (3.1), having a maximum width in the radial direction of the blade ring (2), in each of the water channel groups (3) and the adjacent inner water channel (3.1) thereof is W1; a spacing between the inner water channel (3.1), hav-

ing a minimum width in the radial direction of the blade ring (2), in the water channel group (3) and the adjacent inner water channel (3.1) thereof is W_2 ; a spacing between the inner water channel (3.1), having the minimum width in the radial direction of the blade ring (2), in the water channel group (3) and the inner water channel (3.1), having the maximum width in the radial direction of the blade ring (2), in the adjacent water channel group (3) thereof is W_3 ; and $W_1 > W_3 > W_2$.

6. The cooling structure of the high-speed cup-shaped wheel according to claim 4, wherein a cooling coverage area between the inner water channel (3.1), having the maximum width in the radial direction of the blade ring (2), in each of the water channel groups (3) and the adjacent inner water channel (3.1) thereof is S_1 ; a cooling coverage area between the inner water channel (3.1), having the minimum width in the radial direction of the blade ring (2), in the water channel group (3) and the adjacent inner water channel (3.1) thereof is S_2 ; a cooling coverage area between the inner water channel (3.1), having the minimum width in the radial direction of the blade ring (2), in the water channel group (3) and the inner water channel (3.1), having the maximum width in the radial direction of the blade ring (2), in the adjacent water channel group (3) thereof is S_3 ; and $S_1 > S_3 > S_2$.
7. The cooling structure of the high-speed cup-shaped wheel according to claim 1, wherein the inner water channel (3.1), having the maximum width in the radial direction of the blade ring (2), in each of the water channel groups (3) is close to an outer circle edge of the blade ring (2).
8. The cooling structure of the high-speed cup-shaped wheel according to claim 1, wherein the two or more inner water channels (3.1) each have a roundabout structure, and an axis of each of the two or more inner water channels (3.1) deviates from a circle center of the blade ring (2).
9. The cooling structure of the high-speed cup-shaped wheel according to any one of claims 1 to 8, wherein each of the water channel groups (3) comprises a water passage channel (3.2), which is arranged at a side of the inner water channel (3.1), having the largest length in the radial direction of the blade ring (2), in the water channel group (3).
10. The cooling structure of the high-speed cup-shaped wheel according to claim 9, wherein the water passage channel (3.2) has a roundabout structure, and has an axis deviating from the circle center of the blade ring (2).

Patentansprüche

1. Kühlstruktur eines Hochgeschwindigkeits-Schalenrades, umfassend eine Basis (1) und einen Schaufelkranz (2), wobei der Schaufelkranz (2) auf der Basis (1) angeordnet und fest mit der Basis (1) verbunden ist,

wobei der Schaufelkranz (2) mit einer Vielzahl von Wasserkanalgruppen (3) versehen ist, die in Umfangsrichtung des Schaufelkranzes (2) nacheinander in Abständen angeordnet sind; und **dadurch gekennzeichnet, dass** jede der Wasserkanalgruppen (3) zwei oder mehr innere Wasserkanäle (3.1) umfasst, die in Umfangsrichtung des Schaufelkranzes (2) nacheinander in Abständen angeordnet sind, wobei die Breite jedes der zwei oder mehr inneren Wasserkanäle (3.1) in einer radialen Richtung des Schaufelkranzes (2) allmählich zunimmt.
2. Die Kühlstruktur des Hochgeschwindigkeits-Schalenrades gemäß Anspruch 1, wobei eine Anzahl der inneren Wasserkanäle (3.1) in jeder der Wasserkanalgruppen (3) in einer direkt proportionalen Beziehung zu einer Schnitttiefe des Schaufelrings (2) steht.
3. Die Kühlstruktur des Hochgeschwindigkeits-Schalenrades gemäß Anspruch 2, wobei ein Breitenunterschied zwischen zwei benachbarten inneren Wasserkanälen (3.1) in jeder der Wasserkanalgruppen (3) in radialer Richtung des Schaufelkranzes (2) in umgekehrt proportionaler Beziehung zur Anzahl der inneren Wasserkanäle (3.1) steht.
4. Kühlstruktur des Hochgeschwindigkeits-Schalenrades nach Anspruch 3, wobei der Umfangsabstand zwischen dem inneren Wasserkanal (3.1) und dem benachbarten inneren Wasserkanal (3.1) umso größer ist, je größer die Breite jedes der inneren Wasserkanäle (3.1) in jeder der Wasserkanalgruppen (3) in radialer Richtung des Schaufelkranzes (2) ist.
5. Kühlstruktur des Hochgeschwindigkeits-Schalenrades nach Anspruch 4, wobei ein Abstand zwischen dem inneren Wasserkanal (3.1), der eine maximale Breite in radialer Richtung des Schaufelkranzes (2) aufweist, in jeder der Wasserkanalgruppen (3) und dem benachbarten inneren Wasserkanal (3.1) davon W_1 ist; ein Abstand zwischen dem inneren Wasserkanal (3.1), der eine minimale Breite in radialer Richtung des Schaufelkranzes (2) aufweist, in der Wasserkanalgruppe (3) und dem benachbarten inneren Wasser-

kanal (3.1) davon W2 ist; ein Abstand zwischen dem inneren Wasserkanal (3.1), der die minimale Breite in radialer Richtung des Schaufelkranzes (2) aufweist, in der Wasserkanalgruppe (3) und dem inneren Wasserkanal (3.1), der die maximale Breite in radialer Richtung des Schaufelkranzes (2) aufweist, in der benachbarten Wasserkanalgruppe (3) davon W3 ist; und $W1 > W3 > W2$.

6. Kühlstruktur des Hochgeschwindigkeits-Schalens nach Anspruch 4, wobei eine Kühlabdeckungsfläche zwischen dem inneren Wasserkanal (3.1), der die maximale Breite in der radialen Richtung des Schaufelkranzes (2) aufweist, in jeder der Wasserkanalgruppen (3) und dem benachbarten inneren Wasserkanal (3.1) davon S1 ist; eine Kühlabdeckungsfläche zwischen dem inneren Wasserkanal (3.1), der die minimale Breite in der radialen Richtung des Schaufelkranzes (2) aufweist, in der Wasserkanalgruppe (3) und dem benachbarten inneren Wasserkanal (3.1) davon S2 ist; eine Kühlabdeckungsfläche zwischen dem inneren Wasserkanal (3.1), der die minimale Breite in der radialen Richtung des Schaufelkranzes (2) aufweist, in der Wasserkanalgruppe (3) und dem inneren Wasserkanal (3.1), der die maximale Breite in der radialen Richtung des Schaufelkranzes (2) aufweist, in der benachbarten Wasserkanalgruppe (3) davon S3 ist; und $S1 > S3 > S2$. 10
7. Kühlstruktur des Hochgeschwindigkeits-Schalens nach Anspruch 1, wobei der innere Wasserkanal (3.1), der die maximale Breite in radialer Richtung des Schaufelkranzes (2) aufweist, in jeder der Wasserkanalgruppen (3) nahe an einer äußeren Kreiskante des Schaufelkranzes (2) liegt. 15
8. Die Kühlstruktur des Hochgeschwindigkeits-Schalens gemäß Anspruch 1, wobei die zwei oder mehr inneren Wasserkanäle (3.1) jeweils eine Kreisstruktur aufweisen und eine Achse jedes der zwei oder mehr inneren Wasserkanäle (3.1) von einem Kreismittelpunkt des Schaufelkranzes (2) abweicht. 20
9. Kühlstruktur des Hochgeschwindigkeits-Schalens nach einem der Ansprüche 1 bis 8, wobei jede der Wasserkanalgruppen (3) einen Wasserdurchgangskanal (3.2) umfasst, der an einer Seite des inneren Wasserkanals (3.1) angeordnet ist, der in radialer Richtung des Schaufelkranzes (2) die größte Länge aufweist, in der Wasserkanalgruppe (3). 25
10. Kühlstruktur eines Hochgeschwindigkeits-Schalens nach Anspruch 9, wobei der Wasserdurchgangskanal (3.2) eine kreisförmige Struktur aufweist und eine vom Kreismittelpunkt des Schaufelkranzes 30

(2) abweichende Achse hat.

Revendications

1. Structure de refroidissement d'une roue en forme de coupelle à grande vitesse, comprenant une base (1) et un anneau de lame (2), l'anneau de lame (2) étant disposé sur la base (1) et relié de manière fixe à la base (1), 5

dans lequel l'anneau de lame (2) est pourvu d'une pluralité de groupes de canaux d'eau (3), qui est disposé séquentiellement à intervalles dans une direction circonférentielle de l'anneau de lame (2) ; et **caractérisé par le fait que** chacun des groupes de canaux d'eau (3) comprend deux ou plusieurs canaux d'eau internes (3.1), qui sont disposés séquentiellement à intervalles dans la direction circonférentielle de l'anneau de lame (2), la largeur de chacun des deux ou plusieurs canaux d'eau internes (3.1) dans une direction radiale de l'anneau de lame (2) augmentant progressivement. 10

2. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 1, dans laquelle un certain nombre de canaux d'eau internes (3.1) dans chacun des groupes de canaux d'eau (3) a une relation directement proportionnelle avec une profondeur de coupe de l'anneau de lame (2). 15

3. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 2, dans laquelle une différence de largeur entre deux canaux d'eau intérieurs adjacents (3.1) dans chacun des groupes de canaux d'eau (3) dans la direction radiale de l'anneau de lame (2) a une relation inversement proportionnelle au nombre de canaux d'eau intérieurs (3.1). 20

4. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 3, dans laquelle plus la largeur de chacun des canaux d'eau internes (3.1) dans chacun des groupes de canaux d'eau (3) est grande dans la direction radiale de l'anneau de lame (2), plus l'espacement circonférentiel entre le canal d'eau interne (3.1) et le canal d'eau interne adjacent (3.1) de celui-ci est grand. 25

5. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 4, dans laquelle un espacement entre le canal d'eau intérieur (3.1), ayant une largeur maximale dans la direction radiale de l'anneau de lame (2), dans chacun des groupes de canaux d'eau (3) et le canal 30

d'eau intérieur adjacent (3.1) de celui-ci est W1 ; un espacement entre le canal d'eau intérieur (3.1), ayant une largeur minimale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau (3) et le canal d'eau intérieur adjacent (3.1) de celui-ci est W2 ; un espacement entre le canal d'eau intérieur (3.1), ayant la largeur minimale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau (3) et le canal d'eau intérieur (3.1), ayant la largeur maximale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau adjacent (3) de celui-ci est W3 ; et $W1 > W3 > W2$.

6. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 4, dans laquelle une zone de couverture de refroidissement entre le canal d'eau interne (3.1), ayant une largeur maximale dans la direction radiale de l'anneau de lame (2), dans chacun des groupes de canaux d'eau (3) et le canal d'eau intérieur adjacent (3.1) de celui-ci est S1 ; une zone de couverture de refroidissement entre le canal d'eau intérieur (3.1), ayant une largeur minimale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau (3) et le canal d'eau intérieur adjacent (3.1) de celui-ci est S2 ; une zone de couverture de refroidissement entre le canal d'eau intérieur (3.1), ayant la largeur minimale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau (3) et le canal d'eau intérieur (3.1), ayant la largeur maximale dans la direction radiale de l'anneau de lame (2), dans le groupe de canaux d'eau adjacent (3) de celui-ci est S3 ; et $S1 > S3 > S2$.
7. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 1, dans laquelle le canal d'eau intérieur (3.1), ayant la largeur maximale dans la direction radiale de l'anneau de lame (2), dans chacun des groupes de canaux d'eau (3) est proche d'un bord de cercle extérieur de l'anneau de lame (2).
8. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 1, dans laquelle les deux ou plusieurs canaux d'eau internes (3.1) ont chacun une structure circulaire, et un axe de chacun des deux ou plusieurs canaux d'eau internes (3.1) s'écarte d'un centre de cercle de l'anneau de lame (2).
9. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon l'une quelconque des revendications 1 à 8, dans laquelle chacun des groupes de canaux d'eau (3) comprend un canal de passage d'eau (3.2), qui est disposé sur un côté du canal d'eau intérieur (3.1), ayant la plus grande longueur dans la direction radiale de l'anneau de

lame (2), dans le groupe de canaux d'eau (3).

10. Structure de refroidissement de la roue en forme de coupelle à grande vitesse selon la revendication 9, dans laquelle le canal de passage d'eau (3.2) a une structure circulaire et a un axe s'écartant du centre du cercle de l'anneau de lame (2).

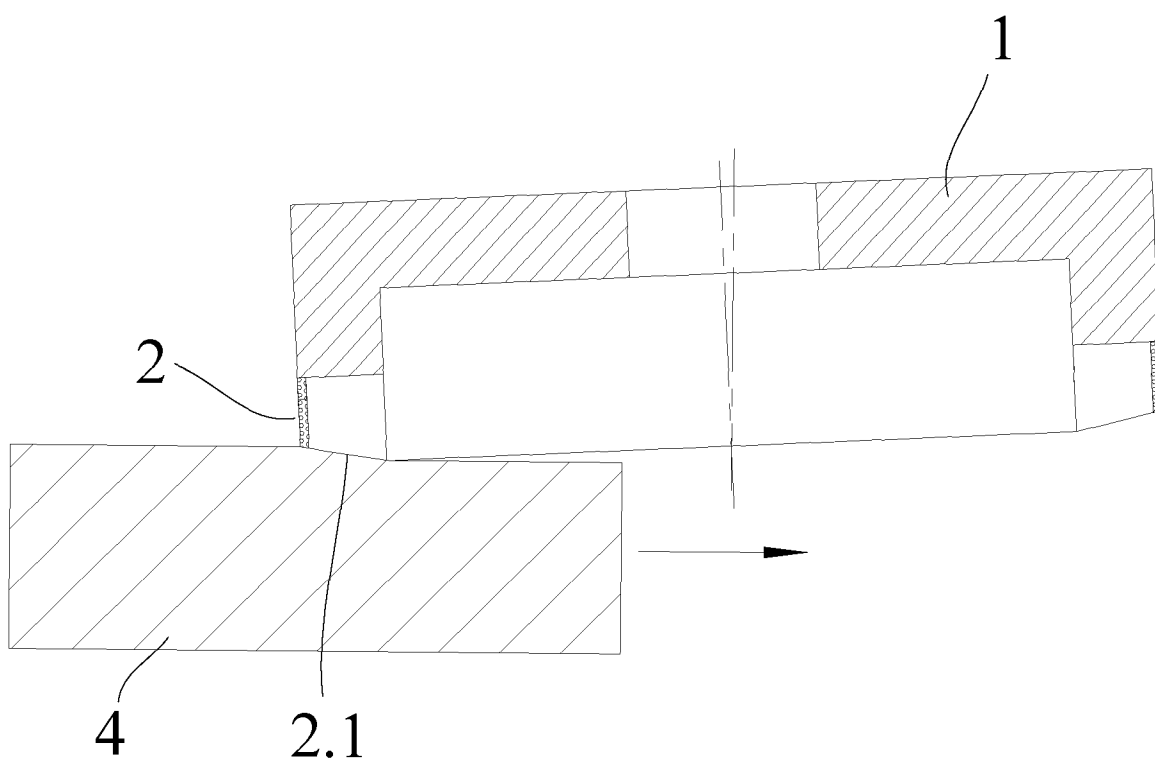


FIG. 1

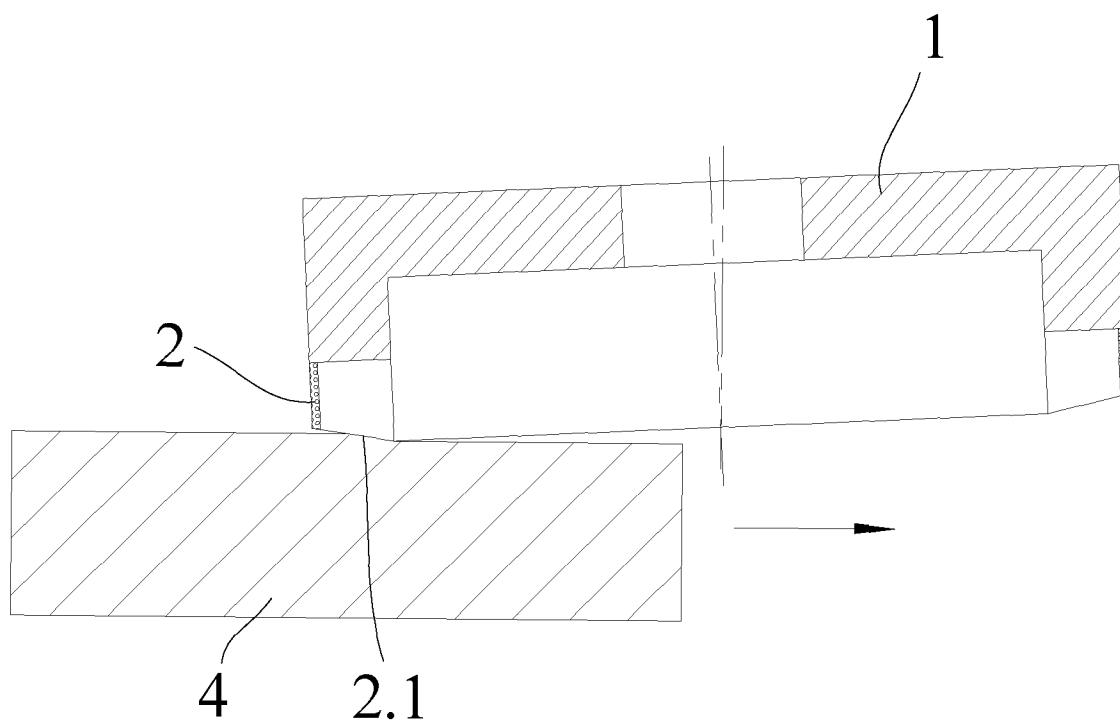


FIG. 2

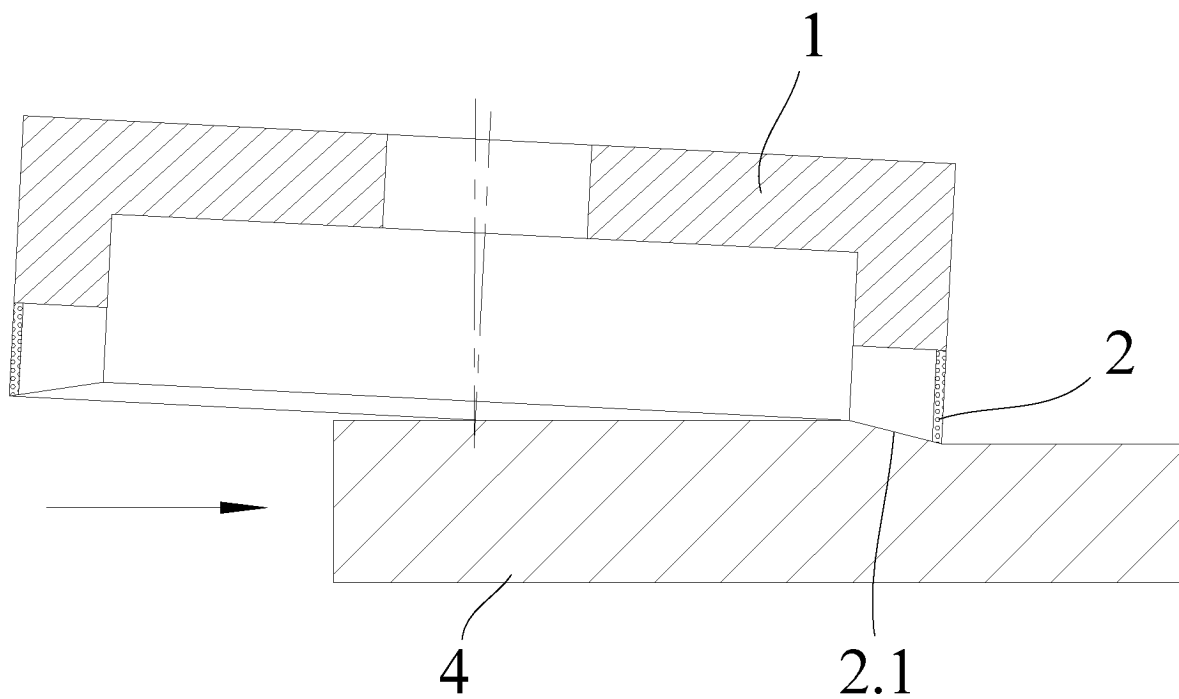


FIG. 3

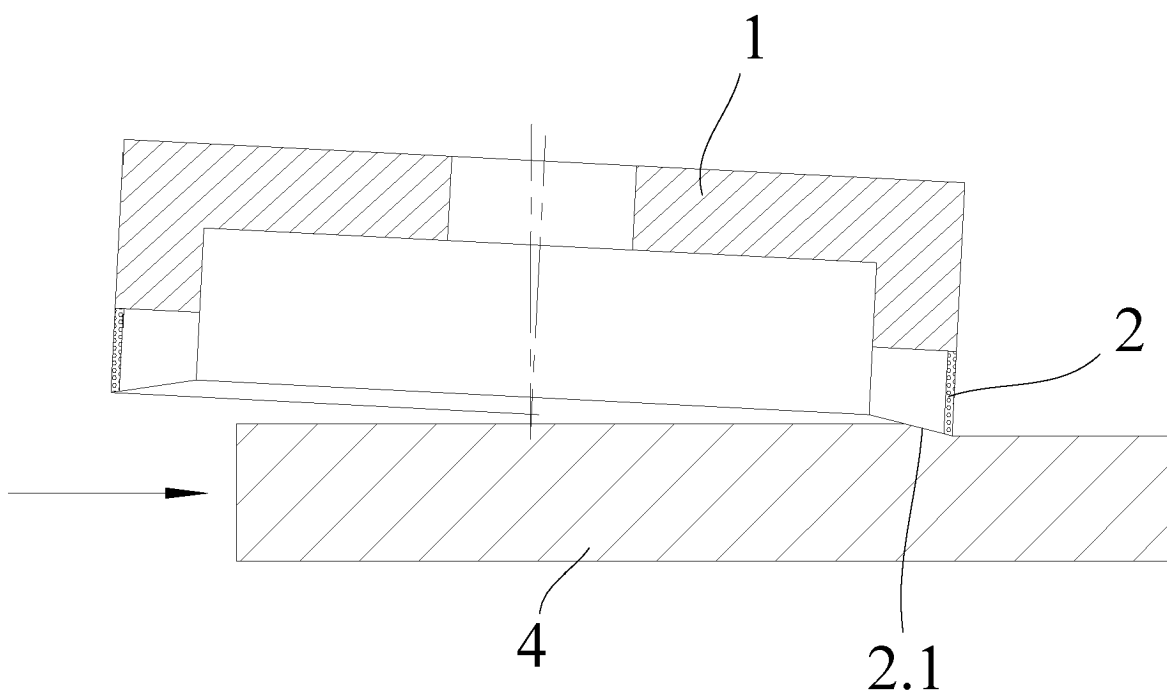


FIG. 4

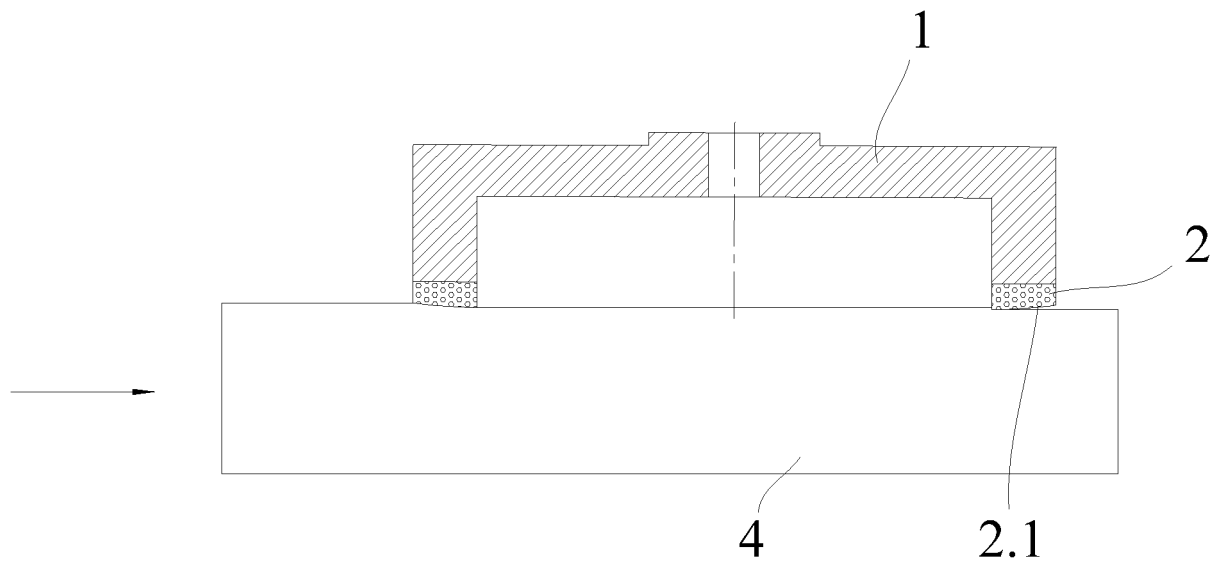


FIG. 5

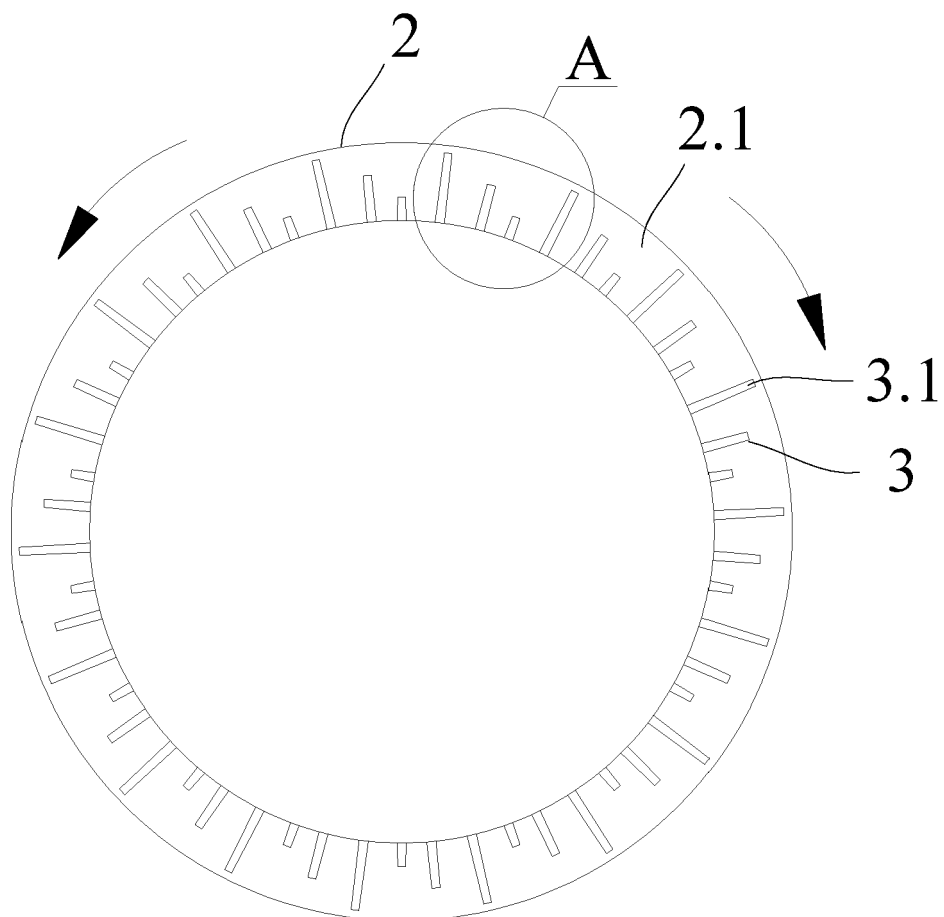


FIG. 6

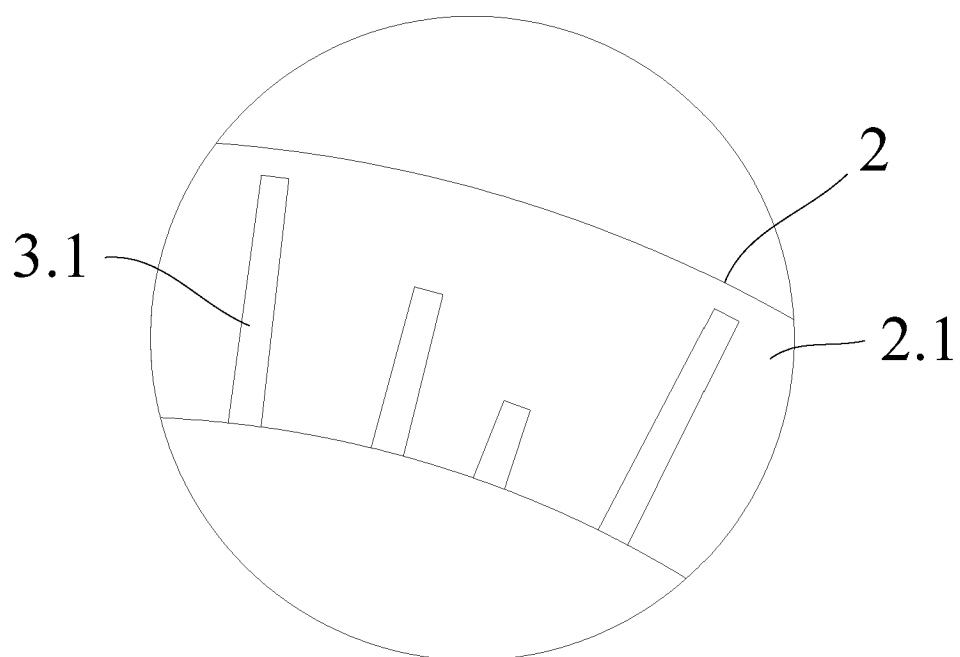


FIG. 7

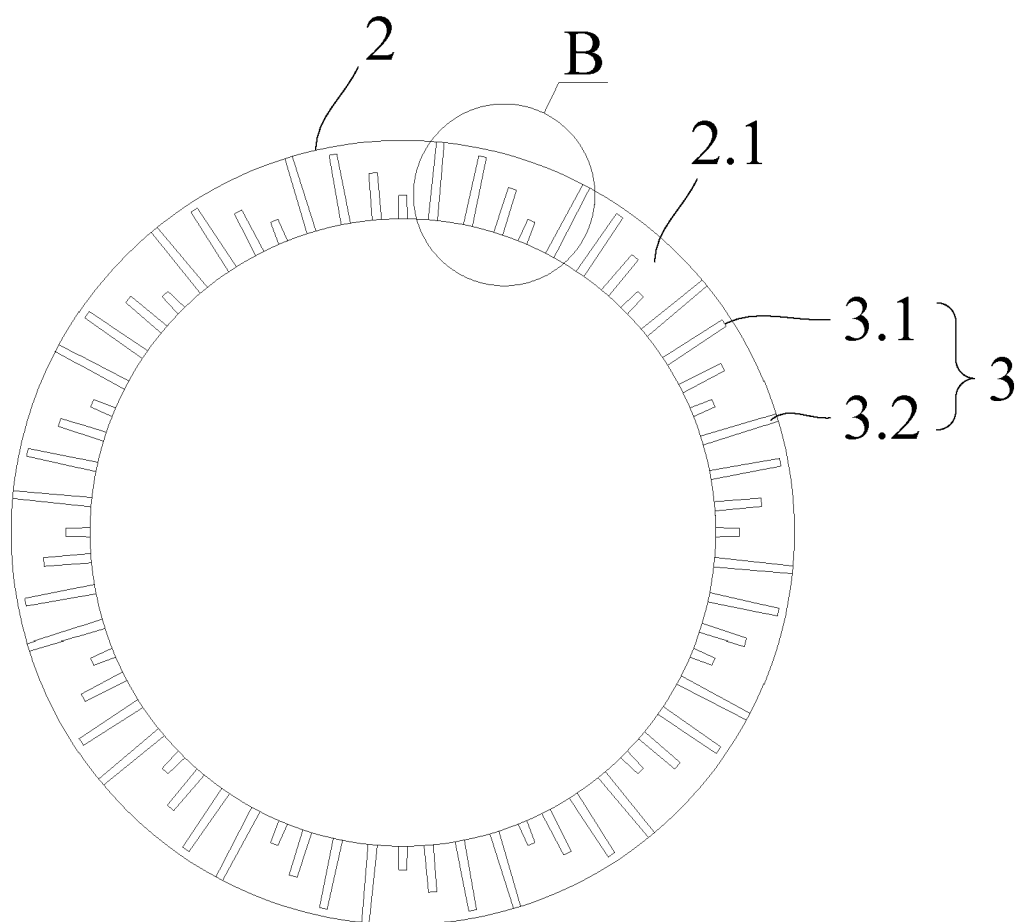


FIG. 8

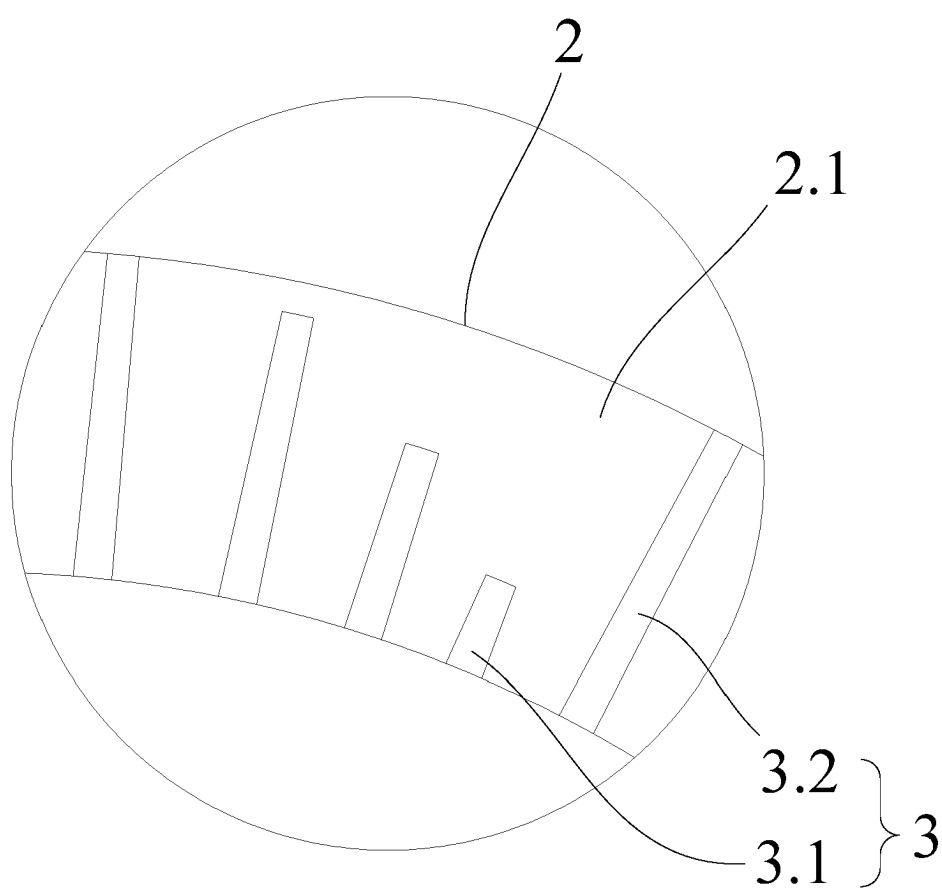


FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 205588162 U [0001]