(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 March 2002 (07.03.2002)

PCT

(10) International Publication Number
WO 02/18083 A2

(51) International Patent Classification[7]: B23C

(21) International Application Number: PCT/KR01/01388

(22) International Filing Date: 16 August 2001 (16.08.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2000/50426 29 August 2000 (29.08.2000) KR

(71) Applicant *(for all designated States except US)*: **KORLOY INC.** [KR/KR]; 53-16, Songjeong-Dong, Heungdeok-Gu, Cheongju-City, Chungcheongbuk-Do 361-290 (KR).

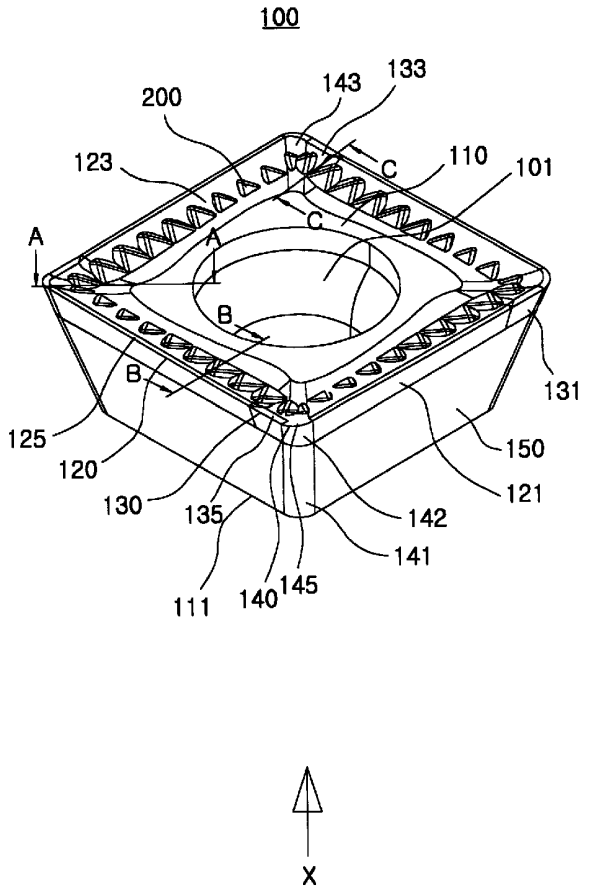
(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SUNG, Wook, Jung** [KR/KR]; Doojin Apt. 101-602, 747, Yulyang-Dong, Sangdang-Gu, Cheongju-City, Chungcheongbuk-Do 362-210 (KR). **LEE, Kwan, Hee** [KR/KR]; 404-17, Uam-Dong, Sangdang-Gu, Cheongju-City, Chungcheongbuk-Do 362-200 (KR). **LEE, Yong, Boo** [KR/KR]; Dongbu Apt. 106-704, Gakyoung-Dong, Heungdeok-Gu, Cheongju-City, Chungcheongbuk-Do 361-260 (KR). **KIM, Young, Heum** [KR/KR]; Hyungseok Apt. 104-204, 2088, Yongam-Dong, Sangdang-Gu, Cheongju-City, Chungcheongbuk-Do 360-181 (KR). **KIM, Hak, Kyu** [KR/KR]; Samil Apt. 106-1303, Bokdae-Dong, Heungdeok-Gu, Cheongju-City, Chungcheongbuk-Do 361-270 (KR). **KIM, Kyung, Bae** [KR/KR]; Hyungseok Apt. 105-102, 1507, Gakyoung-Dong, Heungdeok-Gu, Cheongju-City, Chungcheongbuk-Do 361-260 (KR).

(74) Agent: **YOON, Eui, Sang**; Jangsoo Building, 4th Floor, 1112, Uncheon-Dong, Heungdeok-Gu, Cheongju City, Chungcheongbuk-do 361-110 (KR).

[Continued on next page]

(54) Title: CUTTING INSERT WITH CURVED CUTTING EDGE



(57) Abstract: A cutting insert for milling machining adapted to be mounted on a milling cutter to carry out cutting operation and having primary and secondary cutting edges provided at sides of a rectangular body, each primary cutting edge having a curved line tangential to the adjacent secondary cutting edge, to reduce cutting force and improve flatness of side surface of a machined workpiece, is disclosed. The cutting insert includes an upper face, a bottom face and a plurality of side faces connecting the upper face and the bottom face. The primary cutting edge has chip breakers for guiding chip flow, primary cutting edge land faces and primary cutting edge clearance faces. The primary cutting edges enable a bottom surface and a side surface of a machined workpiece to have a right angle therebetween.

WO 02/18083 A2

(81) Designated States *(national)*: CN, DE, JP, US.

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

CUTTING INSERT WITH CURVED CUTTING EDGE

Technical Field

The present invention relates, in general, to a cutting insert with arcuate cutting edges adapted to be mounted in a milling cutter for cutting a workpiece in a desired shape, and, more particularly, to a cutting insert for milling machining which has primary cutting edges, each being composed of an arcuate line becoming the most convex at a point meeting the adjacent secondary cutting edge as viewed in plan and becoming the most concave at a point meeting the adjacent secondary cutting edge as viewed in front elevation, to carry out milling machining such as plane machining, side machining, slot machining, hole machining or the like, thereby improving quality of machined surfaces of a workpiece, reducing cutting resistance leading to lengthening of service life of the cutting insert, and improving flatness of machined surfaces to cause a bottom surface and a machined side surface of a workpiece to have a right angle therebetween, in particular in the case of side surface machining.

Background Art

In general, a cutting tool is used in cutting operations for cutting workpieces of various materials, and designed to be usually mounted on a machine tool to carry out a cutting operation for cutting a workpiece in a desired shape.

Such a cutting tool comprises a cutting insert having several cutting edges adapted to directly carry out a cutting operation and a cutter body for holding and clamping the cutting insert.

In general, methods for cutting a metal workpiece with such a cutting tool can be divided into two methods, i.e., a method for cutting a rotating workpiece with a stationary cutting tool and a method for cutting a stationary workpiece with a rotating cutting tool.

A milling process belongs to the latter method, and the milling process

includes plane machining, side machining, slot machining, hole machining or the like with a milling cutter.

In an effort to reduce a cutting resistance, increase an expected life span of a cutting tool and improve a machining quality during a cutting process using a milling tool, an improved shape of the insert and a structure for being combined with the cutter body has been actively studied and developed recently. Among the efforts, various efforts to achieve right angles between side faces and a bottom face of the machined workpiece in the cases of side machining and slot machining have been proposed.

In Korean Patent Laid-open publication No. 97-61414, a cutting insert is disclosed in which a cutting insert characterized in that respective cutting edges become convex toward their middle planes as viewed in plan, and inclined downward toward their middle planes as viewed in side elevation, is clamped on a cutter body to reduce a cutting resistance and to achieve a right angle between a side face and a bottom face of the machined workpiece in the case of a side machining.

In the case of the above-mentioned cutting insert, a milling tool is used in which the cutting edges become convex toward their middle planes as viewed in plan and the cutting insert is clamped on the cutter body. Therefore, the right angularity of the machined side surfaces, i.e., the right angularity between the side faces and the bottom faces of the machined workpiece, can be partially improved but cannot be perfectly acheived in the case of the slot machining or a side machining. Furthermore, though it is possible to reduce the cutting resistance owing to an increase of the radial oblique angle by being clamped on the cutter body, and the cutting resistance can be reduced by an increase of the axial oblique angle when a workpiece is machined to a depth of half or less of the cutting edge width, the cutting resistance is reduced by a decrease of the axial oblique angle in the case of being machined to a depth of half or more of the width.

In another publication, U.S. Pat. No. 5,199,827, there is disclosed a cutting insert having cutting edges adapted to cut a portion of a workpiece in a shape of right angle in the case of side machining.

In practice, the optimal machining right angularity can be obtained only in the case of having twisting cutting edges, as in an end mill of an integral or soldered type, in order to form a machined surface having an exact right angle. Since the cutting insert has however straight cutting edges, a flatness of a side machined by the straight cutting edges is not effective than that machined by the twisting cutting edges. Also, since it is impossible to achieve increase of the radial inclined angle and the axial inclined angle related to the cutting resistance when being clamped on a cutter body, the cutting resistance can be reduced.

Disclosure of the Invention

Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a cutting insert for milling machining which has primary cutting edges, each being composed of an arcuate line becoming the most convex at a point meeting the adjacent secondary cutting edge as viewed in plan and becoming the most concave at a point meeting the adjacent secondary cutting edge as viewed in front elevation, to carry out milling machining such as plane machining, side machining, slot machining, hole machining or the like, thereby improving quality of machined surfaces of workpiece, reducing cutting resistance leading to lengthening of service life of the cutting insert, and improving flatness of machined surfaces to cause a bottom surface and a machined side surface of a workpiece to have a right angle therebetween, in particular in the case of side surface machining.

In order to accomplish the above object, the present invention provides a cutting insert for milling machining having an upper face with chip breakers, a bottom face and a plurality of side faces connecting the upper face and the bottom face and adapted to carry out cutting operations such as plane machining, side machining, slot machining, hole machining or the like comprising: primary cutting edges provided between the side faces and the upper face, each of the primary cutting edges having a gentle arcuate line as viewed from above and the side;

secondary cutting edges provided between the side faces and the upper face and meeting the adjacent primary cutting edges, each of the secondary cutting edges having a straight line as viewed from above and the side; and corner cutting edges lying between the primary cutting edges and the secondary cutting edges.

The cutting insert may further comprise: first clearance faces and second clearance faces continuously provided between the bottom face and the corner cutting edges; corner cutting edge land faces and corner cutting edge slant faces continuously provided between the corner cutting edge and the upper face; primary cutting edge clearance faces and secondary cutting edge clearance faces continuously provided between the second clearance faces and under the primary and secondary cutting edges; side clearance face provided between the primary and secondary cutting edge clearance faces and the bottom face; primary cutting edge land faces and primary cutting edge slant faces continuously provided between the primary cutting edges and the upper face; secondary cutting edge land faces and secondary cutting edge slant faces continuously provided between the secondary cutting edges and the upper face; and chip breakers formed on the primary cutting edge slant faces, the secondary cutting edge slant faces and the corner cutting edge slant faces.

The cutting insert may be shaped such that its primary cutting edge has an arcuate edge line which becomes convex toward the adjacent secondary cutting edge and becomes extreme convex at a point meeting the adjacent secondary cutting edge as viewed in plan, and the primary cutting edge has an arcuate edge line which is decreased in height toward the adjacent secondary cutting edge and is most decreased in height at a point meeting the adjacent secondary cutting edge as viewed in front elevation.

The cutting insert may be shaped such that its primary cutting edge has a radius of curvature within a range of 300 ~ 1200mm at point meeting the secondary cutting edge as viewed in plan, and the primary cutting edge has a radius of curvature within a range of 300 ~ 1200mm at point meeting the secondary cutting edge as viewed in front elevation.

The cutting insert may be shaped such that an initial portion of the

primary cutting edge is disposed at a position which is inwardly remote from a straight line connecting the initial portion of the primary cutting edge and the terminating point meeting the adjacent secondary cutting edge, by a distance of 0.005 ~ 0.5mm as viewed in plan, and the initial portion of the primary cutting edge is different from the terminating point meeting the adjacent secondary cutting edge by a height of 0.005 ~ 0.5mm as viewed in front elevation.

According to the above-mentioned present invention, the cutting insert for milling machining is constructed such that the primary cutting edge has an arcuate edge line becoming convex toward the adjacent secondary cutting edge, and then tangential to the straight shaped adjacent secondary cutting edge as viewed in plan, and being gradually decreased in height toward the secondary cutting edge, and then tangential to the straight shaped adjacent secondary cutting edge as viewed in front elevation. With the cutting insert constructed as described above, flatness of a side surface of a machined workpiece is considerably improved in the case of side surface machining, and an inclined angle of the cutting edge is increased, thereby reducing cutting force required in a cutting operation to be reduced and thus enabling quality improvement of a machined product and lengthened service life thereof when the cutting insert carries out cutting operation while being clamped on a cutter body.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a perspective view showing a cutting insert for milling machining according to an embodiment of the present invention;

Fig. 2 is a top plan view showing the cutting insert of Fig. 1;

Fig. 3 is a front elevation view of Fig. 1;

Fig. 4 is an enlarged view of a edge line of the cutting insert of Fig. 2;

Fig. 5 is an enlarged view of a edge line of the cutting insert of Fig. 3;

Fig. 6 is a side elevation view of the cutting insert of Fig. 1, as viewed in a diagonal direction;

Fig. 7 is a cross-sectional view taken along the line A-A of Fig. 1;

Fig. 8 is a cross-sectional view taken along the line B-B of Fig. 1; and

Fig. 9 is a cross-sectional view taken along the line C-C of Fig. 1.

Best Mode for Carrying Out the Invention

Reference now should be made to the drawings, in which the same reference numerals are used throughout the different drawings to designate the same or similar components.

Fig. 1 is a perspective view showing a cutting insert for milling machining according to the present invention.

As shown in the drawing, the cutting insert for milling machining according to the invention is usually made of cemented carbide material by means of powder metallurgy process such as an embossing, a sintering, a grinding, a coating or the like. The cutting insert 100 for milling machining uses only its upper face 110 in the case of a cutting operation of ferrous metal or nonferrous metal. For this purpose, only the upper face 110 is provided with chip breakers 200.

The cutting insert 100 is formed at its center portion with a circular aperture 101 which is vertically perforated therethrough. The cutting insert 100 is shaped to have four sides as viewed in plan. Four corner portions between the sides are provided with corner cutting edges 140, respectively.

Between a bottom face 111 and the corner cutting edge 140 is continuously provided a first clearance face 141 and a second clearance face 142. Between the corner cutting edge 140 and the upper face 110 is also continuously provided a corner cutting edge land face 145 and a corner cutting edge slant face 143.

Between the corner cutting edges 140 is continuously provided a primary cutting edge 120 and a secondary cutting edge 130. The primary cutting edge

120 functions to firstly contact with and cut a workpiece when during process, and is of a gentle arcuate line. The secondary cutting edge 130 functions to improve a roughness of a bottom surface of the cut workpiece, and is of a straight line.

A primary cutting edge clearance face 121 and a secondary cutting edge clearance face 131 are continuously formed between the second clearance face 142 of the corner cutting edge under the primary cutting edge 120 and the secondary cutting edge 130. The primary cutting edge clearance face 121 disposed under the primary cutting edge 120 is composed of a twisted face, the twisting angle of the twisted face is in the range of 3 °~15 ° . A side clearance face 150 is formed between the primary and the secondary cutting edge clearance face 121 and 131 and the bottom face 111.

Between the primary cutting edge 120 and the upper face 110 is continuously provided a primary cutting edge 125 and a primary cutting edge slant face 123. Likewise, between the secondary cutting edge 135 and the upper face 110 is continuously provided a secondary cutting edge land face 135 and a secondary cutting edge slant face 133. A plurality of chip breaker 200 are provided at the primary cutting edge slant face 123, the secondary cutting edge slant face 133 and the corner cutting edge slant face 143.

Fig. 2 is a top plan view showing the cutting insert for milling machining of Fig.1, and Fig. 4 is an enlarged view showing of a cutting edge of a cutting insert for milling machining of Fig. 2.

As illustrated in the drawings, the cutting edge 120 becomes convex from the corner cutting edge 140 to the secondary cutting edge 130. The arcuate line extended between the primary cutting edge 120 and the secondary cutting edge 130 has a radius of curvature (R) of 300 ~ 1200mm. Therefore, the primary cutting edge 120 is tangential to or positioned inside the secondary cutting edge 130. The arcuate line defined by the primary cutting edge 120 necessarily becomes convex in the extreme at its portion tangential to the secondary cutting edge 130. As a result of that, the origin of a radius of curvature of the primary cutting edge 120 is necessarily positioned on a line perpendicular to its edge line at a point (P) tangential to the secondary cutting edge 130. A portion of the

secondary cutting edge 130, which is tangential to the primary cutting edge 120, is shaped in a straight line.

The initial portion of the primary cutting edge 120 is disposed at a position, which is inwardly remote from the maximum convex point of the secondary cutting edge 130 or the primary cutting edge 120, i.e., its point (P) tangential to the secondary cutting edge 130 by a distance (b) of 0.005 ~ 0.5mm. The secondary cutting edge 130 is extended from the point tangential to the primary cutting edge 120 to the curved corner cutting edge 140 by a length (ℓ) of 0.8 ~ 4.0mm.

Fig. 3 is a front elevation view showing the cutting insert for milling machining of Fig. 1, and Fig. 5 is an enlarged view showing the cutting insert of Fig. 3.

As shown in the Figs. 3 and 5, the primary cutting edge 120 is decreased in height toward its adjacent corner cutting edge 140 and is most decreased in height at a position where the primary cutting edge 120 is in contact with the secondary cutting edge 130 as viewed in front elevation.

Therefore, the origin of the radius of the curvature of the primary cutting edge 120 is positioned on the line perpendicular to its edge line at a point (P) tangential to the secondary cutting edge 130. The initial portion of the primary cutting edge 120 is different from the position where the primary cutting edge 120 is in contact with the secondary cutting edge 130 in height, i.e., by a height difference (h)of 0.005 ~ 0.5mm. The secondary cutting edge 130 begins to linearly rise from the position where the primary cutting edge 120 is in contact with the secondary cutting edge 130 to the adjacent corner cutting edge 140 at a constant gradient.

Fig. 6 is a view of the cutting insert for milling machining of Fig. 1 as viewed in its diagonal direction.

As shown in Fig. 1 and 6, the corner cutting edge 140 of the cutting insert 100 for milling machining is composed of an arcuate line connected between the adjacent secondary cutting edge 130 and the adjacent primary cutting edge 120. That is, the corner edge 140 has a curved edge line, which is most decreased in

height at its end meeting the adjacent secondary cutting edge 130, gradually increased in a direction of the primary cutting edge 120, and is most increased at the other end meeting the adjacent primary cutting edge 120 owing to the height difference of the adjacent secondary cutting edge 130 and the adjacent primary cutting edge 120 disposed at its opposite sides.

As a result, the corner cutting edge 140 has a height difference (h) of 0.005 ~ 0.5mm at its both ends meeting the adjacent secondary cutting edge 130 and the primary cutting edge 120. This height difference causes the radial inclined angle to be increased in a state of being clamped on a cutter body (not shown), and also causes the point meeting the adjacent primary cutting edge 120 to be most increased in height to increase the axial inclined angle, thereby reducing a cutting resistance.

The corner cutting edge land face 145 is shaped such that its width is in the range of 0 ~ 0.5mm at its end meeting the adjacent secondary cutting edge land face 135, gradually decreased toward the primary cutting edge land face 125, and is in the range of 0 ~ 0.4mm at its other end meeting the adjacent primary cutting edge land face 125.

The corner cutting edge land face 145 is also shaped such that its inclined angle is in the range of –10 ° ~ +25 ° at its end meeting the adjacent secondary cutting edge land face 135, gradually increased toward the primary cutting edge land face 125, and is in the range of –25 ° ~ +30 ° at its other end meeting the adjacent primary cutting edge land face 125.

Fig. 7 is a cross-sectional view taken along the line A-A of Fig. 1, Fig. 8 is a view similar to Fig. 7, taken along the line B-B of Fig. 1, and Fig. 9 is a view similar to Fig. 7, taken along the line C-C of Fig. 1.

As shown in Fig 8, the primary cutting edge land surface 125 has a width of 0 ~ 0.4mm and an inclined angle of –25 ° ~ +30 °. The primary cutting edge land face 125, with which chips formed during a cutting operation of a workpiece are first contacted, is designed to reinforce a strength of the primary cutting edge 120 that is otherwise reduced by wear of its upper face owing to contact with chips, thereby preventing breakage or damage thereof.

The primary cutting edge clearance face 121, which is a side face of the primary cutting edge 120, is twisted by a shape of the primary cutting edge 120 and the side face clearance face 150, and thus its clearance angle is gradually changed along the length. This enables the cutting resistance to be effectively controlled and the primary cutting edge 120 to be reinforced during a cutting operation. A clearance angle of an area between a portion of the primary cutting edge clearance face 121 corresponding to the initial portion of the primary cutting edge 120 and a portion corresponding to a portion at which the primary cutting edge 120 and the secondary cutting edge 130 meets each other, i.e. a portion at which the primary cutting edge clearance face 121 and the secondary cutting edge clearance face 131 meet each other changes within a range of 5 ° ~ 17 ° along its length.

The straight secondary cutting edge 130 meeting the adjacent primary cutting edge 120 is defined by the secondary cutting edge land face 135 and the secondary cutting edge clearance face 131. A width of the secondary cutting edge land face 135 is in a range of 0 ~ 0.5mm and its inclined angle is in a range of –10 ° ~ +25 °. The secondary cutting edge land face 135 is essentially shaped such that its width is wider than that of the primary cutting edge land face 125 and its inclined angle is smaller than that of the primary cutting edge land face 125, thereby improving a roughness of a bottom surface of the cut workpiece and reducing a cutting force.

As mentioned above, the cutting insert 100 for milling machining according to the invention is clamped on a cutter body in such a way that a screw is threaded in the circular aperture 101 vertically formed at the center of the cutting insert 100. At this point, the cutting insert 100 is clamped such that its axial inclined angle with regard to the axis of the cutter body is in a range of 3 ° ~ 18 ° and its radial inclined angle with regard to the radial direction of the cutter body is in a range of –3 ° ~ –13 °, so as to achieve the effects of decrease of cutting resistance during a cutting operation, improved quality of a machined product and lengthened service life of a cutting tool.

Industrial Applicability

As described above, the present invention provides a cutting insert for milling machining adapted to be clamped on a cutter body in order to carry out plane machining, side surface machining, slot machining, hole machining or the like of a workpiece. The cutting insert is shaped such that its primary cutting edge has an arcuate line tangential to the secondary cutting edge as viewed from above as well as from the side, and the primary cutting edge is most increased in height at its initial end portion and is most decreased in height at its other end meeting the adjacent secondary cutting edge. Therefore, it is possible to improve a right angularity between a side surface and a bottom surface of a machined workpiece, and to increase an inclined angle during a cutting operation, thereby reducing load applied to the cutting tool.

Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. A cutting insert for milling machining having an upper face with chip breakers, a bottom face and a plurality of side faces connecting the upper face and the bottom face and adapted to carry out cutting operations such as plane machining, side machining, slot machining, hole machining or the like comprising:

primary cutting edges provided between the side faces and the upper face, each of the primary cutting edges having a gentle arcuate line as viewed from above and side;

secondary cutting edges provided between the side faces and the upper face and meeting the adjacent primary cutting edges, each of the secondary cutting edges having a straight line as viewed from above and the side; and

corner cutting edges lying between the primary cutting edges and the secondary cutting edges.

2. The cutting insert as set forth in claim 1, further comprising:

first clearance faces and second clearance faces continuously provided between the bottom face and the corner cutting edges;

corner cutting edge land faces and corner cutting edge slant faces continuously provided between the corner cutting edge and the upper face;

primary cutting edge clearance faces and secondary cutting edge clearance faces continuously provided between the second clearance faces and under the primary and secondary cutting edges;

side clearance face provided between the primary and secondary cutting edge clearance faces and the bottom face;

primary cutting edge land faces and primary cutting edge slant faces continuously provided between the primary cutting edges and the upper face;

secondary cutting edge land faces and secondary cutting edge slant faces continuously provided between the secondary cutting edges and the upper face; and

chip breakers formed on the primary cutting edge slant faces, the

secondary cutting edge slant faces and the corner cutting edge slant faces.

3. The cutting insert as set forth in claim 2, in which the primary cutting edge has an arcuate edge line which becomes convex toward the adjacent secondary cutting edge and becomes the most convex at the point meeting the adjacent secondary cutting edge as viewed in plan, and the primary cutting edge has an arcuate edge line which is decreased in height toward the adjacent secondary cutting edge and is most decreased in height at the point meeting the adjacent secondary cutting edge as viewed in front elevation.

4. The cutting insert as set forth in claim 3, in which the primary cutting edge has a radius of curvature within a range of 300 ~ 1200mm at the point meeting the secondary cutting edge as viewed in plan, and the primary cutting edge has a radius of curvature within a range of 300 ~ 1200mm at the point meeting the secondary cutting edge as viewed in front elevation.

5. The cutting insert as set forth in claim 4, in which the origin of the radius of curvature of the primary cutting edge is positioned on a line perpendicular to its edge line at which the primary cutting edge meets the adjacent secondary cutting edge as viewed in plan, and the origin of the radius of curvature of the primary cutting edge is positioned on a line perpendicular to its edge line at which the primary cutting edge meets the adjacent secondary cutting edge as viewed in front elevation.

6. The cutting insert as set forth in claim 2, in which an initial portion of the primary cutting edge is disposed at a position which is inwardly remote from straight line connecting the initial portion of the primary cutting edge and the terminating point meeting the adjacent secondary cutting edge by a distance of 0.005 ~ 0.5mm as viewed in plan, and the initial portion of the primary cutting edge is different from the terminating point meeting the adjacent secondary cutting edge by a height of 0.005 ~ 0.5mm as viewed in front elevation.

7. The cutting insert as set forth in claim 6, in which the corner cutting edge is gradually increased in height from the adjacent secondary cutting edge to the adjacent primary cutting edge.

8. The cutting insert as set forth in claim 7, in which the corner cutting edge has a height difference of 0.005 ~ 0.5mm between its both ends.

9. The cutting insert as set forth in claim 2, in which the primary cutting edge clearance face adjacent to the primary cutting edge is composed of a twisted face having a twisting angle of 3 ° ~ 15 °.

10. The cutting insert as set forth in claim 2, in which the secondary cutting edge land face has a width larger than that of the primary cutting edge land face.

11. The cutting insert as set forth in claim 2, in which the inclined angle of the secondary cutting edge land face is smaller than that of the primary cutting edge land face.

12. The cutting insert as set forth in claim 2, in which the corner cutting edge land face is decreased in width from the secondary cutting edge land face to the primary cutting edge land face.

13. The cutting insert as set forth in claim 12, in which the inclined angle of the corner cutting edge land face is in a range of –10 ° ~ +25 ° at a point meeting the secondary cutting edge land face, is gradually increased toward the primary cutting edge land face, and is in a range of –25 ° ~ +30 ° at a point meeting the primary cutting edge land face.

Fig. 1

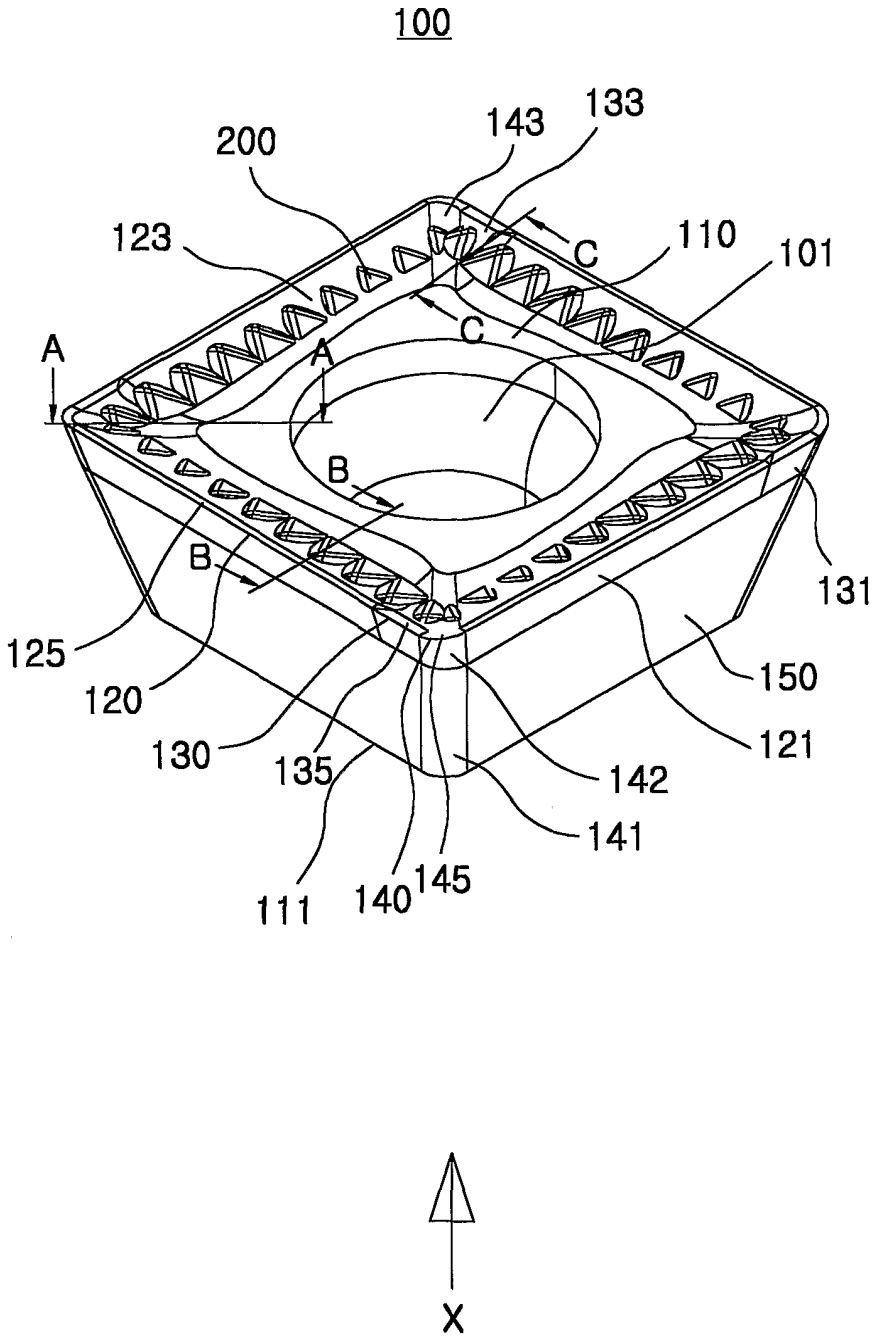

100
200
143
133
123
C
110
101
C
A
A
B
B
131
125
120
150
130
135
121
142
141
111
140
145
X

Fig. 2

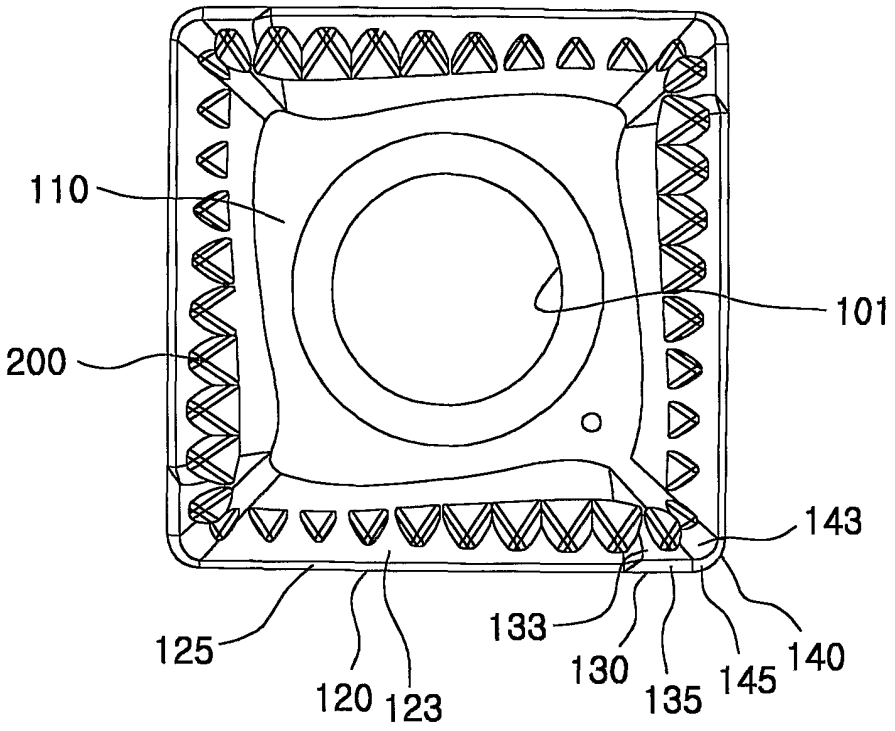

110
101
200
143
125
120
123
133
130
135
145
140

Fig. 3

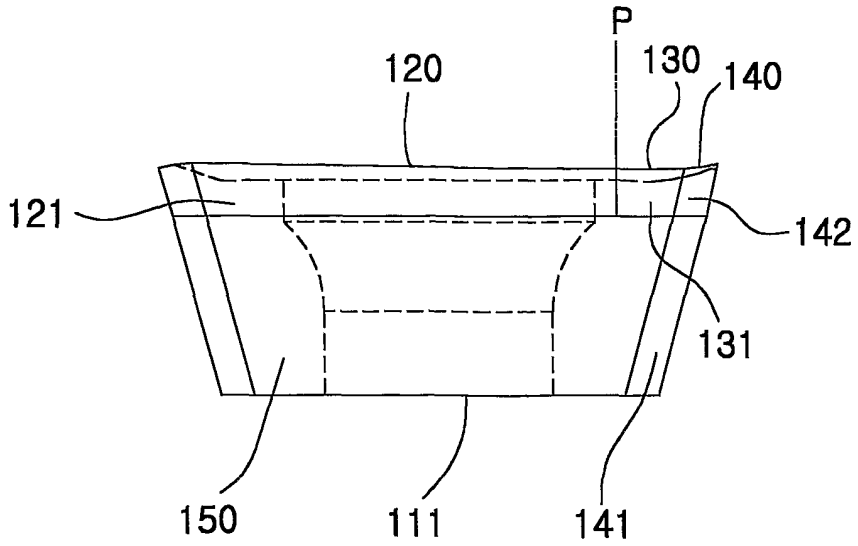

P
120
130
140
121
142
131
150
111
141

Fig. 4

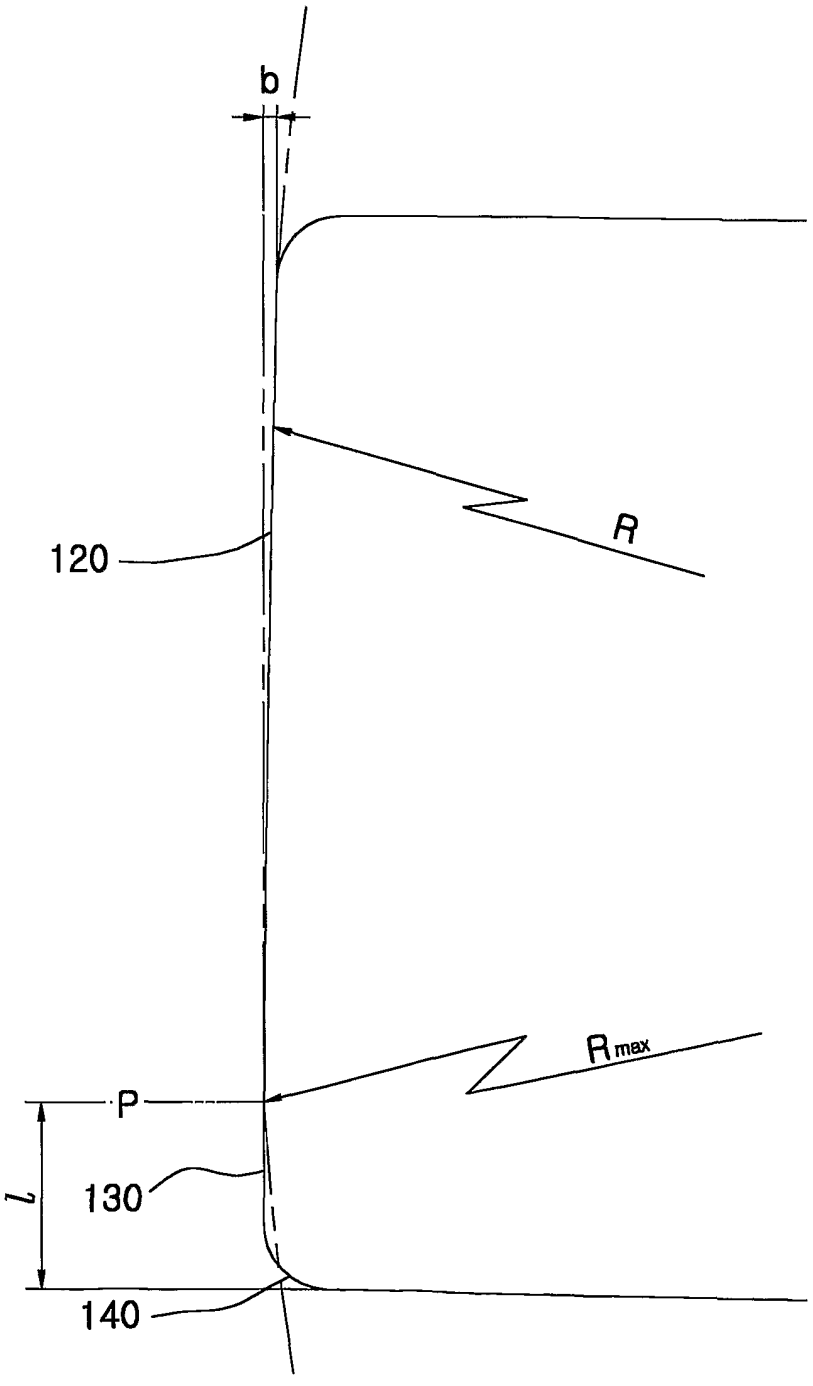


Fig. 5

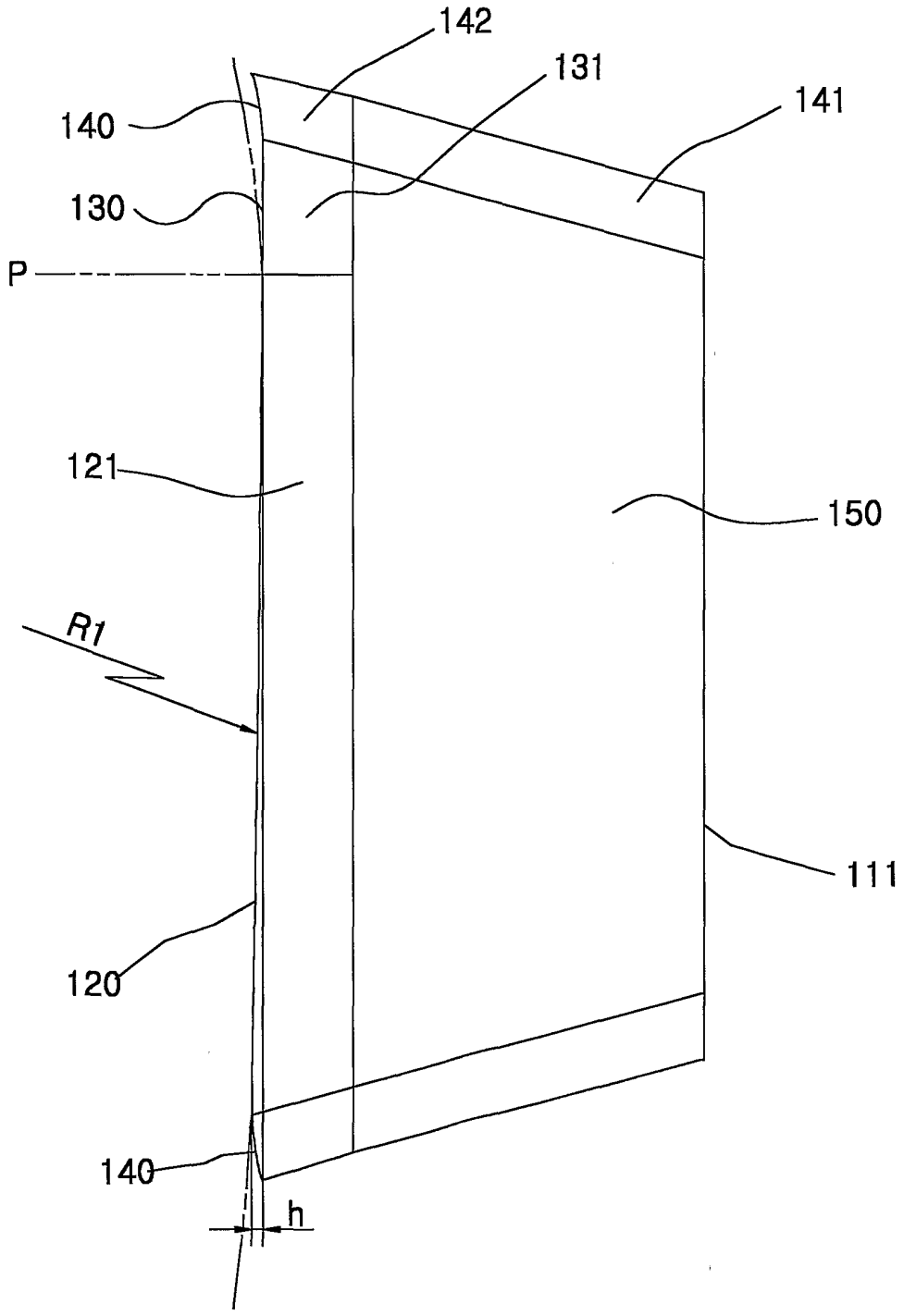


Fig. 6

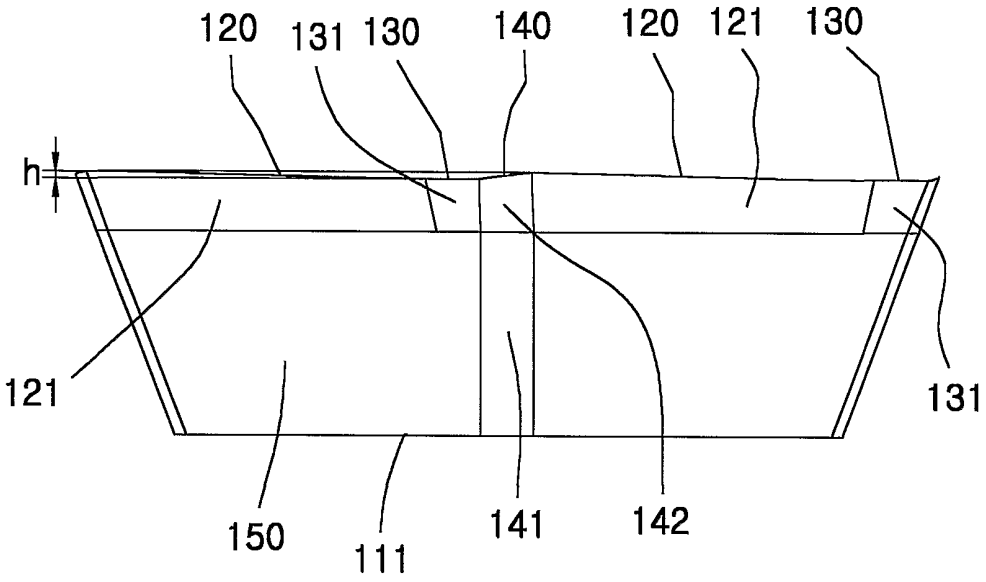

120
131
130
140
120
121
130
h
121
131
150
111
141
142

Fig. 7

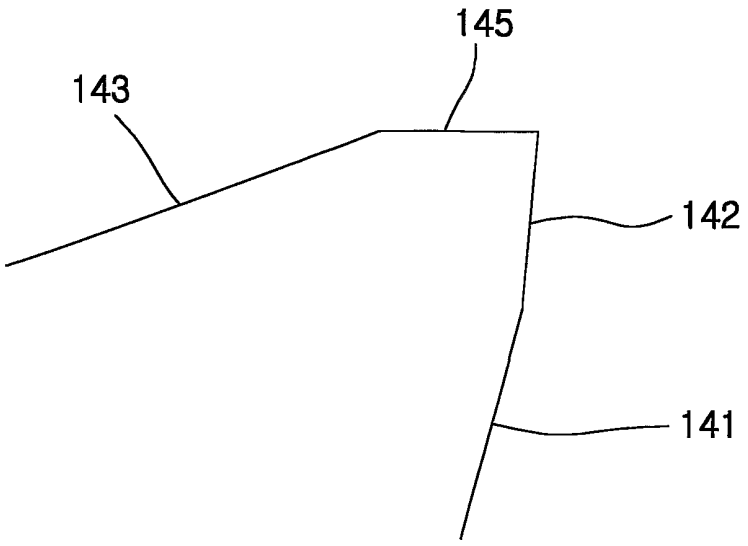

145
143
142
141

Fig. 8

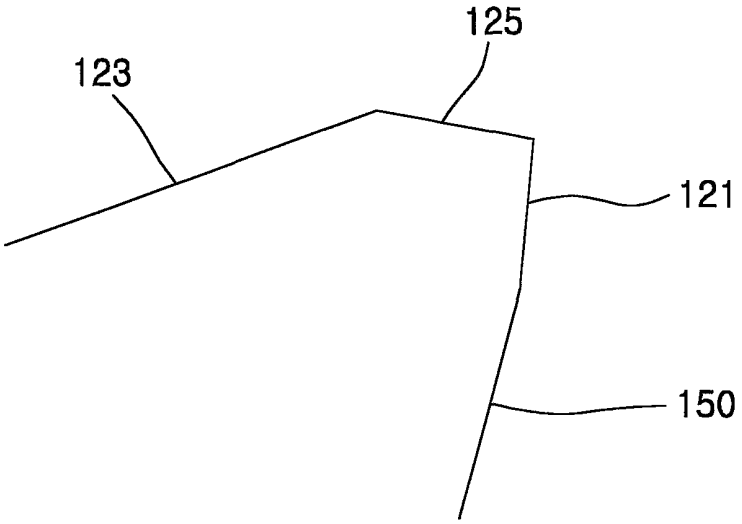


Fig. 9

