

Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 1 066 903 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.01.2001 Bulletin 2001/02

(51) Int. Cl. 7: B23C 5/22

(21) Application number: 00114067.2

(22) Date of filing: 06.07.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

- Kitagawa, Yoshihiro,
Tsukuba Plant
Ishige-machi, Yuuki-gun, Ibaraki-ken (JP)
- Hasegawa, Ken,
Tsukuba Plant
Ishige-machi, Yuuki-gun, Ibaraki-ken (JP)
- Suzuki, Yuuichi,
Tsukuba Plant
Ishige-machi, Yuuki-gun, Ibaraki-ken (JP)

(30) Priority: 09.07.1999 JP 19679499
12.05.2000 JP 2000140972

(71) Applicant:
MITSUBISHI MATERIALS CORPORATION
Chiyoda-ku, Tokyo (JP)

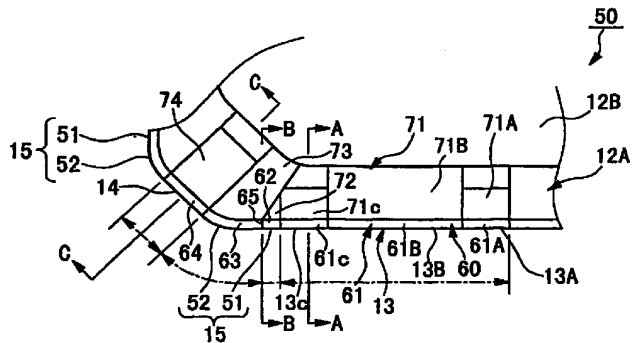
(74) Representative: HOFFMANN - EITLE
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(72) Inventors:
• Hirose, Takeshi,
Tsukuba Plant
Ishige-machi, Yuuki-gun, Ibaraki-ken (JP)

(54) Cutting insert

(57) The sub cutting tooth is formed between the two adjoining main cutting tooth, and the corner tooth connecting the main cutting tooth and sub cutting tooth, and the corner tooth is formed both from the approximately straight line like 1st corner tooth and approximately circular like 2nd corner in order from the main cutting tooth side toward sub cutting tooth side, and the honing over all perimeter of the ridge line is formed and it may get a slope down toward the outside of the cutting insert, and the 1st honing angle of the 1st honing by which the intersection ridge line portion with the side face is made the main cutting tooth is made larger than the 2nd honing angle of the 4th honing by which the intersection ridge line portion with the side face is made the sub cutting, tooth, and the 3rd honing angle in the intersection portion of the 2nd honing and the 3rd honing is made larger than the 1st honing angle.

Fig.2



EP 1 066 903 A2

DescriptionBACKGROUND OF THE INVENTION5 Field of the invention

[0001] This invention relates to the cutting insert using for particularly intermittent cutting which is set to the several milling tools as face milling cutter, end-mill etc.

10 Description of the Background

[0002] Fig.4 is the front view of the cutting insert as one example of the conventional technology . Fig.5 is the cross sectional view by X-X line of the cutting insert which is shown in Fig.4.

[0003] Fig.6 is the central sectional view of the face milling cutter with which it was equipped with the cutting insert which is shown in Fig.4. As shown in Fig.4, this cutting insert10 is formed in the shape of an appearance approximately square shape (Fig.4 is approximately square shape) board type ,and has the under surface 11 which makes a taking a seat side, and the upper face 12 which counters the under surface 11. The main cutting tooth 13 is formed in a ridge line portion which makes the approximately neighborhood of the upper surface 12, the approximately straight line -like sub cutting tooth 14 is formed between the two main cutting tooth 13 and 13 by which it is formed, respectively, and the circular corner tooth 15 is formed between main cutting tooth 13 and sub cutting tooth 14, and the circular corner tooth connects both the cutting tooth 13 and 14 smoothly . The side face 16 which is formed between the under surface 11 and the upper surface 12 inclines outside towards a field 12 and forms the positive tip ,as shown in Fig. 5.

[0004] And the upper surface 12 is made into a lake face, and the side face 16 is made into the frank face.

[0005] Moreover, the central portion of the upper surface 12 and the under surface 11 is penetrated, and the penetrations for the screw penetration is formed.

[0006] All the circumferences of the ridge line portion which makes approximately four rounds of the upper surface 12 is given the honing (honing surface) 18 , as shown in Fig.4 and Fig. 5. That is , The intersection ridge line portion of a honing 18 and the side face 16 are the main cutting tooth 13 and sub cutting tooth 14 and corner tooth 15. The section of this honing 18 which intersects perpendicularly with a ridge line portion might be made into the straight line, and it might get down from this honing 18 toward the outside of the cutting insert 10 to the level surface. The inclination angle (honing angle) θ might be set constant.

[0007] The upper surface 12 of the cutting insert 10 consists of upper surface inclination portion 12A which inclined so that a honing 18 might be intersected, it might get down to the level surface towards the central portion of the cutting insert 10 and it might become a slope, and the upper surface level part 12B which was connected to this upper surface inclination part 12A, and was leveled in near the central portion of the cutting insert 10. In addition, the connection between upper surface inclination part 12A and upper surface level part 12B is smoothed.

[0008] As shown in Fig.6 , This cutting insert 10 is equipped in tip perimeter of main cutter body 21 in the milling cutter 20 for instance, and a part of work material is intermittently cut off by carrying out rotation cutting of the main cutter body 21 to work material.

[0009] The cutting insert 10 is equipped so that the main cutting tooth 13 may project toward the perimeter side of the main cutter body 21,and also so that sub cutting tooth 14 may turn into down tooth of the main cutter body 21. In case of rotation cutting of the work material by the face milling cutter 20, the main cutting is performed by the main cutting tooth 13, and the finished surface is performed by sub cutting tooth 14.

45 Object of this invention

[0010] Although main cutting tooth 13 and sub cutting tooth 14 is connected smoothly by circular corner tooth 15 in above mentioned cutting insert 10, the problem of being easy to break out in corner tooth 15 by the shocks at the time of the instruction to which each cutting tooth 13, 14, 15 begin to hit to the work material at the time of cutting. Moreover, the corner tooth 15 in a center side of rotation such as face milling cutter and end mill etc., bites the chips generated by cutting of the sub cutting tooth 14, as the results, the finished surface is damaged. moreover, as the results of the crush the chip into above mentioned corner tooth 15, the corner tooth 15 will be broken.

[0011] Furthermore, when the vibration of the work material profergate to the corner tooth 15 at the time of cutting, there was also a problem that the corner tooth 15 will be broken.

[0012] This invention was done in view of the above mentioned situation, and aims to offer the cutting insert which is possible to increase the break resistant property of the corner portion near the intersection part of the main cutting tooth and the sub cutting tooth at the cutting.

Summary of the invention

[0013] In order to attain the purpose which solves the above mentioned subject, the cutting insert of this invention given in claim 1 is characterized that the honing angle of corner tooth connecting the main cutting tooth and sub cutting tooth is larger than each honing angle of the above mentioned main cutting tooth and sub cutting tooth in the cutting insert which come to form a honing face in a cutting tooth.

[0014] In a cutting insert above mentioned, since the honing angle over a corner edge is enlarged compared with the honing angle over the main cutting tooth and sub cutting tooth, the break resistance of the corner tooth is raised, therefore, for example, it can prevent occurring to break out in corner tooth by the shock which act to the tooth edge in a starting time of cutting . And since a honing angle is enlarged only against corner tooth, the sharpness of the main cutting tooth and a sub cutting tooth is not reduced.

[0015] Furthermore, the cutting insert of claim 2 is characterized by the height from the under face which makes the seat face of the corner tooth being lower than the height of a sub cutting tooth.

[0016] Since the height from the under face of the corner tooth is lower than the height of a sub cutting tooth in the cutting insert of above mentioned construction, A corner tooth is in a stage of low position than a sub cutting tooth for the direction of rotation of face milling cutter and end mill etc., when the chips generated by cutting of a sub cutting tooth have flowed to the center direction of a rotation , it can prevent the corner tooth by the side of a rotation center biting chips, or being broken the corner tooth by the crash of the chips into the corner tooth.

[0017] Moreover, very small clearance can be performed between the corner tooth used for cutting and work material, when the vibration of work material propagate to the corner tooth in a time of cutting, it can prevent that a corner tooth will be broken.

[0018] Furthermore, it is characterized that the honing angle α of the above mentioned main cutting tooth is set as the range of $0^\circ < \alpha < 60^\circ$ and the honing angle β of above mentioned sub cutting tooth is set as the range of $0^\circ < \beta < 60^\circ$ and the honing angle γ is set as the range $5^\circ < \gamma < 80^\circ$. for the cutting insert of this invention of claim 2.

[0019] In the above mentioned cutting insert , if honing angle α of the main cutting tooth is less than 0° , the effect of forming the honing face ,i.e., the break resistant property of the main cutting tooth cannot be raised, and if it is 60° or more conversely, the sharpness of the main cutting tooth will fall.

[0020] Similarly, if honing angle β of a sub cutting tooth is less than 0° , the break resistant property of a sub cutting tooth cannot be raised, if it is 60° or more conversely, the sharpness of a sub cutting tooth will fall. Furthermore, if honing angle γ of a corner tooth is less than 5° , the break resistant property of a corner tooth cannot be raised, and if it is 80° or more conversely , the sharpness of a corner tooth will fall.

Brief Description of the Drawings

[0021] A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings. Wherein :

Figure 1 is the front view of the cutting insert of one example in this invention ;

Figure 2 is the enlarged front view in principal portion of the cutting insert which is shown in figure 1 ;

Figure 3 (a) is the A-A line cross sectional view of the cutting insert which is shown in figure 2 , and (b) is the B-B line cross sectional view of the cutting insert which is shown in figure 2, and (c) is the C-C line cross sectional view of the cutting insert which is shown in figure 2 ;

Figure 4 is the front view of one example of the conventional cutting insert;;

Figure 5 is the X-X line cross sectional view of the cutting insert which is shown in figure 4;

Figure 6 is the central sectional view of the face milling cutter with which it was equipped with the cutting insert shown in figure 4.

Explanation of Marks

[0022]

- 10, 50 cutting insert
- 13, main cutting tooth
- 14 sub cutting tooth
- 15 corner tooth
- 51 1st corner tooth
- 52 2nd corner tooth

60	honing
61	1st honing
62	2nd honing
63	3 rd honing
5 64	4th honing
65	intersection portion
α	1st honing angle
β	2nd honing angle
$\gamma 1$	3 rd honing angle

10 Detailed Description of the Preferred Embodiments

[0023] It explained , hereafter, one practical form of the cutting insert in this invention, referring to the attached drawings.

15 [0024] Figure 1 is a front view of a cutting insert by one practical form in this invention. Figure 2 is an enlarged front view of a principle portion in cutting insert shown in figure 1. Figure 3 (a) is A-A line cross sectional view of a cutting insert shown in figure 2 and (b) is B-B line cross sectional view of a cutting insert shown in figure 2 and (c) is C-C line cross sectional view of a cutting insert shown in figure 2 .

[0025] In addition , the same mark is allotted to the same portion as the conventional technology mentioned above.

20 [0026] The cutting insert 50 by this example is formed in the shape of an approximately quadrangle plank(approximately square shape in Figure 1) which was made symmetrical to the central axis M, and the insert is formed as the positive insert which the side face 16 made into an frank face inclines outside toward the upper face 12 which is formed an rake face from the under face 11 which is formed the seat face of the cutting insert 50. As shown in Figure 1, the main cutting tooth 13 is formed in the portion of the ridge line which forms approximately four face of the quadrangle respectively of the upper face 12 , and the approximately straight line like sub cutting tooth 14 formed between the two main cutting tooth 13 and 13 which carry out an approximately rectangular cross ,and adjoins, and an approximately circular corner tooth which connects the main cutting tooth 13 and sub cutting tooth 14 to the both side is formed respectively. The corner tooth is formed from both the 1st corner tooth of an approximately straight line like in a plane view from the main cutting tooth 13 side toward the sub cutting tooth 14 side and an approximately circular 2nd corner tooth 52 and the connection between each tooth 13 and 51 and 52 and 14 is smoothed.

30 [0027] The honing 60 (honing face) is given extending the circumferences of the ridge line part which makes an approximately 4 rounds of upper face 12. Here, the honing 60 consists of the 1st honing 61 , the 2nd honing 62, the 3 rd honing 63 , and the 4th honing 64 in order toward the sub cutting tooth 14 from the main cutting tooth 13 corresponding to each tooth 13, 14, 51, and 52 formed in the intersection ridge line portion of a honing 60 and the side face 16, shown in Figure 2 .

35 [0028] The honing 60 inclines that it may get down to the level surface and it may become a slope, the 1st honing angle α (for example, 12°) of 1st honing 61 by which the perimeter side shown in Figure 3 (a) is made the main cutting tooth 13 is made larger than 2nd honing angle β (for example 8°) of the 4th honing 64 by which the perimeter side shown in Figure 3 (c) is made the sub cutting tooth 14 ($\alpha > \beta$).

40 [0029] Furthermore , as shown in Figure 3 (b) , the 3 rd honing angle $\gamma 1$ (for example , 20°) in the intersection portion 65 of the 2nd honing 62 and the 3 rd honing 63 is made larger than 1st honing angle α ($\gamma 1 > \alpha > \beta$). And, the honing angle of the intersection ridge line portion of the 1st honing 61 and the 2nd honing 62 is made equal to 1st honing angle α , the honing angle of the 2nd honing 62 ,namely, the honing angle γ to the corner tooth is set up so that it may become large gradually to the 3rd honing angle $\gamma 1$ according to go to the intersection portion 65(on left side in Figure 2.

45 [0030] On the other hand, the honing angle of intersection ridge line portion of the 3 rd honing 63 and the 4th honing 64 is made equal to 2nd honing angle β , and the honing angle of the 3rd honing 63 ,namely, the honing angle γ to the corner tooth 15 is set up so that it may become small gradually to the 2nd honing angle β from the 3 rd honing angle $\gamma 1$, according to the 4th honing 64 from intersection portion 65 (to left upper side ,in Figure 2).

50 [0031] That is, as shown in Figure 4, the 1st corner tooth 51 formed in the intersection ridge line portion of the 2nd honing 62 and side face 16 inclines so as to get slope down from main cutting tooth toward intersection portion 65, and the 2nd corner tooth 52 formed in the intersection ridge line portion of the 3 rd honing 63 and side face 16 inclines so as to get slope down from sub cutting tooth 14 toward intersection portion 65.

55 [0032] And, the 1st corner tooth and 2nd corner tooth,namely,51 and 52 are formed so as to form the smooth convex curve toward the under face 11 on the whole, and preferably, formed that the corner in the plane view may mostly approach to the under face, namely, the honing angle γ to the corner tooth 15 may make maximum value (the 3 rd honing angle $\gamma 1$). Here, if the honing angle γ to the corner tooth 15 is below 1st honing angle α ($\gamma < \alpha$), the effect of raising the break resistant property of the corner tooth 15 cannot arise. Moreover, the 1st honing angle α is set as the range of $0^\circ < \alpha < 60^\circ$, and is preferably made into $0^\circ < \alpha < 45^\circ$.

[0033] Here, if the 1st honing angle α is less than 0° , the effect giving a honing 60, namely, the break resistant property of the main cutting tooth 13 cannot be raised, and if it is 60° or more conversely, the sharpness of the main cutting tooth 13.

[0034] Moreover, the 2nd honing angle β is set as the range of $0^\circ < \beta < 60^\circ$, and is preferably, made into $0^\circ < \beta < 45^\circ$. Here, if the honing angle is less than 0° , the break resistant property of the sub cutting tooth 14 cannot be raised, if it is 60° or more conversely, the sharpness of the sub cutting tooth 14 will fall.

[0035] Furthermore, the honing angle γ of the corner tooth 15 is set as the range of $5^\circ < \gamma < 80^\circ$. Here, if the honing angle γ of the corner tooth 15 is less than 5° , the break resistant property of the corner tooth 15 cannot be raised, if it is 80° or more conversely, the sharpness of the corner tooth 15 will fall.

[0036] In addition, as shown in Figure 3 (a), (b), and (c), the section which the honing 60 intersects perpendicularly with the ridge line portion with the side face 16 is made into the shape of the straight line for example, and the length of this straight line, namely, regarding to the width of honing, for example, the 1st honing width L1 of the honing 61 is made longer than the 2nd honing width L2 of the 4th honing 64 ($L1 > L2$), and the honing width L3 of the intersection portion 65 is made longer than the 1st honing width L1 ($L3 > L1 > L2$). And the honing width of the 2nd honing 61 is enlarged from 1st honing width L1 to the 3rd honing width L3, toward the intersection portion 65 from the 1st honing 61, and the honing width of the 3rd honing 63 is made small from the 3rd honing width L3 to the 2nd honing width L2, toward the 4th honing 64 from the intersection portion 65. Furthermore, each honing width of each honing 61A, 61B, and 61C of main cutting tooth which constitutes the 1st honing 61 is made equal to the 1st honing width L1 and it sets as constant.

[0037] Moreover, the height M2 from the under face 11 which makes the seat face of the corner tooth 15 is made lower than the height M1 from the under face 11 of the sub cutting tooth 14 ($M1 > M2$).

[0038] As shown in Figure 2, upper inclination portion 12A of the cutting insert 50 which intersect to honing 60 is consisted from the 1st upper face inclination portion 71 and the 2nd upper face inclination portion 72 and the 3rd upper face inclination portion and the 4th upper face inclination portion 74 which intersects each honings 61, 62, 63, and 64 respectively.

[0039] Furthermore, the 1st upper face inclination portion 71 is consisted from the 1st main cutting tooth inclination portion 71A and the 2nd main cutting tooth inclination portion 71B and the 3rd main cutting tooth inclination portion 71C which connect to the each honings 61A, 61B, and 61C of the main cutting tooth, respectively.

[0040] Each inclination portion 71A, 71B, and 71C of the main cutting tooth is formed as the flat face, for example. As shown in Figure 2 and Figure 4, the 1st intersection ridge line 75 is located in lower portion of perpendicular direction than the 3rd intersection ridge line 76 with the 3rd main cutting tooth inclination portion 71C and the 3rd main cutting tooth honing 61C. The 2nd upper face inclination portion 72 and the 4th upper face inclination portion 74 is formed to flat face, for example, and these upper face inclination portion 72, 74 is connected smoothly by the 3rd upper face inclination portion 73 which is primarily concave like.

[0041] And each upper face inclination portion 71, • • •, 74 is connected smoothly with the upper face leveled portion 12B near the central portion of the cutting insert 50. As mentioned above, according to the cutting insert 50 of this example, the 1st honing angle α of the 1st honing 61 is made larger than the 2nd honing angle β of the 4th honing 64 in which the perimeter side is the sub cutting tooth 14 ($\alpha > \beta$), and the 3rd honing angle γ in the intersection portion 65 of the 2nd honing 62 and the 3rd honing 63 is further made larger than the 1st honing angle α , and the honing angle γ of the corner tooth 15 is made larger than the 1st honing angle α ($\gamma > \alpha > \beta$). Therefore, it is possible to increase the break resistant property of the corner tooth 15 without decreasing the sharpness with the sub cutting tooth 14 which performs finish cutting. For example, in a time of the bite to the work material, it is possible to reduce the bearing the breakage on the edge of the corner tooth 15 by the shock which react to the edge of the cutting tooth.

[0042] Furthermore, since the height M2 from the under face 11 which makes the seat face of the corner tooth 15 is lower than the height M1 of a sub cutting tooth, the corner tooth 15 will have fallen back than the sub cutting tooth 14 to the rotating direction of face milling cutter etc., when the chips generated by cutting of a sub cutting tooth 14 have flowed to the center direction of a rotation, it prevents the corner tooth 15 by the side of a rotation center biting chips.

[0043] Moreover, it can prevent the chip's crash into the corner tooth 15 and the corner tooth 15 being broken.

[0044] Moreover, very small clearance can be performed between the corner tooth 15 used for cutting and work material, the vibration of the work material propagate to the corner tooth in a time of cutting, as the results, it can prevent to be broken the corner tooth 15.

[0045] Furthermore, the 1st honing angle α is set as the range of $0^\circ < \alpha < 60^\circ$, if the 1st honing angle α is less than 0° , the effect giving the honing 60, namely, the improvement of the break resistant property of main cutting tooth 13 is not gained, conversely, if it is 60° or more, the sharpness of the of the main cutting tooth 13 will fall. Similarly, the 2nd honing angle β is set in the range of $0^\circ < \beta < 60^\circ$, and if the 2nd honing angle β is less than 0° , the improvement of the break resistant property of the sub cutting tooth 14 is not expected, conversely, if it is 60° or more, the sharpness of the sub cutting tooth 14 will fall. Furthermore, the honing angle γ of the corner tooth 15 is set in the range of $5^\circ < \gamma < 80^\circ$, if the honing angle γ of the corner tooth 15 is less than 5° , the improvement of the corner tooth 15 is not expected, conversely, if it is 80° or more, the sharpness of the corner tooth will fall. In addition, in this example, the 1st honing angle

α of the 1st honing 61 which the perimeter side is made as main cutting tooth 13 is larger than the 2nd honing angle β of the 4th honing 64 which perimeter side is made as sub cutting tooth 14 ($\alpha > \beta$). It may not be limited to this example, the 1st honing angle α may be below the 2nd honing angle β ($\alpha < \beta$).

[0046] In shortly, the 1st honing angle α and the 2nd honing angle β should be just smaller than the honing angle γ of the corner tooth 15. In addition, in this example, the 1st honing width L1 is made longer than the 2nd honing width L2 ($L1 > L2$), the 3rd honing width L3 is made longer than the 1st honing width L1 ($L3 > L1 > L2$), but it is not limited in this example, each honing width L1, L2, L3 may be mutually made equal ($L1 = L2 = L3$), and the size relations between the honing width is no problem. In addition, in this example, the 1st honing width L1 is made longer than the 2nd honing width L2 ($L1 > L2$), the 3rd honing width L3 is made longer than the 1st honing width L1 ($L3 > L1 > L2$), but, it is not limited to this example, the honing width L1, L2, and L3 may be mutually made equal ($L1 = L2 = L3$), other size relations is also permitted.

[0047] In shortly, the mutual size relation of each honing width L1, L2, and L3 is not particularly limited. Moreover, how to take the honing 60 may be the any method such as fabrication by machining or forming by pressing the mold. Moreover, the tip of the honing 60 may be formed so that it may have proper curvature by cross sectional view, and the honing 60 may be made into the double honing.

[0048] Moreover, in this example, although the cutting insert 50 considered as the shape of an approximately square plate, it may have the shape of the polygon board of a triangle or other form without being limited to this square shape. Moreover, in this example, although the case where the cutting insert 50 was equipped to the face milling cutter for shoulder cutting is explained, various kinds of cutting tools such as other milling tools, such as end mill, and lath cutting tool such as a byte, may be also equipped.

[Example]

[0049] The cutting test of the work materials was performed the cutting insert by one example in this invention is into the case of operation. the cutting insert by conventional example is into the case of comparative example.

[0050] Testing condition and the results are shown in Table 1.

[0051] In Table 1, The meaning of the width is 3rd and 4th honing width L2, and L3 [mm] of the sub cutting tooth 14 and corner tooth 15, and the meaning of angle is 2nd and 3rd honing angle β , γ [°] of the sub cutting tooth 14 and corner tooth 15, and also the meaning of height is the height of M1, M2 [mm] from the under face 11 which makes the seat face of the sub cutting tooth 14 and the corner tooth 15.

[0052] The cutting test was examined by equipping the cutting insert 1, 2 by this invention and the cutting insert 1, 2, 3 by conventional example to the face milling cutter 20 shown in Figure 6, respectively, about these three items.

[0053] The work material of length 190 [mm]: SCM 440 was cut at the cutting speed of $V=200$ [m/min], and it compared about three of shock resistant property, cutting resistance and finished surface.

[0054] In the shock resistant property test, the strong intermittent cutting test of the work material in a cutting depth of a $p=2.5$ mm was examined by a unit of 2 times in a various feed rate f [mm/tooth]. The unit of this feed rate f is the advance speed per one tooth.

[0055] The number in a table shows the cutting distance to come to be broken, and ○ mark shows that the cutting tooth has been continued to cut for full length without the tooth being broken.

[0056] In a test of cutting resistance and finished surface, it was examined in a conditions of cutting depth a $p=2.0$ [mm] and feed rate $f=0.2$ [mm/tooth] It was compared for the cutting resistance about the main component force [N], feeding component force [N], back component force [N], and a finished surface was compared ten point average roughness Rz [μm] with the visual inspection. As the results, comparing the conventional example 1 with the example in this invention which the angle β of the sub cutting tooth is different and the height of sub cutting tooth M1 is higher than the height of corner tooth M2, although the conventional example 1 was able to cut 190 [mm] full length twice only to feeding rate $f=0.12$ [mm/tooth], but it was able to cut till the feeding rate $f=0.20$ [mm/tooth] over the full length twice. In cutting resistance, the good results with smaller resistance was obtained in the example of this invention for the main component force, feed component force and back component force.

[0057] About the finished surface, the surface roughness in the example of this invention 1 is smaller than that of the conventional example, and the surface scratch by bite, etc., is not also found out.

[0058] Next, it was compared the conventional example 2 with the example in this invention which the width L2 and L3 are formed longer than that the example 1. The angle γ 1 of corner tooth in the example 2 of this invention is different from that of the example of conventional example 2, and the height of corner tooth M2 is lower than the height of sub cutting tooth M1.

[0059] In shock resistant property, it can not be able to cut 190 [mm] full length in every feed rate f in conventional example 2, whereas, it can be able to cut over the twice for the full length till the feed rate of $f=0.24$ [mm/tooth].

[0060] In cutting resistance, it was shown that the main component force and feed component force in conventional example 2 becomes smaller than that of the example of this invention, however, the back component force in the exam-

ple 2 of this invention was smaller than that of the conventional example. About the finished surface, the roughness of the finished surface of this invention is smaller than than that of the conventional example, and also the surface scratch by bite, etc., was not also found out .

5 **[0061]** Moreover , when the conventional example3 which enlarged the angle β , γ 1 respectively, and made the height M1, M2 lower than that of the conventional example 2 was compared to the example 2 in this invention, in shock resistant property, although the conventional example 3 was able to cut till the feed rate off =0.16 [mm / tooth] over the full length, the example 2 in this invention showed superior property than the conventional example3 . In cutting resistance, it was shown the small value in the example2 of this invention in all of the main component force, feed component force and back component force.

10 **[0062]** Particularly, remarkable effect was seen in back component force. Regarding to the finished surface, it was seen the rough finished surface and also seen the surface scratch by bite, etc., in conventional example 3, whereas, it was obtained the good results in the example 2 of this invention. It has checked that this invention controlled the cutting resistance, and could improve the shock resistant property and surface roughness than the conventional example as shown in above.

15 **[0063]** The disclosure of Japanese priority Application No. H11-196794 filed July 9 , 1999 is hereby incorporated by reference into the present application.

[0064] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is ,therefore, to be understood that within the scope of the appended claims , the invention may be practiced otherwise than as specifically described herein.

20

25

30

35

40

45

50

55

Table 1

	Sub cutting tooth portion			Corner tooth portion			Shock resistant property				
	Width L2	Angle β	Height M1	Width L3	Angle $\gamma 1$	Height M2	f=0.12	f=0.16	f=0.20	f=0.24	f=0.28
Conventional example①	0.12	-20	3.926	0.12	-20	3.926	○	○	42		
Example①	0.12	-8	3.953	0.12	-20	3.926	○	○	○	80	
Conventional Example②	0.20	-8	3.942	0.20	-8	3.942	14	42			
Conventional Example③	0.2	-20	3.897	0.20	-20	3.897	○	○	○	60	
Conventional Example②	0.2	-8	3.942	0.20	-20	3.897	○	○	170	80	
							○	○	○	○	95

Main component force	Cutting resistance			Finished surface	
	Feed component force	Back component force	Rz	Visual	
315	380	195	7.5	Scratch small	
275	315	125	4.2	Scratch free	
260	305	120	8.2	Scratch small	
320	405	220	13.5	Scratch	
295	365	115	4.3	Scratch free	

Shock resistant property W:SCM440 V=200m/min $a_p=2.5\text{mm}$ $f=Var.$

Cutting resistance W:SCM440 V=200m/min $a_p=2.0\text{mm}$ $f=0.2\text{mm/tooth}$

Finished surface W:SCM440 V=200m/min $a_p=2.0\text{mm}$ $f=0.2\text{mm/tooth}$

Claims

- 5
1. The cutting insert characterized by making the honing angle over the corner tooth which connects the main cutting tooth and a sub cutting tooth is larger than each honing angle over the main cutting tooth and the sub cutting tooth.
 2. The cutting insert characterized by making the height from the seat face of corner tooth connected to the main cutting tooth with the sub cutting tooth is lower than the sub cutting tooth in the cutting insert for which it comes to form a honing face in a cutting tooth.
 - 10 3. The cutting insert of the claim 1 characterized that the honing angle α over the main cutting tooth is set in the range of $0^\circ < \alpha < 60^\circ$, and the honing angle β over the sub cutting tooth is set in the range of $0^\circ < \beta < 60^\circ$, and the honing angle γ over the corner tooth is set in the range of $5^\circ < \gamma < 80^\circ$.

15

20

25

30

35

40

45

50

55

Fig.1

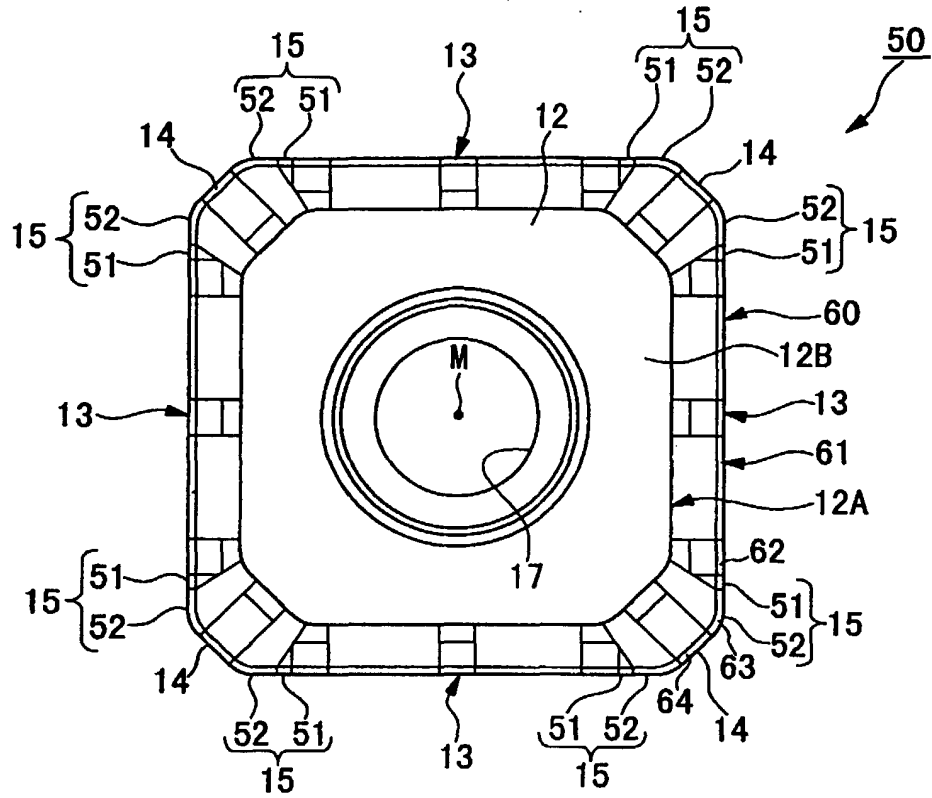
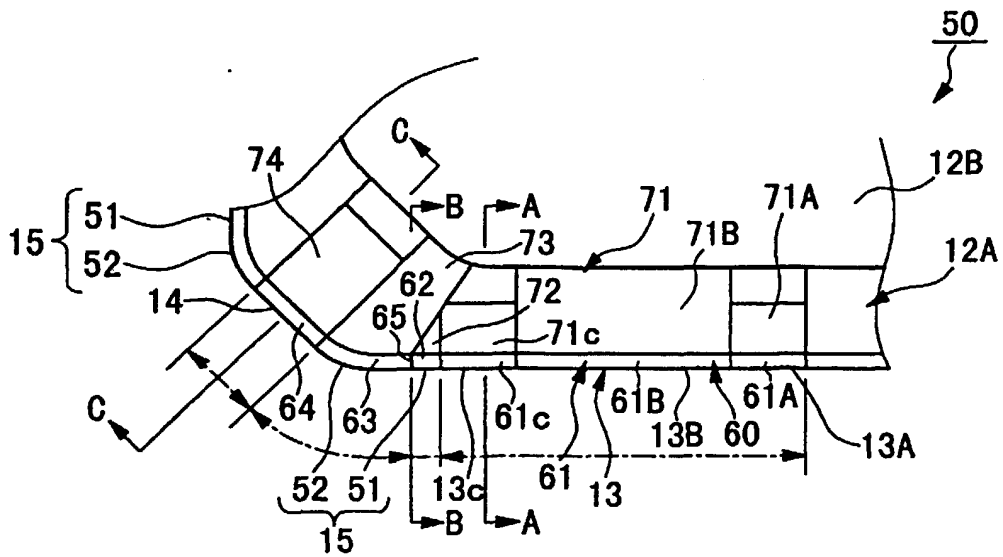
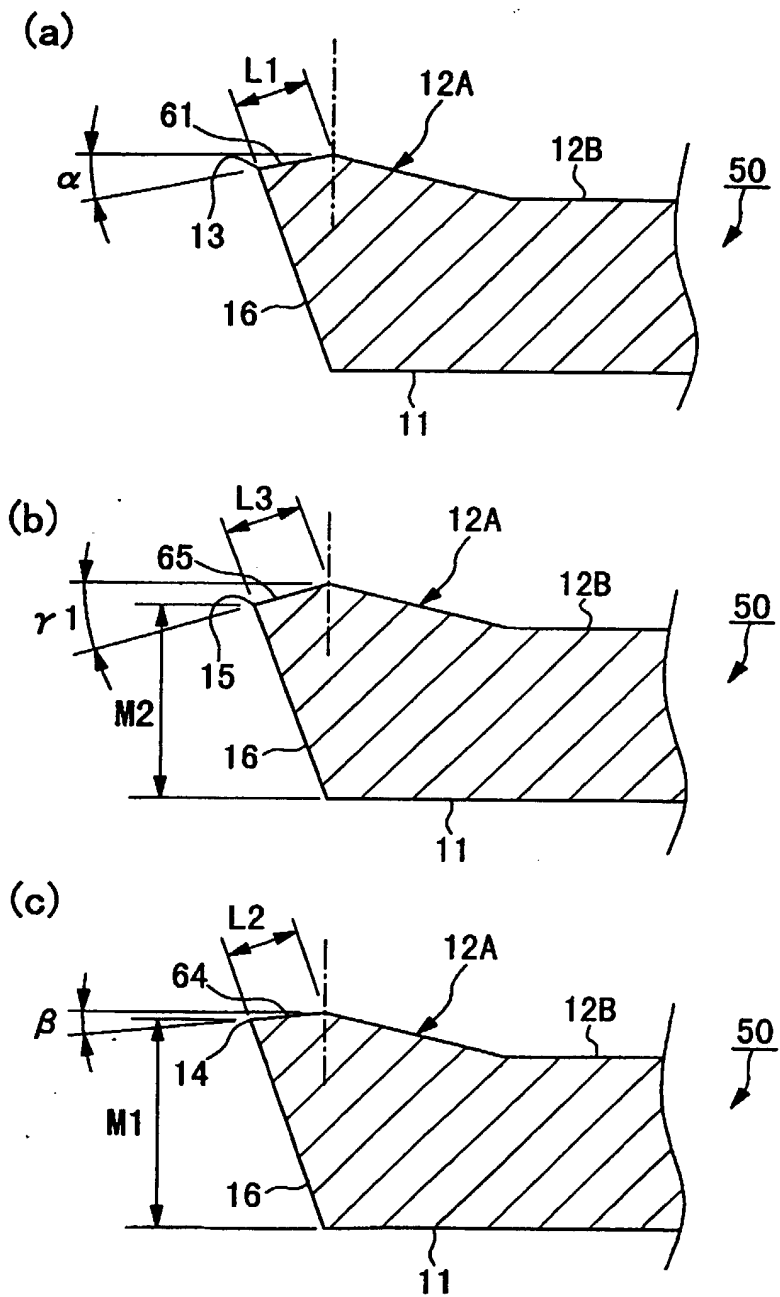


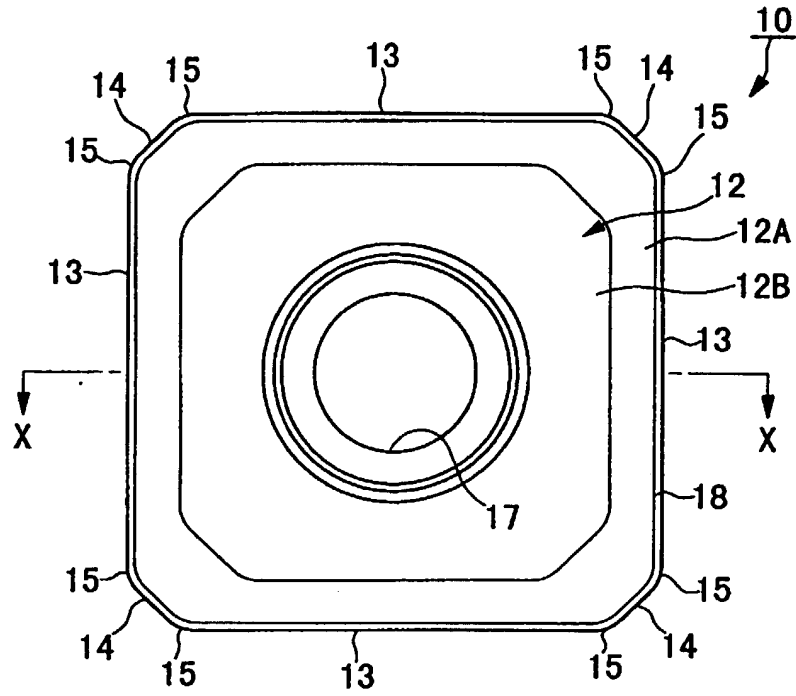
Fig.2



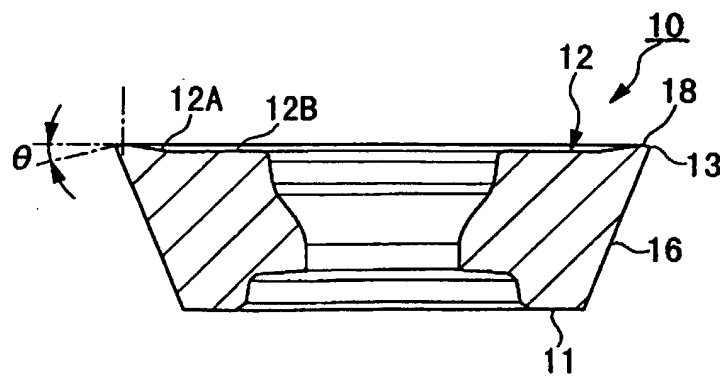
Fig,3



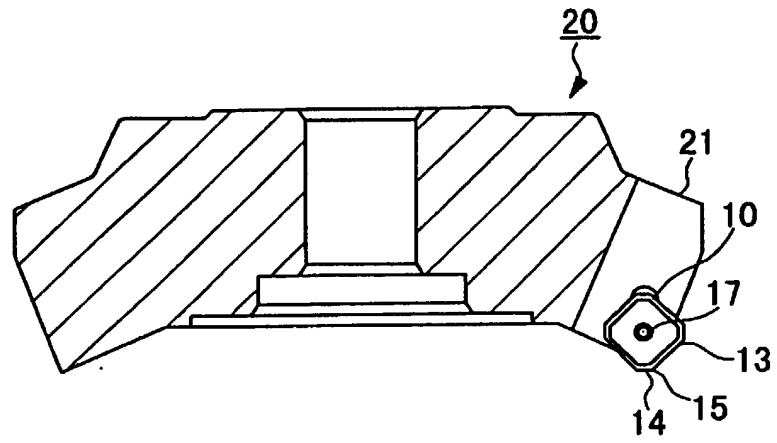
Fig,4



Fig,5



Fig,6



PUB-NO: EP001066903A2
DOCUMENT-IDENTIFIER: EP 1066903 A2
TITLE: Cutting insert
PUBN-DATE: January 10, 2001

INVENTOR-INFORMATION:

NAME	COUNTRY
HIROSE, TAKESHI	JP
KITAGAWA, YOSHIHIRO	JP
HASEGAWA, KEN	JP
SUZUKI, YUUCHI	JP

ASSIGNEE-INFORMATION:

NAME	COUNTRY
MITSUBISHI MATERIALS CORP	JP

APPL-NO: EP00114067
APPL-DATE: July 6, 2000

PRIORITY-DATA: JP19679499A (July 9, 1999) , JP2000140972A (May 12, 2000)

INT-CL (IPC): B23C005/22

EUR-CL (EPC): B23C005/22

ABSTRACT:

CHG DATE=20010202 STATUS=O>&ORDF;&ORDF;&ORDF;&ORDF;The sub cutting tooth is formed between the two adjoining main cutting tooth, and the corner tooth connecting the main cutting tooth and sub cutting tooth, and the corner tooth is formed both from the approximately straight line like 1st corner tooth and approximately circular like 2nd corner in order from the main cutting tooth side toward sub cutting tooth side , and the honing over all perimeter of the ridge line is formed and it may get a slope down toward the outside of the cutting insert, and the 1st honing angle of the 1st honing by which the intersection ridge line portion with the side face is made the main cutting tooth is made larger than the 2nd honing angle of the 4th honing by which the intersection ridge line portion with the side face is made the sub cutting, tooth, and the 3rd honing angle in the intersection portion of the 2nd honing and the 3 rd honing is made larger than the 1st honing angle .