(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 204 678**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **86850195.8**

(22) Date of filing: **02.06.86**

(51) Int. Cl.⁴: **B 28 D 1/18**
B 23 D 61/04

(30) Priority: **05.06.85 SE 8502779**

(43) Date of publication of application:
10.12.86 Bulletin 86/50

(84) Designated Contracting States:
BE CH DE FR GB IT LI

(71) Applicant: **Craelius AB**
Box 504
S-195 01 Märsta(SE)

(72) Inventor: **Andersson, Stephan Ingvar**
Frejgatan 31
S-195 00 Märsta(SE)

(74) Representative: **Westerlund, Christer et al,**
L.A. Groth & Co Patentbyra AB Västmannagatan43
S-113 25 Stockholm(SE)

(54) **A cutting tool.**

(57) A cutting device comprising a rotatable carrier element and a plurality of abrasive cutting segments attached thereto. Each of the segments (4) has an angular cross-sectional shape, and presents one leg (5) which is attached to the periphery (2) of the carrier element (1), and a further leg (6) which is attached to one of the carrier element surfaces adjoining the periphery.

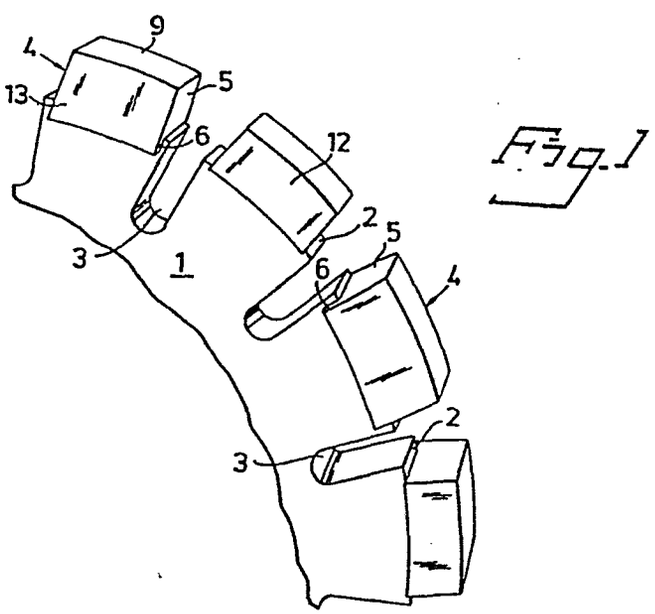


Fig. 1

EP 0 204 678 A1

DESCRIPTION

A CUTTING TOOL

Technical Field

The present invention relates to a cutting tool which comprises a rotatable carrier element and a plurality of abrasive cutting segments attached thereto.

Background Prior Art

Cutting devices which comprise circular cutting discs to which abrasive cutting segments are attached are known to the art. One such cutting disc is retailed, for example, under the registered trademark TIGER. Each cutting segment has the form of a substantially parallelepipedic body made from a mixture of metal and diamond powders. The segment has two mutually opposing surfaces which are either curved or straight, and is brazed to the disc, namely to its periphery, through the intermediary of one of said surfaces. The thickness of the segment, as seen at right angles to the rotational direction of the disc, is slightly larger than the thickness of the disc, in order to prevent the disc from jamming or bindning in the workpiece, and to avoid damaging the disc and/or said workpiece. As the segment becomes worn in use, the height or vertical extension of the segment decreases to the same extent as its thickness, which often means that the segment cannot be utilized fully before it is necessary to replace the segment or to scrap the disc. In addition, it is necessary to manufacture and store large numbers of segments of mutually different thicknesses in order to have available segments which will fit cutting discs of varying thicknesses and diameters.

Cutting devices which comprise rotating tubular drill bits to which abrasive cutting segments are attached are also known in the art. One such drill bit is retailed under the registered trademark PIXIE. Each

segment has the form of a slightly curved, U-shaped body incorporating, inter alia, synthetic diamonds. The free legs of the U-shaped body and the web connecting said legs are brazed respectively to the tubular wall of the drill bit and to the peripheral side edge thereof. The most serious drawback encountered with drill bits of this construction is that it is necessary to manufacture and store large numbers of mutually different segments, since one segment will fit solely a bit of given wall thickness and a given range of diameters.

The US-PS 3 261 384 teaches a circular saw blade with teeth for performing a cutting, chip removing operation. The purpose of making the teeth as angle segments is to balance the shear forces. Special seatings on the saw body are required, which must withstand the large forces. The leg 46 in Figs. 10 - 12 has the sole task of centering the cutting edges on the saw body, and do not participate in sawing. Due to its asymmetric shape the segment cannot be mounted on the saw body so that said leg comes into engagement with either side of the saw body.

The DE-PS 356 554 teaches a circular saw blade for performing a cutting, chip removing operation with the aid of edges on segments which are attached in specially shaped grooves on the saw body. Two differently shaped segments must be used, if they are to be mounted on both sides of the saw body.

The SE 341 799 teaches a circular saw blade with segment teeth for cutting, chip removing operation. Each segment is substantially U-shaped and comprises two or three parts, jointed mutually and to the saw body by rivets. The radially inward legs do not engage against the flat surface of the saw body (so as to be worn at approximately the same rate as the other legs); instead they are inserted in recesses at the periphery of the saw body. For each thickness of saw body there

is further required a segment with appropriately suited thickness.

The DE-AS 2 333 246 teaches a side milling cutter with parallelepipedic cutting bits for chip removing operation, which are attached by clamping bodies in recesses in the milling cutter body.

The segments according to the four last-mentioned publications all perform a chip removing cutting operation with the aid of a specially ground and angled cutting edge. The segments have been given a shape enabling replacement of worn and/or damaged segments, and provide setting of the cutting edges in an accurate, predetermined position.

Summary of the Invention

It is an object of the present invention to eliminate at least partially the drawbacks of prior are cutting devices of the aforedescribed kind and like devices, and to provide a rotating cutting device having abrasive cutting segments which a) can be readily manufactured and utilized fully before needing to be replaced, b) present a relatively large surface so as to facilitate attachment to the carrier element of the device, c) can be used with any carrier element thickness whatsoever, and d) can be fastened to the periphery of the carrier element without need for cooperating notches and projections on the segments and element, respectively.

This object is achieved with a cutting device constructed in accordance with the invention and having the characteristic features set forth in the characterizing clauses of the following claims.

Brief Description of the Drawings

Figure 1 is a perspective view of part of a cutting device according to the invention, comprising a cutting disc provided with abrasive cutting segments which are thicker than the disc;

Figure 2 is an end view of a cutting device according to the invention, comprising the cutting segments of Fig. 1 attached to a thicker disc;

Figure 3 is a perspective view, in larger scale, of one of the cutting elements illustrated in Fig. 1 or Fig. 2, said segment being provided with a fractural impression; and

Figure 4 illustrates to the left of said figure, and in partial cross-section, a cutting disc provided with a conventional cutting segment, and to the right of said figure, also in partial cross-section, a cutting disc provided with a cutting segment according to the invention.

Description of a Preferred Embodiment

The cutting device, shown partially in Fig. 1, comprises a circular steel cutting disc, or so-called rondel 1, having a peripheral surface 2 broken by slots 3, so-called water slots, utilized to cool abrasive cutting elements 4 attached to the rondel between respective slots.

The cutting segments are moulded from a mixture of metal and diamond powders. Each segment 4 has an angular cross-sectional shape and comprises two mutually perpendicular legs 5 and 6, which have a constant thickness along the whole of their lengths. The upper and lower surfaces 9 and 7 of the illustrated leg 5 and the lower surface 8 of the illustrated leg 6 are slightly curved in the longitudinal direction, at least the radius of curvature of the surface 7 corresponding to a mean radius of curvature of the peripheral surfaces of those cutting discs, or rondels, to which the segments are to be fitted. The remaining surfaces of the segments are preferably planar.

The thickness or width of the leg 5 (geometric extension a in Figs. 2 and 3) is not critical and can be chosen to accommodate widely varying rondel thicknesses. In the illustration of Fig. 1 the segments 4

are attached to a rondel 1 which has a thickness smaller than the geometric extension a, whereas in the illustration of Fig. 2 the segments 4 are attached to a rondel 11 which has a thickness equal to or greater than the extension a.

The segments 4 are either brazed or glued to the rondels 1 and 11. Glueing is made possible by the fact that a relatively wide area of each segment is attached to respective rondels 1 and 11, namely the surface 7 of the leg 5, which seats on the peripheral surface 2 of the rondel, and a surface 16 which adjoins the surface 7 and extends at right angles thereto, said surface 16 being attached to the planar side surface of the rondel adjacent the peripheral surface 2.

In order to enable the cutting device to cut, by abrasion, a workpiece with both sides of the rondel 11, and to balance the cutting device of Fig. 1 or Fig. 2 against axially acting forces, the leg 6 of each alternate segment is placed against one side of the rondel and the leg 6 of each other segment against the opposite side thereof, as illustrated in Figs. 1 and 2. If an odd number of segments is preferred, one segment can be divided into two equal parts along the serrated line 15 in Fig. 3, so as to avoid possible problems with imbalance. In this case, a notch 14 can be made centrally on the leg 6, so as to facilitate fracture of the segment along said line and to avoid damage to the segment during the fracturing process. These segment halves are then placed adjacent one another with their legs on respective sides of the rondel.

As will be understood from the aforegoing, when the width of the rondel is smaller than the width of the segments 4, as with the Fig. 1 embodiment, the side surface 12 of respective segments remote from the leg 6 will project radially outwardly from the rondel to a greater extent than the surfaces 13 adjacent the

leg 6, and hence the workpiece will be cut, by abrasion, with the surfaces 12 when brought into abutment with the rondel. On the other hand, when the rondel has a width greater than that of the segments 4, as with the Fig. 2 embodiment, it is the side surfaces 13 adjacent respective legs 6 which protrude furthest from the rondel and which consequently engage the workpiece to be cut.

When the segments 4 are subjected to wear, the peripheral surfaces 9 of the segments become worn, i.e. the segments decrease in height, more quickly than do the segment side-surfaces with which the workpiece is cut, since the leg 6 of respective segments is given a thickness and a wear-resistance commensurate with the material to be worked. Consequently, with the embodiment illustrated in Fig. 2, which is by far the one most used, parts of the leg 6 will still remain when the leg 5 has been worn right down to the peripheral surface 2 of the rondel 11, which prevents the cutting disc from jamming or binding the workpiece and/or avoids damage to the workpiece and to the rondel. In the case of the Fig. 1 embodiment, however, unless the rondel is excessively thick, the extension a will decrease first by abrasion of the vertical cutting surface 12, shown in Fig. 3, down to the plane of the cutting surface 13, whereafter both surfaces 12, 13 are worn down to equal extents with a commensurate decrease in the extension a. If it is desired that wear on the vertical surface 13, or at least on the leg 6, is less rapid than that on the vertical surface 12, the leg 6 may have incorporated therein a material which has a greater resistance to wear than the material in the remainder of the segment 4.

The table below illustrates the results obtained when comparing a typical, conventional parallelepipedic segment K with a comparable segment 4 constructed in accordance with the invention, this comparison being

given with reference to Fig. 4. Each of the two segments is assumed to have a nominal height of 6 mm and a length of 35 mm, and the leg 5 of the segment 4 according to the invention is assumed to have a height or vertical extension of 2.5 mm.

Table

	Conventional segment K		Segment 4 according to the invention		Sort
Total cutting width	3.5	7.0	3.5	7.0	mm
Cutting surface	123	245	123	123	mm^2
Clearance b	0.3	0.5	0.75	0.75	mm
Clearance surface					
Initial	420	420	508	298	mm^2
Final	0	0	88	88	mm^2
Segment volume	735	1470	802	801	mm^3
Brazed surface or glued surface	102	210	158	184	mm^2
Brazed surface/ unit volume	0.14	0.14	0.20	0.23	
Relative costs	x	y	0.09 x	0.54 y	SEK

The table makes clear the following facts, among other things.

The cutting surface is smaller with a broad segment according to the invention than with a corresponding conventional segment, which may result in enabling lower tool feed forces to be used. The clearance is greater with the segment according to the invention, which reduces the risk of binding or jamming. A larger clearance on the part of the conventional segment can only be obtained at the cost of a smaller attachment surface against the periphery of the rondel. The clearance obtained with the segment according to the invention prevails until the segment is

totally worn. The segment according to the invention does not increase in volume with increasing cutting widths, which results in lower material costs than would otherwise be the case, and also means that less force is required for feeding the tool. The brazing or glueing surface on the segment according to the invention is maximal in relation to the volume and weight of the segment, which is important since the segments are subjected to large centrifugal forces. The 9 % higher cost of the thinner segment according to the invention is justified by the beneficial clearance obtained, and is compensated for by the possibility of using a thinner rondel.

It will be understood that the present invention is not restricted to the described and illustrated embodiment, and that the invention is solely limited by the scope of the following claims.

CLAIMS

1. A cutting device comprising a rotatable carrier element and a plurality of single-piece abrasive cutting segments (4) attached to said carrier, each of the segments having an angular cross-sectional shape with two mutually perpendicular legs, characterized in that the one leg (5) is attached to the periphery (2) of the carrier element (1; 11) and that the other leg (6) lies solely against, and is attached to one carrier-element surface adjoining said periphery; in that the longitudinal axes of respective segments extend in the rotational direction of the carrier element; in that all segments are identical; and in that the other leg (6) of certain segments (4) is attached to one carrier-element surface adjoining the periphery (2) while said other leg on certain other segments is attached to the other of the mutually opposite carrier-element surfaces adjoining the periphery (2), such that the other leg projects in its entirety beyond the outer confinement line of the carrier element at right angles to the rotational direction thereof.

2. A cutting device according to Claim 1, characterized in that the other leg (6) of each alternate segment (4) is attached to one of the two mutually opposing carrier element surfaces, while the said other leg of the remaining segments is attached to the other of said mutually opposing carrier-element surfaces.

3. A cutting device according to any of the preceding claims, characterized in that the thickness of the segment (4) at right angles to the rotational direction of the carrier element (1; 11) is smaller than the thickness of the carrier element.

4. A cutting device according to any of the preceding claims, characterized by at least one fractural weakening (14) in the said other leg (6) of the segment

(4), preferably in the form of a notch located centrally between the two ends of said leg.

5. A cutting device according to any of the preceding claims, characterized in that at least one of the two legs (5, 6) of the segment (4) is attached to the carrier element (1; 11) by glueing or brazing.

6. A cutting device according to any of the preceding claims, characterized in that the carrier element (1; 11) has the form of a circular cutting disc.

7. A cutting device according to any of Claims 1 - 5, characterized in that the carrier element comprises a tubular drill bit.

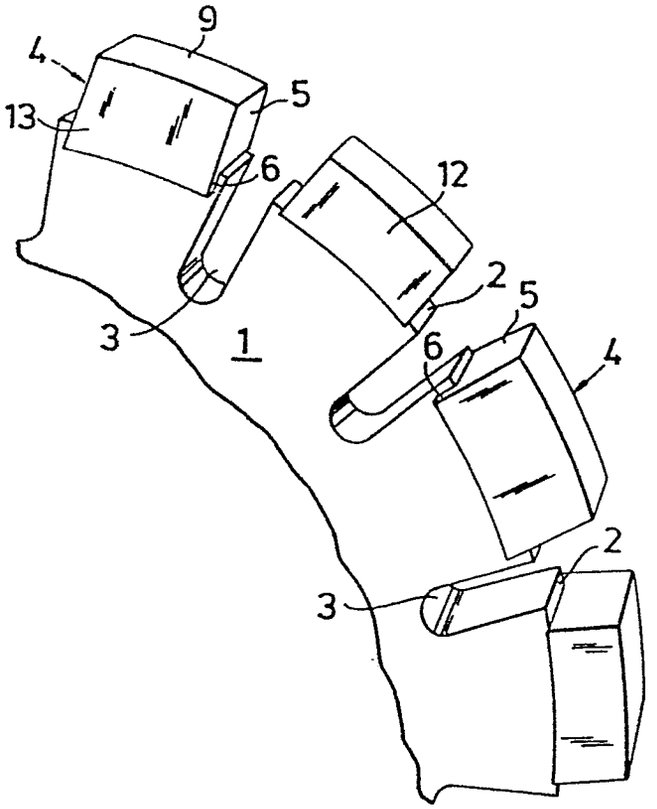


Fig. 1

Fig. 2

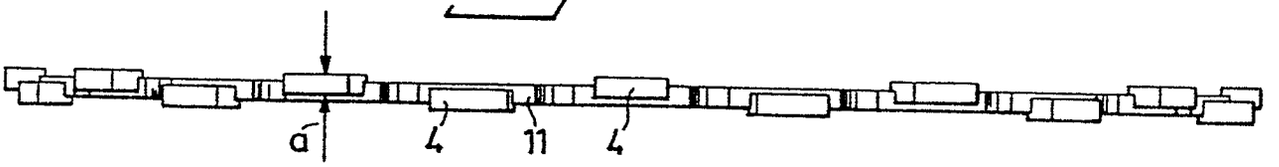


Fig. 3

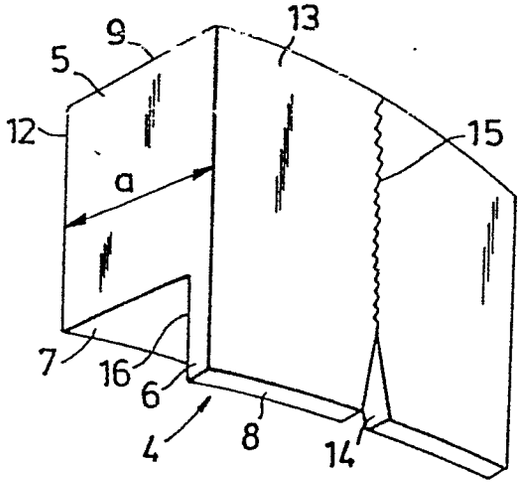
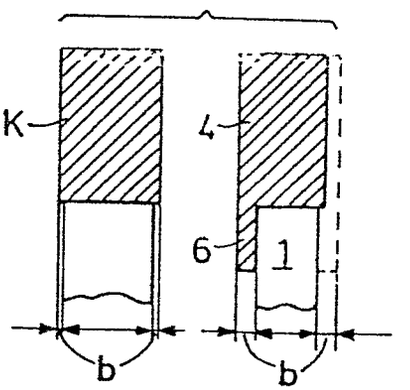


Fig. 4



European Patent Office

EUROPEAN SEARCH REPORT

0204678
Application number

DOCUMENTS CONSIDERED TO BE RELEVANT

EP 86850195.8

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	AT - B - 232 825 (AD. LEIMGRUEBER) * Fig. 4; claim 1 * --	1,5,6	B 28 D 1/18 B 23 D 61/04
A	CH - A5 - 577 365 (TYROLIT) * Fig. 4 * --	1,6	
A	CH - A - 425 595 (FREDERICK) * Fig. 6; claims I,II * --	1,5,6	
A	US - A - 4 291 667 (EICHENLAUB) * Fig. 2,3; claims 2,3,5 * --	1,5,6	
A	GB - A - 1 060 405 (IMPREGNATED) * Fig. 3,4 * --	1,6	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US - A - 2 811 960 (P. FESSEL) * Fig. 1-8 * --	1,3,6	B 23 D 61/00 B 28 D 1/00 B 23 C 5/00 B 24 D 5/00 B 24 D 13/00
A	DE - A1 - 3 220 576 (BSB BIEDRON) * Fig. 1; page 5, lines 14-19 * ----	1,5,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	02-09-1986	NIMMERRICHTER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82