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EUROPEAN PATENT APPLICATION

21 Application number: **89850179.6**

51 Int. Cl.⁵: **E 01 C 23/09**
B 28 D 1/12

22 Date of filing: **31.05.89**

30 Priority: **06.09.88 US 241036**

43 Date of publication of application:
14.03.90 Bulletin 90/11

84 Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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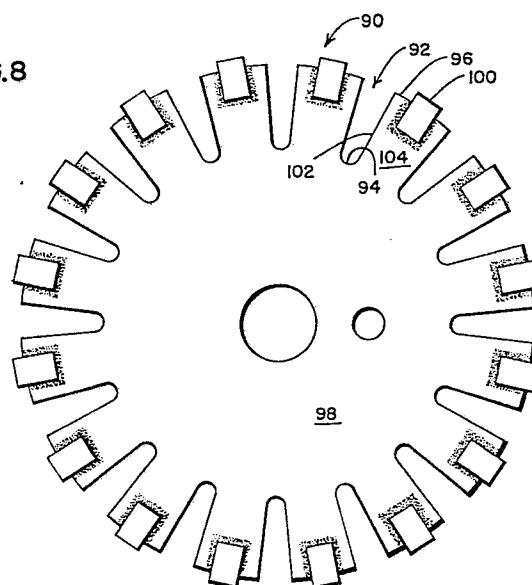
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54 **Diamond saw blade.**

57 A blade having (32, 72, 98) a core with heat notches (40, 44, 80, 92) separating wear surfaces and diamond impregnated segments (34, 11, 100) soldered in notches in the wear surfaces (36, 38, 74, 78, 96). The blade is useful to cut and widen cracks or pins in asphalt and concrete surfaces. The wide diamond segments require the mechanical lock of the notches to hold them to the core.

FIG.8



Description

DIAMOND SAW BLADE

Field of the Invention

This invention relates to diamond abrasive saw blades for enlarging cracks or joints in asphalt or concrete surfaces.

Background of the Invention

Cracks and joints in asphalt or concrete surfaces are a symptom of deterioration of those surfaces. Proper treatment of cracks and joints limits deterioration thus avoiding the need for more costly replacement.

The repair of cracks and joints includes widening and then filling with some type of sealer or other filler. the widening of the cracks and joints is commonly done by cutting them to a uniform width and depth with a saw blade.

Various cutting blades use diamond impregnated segments on the circumference of a disk because of the effectiveness of those segments for cutting asphalt or concrete. Problems encountered include the required use of bulky, expensive cooling fluid systems, methods of attaching the diamond segments to the disc, the width of the segments because cracks vary in width from 1/8" to 1" or larger, and wear on the disc from debris loosened by the cutting.

The basic method of producing the diamond-impregnated segments is through hot or cold molding. Segments are molded straight or to conform to the radius of the disc. A combination of soft and hard materials is used to hold the diamond pieces and to alter any "break-in" period for new segments. U.S. Patent No. 3,443,343 describes several production methods. A constraint in the manufacture of diamond-impregnated segments is that diamond distribution and density of the powder metals used can be controlled only if the depth and width of the segments do not exceed certain dimensions, typically .500 for width. Hence, although segment length may be variable, other dimensions are limited.

To make use of as much depth as possible and hence provide the blade as great a lifetime as possible, the most common method of attaching diamond segments to a core is to attach arcuately formed segments flush to the outer radius of the core disc with silver solder. In this case, the blades must be used with substantial cooling fluid because friction-caused heat can melt the silver solder and cause a premature failure of the blade. The most common cooling fluid is water, and systems range from self-contained units to those requiring large quantities of water supplied by water trucks. Various systems are described in U.S. Patent No. 4,676,557 and seem to be characterized by being bulky and/or expensive. A significant disadvantage of needing a great amount of cooling in the form of fluids is that

the cracks must be allowed to dry for up to several days and then cleaned before being sealed.

Another method of constructing blades uses diamond segments formed on a wrought iron base. The iron base is then machined and welded to the outer radius of the core disc, see U.S. Patent No. 3,590,535. The disadvantage of this method is the increased production costs of both forming the segments and attaching them to the outer radius of the core.

Wear on the core is a problem that has also been approached. The wear is caused by debris formed during cutting acting as an abrasive on the disc. The disc's thickness is reduced until it eventually fails due to mechanical loads produced during cutting. The segments formed on a wrought iron base allow for variations in the thickness of the metal base to control wear on the disc. An irregular shape is produced as the wrought iron base wears disrupting the flow of debris and limiting its abrasive effect. See U.S. Patent No. 3,590,535 for a full explanation of the process.

Another attempt to control the abrasive action of the debris is detailed in U.S. Patent No. 3,763,601. It involves the use of additional wear-resistant segments (similar to those impregnated with diamonds) set radially into the disc to carry the debris with the blade. A disadvantage of this approach is the additional cost of production associated with producing the radial segments and attaching them to the disc.

Summary of the Invention

The present invention addresses the problems inherent in this type of blade in a new way. The present blade is comprised of a core of metal or other suitable material formed with a plurality of transversely oriented segments fastened in wear surfaces and separated by heat-relief notches around the periphery of the core. More particularly, each of the wear surfaces includes a radial slot to mechanically attach the transverse oriented, diamond-impregnated segments. A key advantage of the transverse orientation of the diamond segments is that the segments are wider (can be as wide as prior art segments are long), and a wider kerf can be cut. The wider kerf generally serves as a better preparation for repair of joints and cracks, especially where the cracks are jagged and/or non-uniform in width. The segments can be oriented to produce a wider kerf because they are set into slots in the core in addition to being soldered. Since the diamond segments are set into slots, the amount of segment protruding from the periphery of the core is limited to a small amount for break in only. During operation, the core is allowed to wear at the wear surfaces at the same rate as the diamond segment. Such wear produces much heat and one would think substantial cooling would be needed. The need for substantial

cooling, however, is avoided by including heat relief notches between consecutive surfaces.

Another advantage of the paddle-like orientation of the diamond-impregnated segments is that it results in a dispersal of the debris created by the cutting; the dispersal being over a wider area generally towards the center of the core. The debris dispersal reduces the abrasive effect on the disc thereby postponing mechanical failure and extending the useful life of the blade.

One embodiment of the present blade includes the wear surfaces with diamond-impregnated segments and the heat relief notches spaced uniformly around the periphery of the core.

An alternate embodiment is similar but includes angular sections of the core removed resulting in fewer cutting surfaces which allows for greater maneuverability. This embodiment has the advantage of allowing for greater heat dissipation and may also be useful where large amounts of debris are produced during cutting.

These various advantages and other objects obtained by this invention are further explained and may be better understood by reference to the drawings and to the descriptive matter thereafter in which a preferred embodiment of the invention is described in detail.

Brief Description of the Drawings

Figure 1 is a side elevational view of the most common prior art diamond-impregnated cutting blade;

Figure 2 is a cross-sectional view taken along line 2-2 of Figure 1;

Figure 3 is a side elevational view of an experimental diamond-impregnated cutting blade;

Figure 4 is a cross-sectional view taken along line 4-4 of Figure 3;

Figure 5 is a side elevational view of the preferred embodiment of this invention;

Figure 6 is a cross-sectional view taken along line 6-6 of Figure 5;

Figure 7 is a side elevational view of an alternate embodiment of this invention; and

Figure 8 is a side elevational view of another alternate embodiment.

Detailed Description of the Preferred Embodiments

Referring now to the drawings wherein like reference numerals designate identical or corresponding parts throughout the several views, and more particularly to Fig. 1, the most common prior art type of diamond-impregnated cutting blade is designated generally by the numeral 10. The core 12 is formed with a circular periphery of the desired diameter. The usual core material is a mild steel such as 1020 or 1040. The arcuate diamond-impregnated cutting segments 14 are attached flush on the periphery of the core 12 at even intervals. The

segments 14 are attached with silver solder 16 because the heat generated by other methods would warp the core 12. During use the debris formed from cutting flows under the segments 14 and causes the core 12 to wear away at position 18 (see Figure 2) because of its abrasive nature. If used long enough, the wear at position 18 causes the core 12 to fail.

A non-prior art, experimental prototype blade 20 with a variation of the assembly in Figure 1 is shown in Figure 3. The arcuate diamond-impregnated cutting segments 24 are mounted in limited depth recesses formed in the periphery of the core 22. The recesses aid in preventing segment loosening, but still limit segment width. Although segments 24 are attached more securely than the flush-mounting shown in Figure 1, the wear pattern is not substantially changed as shown in Figure 4. The core 22 eventually fails at position 28 when the debris abrades enough of the core 22 to cause mechanical failure.

Turning now to Figure 5, the changes from both the most common construction shown in Figure 1 and the experimental construction shown in Figure 2 offer substantial advantages for the cutting of asphalt and concrete in preparation for repairing joints or cracks. The core 32 is formed with a circular periphery of the desired diameter out of a mild carbon steel such as 1020 or 1040 or other suitable material. The diamond-impregnated cutting segments 34 are set in preferably equidistantly spaced radial slots milled or otherwise formed in the core 32. The segments 34 are set into the core 32 a length of B from the periphery and extend beyond the periphery a length of A. Both lengths can vary depending on the exact construction of the blade 30. After being set into the slots the segments 34 are silver soldered 42 in place.

The size of the segments 34 can vary within certain parameters as needed by the particular application. In general, the longitudinal length X is less than the radial length Y. This difference in length controls abrasive wear on the core 32 at position 46 by channeling the debris over a larger area. The change can best be seen by comparing Figure 6 to Figures 2 and 4, and more particularly position 46 with positions 18 and 28 in Figures 2 and 4. The net result is that the useful life of the blade is increased.

The width w (which would be the circumferential length in the blades of Figures 1-2) of the segments is shown in Figure 6. The radial slots formed in the core 22 and the silver solder 42 combine to attach the segments 34 securely enough to allow the width w to be greater in blade 30 than in the more common blade 10 (see Figure 1). The additional width w cuts a wider kerf thereby allowing better joint and crack preparation. It also creates a paddlewheel-type action of the blade with the segments 34 acting as paddles to help remove debris from the kerf.

Wear surfaces 36, 38 are located at the periphery of the core 32. The blade 30 is designed so that as the cutting segments 34 wear, so do the wear surfaces 36, 38 thereby retaining blade lifetime overall cutting effectiveness as diameter D decreases.

The core 32 also has heat relief notches 40, 44 formed around the periphery. The angle measured from a radial line can vary depending on the material being cut and the dimensions of the diamond cutting segments 34.

The depth of the heat relief notches 40, 44 as measured along a radial line is C and, in general, should be larger than the set in depth B of the diamond cutting segments 34. That will ensure that as the wear surfaces 36, 38 and the diamond cutting segments 34 wear with use, the heat relief notches 40, 44 remain effective because their minimum depth is (C-B).

The heat relief notches 40, 44 are a significant advantage in that by controlling heat build-up in the core 32 and segments 34, the blade 30 can be used without cooling fluids and accompanying delivery systems.

An additional benefit of the heat-relief notches 40, 44 is the way they transport debris out of the kerf. This action has the further benefit of controlling the wear on the core 32 at position 46.

An alternate embodiment blade is depicted in Figure 7. The blade 70 is essentially the same as the embodiment depicted in Figure 5 with annular sections of the core 72 removed. The remaining outer sections of the core 72 contain the wear surfaces 74, 78; diamond-impregnated cutting segments 76; and heat relief notches 80. Three removed angular sections and groups of remaining cutting segments 76 are preferably both evenly spaced. The exact configuration of removed angular sections, and remaining groups of cutting segments 76 can vary according to the material being cut.

The advantages of the alternate embodiment include a decrease in heat produced during use, greater turning maneuverability for following irregular cracks, and an increase in the ability to cut materials which produce large amounts of debris. The decreased heat production diminishes the possibility that the core 72 will warp or that the diamond cutting segments 76 will loosen due to melting of the silver solder 82. The increased ability to remove debris from the kerf also decreases abrasive wear on the core 72 as discussed for position 46 on Figures 5 and 6. Both the decreased heat production and increased debris-handling ability translates into the elimination of the need for cooling fluid and a longer useful life for the blade 20 in materials where cooling fluid would otherwise be required.

Another alternate embodiment, which is actually the preferred embodiment, is shown in Figure 8. Blade 90 is essentially the same as the embodiment depicted in Figure 5, except the heat relief notches 92 have a more advantageous shape. Each notch 92 is formed to have an arcuate bottom 94 which is spaced a distance from the wear portion 96 of core 98, a distance which is at least as great as the depth of diamond-impregnated segment 100, and preferably equal to about twice the depth of a segment 100. Although the sides 102 of each notch 92 may be parallel to one another, it is not necessary and it is actually preferable that sides 102 be inclined slightly toward one another so that extending portion 104 of

core 98 is not unnecessarily weakened by creating a neck in a region between successive notches inwardly from a diamond-impregnated segment 100.

Blade 90 with notches 92 is particularly advantageous since it has no sharp corners along the interior surfaces of the notches, thereby alleviating a tendency of fracturing near such corners. In addition, the width of notches 92 at the preferable depth allows for more efficient cuttings removal, even when diamond-impregnated segments 100 are near the end of their wear life. Furthermore, the substantial width of the notches even at a depth beneath the bottom or inwardly most side of diamond-impregnated segments 100, results in greater cooling.

Although similar blades and cutting instruments are known in the art, it has not been until the present invention that the problems of operating and maintaining fast, free cutting blades without cooling fluid, manufacturing the wider diamond-impregnated cutting segments, and controlling wear on the core of the blades have effectively been solved.

Thus, this present invention has been described with numerous characteristics and advantages set forth. It should be understood, however, that the disclosure is illustrative only, and changes made, especially in matters of shape, size, and arrangement, to the full extent extended by the general meaning of the terms in which the appended claims are expressed, are understood to be within the principle of the present invention.

Claims

1. A random crack saw blade, comprising:
a metal core adapted to be rotated about an axis of rotation, said core having a periphery with a plurality of wear surfaces and a plurality of heat relief notches, said core further having a slot in each wear surface;
and a plurality of diamond-impregnated segments; and
means for fastening one of said diamond-impregnated segments in each of said slots;
whereby both said diamond-impregnated segments and said wear surfaces can wear, said notches providing heat relief when said wear surfaces of said core wear.

2. The blade in accordance with claim 1 wherein each of said segments includes a leading side and a cutting surface, said leading side having a depth, said cutting surface having a length, each of said segments having said depth greater than said length.

3. The blade in accordance with claim 1 wherein each of said segments includes a leading side and a cutting surface, said leading side having a width, said cutting surface having a length, each of said segments having said width greater than said length.

4. The blade in accordance with claim 1 wherein said segments are located in regularly spaced groups, said core being formed to have a hub and cutting areas extending therefrom for said groups and cut-away portions between

said cutting areas.

5. A random crack saw blade, comprising:
a metal core adapted to be rotated about an
axis of rotation;
a plurality of diamond-impregnated segments;
means for fastening said diamond-impregnated
segments to the periphery of said core, said
fastening means including means for mechan-
ically locking each of said segments to said
core, said locking means including portions of

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said core which necessarily wear away as said
segments wear away, said core including a heat
relief notch between adjacent segments.

6. The blade in accordance with claim 5
wherein said diamond-impregnated segments
have a depth and wherein said heat relief
notches include arcuate bottoms space about
twice said segment depth from said wear
portions of said core.

FIG. 1
(PRIOR ART)

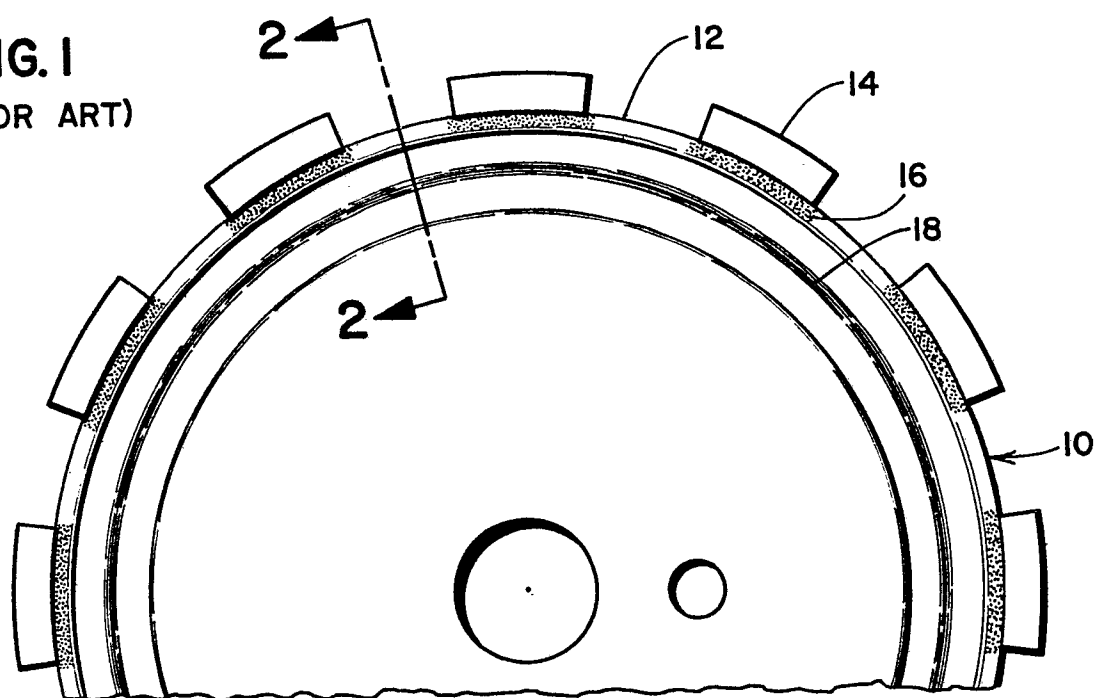


FIG. 2
(PRIOR ART)

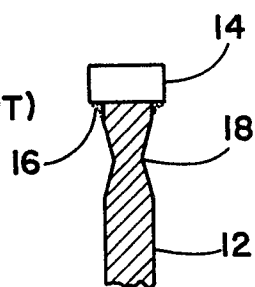


FIG. 4

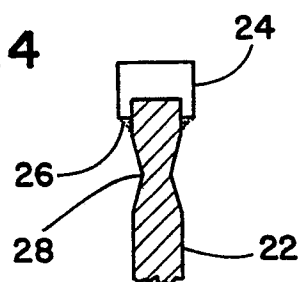


FIG. 3

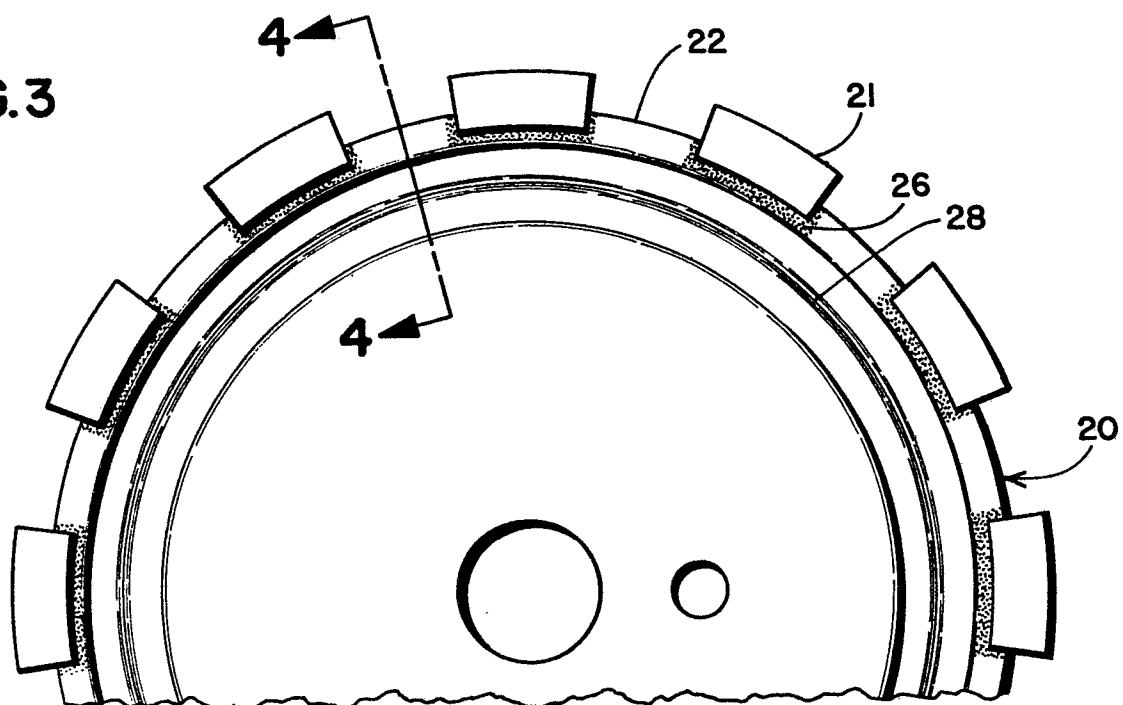


FIG.5

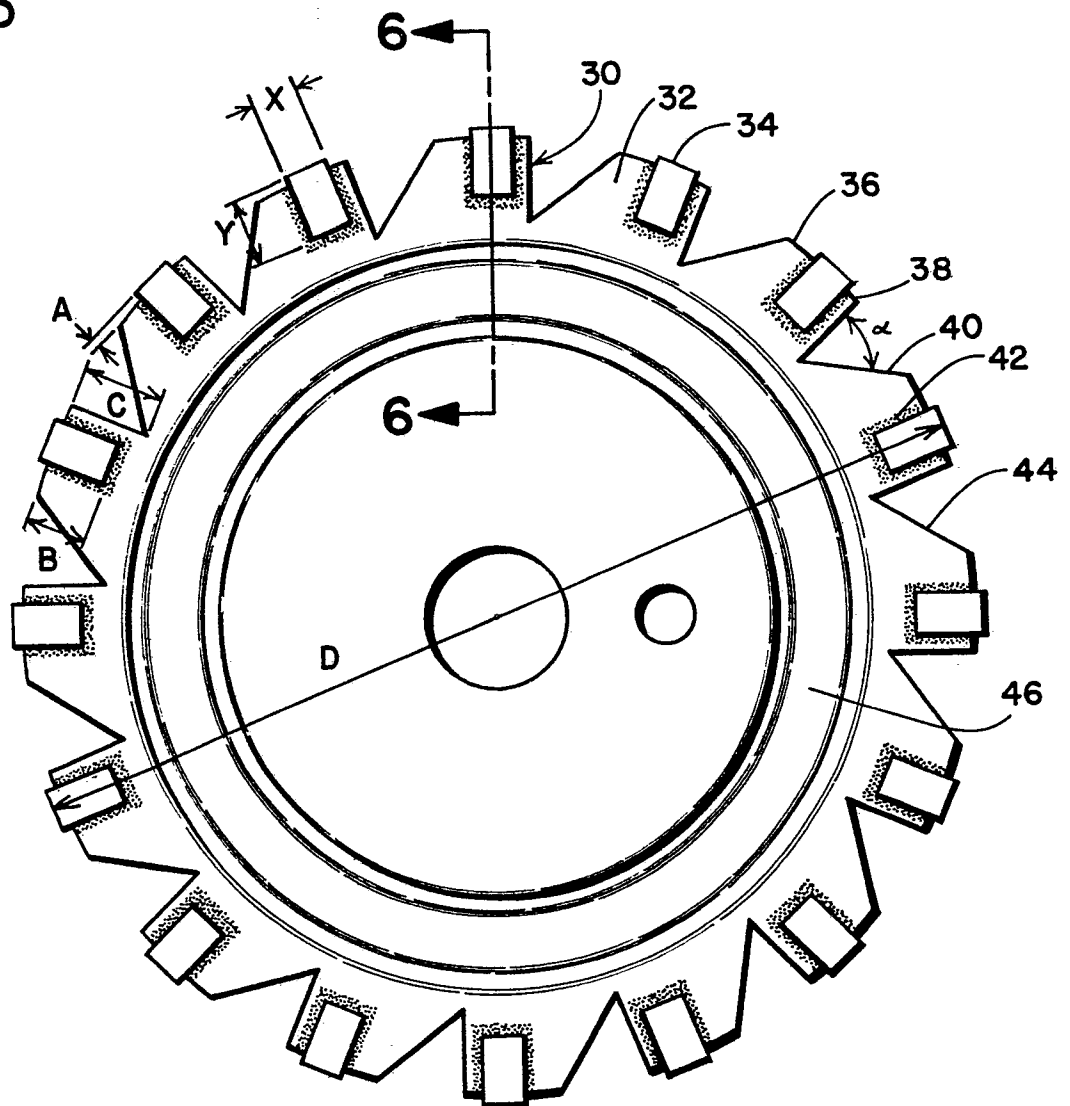


FIG.6

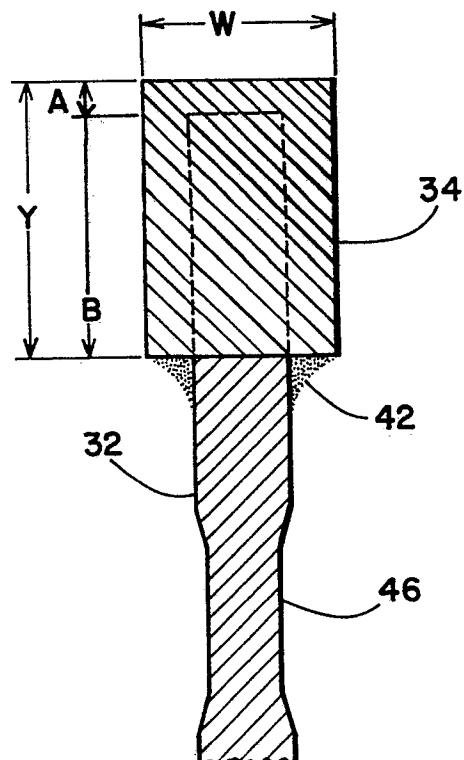


FIG. 7

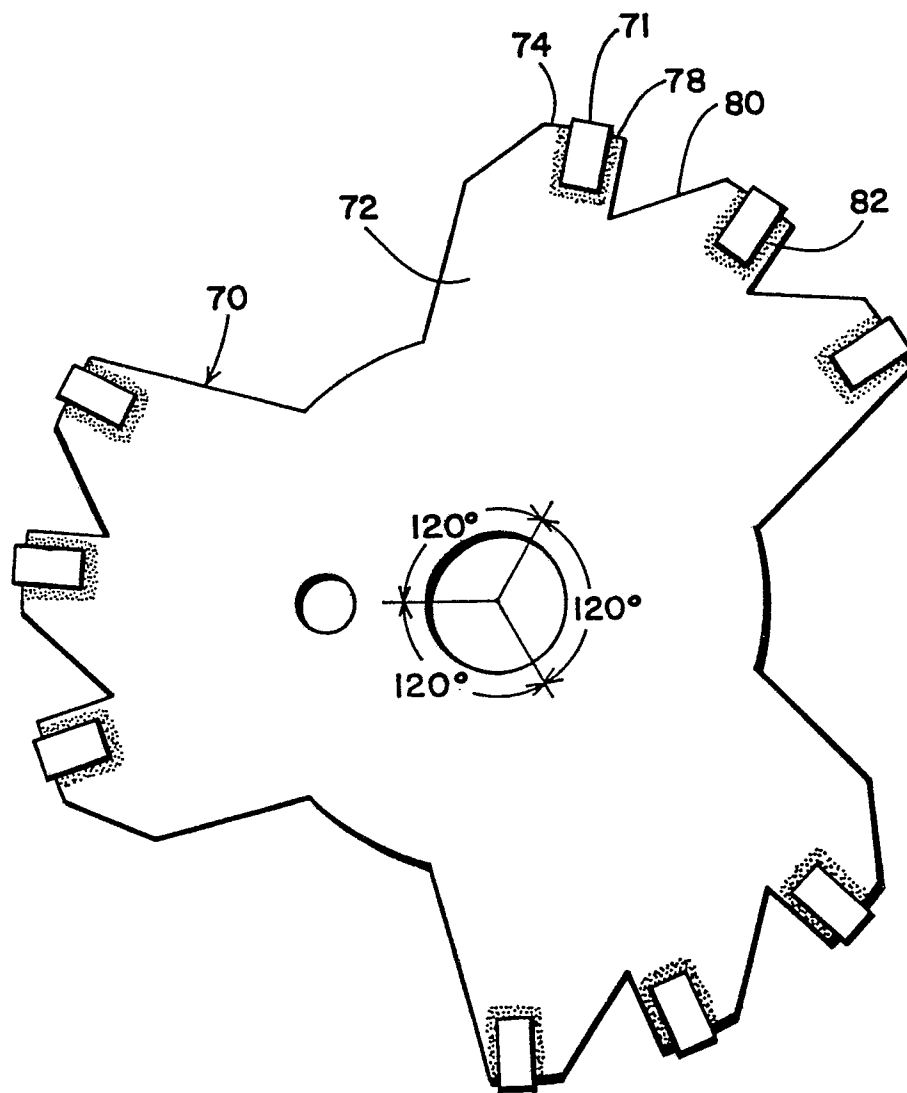
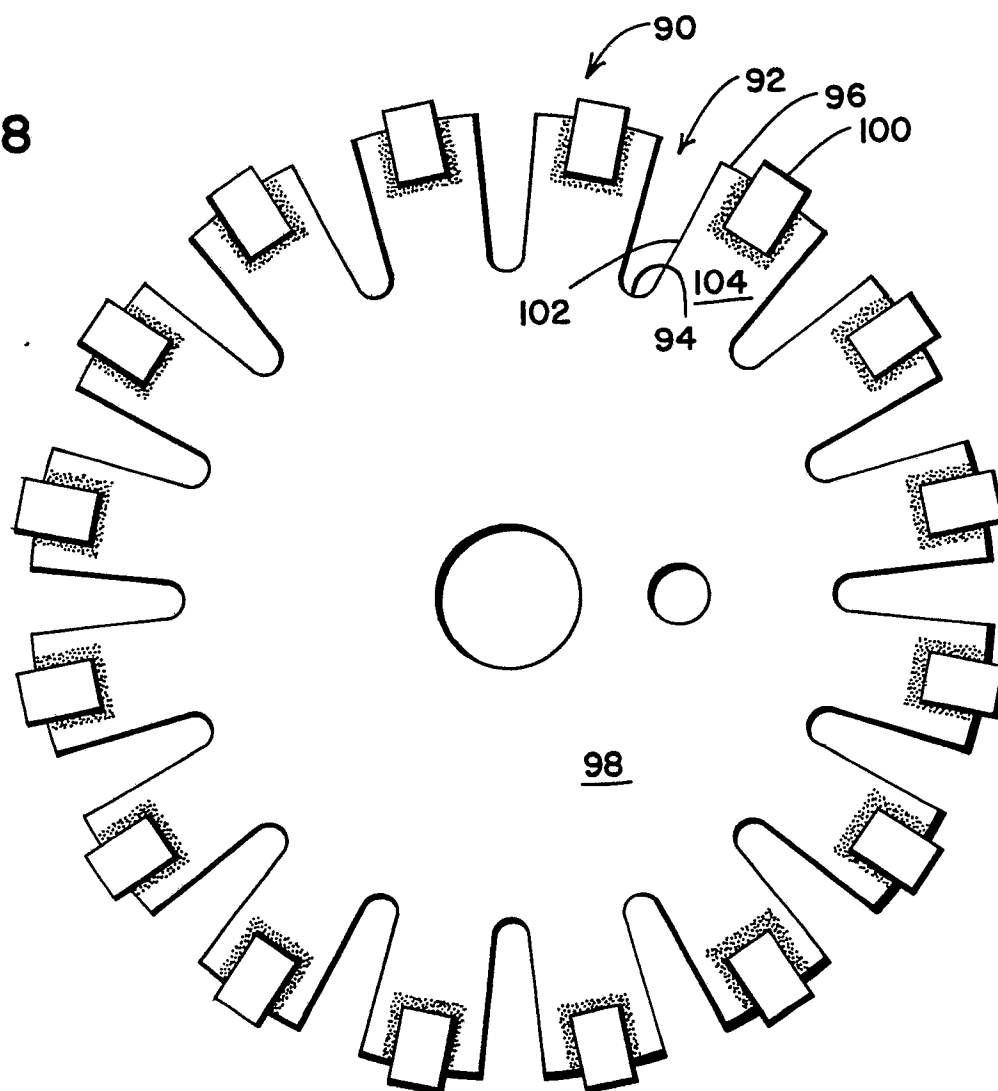


FIG.8





DOCUMENTS CONSIDERED TO BE RELEVANT			EP 89850179.6
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	FR - A - 1 403 863 (ARC) * Column 2, lines 23-31 *	1,2,3, 5,6	E 01 C 23/09 B 28 D 1/12
Y	--	4	
X	US - A - 3 517 463 (NIEMIEC) * Totality *	1,2	
A	--	5,6	
A	SOVIET INVENTIONS ILLUSTRATED, sections P,Q, week E 38, November 3, 1982 DERWENT PUBLICATIONS LTD., London, P 64 * SU-880 773 (GRIGORYAN) *	3	
Y	DE - C - 172 082 (RITTERSHAUS) * Fig. 1,2 *	4	
Y	DE - C - 174 441 (MICHEL) * Claim *	4	TECHNICAL FIELDS SEARCHED (Int. Cl. 4) B 23 C B 23 D B 27 B E 01 C
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 11-09-1989	Examiner GLAUNACH
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			