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

(11) Publication number: **0 355 436 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 89113645.9

(51) Int. Cl.4: **B28D 1/12 , //B24D5/12**

(22) Date of filing: 25.07.89

(30) Priority: 25.08.88 US 236580

(43) Date of publication of application: 28.02.90 Bulletin 90/09

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

(71) Applicant: GENERAL ELECTRIC COMPANY
1 River Road
Schenectady New York 12305(US)

(72) Inventor: Clark, Thomas Clark
2051 Highland View Drive
Powell Ohio 43065(US)

(74) Representative: Catherine, Alain
General Electric France Service de Propriété Industrielle 18 Rue Horace Vernet
F-92136 Issy-Les-Moulineaux Cedex(FR)

(54) **Sawblade segments containing fine diamond or cubic boron nitride particles.**

(57) There are provided cutting segments for use in a saw blade which comprise superabrasive cutting elements, an amount of abrasion resistant particles effective for causing non-uniform wearing of said segments, and a bonding matrix.

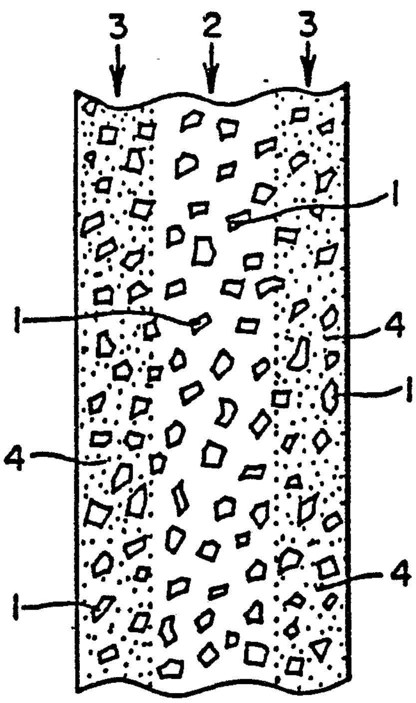

FIG. 1

EP 0 355 436 A2

SAWBLADE SEGMENTS CONTAINING FINE DIAMOND OR CUBIC BORON NITRIDE PARTICLES

Background of the Invention

The present invention generally relates to circular saw blades of the kind used for sawing hard materials such as granite, marble, filled concrete and the like. More particularly, the present invention relates to diamond cutting segments containing fine particles of diamond or cubic boron nitride (CBN) at the segments edges so as to reduce blade deviation during the sawing process.

Conventionally, the cutting of hard materials such as granite, marble, filled concrete and the like is achieved with the use of diamond saws. The blade of a saw of this type consists of a circular steel disc having a plurality of segments spaced around and brazed to the surface thereof. Each saw segment consists of diamond abrasive bonded in a suitable alloy or metal matrix such as bronze or cobalt, for example.

During operation it is found that the blade may deflect and vibrate laterally, i.e., substantially parallel to the axis of rotation. This causes the width of the cut to be larger than the width of the blade, with the result that the cutting efficiency of the blade is reduced. More importantly, deviations in cut direction may be caused. In addition, the rough surfaces on the workpiece must be ground flat and polished for many uses, such as decorative tiles. The lateral vibrations causing these drawbacks may he reduced by the use of wider saw blades or the use of stabilizing flanges. Wider saw blades have the disadvantage that more diamonds are required, whereas stabilizing flanges have the drawback that the depth of cut which can be achieved is limited.

A different approach to minimizing deviations in cut direction has been to utilize so-called "sandwich" segments. Such sandwich segments generally comprise a center section having a lower concentration of diamonds as compared to the side sections. There are also variations to the sandwich segments such as, for example, employing a different size of cutting diamond in the center section than in the side sections.

Another variation of the sandwich segment is described in U.S. Patent No. 4,505,251 to Stoll. Cutting segments manufactured in accordance with this disclosure comprise a conventional mixture of bonding metal and diamonds; however, a quantity of filler is added to the mixture. The filler will withstand the sintering process, but subsequently falls out so that pores are provided. A segment is made with only the center porous, while the side sections are as dense as is conventional. The result is that the porous section can receive coolant for efficient cutting and the center sections wears faster to yield a concave cutting edge.

Despite all the advances in the art there remains a significant need for circular saw blades which exhibit less deviation in cutting direction than can be obtained with presently available circular saw blades.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide improved saw blades and saw blade segments for use in cutting granite, marble, filled concrete and other hard materials.

It is another object of the present invention to provide saw blades having segments which will wear non-uniformly so as to provide a concave wear surface and thereby minimize blade path deviation.

In accordance with the foregoing objects, there are provided cutting segments for use on circular saw blades which contain an effective amount of abrasion resistant particles in the edges or side sections of said segments. Preferably, the cutting elements are diamonds and the concentration of such cutting diamonds is about the same in the center section of the saw blade segments as in the side sections. The finer abrasion resistant particles added in the side sections of the segments cause the segments to wear non-uniformly, thereby providing a concave wear surface which minimizes the ability of the saw blade to deviate from its cutting path. The abrasion resistant particles are preferably small (i.e. less than about 80 mesh) diamond, cubic boron nitride or tungsten carbide particles.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a front elevation view of a portion of a preferred embodiment of a saw blade segment of the present invention.

FIG. 2 is a front elevation view of the interface created between the saw blade segment shown in FIG. 1 and a stone workpiece during the sawing operation.

FIG. 3 is a front elevation view of a portion of an alternate embadiment of a sawblade segment of the present invention.

FIG. 4 is a front elevation view of the interface created between the saw blade segment shown in FIG. 3 and a stone workpiece during the sawing operation.

DESCRIPTION OF THE INVENTION

In accordance with the present invention there are provided novel saw blade segments comprising diamond cutting elements and small abrasion resistant diamond, CBN or tungsten carbide particles which cause the segments to wear non-uniformly.

Referring now to the drawing, FIG. 1 illustrates a preferred embodiment of a cutting segment for use on sow blades for cutting granite, marble, filled concrete and other hard materials. As can be seen, the concentration of diamond cutting elements 1 in the center section 2 is preferably about the same as the concentration of diamond cutting elements 1 in the side sections or matrices 3. It should be appreciated, however, that a larger or smaller concentration of diamond cutting elements 1 can be employed in the center section 2 without departing from the spirit or intended scope of the invention. For example, it is expected that in some applications it may be desirable that the concentration of diamond cutting elements 1 in the center section 2 be greater than the concentration of diamond cutting elements 1 in the side sections 3. The most important consideration in the practice of the invention is that a non-uniform cutting rate be achieved by including an effective amount of abrasion resistant particles 4 in side sections 3. Saw blade segments manufactured with abrasion resistant particles 4 in side sections 3 will exhibit concave wear and will form a ridge on stone workpiece 5 as shown in FIG. 2. It is the presence of this ridge which minimizes the ability of the saw blade to deviate from its cutting path.

Any suitable particles may be utilized as the abrasion resistant particles 4; however, it has been found that diamond, CBN and tungsten carbide particles are particularly effective.

In general, the abrasion resistant particles 4 should be less than about 80 mesh. Of course, the optimum mesh size for a particular application can be determined without undue experimentation. The concentration of abrasion resistant particles can also vary depending upon the particular application, but a concentration of from about 0. 10 to about 0.35 carats per cubic centimeter has been found to be effective.

Diamond cutting elements 1 can be of one mesh size range, for example, 40/50 or 35/40, or a mixture or blend of mesh size ranges, such as 30/40 with 40/50. In addition, it is contemplated that a different mesh size can be used in the center section 2 than in the side sections 3. Alternatively, it is contemplated that either the center section 2 or the side sections 3 use one mesh size while the other uses a mixture of mesh sizes. The proportion of one mesh size to a second or third mesh size in such a mixture of mesh sizes is not critical to the present invention. Also, the concentration of diamond cutting elements 1 can vary over a large range as can the proportion of cutting elements 1 in the center section 2 as compared to the side sections 3. Generally, the concentration of diamond cutting elements 1 in the center section 2 ranges from about 0.6 carats per cubic centimeter to about 2.0 carats per cubic centimeter, and the concentration of diamond cutting elements in the side sections 3 ranges from about 1.0 carats per cubic centimeter to about 2.0 carats per cubic centimeter. Most preferably, the concentration of diamond cutting elements 1 is about the same in center section 2 and side sections 3.

Although FIG. 1 shows a sharp transition between center section 2 and side sections 3, it is possible to make such interface gradual with respect to either the cutting elements 1, the abrasion resistant particles 4, or both. The width of center section 2 with respect to each side section 3 can vary over a wide range, but preferably is from about 1:2 to about 3:1.

FIG. 3 shows a less preferred alternate embodiment of the present invention wherein the abrasion resistant particles 4 are disposed in center section 2. With such arrangement, convex wearing of the segment's surface results and a valley forms in the stone workpiece 5, as illustrated in FIG. 4.

Diamond cutting elements 1 and abrasion resistant particles 4 are substantially uniformly dispersed throughout a conventional alloy or metal bonding matrix, for example, bronze, cobolt, cemented carbides or the like. Depending upon the end-use, the matrix may be a material such as a ceramic or molded plastic.

To provide a segment made in accordance with the present invention, the segment is made substantially the same as prior art segments, however, to a portion of the cement and diamond mixture is added a quantity of abrasion resistant particles. Of course, in some embodiments it is necessary to prepare a conventional cement and diamond mixture as well as a second mixture having a lower concentration of diamond cutting elements 1 than is contained in the first mixture. To such second mixture is also added an effective amount of abrasion resistant particles. After the appropriate mixtures are prepared, cutting segments can be made by techniques well known to those skilled in the art.

Although the present invention is directed to the use of diamond cutting elements, it is anticipated that the concept of the present invention will be equally effective with CBN cutting elements inasmuch as diamond and CBN are both classified as "superabrasives."

From the foregoing, it will be apparent that numerous other variations, modifications and rearrangements may be made without departing from the spirit and intended scope of the invention.

In order to better enable those skilled in the art to practice the present invention, the following example is provided by way of illustration and not limitation.

EXAMPLE

In a cobolt bond, a segment design which gave the desired improvement in reduction of deviation was prepared as follows: The sides were made using a concentration of 1 .20 carats per cubic centimeter of which 15 percent by weight was 170/200 mesh fine diamond as abrasion resistant particles and 85 percent by weight was 30/40 mesh diamond (MBS 750 available from General Electric Company) as cutting elements. The center was 0.75 carats per cubic centimeter of 30/40 mesh diamond (MBS 750 available from General Electric Company) as cutting elements. The bond metal was extra fine mesh cobolt with 5 percent by weight tin added, and the segments were sintered at 830°C and 350 kg/cm^2 for 15 minutes. Seventy segments were mounted on a rotary blade of 1000 mm diameter and used to cut various granites. The desired wear pattern developed quickly and persisted throughout the test. Blade deviation was significantly less than can be obtained with conventional saw blade segments.

Claims

1. A cutting segment for use in a sawblade,comprising superabrasive cutting elements and an amount of abrasion resistant particles effective for causing non-uniform wearing of said cutting segment dispersed in a bonding matrix.

2. A cutting segment as set forth in Claim 1, wherein the concentration of cutting elements in the center section is about equal to the concentration of cutting elements in the side sections.

3. A cutting segment as set forth in Claim 1, wherein the concentration of cutting elements in the center section is greater than the concentration of cutting elements in the side sections.

4. A cutting segment as set forth in Claim 1, wherein the concentration of cutting elements in the center section is less than the concentration of cutting elements in the side sections.

5. A cutting segment as set forth in Claim 1, wherein the cutting elements are diamond and the abrasion resistant particles are selected from the group consisting of diamond, cubic boron nitride, tungsten carbide, and mixtures thereof.

6. A cutting segment as set forth in Claim 5, wherein the abrasion resistant particles are less than about 80 mesh.

7. A cutting segment as set forth in Claim 6, wherein the abrasion resistant particles are present in an amount of from about 0.10 carats per cubic centimeter to about 0.35 carats per cubic centimeter.

8. A cutting segment as set forth in Claim 1, wherein the cutting elements are diamond and wherein the mesh size of the diamond in the center section is different than the mesh size of the diamond in the side sections.

9. cutting segment as set forth in Claim 1, wherein the interfaces between the center section and the side sections are gradated.

10. A cutting segment as set forth in Claim 1, wherein the width of the center section relative to the width of each side section ranges from about 1:2 to about 3:1.

11. A cutting segment for use in a saw blade, consisting essentially of:

(a) a center section consisting essentially of diamond cutting elements having a mesh size of from about 30/40 to about 40/50;

(b) side sections consisting essentially of diamond cutting elements having a mesh size of from about 30/40 to about 40/50, and an amount of abrasion resistant particles less than about 80 mesh effective for causing concave wearing of said cutting segment and selected from the group consisting of diamond, cubic boron nitride, tungsten carbide and mixtures thereof; and

(c) a bonding matrix for said center section and said side sections.

12. A saw blade having at least one cutting segment according to Claim 1 affixed thereto.

13. A saw blade as set forth in Claim 12 wherein the saw blade is a circular saw blade.

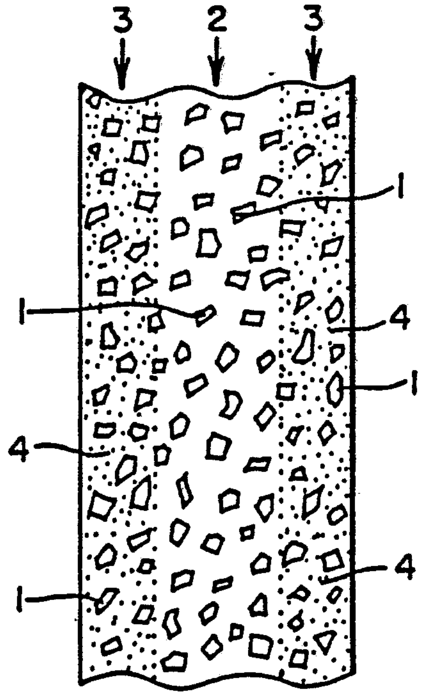

FIG. 1

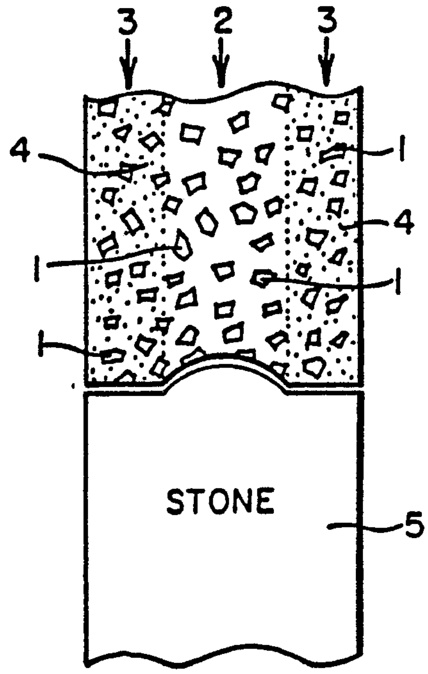

FIG. 2

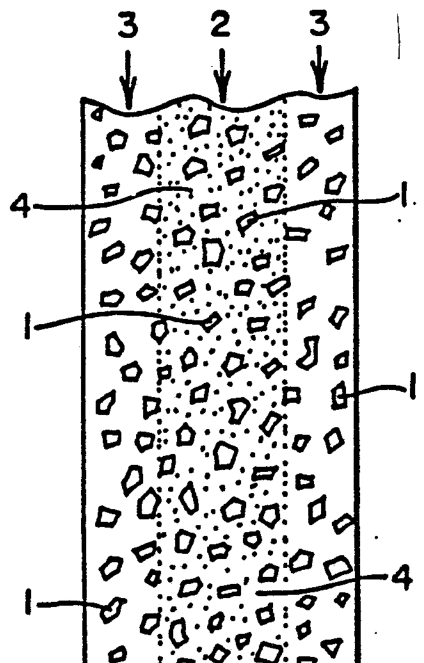

FIG. 3

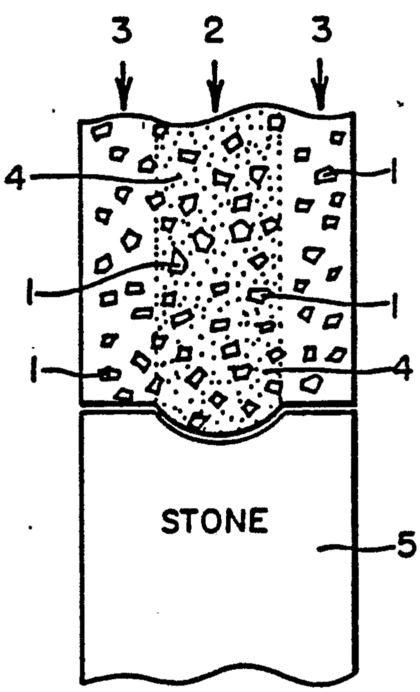

FIG. 4