United States Patent

Weiss, deceased

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[45] **Feb. 8, 1972**

[54] ANNULAR CUTTING BLADES

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[73] Assignee: **Sel-Rex Corporation**

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[52] **U.S. Cl.** **51/206**

[51] **Int. Cl.** **B24d 5/00,** B24d 7/00

[58] **Field of Search** 51/206, 73; 125/15

[56] **References Cited**

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[57] **ABSTRACT**

Annular cutting blades having thin metal cores carrying annular cutting portions comprising abrasive particles such as diamond dust and a metallic matrix in which the particles are embedded; the matrix being of metal or metal alloys of selected hardness.

2 Claims, 5 Drawing Figures

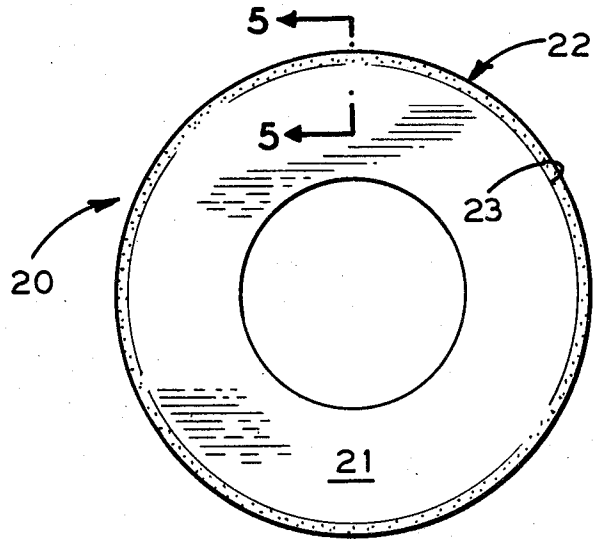


FIG. 1

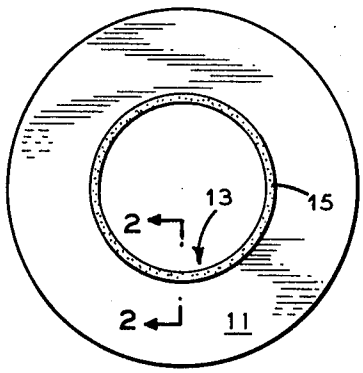


FIG. 2

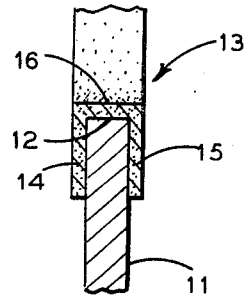


FIG. 3

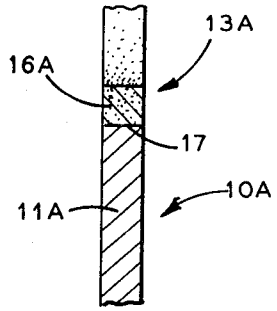


FIG. 4

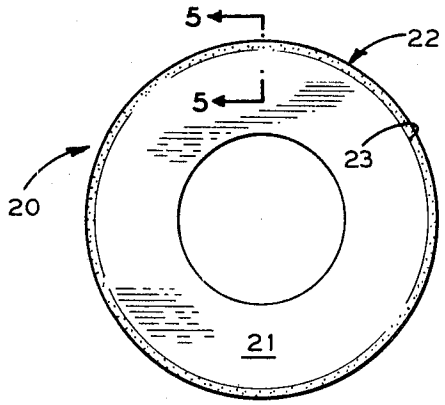
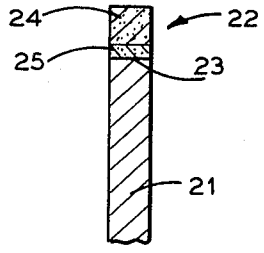


FIG. 5



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ANNULAR CUTTING BLADES

BACKGROUND OF THE INVENTION

In cutting or slicing very hard materials, annular cutting blades are being used of progressively smaller core thickness, to reduce cutting waste of expensive hard material. However, with thinner cutting blades, a number of problems arise. Thus, there is an increased tendency to encounter damage of the slices of hard material. This in turn requires subsequent lapping operations and a consequent reduction in thickness of the slices, which must be taken into account in cutting the original slices.

Also, the load on the cutting blades is substantial, resulting in blade deformation, blade destruction, damage of the cut material and reduced output of the cutting or slicing machines.

Accordingly, an object of this invention is to provide improved annular cutting blades having thin metal cores carrying annular cutting portions made up of abrasive particles such as diamond dust and a matrix of metal or metal alloy of selected hardness; such cutting blades producing cut surfaces in hard material which are substantially free of damage, the cut material meets the specification to which it is being cut and the blade produces a sufficient number of slices to satisfy the economics of the operation.

Another object of this invention is to provide annular cutting blades of the character described wherein the cutting kerf is kept at a minimum to conserve expensive material being cut and eliminating waste of material associated with unnecessary lapping operations.

A further object of this invention is to provide annular cutting blades of the character described in which the volumetric proportion of abrasive particles to metal matrix is substantially increased, to thereby increase the normal life of the blades and the cutting rate thereof to improve the production rates of the cutting machines.

Still another object of this invention is to provide annular cutting blades of the character described which have markedly reduced blade deformation in use, to increase the efficiency of the cutting operation and to produce cut and sliced hard material having substantially damage free cut surfaces.

Other objects of this invention are in part obvious and in part hereinafter pointed out.

DESCRIPTION OF THE DRAWING

FIG. 1 is a plan view of an annular cutting blade embodying the invention;

FIG. 2 is an enlarged sectional view taken on the line 2—2 of FIG. 1;

FIG. 3 is a sectional view of another embodiment;

FIG. 4 is a plan view of a further embodiment; and

FIG. 5 is an enlarged sectional view taken on the line 5—5 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG. 1, 10 designates an annular cutting blade embodying the invention. The same comprises an annular disc 11 of aluminum, steel, brass or the like. Such disc may have a thickness ranging from 0.001 inch to 0.004 inch or more.

The inner annular edge of blade 10, generally indicated at 12, is provided with an annular cutting portion 13 which is capable of cutting very hard materials. Such cutting portion 13 is made up of abrasive particles such as diamond dust, aluminum oxide, or the like, distributed in a metal or metal alloy matrix.

Whereas in conventional cutting blades, the abrasive particles are distributed in a relatively hard metal or metal alloy matrix, in the instant invention, the matrix is relatively soft. Thus, the matrix may be formed from nickel, lead-tin; tin-copper; bismuth-tin; D.P.H. 75/100; soft copper 100/125 and other suitable metals and metal alloys. However, the hardness of the selected metal or metal alloy should not exceed a D.P.H. reading of 275.

The cutting portion 13 may be formed by electrodepositing the mixture of diamond particles and selected metal or metal alloy, in the manner as fully set forth in applicant's U.S. Pat. No. 3,356,599. Also, the volumetric proportion of diamond particles to metal matrix may range from 40 percent to 85 percent, with the deposit showing a radial thickness based on one to three particles in superimposed relation.

As shown in FIG. 2, the cutting portion 13 comprises marginal portions 14, 15 and a connecting radial portion 16. With blade cores 11 of a thickness of 0.002 inch and with the marginal portions 14, 15 having a thickness of 0.001 inch each, the resultant kerf would be of the order of 0.004 inch.

It has been found that with cutting blades of the instant invention, the cut surfaces of the hard materials being cut are remarkably free of surface damage, pitting, etc. Thus, the usual lapping operations become unnecessary. This in turn eliminates loss of material due to the lapping operation, allowing the hard material to be sliced to a thickness equal to the required finished thickness.

Further, it has been found that with the blades of the instant invention, blade deformation under load is materially reduced and the actual cutting load is decreased so as to increase the rate of cutting by the blades, with consequent increased production rates.

The instant invention may be applied to slotting or cutoff blades 10A, as shown in FIG. 3. Here the metal blade core 11A carries cutting portion 13A on its radial edge 17 only. Cutting portion 13A is similar to that indicated at 12, in FIG. 2.

FIGS. 4, 5 show another embodiment of the invention, wherein, the annular metal blade 20, having a metal core 21, has a cutting portion 22 on the outer edge 23 thereof. The cutting portion 22 is preformed by electrodeposition operations, as set forth in detail, in copending application, Ser. No. 831,943, filed June 10, 1969.

Thus, cutting portion 22 comprises an outer strata 24 comprising abrasive particles distributed in a metal matrix; and an inner strata 25 of metal in integrated relation to strata 24. Strata 24 is formed by electrodepositing a mixture of relatively soft metal or metal alloy, having a hardness not exceeding a D.P.H. reading of 275, and abrasive particles such as diamond particles of selected sizes, on a form, followed by the electrodeposition of the metal forming strata 25 on strata 24. The composite cutting portion 22 is then removed from the form, as set forth in said application Ser. No, 831,943.

The metal of strata 25 is quite hard, as compared to the hardness of the metal matrix of strata 24, and may be nickel, nickel-cobalt and the like. Such metals and alloys have a hardness exceeding a D.P.H. of 500.

The preformed cutting portion 22 is machined on its I.D. to a precise diameter; while core 21 is also machined, on its O.D. to a precise diameter which is slightly greater than the I.D. of preform 22. The core 21 is then cooled to low temperatures to reduce the O.D. thereof, allowing the assembly thereof with preform 22. On reaching room temperature, the core 21 will be in tightly gripping relation to preform 22. Alternatively, core 21 and preform 22 may be secured to each other, by brazing, soldering or epoxy resin adhesive.

It is understood that the size of the diamond or other abrasive particles is selected in accordance with the type of cutting, slicing or slotting operation and the nature of the material being cut, sliced or slotted.

While the instant invention is particularly applicable to relatively thin metal core blades; the same may also be applied to core blades of relatively larger thicknesses. Also, the cutting portions comprising the abrasive particles and soft metal matrix, may have varying radial and marginal dimensions, determined by the nature of the material being cut, sliced or slotted, as well as the desired kerf.

The term D.P.H. refers to Diamond Pyramid Hardness which is measured on a Tukon microhardness tester, in a manner known in the art.

I claim:

1. A cutting blade for hard materials comprising an annular metal core and an annular cutting portion on the outer annular edge portions of said core, said cutting portion comprising a metallic matrix and abrasive particles distributed through said matrix, said metallic matrix having a hardness not exceeding about 275 D.P.H.; said cutting portion including a metal backing layer in integrated relation to the metallic matrix having abrasive particles distributed therethrough, said metal backing having a hardness greater than the hardness of the metal of said metallic matrix.

2. A cutting blade as in claim 1 wherein said cutting portion and said core are in shrunken secured relation to each other.

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