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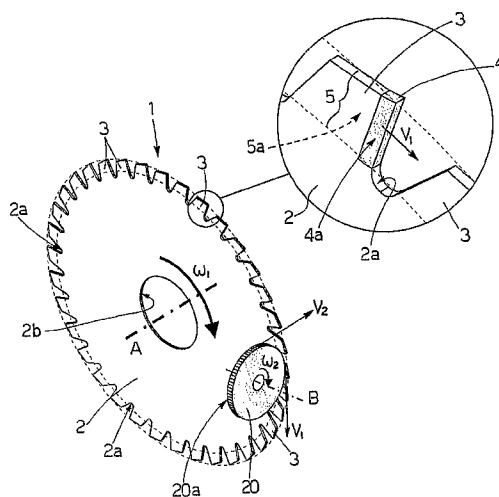
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(54) Title: METHOD OF GRINDING A TIPPED-TOOTH DISK CUTTER



(57) Abstract: A grinding method for grinding a tipped-tooth disk cutter (1) having a central disk (2) coaxial with a main axis of rotation (A), a number of equally spaced radial teeth (3) projecting from the peripheral edge (2a) of the central disk (2) and defining the toothed rim (5) of the disk cutter (1), and a number of high resistance-material tips (4) each soldered to the crest of a respective tooth (3) to form the cutting part of the tooth (3); the grinding method including the steps of rotating the work disk cutter (1) about the main axis of rotation (A) at an angular speed (ω_1) substantially equal to the nominal angular speed of the disk cutter (1) in use; and then bringing into contact with the two faces (5a, 5b) of the toothed rim (5) the abrasive peripheral surface (20a, 30a, 40a) of a grinding wheel (20, 30, 40) rotating about its axis of symmetry (B, C, A) at a predetermined angular speed (ω_2 , ω_3), so as to grind the sides (4a) of the tips (4) so that the surface of the sides (4a) has a profile complementary to a toroidal reference surface (R' , R'') having an axis of rotation and symmetry coincident with the main axis of rotation (A).

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METHOD OF GRINDING A TIPPED-TOOTH DISK CUTTER

TECHNICAL FIELD

10 The present invention relates to a method of grinding a tipped-tooth disk cutter.

More specifically, the present invention relates to a method of grinding and sharpening a tipped-tooth disk cutter for cutting wood and similar, to which the
15 following description refers purely by way of example.

BACKGROUND ART

As is known, tipped-tooth disk cutters for cutting planks and panels of wood, fiberboard, and similar normally comprise a central steel disk with a number of
20 angularly equally spaced radial teeth projecting from the peripheral edge of the disk; and a number of tips of hard material, such as metal, ceramic, sintered hybrid material, or similar, each soldered to the crest of a respective projecting radial tooth to form the cutting
25 part of the tooth.

To ensure a clean cut, the high resistance-material tips, after being soldered to the central disk, are machined to grind and sharpen the sides of each tip to a

predetermined angle with respect to the centreline plane of the disk cutter, i.e. the central disk plane.

More specifically, each high resistance-material tip is sharpened so that the two sides slope a few degrees with respect to the disk plane, and diverge so that the face or cutting surface of each tooth is substantially in the form of an isosceles trapezium with the minor base facing the centre of the disk.

At present, simultaneous grinding and sharpening of tipped-tooth disk cutters are performed by repeating the following operations for each tooth on the cutter:

- clamping the disk cutter by means of a movable-jaw clamping device, which grips both sides of the body of the central disk, at the peripheral edge portion from which the work tooth projects; and

- grinding off a thin layer of metal material from the two sides of the corresponding high resistance-material tip to achieve the desired angle of the sides with respect to the centreline plane of the disk cutter.

Though fast and cheap, the above method of grinding disk cutters fails to take into account the natural twist of the central disk and, hence, to ensure the teeth are aligned perfectly, in use, with the centreline plane of the disk cutter.

As is known, the central disk is subjected to various straining machining operations which may result in slight twisting of the disk body and, hence, in misalignment of some of the teeth with respect to the

centreline plane of the disk cutter, i.e. the central disk plane.

Leaving aside the flaws in the central disk, when grinding the disk cutter, the movable-jaw clamping device exerts, on both sides of the peripheral edge portion from which the work tooth projects, such a strong gripping force as to locally deform the central disk and restore the work tooth to a condition of perfect alignment with the centreline plane of the cutter, regardless of its former position with respect to the centreline plane.

As a result, the sides of the high resistance-material tip are trimmed using the centreline plane of the tooth, as opposed to that of the disk cutter, as a reference plane.

Deformation of the central disk by the clamping device being elastic, i.e. nonpermanent, at the end of the grinding operation, all the teeth on the disk cutter originally out of line with the centreline plane of the cutter obviously tend to return to their original position, so that the sides of the tips are misaligned with respect to the centreline plane of the disk cutter, with all the disadvantages this involves.

When working with teeth slightly misaligned with respect to the centreline plane of the disk cutter, in fact, the mechanical stress produced during material removal tends to be discharged almost exclusively on the sides of the high resistance-material tips projecting beyond the ideal outline of the disk cutter, i.e. on the

sides of the tips of the misaligned teeth, thus resulting in rapid wear of the tool.

In addition, cutting with teeth slightly misaligned with respect to the centreline plane of the disk cutter produces scoring and other flaws that are clearly visible
5 on the cut part, even to the naked eye.

DISCLOSURE OF INVENTION

It is an object of the present invention to provide an alternative method of grinding tipped-tooth disk cutters for cutting wood and similar, designed to
10 eliminate the aforementioned drawbacks.

According to the present invention, there is provided a method of grinding a tipped-tooth disk cutter, as claimed in Claim 1 and, preferably, though not
15 necessarily, in any one of the dependent Claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

20 Figure 1 shows a schematic view in perspective of a first step in a method of grinding tipped-tooth disk cutters in accordance with the teachings of the present invention;

Figure 2 shows a schematic view in perspective of a
25 second step in the method of grinding tipped-tooth disk cutters in accordance with the teachings of the present invention;

Figure 3 shows a front view, with parts in section

and parts removed for clarity, of the Figure 2 disk cutter;

Figure 4 shows a front view, with parts in section and parts removed for clarity, of a first variation of the grinding method shown in the previous drawings;

Figure 5 shows a front view, with parts in section and parts removed for clarity, of a second variation of the grinding method shown in the previous drawings;

Figure 6 shows a view in perspective, and Figure 7 a front view with parts in section and parts removed for clarity, of a third variation of the grinding method shown in the previous drawings.

BEST MODE FOR CARRYING OUT THE INVENTION

With reference to Figures 1, 2 and 3, the method according to the present invention of grinding a tipped-tooth disk cutter is particularly advantageous for grinding and sharpening tipped-tooth disk cutters 1, which substantially comprise a central disk 2 coaxial with and rotating about a predetermined axis A; a number of angularly spaced radial teeth 3 projecting from the peripheral edge 2a of central disk 2; and a number of tips 4 of hard material, each soldered to the crest of a respective tooth 3 to form the cutting part of tooth 3.

More specifically, radial teeth 3 project from peripheral edge 2a of central disk 2 while preferably, though not necessarily, remaining coplanar with the centreline plane M of the disk, in turn perpendicular to axis A, and define, together with tips 4, the toothed rim

5 of disk cutter 1.

The high resistance-material tips 4 are made of metal, ceramic, sintered hybrid material, or similar, depending on the type of material to be cut, are fixed to
5 respective radial teeth 3 so as to be locally substantially coplanar with the centreline plane of tooth 3, which in turn may or may not coincide with the centreline plane M of central disk 2, and, prior to grinding, are prismatic in shape with a substantially
10 trapezoidal or rectangular section. Tips 4 are of a minimum width, measured perpendicular to centreline plane M of the disk, greater than the thickness δ of central disk 2, so that the sides 4a of each tip 4 project beyond the flat lateral surface of central disk 2.

15 In addition to the above, central disk 2 preferably, though not necessarily, also comprises a central through hole 2b coaxial with the axis of symmetry and rotation A of the disk.

With reference to Figures 1, 2 and 3, the grinding
20 method according to the present invention substantially comprises:

- rotating the work disk cutter 1 about axis A at a predetermined angular speed ω_1 ;

and, as disk cutter 1 rotates :

25 - bringing into contact with at least one of the two faces 5a and 5b of toothed rim 5 of disk cutter 1 the abrasive cylindrical or truncated-cone-shaped peripheral surface of a grinding wheel rotating about its axis of

symmetry at a predetermined angular speed, and oriented so that, in the contact region with toothed rim 5, the abrasive peripheral surface of the grinding wheel is substantially tangent to face 5a, 5b of toothed rim 5 to
5 grind, i.e. remove material by mechanical abrasion from, sides 4a of tips 4, so that the surface of sides 4a has a profile complementary to a toroidal reference surface having an axis of rotation and symmetry coincident with the axis of rotation A of disk cutter 1.

10 More specifically, in the grinding method according to the present invention, the work disk cutter 1 is rotated about axis A at an angular speed ω_1 substantially equal to the nominal angular speed of the tool by which disk cutter 1 is rotated in use, or which at any rate
15 falls within a predetermined range 30% below or above the nominal angular speed of disk cutter 1 itself.

In addition, the grinding method according to the present invention employs a disk or cup grinding wheel rotating about its axis of symmetry at such an angular
20 speed that, in the contact region with toothed rim 5 of disk cutter 1, the tangential speed of the abrasive cylindrical or truncated-cone-shaped peripheral surface of the grinding wheel has substantially the same direction and sense, locally, as the tangential speed v_1
25 or toothed rim 5 of disk cutter 1. Preferably, though not necessarily, the disk or cup grinding wheel must also rotate about its axis of symmetry at such an angular speed that, in the contact region with toothed rim 5 of

disk cutter 1, the tangential speed of the abrasive cylindrical or truncated-cone-shaped peripheral surface of the grinding wheel is locally greater at all times than the tangential speed v_1 of toothed rim 5.

5 In the example shown, the grinding method according to the present invention substantially comprises:

- rotating the work disk cutter 1 about axis A at an angular speed ω_1 substantially equal to the nominal angular speed at which disk cutter 1 is rotated in use;

10 and, as disk cutter 1 rotates,

- bringing into contact with a first face 5a of toothed rim 5 of disk cutter 1 the abrasive cylindrical or truncated-cone-shaped peripheral surface 20a of a first grinding wheel 20 rotating about its axis of symmetry B in preferably, though not necessarily, the same direction as disk cutter 1, and oriented so that, in the contact region with toothed rim 5, the abrasive peripheral surface 20a of the grinding wheel is substantially tangent to face 5a of toothed rim 5 to
15 grind sides 4a of tips 4, so that the surface of sides 4a has a profile complementary to a first toroidal reference surface R' having an axis of rotation and symmetry coincident with the axis of rotation A of disk cutter 1; and

25 - bringing into contact with the second face 5b of toothed rim 5 of disk cutter 1 the abrasive cylindrical or truncated-cone-shaped peripheral surface 30a of a second grinding wheel 30 rotating about its axis of

symmetry C in preferably, though not necessarily, the same direction as disk cutter 1, and oriented so that, in the contact region with toothed rim 5, the abrasive peripheral surface 30a of the grinding wheel is
5 substantially tangent to face 5b of toothed rim 5 to grind sides 4a of tips 4, so that the surface of sides 4a has a profile complementary to a first toroidal reference surface R" having an axis of rotation and symmetry coincident with the axis of rotation A of disk cutter 1.

10 Obviously, second face 5b of toothed rim 5 of disk cutter 1 may be ground by grinding wheel 30 simultaneously with or after grinding first face 5a of toothed rim 5.

In addition, in the grinding method according to the
15 present invention, the two grinding wheels 20 and 30 are positioned contacting toothed rim 5 of disk cutter 1 so that the two toroidal reference surfaces R' and R" are located on opposite sides of the centreline plane M of central disk 2, and are preferably, though not
20 necessarily, specular in shape with respect to centreline plane M.

With reference to Figure 3, in particular, in the grinding method according to the present invention, grinding wheel 20 is positioned so that the first
25 toroidal reference surface R' is defined by a truncated-cone-shaped surface having an axis of symmetry coincident with the axis of rotation A of disk cutter 1, and a generator inclined at an angle α of 0 to 10 degrees with

respect to the centreline plane M of disk cutter 1; and grinding wheel 30 is positioned so that the second toroidal reference surface R" is defined by a truncated-cone-shaped surface having an axis of symmetry coincident with the axis of rotation A of disk cutter 1, and a generator inclined at an angle β of 0 to 10 degrees with respect to centreline plane M.

In addition, in the example shown, angle β of the generator of second toroidal reference R" is preferably, though not necessarily, equal to angle α of the generator of first toroidal reference surface R' with respect to centreline plane M.

As regards grinding wheels 20 and 30, in the grinding method according to the present invention, and as shown in Figures 1 and 2, grinding wheel 20 is rotated about axis B at such an angular speed ω_2 that, in the contact region with face 5a of toothed rim 5, the tangential speed v_2 of abrasive peripheral surface 20a of grinding wheel 20 has substantially the same direction and sense locally as the tangential speed v_1 of toothed rim 5 of disk cutter 1, and is preferably, though not necessarily, greater than the tangential speed v_1 of toothed rim 5. Similarly, in the grinding method according to the present invention, grinding wheel 30 is rotated about axis C at such an angular speed ω_3 that, in the contact region with face 5b of toothed rim 5, the tangential speed v_3 of abrasive peripheral surface 30a of grinding wheel 30 has substantially the same direction

and sense locally as the tangential speed v_1 of toothed rim 5 of disk cutter 1, and is preferably, though not necessarily, greater than the tangential speed v_1 of toothed rim 5.

5 In the grinding method according to the present invention, tangential speed v_2 of grinding wheel 20 is preferably, though not necessarily, substantially equal to tangential speed v_3 of grinding wheel 30.

With reference in particular to Figure 3, the
10 grinding method according to the present invention preferably, though not necessarily, employs disk grinding wheels 20, 30 with a cylindrical abrasive peripheral surface 20a, 30a of a nominal height l smaller than the height h of tips 4 measured parallel to the centreline
15 plane M of disk cutter 1.

In which case, in the grinding method according to the present invention, the rotating disk grinding wheels 20, 30 so designed are moved axially along faces 5a and 5b of toothed rim 5 as disk cutter 1 rotates, while
20 maintaining the abrasive peripheral surface 20a, 30a of each grinding wheel tangent to the corresponding toroidal reference surface R_1 , R'' .

The advantages of adopting the grinding method according to the present invention are obvious : sides 4a
25 of high resistance-material tips 4 are all ground using the centreline plane M of disk cutter 1 as a reference, regardless of whether or not the radial teeth 3 supporting tips 4 are aligned perfectly with centreline

plane M of disk cutter 1. The two toroidal reference surfaces, in fact, are fixed with respect to the centreline plane of disk cutter 1.

Moreover, by grinding sides 4a of tips 4 with disk
5 cutter 1 rotating at an angular speed ω_1 substantially equal to the nominal angular speed of the tool, i.e. the angular speed at which disk cutter 1 is rotated by the spindle of the machine in use, sides 4a are ground with central disk 2 in the actual work configuration.

10 As is known, in fact, as disk cutter 1 rotates, the centrifugal forces generated by rotation are discharged on, and tend to deform, the body of central disk 2, thus gradually altering the natural twist of the body of central disk 2 as rotation speed increases. Working on
15 disk cutter 1 rotating at an angular speed substantially equal to the nominal angular speed of the tool ensures sides 4a of tips 4 of teeth 3 of disk cutter 1 are aligned perfectly with the two toroidal reference surfaces R' and R" at the actual speed at which sides 4a
20 are designed to cut the workpiece.

Perfect alignment of sides 4a at the nominal angular speed of disk cutter 1 obviously ensures the mechanical stress produced during material removal is distributed evenly between all the tips 4 of teeth 3, thus increasing
25 the working life and improving the cutting quality of disk cutter 1.

Clearly, changes may be made to the method of grinding disk cutter 1 as described and illustrated

herein without, however, departing from the scope of the present invention.

More specifically, with reference to the Figure 4 variation, in the grinding method according to the present invention, grinding wheels 20 and 30 may be positioned so that the two toroidal reference surfaces R' and R'' are defined by two annulus shaped surfaces located on opposite sides of centreline plane M of disk cutter 1, coaxial with the axis of rotation A of disk cutter 1, and preferably, though not necessarily, equidistant from centreline plane M.

In this variation, the difference k between the longer radius and the shorter radius of toroidal reference surface R' and/or R'' is less than the height h of tips 4 measured parallel to centreline plane M, and is preferably, though not necessarily, less than 0.5 of a millimetre.

With reference to Figure 5, as opposed to using disk or cup grinding wheels 20, 30 brought, in close succession, into contact with side 4a of tip 4 of each tooth 3 of toothed rim 5 of disk cutter 1, the grinding method according to the present invention may also grind sides 4a of tips 4 using a large cup grinding wheel 40 coaxial with axis A of disk cutter 1, and which preferably, though not necessarily, rotates about axis A in the same direction as disk cutter 1, and is so sized that its abrasive peripheral surface 40a is brought simultaneously into direct contact with all of sides 4a

on the same face 5a, 5b of toothed rim 5 of disk cutter 1.

In other words, cup grinding wheel 40 is so sized that its abrasive truncated-cone-shaped peripheral surface 40a covers the whole face 5a, 5b of toothed rim 5 of disk cutter 1.

Cup grinding wheel 40 must obviously be able to rotate about axis A at an angular speed ω_4 other than that of disk cutter 1, whereas the rotation direction may be the same as or differ from that of disk cutter 1.

The main advantage of this variation lies in drastically reducing, if not completely eliminating, mechanical resonance phenomena, which may arise in disk cutter 1 when sides 4a of teeth 3 impact, in close succession, the abrasive cylindrical or truncated-cone-shaped peripheral surface 20a, 30a of a small disk or cup grinding wheel 20, 30.

With reference to Figures 6 and 7, still rotating disk cutter 1 about axis A at predetermined angular speed ω_1 , the grinding method according to the present invention may also be implemented using, instead of disk or cup grinding wheels 20, 30, 40, one or more electroerosion electrodes 50 positioned simultaneously or successively in front of the two faces 5a, 5b of toothed rim 5 of disk cutter 1. Each electrode 50 is oriented so that its active surface 50a, i.e. the surface where the electric arcs typical of electroerosion processes are formed, is positioned facing and a predetermined distance

from at least one portion of face 5a, 5b of toothed rim 5, and is substantially tangent to a toroidal reference surface R' , R'' having an axis of rotation and symmetry coincident with axis of rotation A of disk cutter 1.

5 Electrodes 50 are obviously connected in known manner to an electric source (not shown) for generating a preferably, though not necessarily, pulsatingly time-variable electric potential difference between electrodes 50 and disk cutter 1, and the distance between active
10 surface 50a of electrode 50 and the surface of face 5a, 5b of toothed rim 5 is such as to initiate electroerosion phenomena to electrically erode sides 4a of tips 4, so that the surface of sides 4a has a profile complementary to said toroidal reference surface R' , R'' having an axis
15 of rotation and symmetry coincident with the axis of rotation A of disk cutter 1.

More specifically, the distance between active surface 50a of electrode 50 and the surface of face 5a, 5b of toothed rim 5 ranges between 0 and 2-3 millimetres,
20 the lower limit excluded, to prevent sides 4a of tips 4 from clashing against the body of electrode 50.

In this case, the grinding method according to the present invention substantially comprises:

- rotating the work disk cutter 1 about axis A at a
25 predetermined angular speed ω_1 ;

and, as disk cutter 1 rotates,

- positioning close to at least one of the two faces 5a, 5b of toothed rim 5 of disk cutter 1 the active

surface 50a of an electroerosion electrode 50 oriented so that active surface 50a is positioned facing and a predetermined distance from at least one portion of face 5a, 5b of toothed rim 5, and is locally substantially
5 tangent to a toroidal reference surface R', R" having an axis of rotation and symmetry coincident with axis of rotation A of disk cutter 1, so as to electrically erode sides 4a of tips 4, so that the surface of sides 4a has a profile complementary to the toroidal reference surface.

10 In other words, in this variation, material is removed from sides 4a of tips 4 by electroerosion, as opposed to direct-contact mechanical abrasion.

CLAIMS

1) A grinding method for grinding a tipped-tooth disk cutter (1) comprising a central disk (2) coaxial
5 with a main axis of rotation (A), a number of equally spaced radial teeth (3) projecting from the peripheral edge (2a) of said central disk (2) and defining the toothed rim (5) of the disk cutter (1), and a number of high resistance-material tips (4) each soldered to the
10 crest of a respective tooth (3) to form the cutting part of the tooth (3); said grinding method being characterized by comprising the steps of:

- rotating the work said disk cutter (1) about said main axis of rotation (A) at a predetermined angular
15 speed (ω_1); and

- as the disk cutter (1) rotates, removing material from the sides (4a) of the tips (4) on at least one face (5a, 5b) of said toothed rim (5) so as to trim via material removal said sides (4a) so that the surface of
20 the sides (4a) has a profile complementary to a toroidal reference surface (R', R'') having an axis of rotation and symmetry coincident with said main axis of rotation (A).

2) A grinding method as claimed in Claim 1, characterized in that, during said step of trimming the
25 sides (4a) of said tips (4), said work disk cutter (1) is rotated about its main axis of rotation (A) at an angular speed (ω_1) within a predetermined range ranging between 30% below or above the nominal angular speed of the tool

by which the disk cutter (1) is rotated during cutting.

3) A grinding method as claimed in Claim 2, characterized in that, during said step of trimming the sides (4a) of said tips (4), said work disk cutter (1) is
5 rotated about its main axis of rotation (A) at an angular speed (ω_1) substantially equal to the nominal angular speed at which the disk cutter (1) is rotated during cutting.

4) A grinding method as claimed in Claim 1, 2 or 3,
10 characterized in that said step of trimming the sides (4a) of said tips (4) comprises the step, as the disk cutter (1) rotates, of bringing into contact with at least one of the two faces (5a, 5b) of said toothed rim (5), the abrasive peripheral surface (20a, 30a, 40a) of a
15 grinding wheel (20, 30, 40) rotating about its axis of symmetry (B, C, A) at a predetermined angular speed (ω_2 , ω_3 , ω_4), said grinding wheel (20, 30, 40) being so oriented that, in the contact region with the toothed rim (5), the abrasive peripheral surface (20a, 30a, 40a) of
20 the grinding wheel (20, 30, 40) is substantially tangent to the face (5a, 5b) of said toothed rim (5), so as to grind the sides (4a) of the tips (4) so that the surface of the sides (4a) has a profile complementary to a toroidal reference surface (R', R'') having an axis of
25 rotation and symmetry coincident with said main axis of rotation (A).

5) A grinding method as claimed in Claim 4, characterized in that, at the step of bringing the

abrasive peripheral surface (20a, 30a) of a grinding wheel (20, 30) into contact with at least one of said two faces (5a, 5b) of said toothed rim (5), said grinding wheel (20, 30) rotates about its axis of symmetry (B, C) at such an angular speed (ω_2 , ω_3) that, in the contact region with said toothed rim (5), the tangential speed (v_2 , v_3) of said abrasive peripheral surface (20a, 30a) has substantially the same direction and sense locally as the tangential speed (v_1) of said toothed rim (5).

6) A grinding method as claimed in Claim 4, characterized in that, at the step of bringing the abrasive peripheral surface (20a, 30a) of a grinding wheel (20, 30) into contact with at least one of the two faces (5a, 5b) of said toothed rim (5), said grinding wheel (20, 30) rotates about its axis of symmetry (B, C) at such an angular speed (ω_2 , ω_3) that, in the contact region with said toothed rim (5), the tangential speed (v_2 , v_3) of said abrasive peripheral surface (20a, 30a) is greater than the tangential speed (v_1) of said toothed rim (5).

7) A grinding method as claimed in any one of the foregoing Claims, characterized in that said grinding wheel (20, 30, 40) has a cylindrical or truncated-cone-shaped abrasive peripheral surface (20a, 30a, 40a).

8) A grinding method as claimed in Claim 1, 2 or 3, characterized in that said step of trimming the sides (4a) of said tips (4) comprises the step, as the disk cutter (1) rotates, of positioning the active surface

(50a) of an electroerosion electrode (50) close to of at least one of the two faces (5a, 5b) of said toothed rim (5), said electrode (50) being so oriented that said active surface (50a) is positioned facing and a
5 predetermined distance from at least one portion of the face (5a, 5b) of said toothed rim (5), and is locally substantially tangent to a toroidal reference surface (R' , R'') having an axis of rotation and symmetry coincident with said main axis of rotation (A), so as to
10 electrically erode the sides (4a) of the tips (4) so that the surface of the sides (4a) has a profile complementary to said toroidal reference surface (R' , R'').

9) A grinding method as claimed in any one of the foregoing Claims, characterized in that said toroidal
15 reference surface (R' , R'') is a truncated-cone-shaped surface having an axis of symmetry coincident with said main axis of rotation (A), and a generator inclined at an angle (α , β) of 0 to 10 degrees with respect to the centreline plane (M) of said disk cutter (1), in turn
20 perpendicular to said main axis of rotation (A).

10) A grinding method as claimed in any one of Claims 1 to 8, characterized in that said toroidal reference surface (R' , R'') is an annulus shaped surface having an axis of symmetry coincident with said main axis
25 of rotation (A).

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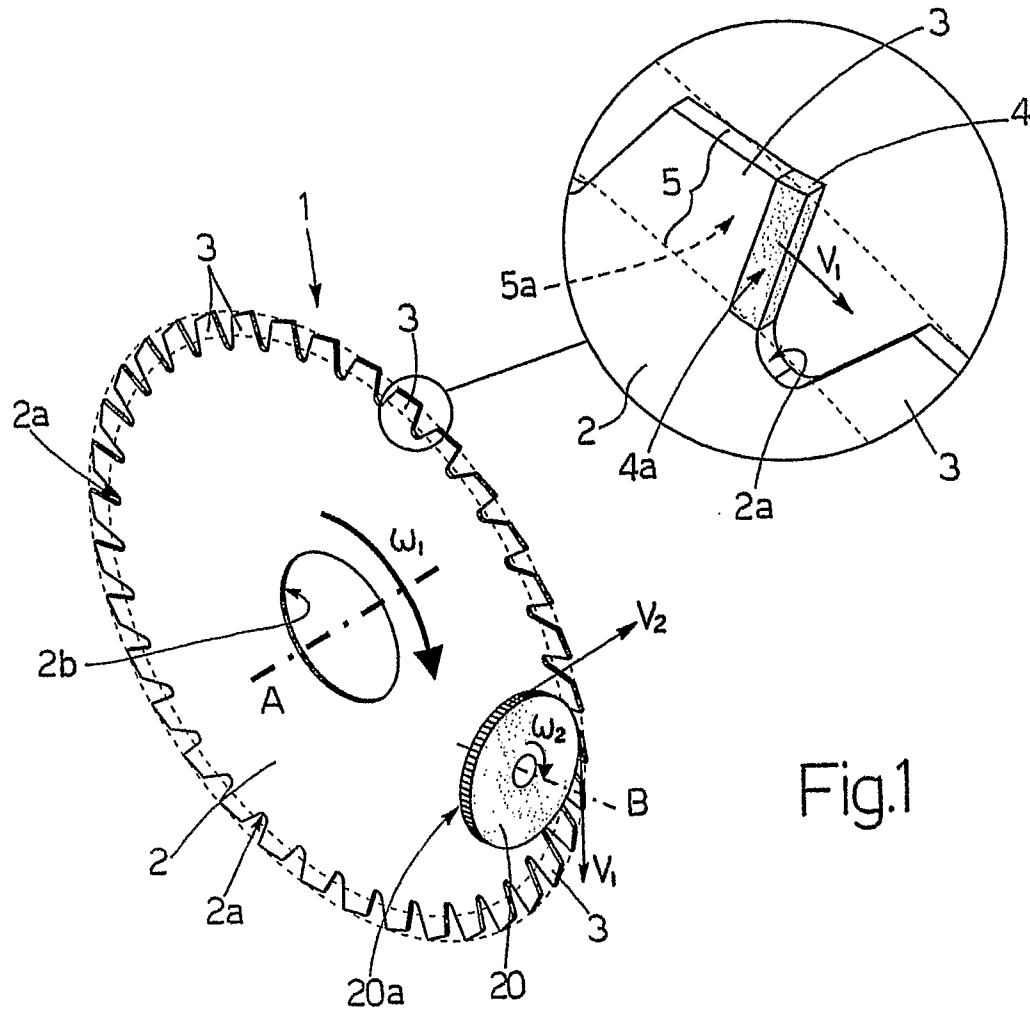


Fig.1

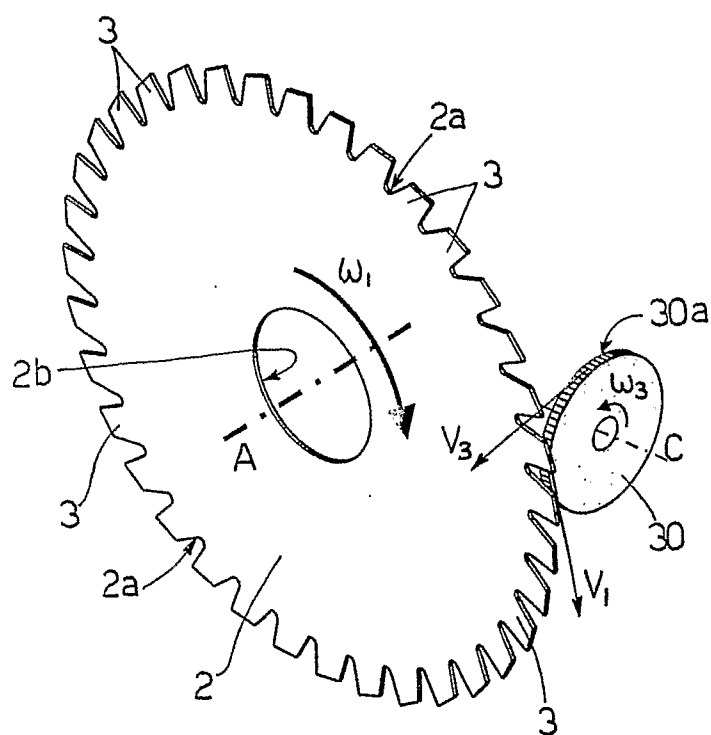
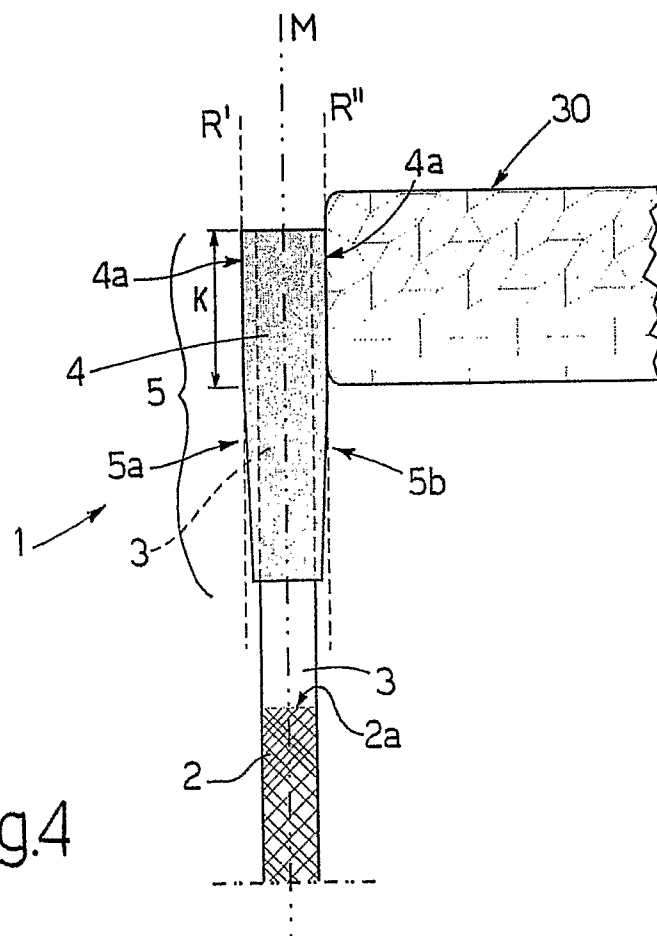
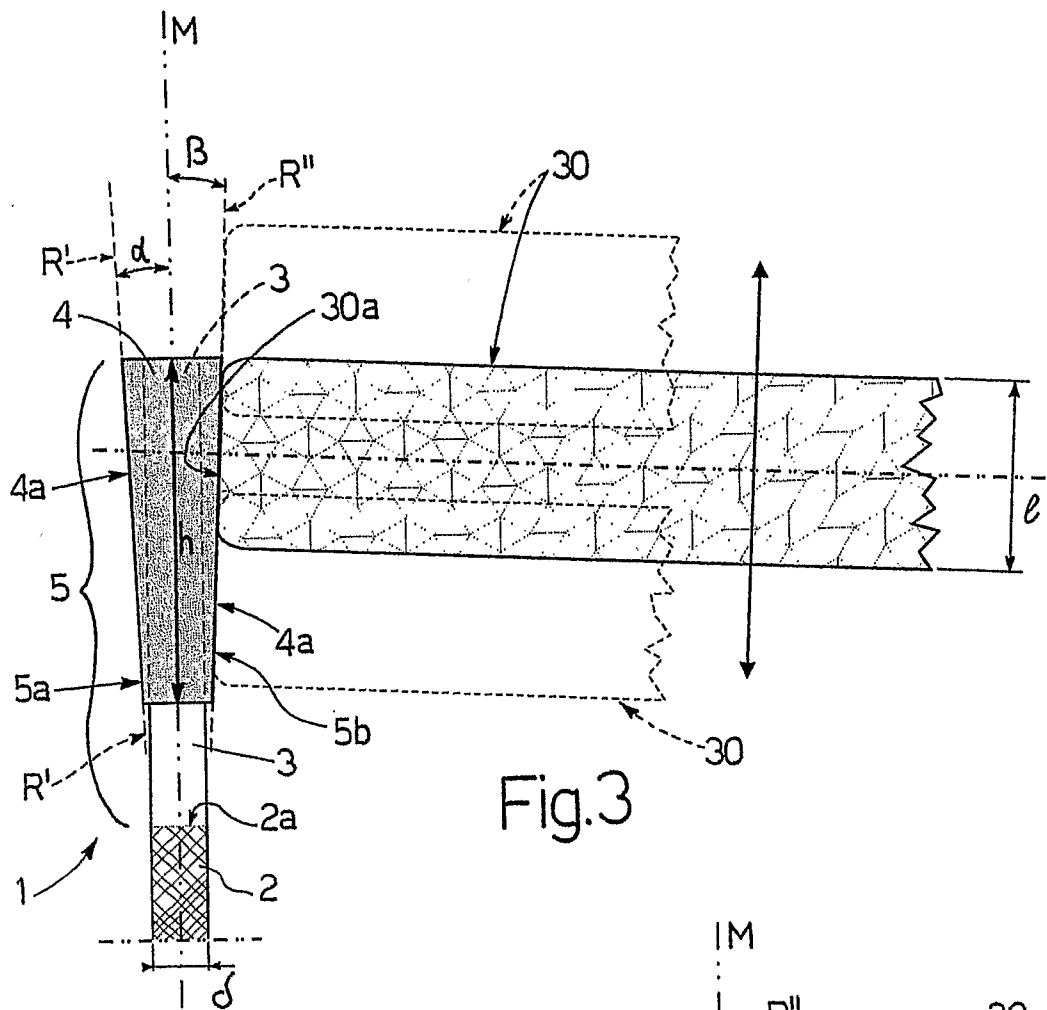
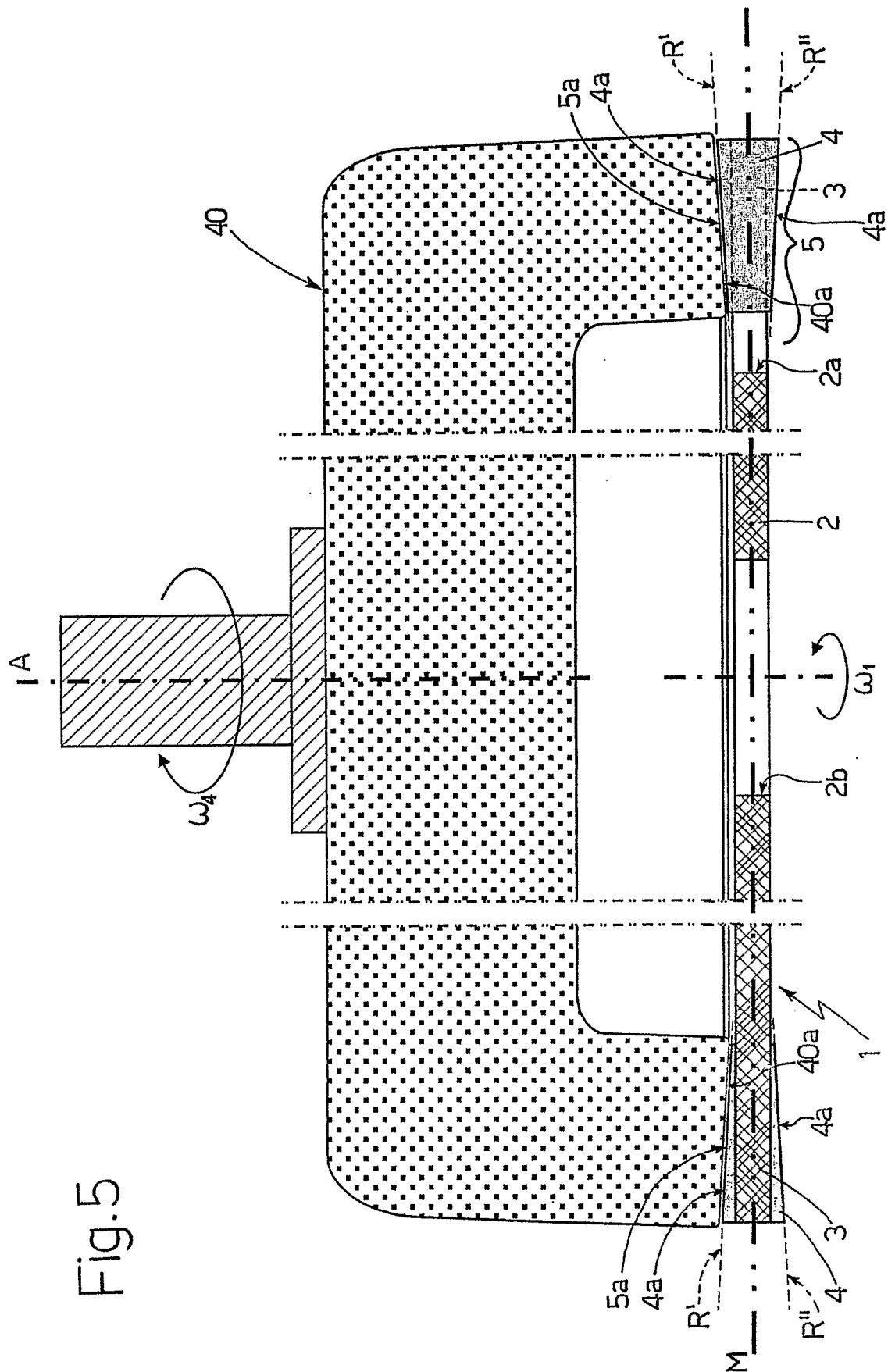


Fig.2

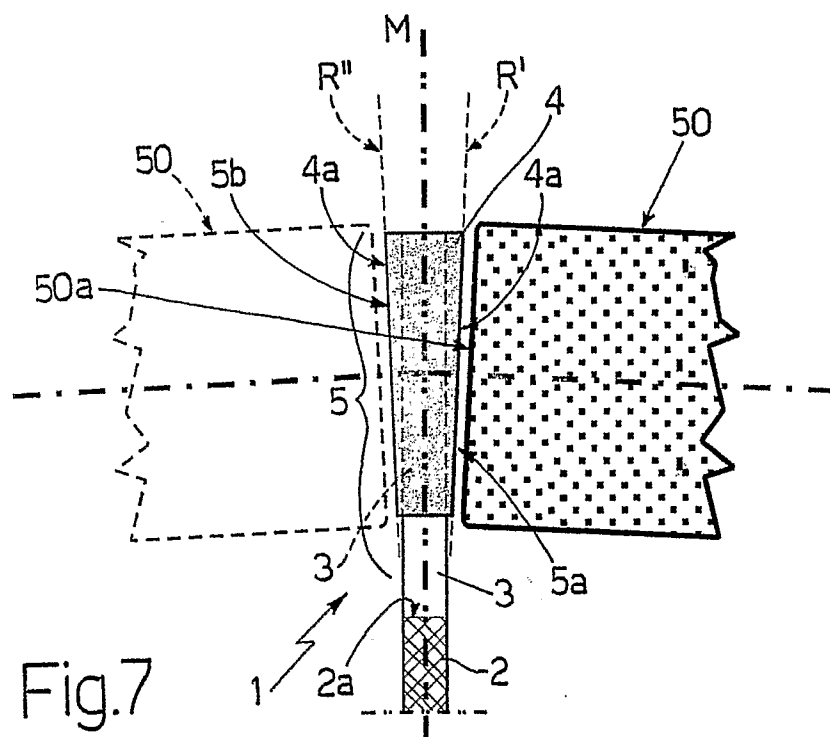
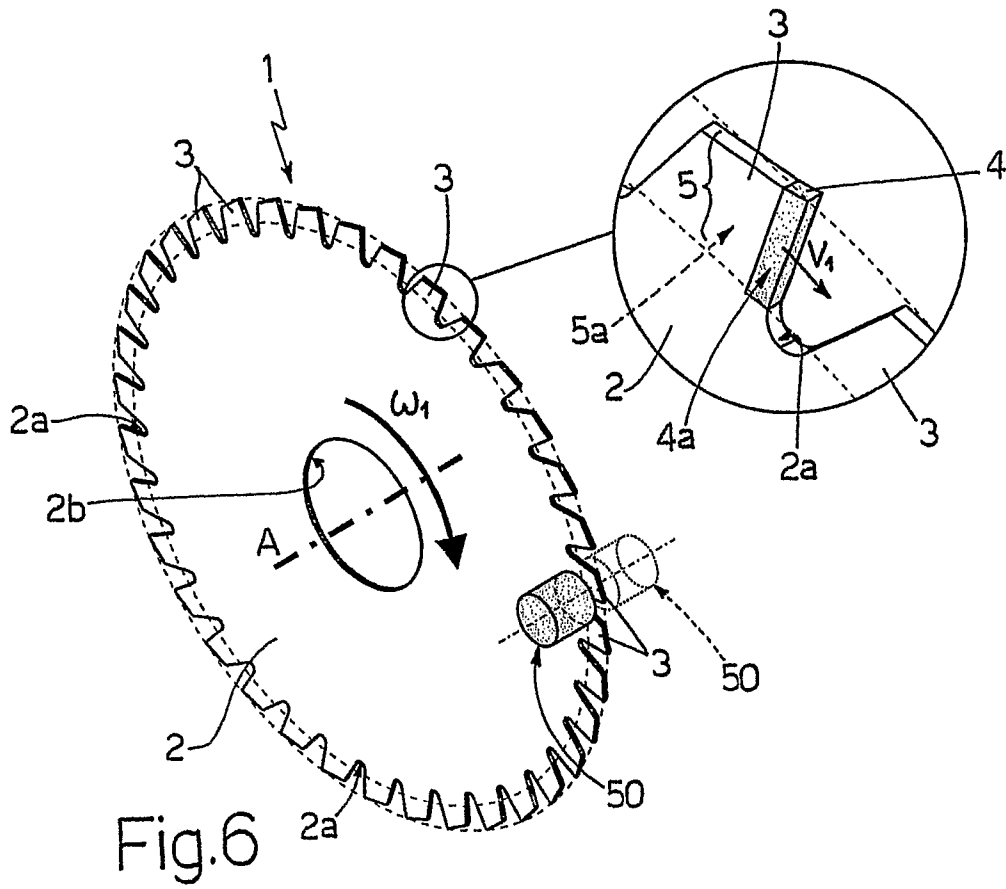
2 / 4





5.
E.g.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2006/002135

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23D63/18 B24B3/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B23D B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 06 262430 A (MARUNAKA KAKOKI KK) 20 September 1994 (1994-09-20)	1
Y	abstract; figures 6-8 paragraphs [0031] - [0035] -----	2-10
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Y	US 5 522 283 A (BROWN ERNEST W [US]) 4 June 1996 (1996-06-04) column 1, line 14 - line 45 -----	2-10
A	DE 196 26 388 C1 (VOLLMER WERKE MASCHF [DE]) 31 July 1997 (1997-07-31) abstract; figures 7-9 ----- -/--	8

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

16 November 2006

Date of mailing of the international search report

23/11/2006

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2006/002135

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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