United States Patent [19]

Costil

[11] **3,916,582**

[45] **Nov. 4, 1975**

[54] **CUTTING-TOOL GRINDING METHOD**

[76] Inventor: **Marcel Costil,** 22 Rue Vignon, Cormeilles-en-Parisis, France

[22] Filed: **June 6, 1974**

[21] Appl. No.: **476,999**

[30] **Foreign Application Priority Data**

June 20, 1973 France 73.22552

[52] **U.S. Cl.** **51/288**

[51] **Int. Cl.²** **B24B 3/06;** B24B 3/18

[58] **Field of Search** 51/288, 124, 225

[56] **References Cited**

UNITED STATES PATENTS

2,328,549	9/1943	Eich	51/288 X
3,073,076	1/1963	French	51/225 X
3,094,822	6/1963	Umbdenstock	51/225
3,117,399	1/1964	Schoeppell	51/288 X
3,156,074	11/1964	Baltz	51/288 X
3,448,545	6/1969	Belousov	51/288 X
3,626,436	12/1971	Lhomme	51/124 R
3,626,645	12/1971	Rochet	51/288
3,656,264	4/1972	Mackey	51/288
3,680,263	8/1972	Johnson	51/288 X

FOREIGN PATENTS OR APPLICATIONS

250,713	7/1948	Switzerland	51/288

Primary Examiner—Donald G. Kelly
Attorney, Agent, or Firm—Fleit & Jacobson

[57] **ABSTRACT**

The method of grinding or sharpening axial-thrust cutting tools consists in bringing the tool to a first position for grinding the rake plane, the tool axis lying in a vertical plane inclined to the horizontal median plane of the grinding wheel according to the rake angle, with the tool centre coincident with the point of intersection of the tool axis with the pivot axis of the jig supporting the tool-holder, the tool being subsequently brought to another position for grinding the cutting face passing through the centre of said tool by pivoting said jig about said jig pivoting axis, in combination with an angular setting, obtained by pivoting said tool holder about its pivot axis passing through said point of intersection, and eventually bringing said tool to a third position for grinding the small face bounding the cutting lip in the central portion of the tool tip, by pivoting said jig in a direction opposite to the direction of the movement having led to said second position.

1 Claim, 12 Drawing Figures

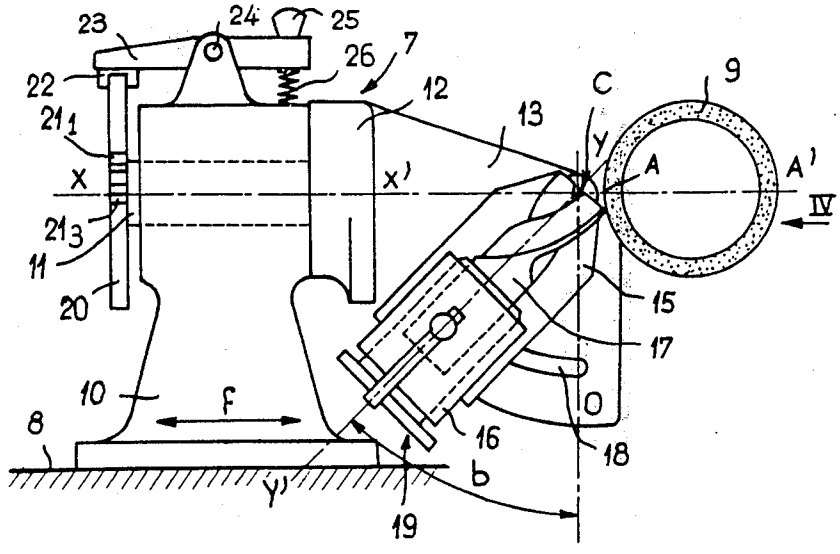


Fig-1

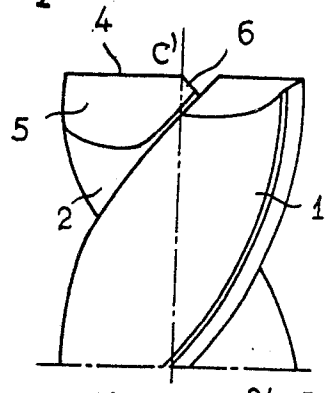


Fig-2

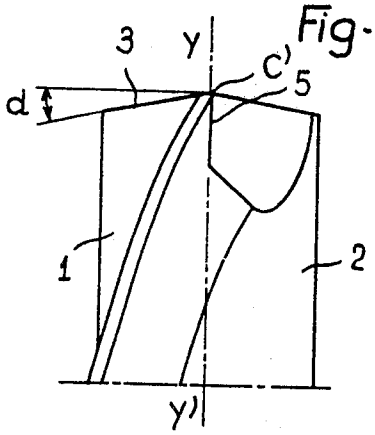


Fig-3

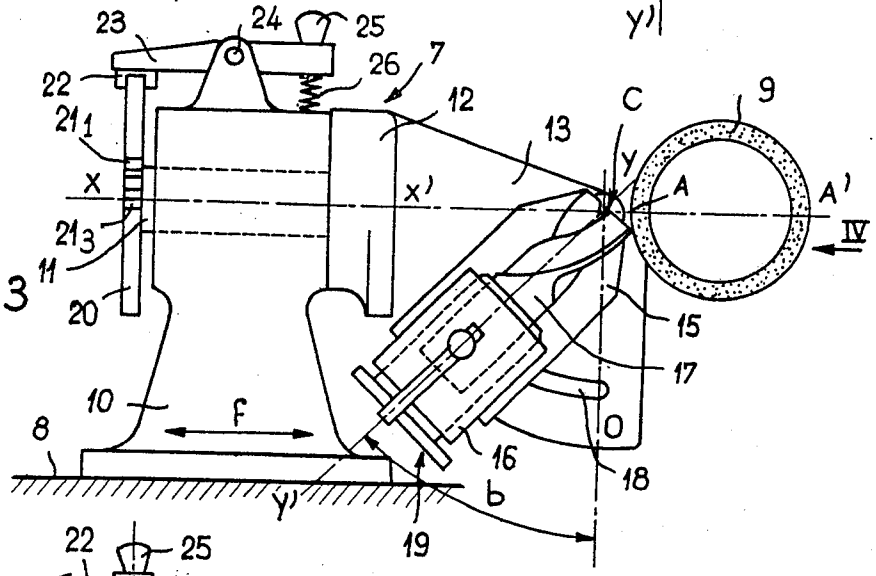


Fig-4

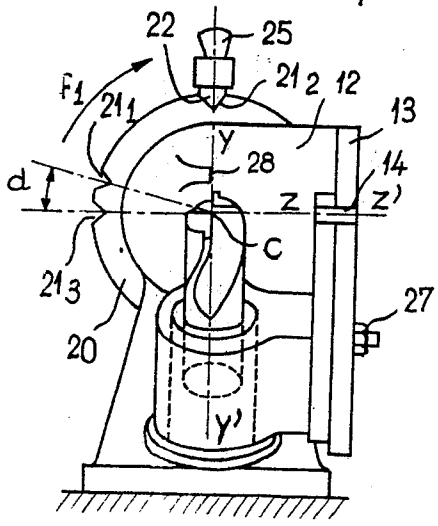


Fig-5

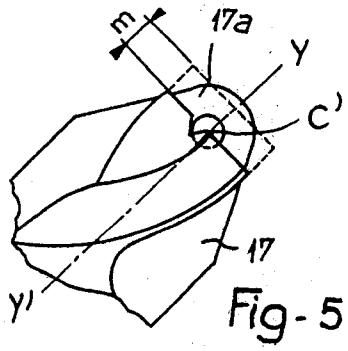


Fig-7

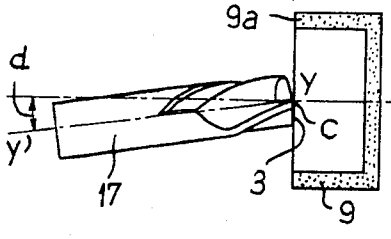


Fig-6

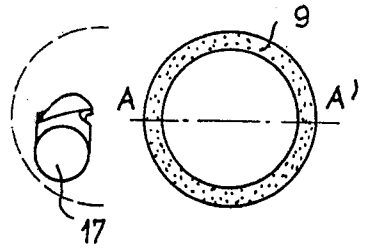


Fig-9

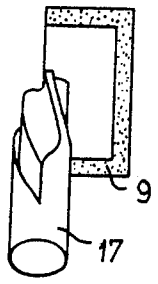


Fig-8

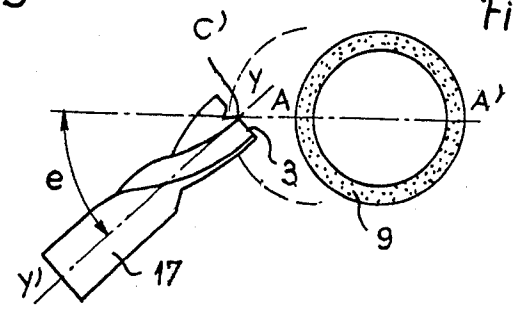


Fig-11

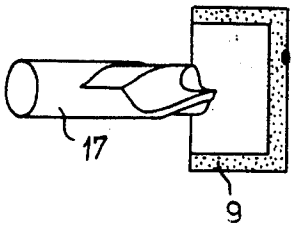


Fig-10

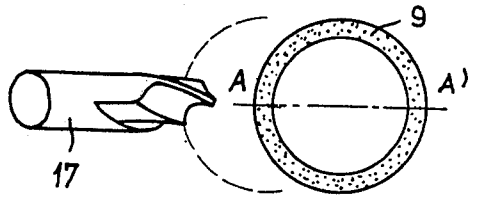
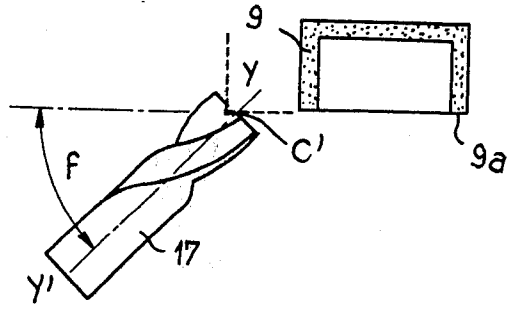


Fig-12



CUTTING-TOOL GRINDING METHOD

The present invention relates to a method of grinding or sharpening cutting-tools of the milling type operating accessorily or continuously by axial thrust or dip-cutting, such as milling cutters, reaming cutters, so-called "Aviation" cutters, flat-bottomed twist drills, blades and other tools, utilized for cutting metals and metal alloys, wood and resinous compounds, this invention also covering a sharpening machine jig for carrying out said method.

At present, the various tools mentioned hereinabove, which have at least one cutting lip or edge are ground by using basically and conventionally a plurality of conventional accessories devised for most grinding machines, the sharpening operation involving a plurality of successive steps with a consequently great loss of time, while giving frequently inaccurate results, when it is desired to obtain at least one cutting lip or edge passing through the centre in at least two planes, the first plane constituting the cutting rake and the other plane the cutting face.

It is the essential object of the present invention to provide a grinding method and a tool jig or mounting so designed that the necessary requirements of cutting tools operating by axial thrust can be met with a relatively high degree of precision without removing the tool from the jig.

This method of grinding tools having at least one cutting edge or lip sharpened by means of a straight-cup grinding wheel in a first cutting-rake plane and in a second cutting-face plane, is characterised in that the tool remains stationary in a tool holder throughout the sharpening operations, said tool holder being arranged in a mounting or jig adapted to be fed longitudinally past the grinding wheel and transversely, i.e. parallel to the axis of said grinding wheel, on a grinder table, and is caused to pivot bodily with said jig about a first axis forming an extension of the horizontal median plane of the grinding wheel and converging with another axis common to said tool holder and to the tool to be sharpened, said other axis being adapted to be set by moving same angularly in a plane containing said first axis, by pivoting said tool holder about a pivot shaft rigid with said jig or mounting, the extension of the axis of said last-named pivot shaft passing through the point of intersection of said convergent axes and being perpendicular to the first axis. Furthermore, these combined pivotal movements permit of:

1. bringing the tool to be sharpened to a first arbitrarily selected position in which its axis lies in a vertical plane inclined to the median horizontal axis of the grinding wheel by a negative angle equal to the cutting-plane rake of the tool, the worn portion to be removed from the tool projecting beyond the centre to be formed which is coincident with said point of intersection of the aforesaid axes, the tool end being subsequently caused to engage the operative front surface of the rotating grinding wheel for performing a first grinding operation of said cutting rake plane by effecting a longitudinal movement of said jig;

2. bringing the tool to a second position by subsequently pivoting said jig about said first axis through a selected angle, said pivotal movement being combined with another angular setting of the tool axis by pivoting the tool holder through a predetermined angle about its pivot pin in order to carry out a second grinding operation consisting in forming said cutting face in a second plane containing the tool centre;

3. bringing the tool to a third position by pivoting same as a consequence of the rotation of said jig about the first axis in the direction opposite to that of said pivotal movement towards the second position, the angular setting of the tool approaching that of said second position, the tool axis then lying in the median horizontal plane of the grinding wheel and forming a desired angle with the front operating surface of the wheel, the tool end being caused to follow said front face by moving the jig longitudinally in order to cut off in the central portion of said tool end during a third grinding operation, a small flat face intersecting the rake plane along a line forming with the cutting edge an angle not in excess of 90° and having its apex located centrally of the tool, said small flat face bounding the cutting edge in the central portion thereof.

The mounting or jig for carrying out the grinding method set forth hereinabove is characterised essentially in that it comprises a fixed vertical support rigidly secured to a grinding table adapted to travel longitudinally past the grinding wheel and in the transverse direction parallel to the axis of rotation of said wheel, the pivoting supporting thereof having a horizontal pivot shaft housed in said vertical support, an indexing disc rigid with said shaft and adapted to co-act with first means for indexing and locking said shaft in a first desired position of a tool-holding headstock in which the tool to be ground is secured, said pivoting support comprising a longitudinal portion off-set transversely parallel to the pivot shaft and supporting a pivot pin permitting the angular or turning movements of the tool-holding headstock in a plane parallel to said off-set portion, this off-setting being such that the common axis of said tool and tool holder, in all angular positions of said tool holder, and the pivot axis of said pivoting support, converge to a point also contained in the pivot axis of said tool holder, the headstock of said tool holder being further associated with said pivoting support through means capable of locking said headstock in the desired angular position, another indexing device being provided for rotating the tool through the desired angle in its headstock, means being also contemplated for moving the tool in its axial direction within said headstock.

A clearer understanding of this invention will be had as the following description proceeds with reference to the attached drawing illustrating diagrammatically by way of example a typical form of embodiment of a tool mounting and of the various steps of the method of grinding the tool. In the drawing:

FIG. 1 is a side elevational view showing the cutting end of a two-edged tool, also shown in FIG. 2, to illustrate the limit plane at the centre of the cutting edge;

FIG. 2 is an elevational view, in a different plane, of the same tool, to illustrate the cutting-rake plane and the cutting-face plane, respectively, thereof;

FIG. 3 illustrates diagrammatically in elevation the mounting or jig according to this invention, mounted on a grinder table, in the position for grinding the cutting face plane;

FIG. 4 is a side elevational view of the mounting or jig of FIG. 3, as seen in the direction of the arrow IV;

FIG. 5 illustrates the end of a worn tool before commencing the grinding operation;

FIG. 6 is a front elevational view of the straight-cup grinding wheel, with the tool to be sharpened, in the position for grinding the cutting-rake plane, of which

FIG. 7 is a side view;

FIG. 8 illustrates the same front elevational view with the tool positioned for forming the cutting-face plane, of which FIG. 9 is a side view, and

FIG. 10 is a front view showing the tool positioned for grinding the plane bounding the cutting edge at the centre, FIG. 11 being a side elevational view and FIG. 12 a plane view thereof.

Referring first to FIGS. 1 and 2, a tool sharpened according to the method of this invention and comprising for example two flutes 1 and 2, has a first plane 3 constituting the cutting rake, the rake angle being designated by the reference letter *d* and the cutting lip by the reference numeral 4; another cutting face plane 5 passes through the centre C' of the tool axis YY', and a third plane 6 constitutes the limit at said centre C' of the cutting lip 4.

In FIGS. 3 and 4, there is shown diagrammatically a mounting or jig 7 secured to the table 8 of a grinding machine comprising a straight-cup grinding wheel 9. The table 8 and its jig 7 can be moved longitudinally past the grinding wheel 9, as shown by the arrows *f*, or transversely, parallel to the axis of rotation of said grinding wheel.

The jig comprises a fixed vertical support 10 in which the horizontal shaft 11 of a pivoting support 12 is housed, the median axis XX' of shaft 11 lying in coextensive relationship to the horizontal median plane of grinding wheel 9.

The pivoting support 12 comprises a plate 13 off-set laterally, parallel to the shaft 11, in which a pivot pin 14 is secured to permit the angular pivotal movements, parallel to the plane of plate 13, of the head 15 of the tool-holding headstock 16 in which the tool 17 to be ground or sharpened is secured. The plate 13 has formed therein, in the vicinity of its edge opposite said pivot pin 14, an arcuate slot 18 covering about 45° and centered to the axis ZZ' of pivot pin 14.

Indexing means illustrated diagrammatically at 19 permit of detent-positioning the tool in the headstock in any desired position. Means 27 are also provided for locking the head 15 in any desired angular position.

The axis XX' of pivot shaft 11 of support 12, and the axis YY' of said headstock 16 and consequently of the tool 17 to be sharpened converge to a point C through which the axis ZZ' of pivot pin 14 of said tool-holding headstock 16 and consequently the tool 17 to be ground are also caused to converge.

An indexing disc 20 of an indexing system is rigid with the pivot shaft 11 and comprises a number of notches 21_1, 21_2, 21_3 properly distributed along the outer periphery of said disc 20. A catch 22 adapted to lock the disc 22 in the selected angular position by engaging one of said notches 21 is carried by one end of a two-armed lever 23 fulcrumed by means of a pivot pin 24 to said fixed support 9, said pin 24 extending at right angles to the shaft 11 of pivoting support 12. The other end of lever 23 carries a released knob 25 and the lever 23 is constantly urged to its detent-positioning position, i.e. to the position in which the catch 22 engages one of the notches 21, by a coil compression spring underlying said knob 25 in order to lock the pivoting support 12 in the selected position. These notches are so disposed along the outer periphery of disc 20 that the first notch 21_1 corresponds to the pivoting support 12 position in which the tool face 3 is ground to obtain its face 3, i.e. the cutting rake. To the second notch 21_2 there corresponds the tool position for sharpening the plane 5 of the cutting face, this notch 21_2 being spaced angularly from notch 21_1 by an angle of, say, 90°—*d* (*d* being the desired rake angle) in the forward direction as shown by the arrow f_1 of FIG. 4. The third notch 21_3 corresponds to the position necessary for grinding a plane 6 limiting the cutting lip 4 at the centre C'.

A boss 28 formed on the pivoting support 12 and having a face extending in a vertical plane containing the pivot axis XX permits of determining the position of this axis in relation to the grinding wheel 9. This boss 28 may advantageously comprise a grinding-wheel truing diamond and permits of gauging a stop (not shown) for the transverse or cross-slide of the table 8, to limit the stroke thereof.

The device operates as follows:

Firstly, the tool 17 to be sharpened or ground is inserted into the tool holder 16 so that the worn or untrue portion 17*a* of the tool projects by a distance *m* from the point C of intersection between the axes, which is to determine the future centre C' of the sharpened or ground tool (FIG. 5).

Then, three operations are performed, as follows:

I. A first operation, for example grinding the cutting rake face 3. To this end, the catch 22 is firstly released by depressing the knob 25 of the indexing or detent-positioning device while compressing the spring 26. Then the disc 20 is rotated in the direction of the arrow f_1 (FIG. 4) until the notch 21_1 registers with catch 22. Upon release of knob 25 the catch 22, due to the expansion of spring 26 reacting against the lever 23, is caused to engage the notch 21_1 and the pivoting support 12 is thus locked. Then the axis YY' of tool 17 is caused to coincide with the O position of graduated segment *b* by pivoting the headstock 16 about the pivot pin 14. Thus, the tool 17 is positioned as shown in FIGS. 6 and 7, with its axis YY' in a vertical plane and forming with the horizontal median plane AA' of the grinding wheel an angle *d* equal to the desired rake angle. Under these conditions, it is only necessary to move the support 10 longitudinally on the table 8 until the tool end contacts the operative front face 9*a* of grinding wheel 9 for (possibly with transverse movements) grinding the face 3 of the tool and thus form the rake face thereof, until the cross slide (not shown) abuts the stop means contemplated.

II. In a second operation consisting for example in grinding the cutting face plane 5, the catch 22 is again released from the indexing means and the disc 20 is rotated in the direction opposite the arrow f_1 until the catch 22 engages notch 21_2, and the tool axis YY' is shifted angularly through a selected angle *b* (for example 45°) by pivoting the tool holder 16 about the pivot pin 14.

Thus, the tool 17 is brought to the position shown in FIGS. 3, 4 and 8, 9, with its axis YY' lying in a vertical plane inclined by an angle $e = 90°-b$ in relation to the median horizontal plane A–A' of grinding wheel 9.

Then the cutting face 5 is sharpened by bringing the tool end firstly into the plane of the operative front face 9*a* of grinding wheel 9, and subsequently moving the jig 7 along the wheel 9.

The purpose of angle *e* is to determine a sufficient surface area of contact with the grinding wheel, said area decreasing towards the tool centre.

III. The last operation consists in grinding a face 6 bounding the cutting lip or edge centrally of the tool tip, the intersection of said face 6 with the face 3 obtained during the first operation forming a desired

angle with the cutting lip **4**, of which the apex is coincident with the centre C'. To this end, after releasing the catch **22**, the notch 21_3 of indexing disc **20** is brought in radial alignment with this catch as already described hereinabove. Then, assuming that this operation follows the preceding one, the disc **20** is rotated through the desired angular value in the direction of the arrow f_1 of FIG. **4**. The angular position *b* of the tool axis on the pivoting support approximate that of the second operation described hereinabove. As illustrated in FIGS. **10** to **12**, the tool **17** is thus positioned in the median horizontal plane A–A' of the grinding wheel, so as to form with the vertical plane containing the operative face **9***a* of grinding wheel **9** a predetermined angle *f* corresponding to the position of plane YY' of tool **17** with respect to said face **9***a*. Under these conditions, the tool end is caused to engage the operative face of the grinding wheel and the jig **7** is fed longitudinally to grind the face **6**. A stop (not shown) carried by table **8** limits this travel.

The three operations described hereinabove may of course be carried out in a different order, provided that the grinding step is completed when the axis XX' of jig **7** is coincident with the vertical plane of operation **9***a* in front of the straight-cup wheel **9**, a requirement easily met by using a simple stop (not shown) on the transverse slide of the table of the grinding machine, gauged by means of the above-mentioned boss **28** on the pivoting support **12**.

It may be noted that the grinding of the plane constituting the cutting face **5** is further facilitated if the plane of face **6** is ground beforehand.

To grind the other lips, if any, of the tool **17**, it is only necessary, by using the indexing device **19** of the tool-holding headstock **16**, to rotate the tool **17** about its axis through an angle corresponding to the number of lips and then to carry out the first two operations described hereinabove as Operations I and Operation II (cutting rake and cutting face of each subsequent lip).

It is worth pointing out that throughout the above-described tool grinding operations it is not necessary to remove the tool from its holder. Therefore, a high degree of precision in the determination of the centre through the three grinding planes is achieved.

Although a specific form of embodiment of this invention has been described hereinabove and illustrated in the accompanying drawing, it will readily occur to those skilled in the art that various modifications and changes may be brought thereto without departing from the scope of the invention as set forth in the appended claims.

I claim:

1. Method of sharpening cutting tools operating by axial thrust and having at least one cutting lip to be sharpened by means of a straight-cup grinding wheel in a first cutting rake plane and a second cutting face plane, characterised in that said tool is secured in a tool holder throughout the grinding operations, said tool holder being incorporated in a jig adapted to travel longitudinally past the grinding wheel and transversely, parallel to the axis of rotation of said wheel on a sharpening-machine table, and to pivot bodily with said jig about a first axis constituting the extension of the horizontal median plane of said wheel and converging with another axis common to said tool-holder and to the tool to be sharpened, said other axis being adapted to be set by causing an angular displacement of said tool holder in a plane containing said first axis by pivoting about a pivot pin rigid with said jig and having its axis directed to the point of intersection axis, the arrangement being such that these combined pivotal movements are adapted to:

a. bring said tool to a first arbitrarily selected position in which its axis lies in a vertical plane inclined to the horizontal median plane of the grinding wheel by a negative angle equal to the rake angle of the cutting plane of said tool, the worn portion to be removed from the tool projecting beyond the centre to be formed which is coincident with said point of intersection of the first and second axes, the tool end being caused to engage the operative front face of the rotating grinding wheel for performing a first grinding operation consisting in grinding said first cutting rake plane by effecting a longitudinal movement of said jig;

b. bring said tool to a second position by subsequently pivoting said jig about said first axis through a desired angle, said pivotal movement being combined with another angular setting of the tool axis by pivoting the tool holder through a predetermined angle about its pivot pin in order to carry out a second grinding operation consisting in forming said cutting face in a second plane containing the tool centre, and

c. bring the tool to a third position by subsequently pivoting said jig about said first axis but in a direction opposite to that of said pivotal movement to said second position, the tool axis then lying in the horizontal median plane of the grinding wheel and forming a predetermined angle with the operative front face of said wheel, the tool end being caused to follow said front face of the wheel by effecting a longitudinal movement of said jig in order to cut the central portion of said tool end, during a third grinding operation, to form a small face intersecting the rake plane along a line forming with the cutting lip an angle not in excess of **90°** and having its apex coincident with the tool centre, said small face limiting the central portion of the cutting lip.

* * * * *