

June 10, 1969

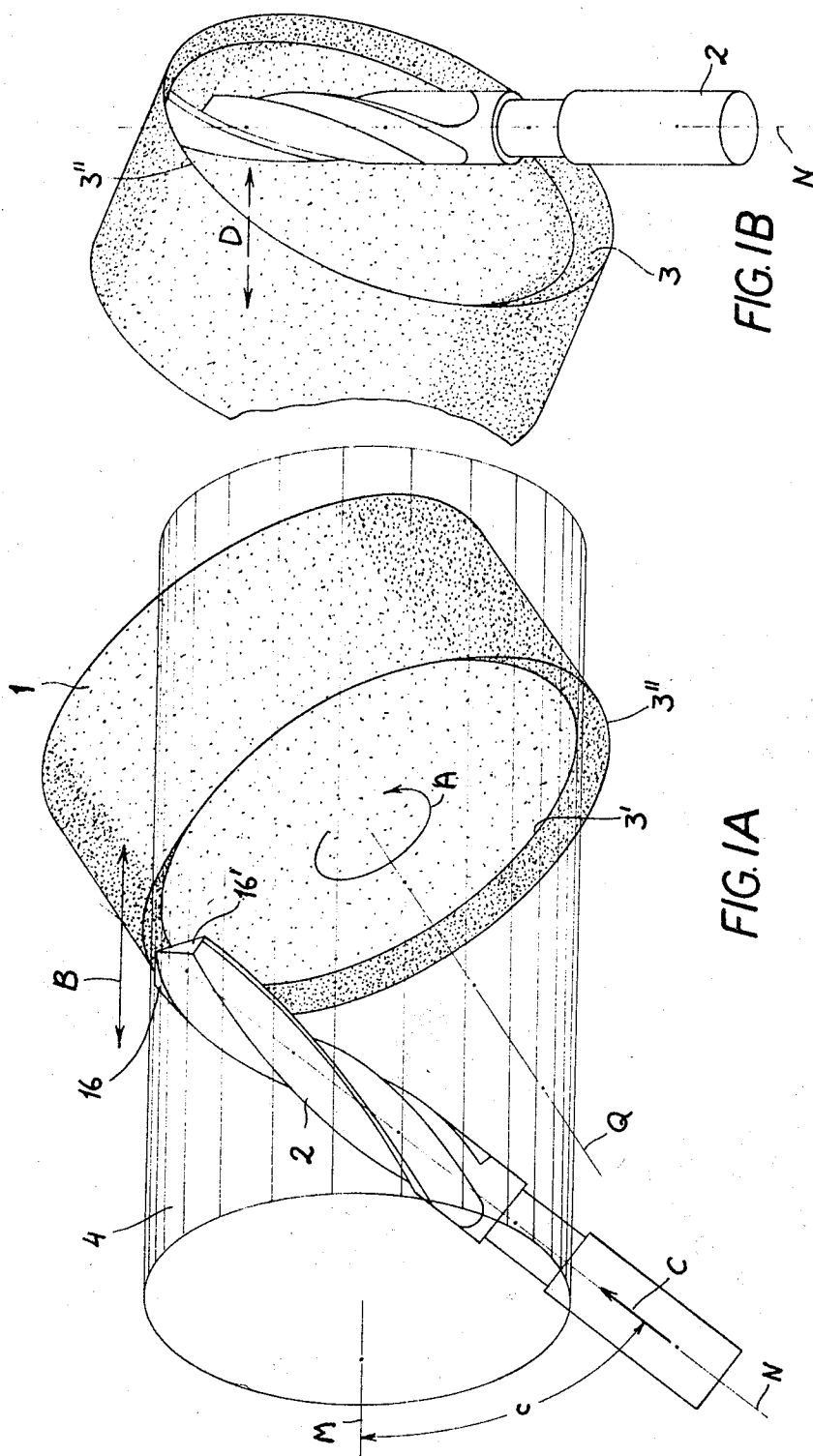
V. BELOUSOV ET AL

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METHOD OF AND MEANS FOR SHARPENING TWIST DRILLS

Filed Sept. 23, 1965

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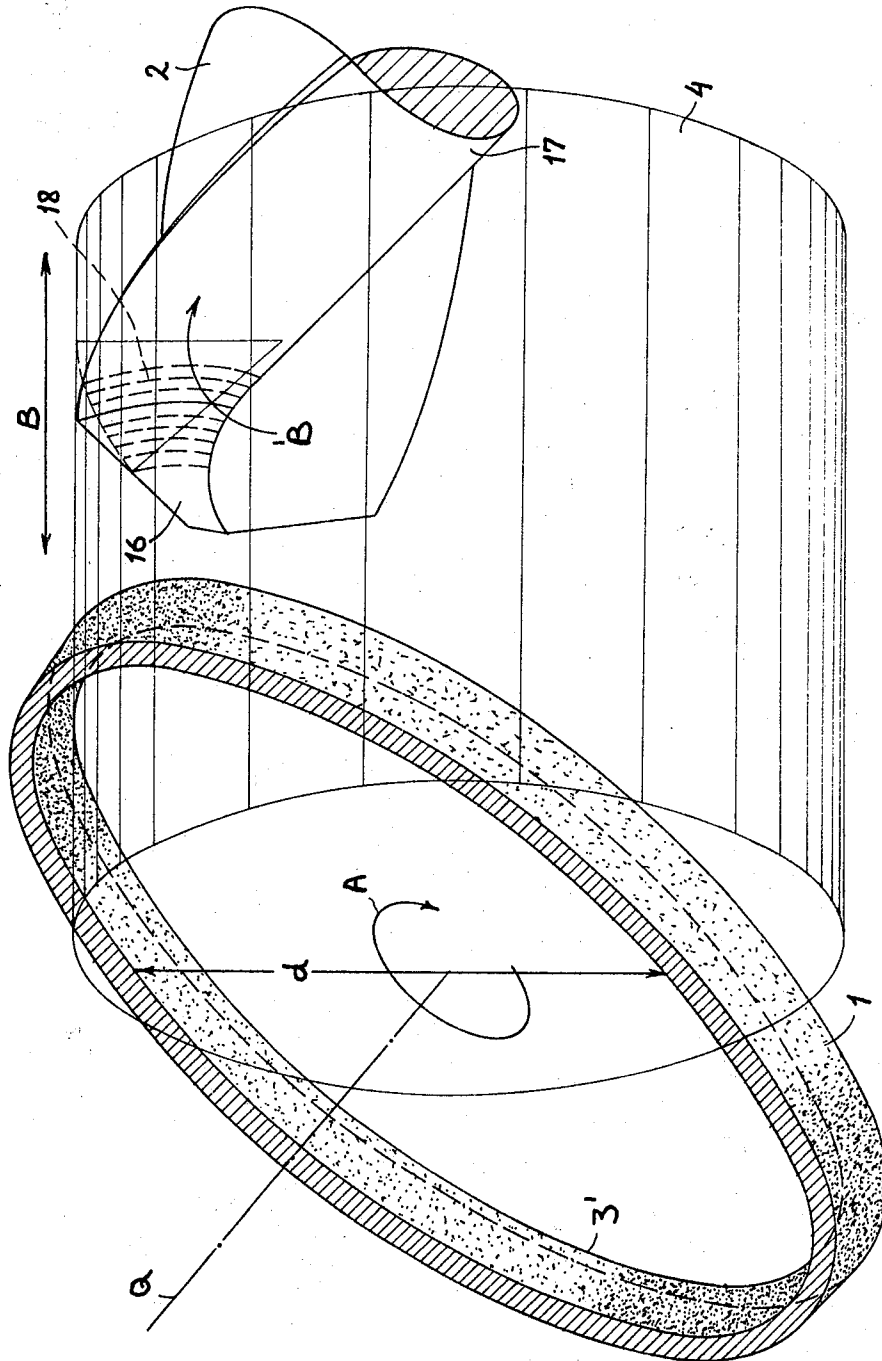
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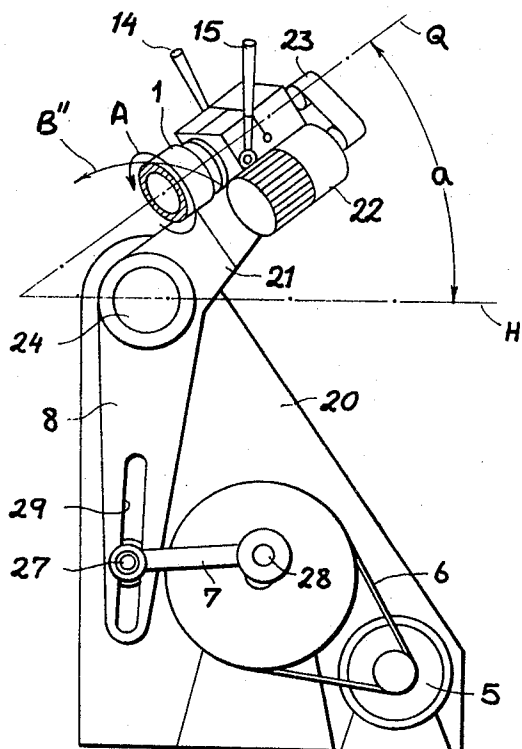


FIG. 3A

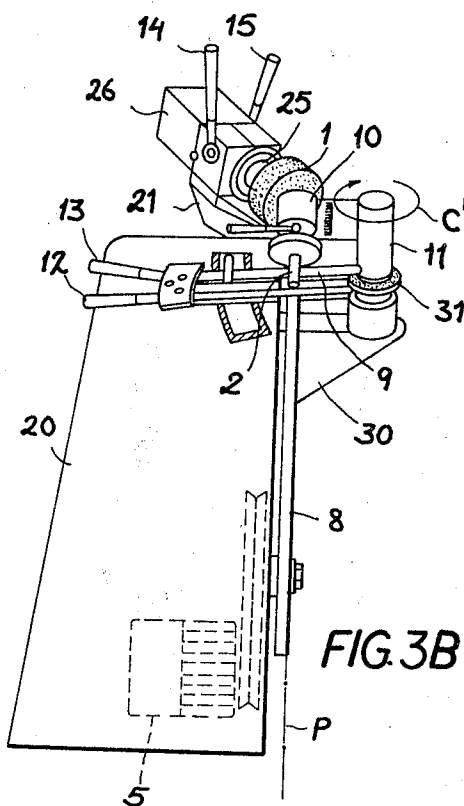


FIG. 3B

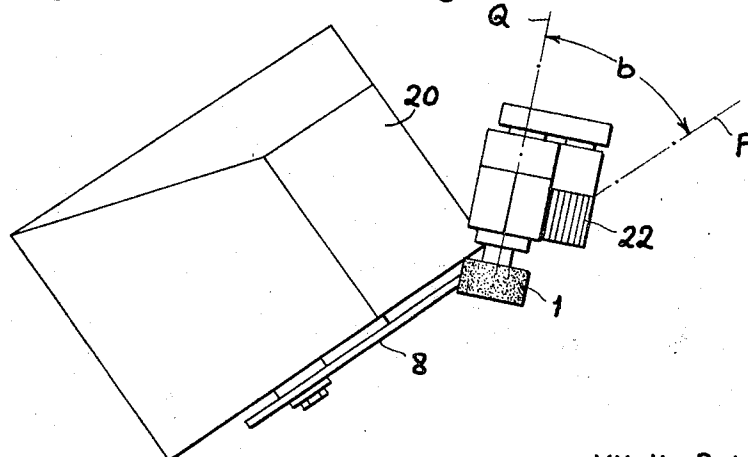


FIG. 3C

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METHOD OF AND MEANS FOR SHARPENING TWIST DRILLS

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8 Claims

ABSTRACT OF THE DISCLOSURE

A twist drill is sharpened by reciprocating it generally rectilinearly in a plane passing through the drill axis and along a line including an angle of 40 to 50° with that axis while holding the tip of the drill against a cup-shaped grinding wheel rotating about an axis which is skew to the drill axis and includes with the aforementioned plane an angle of 40 to 50°.

Our present invention relates to a method of sharpening twist drills and to a machine for carrying out this method.

Conventional drill-sharpening technique utilizes flat, cylindrical or conical grinding disks or wheels executing relatively complex motions with reference to the drill to be sharpened. With the use of a cup-shaped grinding wheel having a frustoconical inner periphery, for example, each end face or land of the drill may be given its generally conical shape by letting the axis of the rotating wheel revolve about the tip of the drill which comes into contact with the abrasive wheel edge once per revolution. At the moment of contact the drill axis intersects the wheel axis at an acute angle whose magnitude, together with that of the vertex angle of the frustum, determines the apex angle of the drill at the junction of its lands; it is therefore necessary to maintain the proper shape of the frustoconical grinding-wheel surface by trueing it with the aid of a diamond whenever it is deformed by wear.

The general object of our invention is to provide a method of and means for sharpening twist drills in a more efficient manner and with elimination of such trueing step.

This object is realized, pursuant to our invention, by positioning the drill with its axis skew to the axis of a cup-shaped grinding wheel and relatively reciprocating the wheel and the drill with a generally rectilinear motion in a plane containing the drill axis and in a direction which includes an acute angle, with the drill axis, the wheel axis also including an acute angle of preferably 40° to 50° with the aforesaid plane. During this reciprocating motion, the tip of the drill is periodically engaged by an inner peripheral edge of the wheel along a contact area which is part of an elliptical cylinder; this imparts to the engaged land of the drill an elliptically cylindrical curvature defining a cutting edge which is much more efficient than that obtainable by standard techniques so that the service life of the drill is three to six times as long as that of drills conventionally sharpened. Furthermore, since the same circular edge sweeps the entire surface of the land, there is no longer any need for trueing the abrasive face of the grinding wheel.

The relative reciprocation between the wheel motion and the drill support need not be exactly rectilinear but can proceed along an arc of a circle of large radius approximating a straight line; thus, a machine for carrying out the aforescribed method may include a crank drive for oscillating a supporting arm about a fulcrum remote

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from the region of contact between the drill and the grinding wheel.

The invention will be described in greater detail with reference to the accompanying drawing in which;

FIG. 1A is a perspective view of a grinding wheel and a drill cooperating therewith in accordance with the invention;

FIG. 1B is a view similar to FIG. 1, showing the drill and the wheel from a different angle;

FIG. 2 is another view generally similar to FIG. 1A, illustrating a further aspect of our improved grinding method;

FIG. 3A is a side-elevational view of a machine for carrying out the method of FIGS. 1A-1C;

FIG. 3B is an end-elevational view of the machine of FIG. 3A, with a drill in position thereon; and

FIG. 3C is a top view of the machine without the drill and its mounting.

In FIGS. 1A and 1B we have shown a cup-shaped grinding wheel 1 rotatable about an axis Q as indicated by arrow A, the wheel having a circular rim 3 centered on axis Q. The concave side of rim 3, which is of generally frustoconical shape, is in contact with a land 16 of a twist drill 2 having an axis N skew to the wheel axis Q, the wheel 1 and the drill 2 being relatively oscillated in a direction B which includes an angle c with drill axis N. During this relative reciprocation, the rim portion 3 of wheel 1 engages the land 16 of drill 2 along part of the periphery of an imaginary elliptical cylinder 4 whose axis M is parallel to the direction B, the intersection of this cylinder with any plane perpendicularly to axis Q having the shape of a circle whose radius d (FIG. 2) is that of the inner edge 3' of rim 3. As the wheel rotates in the direction A, edge 3' periodically sweeps across land 16 to give it an elliptically cylindrical shape. At the same time, any irregularities developing along the substantially frustoconical rim surface are automatically evened out by the linear contact between the land 16 and the inner wheel periphery as the drill 2 is slowly advanced along its axis N, to the extent dictated by the desired depth of grind, as indicated by arrow C. As will likewise be apparent from FIG. 1A, the outer edge 3'' and adjacent portions of rim 3 curve away from the cylinder 4 so as not to participate in the sharpening process proper which is performed exclusively by the inner edge 3'. After the land 16 has been suitably sharpened, the drill 2 may be axially retracted and rotated through 180° for a sharpening of the opposite land 16'.

As illustrated in FIG. 2, a generally toroidal transition zone 18 may be formed between the land 16 and the adjoining drill flank 17 by relatively rotating the wheel 1 and the drill 2 in a direction B' along an arc centered on a point O which is relatively close to the point of contact between drill 2 and wheel rim 3. On the other hand, as described hereinafter with reference to FIGS. 3A-3C, the rectilinear reciprocation B may be replaced in practice by an oscillation around an arc whose center is relatively remote from that point of contact.

If the lands 16, 16' are to converge at a pyramidal point, the drill 2 may be laterally displaced (arrow D, FIG. 1B) to change the location of its point of contact with wheel 1, with corresponding modification of the shape of the drill tip. If the cutting edge of each land is to be divided into two or three segments inclined at different angles, this may be accomplished by varying the angle of inclination a of drill axis Q with reference to the direction of reciprocation B.

A machine for performing the grinding operation described above has been illustrated in FIGS. 3A, 3B and 3C. It comprises a base 20 having an arm 21 which supports a driving unit for the grinding wheel 1, this unit

including a motor 22 and a transmission belt 23. The shaft of wheel 1 is journaled in a bearing sleeve 25 held in a clamp 26. Mounting arm 21 is swingable about a fulcrum 24 and is integral with an arm 8 linked at 27 with a pitman 7 reciprocated by a crank pin 28 under the control of a drive motor 5 via a transmission belt 6. The position of coupling 27 along arm 8 is adjustable in a slot 29 thereof to vary the effective stroke length of oscillation B which, of course, must be sufficient to carry the working edge 3' across the entire land 16 or 16' (FIG. 1A).

A bracket 30 on base 20 supports a shaft 11 which is rotatable, as indicated by arrow C', and carries a chuck 10 holding the drill 2 to be sharpened. A pair of handles 12, 13 are joined to shaft 11 at opposite sides of a yieldable coupling 31. In order to bring the drill 2 up against the wheel 1, handle 12 may be swung in the direction C' for rapid engagement of the drill with the wheel whereupon this handle may be immobilized by an adjustable detent and handle 13 may be actuated to continue the axial advance of the drill at a reduced rate. If the wheel 1 requires readjustment after a certain amount of wear, clamp 26 as opened by the release of a locking lever 14 and the wheel is axially shifted by rotation of a lever 15 which is connected with the journal 25 of the wheel shaft through a rack-and-pinion drive not shown.

Arrow B'' in FIG. 3A represents the aforescribed arcuate oscillation about fulcrum 24 which replaces the linear oscillation B illustrated in FIGS. 1A and 2. This oscillation, as best seen in FIG. 3B, takes place in a vertical plane P which also contains the axis of drill 2. The general direction of the oscillatory motion B'' is represented in FIG. 3A by a horizontal line H. The angle of elevation of wheel axis Q with reference to the level H has been shown at *a* in FIG. 3A and may range between 40° and 50°. A similar angle *b* is shown in FIG. 3C to be included between wheel axis Q and plane P.

We have found that, by the use of our improved method and machine, the time for sharpening medium-sized drills can be reduced by 10 to 20 seconds. The operation may be performed without cooling and, for reasons already set forth, does not require any reshaping of the abrasive wheel surface by a diamond inasmuch as the working edge 3' is invariably defined by the inner diameter *d* (FIG. 2) of the cylindrical wheel portion. The rapid/slow positioning device 11-13 speeds up the ancillary operations, such as the rotation of the drill chuck 10 through 180° after the grinding of the first land. Moreover, the shape of the cutting faces of the drill may be widely varied by suitable choice of the relative positions of the drill and the wheel.

We claim:

1. A method of sharpening twist drills by means of a cup-shaped grinding wheel having an annular edge centered on an axis of rotation, comprising the steps of rotating said wheel about said axis of rotation, holding an end face of a twist drill against the concave side of said annular edge while positioning the drill with its axis skew to said axis of rotation, and relatively reciprocating said drill and said wheel with a generally rectilinear motion in

a plane containing the drill axis and in a direction which includes a first acute angle with said drill axis, said axis of rotation including a second acute angle with said plane.

2. A method as defined in claim 1 wherein said second acute angle ranges between 40° and 50°.

3. A method as defined in claim 1 wherein said drill is advanced along its axis toward said wheel at a rate which is slow compared with the rate of reciprocating motion.

4. A machine for sharpening twist drills, comprising a cup-shaped grinding wheel with an annular edge centered on an axis of rotation; mounting means journaling said wheel for rotation about said axis; first drive means for so rotating said wheel; supporting means for holding an end face of a drill against the concave side of said edge of said grinding wheel while maintaining the drill axis skew to said axis of rotation; second drive means for relatively oscillating said supporting means and said mounting means with a generally arcuate motion with a long radius in a plane containing the drill axis and in a direction including a first acute angle with said drill axis, said axis of rotation including a second acute angle with said plane; and feed means for relatively advancing said mounting means and said supporting means toward each other along said drill axis.

5. A machine as defined in claim 4 wherein said second drive means comprises a swingable support for said mounting means, said support having a fulcrum remote from said end face.

6. A machine as defined in claim 5 wherein said second drive means further includes a crank drive forming a junction with said arm and stroke-adjusting means for varying the distance of said junction from said fulcrum.

7. A machine as defined in claim 4 wherein said second acute angle ranges between 40° and 50°.

8. A machine as defined in claim 4 wherein said feed means comprises a first operating member for rapidly moving said drill into contact with said wheel and a second operating member actuatable in an arrested position of said first operating member for slowly advancing said drill along its axis.

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HAROLD D. WHITEHEAD, *Primary Examiner.*

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