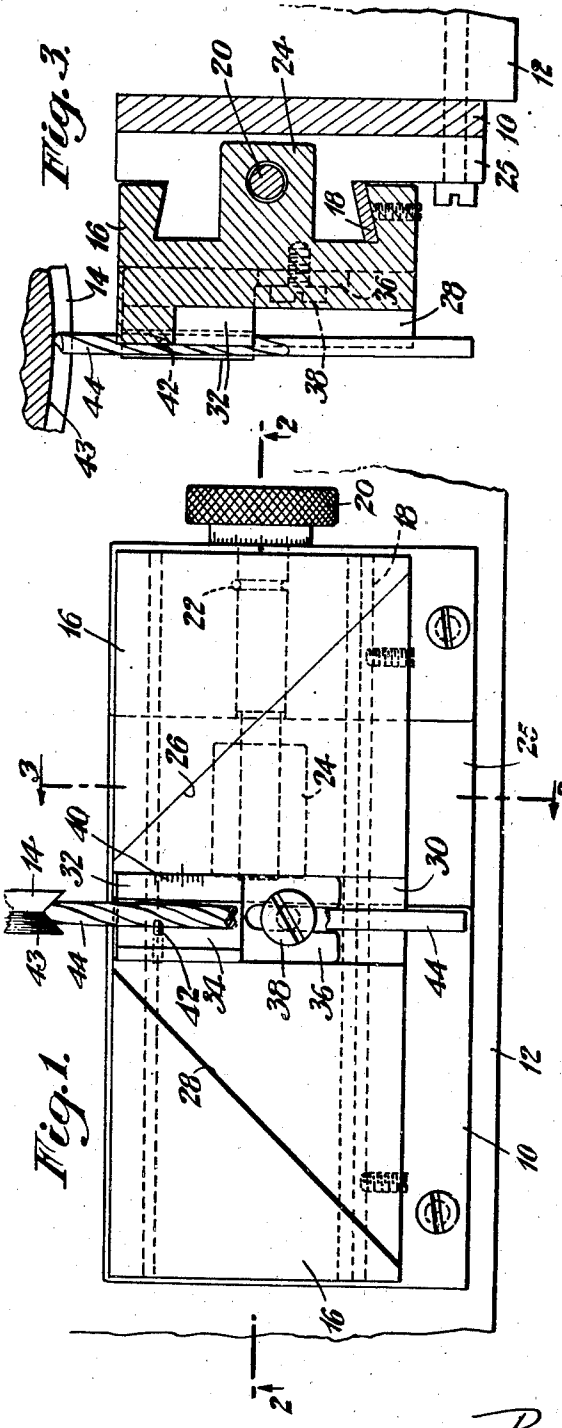
July 22, 1947. K. KRONWALL 2,424,470

METHOD AND APPARATUS FOR POINT-GRINDING DRILLS

Filed Oct. 6, 1944 2 Sheets-Sheet 1



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Filed Oct. 6, 1944 2 Sheets-Sheet 2

Fig. 7.

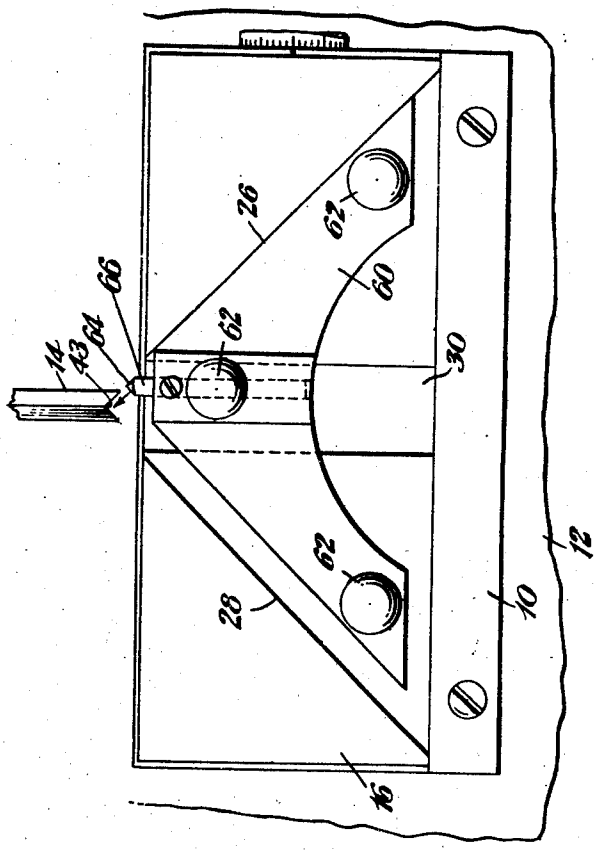


Fig. 5.

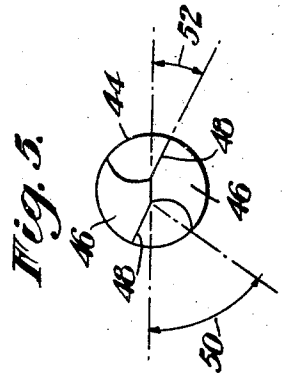
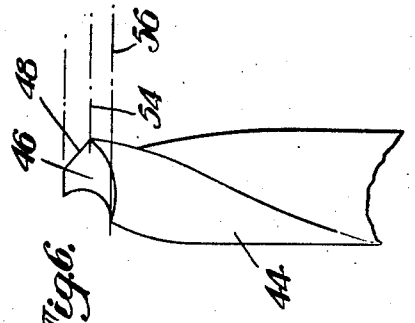


Fig. 6.



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Patented July 22, 1947

2,424,470

UNITED STATES PATENT OFFICE

2,424,470

METHOD AND APPARATUS FOR POINT-GRINDING DRILLS

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Application October 6, 1944, Serial No. 557,424

14 Claims. (Cl. 51—219)

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This invention relates to the art of making drills and more particularly to an improved method and apparatus for point grinding drills.

Twist drills as now produced have conventional curved or rounded points. Experience has shown that the amount of clearance of such points is rather difficult to control and that it is even more difficult to equalize the clearance on both cutting lips of the point.

I have discovered that by a unique procedure a point can be ground on a twist drill that has uniform cutting edges and a uniform and equal amount of clearance on both cutting lips, and that the amount of the clearance is subject to precise regulation. Furthermore, the resulting surfaces of the point will be flat as distinguished from the usual curved or rounded point surfaces.

An important feature of the invention is the discovery that if the end of a twist drill rod to be pointed is brought in contact with the periphery of a grinding wheel, dressed to provide a regular V-shaped groove having an included angle of about that desired for the drill point, and the flutes of the drill are positioned in a certain manner, a drill point having flat surfaces and the desired point-clearance, will be produced. The positioning of the flutes with respect to the grinding wheel determines the results obtained. The drill to be pointed is mounted with its axis radially of the grinding wheel, and the fluting adjusted so that the flutes at the end of the drill will be substantially aligned in the plane of the vertex of the groove in the wheel when the drill point is at the vertex of the groove. The drill is then moved toward the grinding wheel with a turning motion so that the drill is rotated at a rate determined by the pitch of the fluting.

I have discovered that if the drill to be pointed is correctly positioned with respect to the wheel, and the drill brought in contact with the dressed included angular surfaces of the wheel, in the manner stated, the desired point will be produced, even though more than the necessary length of the drill is ground off. I have also discovered that the point-clearance may be changed and controlled by varying the initial position of the drill with respect to the wheel.

Another important feature of the invention is the provision of an apparatus which is relatively simple in form for carrying out the improved method and for making drills having the improved characteristics. The apparatus preferably includes a grinding wheel of relatively large diameter (14 to 16 inches) mounted for rotation

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in a suitable grinding machine. For convenience the wheel is preferably mounted for rotation in a vertical plane and is dressed to provide an included peripheral angle, of, for example, from about 100° to 120° F. The apparatus also preferably includes a stationary substantially horizontal table mounted adjacent the periphery of the wheel with its surface on approximately a horizontal radius of the wheel. The table also includes an adjustable drill guide adapted to guide the drill toward the wheel on a radius of the wheel, the drill guide being provided with a means such as a guide pin which fits in one of the flutes of the drill rod and which causes the rotation of the drill rod as it is moved forward in contact with the grinding wheel.

The improved apparatus includes other features which will be described more in detail hereinafter.

Other objects, features and advantages of the present invention are described herein in detail in connection with the accompanying drawings forming a part of this application.

In the drawings:

Figure 1 is a plan view, with certain parts broken away, of an apparatus constructed in accordance with the features of the present invention, and particularly adapted for carrying out the improved method of point-grinding twist drills.

Fig. 2 is a vertical sectional view of the apparatus shown in Fig. 1, taken on the line 2—2.

Fig. 3 is a vertical sectional view of the apparatus shown in Fig. 1, taken on the line 3—3.

Fig. 4 is an enlarged detailed view of the drill guide shown in Fig. 1, illustrating the manner of positioning of the drill in the drill guide.

Fig. 5 is an end view of a twist drill pointed by the process of the present invention and having the improved characteristics described herein.

Fig. 6 is a side view of the twist drill shown in Fig. 5.

Fig. 7 is a view similar to that of Fig. 1, showing how a part of the apparatus shown in Fig. 1 is used in connection with an additional fixture for dressing the periphery of the grinding wheel.

Referring to the drawings, one form of relatively simple apparatus constructed in accordance with the features of the present invention, and which is adapted for point-grinding twist drills in accordance with the invention, is shown in Figs. 1, 2 and 3. The apparatus includes a table base 10 preferably secured to the top of a bench or a part of a grinder frame 12 by means of bolts or screws as shown. The table base 10

is mounted adjacent a grinding wheel 14 of relatively large diameter compared to that of the drill, and of sufficient thickness to accommodate the size of drills to be pointed. Extremely small drills may be pointed by the apparatus and procedure of the present invention as well as drills of one-sixteenth, one-eighth, three-sixteenths inch, and larger. The grinding wheel 14 is conveniently mounted on a fixed horizontal geometric axis and driven at a very high speed, and the table base 10 is symmetrically mounted on the bench 12 with respect to the wheel 14, slightly below a horizontal radius of the wheel 14.

The table unit includes the fixed base 10 and a laterally movable table 16 which is keyed to the base by means of a conventional dove-tailed connection, as shown in Fig. 3. The dove-tailed connection includes a movable key member 18 held in place by set screws which are also used for adjusting the tightness of the dove-tailed joint between the table 16 and the base 10. The member 18 also provides for quick assembly of the table unit and permits the use of the construction shown for adjusting the position of the table laterally with respect to the grinding wheel 14. This construction includes an adjustment screw 20 mounted in one end of the base 10 and keyed thereto by a pin 22. The stem of the screw 20 extends horizontally into the base 10 and operates by a threaded connection in a lug 24 which comprises a fixed part of the table 16. The hub surface of the screw 20 is preferably provided with a calibrated scale so that the lateral position of the table 16 with respect to the grinding wheel 14 can be accurately adjusted and the position noted. The lug 24 operates in a suitable space or cross channel 25 in the base 10, as shown in Figs. 2 and 3.

The table 16 is provided with two converging straight vertical surfaces 26 and 28 which extend at the same angle to a projected horizontal radius of the wheel 14 extending between the surfaces. The table 16 also includes a central horizontal channel or slot 30 symmetrically spaced with respect to the surfaces 26 and 28, and approximately transversely through the central portion of the table in alignment with the wheel 14. The bottom of the channel 30 is preferably parallel to the horizontal radius of the wheel 14 and symmetrical to its plane.

The pointing apparatus includes a drill guide block 32 which fits the channel 30 and is slidable therein toward and away from the wheel 14. The drill guide 32 is provided with a V-shaped slot 34 in its upper surface for guiding the drill to be pointed. The drill guide block is also provided with a slotted tail piece 36 by which the block may be locked in any desired position by means of a screw 38. This position may be determined in relation to the graduations 40 on the block. The drill guide block 32 is also provided with a substantially horizontal guide pin 42 which is set in the high side of the block and which extends into the V-slot 34, so that it will project into one of the flutings of the drill to be pointed.

The periphery of the grinding wheel 14 is preferably dressed so that it is provided with an included angle, as shown in Figs. 1 and 7, the included angle being somewhat smaller than that desired for the point angle of the drill. For example, in order to obtain an included point angle of about 120°, it is desirable to dress the wheel with an included angle of about 105°. The V-shaped angle in the periphery of the wheel is made symmetrical with respect to the plane of the wheel or with respect to a radial plane through the vertex 43 of the angle.

In using the apparatus described above for point-grinding drills, a drill 44 is placed in the V-slot 34 with the lower edge of one of the flutes engaging the guide pin 42, as shown in enlarged detail in Fig. 4. The table 16 is thereupon moved by the adjusting screw 20 so that the drill is centered with respect to the vertex 43 of the wheel. The height of the drill guide block 32 is made such that the axis of the drill 44 substantially coincides with a radius through the vertex 43. The drill guide block 32 is positioned with respect to the wheel 14 and particularly with respect to the vertex 43, so that one of the spiral flutes of the drill will always be up at the position of the vertex 43. After the above-mentioned adjustments have been made and the wheel 14 is rotated, the drill 44 is pushed toward the wheel with the lower edge of one of the flutes always engaging the guide pin 42. This forward movement causes the rotation of the drill at a rate so correlated to the rate of its advance toward the grinding unit that as metal is ground from the drill end to form the point, the elements of the point of the drill will always have the same relationship to the two flutings of the drill. It will be apparent that if the distance of the guide pin 42 from the vertex 43 is properly controlled, the desired point-clearance will be obtained. Furthermore, as long as this distance remains constant, the clearance surfaces and cutting edges of the drill will retain a constant relationship to the drill flutings. The drill may be readily pushed toward the grinding wheel by the operator, and since the pin 42 engages the lower edge of one of the flutings, the drill will rotate practically automatically with very little control by the operator, because the pin forces the rotation if the drill is pushed forward in its position in the V-shaped slot 34.

Figs. 5 and 6 show the drill 44 pointed by the process and apparatus of the present invention. It will be noted that the chisel edge extends through the axis of the drill at approximately the position where the metal is the thinnest between the flutings. The angle of the chisel edge with respect to the cutting edges, however, will vary somewhat, depending upon the amount of clearance desired. The drill, as shown, has flat clearance surfaces 46 which recede away from the cutting edges 48. The amount of clearance may be determined by the relative sizes of angles 50 and 52 with respect to a line or plane through the chisel edge, as shown in Fig. 5. If these angles are of equal size, no clearance is present. If angle 50 is larger than angle 52, there is a positive clearance, while on the other hand there would be a negative clearance if angle 50 were smaller than angle 52. If desired, the clearance may be determined alone by the angle 52 formed between one of the cutting edges 48 and a line through the chisel point which corresponds to the angle 52. The clearance may also be determined by the distance between lines 54 and 56 in Fig. 6, which are drawn parallel to the chisel point line where the flat surface 46 cuts the edges of the flutings, as shown. The greater the distance, as indicated, the greater the clearance. The clearance may also be determined by the angle formed between the chisel edge line in Fig. 6 and a line through the starting points for lines 54 and 56 on the surface 46.

From a consideration of the relationships de-

scribed above between the position of the guide pin 42 and the vertex 43 of the wheel 14, it will be apparent that as the drill is moved toward the wheel, the same drill point will be obtained for any given setting of the block 32. This is true because the drill is rotated toward the wheel at a rate determined by the pitch of the flutings, so that at any given point beyond the pin 42, the position of the flutings remains the same. Therefore, as the guide block 32 is moved and set closer to the wheel 14, the point-clearance will be decreased, that is, the angle 52 in Fig. 5 will become larger. If a greater point-clearance is desired than that for any particular setting, the guide block 32 is moved slightly away from the wheel 14. These changes will be apparent from a consideration of the position of the drill 44 with respect to the wheel 14 in Fig. 1, since the upper cutting edge 48 will approach nearer to the plane of the vertex 43 as the guide block 32 is moved away from the wheel, thus decreasing the angle 52 and increasing the point-clearance. The scale 40 may be used to note the settings for successive operations.

The chisel edge of the drill is always formed in the plane of the vertex 43 of the V-shaped groove in the periphery of the wheel 14. For a given drill and a given setting of the guide block 32, the chisel edge will always have the same position with respect to the flutings and to the cutting edges 48. Since the chisel edge of the drill is in the plane of the vertex 43 of the wheel 14, the angle 52 may be regarded as between this plane and one of the cutting edges of the drill. The angle 50 may be measured in the same way. If desired the vertices of the angles 50 and 52 may be at the axis of the drill.

The vertex 43 of the grinding wheel 14 may become slightly rounded after a considerable number of drills have been pointed, but experience has shown that a slight rounding of the chisel edge of the drill does not reduce its cutting efficiency. In very small drills where a sharp chisel edge is more necessary, this can be obtained by slightly oscillating the wheel 14 or by a slight movement of the table from one side to the other by means of the screw 20. This oscillation is usually employed for drills smaller than one-sixteenth inch diameter. The movement required is very small, not over one-sixteenth of an inch.

The dressing of the grinding surfaces of the wheel 14 is of utmost importance, and the sharp internal peripheral angle must be dressed with a diamond that has a comparatively small point angle. The apparatus for dressing the wheel 14 is shown in Fig. 7 in which the table 16 with its surfaces 26 and 28 are used. The drill guide block 32 is removed from the table 16 and replaced by a dressing fixture 60 which overlies the channel 30, and which has angular surfaces corresponding to the surfaces 26 and 28. These surfaces, like the surfaces 26 and 28, are at an angle to each other equal to that desired in the periphery of the wheel 14. The fixture 60 is also provided with knobs 62 to be used by the operator, and with a diamond point 64 set in a mounting rod 66 which is adjustably held in the center of the forward end of the fixture 60 by means of a set screw, as shown. A perfect V-shaped symmetrical groove is formed in the periphery of the grinding wheel by rotating the wheel and simultaneously operating the dressing fixture 60 first along one of the surfaces 26 and 28 and then along the other. In Fig. 7 the dressing fixture is

shown in engagement with the surface 26, and its motion is directly along that surface in the direction of the arrow adjacent the diamond point 64, until one side of the V-angle is dressed. In the course of use, the diamond will wear to a very sharp point and will maintain this point throughout its useful life.

The apparatus of the present invention comprises a relatively simple construction by which the periphery of a grinding wheel may be dressed with a diamond point and the apparatus thereafter be used for mounting a drill guide block for pointing twist drills. In the dressing and grinding operations, it is important that both the dressing and the actual point-grinding be done with the diamond and the drill mounted radially to the grinding wheel center. Drill guide blocks 32 may be made special for particular sizes of drills, if desired, but where there is no great difference in size, a single block may be used for several sizes. The V-shaped angular grinding surfaces may be provided in other ways, as by using two grinding wheels. The two grinding wheels, after being dressed with the desired angle, are placed together in such a manner as to form an included V-angle groove. The wheels used for such an arrangement should preferably be of the inter-locking type. While the apparatus is substantially hand-manipulated, and the drills are described as held and moved in the apparatus by hand, it is obvious that suitable automatic means may be provided for carrying out these operations. Various other modifications may be made without departing from the spirit and scope of the invention.

Having described the invention in its preferred form, what is claimed as new is:

1. An apparatus for point-grinding twist drills, comprising a grinding wheel of relatively large diameter compared with the diameter of the drill to be ground, said wheel being from about fourteen to sixteen inches in diameter and having a peripheral V-shaped groove, the sides of which constitute grinding surfaces, means for mounting a drill to be pointed so that its axis is substantially on a radius of said wheel through the vertex of said groove, said means including a member adapted to extend into a drill fluting, and means for aligning the axis of the drill with the vertex of said V-shaped groove whereby both lips of the drill may be ground simultaneously.

2. The method of point grinding a twist drill having a pair of flutings and a pair of cutting edges, which comprises positioning the drill with respect to a rotating grinding wheel whose periphery includes grinding surfaces forming an included angle approximating that of the angle desired for the drill point so that the axis of the drill is substantially on an extended radius of the wheel passing through the vertex of said included angle and moving the drill toward the vertex of the grinding wheel and simultaneously rotating the drill on its axis at a rate correlated to the pitch of the flutings so as to maintain the flutings at the end of the drill in a predetermined relationship with respect to the plane through the vertex of said included angle.

3. The method of point grinding fluted twist drills to substantially provide flat clearance surfaces therefor which comprises moving the drill to be pointed axially with an axial rotational movement toward the periphery of and substantially on an extended radius of a rotating grinding wheel having peripheral grinding surfaces forming an included V-angle groove, controlling

the initial position of the drill flutings in relation to the grinding surfaces of said groove, and controlling the axial rotation of the drill so that such rotation bears a predetermined relationship to the forward movement of the drill as its point is ground away by contact with such grinding surfaces whereby the initially controlled relative positions of the drill flutings and the grinding surfaces are maintained.

4. An apparatus for point grinding twist drills, comprising a grinding wheel having a peripheral V-shaped groove, a table mounted adjacent the periphery of said wheel and adjustable laterally with respect to a plane through the vertex of said groove, means on said table adjustable toward and away from the periphery of said wheel for positioning a drill to be pointed in a predetermined axial relationship with respect to the peripheral groove, said means being constructed in such a way as to permit axial movement of a drill with respect thereto, and means on said drill positioning means for causing rotation of the drill when the drill is moved toward the grinding wheel with respect to the drill positioning means.

5. In an apparatus for point grinding twist drills, including a grinding unit having moving grinding surfaces presenting a V-shaped groove adapted for simultaneously grinding both cutting lips of a drill, a drill holding means mounted opposite said groove and arranged to be moved toward and away from the groove of said unit, said means including a guideway adapted to guide a drill axially toward the vertex of said groove, a member on said drill holding means adapted to extend into a fluting of a drill and to thereby cause its axial rotation when the drill is moved axially in the guideway of the holding means, and means for securing said drill holding means opposite said groove in a predetermined fixed position with respect to said grinding surfaces.

6. An apparatus, of the type described, comprising a grinding wheel having a peripheral V-shaped groove, a table mounted with a side adjacent the periphery of the grinding wheel, said table having a cross channel opposite the periphery of said wheel and substantially parallel with a plane through the vertex of said groove, said channel being adapted to receive and mount a drill holding means opposite said groove, said table also including a pair of straight-bearing shoulders one on each side of said channel and converging at equal angles to said channel toward the periphery of said grinding wheel, said shoulders being at an angle with respect to each other which is slightly less than the point angle desired for the drills to be ground, said shoulders being adapted to serve as guides for a dressing fixture adapted to be used for the dressing of the surfaces of said V-shaped groove, and means for adjusting the table and wheel with respect to each other axially of the wheel.

7. An apparatus as defined by claim 6 in which said apparatus includes a drill guide adjustably mounted in said cross channel.

8. An apparatus as defined by claim 6 which includes a triangular-shaped dressing fixture mounted between said shoulders, and means for mounting a diamond in the vertex of said fixture adjacent said wheel for dressing the wheel.

9. A method of making a twist drill having a point with flat clearance surfaces from drill stock having a pair of flutings, which comprises point grinding the fluted drill stock between a pair of rotating grinding surfaces of a grinding unit in which said surfaces are at an angle with respect to each other corresponding to about the angle desired for the clearance surfaces of the drill point, holding the drill stock during the point grinding operation with its axis substantially in the plane through the vertex of said surfaces and pointing toward the axis of rotation of said surfaces, positioning the drill stock axially with respect to the grinding surfaces so that each grinding surface is adapted to grind a cutting edge with a flat clearance surface receding therefrom, and during the grinding operation moving the drill stock endwise toward the grinding surfaces and simultaneously rotating the drill stock on its axis so that the stock is rotated at a rate correlated to the pitch of the flutings, whereby the cutting edges are formed at a predetermined position with respect to the vertex of the grinding surfaces.

10. A method of making a twist drill as defined by claim 9 in which the grinding of the drill stock between the grinding surfaces produces a chisel point on the end of the stock, and relative oscillatory lateral movement is produced between the drill stock and grinding unit to thereby sharpen the chisel point edge of the drill stock.

11. A method of making a twist drill having a point with flat clearance surfaces from drill stock having a pair of flutings, which comprises point grinding the fluted drill stock between a pair of rotating grinding surfaces of a grinding unit in which said surfaces are at an angle with respect to each other corresponding to about the angle desired for the clearance surfaces of the drill point, holding the drill stock during the point grinding operation with its axis substantially in the plane through the vertex of said surfaces and pointing toward the axis of rotation of said surfaces, positioning the drill stock axially with respect to the grinding surfaces so that the edge of each fluting terminating in a cutting edge will contact a grinding surface substantially nearer to the vertex of the grinding surfaces than the point of contact of the opposite edge of the fluting with a grinding surface, and during the grinding operation moving the drill stock endwise toward the grinding surfaces and simultaneously rotating it on its axis so that the stock is rotated at a rate correlated to the pitch of the flutings, whereby flat clearance surfaces are formed which recede from the respective cutting edges.

12. The method of point-grinding twist drills having two cutting edges which comprises rotating two grinding surfaces having fixed geometrical axes and so positioned as to present an included V-angle groove, the rotation of each grinding surface being about its fixed geometrical axis, bringing the end of a drill to be point-ground axially into uniform engagement with the surfaces forming said groove with the cutting edges in a pre-determined relationship with respect to the respective grinding surfaces, advancing the drill axially toward the grinding surfaces as the point of the drill is ground away, and simultaneously and slowly rotating the drill on its axis and relatively to the grinding surfaces at a rate so correlated to the rate of its advance toward the grinding unit, as the grinding operation proceeds, as to maintain said relationship.

13. The method of forming flat clearance surfaces on the point of a twist drill having a pair of flutings and a corresponding pair of cutting edges which comprises rotating two grinding surfaces having fixed geometrical axes and so positioned as to present an included V-angle groove,

the rotation of each grinding surface being about its fixed geometrical axis, bringing the end of a drill to have the flat clearance surfaces formed on the point thereof into uniform engagement with the respective grinding surfaces forming said groove, with the cutting edges of the drill so positioned with respect to said groove that a plane through the vertex of the groove extends substantially crosswise through the axis of the drill where the metal is the thinnest between the drill flutings at the end of the drill, and simultaneously advancing the drill axially toward the vertex of the groove and slowly and only slightly rotating the drill as it is so advanced, such rotation of the drill being at a rate so correlated to the rate of its advance toward the vertex of the groove, as to maintain said relationship, so that said grinding surfaces simultaneously separately grind the respective clearance surfaces of the drill.

14. An apparatus for point-grinding twist drills comprising a grinding unit having grinding surfaces movable about a fixed axis and presenting a V-shaped groove the sides of which form an angle of about that desired for the clearance surfaces of the drill point, a base, means adjacent said groove for supporting and mounting the drill to be pointed, said means being constructed and arranged to be moved in the plane of the vertex of the groove of said unit and including a guideway extending substantially radially with respect to said fixed axis in which the drill may be moved axially toward said grinding surfaces, said guideway being positioned in said means so as to substantially align the axis of the drill uniformly with respect to said groove, means for adjusting the position of said supporting means on said base laterally with respect to a plane through the vertex of said groove dividing the angle thereof, whereby the axis of the drill may be moved into said plane, and means for engaging the drill and adapted to cause the drill to rotate on its axis when it is moved in said guideway toward the groove of the grinding unit.

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