

Dec. 11, 1962

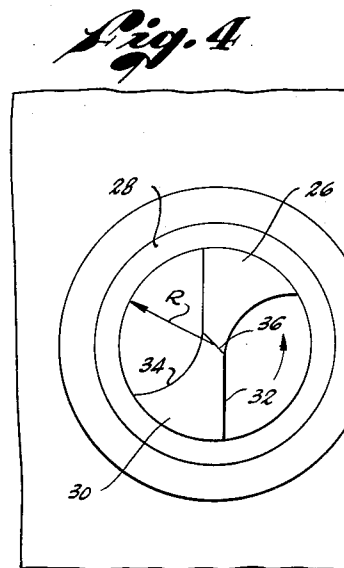
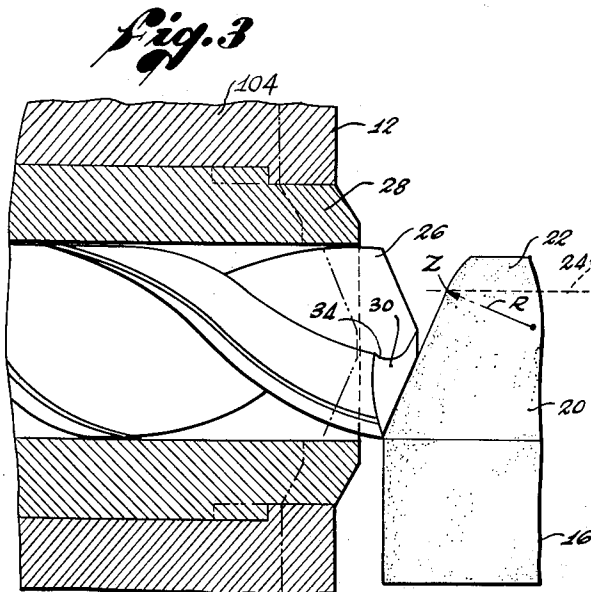
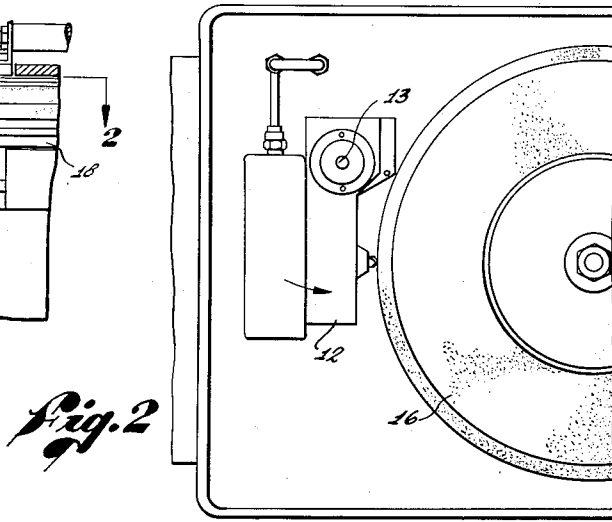
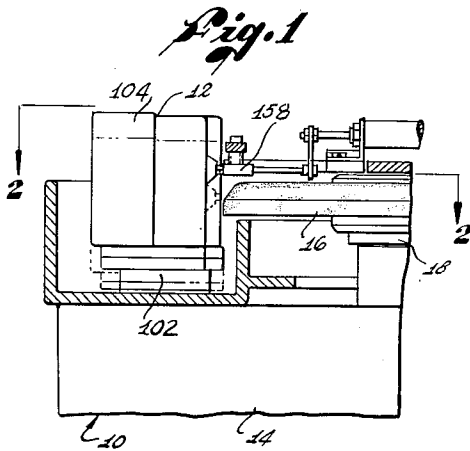
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DRILL POINTING METHOD AND MACHINE

Filed June 6, 1960

3 Sheets-Sheet 1



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DRILL POINTING METHOD AND MACHINE

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3 Sheets-Sheet 2

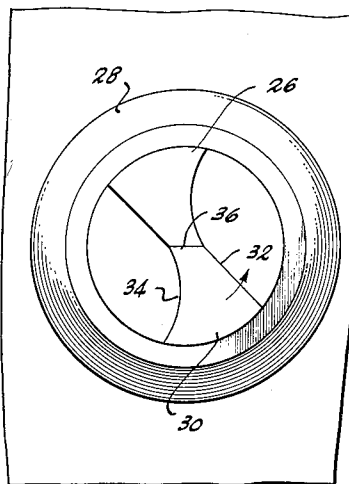
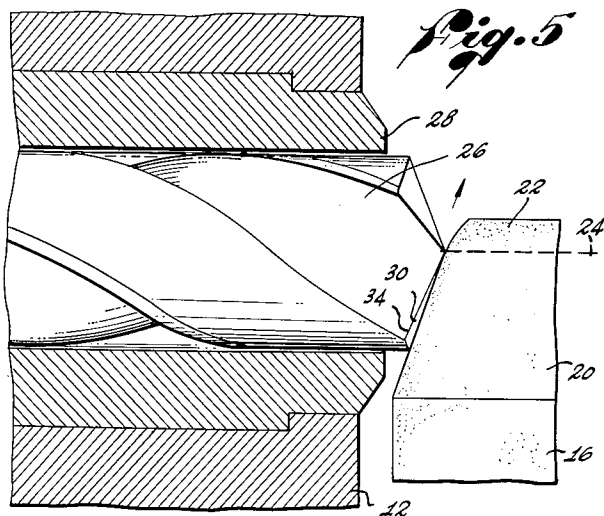


Fig. 6

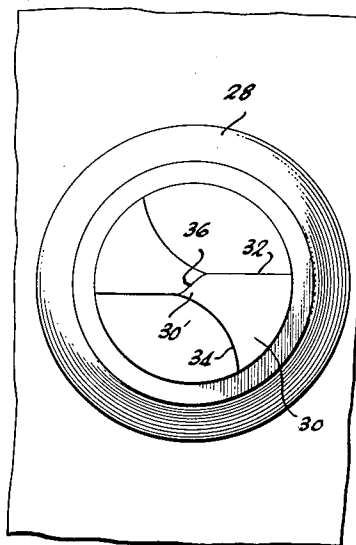
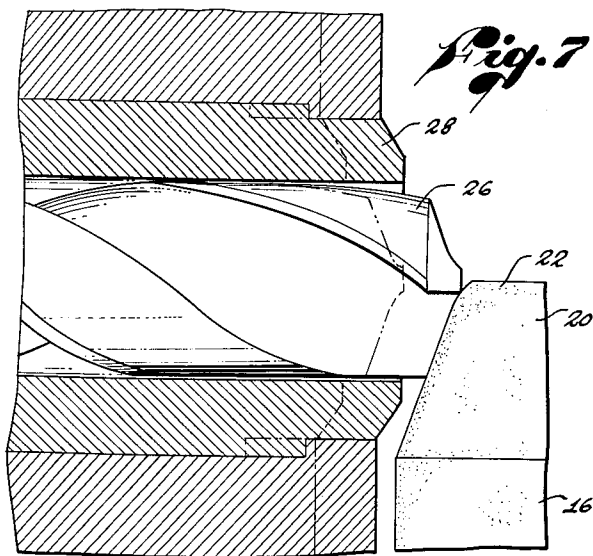


Fig. 8

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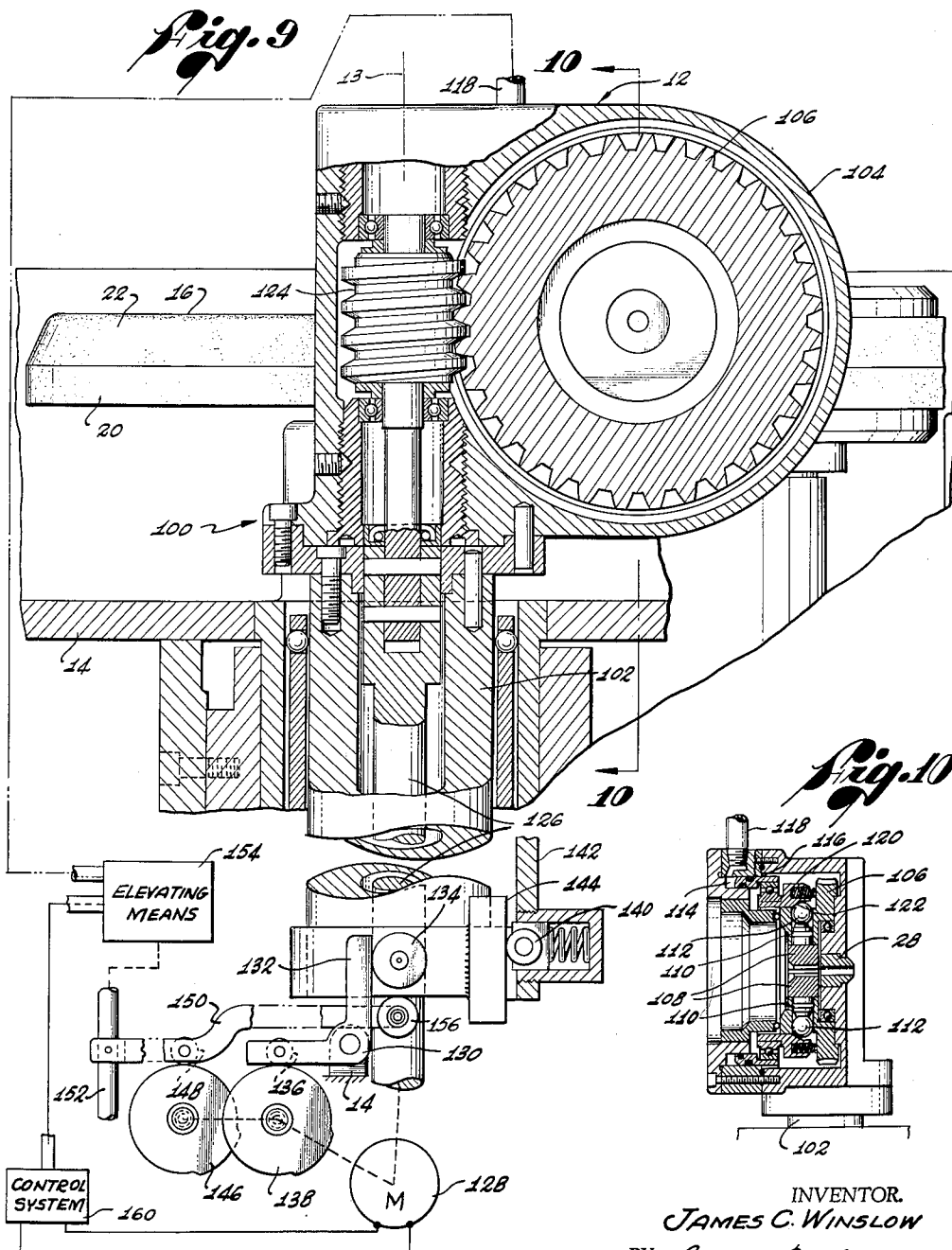
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DRILL POINTING METHOD AND MACHINE

Filed June 6, 1960

3 Sheets-Sheet 3



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3,067,548

DRILL POINTING METHOD AND MACHINE

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Filed June 6, 1960, Ser. No. 33,972

5 Claims. (Cl. 51—94)

This invention deals generally with the art of pointing drills and particularly with improvements in the drill pointing method and machine disclosed in copending application Serial No. 815,509 filed May 25, 1959, for Drill Pointer.

Briefly, the drill pointing machine of the copending application comprises a holder for a drill to be pointed, a rotary grinding wheel having a coaxial grinding surface terminating in a coaxial grinding edge, and means for synchronously rotating the drill and relatively moving the latter and grinding wheel in such a way that the relative movement of the drill tip is over the grinding surface and across the grinding edge. These movements are timed so that a relief or hollow is ground in the trailing edge of each lip of the drill to provide the latter with a relatively sharp center point.

The present invention provides a grinding wheel for use on the prior drill pointing machine to adapt the latter to grinding conventional drill points. In such a conventional point, the lips of the drill are tapered toward their trailing edge to provide clearance but are not hollow ground.

A general object of this invention is, therefore, to provide an improved method of and machine for grinding conventional points on drills.

Another object of the invention is to provide an improved grinding wheel for use in grinding conventional drill points.

Other objects, advantages and features of the invention will become readily apparent as the description proceeds.

Briefly, these objects are achieved by providing the prior drill pointing machine with a grinding wheel having a beveled peripheral grinding surface tangentially merging into a convex peripheral grinding surface. This grinding wheel and the drill to be pointed are relatively moved and the drill is rotated in such a way that the relative movement of the rotating drill tip is over the beveled grinding surface toward and finally across the circular line of tangency of the two grinding surfaces.

These movements are timed so that a relief angle is ground on each lip of the drill without undercutting or hollow grinding the trailing edge portions of the lips. A conventional point is thus formed on the drill.

The invention may be better understood from the following detailed description thereof, taken in connection with the annexed drawings, wherein:

FIG. 1 illustrates the present grinding wheel installed on the prior drill pointing machine;

FIG. 2 is a view on enlarged scale looking in the direction of the arrows on line 2—2 in FIG. 1;

FIG. 3 is an enlarged view illustrating the position of initial contact of the drill tip and grinding wheel during each grinding pass of the drill;

FIG. 4 is an end view of the drill tip in FIG. 3;

FIG. 5 is a view similar to FIG. 3 illustrating the drill tip in an intermediate position;

FIG. 6 is an end view of the drill tip in FIG. 5;

FIG. 7 is a view similar to FIG. 3 illustrating the final position of contact of the drill tip and grinding wheel during each grinding pass of the drill;

FIG. 8 is an end view of the drill tip in FIG. 7;

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FIG. 9 is a semi-diagrammatic illustration of certain mechanism of the machine; and

FIG. 10 is a section, on reduced scale, taken along line 10—10 in FIG. 9.

In these drawings, the prior drill pointing machine is denoted by the numeral 10. As described more fully in the prior application Serial No. 815,509, this machine comprises a drill holder 12 which is oscillated and reciprocated on a vertical axis 13 by mechanism 100 (FIGS. 9 and 10), soon to be described, within the frame or base 14 of the machine.

The grinding wheel 16 of this invention is mounted on the vertical, rotatably driven spindle 18 of the machine 10. As shown best in FIGURE 3, this grinding wheel is formed with a beveled, peripheral grinding surface 20, the intersection of which with a plane containing the axis of the grinding wheel is approximately a straight line, and a convex, peripheral grinding surface 22 which merges tangentially with the beveled grinding surface. The coaxial line or zone Z of tangency of these two grinding surfaces is located in a plane 24 normal to the axis of the grinding wheel.

The convex grinding surface 22 has been shown as being circularly curved in a radial plane of the grinding wheel and to have a radius R. It will become evident as the description proceeds, however, that the surface 22 may have other than a circular curvature.

A drill 26 to be pointed is inserted through a fixed drill bushing 28 carried by the drill holder 12 to a position wherein the tip of the drill is located a slight distance beyond the forward end of the bushing, as may be observed best in FIGS. 3, 5 and 7. During operation of the machine, the drill 26 is rotated in the fixed bushing 28 in synchronism with oscillation and reciprocation of the drill holder 12 to move the drill tip past the grinding wheel 16 in the manner illustrated in FIGS. 3-8. The above movements of the drill holder 12 and the drill 26 are produced by the mechanism 100 illustrated in FIGS. 9 and 10, to which reference is now made. Since the present grinding machine 10, except for the grinding wheel 16, and including the drill holder 12 and the mechanism 100, is identical to that of copending application Serial No. 815,509, drill holder 12 and mechanism 100 have been illustrated in semi-diagrammatic fashion in FIGS. 9 and 10 and will be only briefly described herein. If a more detailed description of these parts is desired, therefore, reference should be had to application Serial No. 815,509.

In FIGS. 9 and 10, drill holder 12 will be observed to comprise a vertical, tubular post 102 which is supported on the base 14 for rotation and axial movement on the axis 13. Mounted on the upper end of post 102 is a hollow, generally semicylindrical head structure 104 having a forward wall in which the drill bushing 28 is fixedly mounted, as shown. Rotatably supported in the head 104, behind the bushing 28, is a worm gear 106 which turns on the axis of the bushing. This gear carries diametrically opposed, radially movable chuck jaws 108 backed up by plungers 110 and balls 112. Head 104 has a rear, annular hydraulic cylinder 114 coaxial with the gear 106. In this cylinder is an annular piston 116. When hydraulic fluid under pressure is admitted to the cylinder 114, at the rear of the piston 116, through an inlet 118, piston 116 is moved forwardly.

Rotatably supported on the forward end of the piston 116 is a coaxial, annular cam 120 having a conical inner cam surface 122 bearing against the balls 112. When piston 116 is moved forwardly by fluid pressure in cylinder 114, chuck jaws 108 are cammed inwardly to grip the shank of the drill 26 positioned in the drill bushing

28. Rotation of gear 106, then, rotates the drill in the bushing.

Worm gear 10 meshes with a worm 14 rotatably supported in the head 104 for turning on the axis 13. Extending axially through the post 102 is a rotary drive shaft 126 which is drivably connected at its upper end to the worm 124. The lower end of the shaft 126 is drivably coupled to a motor 128, as diagrammatically indicated in FIG. 9, for rotation of the shaft 126 by the motor. Accordingly, when a drill 26 is positioned in the bushing 28 and the chuck jaws 108 are set, motor 128 drives the drill in rotation in the bushing through the shaft 126 and gears 106, 124.

Indicated at 130 is a bell crank which is pivoted on the machine base 14 and includes an arm 132 engaging a roller 134 on the lower end of the post 102. The other arm of the bell crank 130 carries a cam follower roller 136 which rides on a cam disc 138. Cam disc 138 is shaped to rock the bell crank lever 130 in a direction to urge the bell crank arm 132 against the post roller 134 and thereby rotate the post 102, and, hence, the entire drill holder 12, on the axis 13. A spring-loaded roller 140, mounted on a part 142 of the machine base 14 and engaging a longitudinal surface 144 on the post 102, urges the latter, and, hence, the entire drill holder 12, in the opposite direction on axis 13. During continuous rotation of cam 138, then, the drill holder 12 is oscillated on the axis 13.

Indicated at 146 is a second cam disc which engages a cam follower roller 148 carried on and located intermediate the ends of an arm 150. One end of arm 150 is pivotally attached to a vertically positionable or movable rod 152 which is vertically positionable or movable by a means 154 labeled "elevating means" for reasons to be seen shortly. The other end of arm 150 comprises a fork which straddles the shaft 126 and carries a pair of rollers 156 (only one shown) on which the lower end face of post 102 rests. Post 102 and, therefore, the entire drill holder 12 are thus rotatably supported on the forked end of the arm 150. When rod 152 is stationarily located in its position of FIG. 9, rotation of cam 146 rocks the arm 150 about its pivotal connection to the rod and thereby causes reciprocation of the drill holder 12 along the axis 13, the drill holder being elevated by the cam and returned downwardly under its own weight. Cams 138 and 146 are drivably coupled to the motor 128, as diagrammatically indicated in FIG. 9, for rotation of the cams in unison by the motor.

From the preceding description, it is evident that during operation of motor 128, shaft 126 and cams 138, 146 are driven in rotation in synchronism so that the drill holder 12 is synchronously oscillated and reciprocated on the axis 13 and the drill 26 is rotated in the drill bushing 28 in synchronism with oscillation and reciprocation of the drill holder.

Elevating means 154 is operable to shift the rod 152 downwardly from its position of FIG. 9 while the cams 138, 146 are stationary. When this occurs, arm 150 is rocked on the cam 146, about its cam follower roller 148 as a center, and elevates the drill holder 12. Elevating means 154 is arranged to elevate the drill holder 12 in this way to the loading position of the drill holder, shown in solid lines in FIG. 1, wherein the drill bushing 28 in the drill holder is axially aligned with a fixed drill locator 158 on the machine.

Indicated at 160 is a control system for energizing the motor 128, controlling the drill holder elevating means 154, and the admission of hydraulic fluid to the drill holder chuck cylinder 114. Control system 160 is identical to that described in the aforementioned copending application Serial No. 815,509 and, therefore, has been only diagrammatically illustrated in FIG. 9. Control system 160 is arranged to effect the following sequence of operations of the machine:

The drill holder elevating means 154 is initially oper-

ated to elevate the drill holder 12 to its solid line, loading position of FIG. 1. A drill 26 to be pointed is now inserted through the bushing 28, from the rear, until the tip of the drill engages the drill locator. The drill locator 5 locates the drill in a predetermined angular position and a predetermined axial position in the drill holder. The tip of the drill then extends slightly beyond the forward end of the drill bushing 28, as shown in FIG. 3. Hydraulic fluid under pressure is then admitted to the chuck cylinder 114 of the drill holder to cause the chuck jaws 108 to grip the drill shank.

Drill holder elevating means 154 are next operated to lower the drill holder to its initial grinding position of FIGS. 3 and 4 and the motor 128 is energized. In the initial grinding position of the drill holder, initial contact is established between the drill tip and the grinding wheel 16. In this position of initial contact, one lip 30 of the drill engages the beveled grinding surface 20 of the grinding wheel along the leading edge 32 of the lip and this edge is disposed approximately in a plane containing the axis of the grinding wheel, as shown. The leading edge of the lip is thereby ground to form a cutting edge.

Motor 128, now energized, drives the cams 138, 146 and the drill 26 in synchronized rotation. Rotation of these parts is so synchronized and the cams 138, 146 are so shaped as to effect the following grinding cycle:

From the position of initial contact of FIGS. 3 and 4, the drill holder is swung toward the grinding wheel and is simultaneously axially moved in the upward direction while the drill is synchronously rotated in the holder to bring the trailing surface area of the lip behind its leading edge 32 into contact with the grinding surface. This rotation of the trailing surface area of the lip into contact with the grinding surface simultaneously with axial advancement of the drill tip toward the grinding surface and transverse movement of the tip toward the convex grinding surface 22 grinds a relief angle on the lip.

These three movements are timed so that the drill tip passes through the position of FIG. 5, in which both the drill axis and the chisel edge 36 of the drill are located in the plane of tangency 24 of the two grinding surfaces 20 and 22. In this position, the chisel edge is ground.

During continued axial, transverse and rotational movement of the drill from the position of FIG. 5, the tip of the drill moves across the coaxial zone Z of tangency of the grinding surfaces 20 and 22 on the grinding wheel onto the convex grinding surface 22 and the trailing end of the lip is rotated into contact with beveled grinding surface 20 to complete grinding of the relief angle on the lip.

It can be readily observed that in the grinding position of FIG. 5, the final trailing portion of lip 30 has not yet been ground so that the drill tip must undergo further axial, transverse and rotational movement past the grinding wheel to complete grinding of the relief angle on the lip. It will also be obvious that in order to avoid grinding of the chisel edge 36 away to a conical point during this continued movement of the drill tip beyond the position of FIG. 5, the center of the tip must move out of contact with the grinding wheel.

In the drill pointing machine of the copending application Serial No. 815,509, the beveled grinding surface intersects the upper face of the grinding wheel on a sharp circular grinding edge. The chisel edge of the drill is ground just below this grinding edge and then immediately moves across the latter edge out of contact with the wheel. During the following movement of the drill lip across the grinding edge, the latter grinds a relief in the lip, as mentioned earlier.

In the present grinding machine, during continued movement of the drill beyond the position of FIG. 5 to the final grinding position of FIG. 7, the trailing edge portion of the lip 30 is rotated past the grinding wheel

to complete grinding of the lip relief angle. The transverse movement of the drill between these positions moves the chisel edge 36 out of engagement with the beveled grinding surface 20, across the coaxial zone Z of tangency of the grinding surfaces 20, 22, onto the convex grinding surface 22 so that the final grinding of the lip in the tapered area 30' immediately adjacent to the chisel edge 36 is done by the convex grinding surface. The chisel edge 36 is ground slightly by the latter grinding edge and is thereby made slightly arcuate, as shown.

The drill holder 12 is now rotated away from the grinding wheel, to disengage the drill tip from the grinding wheel, and is lowered to return the holder to its initial grinding position of FIG. 3. During this return of the drill holder to its initial grinding position, continued rotation of the drill 26 in the holder brings the leading edge of the other lip of the drill into the correction position for initial contact with the beveled grinding surface 20 of the grinding wheel, i.e., the position of FIG. 3. The above grinding cycle is then repeated on the latter lip of the drill, after which the drill holder is again returned to its initial grinding position of FIG. 3 and the first lip of the drill is reground, and so on. In the finished ground drill, then, the tip is formed with a conventional point in which both lips have a relief angle. The final chisel edge 6 is generally S shaped, as shown.

It will be obvious from FIG. 7 that if the beveled grinding surface 20 extended to the top face of the grinding wheel, the chisel edge 36 would be ground away to the axis of the drill in the final grinding position of FIG. 7 and the other half of the chisel edge would be similarly ground away during grinding of the other lip.

If the drill tip moved across a circular grinding edge on the grinding wheel, on the other hand, as in the prior drill pointing machine, the lips of the drill would be undercut, as explained in the prior application.

By providing the grinding wheel with the convex grinding surface 22, a conventional point, having lips which are not undercut, can be ground on the drill without completely grinding away the chisel edge.

Clearly, therefore, the invention herein described and illustrated is fully capable of attaining the objects preliminarily set forth.

What is claimed is:

1. In a drill pointing machine, the combination of a frame, a rotary grinding wheel on the frame having a first coaxial grinding surface, the intersection of which with a plane containing the axis of the wheel is approximately a straight line, and a second coaxial, convex grinding surface which merges approximately tangentially with said first grinding surface along a coaxial zone of tangency, a drill holder on the frame, and means for effecting initial relative movement between said holder and the grinding wheel to bring the tip of a drill in the holder and said first grinding surface into initial contact with the drill axis inclined at a predetermined angle to the first grinding surface and subsequent relative movement of the drill and grinding wheel past one another in such manner that the relative movement of the drill with respect to the wheel is a compound movement involving relative, approximately axial movement of the drill toward said first grinding surface and simultaneous relative lateral movement of the drill toward said second grinding surface and finally across said coaxial zone of tangency of said grinding surfaces, and means for rotating the drill in synchronism with said relative movement between the drill and grinding wheel.

2. In a drill pointing machine, the combination of a frame, a rotary grinding wheel on the frame having a first beveled, peripheral grinding surface and a second peripheral, convex grinding surface which merges approximately tangentially with said first grinding surface along a coaxial zone of tangency, a drill holder on the frame, and means for effecting initial relative movement between said holder and the grinding wheel to bring the

tip of a drill in the holder and said first grinding surface into initial contact with the drill axis inclined at a predetermined angle to the first grinding surface and subsequent relative movement of the drill and grinding wheel past one another in such manner that the relative movement of the drill with respect to the wheel is a compound movement involving relative, approximately axial movement of the drill toward said first grinding surface and simultaneous relative lateral movement of the drill toward said second grinding surface and finally across said coaxial zone of tangency of said grinding surfaces, and means for rotating the drill in synchronism with said relative movement between the drill and grinding wheel.

3. In a drill pointing machine, the combination of a frame, a rotary grinding wheel on the frame having a first coaxial grinding surface, the intersection of which with a plane containing the axis of the wheel is approximately a straight line, and a second coaxial, convex grinding surface, the intersection of which with said plane is a generally circularly curved line and which merges approximately tangentially with said first grinding surface along a coaxial zone of tangency, a drill holder on the frame, and means for effecting initial relative movement between said holder and the grinding wheel to bring the tip of a drill in the holder and said first grinding surface into initial contact with the drill axis inclined at a predetermined angle to the first grinding surface and subsequent relative movement of the drill and grinding wheel past one another in such manner that the relative movement of the drill with respect to the wheel is a compound movement involving relative, approximately axial movement of the drill toward said first grinding surface and simultaneous relative lateral movement of the drill toward said second grinding surface and finally across said coaxial zone of tangency of said grinding surfaces, and means for rotating the drill in synchronism with said relative movement between the drill and grinding wheel.

4. In a drill pointing machine, the combination of a frame, a rotary grinding wheel on the frame having a first beveled, peripheral grinding surface and a second peripheral, generally circularly curved, convex grinding surface which merges approximately tangentially with said first grinding surface along a coaxial zone of tangency, a drill holder on the frame, and means for effecting initial relative movement between said holder and the grinding wheel to bring the tip of a drill in the holder and said first grinding surface into initial contact with the drill axis inclined at a predetermined angle to the first grinding surface and subsequent relative movement of the drill and grinding wheel past one another in such manner that the relative movement of the drill with respect to the wheel is a compound movement involving relative, approximately axial movement of the drill toward said first grinding surface and simultaneous relative lateral movement of the drill toward said second grinding surface and finally across said coaxial zone of tangency of said grinding surfaces, and means for rotating the drill in synchronism with said relative movement between the drill and grinding wheel.

5. The method of pointing a drill with a rotary grinding wheel having a first coaxial grinding surface, the intersection of which with a plane containing the axis of the wheel is approximately a straight line, and a second convex, coaxial grinding surface which merges approximately tangentially with said first grinding surface along a coaxial zone of tangency, said method comprising the steps of relatively moving the drill and grinding wheel toward one another to bring the drill tip and first grinding surface into contact with the drill axis inclined at a predetermined angle to the first grinding surface and thereafter relatively moving the drill and grinding wheel past one another in such manner that the relative movement of the drill with respect to the wheel is a compound movement involving relative, approximately axial

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movement of the drill toward said first grinding surface and simultaneous relative lateral movement of the drill toward said second grinding surface and finally across said coaxial zone of tangency of said grinding surfaces, and simultaneously rotating the drill in synchronism with said relative movement between the drill and grinding wheel.

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