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MACHINE FOR GRINDING THE END FACES OF THE LIPS OF TWIST DRILLS

Original Filed Oct. 10, 1924 3 Sheets-Sheet 1

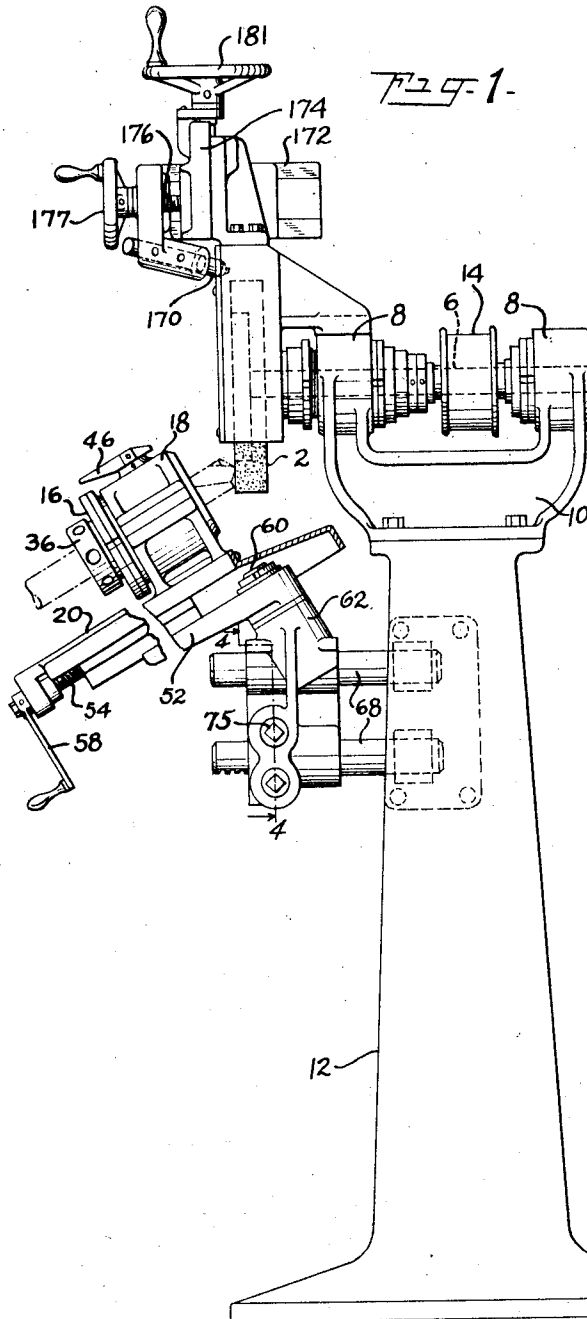


Fig. 1-

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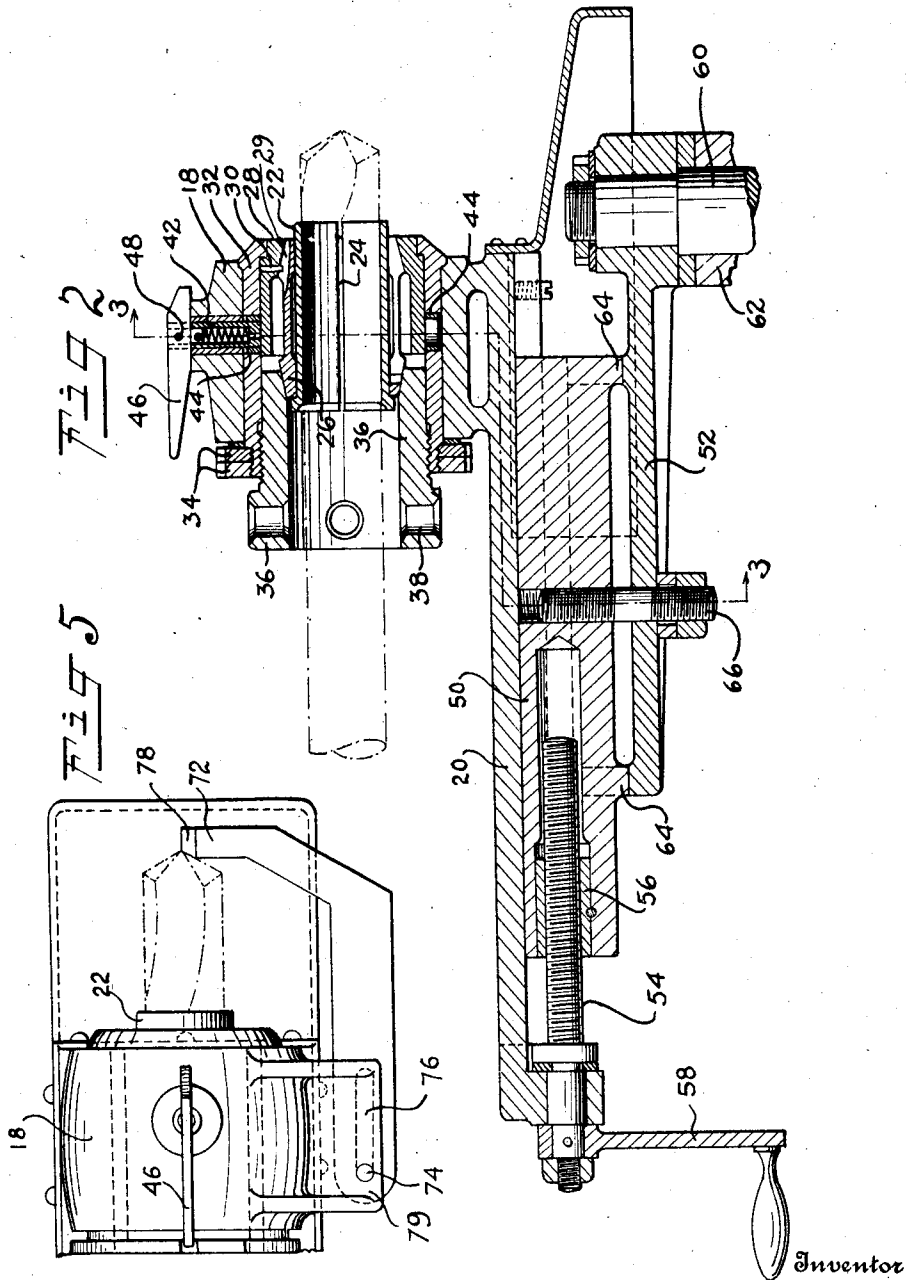
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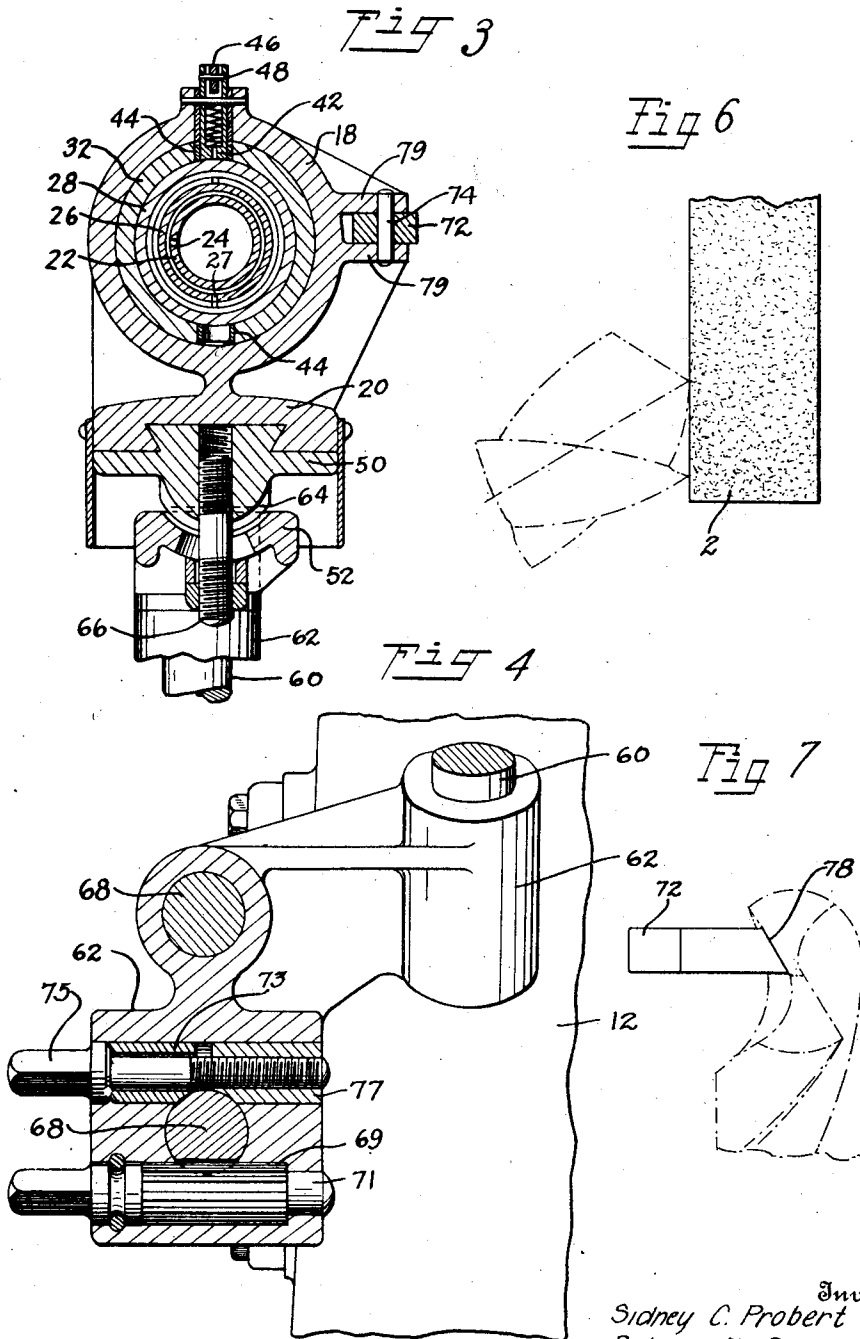
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UNITED STATES PATENT OFFICE.

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MACHINE FOR GRINDING THE END FACES OF THE LIPS OF TWIST DRILLS.

Original application filed October 10, 1924, Serial No. 742,770. Divided and this application filed October 5, 1927. Serial No. 224,122.

The present invention relates to machines for grinding twist drills. This application constitutes a division of our earlier application, Serial No. 742,770, filed October 10, 1924.

It is highly important in grinding twist drills that the drill should be accurately ground according to certain specifications, in order that the drill may cut with the proper speed and accuracy. The point of the drill should be ground to an angle of substantially 118° for ordinary work. Because of the shape of the flutes, the cutting edges of the drill will then be straight, while if the drill is ground to any other angle these edges will be curved and will be liable to cut an irregular hole. However, various different materials to be drilled require drill point angles other than 118° for best results and in these cases it is desirable to grind the cutting edges of the lips so that they will still be straight, and will be parallel with each other, and that the outer corners will be 180° apart. Accuracy is required in giving the proper lip clearance. A drill having too little lip clearance will not cut readily and is liable to split at the web. A drill having too much lip clearance will become dull quickly and is liable to chatter. For any given point angle or clearance, a drill should be ground symmetrically about its axis, that is, each cutting face should have the same amount of clearance and each cutting edge should be straight and parallel with the other. Also these edges should be spaced 180° apart and the drill point should be in the exact center of the fluted body.

The proper grinding of a twist drill by hand takes some time and requires considerable skill and care, so that the operation must be performed by a skilled operator. The grinding operation includes the grinding of the end faces of the lips to the proper angle and to produce the desired degree of clearance.

The principal object of the present invention is to produce a new and improved machine for grinding the end faces of the lips of twist drills, upon which such drills may be ground much more quickly and with greater accuracy than can be done by hand or by any other drill grinding machines heretofore produced. In the present machine the greater

accuracy resulting in the grinding of a drill is principally due to the construction and mode of operation of the drill-holding mechanism by which the drill is held by the outside diameter of the fluted body and is turned or indexed about the true axis of the drill in shifting the grinding operation from one lip to the other of the drill.

A still further object of the invention is to produce a drill grinding machine for grinding the end faces of the lips which may be quickly, easily and accurately adjusted for grinding different sizes of drills.

With the above objects in view the invention comprises the novel and improved features, constructions and combinations of parts hereinafter described and particularly pointed out in the claims, the advantages of which will be readily understood and appreciated by those skilled in the art.

The invention will be clearly understood from the accompanying drawings illustrating the invention in its preferred form and the following detailed description of the constructions therein shown.

In the drawings—

Figure 1 is a view in front elevation of a portion of a grinding machine embodying the present invention;

Figure 2 is a view in vertical section of the drill-holding devices shown in Figure 1, and certain associated parts taken substantially in a plane containing the axis of the drill holder;

Figure 3 is a sectional view of the drill-holding devices taken at right angles to Figure 2 along the line 3—3;

Figure 4 is a detailed sectional view substantially on the line 4—4 of Figure 1;

Figure 5 is a view of part of the mechanism shown in Figure 2 taken from above in a direction substantially perpendicular to the axis of the drill holder; and

Figures 6 and 7 are diagrammatic views illustrating the manner in which the drills are positioned in the holding devices before grinding.

The machine embodying the present invention in the form illustrated in the drawings of this application is a double machine for the grinding of both the end and inner faces of the lips of a drill. The end face grinding mechanism is the only portion illustrated in detail in the figures and covered by the claims

of the present application. The mechanism shown in the present application comprises a rotary grinding disk 2 secured to one end of a shaft 6 mounted in bearings 8 formed on a bracket 10 secured to the upper end of a standard or pedestal 12. Upon the shaft 6 is mounted a belt pulley 14 about which passes a suitable driving belt (not shown). The grinding disk 2 is provided with a central recess extending inwardly from the outer face of the disk as indicated in dotted lines.

The grinding disk 2 is used for grinding the end faces of the lips of the drill, the drill being presented to the outer lateral face of the peripheral portion of the disk. The drills are presented to the disk 2 in the manner illustrated in Fig. 1. In grinding the end face of each lip of the drill the drill is first presented to the grinding disk in the position shown in Fig. 1, with the forward portion of the lip in contact with the grinding disk, and is then turned about an axis oblique to the plane of the disk to cause the grinding wheel to grind progressively toward the rear portion of the face of the lip, and at the same time to back off this face to produce the proper clearance. After the grinding of the end face of one lip of the drill, the drill is turned through 180° about its axis to locate it in position for grinding the end face of the other lip. When the point of a drill is to be ground to an angle of 118° the drill is held with its axis at an angle of 59° to the grinding disk at the beginning of the grinding operation upon the end face of each lip.

The drill is supported with its axis in oblique position with relation to the grinding disk 2 by clamping the drill in a rotary chuck indicated as a whole at 16 mounted to rotate within a projecting portion 18 of a slide 20. The drill is secured in the chuck by a clamping sleeve which engages the peripheral portion of the drill, thereby accurately centering the drill with relation to the chuck. The sleeve in which the drill is inserted and by which it is clamped in position is indicated at 22 (Figs. 3 and 2) and is provided with a longitudinal cut or slot 24 to enable the sleeve to contract and expand. The sleeve 22 is surrounded by a collet 26 provided with a longitudinal slot 27 extending from each end of the sleeve 22 partially through the sleeve longitudinally, the slots having a staggered arrangement. This enables the collet to be contracted about the sleeve. The collet 26 is beveled at its opposite ends and the inner end thereof engages a bushing 28 having a corresponding bevel and connected with the collet by means of a pin 30 mounted in the bushing and engaging in a slot 29 in the collet to cause the collet and bushing to turn together. The bushing 28 is secured in a barrel 32 rotatably mounted in the projecting portion 18 of the slide 20 and held in the position 18 by means of lock collars 34.

The bevel at the opposite end of the collet 26 is arranged to be engaged by a corresponding bevel at the end of a sleeve 36 threaded into the barrel 32. At its outer end the sleeve 36 is provided with a series of openings 38 in which a suitable tool may be inserted to enable the sleeve readily to be rotated manually. By the turning of the sleeve 36 in one direction or the other, the collet 26 and the drill sleeve 22 will be contracted or allowed to expand to clamp or release the drill.

As stated above the barrel 32 is rotatably mounted within the projecting portion 18 of the slide 20. Means is provided for locating and locking the barrel in either of two positions 180° apart to locate the drill in position for starting the grinding operation on either of the two lips. This means comprises a spring-pressed locking pin 42 mounted to slide longitudinally in the projection 18, the inner end of which is arranged to engage in either of two bushings 44 located 180° apart in the barrel. The locking pin is withdrawn from the bushings by means of a hand lever 46 pivoted at 48 on the pin.

The slide 20 is arranged to slide at an oblique angle to the plane of the grinding disk 2 in a direction substantially parallel to the axis of a drill held in the chuck to adjust the drill axially with relation to the disk. The slide 20 is mounted on a support 50 secured to an arm 52, the support having a dove-tail projection which engages in a correspondingly shaped groove in the slide. The slide is arranged to be adjusted with relation to the support by mechanism comprising a shaft 54 rotatably mounted and held from longitudinal movement in a projection on the slide and threaded into a sleeve 56 secured in said support and an operating arm 58 secured to the shaft by which the shaft may be manually rotated.

To enable the drill to be swung to transfer the point of operation from the forward part of the lip toward the rear portion thereof, the arm 52 is pivoted by means of a stud 60 to a bracket 62. The axis about which the arm 52 is arranged to swing is oblique to the plane of the grinding wheel and lies in a plane perpendicular to the axis of the drill and also is parallel to a line in said plane and perpendicular to the axis of the drill.

At the beginning of the grinding operation upon the end face of a lip, the drill is located with the forward edge of the lip to be ground lying at a predetermined angle to a plane containing the axis of the drill which plane is also parallel to the axis of the stud 60. With the drill located in this position the slide 20 is adjusted to bring the portion of the lip adjacent its cutting edge into contact with the grinding disk and the arm 52 is then swung toward the front of the machine or to the right, Figure 3, to transfer the point of

operation toward the rear portion of the lip. When the drill is located so that the axis of the stud 60 intersects the axis of the drill no clearance will be produced during this operation. To enable the end face of the lip to be backed off during this movement of the arm 52 to produce clearance, the support 50 is mounted on the arm 52 so that the support may be adjusted laterally with relation to the arm. In the construction shown the support 50 is provided with rockers 64 arranged to engage correspondingly shaped beds on the arm 52 and the support is secured in position on the arm by means of a bolt 66 passing through a slot in the arm and threaded into the support. By locating the support 50 so that the axis of the drill occupies different positions to the right of the axis of the stud 60 (Fig. 3) the lip of the drill will be ground with different degrees of clearance, the farther the axis of the drill is located from the axis of the stud the greater the clearance produced.

To enable the axis of the stud 60 to be adjusted in a direction transverse to the grinding disk, the bracket 62 is mounted to slide upon supporting studs 68 secured to the frame of the machine and preferably arranged horizontally. The bracket is adjusted longitudinally on the studs by means of a rotatable pinion 69 (see Fig. 4) secured to a shaft 71 mounted in the bracket, the pinion meshing with teeth on the lower stud 68. The bracket 62 is clamped in position on the studs by means comprising a clamping sleeve 73 mounted to slide longitudinally in a bore in the bracket and arranged to engage the lower stud 68 as shown in Figure 4. The clamping sleeve is actuated to clamp the stud by means of a bolt 75 passing through the sleeve and threaded into a nut 77 secured in the bracket.

To enable the forward face of the lip of a drill to be located in the proper position for starting the grinding operation, the machine is provided with a lip gage 72 (Fig. 5) having an inclined face 78 for engagement with the forward face of the lip. This gage is pivoted between two spaced plates 79 extending from the projecting portion 18 of the slide 20 by a pin 74 engaging in a slot 76 in said gage. This construction enables the gage to be swung into and out of operating position and to be adjusted in the direction of the axis of the chuck.

When a drill is inserted in the chuck the barrel 32 is locked in position by the engagement of the locking pin 42 in one of the bushings 44. In grinding the end faces of the lips of a drill upon the mechanism described the drill is inserted in the drill sleeve 22 which has been allowed to expand by turning sleeve 36 to receive the drill and is positioned longitudinally so that the chuck will grip the drill at the desired distance from the point. The drill is located in the proper rotary position by engaging one of the lips of the drill with the lip gage 72, which is swung into operative position as shown in Fig. 5 and is adjusted to correspond with the longitudinal position of the drill. After the drill is adjusted the sleeve 36 is rotated to clamp the drill in position in the chuck. After locating the drill in the proper position in the manner described, the slide 20 is adjusted to bring the forward portion of the lower lip into contact with the grinding wheel and the arm 52 is then swung forwardly to grind the entire end face of this lip. If desired, two or more cuts may be taken with a slight adjustment of the slide 20 to adjust the drill slightly toward the grinding wheel after each cut. When the grinding of the face of one lip is completed the locking pin 42 is disengaged from the bushing 44 in which it is engaged to release the barrel 32 and the barrel is turned through 180° until the locking pin snaps into the other bushing 44. This will locate the other lip of the drill in position to be ground. The grinding of this lip may be performed in the same manner as the first lip.

The machine is provided with a mechanism supporting a truing tool for the disk 2 for truing up the grinding surface thereof. The truing mechanism is not claimed in this application, this mechanism forming the subject matter of claims in our co-pending divisional application Serial No. 224,121, filed October 5, 1927.

The tool for truing up the grinding disk 2 is indicated at 170. This tool is supported in position to engage the outer lateral face of the grinding disk adjacent its periphery with which the drills are engaged in grinding the same. The tool 170 is secured in a laterally extending arm on a slide 172 arranged to slide in a direction transverse to the plane of the grinding disk and preferably perpendicular to said plane. The slide 172 is supported on a slide 174 mounted to slide on the frame of the machine, preferably in a direction substantially parallel with the plane of the grinding disk. The movement of the slide 172 carries the truing tool into and out of position to engage the lateral face of the grinding disk, while the movement of the slide 174 carries the acting end of the tool across the surface to be ground in a direction substantially radial to the disk.

The slide 172 is adjusted by mechanism comprising a shaft 176 rotatably mounted in the slide and held from longitudinal movement therein, the inner end of which shaft is threaded into the slide 174. The shaft 176 has a hand wheel 177 secured to the outer end thereof to enable the shaft to be rotated manually.

The slide 174 is adjusted by mechanism comprising a shaft rotatably mounted in the slide and held from longitudinal movement

therein, the inner end of which shaft is threaded into the frame of the machine. The said shaft carries a hand wheel 181 secured to its upper end.

5 Figures 6 and 7 illustrate the manner in which a drill is positioned in starting the grinding operation on the end face of one of the lips. Figure 7 illustrates the manner in which the forward face of the lip is located in
10 a predetermined angular position by its engagement with the inclined face of the gage 72.

To enable different sizes of drills readily to be ground upon the present machine drill
15 sleeves 22 of different sizes are provided and also collets 26 having different interior diameters are provided to correspond with the different sizes of drill sleeves. The collet and drill sleeve of the chuck may be readily with-
20 drawn from the chuck upon unscrewing and removing the actuating sleeve 36. Thus, the collet and drill sleeve for one size of drill may be removed from the chuck and another collet and drill sleeve for another size of drill substituted therefor very quickly and easily.

Upon the present machine drills of various sizes may be ground with a high degree of accuracy and no particular skill is required in
30 operating the machine. Thus the drill grinding operation may be performed by an unskilled operator and the time ordinarily required in the grinding of the end faces of the lips of twisting drills is greatly reduced. Thus, a large part of the cost of maintaining
35 such drills in sharpened condition in manufacturing plants will be saved by the use of this machine.

In the present machine the drill is held by its finished outside surface in each grinding
40 operation and is indexed about the true center or axis of this surface. Thus, the end faces of the lips of the drill are ground accurately in predetermined relation to the outside surface of the drill.

45 The present machine preferably also embodies devices for grinding the inner faces of the lips of drills. The devices for grinding the inner faces of the lips may advantageously be mounted on the same pedestal as
50 the devices for grinding the end faces of the lips described in the present invention and may advantageously be driven from the same source. Thus, for example, the grinding disk for use in grinding the inner faces of the lips
55 may advantageously be mounted on the end of the shaft 6 opposite to the disk 2, as is shown and described in application, Serial No. 742,770 above referred to, of which the present application constitutes a division. The
60 present invention, however, may be embodied in a separate machine where this is desirable.

It is to be understood that the invention is not limited to the particular construction and arrangement of parts of the illustrated embodiment of the invention but that the inven-

tion may be embodied in other forms within the scope of the claims.

What is claimed as new is:

1. A drill grinding machine having, in combination, a rotary grinding wheel, a slide
70 movable transversely of the wheel, a rotary indexing chuck mounted on the slide and arranged to grip the periphery of the drill, a pivot for the slide about which the slide is arranged to swing in a plane transverse to the
75 plane of the wheel, means for locating the chuck in either of two predetermined positions 180° apart for grinding opposite sides of the drill, and a support about which the slide may be rocked on an axis substantially 80 parallel to the axis of the drill to vary the clearance.

2. A drill grinding machine having, in combination, a rotary grinding wheel, a slide
85 movable in a direction oblique to the plane of the wheel, a rotary indexing chuck mounted on the slide and arranged to grip the periphery of the drill, a pivot about which the slide is arranged to swing in a plane oblique to the plane of the wheel, means for
90 locating the chuck in either of two predetermined positions 180° apart for grinding opposite sides of the drill, and a slide, upon which the pivot is carried, movable in a direction substantially perpendicular to the
95 plane of the wheel.

3. A drill grinding machine having in combination a rotary grinding wheel, a carrier for supporting a drill in a position oblique
100 to the grinding face of the wheel to present the end face of a lip of the drill to the wheel, a pivot for the carrier transverse to the axis of the drill and offset from said axis, about which pivot the carrier is arranged to swing during the grinding operation to carry the
105 end face of a lip of the drill transversely across the grinding face of the wheel, and devices by which the drill carrier may be adjusted to adjust the axis of the drill transversely of the axis of the carrier to vary the clearance. 110

4. A drill grinding machine having in combination a rotary grinding wheel, a carrier for supporting a drill in a position oblique
115 to the grinding face of the wheel to present the end face of a lip of the drill to the wheel, a pivot for the carrier transverse to the axis of the drill and offset from said axis, about which pivot the carrier is arranged to swing during the grinding operation to carry the
120 end face of a lip of the drill transversely across the grinding face of the wheel, and devices by which the drill carrier may be adjusted to adjust the axis of the drill transversely of the axis of the carrier to vary the clearance, comprising an arcuate bed, an arc-
125 uate rocker for engaging said bed, and means for securing said rocker in position on said bed.

5. A drill grinding machine having in combination a carrier, a rotary indexing 130

chuck mounted on the carrier for supporting a drill in a position oblique to the grinding face of the wheel to grind the end face of a lip of the drill, a pivot for the carrier transverse to the axis of the drill and offset from said axis about which pivot the carrier is arranged to swing during the grinding operation to carry the end face of a lip of the drill transversely across the grinding face of the wheel, and devices by which the drill carrier may be adjusted to adjust the axis of the drill transversely of the axis of the carrier to vary the clearance.

6. A drill grinding machine having in combination a rotary grinding wheel, means for supporting a drill in position oblique to the grinding face of the wheel to present the end face of a lip of the drill to the wheel, comprising a slide mounted for adjustment in a direction substantially parallel with the axis of the drill, a support for the slide mounted to swing on an axis transverse to the axis of the drill and offset from said axis and so located with relation to the wheel that the point of the drill is carried transversely past the grinding face of the wheel by the swinging movement of the support, and devices by which the slide may be adjusted transversely of the latter axis to vary the clearance.

7. A drill grinding machine having in combination a rotary grinding wheel, a carrier for supporting a drill in position oblique to the grinding face of the wheel to present the end face of a lip of the drill to the grinding

wheel, means by which the carrier may be adjusted to adjust the drill in a direction substantially parallel with the axis of the drill, a pivot for the carrier transverse to the axis of the drill and offset from the axis of the drill, about which the carrier is arranged to swing during the grinding operation to carry the end face of a lip of the drill transversely across the grinding face of the wheel, and devices by which the drill carrier may be adjusted transversely of said pivot to vary the clearance.

8. A drill grinding machine having in combination a rotary grinding wheel, a carrier for supporting a drill in a position oblique to the grinding face of the wheel to present the end face of a lip of the drill to the wheel, a pivot for the carrier transverse to the axis of the drill and offset from said axis, about which pivot the carrier is arranged to swing during the grinding operation to carry the end face of a lip of the drill transversely across the grinding face of the wheel, devices by which the drill carrier may be adjusted to adjust the axis of the drill transversely of the axis of the carrier to vary the clearance, and devices for supporting the said pivot arranged for adjustment to adjust the pivot in a direction substantially normal to the grinding face of the wheel.

Signed at Detroit, Michigan, this 29th day of September, 1927.

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