

March 29, 1966	F. STRIEPE	3,242,918
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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

5 Sheets-Sheet 1

Fig. 1

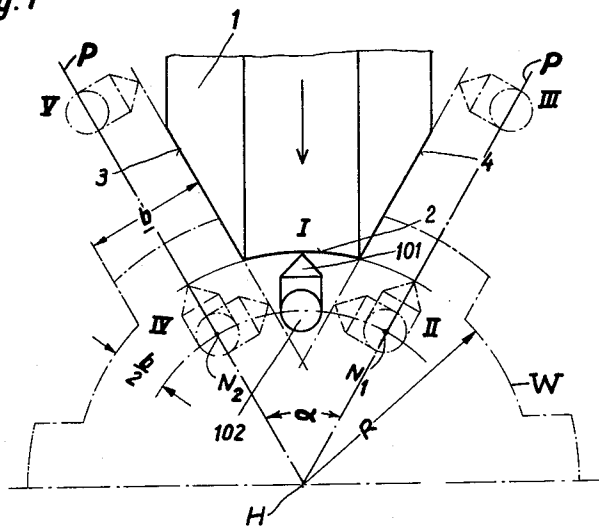
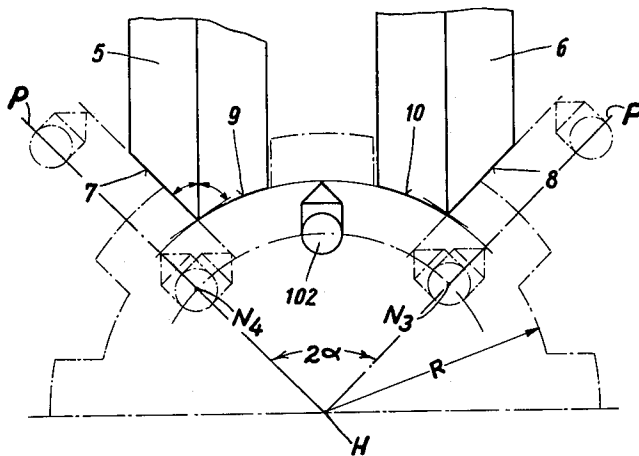


Fig. 2



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March 29, 1966

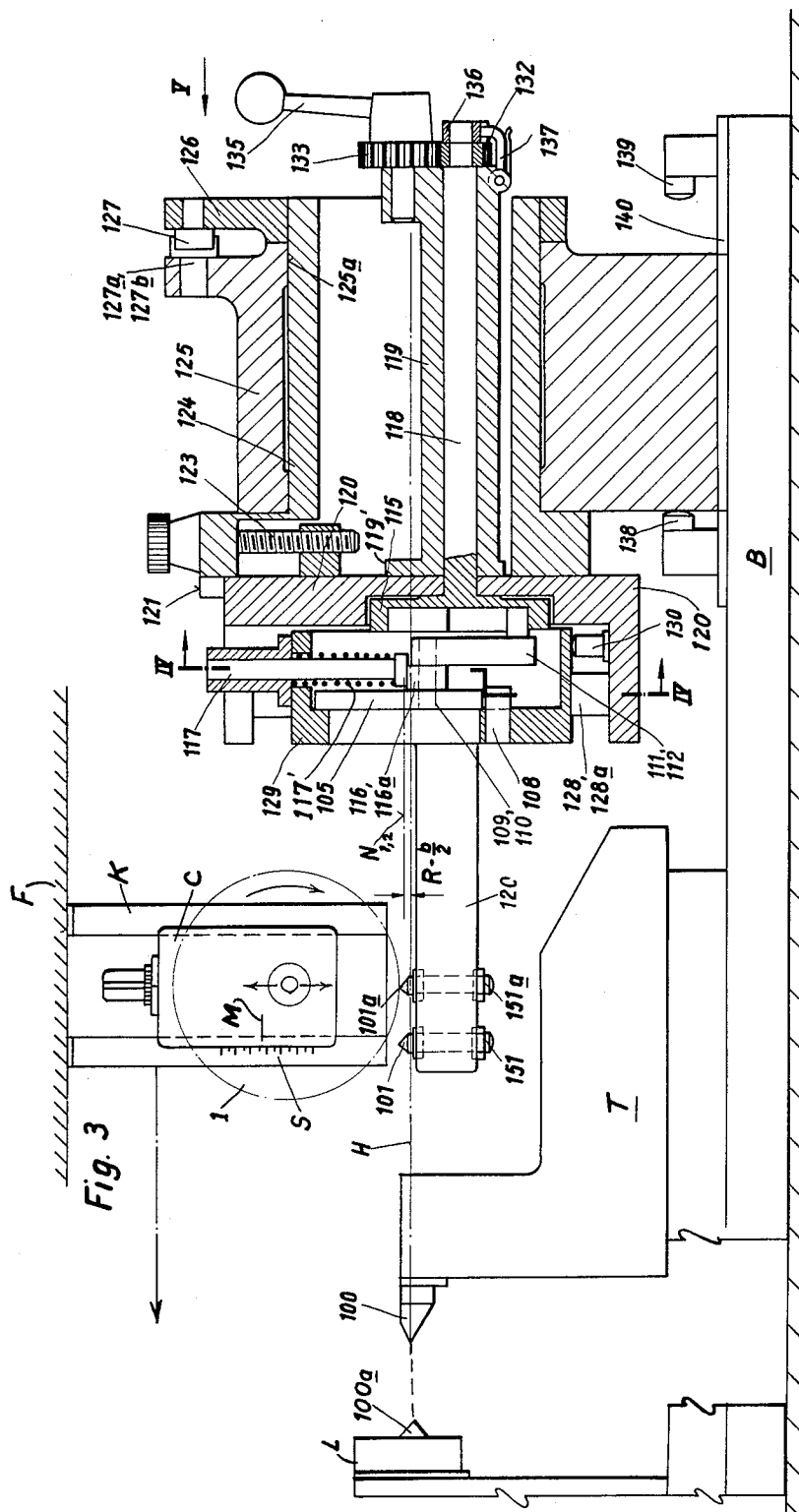
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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

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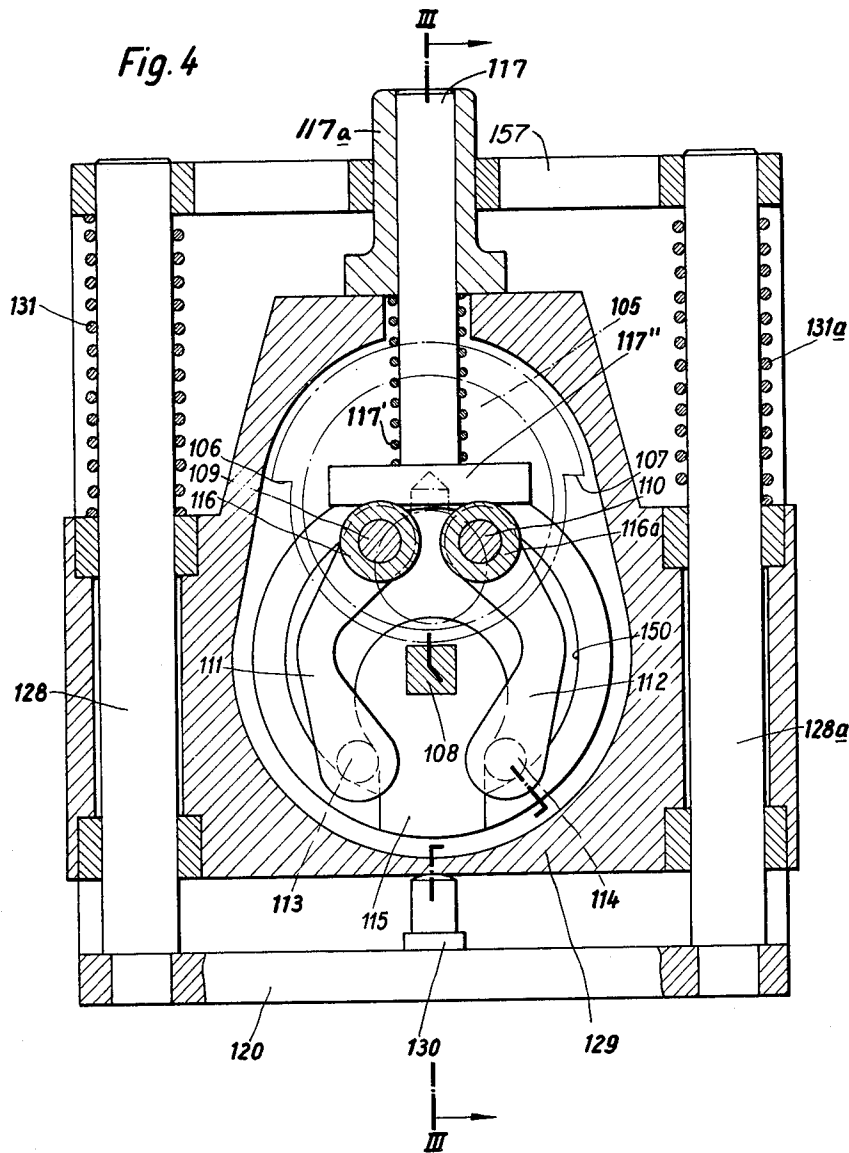
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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

Filed Aug. 22, 1962

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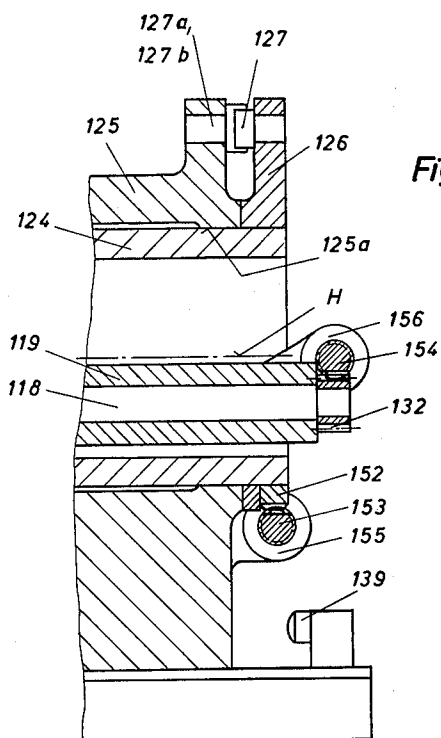
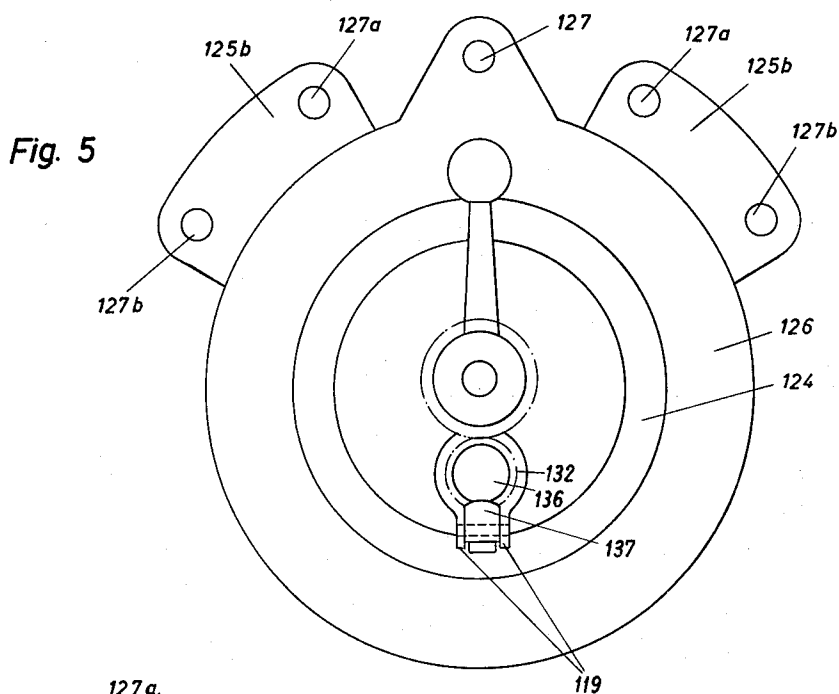
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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

Filed Aug. 22, 1962

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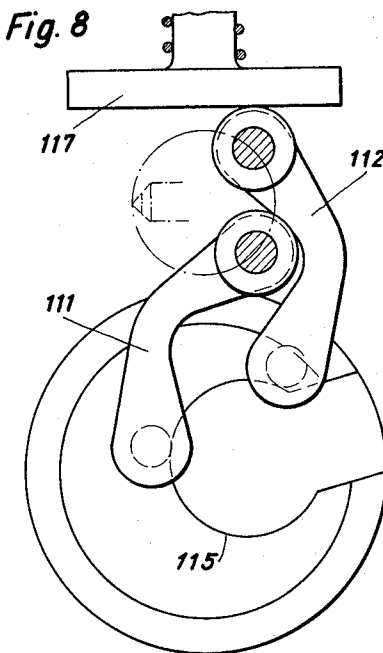
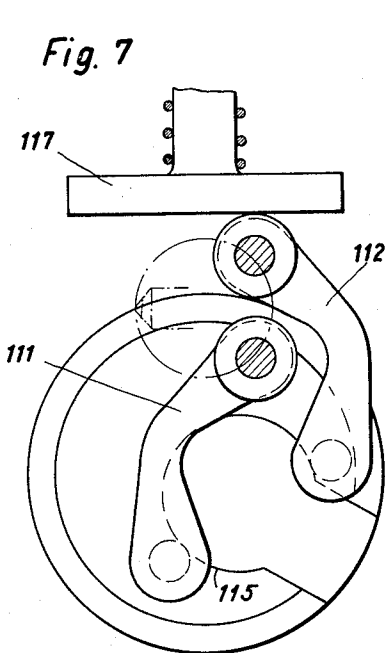
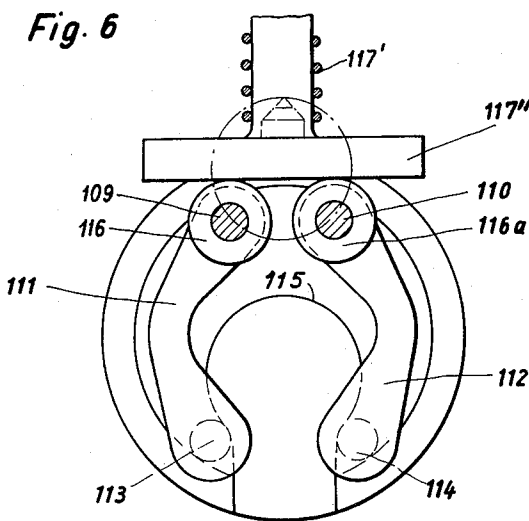
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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

Filed Aug. 22, 1962

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DRESSING TOOL FOR SPLINE SHAFT GRINDING MACHINES

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Filed Aug. 22, 1962, Ser. No. 218,665

Claims priority, application Germany, Sept. 2, 1961, Z 8,950

8 Claims. (Cl. 125—11)

This invention relates to tools for dressing grinding wheels to a particular profile for grinding spline grooves in machinery shafts.

Prior art wheel dressing tools for machines have the complexity of requiring separate diamonds, each in its own actuating mechanism, one for dressing the flanks of the grinding wheel and another for dressing the intermediate surface therebetween at the rim of the wheel. In such machines separate adjustment of the diamonds must be made relative the vertical central plane of the work and such adjustment is made without reference to the work. Accordingly, repeated trial and error measurements are necessary in the course of the complete dressing of the grinding wheel. The operator time is, therefore, high and requires considerable skill. Further, the inherent principles of such a method do not lend themselves for automatic operation.

The objects of the present invention are to overcome the cumbersome use of prior art machines and to provide a machine which is substantially automatic and simpler in construction and adjustment and exceedingly accurate in use.

The invention contemplates the use of a single rockable and translationable diamond and a novel mounting therefor, such that it may be readily shifted in position for dressing the arcuate concavity of the grinding wheel rim and also the conical flanks of the wheel adjoining the concave rim. Thus, the diamond is initially set for rocking movement and is subsequently set for straight line movement at an angle on each side of the wheel for flank dressing. Further, a mechanism is provided which automatically moves the diamond to the correct positions under operator control. The location of the diamond and its immediately coacting components is such in relation to the machine in which the grinding wheel is to be used as to provide for a common axis of rocking of the diamond and of indexing of the shaft to be subsequently ground. Accordingly, a single diamond point in effect traces the precise contour of the spline groove to be ground into the shaft by being rocked as it dresses the wheel on the axis of the shaft, namely, in alignment with the footstock axis of the machine which holds the shaft to be ground and which machine serves to index the shaft for cutting a series of splines. Similarly, the flanks of the wheel are dressed by orienting the diamond for movement, translationally, at a fixed angle on each side of the wheel, but maintaining the wheel and the diamond at all times in position determined by the subsequent position of the wheel when it is shifted from the dressing machine to a position over the work for spline cutting. Thus, the median plane of the wheel contains the axis of rocking of the diamond and is fixed with respect to the paths of translational flank cutting movement, and likewise with respect to the position of the shaft to be subsequently ground, since the shaft and the rocking axis of the diamond are coaxial at all times.

The same concept is carried out when two wheels are simultaneously dressed, except that the spaced median planes of the wheels are parallel to each other and to the common rocking axis of the diamond and the shaft indexing axis.

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A detailed description of the invention now follows in conjunction with the appended drawing in which:

FIG. 1 is a diagrammatic view taken in a plane at right angles to the rotational or rocking axis of the diamond point for dressing a wheel to cut a six spline shaft;

FIG. 2 is a similar view but showing the arrangement for simultaneously dressing of two grinding wheels, for cutting an eight-spline shaft;

FIG. 3 is a longitudinal section showing the construction of the diamond-actuating mechanism;

FIG. 4 is a section through IV—IV of FIG. 3 to an enlarged scale;

FIG. 5 is a view in the direction of the arrow V of FIG. 3;

FIG. 6 is an elevation of certain of the components of FIGS. 1 and 2 showing the mechanism in initial position;

FIG. 7 shows the position of the components of FIG. 6 at the beginning of linear motion of the diamond;

FIG. 8 shows the components at the end of linear motion of the diamond; and

FIG. 9 shows a modified arrangement for powering the mechanism by hydraulic motors or the like instead of by hand.

Referring now to the drawing, and in particular, FIG. 1, the schematic arrangement and relationship between the rotating grinding wheel 1 to be dressed and a diamond point 101 is illustrated. Thus, the grinding wheel has a central arcuate concave rim 2 having straight sided conical flanks 3 and 4. The diamond 101 is shown in solid lines in its initial central position I, and it is mounted on the diamond carrier arm 102.

It will be noted that the work W is shown in phantom lines, the splines and grooves therebetween being readily apparent and having parallel sides, only the upper portion of the work being shown, but it will be understood that it constitutes a complete cylinder in which the spline grooves are to be machined by the grinding wheel.

The motion of the point of the diamond is initially on an arc from the central position shown in full lines to the extreme right-hand corner, rotating around the axis H, which axis is the axis of the work when in the indexing lathe L (see FIG. 3), between centers 100 and 100a. The point of the diamond rocks initially on a radius R of the base cylinder with respect to the axis H, thus dressing half the concave rim, and the arm 102 continues its movement to the right to position II. At this time the diamond is rotated 90 degrees on the axis N1 which is parallel to axis H, and is at the beginning of another motion. Thus, the diamond point then moves in a straight line to position III, the direction II—III being radial from axis H. Such motion is for dressing the conical flank 4. Subsequently the diamond point reversely translates back to the position II, from position III, rotates to radial position once more around axis N1 and then sweeps past the arcuate rim 2 of the extreme left-hand corner of the arc, thus dressing the remaining half of the surface 2, and arm 102 continues movement to the axis N2 parallel to axis H. The same action then ensues, in that the diamond is rotated 90 degrees so that in a translation traverse it will dress the straight conical face 3 of the rotating wheel, proceeding from position IV to position V. Reverse translation is then had from V to IV, reverse 90 degree orientation occurring at IV around axis N2, causing the diamond axis to become radial with respect to axis H, and the diamond then rocks around axis H back to position I.

There is a particular relationship maintained between the thickness *b* of the splines and the position of the side axes N1 and N2 with respect to the axis H. Thus, the height of the diamond from the rotational axis of arm

102 is $b/2$, and such axes are, of course, located at the distance R minus $b/2$ from the axis H . By providing such relationship the axes $N1$ and $N2$ will be located at such positions with respect to the respective wheel flanks to be dressed, that the sides of the splines will come out parallel and symmetrical with respect to the radial plane P , which, in this case is the desired condition. Such relationship is particularly well adapted for cutting six parallel sided splines as shown, FIG. 1, or eight splines as shown in FIG. 2. A further relationship between the axes $N1$ and $N2$ in FIG. 1 is the fact that they are at the same distance R minus $b/2$ from each other. Accordingly, the axes H , $N1$, and $N2$ are all parallel and form an equilateral triangle.

Referring now to FIG. 2, the same relationship is carried out for the location of the parallel side axes $N3$ and $N4$, but in this case no equilateral triangular relationship is afforded between these axes and the rotary axis H of the diamond arm 102, for the reason that two grinding wheels 5 and 6 are being dressed simultaneously for the purpose of machining or grinding a shaft having eight splines. In this instance the motions of the diamond point are the same as described above, except, of course, for the longer arcuate sweep required to dress the surfaces 9 and 10 which are spaced by virtue of the spacing of the wheels. Likewise, the axes $N3$ and $N4$ must be spaced further apart as will be obvious, in order for the diamond to dress the side flanks 7 and 8 of the respective wheels. The arrangement of FIG. 2 has an advantage in that two wheels may be simultaneously dressed because of the symmetry of the arcuate surfaces 9 and 10 and it being noted the tangents form the same angle with the median planes of the wheels.

Having thus described the motion for the diamond point as above, it will be apparent that the same diamond point can be used for dressing the arcuate flanks of grinding wheels, by 90 degree rotation of such points on side axes such as $N1$ through $N4$ and by rocking of the diamond carrier arm by the pitch angle α or a multiple thereof on the axis H .

Reference is now made to FIG. 3 showing a cross sectional elevation of the mechanism which actuates the diamond. However, the arm 102 holds a diamond 101, as well as a diamond 101a and it will be understood that the diamond 101 is for rough dressing and the diamond 101a is for final or finish dressing. Thus a good deal of wear on the latter diamond is avoided by initial use of the rough dressing diamond 101. Either diamond is brought into contact with the rotary grinding wheel 1 by being mounted on arm 102 ultimately carried in a slide block 125 which can be translated between the stops 138 and 139 on guides 140 on the reciprocating table B. The table B also carries the slidable tail stock T having a tail stock point 100 axially aligned on the axis H with the axis 100a of the head stock of lathe L.

The grinding wheel 1 is rotatively mounted in a vertically adjustable carriage C in turn mounted in a carrier K supported by the machine frame F. Table B will be understood to be slidable left or right to be brought into position as represented in FIG. 3, or into position for grinding a work carried on the axis H between the head stock and the tail stock. Accordingly, it will be seen that the movements of the diamond point (by comparison with FIG. 1) describes a contour in space which is the contour of the spline groove to be cut into the shaft and the contours are aligned because the axis H is common.

The vertical adjusting carriage C and its scale S is for the purpose of adjusting the wheel with reference to the diamond, with considerable accuracy. Once the diamond has been adjusted, the table can simply be shifted to the right until the grinding wheel is in position to perform its function of grinding a shaft. By appropriate indicia markings M or stops provided (not shown) in conjunction with the scale S, the wheel can be set to an initial

grinding position for the first cut, and subsequently the wheel is at such point as has been predetermined by the scale, special indicia, or stop, that it is exactly in the position in which it was while being finally dressed. In that way extreme accuracy of machining is effected and considerable labor is saved by eliminating the various adjustments of the diamonds and measurements of the work heretofore required in prior art equipment.

The above description sets forth the geometry of the invention whence the various advantages are achieved, it being understood, of course, that the slide block 125 can be set in intermediate positions between 138 and 139 when desired for effecting measurements or settings of the wheel and diamond points.

The particular mode of effecting the motions of the diamond comprises the utilization of a rotative sleeve 124 having smooth rotative bearing at surfaces such as 125a within the slide block 125. Such oscillatory or rocking motion of sleeve 124 effects the rocking of the diamond point for producing the arcuate motion on the radius R about the axis H , as seen in FIG. 1. The rocking limits of sleeve 124 are determined by a peg 127 carried in a ring 126 secured to the sleeve, which peg can abut (FIG. 5) pegs 127a carried in ears 125a of the block 125, in either direction, which pegs are removable. Peg 127 may be replaced by pegs of varying diameter, in order to control arcuate traverse of sleeve 124 so as to provide for various sizes of splines. Similarly, pegs 127b are carried in the same ears 125b, but separated at a greater arcuate distance than the previous pegs, whereby to cut splines of greater arcuate degree. Thus, for example pegs 127a provide for a 60 degree arcuate traverse for cutting six splines and pegs 127b provide for a 90 degree traverse for cutting eight splines. It should be noted at this time that the axis of the sleeve 124 is a prolongation of the axis H about which the diamond point rocks. An adjusting screw arrangement 123 carried by sleeve 124 carries a bracket 120 which is guided by a dovetail portion 121 of sleeve 124 for reciprocal movement. Thus, the dovetail portion 121 will be understood to mate with a complementary dovetail channel in the bracket 120, and since the adjusting mechanism 123 is carried by sleeve 124 which is radially fixed, it will be apparent that rotation of the threaded spindle will effect reciprocal movement of the bracket 120 to provide initial adjustment of rocking radius R of arm 102 and the diamonds with respect to H .

Accurate final adjustment of the diamond points on arm 102 is provided for by means of the adjusting screws 151 and 151a so that the actual cutting tips of the diamonds are precisely located with respect to the axis H insofar as the distance $b/2$ and radius R are concerned and, of course, with respect to the parallel side axes.

The diamond carrier arm 102 is secured to a disc 105 which is mounted in a cross guide plate 129 (FIGS. 3 and 4) for rotation on the axis N . Disc 105 is provided with shoulders 106 and 107 (FIG. 4) which may abut either side of a stop element 108 carried by plate 129 (FIG. 3). Thus, disc 105 may rotate 90 degrees in either direction, as viewed on FIG. 4. The disc 105 carries pins 109 and 110 (FIGS. 3 and 4) which pivotally connect the disc to respective links or cam follower levers 111 and 112, said levers having respective cam follower pins 113 and 114, which protrude into a crescent shaped cam groove 50 of a rotary cam 115. A rod 117 is shiftably mounted in a bushing 117a and is biased by a spring 117' against a foot element 117'', which by virtue of the spring bias bears against rollers 116 and 116a which are rotationally carried on the respective pins 109 and 110. The pressure of the foot piece 117'' maintained on the rollers keeps the cam levers in the position shown in FIGS. 4 and 6, maintaining a central or upright position of the diamond point, as shown in FIG. 3, cam pins 113 and 114 being then at the crescent corners.

The bracket 120 (FIG. 4) has a pair of guide posts

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128 and 128a which guide reciprocal movement of the cross head plate 129, which rests in lowermost position on a peg 130 carried at the bottom of bracket 129 and being maintained in position against the peg by means of springs 131 and 131a which extend between the side portions of the cross head plate 129 and the upper cross-arm 157 of the bracket 120, as clearly seen on FIG. 4, which cross-arm is a slide bearing for the bushing 117a.

From the above description it will be apparent that the arm 102 may reciprocate radially with respect to axis H and may also have rocking motion in either direction with respect thereto.

Referring to FIG. 3, it will be noted that cam 115 is carried by a shaft 118 within sleeve 124, which shaft carries a gear 132 meshing with a gear 133 which is rotative in either direction by means of a handle 135. Shaft 118 is rotative in a sleeve 119 having a flange 119' fixed to bracket 120. The outer end of shaft 118 carries a notched collar 136 coacting with a resilient pawl or resiliently biased pawl 137.

It will be noted that handle 135 is on a stub shaft having an axis close to axis H, which is the axis of sleeve 124, so that if the handle be locked to sleeve 124 it can rotate that sleeve. The notch 137 in conjunction with the bias of the spring 117' acting on foot 117" maintains the cam levers in the position shown in FIGS. 4 and 6.

Referring to FIGS. 7 and 8, the action of the cam levers effected by rotation of the cam is noted, and the locations of the diamond points will be seen to have changed. FIG. 7 corresponds to the position of the diamond point after being rotated about the axis N1 (FIG. 1) as seen at position II. FIG. 8 shows the translated position of the diamond point effected by continued rotation of cam 115 and corresponds to the final position of the diamond point at position III, FIG. 1, the diamond having moved translationally to dress flank 4.

It will further be understood that rotation of the cam 115 in the opposite direction will produce translation on line IV-V for dressing the opposite flank 3.

In operation, if the hand lever 135 be rotated clockwise (FIG. 5), it will force rotation of the sleeve 124 (around axis H), since it is carried on sleeve 119 which is secured to bracket 120, which is in turn slidably keyed to sleeve 124 via the radial adjusting mechanism 123 and dovetail 121. Such rotation of sleeve 124 continues until the stop pin 127 strikes the right-hand stop pin 127a (or 127b). During this rotation the entire system carried by sleeve 124, including the diamond points, rotate around the axis H and the diamond points move to a degree for cutting either six or eight splines, depending upon whether or not the pin 127a or 127b is used. The arcuate distance I-II (FIG. 1) is thus traversed and when pin 127 strikes the stop pin 127a (at the right on FIG. 5), sleeve 124 is prevented from further rotation and arm 102 is at the axis N1. At this time, due to continued force applied to handle 135, pawl 137 snaps out of the notch in collar 136. The continued rotation of lever 135 effects via the gears 132 and 133, counter-clockwise rotation of shaft 118 and integral cam 115 to produce motion of the cam lever 112 for effecting 90 degree rotation of the diamond and then straight line traverse, for flank dressing (FIGS. 6, 7, 8). Inasmuch as the arm 102 is carried by the disc 105, it will rotate with such disc to an extent of 90 degrees, as provided by the disc shoulder 106 abutting the relatively fixed stop 108. At this time the components are in the position shown in FIG. 7, the axis of the diamond having been rotated 90 degrees, on the axis N1 (FIG. 1), the rocking of the diamond in dressing the right-hand portion of arcuate surface 2 being finally stopped at axis N1 by abutment of pin 127 with right-hand pin 127a (or 127b). It will be noted that due to the crescent shape of cam recess 150 the cam pin 114 is at a corner of the crescent, and thus there is no choice of movement for this cam pin but to be pushed by the

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corner of the recess, and thus effect rotation of disc 105 to effect a 90 degree rotation of arm 102 at the axis N1 (FIG. 1), the axis of the diamond now being normal to flank 4. During the 90 degree rotation of disc 105, pressure of roller 116a on foot 117" has compressed spring 117' against bushing 117a. When further movement of the disc 105 is blocked at shoulder 106 (FIG. 4), continued rotation of the hand lever 135 then causes the cross-head guide plate 129 to slide on its guide posts 128 and 128a against the bias of the respective springs 131 and 131a in the direction II-III (FIG. 1) up to position III (FIG. 1).

The direction II-III is likewise determined by abutment of pin 127 with pin 127a, the bracket 120 then being aligned with its rods 123, 128a (FIG. 4) parallel to path II-III (FIG. 1). Continued handle movement results in the translational motion of the diamond point on path II-III, FIG. 8 showing the components at position III. Thus, disc 105 being locked against rotation at stop 108, lever 112 is forced to rise as cam 115 rotates. Cam lever 111, in this action does not have any effect but merely hangs free. Of course, cam lever 111 produces precisely the same result for effecting the 90 degree clockwise rotation of disc 105 in position IV and the traverse IV-V (FIG. 1) for dressing the flank 3 of the wheel when handle 35 is put in reverse rotation, wherein all motion directions just described are reversed, the diamond then moving in the path III-II-I-IV-V, lever 12 then hanging free for path IV-V.

The movement of pins 109 and 110 which secure the cam levers 111 and 112 to the diamond arm carrying disc 105 is always against the bias of the foot 117", as effected by the spring 117'. This effects a suitable reaction to maintain proper engagement of the components involved at all times in either direction of motion of hand lever 135.

The ultimate reaction base for the movement of the cam levers against pressure of spring 117' is provided by the stops 127a or 127b.

In summation of the above, the dressing of the wheel in one direction is caused by rotation of handle 135 in one direction, whereby all things occur automatically by way of effecting the motion of the dressing diamond for one half of the wheel, and by reverse rotation of the handle for the other half of the wheel, for a six spline shaft, the same action being had for an eight spline shaft utilizing two wheels (FIG. 2) depending upon selection of abutments 127a or b with pin 127.

The above disclosure contemplates manual operation of the present function. However, power operation may be provided, as shown in FIG. 9, wherein all reference characters pertain as heretofore described for corresponding parts. In this instance, however, a shaft in the form of a gear rack 154 may be driven by a hydraulic motor 156 to rotate gear 132, with which it meshes, the rack and motor being mounted to rotate around axis H with sleeve 124. This effects rotation of shaft 118, all as previously described. Similarly, a gear rack 153 may be motivated by hydraulic motor 155 to rotate a gear segment 152 secured to sleeve 124, for effecting rotational function of that sleeve. Obviously, any type of automatic cyclic and sequential control for the motors may be utilized such as limit switches, etc., for the gear racks, or other means known in the automation art, so that the motors will operate at the proper times to effect the sequence of functions achieved by actuation of sleeve 124 and shaft 118, all as previously described.

The invention as described is subject to variation. For example, various diameter pegs 127 can be used for effecting differing flank angles. Changes in design can produce machines for cutting various numbers of splines, etc. However, the basic novelty for producing a simple and compact machine resides in the dimensional relationship of providing a diamond axis of length $b/2$ from the point of rotation around the side axes, where b is the

distance between spline flanks, and the distance between the central axis H and either side axis (N1, N2, N3, N4) is $R-b/2$, R being the radius of the base circle of the splined shaft.

I claim:

1. In a machine for dressing a grinding wheel, a rockable element 124, and means 127, 135, etc., for rocking said element on a predetermined axis H to a limiting position, dressing cutter support means 105, 129, etc., carried by said element and rockable therewith and movable radially with respect to said axis and comprising arm means 102 for holding dressing cutter means 101, 101a having rotational movement about said axis as said rockable element is rocked to dress the rim of a grinding wheel, said dressing cutter support means comprising a radially slidable guide plate 129 and comprising rotative means 105 carried by said plate and rotative relative thereto, said arm means 102 being carried by said rotative means and rotative therewith, actuating means 118, etc., connected with said rotative means 105 to effect rotation thereof relative said plate 129 for rotatively orienting said cutting means to dress a flank of a grinding wheel, said actuating means comprising elements 106, 107, 108, 112, 115, 118, etc., for effecting translation of said rotative means to translate said cutter means after said orientation of said cutter means for effecting said flank dressing.

2. In a machine as set forth in claim 1, said actuating means comprising a rotative shaft 118, a cam means 115 rotatable by said shaft, cam lever means 111, 112 pivotally disposed intermediate said rotative means 105 and said cam means, a stop means 106, 107, 108 disposed to limit to a predetermined degree the rotative orientation of said cutting means, wherein force exerted on said rotative means by said cam lever means subsequent to operation of said stop means effects translation of said rotative means along with said guide plate 129 to effect said translation of said cutter means.

3. In a machine as set forth in claim 1, said means for rocking said rockable element to a limiting position comprising fixed abutment means 127a, b, said rockable element having means engageable therewith, said actuating means comprising a rotative shaft 118, detent means 136 intermediate said rockable element and said rotative shaft through which torque is transmitted from said rotative shaft to said rockable element until said rockable element engages said abutment means, said engagement being operative to release said detent means, and said actuating means having elements connecting said shaft to said rotative means 105 whereby upon release of said detent means said shaft is operative to effect rotation of said rotative means and to effect said orientation subsequently to effect said translation of said rotative means and said guide plate 129.

4. In a machine as set forth in claim 1, said means for rocking said rockable element to a limiting position comprising fixed abutment means 127a, b, said rockable element having means engageable therewith, said actuating means comprising a rotative shaft 118, detent means 136 intermediate said rockable element and said rotative shaft through which torque is transmitted from said rotative shaft to said rockable element until said rockable element engages said abutment means and wherein said engagement is operative to release said detent means, and said actuating means having elements connecting said shaft to said rotative means 105 whereby upon release of said detent means said shaft is operative to effect rotation of said rotative means and to effect translation of said rotative means and said guide plate 129, and bracket means 120 carried by said rockable element and radially adjustable with respect thereto to adjust said cutter means with respect to said axis, said guide plate being guided for translation in said bracket.

5. In a machine for dressing a grinding wheel for cutting splines in a shaft on a base circle of predeter-

mined radius and wherein said splines are to be of predetermined width, a rockable element 124, and means for rocking said element on a predetermined axis H up to a limiting position, dressing cutter support means 105, 129, etc., carried by said element and rockable therewith and movable radially with respect to said axis and comprising arm means 102 for holding dressing cutter means 101, 101a and having rotational movement about said axis as said rockable element is rocked to dress the rim of a grinding wheel wherein the cutting point of said cutter means is positioned at said predetermined radius from said axis, said dressing cutter support means comprising a linearly slidable guide plate 129 and rotative means 105 carried by said plate and rotative with respect thereto, said arm means 102 being carried by said rotative means and rotative therewith, actuating means 118, etc., connected with said rotative means to effect rotation thereof for rotatively orienting said cutting means into position to dress a flank of said wheel, said orientation being about an axis N1, N2 spaced from and parallel to said first mentioned axis and being determined by the limiting position of rocking of said rockable element, said actuating means comprising elements for effecting translation of said rotative means and said guide plate 129 to translate said cutter means after said orientation of said cutter means for effecting said flank dressing, and said second-mentioned axis being at a distance from said first-mentioned axis equal to said radius less half the thickness of a spline.

6. In a machine of the class described, a reciprocating table, a rockable element 124 on said table and means for rocking said element around an axis, arm means 102 carried by said rockable element for holding a pair of dressing cutters spaced from each other longitudinally of the arm 101, 101a and said arm means having rotational movement as said rockable element is rocked for dressing the rim of a grinding wheel, said rockable element having support means 125 on said table operative for shifting of said rockable element longitudinally along said axis so as to selectively bring either cutter to position for dressing said wheel, said support means having spaced abutments 138, 139, for locating said rockable member for either cutter position.

7. In a machine for dressing grinding wheels for cutting splines in a shaft on a base circle of predetermined radius and wherein said splines are of predetermined width, a table, a rockable element 124 on said table, and means for rocking said element on a predetermined axis, dressing cutter support means comprising arm means 102 carried by said rockable element and having adjustable elements for holding dressing cutter means 101, 101a, for fine radial adjustment thereof with respect to said axis, support means for said arm means comprising a bracket secured to said rockable element and means affording radial adjustment with respect thereto, said arm means and said bracket means being rockable with said rockable element to dress the rim of a grinding wheel; actuating means 118, etc., connected with said arm means to effect rotation thereof relative said rockable element for rotatively orienting said cutting means to dress a flank of said wheel, said orientation being on an axis spaced from and parallel to said first mentioned axis, said actuating means comprising elements for effecting translation of said arm means to translate said cutter means after said orientation for effecting said flank dressing, said cutter means having a cutting point rotative about said first-mentioned axis on a radius equal to the radius of said base circle for dressing said wheel rim, means to limit rocking of said rockable element when said cutter means is at said second-mentioned axis to position said cutter means for said orientation, and said latter axis being at a distance from said first-mentioned axis equal to said radius less half the thickness of a spline.

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8. In a machine for dressing a grinding wheel, a rockable element 124, and means comprising a rotative shaft 118 for rocking said element on a predetermined axis H to a limiting position, dressing cutter support arm means 102 for holding dressing cutter means 101, 101a, having rotational movement about said axis with said rockable element, for dressing the rim of a grinding wheel, and means comprising actuating elements for securing said arm means to said rockable element for rotation with respect to said axis and for radial translation with respect thereto, said shaft having means comprising a driving connection with said actuating elements to effect said relative rotation of said arm means in a direction opposite to the direction of rocking of said rockable element, wherein said relative rotation effects orientation of said cutter means for translational dressing of a flank of said wheel by addressing the point of said cutter means against said flank subsequent to rocking of said cutter means about said axis in dressing said rim.

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References Cited by the Examiner

UNITED STATES PATENTS

1,271,495	7/1918	Ward	51—289
1,979,536	11/1934	Edgar	125—11.4
2,220,648	11/1940	Harley et al.	125—11.1
2,312,347	3/1943	Madsen	125—11
2,355,020	8/1944	Turrettini	125—11
2,587,261	2/1952	Wildhaber	125—11
2,772,670	12/1956	Jones	125—11.4
2,782,778	2/1957	Balsiger	125—11.1

FOREIGN PATENTS

397,718	8/1933	Great Britain.
439,800	9/1948	Italy.

HAROLD D. WHITEHEAD, *Primary Examiner.*JOHN C. CHRISTIE, LESTER M. SWINGLE,
*Examiners.*20 J. E. PEELE, *Assistant Examiner.*