

May 5, 1970

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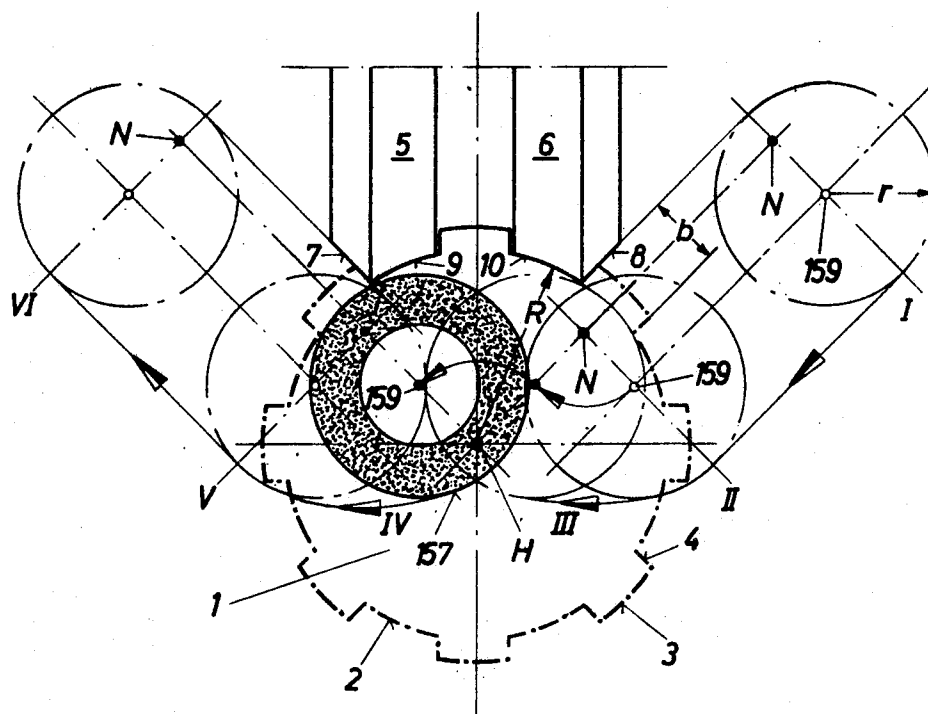
3,509,864

GRINDING WHEEL PROFILING DEVICE

Filed Aug. 31, 1967

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Fig. 1



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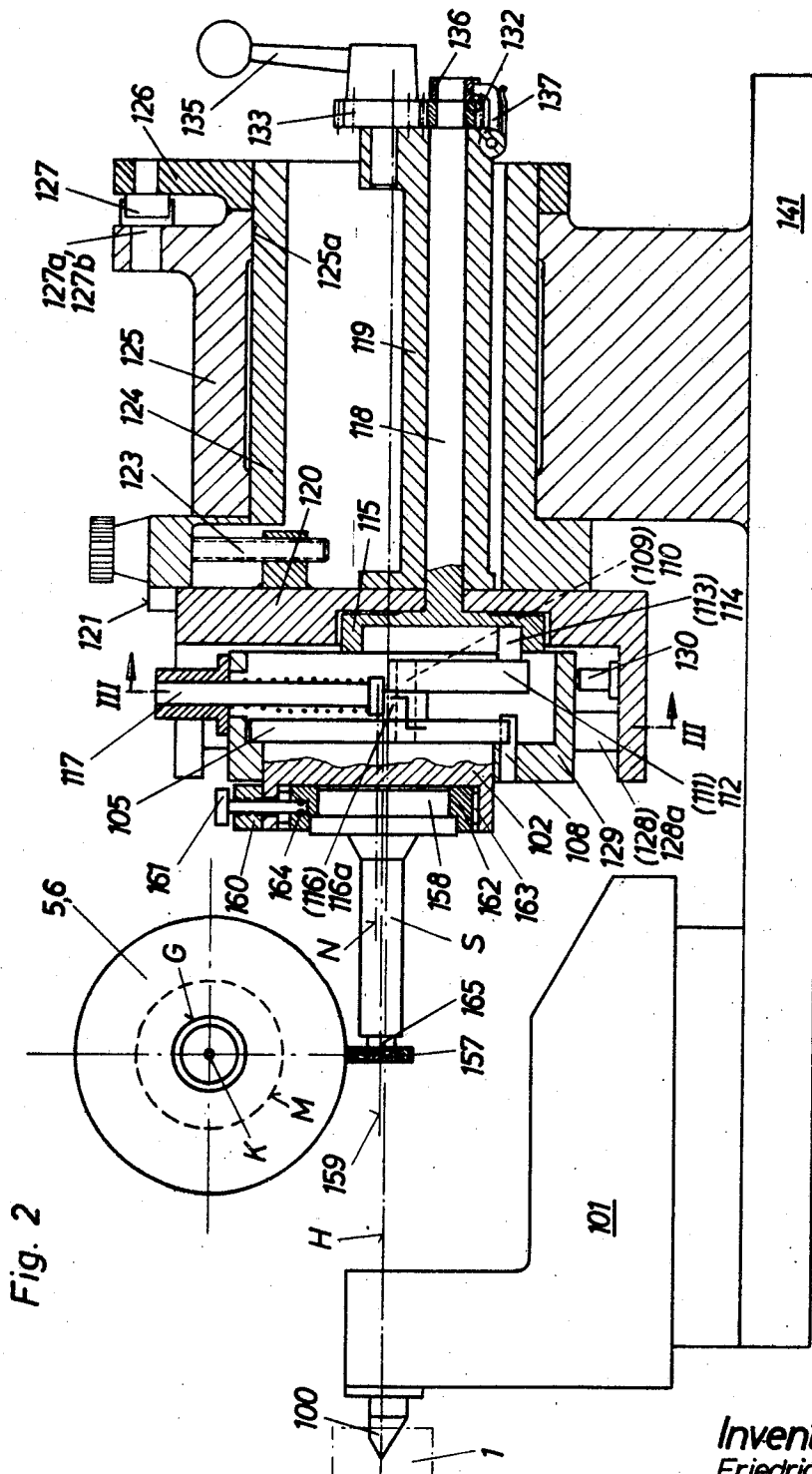


Fig. 2

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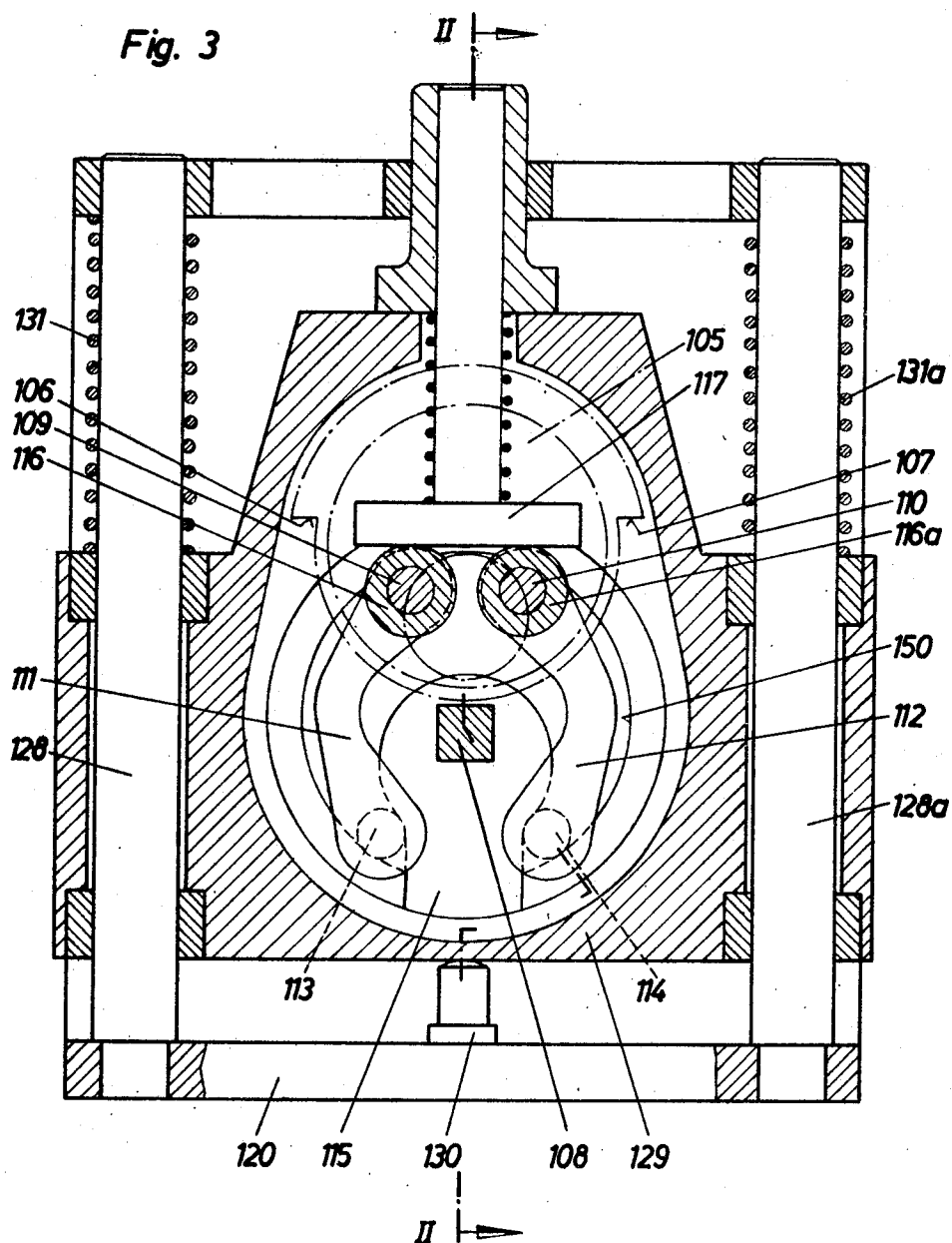
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GRINDING WHEEL PROFILING DEVICE

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Filed Aug. 31, 1967, Ser. No. 664,739
Claims priority, application Germany, Sept. 3, 1966, Z 12,410

Int. Cl. B24b 53/06

U.S. Cl. 125—11

4 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to mechanisms for dressing or trueing grinding wheels which are profiled with a predetermined contour for cutting shaft splines. The particular feature of the invention resides in the use of a cylindrical diamond wheel which is power-rotated and guided in a path to follow the peripheral contour of grinding wheels of predetermined shape. Such diamond wheels will considerably outlast diamond points conventionally used for the purpose. The mechanism provides for a motor rotated diamond wheel wherein the axis of rotation is transverse to the axis of the grinding wheel being dressed. By rotating both the grinding wheel and the trueing wheel in the course of dressing, an oblique relative motion of the peripheries is effected wherein the peripheral speed of the dressing wheel can be equal to that of the grinding wheel during dressing.

The prior art has heretofore used diamond trueing wheels which are specially profiled for dressing grinding wheels. Such specially profiled wheels match the profiles of grinding wheels they are intended to dress and are very expensive. Furthermore, any wear in the profile of such a diamond wheel causes inaccuracies in the dressing process. However, in the present invention a cylindrical diamond wheel is used and accordingly wear of such a wheel does not cause inaccuracy. Further prior art is shown in the U.S. patent to Striepe, 3,242,918, owned by the assignee of the present application and issued to the inventor of the present application. This prior art patent shows a mechanism for guiding a diamond point to effect trueing of profiled grinding wheels. There is a general similarity in the mechanism of the aforementioned patent and the mechanism of the present invention; accordingly, recourse may be had to the patent for details of information not included in the present application.

Briefly, the invention comprises a cylindrical dressing wheel of substantially smaller radius than the radius of the shaft on which splines are to be cut by the grinding wheels. The trueing wheel is carried on an elongated shaft rotated by a small electric motor. The combination comprising the dressing wheel, shaft and motor is carried in a rotative carrier wherein such rotative carrier is rotated on a predetermined axis for effecting dressing of the arcuate portion of the periphery of a grinding wheel. Initially, the dressing wheel is translated linearly to dress a straight beveled flank, followed by a bodily rotation of the dressing wheel to a position for arcuate movement to dress an arcuate periphery, and thence followed by another bodily rotation and finally a translation to dress another straight-sided flank.

In the present form of the invention, the radius of the dressing wheel is greater than the chordal width of the splines to be provided on the shaft.

In the drawings:

FIG. 1 is a diagrammatic illustration of the movement of a dressing or trueing wheel in dressing the peripheral contour of grinding wheels, wherein the radius of the dressing wheel is greater than the chordal width of a spline to be ground on a shaft,

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FIG. 2 is a longitudinal cross-section showing the major components of the mechanism for actuating the motion of the dressing wheel, and represents a section through II—II of FIG. 3, and

FIG. 3 is a cross-section through III—III of FIG. 2. Referring to the drawing, a shaft 1 (FIG. 1) is illustrated in phantom, having the axis H and base circle 2. Splines 3 of width b are to be ground. Grinding wheels 5 and 6 are profiled to cut straight flank splines as by the straight conical surfaces 7 and 8. The base surfaces are arcuately cut to the base shaft radius R by the inner peripheral curved grinding surfaces 9 and 10 of wheels 5 and 6, respectively.

A cylindrical diamond dressing wheel 157 is shown in FIG. 1 having a radius r less than R but greater than the spline width b , and is illustrated in several positions I—VI. The actual initial position is shown at IV, but for purposes of explanation it is assumed to be in an initial position designated as I. It will be noted that the location of an axis N is indicated at position I. This is the rotational axis of a carrier disc 102 (FIG. 2) which is reversibly rotatable and which carries the electric motor 158 and rotary shaft and supporting structure, S, for dressing wheel 157 which rotates on axis 159 between axes H and N.

The disc 102 is translated so that the axis N moves to the location shown in position II of FIG. 1. At this time it is rotated so as to bodily swing the axis 159 of wheel 157 on the arc A about axis N to position III, the swing being 90° .

The point at which the linear (I to II) motion ceases and the arcuate (II to III) motion of the wheels 157 commences is subsequent to the grinding of surface 8, and when the axis N has moved to a point which is

$$R - \frac{b}{2}$$

from the axis H. At this point the wheel 157 has sufficiently cleared the flank 8 and is exactly in position to dress the arcuate surfaces 9 and 10. This rotation from position II to III occurs at a point which is dependent on whether six or eight splines, with parallel flat sides, are to be ground. A simple changeover of parts in the invention provides for grinding six or eight splines.

At position III the wheel 157 is exactly poised for movement in dressing the arcuate peripheries 9 and 10. The arcuate motion at position III is to an extent of 90° around axis H going clockwise until the position IV is reached. The rotation about the axis H is effected by a collar 124 which is rotative on axis H parallel to axis N.

At position IV the axis N is once more at a distance of

$$R - \frac{b}{2}$$

from axis H. Accordingly, another clockwise movement of 90° around axis N is effected to bring the wheel 157 into position V. This is followed by linear translation to dress the surface 7, bringing wheel 157 to an end position VI, at which time a completely reversed actuation takes place which brings the wheel 157 back to the initial position I.

It will be noted that the revolving of axis 159 occurs when axes H and N are aligned with the radial center lines of the splines adjacent the exterior grinding wheel flanks 7 and 8.

Referring to FIGS. 2 and 3, the diamond trueing wheel and its immediate associated mechanism is linearly translated by the linear translational movement of a cross-head 129 guided on posts 128 and 128a, all carried in a bracket 120. Springs 131 and 131a are utilized to bias the crosshead, together with its own weight, downwardly against a stop pin 130 in bracket 120. The carrier disc 102

is rotatably mounted in crosshead 129 so as to rotate about the axis N. Bracket 120 is carried by collar 124, rotative on axis H on bearing surface 125a of housing 125.

The carrier disc 102 has a flange 105 secured to it which flange has abutment shoulders 106 and 107 abutable with respective sides of fixed stop 108 carried by the crosshead 129. This limits rotation of carrier 102, in either direction around axis N, and constrains the motion to 90° either way as will be apparent from the opposite positions of the shoulders on the flange.

The rotary motion of carrier 102 is effected by a rotary cam 115 wherein crescent shaped cam grooves 150 actuate respective cam levers 111 and 112 having respective follower pins 113 and 114 in the cam grooves. Thus rotation of the cam 115 in one direction or the other will cause a respective cam lever to move upwardly against a spring pressed pad 117. The action is shown and described in *Striepe* 3,242,198 (FIGS. 7 and 8) and accordingly need not be repeated here. The upper ends of the cam levers are pivoted as by pins 109 and 110 to the flange 105 and thus serve to rotate that flange 105 and the carrier 102 secured thereto in a direction depending upon the direction of rotation of the cam 115. The spring pressed pad 117 bears against the rollers 116 and 116a of levers 111 and 112, respectively, maintaining the cam levers in an initial symmetrical position as shown in FIG. 3; the cam pins 113 and 114 abut at the corners of the cam grooves in readiness for movement. The truing wheel 157 is in its actual initial position as shown at IV in FIG. 1 at this time.

From the foregoing it will be apparent that wheel 157 is translated to dress surfaces 7 and 8 when bracket 120 is translated and is bodily swung around axis N when carrier disc 102 is rotated, and is swung around axis H to dress surfaces 9 and 10 when collar 124 is rotated.

Referring to FIG. 2, a shaft 118 is shown as integral and axially aligned with cam disc 115 and will be understood to effect rotation of the cam disc. Shaft 118 is rotatively carried in sleeve 119 which is integrally flanged to the bracket 120. Bracket 120 is linearly slidable in guide means 121 provided on both sides of the bracket and which guide means is integral with collar 124 heretofore described as rotatively carried in housing 125. Housing 125 is a support integral with a base 141.

The collar 124 carries an adjusting screw 123 whereby the bracket 120 can be radially moved in the guide means 121 for the purpose of setting the distance between the shaft H and the surfaces 9, 10 of the grinding wheel which is equal to R.

The support means S houses the shaft 165 of the dressing wheel which is driven by a motor 158. The motor 158 is socketed in a slide 162 longitudinally movable in guide rails 163 of the carrier disc 102. A lug 160 is fixed to the carrier disc. An adjusting screw 161 is inserted in a thread of the lug. The lower end of the adjusting screw enters into a cavity of the slide 162 to which it is fixed by a locking washer 164. The screw 161 is turned for the purpose of moving the slide along the guide 163 and thereby setting the distance between the periphery of the truing wheel and the axis N of the carrier disc, which distance must be equal to half the width of the splines ($b/2$).

For adjusting the profiling device at the beginning of a grinding operation, the distance $b/2$ is regulated by setting the screw 161. The distance $b/2$ being correct, the radius R is determined by turning the screw 123.

When the truing wheel 157 has been worn to the point where the radius is smaller than the required radius r , the truing radius R and the distance $b/2$ between the axis N and the periphery of the truing wheel 157 is no longer correct. Accordingly screw 161 is rotated to shift the slide block 162 in order to re-establish the correct value $b/2$.

Collar 124 has a rear arm 126 integral therewith which carries a peg 127 intermediate and abutable with each of a pair of predeterminedly spaced stops 127a carried in flanges of housing 125 depending upon direction of rota-

tion of collar 124. Another pair of stops 127b, can also be utilized. The pairs of stops 127a, or 127b, are spaced such that collar 124 moves within an angle of 45° for eight spline shafts, and 60° for six spline shafts.

Striepe Patent 3,242,918 illustrates the arrangement (FIG. 5) just described. Different pegs such as 127 cooperate with a pair of stops 127a, or 127b respectively, depending on whether six or eight splines are to be cut.

Cam disc 115 is rotated by shaft 118 which has a gear 132 keyed at its exterior end meshing with a gear 133 rotatively carried by sleeve 119 and having a manually operable crank lever 135. A detent ring 136 having a longitudinal slot is secured at the outer end of sleeve 119 integral with bracket 120 and a spring pressed pawl 137 carried by sleeve 119 serves to effect an initial locking of the bracket 120 and cam 115. This effects the initial position of wheel 157 (FIG. 1) and for the cam levers 111 and 112 (FIG. 3) in coaction with the spring pressed pad 117. In such initial positions as just described, lever 135 is vertical and intermediate stops 127a (or 127b) as shown and described in *Striepe* Pat. 3,242,918 (FIG. 5).

Upon initial rotation of lever 135 clockwise, collar 124 and the entire system carried by it including the axis 159 of the diamond wheel 157 is rotated in a clockwise direction from position IV to position III of FIG. 1 around axis H which is the axis of collar 124. Such rotation of the entire system continues until stopped by abutment of the peg 127 with a stop 127a. It will, of course, be understood that if the lever 135 were rotated in the opposite direction, then collar 124 would cease rotation by abutment of peg 127 with the opposite stop 127a.

At position III crosshead 129 is slanted parallel to wheel surface 8 and rotation of the system is stopped by abutment of peg 127 with a stop 127a, the pawl 137 is forced out of the slot in ring 136 and continued rotation of lever 135 will cause gear 133 to rotate gear 132 thus rotating shaft 118 and cam disc 115 counter-clockwise as viewed on FIG. 3. Cam lever 112 is then actuated by cam pin 114, being raised to effect rotation of the flange 105 causing 90° rotation of carrier disc 102 to which it is secured. The 90° rotation is predetermined by the shoulder 106 of flange 105 abutting the stop 108 carried in the crosshead 129. This stops further rotation of the cam disc 115 with respect to the crosshead 129 which rotation has moved axis 159 of wheel 157 around axis H from position III to II. Continued rotation of the lever 135 causes the cam disc 115 to continue rotation and cam lever 112 acting through the flange 105 and carrier 102 pushes the crosshead 129 (carrying the diamond wheel 157) upwardly on guide rods 128 and 128a so that the diamond wheel moves linearly to dress the surface 8 and arrives at position I. The cam lever 111 does not participate at this time, the pin 113 floating freely in the respective cam groove. Upward movement of either cam lever is always against the resilient pressure of pad 117 which receives reaction support by either of the stops 127a or 127b to insure proper positioning of the cam levers in the initial positions of FIG. 3 when rotation of lever 135 brings that lever back into perpendicular initial position to reestablish the initial position of the diamond wheel as shown in FIG. 1.

It will be clear from the symmetry of the mechanism that from position I the wheel 157 can be actuated by counter-clockwise movement of lever 135 to position VI and thence returned to position IV. In actuating the wheel 157 from I to VI, lever 111 and shoulder 107 are used.

Referring now to the slidable base 141, it will be understood to be carried on the grinding machine and it also carries the tail stock 101 and dead center 100. Noting that the shaft 1 to be ground has one end carried in the tail stock, and it being understood that the grinding wheels 5, 6 are fixed in position, it will be understood

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that sliding of the base 141 to the left will bring the diamond wheel into position for dressing the grinding wheels, or sliding the base 141 to the right will bring the shaft 1 into position for spline grinding.

It will be noted that the plane of the dressing wheel 157 is normal to the plane of the grinding wheels and that the axis 159 is transverse to the axis K of the grinding wheels which are supported in any suitable manner for rotation on a shaft G having the rotary power means M. Thus the plane of the dressing wheel is generally normal to a diametric plane taken vertically and containing the axis K.

Of particular note is the fact that the simplicity of the arrangement provides for the rotation of axis 159 around axis N when the dressing wheel is in a position such that those two axes are in the same plane with the axis H. Axis H is at a distance corresponding to the distance between the work or shaft center and the base radius R as will be apparent from FIG. 1.

Accordingly, inasmuch as the dressing wheel and the grinding wheels have separate rotary motive power means it will be understood that a ratio of peripheral speeds can be provided and it has been found advantageous for the grinding wheel to rotate with a peripheral dressing speed approximately equal to the peripheral speed of the dressing wheel so that the abrasion lines will run obliquely to the peripheral movement of the grinding wheels.

Although the invention is illustrated as a machine for dressing a pair of parallel grinding wheels, it will be appreciated that a single wheel may be dressed. Accordingly, the claims should be construed as relating to single wheels, the plural term "wheels" as used in the claims referring to grinding wheels in general and not intended to restrict the claims to arrangements wherein two wheels are dressed. For example, a composite wheel as shown in FIG. 1 of the Striepe patent can be dressed.

What is claimed is:

1. In a machine for dressing a grinding wheel 5, 6 having portions of concave and bevelled contour for grinding splines 2, 3 of a predetermined width b in a shaft 1 having an axis H generally transverse to the grinding wheel axis K during grinding: which comprises a motor

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driven rotative shaft S for supporting and rotating a dressing wheel 157 on the axis 159 of said shaft, wherein said latter axis 159 is generally normal to the axis K of said grinding wheel when said grinding wheel is being dressed; means for supporting said shaft comprising elements for translating said shaft S to carry said dressing wheel in both an arcuate and straight path to dress the contour of said grinding wheel; wherein said elements comprise a rotative carrier 120; means 123 for radially adjusting the radius of movement of said carrier, said carrier having a further rotative carrier 102 carrying a slide block 162 radially movable relative to the rotative axis of said latter carrier; said shaft S being carried on said slide block with its axis 159 transverse to the path of sliding of said slide block; adjusting means 160, 161, 164 on said latter carrier 102 for radially adjusting said slide block to position said shaft to compensate for wear of said dressing wheel to maintain the periphery thereof at a predetermined distance, equal to half the spline width b , from the axis N of said carrier 102.

2. In a machine as set forth in claim 1, said slide block adjustment means comprising a member 161 having threaded coaction with said carrier 102 and engaging said slide block 162 for radially adjusting said slide block to adjust the position of said shaft S.

3. In a machine as set forth in claim 1, said slide block carrying a motor and said shaft extending outwardly of said motor normal to the path of radial adjustment of said slide block.

4. In a machine as set forth in claim 2, said slide block carrying a motor and said shaft extending outwardly of said motor normal to the path of radial adjustment of said slide block.

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