

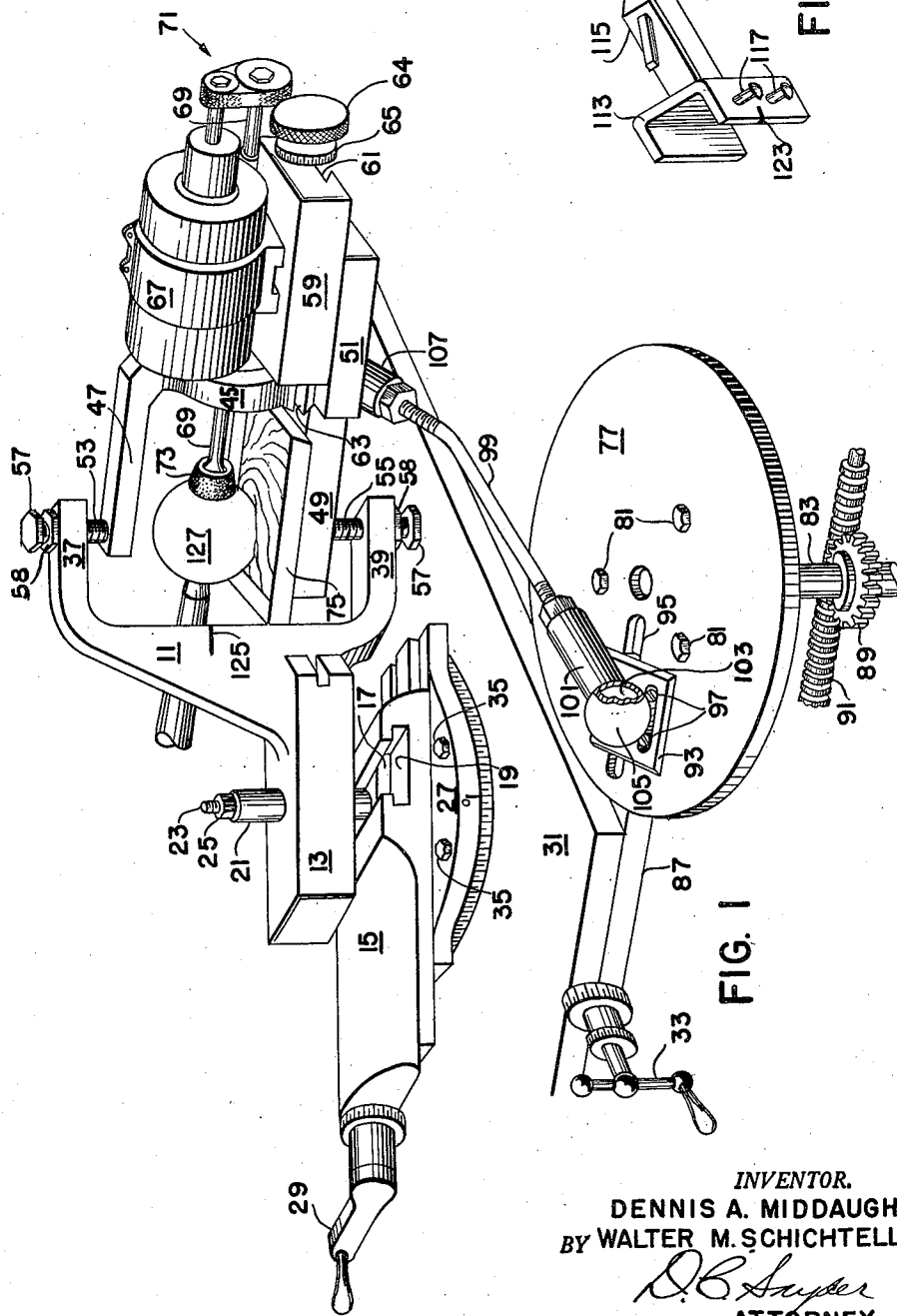
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D. A. MIDDAGH ET AL
SPHERICAL GRINDING APPARATUS

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

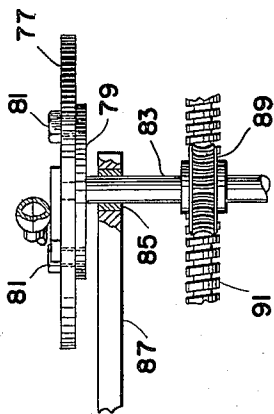


FIG. 4

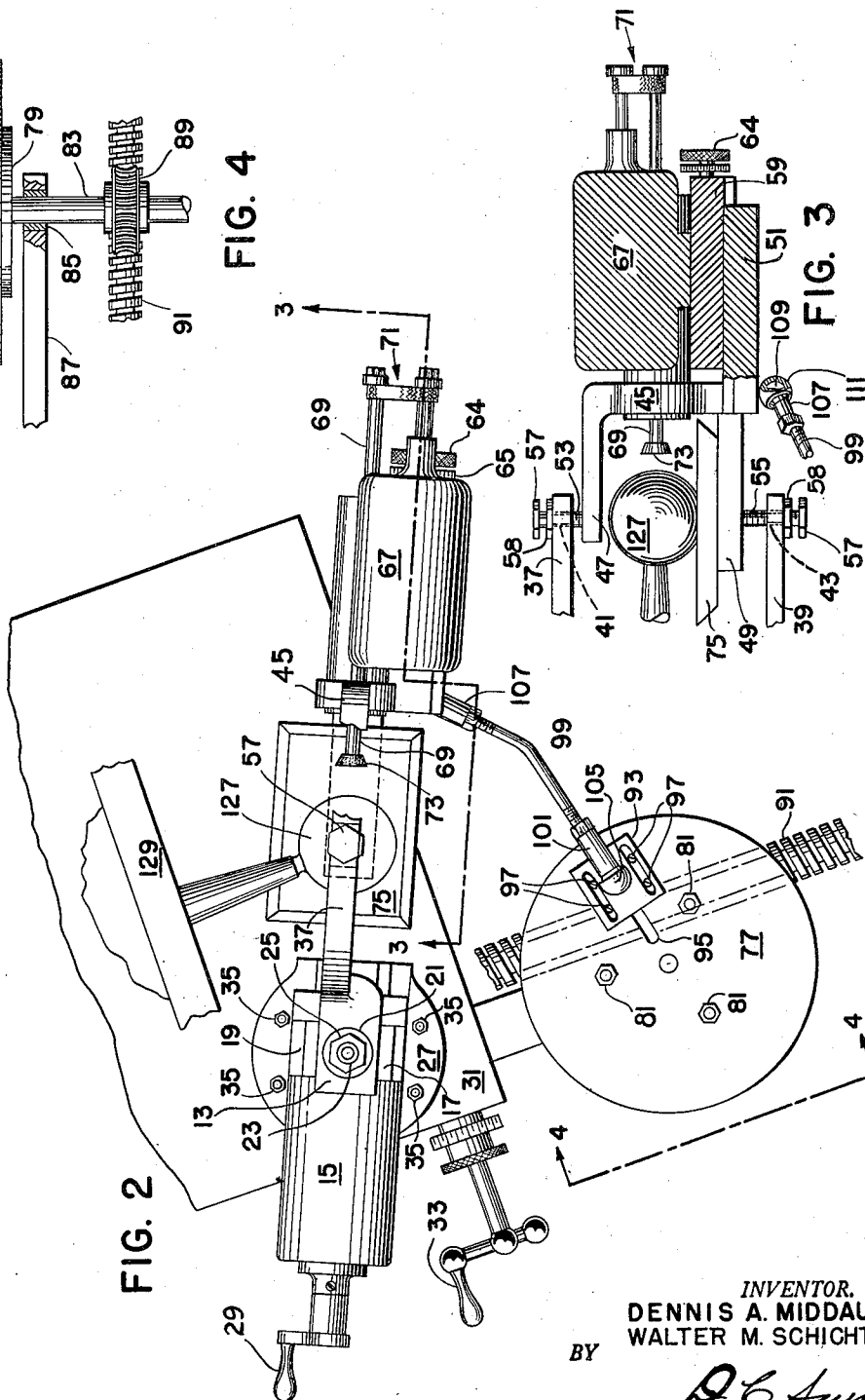


FIG. 2

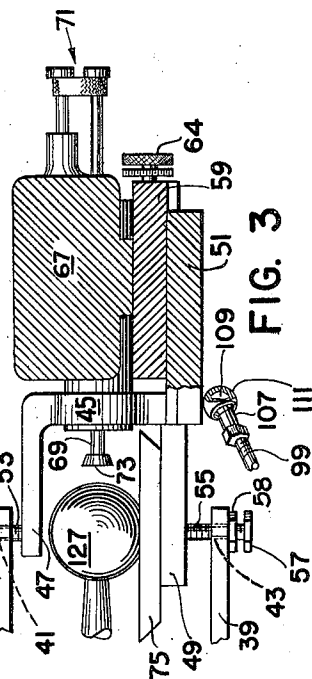


FIG. 3

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SPHERICAL GRINDING APPARATUS

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3 Claims. (Cl. 51—55)

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amended April 30, 1928; 370 O. G. 757)

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This invention relates to improvements in tools, and more particularly pertains to improvements in universal grinding attachments for lathes.

In machining a connecting rod having a hardened ball portion integral one end of said rod, it has been conventional practice to rough the connecting rod ball to within .003" of finished size with a radius tool, harden the ball, and then employ a cast-iron lapping-plate to lap the ball to finished size and attain a high finish thereon. However, the lapping process is so slow that no more than .003" can be allowed for the finishing operation, even though .003" is not always sufficient to clear the surface of the ball, due to warping and pitting of the metal that occurs during hardening. As a result, the requirements of a high and uniform finish for the ball of the connecting rod is, frequently, not met, and time, labor and material expended fruitlessly. In addition, lapping is a manual process, dependent in large measure on the skill of the operator and at best excessively slow and productive of non-uniform results.

The primary object of the invention is to provide a universal grinding attachment for a lathe and a method of grinding an object such as the ball of a connecting rod.

Another object is to provide a universal grinding attachment of simple and durable construction adapted to grind an object such as the ball end of a connecting rod.

Still another object is to provide a universal grinding attachment adapted to machine a ball accurately, speedily and automatically.

A further object is to provide a universal grinding attachment adapted to machine a ball uniformly and symmetrically through a depth of cut heretofore deemed inordinate.

Another object is to provide a novel method of machining a ball to a high finish.

Further objects and advantages of this invention, as well as its construction, arrangement and operation will be apparent from the following description and claims in connection with the accompanying drawings, in which

Fig. 1 is an isometric view of a universal grinding attachment, associated elements of a lathe on which said attachment is mounted, and a portion of a workpiece such as a connecting rod, showing a preferred embodiment of the invention;

Fig. 2 is a fragmentary plan view of the elements shown in Fig. 1, shown in another operating position;

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Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is an elevation, partly broken away, taken in the direction of the line 4—4 of Fig. 2; and Fig. 5 is an isometric view of an associated holder for a grinding-wheel cutter.

Similar numerals refer to similar parts throughout the several views.

The grinding attachment, generally, includes means for positioning a grinding-tool assembly upon the carriage of a lathe and relative a workpiece, and for securing said grinding-tool assembly in selected position, a grinding-tool assembly adapted to position a grinding-tool relative a workpiece, to secure said grinding-tool in selected position and to rotate said grinding-tool, and means to oscillate said grinding-tool assembly in an arcuate path.

The means for positioning and securing the grinding-tool assembly includes a yoke 11 carried on an arm 13, the mounting of said arm 13 being receivable by a conventional compound rest. Such rest includes tool-feed carriage 15, which carries block 17 slidably in T-slot 19 of said tool-feed carriage. Block 17 mounts threaded bolt 23 having a tightening-nut 25, a tubular spacer 21 that is larger in diameter than the bore in arm 13 acting as a bearing or clamping washer which nut 25 acts against to clamp arm 13 in place. Block 17 is prevented from sliding relative to carriage 15 by rotation of tightening-nut 25, and thus secures yoke 11 against movement relative to carriage 15. Said carriage 15 is slidable rectilinearly upon carriage-plate 27 by means of crank 29. Carriage-plate 27 is rotatable relative to lathe-carriage 31 by means of crank 33, while nuts 35 are provided to secure carriage-plate 27 against such rotation.

Yoke 11, in secured position, is disposed normal to the surface of lathe-carriage 31, with legs 37 and 39 of said yoke in a common vertical plane, and with bore 41 in leg 37 and bore 43 in leg 39 (see Fig. 3) having a common vertical axis.

The grinding-tool assembly includes a yoke 45 having legs 47 and 49, and an arm 51 forming a base for the motor table hereinafter described. The facing ends of studs 53 and 55 are pointed to fit conical bores or recesses in the confronting faces of the legs 47 and 49. Said studs 53 and 55 threadedly fit the bores 41 and 43 in legs 37 and 39 respectively, and are provided with bolt heads 57 by means of which said studs are rotated to obtain their desired position and desired tightness of fit of the ends in the bores or sockets in arms 47 and 49. Lock nuts 58 are also provided

on said studs 53 and 55 for retaining said studs in adjusted position. The longitudinal axes of studs 53 and 55 are parallel or common to facilitate rotation of yoke 45 with said studs as pivot points.

Table 59 is mounted slidably upon arm 51, keyway 61 of said table riding on key 63 of arm 51. Fine adjustment of the position of table 59 relative arm 51 is obtained through suitable feeding means (not shown) actuated by wheel 64, which carries graduated disc 65. Preferably, the graduations of disc 65 indicate rectilinear feed of the order of .0005" or less.

Motor 67 is mounted on table 59, and drives shaft 69 through belt linkage 71. Said shaft 69 extends through yoke 45 and carries grinding wheel 73 between legs 47 and 49 of yoke 45, the axis of said shaft being disposed in the plane of said legs and parallel the surface of lathe-carriage 31.

Leg 49 of yoke 45 carries a pan 75, said pan being so positioned and proportioned as to carry a coolant and dust-absorbent solution in which the ball of the connecting rod being ground is partially immersed during the performance of the grinding operation.

The means to oscillate the grinding-tool assembly in an arcuate path includes the following structure: A disc or turntable 77 is mounted on a support 79 (see Fig. 4) by bolts 81, and said support is mounted on the end of a shaft 83, so that said turntable is carried normal to said shaft. The shaft 83 is secured rotatably in the bearing 85 of an arm 87 extending from lathe-carriage 31, whereby the face of said turntable is secured parallel to the face of said lathe carriage. Gear 89 is mounted on shaft 83, in mesh with the conventional worm or lead-screw 91 of the lathe and rotated thereby.

Plate 93 is mounted slidably in the radial slot 95 of turntable 77 and is provided with a plurality of setscrews 97 adapted to secure said plate against movement relative said slot. Connecting rod 99 is threaded into sleeve 101, which carries ball 103 at the end of said sleeve distal rod 99, said ball 103 being mounted rotatably in knuckle 105, which in turn is mounted on plate 93, normal thereto. Thus, connecting rod 99 is adapted to rotate universally in knuckle 105. The opposite end of connecting rod 99 is threaded into sleeve 107, which carries ball 109 at the end of said sleeve distal rod 99, said ball 109 being mounted rotatably in knuckle 111 (see Fig. 3), which in turn is mounted on the nether face of base 51, normal thereto. Thus, connecting rod 99 is adapted to rotate universally in knuckle 111.

In aligning the grinding-tool assembly, a holder for a diamond cutter, shown in Fig. 5, is employed. Said holder comprises a C-clamp 113 mounting an arm 115 and having a plurality of thumb-screws 117 adapted to secure said clamp upon yoke 11, a diamond cutter 119 secured in the end of said arm distal said clamp by a setscrew 121, and a score or mark 123, which can be aligned with a score or mark 125 on yoke 11 to facilitate accurate positioning of said holder on said yoke. With the grinding-wheel 73 (preferably a hollow mill grinding-wheel) mounted on shaft 69, the holder mounted on yoke 11, and said yoke 11 so positioned that yoke 45 rotates on an axis that passes through the longitudinal axis of the lathe chuck, said diamond cutter is employed to cut the face of grinding-wheel to the radius to be ground. Such cutting is effected by rotating grinding-wheel 73 on shaft 69 by means

of motor 67 and oscillating yoke 45 by means of connecting rod 99, turntable 77, gear 89 and feed screw 91.

When the grinding-wheel 73 has been cut to desired shape, the holder is removed from the yoke and the workpiece 127 mounted in the chuck 129 of the lathe. A suitable coolant, such as a solution of sodium carbonate and water, is poured into pan 75, said solution serving to cool the workpiece, which is partly immersed in it, and to suppress dispersion of material abraded from the workpiece and from the grinding-wheel.

With the compound rest of the lathe so adjusted and secured that the common axis of bearings 53 and 55 passes vertically through the center of the connecting-rod ball to be ground, operation of the device is apparent. The lathe chuck 129 rotates the workpiece, motor 67 rotates hollow mill grinding-wheel 73, and the grinding-wheel assembly is oscillated through an arcuate path (of desired radius, by virtue of the adjustment of wheel 64, which feeds table 59), said path being of an extent determined by the positioning of plate 93 relative radial slot 95, since such positioning determines the throw of connecting rod 99 as it is moved by turntable 77, which in turn is driven by lathe lead screw 91 through gear 89 and shaft 83. It is to be noted that further adjustment of the throw of connecting rod 99 can be effected by adjustment of the position of said rod relative sleeve 101 or sleeve 107, or both.

Various modifications and changes can be made in the subject device without departing from the scope of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

We claim:

1. In a lathe having a driving means, a chuck carried in the headstock thereof and adapted to secure a workpiece on said lathe, a compound rest carrying a tool-feed carriage adapted to present a tool against such workpiece and a longitudinal-feed lead screw carried by said lathe and disposed parallel to the axis of rotation of said chuck, said chuck and lead screw being rotated by said driving means, a universal grinding attachment comprising a first yoke mounted on said carriage, a second yoke having legs pivoted on threaded studs mounted in the legs of said first yoke, said studs being adapted to elevate and depress said second yoke relative said first yoke, a grinding tool carried by said second yoke, means to rotate said grinding tool mounted on said second yoke, a disc having a radial slot mounted rotatably on said lathe, said disc being rotated by said lead screw, and a connecting rod secured in said slot and to said second yoke whereby said second yoke is oscillated on the axis of said studs.

2. In a lathe having a driving means, a chuck carried in the headstock thereof and adapted to secure a workpiece on said lathe, a compound rest carrying a tool-feed carriage adapted to present a tool against such workpiece and a longitudinal-feed lead screw carried by said lathe and disposed parallel to the axis of rotation of said chuck, said chuck and lead screw being rotated by said driving means, a universal grinding attachment comprising a first yoke mounted on said carriage, a second yoke having legs pivoted on studs mounted in the legs of said first yoke, said second yoke being rotatable on an axis in-

intersecting the axis of rotation of said chuck, a grinding tool carried by said second yoke, said studs being threaded in bores in the legs of said first yoke to provide means to elevate and depress said second yoke relative said first yoke, 5 means to rotate said grinding tool mounted on said second yoke, a disc having a radial slot mounted rotatably on said lathe, a gear carried by said disc, said gear being rotated by said lead screw, a plate mounted slidably in said slot, 10 means to secure said plate against movement relative said slot carried by said plate and engaging said disc, and a connecting rod secured to said plate and to said second yoke whereby said second yoke is oscillated on the axis of said studs.

3. In a lathe having a driving means, a chuck carried in the headstock thereof and adapted to secure a workpiece on said lathe, a compound rest carrying a tool-feed carriage adapted to present a tool against such workpiece and a longitudinal-feed lead screw carried by said lathe and disposed parallel to the axis of rotation of said chuck, said chuck and lead screw being rotated by said driving means, a universal grinding attachment comprising a first yoke mounted on said carriage, a second yoke having legs pivoted on studs mounted in the legs of said first yoke, said second yoke being rotatable on an axis intersecting the axis of rotation of said chuck, a grinding tool carried by said second yoke, said studs being threaded in bores in the legs of said first yoke to provide means to elevate and depress said second yoke relative said first yoke, means to rotate said grinding tool mounted on said second yoke, a disc having a radial slot mounted rotatably on said lathe, a gear carried by said disc, said gear being rotated by said lead screw, a plate mounted slidably in said slot, a knuckle secured on said plate, means to secure said plate against movement relative said slot carried by said plate and engaging said disc, and a con-

necting rod having a ball in one end carried universally in said knuckle, the other end of said rod being secured rotatably to said second yoke.

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