April 2, 1946. M. F. BOECK ET AL 2,397,463

THREADING APPARATUS

Filed June 21, 1943 3 Sheets-Sheet 1

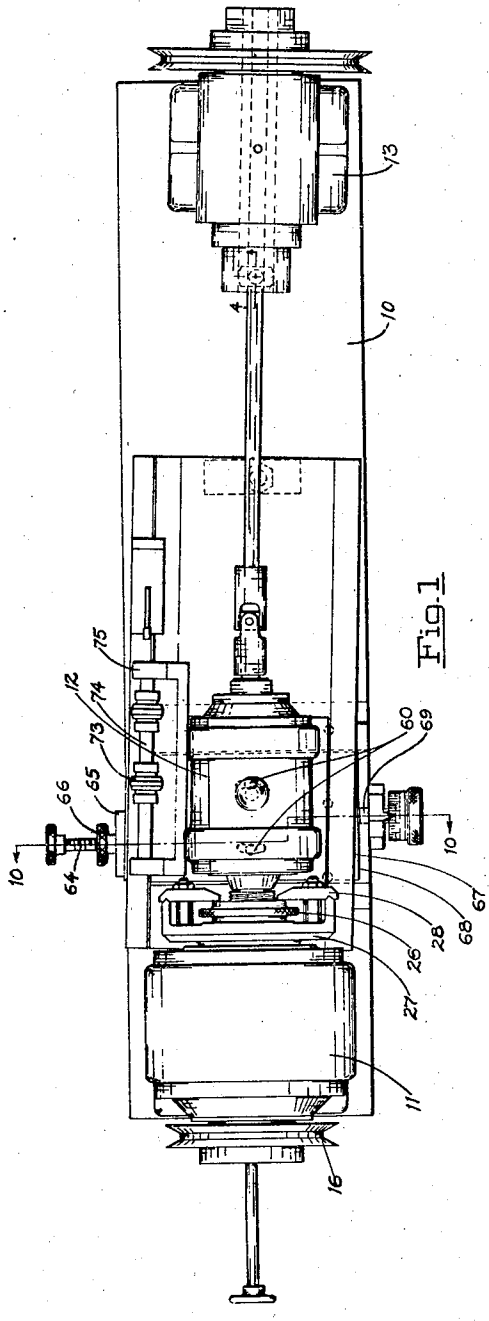


Fig. 1

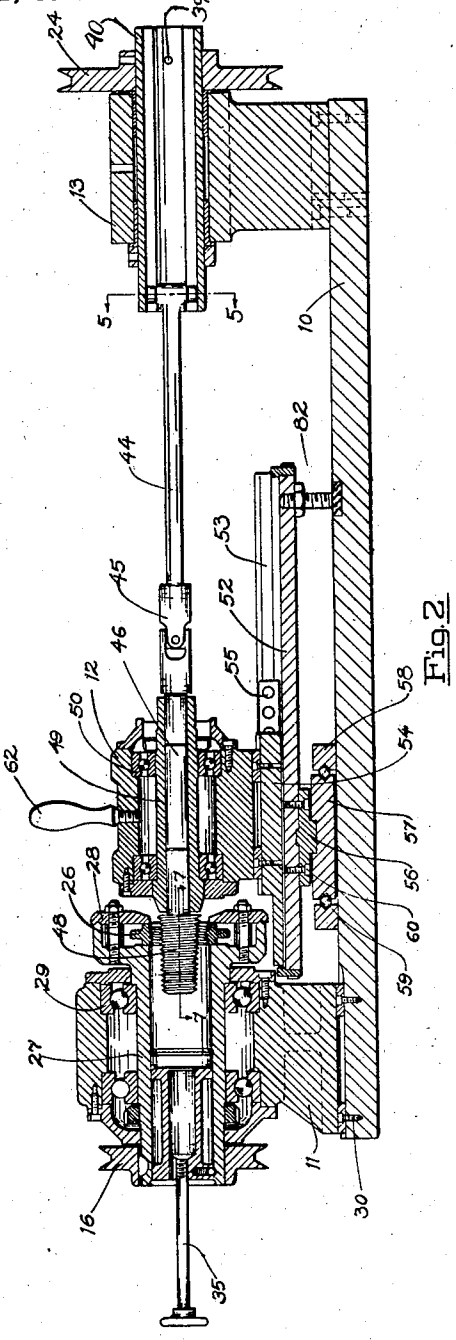


Fig. 2

INVENTORS
Max F. Boeck and
Harry L. Rausch
Edward J. Noe Jr

BY

ATTORNEY.

April 2, 1946. M. F. BOECK ET AL 2,397,463

THREADING APPARATUS

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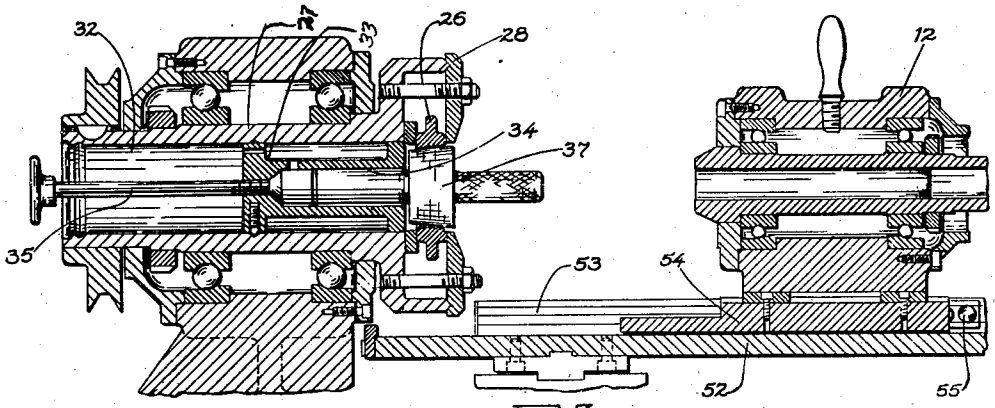


Fig. 3

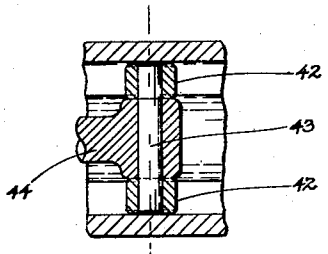


Fig. 4

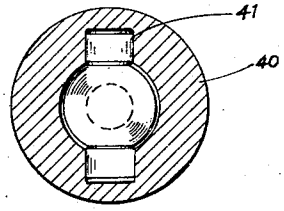


Fig. 5

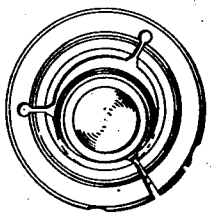


Fig. 6

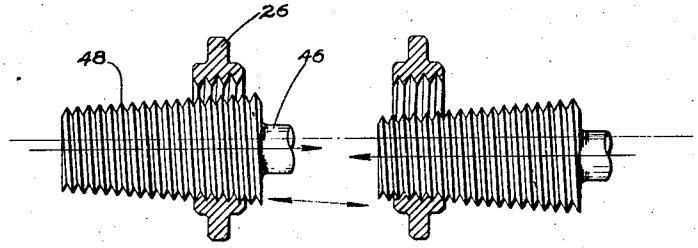


Fig. 7

Fig. 8

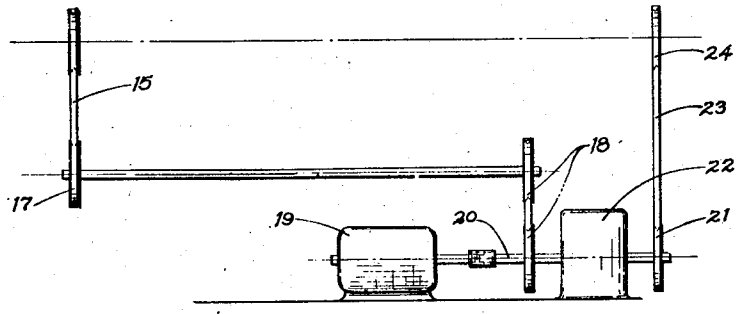


Fig. 9

INVENTORS
Max F. Boeck and
Harry L. Rauson
BY
Edward J. Noeth
ATTORNEY.

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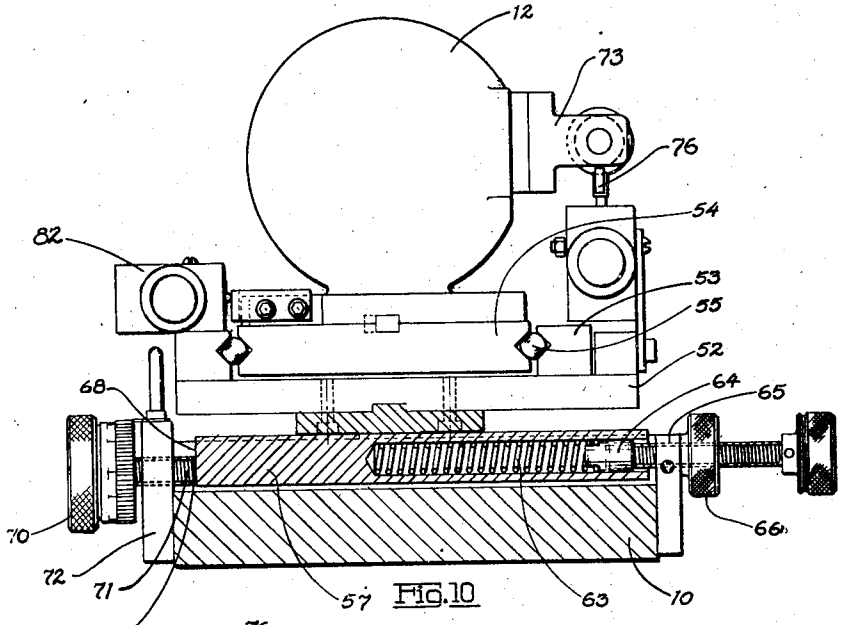


Fig. 10

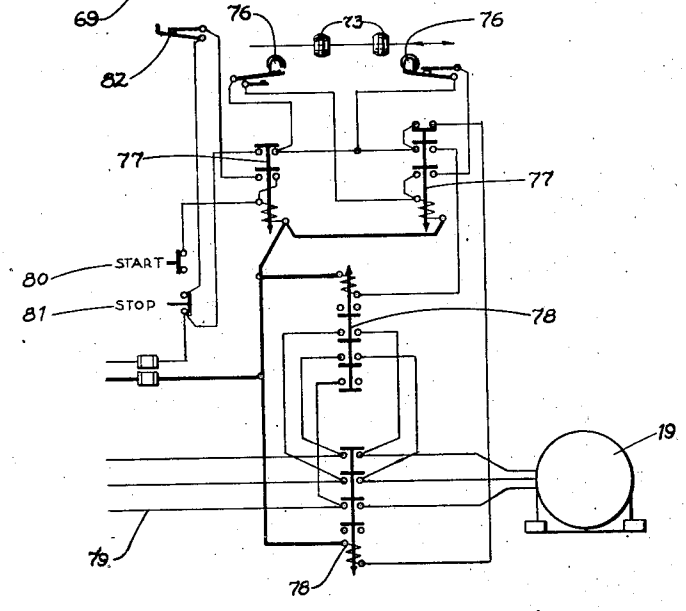


Fig. 11

INVENTORS
Max F. Boeck and
Harry L. Rausch

BY Edward J. Nos Jr.

ATTORNEY.

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UNITED STATES PATENT OFFICE

2,397,463

THREADING APPARATUS

Max Fred Boeck and Harry L. Rausch, Dayton, Ohio, assignors to The Sheffield Corporation, Dayton, Ohio, a corporation of Ohio

Application June 21, 1943, Serial No. 491,636

9 Claims. (Cl. 51—50)

This invention relates to the cutting or finishing of threaded or gauging members and the like.

One object of the invention resides in the method of making or finishing a tapered thread, in which the workpiece is rotated about its own axis while in engagement at one side thereof with a rotatable serrated tool which produces a progressive cutting action in an annular direction around the workpiece.

Another object resides in the method of lapping a tapered thread, in which the thread is engaged along its axial length but at only one side of the workpiece with a rotatable threaded lapping tool, one of these parts having a movement eccentric of the work axis so as to progressively lap the work in an annular direction around the work.

Another object is the provision of apparatus for carrying out these methods.

Another object is the provision of apparatus for finishing a threaded workpiece, embodying a rotatable work holder and a serrated finishing tool which is arranged eccentric of the work axis and having provision for movement in a predetermined direction angularly related to the work axis.

Another object is the provision of apparatus embodying a rotatable work holder, and a rotatable tool holder which is mounted in a support capable of movement substantially transversely of the work axis and movable also at an angle to the work axis corresponding to the taper angle of the surface to be finished on the work piece.

Other objects and advantages of the invention will be apparent from the following description, the appended claims and the accompanying drawings, in which,

Fig. 1 is a plan view of an apparatus embodying or for carrying out the present invention;

Fig. 2 is a longitudinal vertical section of the apparatus shown in Fig. 1.

Fig. 3 is an enlarged view corresponding to the left hand portion of Fig. 2, with the tool holder in a retracted position;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a section on the line 5—5 of Fig. 2;

Fig. 6 is an end view showing the relative engagement of the workpiece and the lapping tool;

Fig. 7 is a section on the line 7—7 of Fig. 2;

Fig. 8 is a section corresponding to Fig. 7 but showing the lapping tool at the opposite end of its limit of travel;

Fig. 9 is a diagrammatic showing of the drive connections;

Fig. 10 is a vertical section on the line 10—10 of Fig. 1; and

Fig. 11 is a diagrammatic showing of the electrical connections.

Referring more particularly to the drawings, in which the same reference numerals have been applied to corresponding parts in the several views, 10 designates the mounting base or frame, below which the drive motor and gears are arranged, and on which is carried a work holder 11, a tool support 12 and a drive shaft bearing 13. The tool support 12 carries a rotatable finishing tool herein shown as a threaded tapered lapping plug, as the invention has been described herein as particularly applicable for the lapping of tapered thread rings such as ring gauges or the like. In lapping a threaded plug the lapping tool would be a threaded ring, it being apparent that other forms of lapping tool may of course be substituted for the particular thread lap which has been shown.

The workpiece which may be an internally threaded ring having tapered threads is carried for rotation about its own axis in the work holder 11, and is rotated at a suitable speed, as by a drive belt 15 operating around pulleys 16 and 17 (see Figs. 2 and 9). The pulley 17 is driven by pulley 18 from a drive motor 19. The shaft 20 which carries one of the gears 18 also operates a gear 21 through a speed reducing gear box 22. Pulley 21 is connected by belt 23 to a pulley 24 which is connected to the lapping tool as will be presently described. The relative speeds of the pulleys 16 and 24 is preferably such that the workpiece is driven substantially faster than the lapping tool, the workpiece and the lapping tool turning in opposite directions. It has been found quite satisfactory to have the workpiece turned at a speed of about 180 R. P. M. with the lapping tool turned at a speed of about 20 R. P. M.

The workpiece, designated by numeral 26, which is shown as a threaded ring gauge adapted for gauging pipe threads, is held in a centered relation with respect to the work carrying arbor 27 by means of clamps 28. The arbor 27 is rotatably mounted by suitable bearings 29 in the work holder 11, the pulley 16 being secured to one end of the arbor. The work holder 11 is fastened as by means of suitable securing screws to the plate 10. The work carrying arbor 27 is preferably hollow, having a cylindrical chamber 34. Normally the piston 33 is in its retracted or outer position as illustrated in Fig. 2, and it may be moved to that position by the stem or handle 35. When the workpiece is being mounted on the end of the arbor 27, the stem 35 is pushed inwardly to move the piston into the position shown in

Fig. 3, and with the workpiece 26 held loosely by the clamps 28, an exact centered position of the workpiece is obtained by applying a centering plug 37 into the workpiece, one portion of the centering plug 37 having a conical surface that fits into the tapered threads of this workpiece, and having another cylindrical portion which fits into the chamber 34 of the piston. Since the chamber 34 is exactly concentric with the axis of rotation of the work carrying arbor, the workpiece will be adjusted into a centered relationship on the arbor, and the clamps 28 are then tightened, and the centering plug 37 removed.

The pulley 24 is secured by means of a pin 39 to a hollow shaft 40 which is rotatably journaled in the drive shaft bearing 13. Shaft 40 is provided with slots or grooves 41 which form guideways for rollers 42 rotatably carried on a pin 43 which is secured to a drive rod 44. This rod is connected by a flexible coupling 45 to the shaft section 46 which is fixed to tool holder or spindle 49 in which the lapping plug 48 is fixed, as by a suitable set screw, not shown. The shaft section 46 is removably fixed in tool holder 49, which is supported by means of anti-friction bearings 50 for free rotation in the support 12.

The support 12 is arranged for sliding movement on a carrier 52 so as to move in a direction towards and from the workpiece. The carrier, which is preferably an elongated plate, is provided with guideways 53 which guide the base portion 54 of the support 12. Suitable anti-friction rolls or balls 55 are interposed between the parts 53 and 54. The plate 52 is rotatably adjustable on but fixed to a plate 56, which is secured to a transversely extending plate 57. This plate 57 is guided for movement transversely of the axis of the work, in a mounting base 58, with suitable anti-friction balls or rollers 59 interposed between the parts 57 and 58. The arrangement of the carrier 52 on the mounting base 58 thus permits transverse movement of the tool, and the arrangement of the tool support 12 on the carrier permits movement of the tool in a direction generally towards and from the workpiece. The direction of movement of the tool depends on the adjustment of the carrying plate 52 on the plate 56, this adjustment permitting the location of the guideways 53 so they extend parallel to the desired taper angle of the threads on the workpiece, and by taper angle of the threads on the workpiece is meant the angle between the work axis and a plane touching the ends of all the threads at one side of the work. The adjustment of the carrier plate 52 on the plate 56 is accomplished by loosening the fastening screws 60 which are threaded in the carrier plate 52 and which are arranged in arcuate slots in the plate 56 concentric with the vertical axis of this plate. The carrier plate 52 can then be turned relatively to plate 56 to align the guide ways 53 with the desired taper angle of the threads on the workpiece. The screws 60 are then tightened to rigidly hold the parts 52 and 56 against relative displacement.

Arranged preferably at the top of the tool support 12 is a handle 62 which the operator may grasp in order to move the tool support, and consequently move the tool, into a desired working position with respect to the workpiece. Movement of the tool, either in a direction transverse of the work piece axis or in a direction towards or from the workpiece, is effected without interfering with the rotational drive of the tool, since the flexible connection 45 permits misalignment of the axes of the tool and the rod 44, and the connection between the rod 44 and the shaft 40 permits, in effect, a telescopic movement of the rod 44 along the shaft 40 while maintaining a rotational drive connection. The operator is thus enabled, by grasping and moving the handle 62, to retract the tool to the right from the position shown in Fig. 2 to the position shown in Fig. 3. As shown in Fig. 1, the bearing housing 13 is laterally displaced from the axis of the workpiece, and the drive shaft 40 is at a slight angle to the work axis, corresponding preferably to the average taper angle of workpieces to be finished, so that when the tool is operating the axis of the rod 44 will be approximately in alignment with the axis of the shaft 40. The axis of the rod 44, however, will be at a slight angle to the axis of the shaft section 46, since the latter is positioned by the tool holder with the axis of the tool parallel to but displaced from the axis of the workpiece.

The plate 56 is normally substantially below the tool support 12. Inasmuch as the carrier plate 52 is rather long, it is preferably supported at its overhanging end by means of a foot 82 which is adjustably screwed into the plate 52 and bears against a flat thrust surface 83 on the base 10. This foot slides over the smooth thrust surface as the plate moves transversely.

The threaded lapping tool 48 shown in Figs. 6, 7, and 8 is made preferably of cast iron or other suitable material adapted for satisfactory lapping operation. It is considerably longer than the length of the thread to be lapped on the workpiece and is of substantially smaller diameter than the threads in the workpiece. The threads on the lapping tool have the same pitch distance as the threads to be lapped on the workpiece. As shown, the larger end of the threaded lapping tool is small enough in diameter so that the lapping tool can move through the workpiece without jamming against it. In use, the operator, by grasping the handle 62, can move the lapping tool into the workpiece and then, as the lapping tool is moved laterally with respect to the axis of the workpiece, the threads of the lapping tool are brought into contact with the threads on the workpiece. Before these threads engage, the drive motor is started so that the workpiece and the lapping tool are turned, each on its own axis, these axes being parallel to one another but relatively spaced during the lapping operation. Since the tool support 12 is free to move towards and from the workpiece, the lapping tool will be drawn along the workpiece by reason of the threaded engagement that takes place at one side of the lapping tool with one side of the workpiece. The lapping tool is thus caused to travel along the workpiece in one direction or the other, so that the thread on the workpiece is progressively lapped in an annular direction around the workpiece. As the line of contact varies annularly around the workpiece, the threads on the workpiece are lapped until the desired size and finish is obtained. A reversal in the direction of rotation of both the lapping tool and the workpiece takes place automatically when these parts are in the relative positions approximately as shown in Figs. 7 and 8, causing the lapping tool to move first in one direction and then the other with a considerable axial travel during the lapping operation. This automatic reversal is effected by limit switches and a reversible motor, or an equivalent construction, as will be presently described.

It will be apparent that as the axial movement of the lapping tool takes place, the axis of the

tool is simultaneously displaced laterally the exact amount required to maintain the lapping tool in threaded engagement and effective lapping contact with the work, since the guides 53 of carrier 52 are arranged in exact parallelism with the taper angle of the threads on the workpiece. To provide a yielding engagement with a predetermined pressure between the lapping tool and the workpiece, the tool support 12 is spring pressed in a transverse direction preferably towards the operator. The spring, shown in Fig. 10 and designated 63 is arranged in the plate 57 which is movable transversely of the workpiece axis as previously described. One end of the spring engages against an adjustable stop 64 which is adjustably threaded in a lug 65 and held in adjusted position by a lock nut 66. The lug 65 is fixed on the plate 10 as shown in Figs. 1 and 10. The spring 63 thus yieldingly urges the carrying means 52 and the tool support 12 in a direction to engage the lapping tool with the work, and with a pressure determined by the setting of the screw 64. The operator can readily move the tool against the pressure of the spring 63 by pushing on the handle 62 before he moves the tool into the work and the tool is then moved laterally and engaged with a yielding pressure when he releases the push on the handle. The plate 57, as shown in Figs. 1 and 10 has a side surface 68 parallel to the axis of the workpiece. This surface 68 is engaged by an adjustable stop 69 which prevents continued lapping on the work after the proper size is obtained, the stop 69 being previously set into a desired position, as by adjusting the handle 70 to move the threaded stem 71 along the lug 72. When the lapping tool is first brought into engagement with the workpiece there is a substantial space between the end of the stop 69 and the side surface 68, but as the lapping operation proceeds, and the workpiece is lapped, the surface 68 is moved over by the spring and finally contacts the stop 69 which locates the lapping tool in final lapping position. If there are some portions of the workpiece, due to a very slight eccentricity or uneven lapping, which require further lapping, those portions of the workpiece will continue to be lapped while the other portions of the workpiece, which have been lapped to final size, will be held out of pressure contact with the lapping tool by means of the stop 69. With this stop properly set, excessive lapping such as would wear down the workpiece to an undesired extent, is prevented. The operator is therefore relieved of the responsibility of determining exactly when the lapping operation is completed.

Limit switches which control the reversing of the motor after the predetermined amount of travel of the lapping tool takes place are controlled by switch operating discs 73 adjustably mounted so they can be set at predetermined positions on a stationary shaft 74 which is carried by a bracket 75. The bracket is fixed to the tool holder 12. These discs 73 operate switch controls 76. The closing of these switches operates reversing relays 77 to control reversing switches 78. The reversing switches 78 change the phase relationship of the current supplied from a three phase source 79 to the motor 19. Start and stop switches 80 and 81 in a starting circuit are manually moved by the operator at the start and stop of any lapping operation. The starting circuit also includes a limit switch 82, operated by a stop 83 on the support 12, which insures stopping of the motor if the switch 76 should fail to do so.

While the form of apparatus and the method of operation herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus and method, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. Apparatus for lapping taper threads of an internally threaded workpiece comprising a work holder, a threaded lapping tool having tapered threads and having an effective lapping portion longer than the thread length to be lapped and substantially smaller in diameter than the threads lapped, means for rotating the work holder, means for rotating the tool, means for maintaining the axis of the tool parallel to the work axis, means for periodically reversing the direction of rotation of the tool, and means for mounting the tool for free rectilinear movement in a predetermined direction at an angle to the axis of the workpiece corresponding to the taper angle of the threads on the workpiece, so that motion in such predetermined direction is dependent entirely upon engagement of the workpiece with the tool.

2. Apparatus of the character described comprising a work holder for holding a threaded workpiece, means for rotating said holder about the work axis, a rotatable tool holder having a threaded lapping tool of an effective length longer than the thread to be lapped, means for rotating the tool holder about an axis parallel to the work axis, a support for said tool holder, means guiding said support for rectilinear movement substantially transversely of the work axis and for free rectilinear movement towards and from the work position but in a direction angularly related to the work axis, the motion of the support in the latter direction being unrestrained so that movement in such direction takes place merely by action of the tool on the work, means for reversing the direction of rotation of the tool, a stop for limiting transverse movement of the tool holder, and spring means for yieldingly urging said support against said stop.

3. Apparatus of the character described comprising a work holder, means for rotating the holder about the work axis, a rotatable tool holder, means for rotating the tool holder, a support for said tool holder, a plurality of slides mounted one on the other with one of said slides carrying said support for mounting said tool holder for movement in a plurality of predetermined directions one of which is substantially transversely of the work axis and the other of which is substantially towards and from the work position but in a direction angularly related to the work axis, yielding means operable on said support to maintain yielding engagement of the tool with the work, and means for automatically reversing the direction of rotation of both the work holder and the tool holder as predetermined positions of the tool holder are attained.

4. Apparatus for lapping taper threads of an internally threaded workpiece comprising a work holder, a threaded lapping tool having tapered threads and having an effective lapping portion longer than the thread length to be lapped and substantially smaller in diameter than the threads lapped, a support for the lapping tool, carrying means for said support and providing for free endwise movement of the support in a direction angularly related to the work axis in accordance with the taper angle of the threads, the movement of the support in such angularly related direction

being unrestrained so that motion of the support is merely caused by the inter engagement of the work and the tool, means for guiding the carrying means for movement of the carrying means in a direction transverse of the work axis, and means for rotating the tool and the work at different speeds of rotation.

5. Apparatus for lapping taper threads of an internally threaded workpiece comprising a work holder, a threaded lapping tool having tapered threads and having an effective lapping portion longer than the thread length to be lapped and substantially smaller in diameter than the threads lapped, a support for the lapping tool, carrying means for said support and guiding the support for free endwise movement of the support in a direction angularly related to the work axis in accordance with the taper angle of the threads, means for guiding the carrying means for movement of the carrying means in a direction transverse of the work axis, and means for rotating the tool and the work at different relative speeds and in timed relation with one another, a stop for limiting transverse movement of the carrying means, and spring means for yieldingly urging said carrying means against said stop.

6. Apparatus for lapping tapered workpieces comprising a first holder and a second holder, one of said holders having means for supporting a tapered threaded workpiece, a tapered threaded lapping tool carried by the other holder, means for rotating said holders at relatively different speeds, means for maintaining the axes of said holders in parallelism and supporting said holders for free relative movement towards and from one another so that one of the holders may be propelled by the threaded engagement of the workpiece and the lapping tool at one side of the workpiece, means yieldingly urging one of said holders laterally of the work axis to hold the tool and the workpiece in yielding engagement during the lapping operation, and stop means for limiting lateral movement of the yieldingly urged holder.

7. Apparatus for taper threading comprising a work holder, a threaded tapered tool having threads of smaller diameter but the same pitch as the threaded portion of the workpiece, means for rotating said work holder and said threaded tool at relatively different speeds, means for holding the tool axis parallel to the work axis and extending into the work, and guide means for mounting said work holder and tool for horizontal free relative rectilinear movement towards and from one another in a predetermined direction corresponding to the taper angle of the work, and means for yieldingly urging the tool laterally of the work axis to maintain yielding engagement with one side of the work.

8. Apparatus for lapping an internal thread on a workpiece comprising a work holder, a threaded lapping tool, means for rotating said work holder about an axis corresponding to the work axis, means for rotating said tool about its own axis at a speed differing from that of the work holder, slides carrying said tool for movement in two directions one of which is generally transverse of the work axis and the other of which is generally in a direction towards and from the workpiece, said tool being substantially free and unrestrained in its movements in the latter direction, means yieldingly urging the tool in said transverse direction so that the threaded portions of the tool and the workpiece produce relative movement generally in the direction of the workpiece axis, adjustable means for limiting the lateral motion of the tool, and means for automatically changing the relative speeds of rotation after a predetermined relative movement of the tool along the workpiece to reverse the direction of travel.

9. Apparatus for lapping taper threads of an internally threaded workpiece comprising a work holder, a threaded tapered lapping tool tapered in accordance with the taper of the workpiece, means for rotating the work holder concentric with the work axis, a tool head for the lapping tool, means for rotating the tool in said head at a speed differing from that of the workpiece, and means for mounting the tool head for free rectilinear movement in a predetermined direction inclined to the work axis at an angle corresponding to the taper angle of the work, a carrier supporting said mounting means for movement at right angles to the work axis, and means for yieldingly urging the mounting means on said carrier to yieldingly hold the tool against the work.

MAX F. BOECK.
HARRY L. RAUSCH.