April 12, 1927. 1,624,868

B. M. W. HANSON

METAL WORKING MACHINE

Original Filed March 9, 1922 5 Sheets-Sheet 1

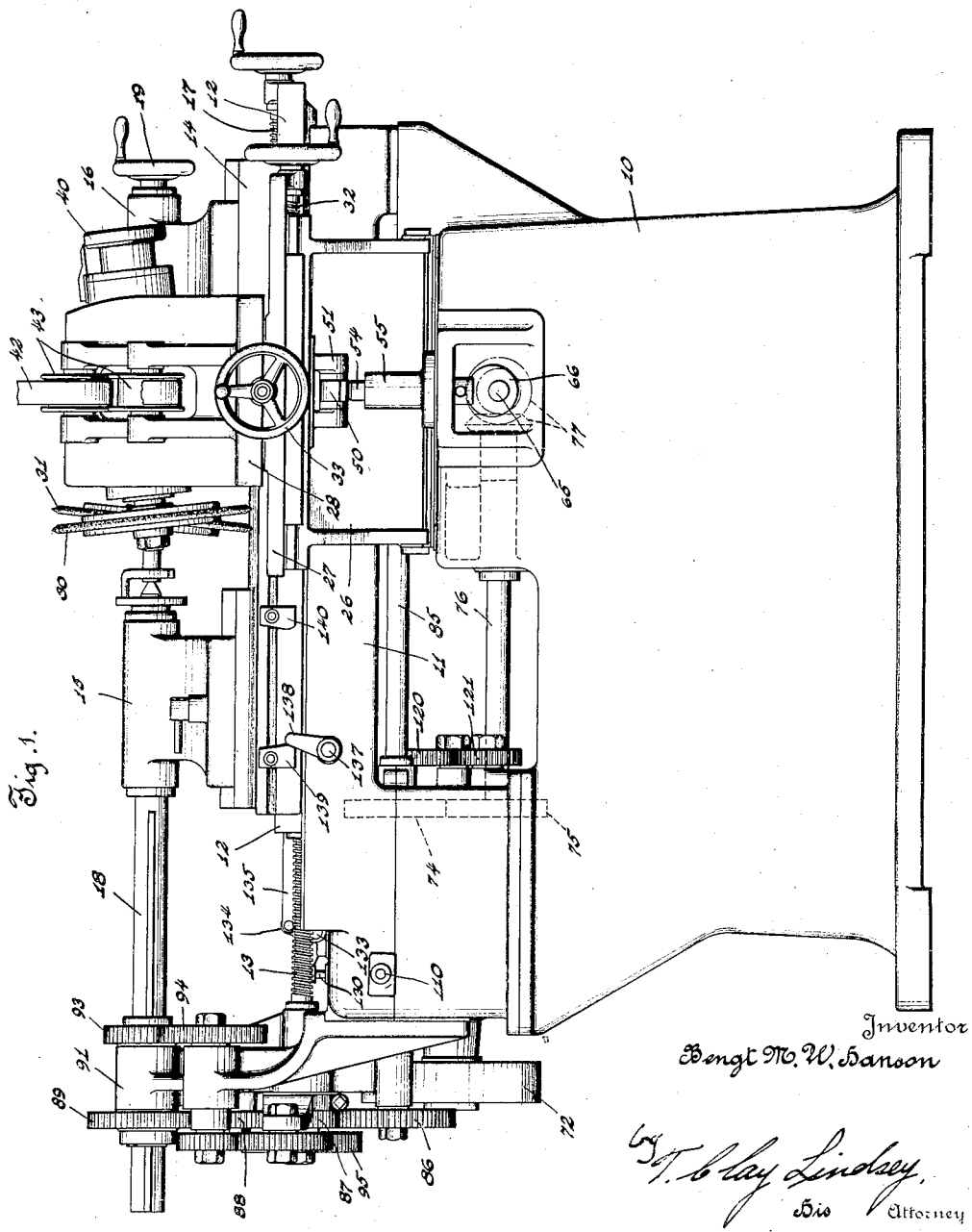


Fig. 1.

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METAL WORKING MACHINE

Original Filed March 9, 1922 5 Sheets-Sheet 2

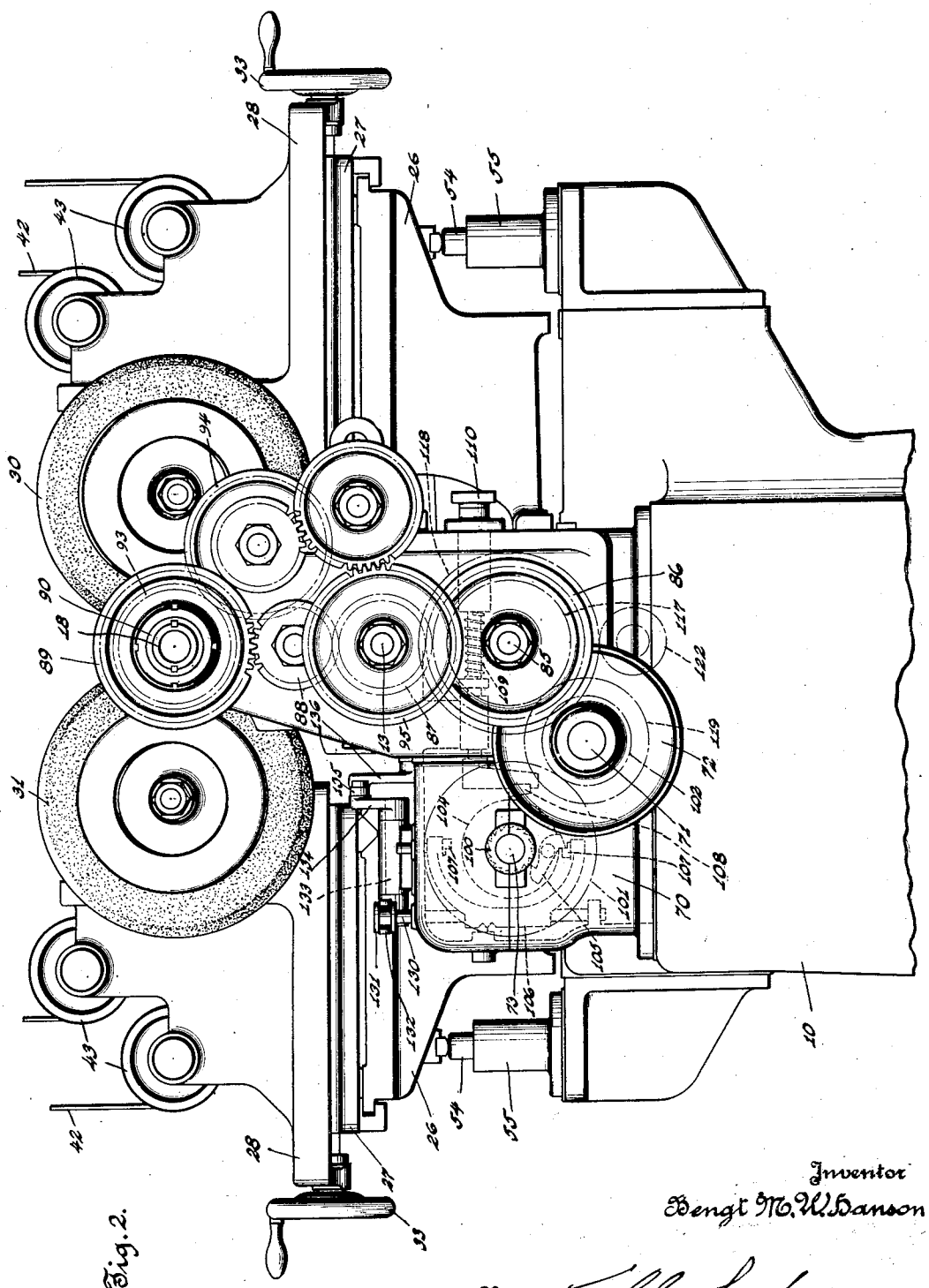


Fig. 2.

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METAL WORKING MACHINE

Original Filed March 9, 1922 5 Sheets-Sheet 3

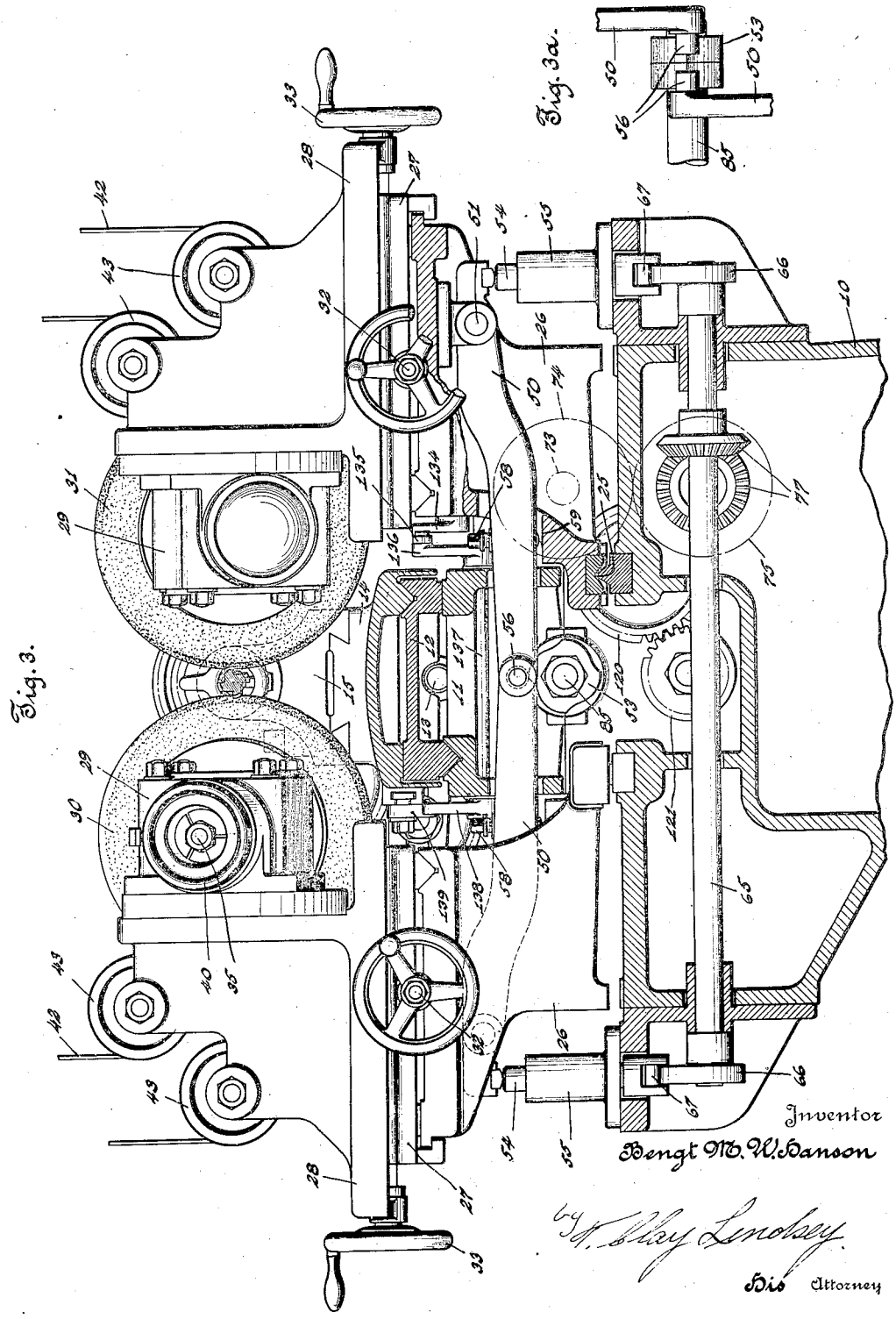


Fig. 3.

Fig. 3a.

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METAL WORKING MACHINE

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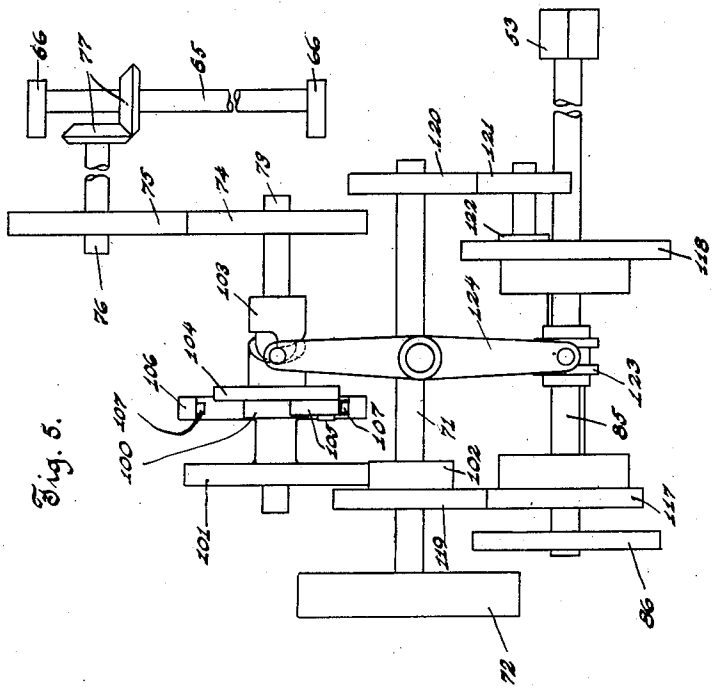


Fig. 5.

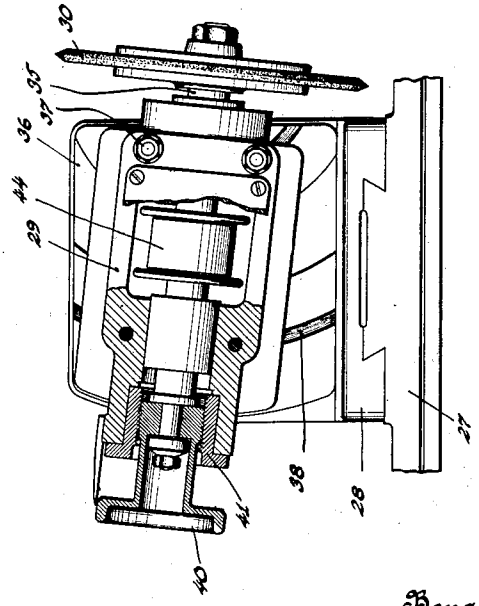


Fig. 4.

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METAL WORKING MACHINE

Original Filed March 9, 1922 5 Sheets-Sheet 5

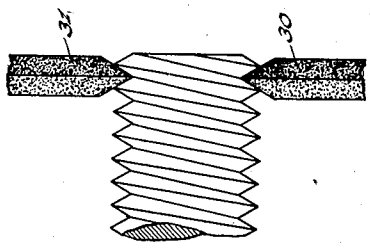


Fig. 7.

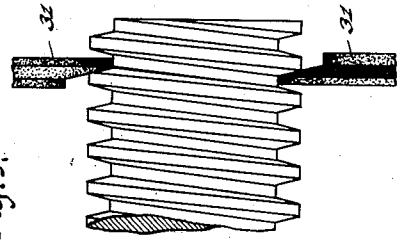


Fig. 9.

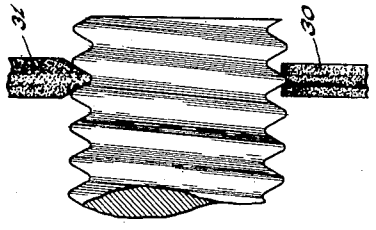


Fig. 8.

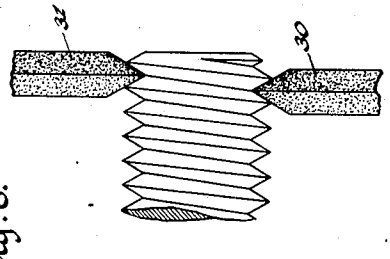


Fig. 6.

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Patented Apr. 12, 1927. 1,624,868

UNITED STATES PATENT OFFICE.

BENGT M. W. HANSON, OF HARTFORD, CONNECTICUT; EINAR A. HANSON AND CLARENCE E. WHITNEY EXECUTORS OF SAID BENGT M. W. HANSON, DECEASED.

METAL-WORKING MACHINE.

Application filed March 9, 1922, Serial No. 542,442. Renewed October 24, 1924.

This invention relates, generally, to grinding machines, and finds particular utility in a machine for grinding a thread, for instance the thread of a gage plug, tap, or the like. While the invention is peculiarly adapted for this use, its application is not limited thereto, it being understood that machines constructed in accordance with the invention are susceptible of various modifications, changes and adaptations, and that the present disclosure is by way of illustration only and is not to be taken as restrictive of my conception.

The aim of the invention is to provide certain improvements in a machine of the sort described which will very materially increase the rate of production of the machine, permitting the pieces of work, such as threaded members, to be more expeditiously and quickly ground, and thereby materially reducing their cost of manufacture. Also, to provide a machine of this sort which will operate with great uniformity and precision, thus insuring that the work is given extreme accuracy in all particulars.

A machine involving the present invention is provided with means, such as a spindle, for rotatably carrying the work and a pair of tools, in the present instance these tools being in the form of grinding wheels, one mounted to each side of the work and adapted to operate either one at a time or simultaneously thereon, as desired; the movements of the work and grinding wheels being so correlated and controlled that accuracy and uniformity in the work is assured. The arrangement is such that one of the tools may be used as a roughing wheel and the other wheel may be employed for taking a finishing cut; or both of the wheels may be used to take a finishing cut, one on one face of the thread and the other on the other face of the thread; or one wheel may be used to take a finishing cut on one thread and the other on another thread of a multi-threaded member; or in other combinations. Also, means are provided for moving the wheels either simultaneously or singly to and from the work in accordance with the contour thereof, and the wheels are adapted to be moved simultaneously away from the work after the cut has been taken to permit the work to be moved on its reverse stroke. The machine has other features of novelty and advantage which will be hereinafter pointed out in detail.

In the accompanying drawings:

Fig. 1 is a front view of the entire machine;

Fig. 2 is a left end view thereof;

Fig. 3 is a transverse view taken substantially on line 3—3 of Fig. 1;

Fig. 3ª is a detail view showing in top plan the pattern disk for giving to the grinding wheel such motion that an irregular contour may be given to the work as, for instance, where the work operated upon is a tap which is to be relieved back of its cutting edges;

Fig. 4 is a view of a journal box for one of the grinding wheels;

Fig. 5 is a diagrammatic layout of the driving mechanism for controlling and timing the movement of the work and grinding wheels; and

Figs. 6 to 9 are views diagrammatically showing the wheels operating on threads of various types. In Fig. 6, the wheels are operating on a member having a single thread; in Fig. 7, on a member having two threads; in Fig. 8, on a thread similar to a Whitworth thread; and in Fig. 9, one grinding wheel operates on one face of the thread and the other grinding wheel on the other face.

Referring to the drawings in detail, the general arrangement and organization of the principal parts of the machine will be readily understood from Figs. 1, 2 and 3. 10 is a pedestal or bed on the top of which is fixed a longitudinally extending narrow table or platform 11 supporting the work holder. This holder comprises a main slide 12 adapted to be moved longitudinally on the table 11 by a lead screw 13, a supplemental slide 14 mounted for adjustment on the main slide 12, and head and tail stocks 15 and 16, respectively, mounted on the supplemental slide 14. The supplemental slide may be longitudinally adjusted in any suitable manner to correlate the work to the grinding wheels, as by means of a screw 17. The head stock is provided with a spindle 18 which is driven as hereinafter described more in detail. The head stock and the tail stock may either or both be mounted for adjustment on the supplemental slide to accommodate pieces of work of different

lengths, and, as is usual, they may be clamped in any desired position of adjustment. The tail stock center may be longitudinally adjusted in the tail stock by the hand wheel 19.

Located to each side of the work holder and fulcrumed on knife edges 25 is a rocking bed 26. Carried by each of the rocking beds is a tool holder consisting of a pair of superimposed slides 27 and 28 adjustable at right angles to each other, and a journal box 29 on the upper slide 28 in which a grinding wheel spindle or shaft 35 is journalled. The respective grinding wheels are indicated by the numerals 30 and 31. The respective slides 27 together with the transverse slides 28 thereon may be adjusted longitudinally of the work spindle by turning screws 32. The slides 28 may be adjusted transversely to and from the axis of the work by turning the hand wheels 33 so as to bring the grinding wheels into proper relation with the work.

The journal boxes 29 are angularly adjustable on the slides 28 to permit the grinding wheels to be brought into inclined positions corresponding to the lead of the thread to be ground. As will be seen from Fig. 4, the journal box 29 is mounted in a way 36 in the face of the slide 28, and the center of curvature of this way is approximately the center of the wheel 30. Each of the journal boxes is locked in adjusted position as by means of bolts 37 the heads of which work in undercut grooves 38 having the same center of curvature as the ways 36. In order that the grinding wheels may engage the work at different points along its length, the grinding wheels are adjustable one relative to the other in the general direction of their axes, and this adjustment may be brought about, in the present instance, either by turning the screws 32 to relatively adjust the tool holders on the rocking beds 26, or, if desired, the grinding wheel shaft carrying the grinding wheel 30 may be longitudinally adjusted in the bearing box 29, as shown in Fig. 4. From this figure, it will be seen that by turning the bolt 40, which has threaded engagement with the sleeve 41 fixed to the journal box 29, the shaft 35 will be longitudinally adjusted.

The grinding wheel spindle may be driven in any suitable manner, as by means of belts 42 passing over idlers 43 and pulleys 44 fixed to the grinding wheel shafts.

With the arrangement described, it will be understood that the beds supporting the grinding wheels are fulcrumed at their inner or adjacent ends on the knife edges 25 for rocking movement towards and away from each other and the work. The feature of supporting the rocking beds on kinfe edges is of particular advantage in that the beds may be positioned with the greatest accuracy, and there is little or no wear at the fulcrum points since there is substantially no friction. As hereinafter described, automatically controlled means are provided for longitudinally reciprocating the work holder, it being moved on its operative stroke at a speed corresponding to the lead of the thread, and on its reverse stroke at a relatively greater speed so as to save time. The grinding wheels, in the present instance, are arranged to complete the grinding operation during one operative stroke of the work holder and are moved away from the work and held clear thereof during the reverse stroke. It will also be seen that by rocking the beds during the grinding operation, practically any desired contour may be given to the work.

The rocking beds are automatically moved to and from the work, both to give to the work the desired contour and to withdraw the grinding wheels from the work after the cutting operation and on the reverse stroke of the work, through rocking levers 50 pivoted, as shown in Fig. 3, to the respective rocking beds as at 51. The inner or longer ends of the levers overlap and each is provided with a pin 56 (see Fig. 3[a]) adapted to rest upon a pattern plate 53. The shape of the pattern disk or cam 53 will correspond to the contour to be given to the finished work, and the disk will be rotated at the same speed as the work. Where the work is in the form of a tap, the cutting edges of which are to be relieved, this disk will, as shown, have a number of lobes corresponding in number to the lands of the tap, and these lobes will be relieved corresponding to the relief to be given to the tap. The outer ends of the levers are relatively short and are supported on the upper ends of the plungers 54 mounted for vertical movement in sleeves 55 fixed to the bed 10. It will be evident that, when the pattern disks are rotated, the levers 50 will be rocked about their fulcrums on the ends of the plungers 54 so that the rocking beds, together with the grinding wheels carried thereon, will be oscillated back and forth to produce a shape on the work corresponding to the shape of the pattern disk. When it is desired that both wheels operate to effect the same relief, a single pattern disk may be provided for both levers, or a pair of like disks may be used. It may be desired, however, that one wheel cut a different relief than the other, for example one wheel may be employed to cut a relief adjacent the cutting edge of the lands and the other may be used to cut a greater relief at the heel of the lands, and in this event the respective disks or disk sections 53 will vary in contour. In some instances, it may be desired not to disturb the position of one of the grinding wheels during the grinding operation but to rock the

other wheel, as for instance, where one of the grinding wheels is to perform a roughing operation on a tap without effecting relief, while the other grinding wheel is to take a finishing cut during which relief is effected. When this is the case, one of the rocking levers, for instance the rear one, where the rear wheel 31 is to be used as a roughing wheel, may be thrown out of operative relation to the pattern disk 53, by turning down a screw 58 in the lever 50 and against an abutment 59 on the rocking bed so as to raise the long end of the lever out of engagement with the pattern disk. Both of the levers 50 may be raised out of engagement with this disk, if desired.

The grinding wheels are automatically moved into operative engagement with the work and out of engagement therewith by respectively raising and lowering the plungers 54 through the following mechanism. Extending transversely of the machine is an automatically driven shaft 65 on the opposite ends of which are similar cams 66 on which ride rollers 67 journalled in the lower ends of the plungers 54. When the cams are in the position shown in Figs. 2 and 3, they hold the tool holders with the grinding wheels in engagement with the work. When the shaft 65 is turned through an angle of 180°, the plungers 54 are lowered, whereupon the levers 50 swing downwardly about the pattern disk as a fulcrum, the result being the grinding wheels are moved to inoperative positions.

The mechanism for the control and timing of the cams 66, the pattern disk 53, and the lead screw 13 for the work holder is as follows. At the left hand end of the machine is a gear box 70 in which is journalled a constantly rotating shaft 71 provided with a drive pulley 72. Parallel with the shaft 71 is a shaft 73 adapted to be intermittently rotated. Fixed to this shaft is a gear 74 which drives, through the gear 75, shaft 76 and bevel gears 77, the shaft 65 to which the reversing cams are fixed, as heretofore described.

Adjacent to the shaft 71 is a shaft 85 to which is fixed the pattern disk 53. Fixed to the outer end of this shaft is a gear 86 which, as most clearly shown in Fig. 1, meshes with a gear 87 loose on the lead screw 13. The idler gear 87 is in mesh with an idler 88 which, in turn, is in mesh with a gear 89 fixed to a sleeve 90 journalled in a bearing 91. Mounted for longitudinal movement in this sleeve and keyed to the sleeve, so as to turn therewith, is the head stock spindle 18. 93 designates a gear fixed to the sleeve 90 and connected up by change speed gearing 94 to a large gear 95 fixed to the outer end of the lead screw 13. It will be seen that the drive from the shaft 85, which carries the pattern disk 53, to the work spindle is through the gears 86, 87, 88 and 89, and these gears are in such ratio that the work spindle and pattern disk will be driven in unison. The drive for the lead screw is effected from the work spindle through the change speed gearing 94 which will be arranged in accordance with the lead of the thread being operated upon.

As previously stated, the shaft 73 is adapted for intermittent rotation, which means that the reversing cams 66 driven through this shaft are periodically rotated, and the reversing clutch mechanism, hereinafter described, for the lead screw of the work holder is shifted at proper intervals. The intermittent rotation of the shaft 73 is controlled by an escapement ratchet clutch mechanism associated therewith and which, in turn, is controlled by the movement of the work table. The escapement ratchet clutch mechanism includes a constantly driven unit loose on the shaft 73 and comprising a ratchet wheel 100 and a gear 101 meshing with a gear 102 fixed to the main drive shaft 71. Fixed to the shaft 73, so as to rotate therewith, is a grooved cam 103 having an integral disk 104 to which is pivoted a pawl 105. The intermittent engagement of this pawl with the ratchet wheel 101 is controlled by a yoke 106 having a pair of diametrically opposite stops 107. For the purpose of automatically stopping the work holder at the end of its operative stroke, the escapement clutch mechanism is provided with a third stop 108 normally maintained by a spring 109 in the path of movement of the pawl 105 for engagement therewith. To start the machine, the stop 108 may be withdrawn from engagement with the pawl by pulling on a rod 110.

The clutch reversing mechanism for the lead screw is mounted on the shaft 85. It will be seen, most clearly from Fig. 5, that there is provided on the shaft 85 a pair of normally loose gears 117, 118. One of these gears, gear 117, is constantly driven at a relatively fast speed in one direction to quickly reverse the work holder by means of a gear 119 fixed to the shaft 71. The other gear 118 is driven, through the reduction gearing 120, 121 and 122, in the opposite direction and at a relatively slower speed so as to obtain the desired cutting speed. Associated with the gears 117, 118 are clutches, the detail construction of which is not illustrated. It is sufficient to say that when the sleeve 123, slidably mounted on the shaft 85, is moved in one direction, one of the gears will be fixed to the shaft; and when moved in the other direction, the other gear will be fixed to the shaft. Movement of this sleeve is effected by the intermittently actuated cam 103 acting through a shipper 124.

The escapement ratchet clutch mechanism is controlled by the movement of the work holder as follows. The yoke 106 is carried by a vertically movable rod 130 provided at its upper end with a grooved collar 131 which receives the forked end of a lever 132 extending from a shaft 133 having at its forward end an arm 134 connected by a link 135 to an arm 136 fixed to a shaft 137 journalled in a table 11 and having at its forward end a finger 138 positioned between a pair of adjustable dogs 139, 140 on the front face of the supplemental slide 14 of the work holder.

The operation of the complete machine is very briefly as follows. The work, which is here shown as being in the form of a tap, is positioned between the head stock and tail stock of the work holder and, where the cutting edges are to be relieved for instance, a pattern cam corresponding in shape to the transverse contour to be given to the work will be positioned on the shaft 85. The grinding wheels will be angularly adjusted on the tool holders in accordance with the lead of the thread, this adjustment being provided for by mounting the journal boxes 29 as described. The grinding wheels will then be relatively adjusted longitudinally so that they are properly correlated relative to the thread to be operated upon. As previously stated, the grinding wheels may operate simultaneously upon a single thread, as shown in Fig. 6, and one of the wheels may be a roughing wheel and the other a finishing wheel. In Fig. 7, the wheels are shown as operating upon different threads of a double-threaded member; while in Fig. 8, one of the grinding wheels is cutting the groove of a thread, and the other the crown of the thread. In Fig. 9, one of the grinding wheels is cutting one face of the thread, and the other the opposite face of the thread. In the event that one of the wheels, for instance the wheel 31, is to be used as a roughing wheel, the lever 50 associated with the rocking bed for that wheel is raised out of engagement with the pattern disk 53 by turning down the screw 58, as heretofore described. Adjustment of the grinding wheels and the rocking beds transversely of the work is effected by adjusting the slides 28 on the slides 27.

The machine, having been properly set up, the operator will push in the rod 110 to withdraw the third stop 108 from the pawl of the ratchet clutch mechanism, whereupon the pawl will engage the constantly driven ratchet wheel 100 so that the shaft 73 will rotate until the pawl is again tripped in the position shown in Fig. 1. Owing to this rotation of the shaft, the reversing cams 66 are rotated to the position shown in Figs. 2 and 3 so as to rock the beds towards each other and thus move the wheels into operative relation to the work. Further, during this partial rotation of the shaft 73, the cam 103 has thrown the shipper lever in a direction to engage the gear 118 with the shaft 85, whereupon the lead screw is rotated in a direction and at such speed to move the work on its operative stroke in accordance with the lead of the thread. The pattern disk, being carried by this shaft 85, will also rotate in unison with the work and, owing to the engagement of the rocking levers 50 on this pattern cam, the rocking beds, together with the grinding wheels carried thereby, will be oscillated so as to give the work the desired contour.

When the work has completed its operative stroke, the dog 139 will engage the finger 138 and through the connections described the yoke 106 will be lowered, thus releasing the pawl of the ratchet clutch, the result being the shaft 73 will be driven through an angle of 180°, that is until the pawl is disengaged from the ratchet wheel by the upper stop of the escapement yoke. When shaft 73 so rotates, the cams 66 are turned through half a revolution so that the plungers 54 will be lowered, permitting the rocking beds to swing away from each other, thus freeing the work from the grinding wheels about the same time the reversing gear 117 will be fixed to the shaft 85 so that reverse movement of the work holder at a given rate of speed is effected. When the work holder reaches the end of its inoperative or reverse stroke, the dog 140 will engage the finger 131, whereupon the escapement yoke will be again shifted to release the pawl of the ratchet clutch mechanism. The third stop 108 will trip this pawl and stop the shaft 73 in such position that the reversing clutch mechanism associated with the shaft 85 is in neutral position. The finished piece of work may now be removed, a new piece substituted in its place, and the operation repeated.

I claim as my invention:—

1. In a machine for grinding threaded members and the like, a plurality of independently mounted grinding wheels, each having a formed edge adapted to grind a groove or grooves in the work, a holder for rotatably supporting a piece of work in operative relation to said tools, means for relatively moving said holder generally longitudinally of said wheels in accordance with the lead of the thread on the work, and means for automatically moving said grinding wheels transversely of the work.

2. In a machine of the character described, a plurality of grinding wheels independently supported for angular adjustment in accordance with the lead of the thread to be ground, a holder for rotatably supporting a piece of work in operative relation to said wheels, and means for moving said holder

longitudinally in accordance with the thread to be ground.

3. In a machine of the character described, a pair of grinding wheels independently supported for relative longitudinal adjustment and for angular adjustment in accordance with the thread to be ground, a work holder for rotatably supporting a piece of work between and in operative relation to said wheels, and means for moving said holder longitudinally in accordance with the lead of the thread to be ground.

4. In a machine of the character described, a fixed bed, a longitudinally movable work holder thereon, a pair of independent and transversely movable beds on said fixed bed one to each side of said holder, a pair of superimposed slides on each movable bed and adjustable at right angles to one another, a grinding wheel angularly adjustable on the upper slide of each pair, and means for controlling the movement of said movable beds.

5. In a machine for grinding threaded members and the like, a work holder adapted to rotatably support a piece of work, means for moving said holder longitudinally in accordance with the lead of the thread on the work, a pair of rocking beds one to each side of said holder, a grinding wheel rotatably mounted on each of said beds and each having a formed edge adapted to operate upon the groove or grooves on the work, and means for rocking said beds in unison.

6. In a machine for grinding threaded members and the like, a work holder for rotatably supporting a piece of work, means for longitudinally moving said holder in accordance with the lead of the thread on the work, a pair of rocking beds, a tool holder adjustably mounted on each bed, a grinding wheel adjustably mounted in each holder and each wheel being disposed in a plane at an angle to the axis of the work, and means for rocking said beds.

7. In a machine of the character described, a reciprocable holder for rotatably supporting a piece of work, a pair of independently mounted tool holders, a grinding wheel supported on each tool holder with their axes extending generally in the direction of the axis of the work holder, and means controlled by the movement of said work holder for moving said tool holders to and from the axis of the work.

8. In a machine of the character described, a reciprocable holder for rotatably supporting a piece of work, a plurality of independent and transversely movable tool holders, a grinding wheel rotatably supported in each tool holder for operation upon the work, and automatically operated means for moving said tool holders back and forth transversely of the work during each rotation thereof.

9. In a machine of the character described, a sliding holder adapted to rotatably support a piece of work, a pair of independently mounted tool holders, a grinding wheel supported in each tool holder for operation upon the work, means for adjusting one, at least, of said grinding wheels longitudinally of the other and the work, and means common to both tool holders for moving the same with said grinding wheels thereon simultaneously relative to the work.

10. In a machine of the character described, a fixed bed, a work holder mounted for reciprocating movement thereon, a pair of tool holders independently mounted for movement to and from the work, a grinding wheel on each tool holder, and means for moving said tool holders with the tools thereon away from the work on the reverse stroke of said work holder.

11. In a machine of the character described, a fixed bed, a work holder mounted for reciprocation thereon, a pair of tool holders, a grinding wheel mounted in each tool holder with their axes extending generally in the direction of the axis of the work holder, and intermittently actuated means controlled by the movement of the work holder for moving said tool holders apart so that the grinding wheels clear the work on the reverse stroke of said work holder.

12. In a machine of the character described, a fixed bed, a work holder mounted for reciprocation thereon, a pair of rocking beds one to each side of said work holder, a grinding wheel rotatably supported in each rocking bed for operation upon the work, and means for rocking said rocking beds in opposite directions on the reverse stroke of said work holder so that the grinding wheels clear the work.

13. In a machine for grinding taps and the like, a work holder for rotatably supporting a piece of work, means for moving said work holder in accordance with the lead of the thread on the work, a pair of independently mounted tool holders mounted for movement at right angles to the direction of movement of said work holder, a grinding wheel rotatably supported in each tool holder with its axis extending generally in the direction of the axis of the work, and means for moving said tool holders back and forth during the grinding operation to effect relief on the teeth of the work.

14. In a machine of the character described, a work holder for rotatably supporting a piece of work, means for moving said holder in accordance with the lead of the thread to be ground, a pair of rocking beds one on either side of said work holder, an adjustable tool holder on each bed, a grinding wheel rotatably supported in each tool holder for operation upon the work, each of said wheels having a formed edge for operation upon the groove or grooves on the

work, and means for moving said rocking beds to give the desired circumferential contour to the work.

15. In a machine of the character described, a work holder for rotatably supporting a piece of work, means for moving said holder in accordance with the lead of the thread on the work, a pair of rocking beds one to each side of said work holder, a tool holder on each rocking bed, a grinding wheel rotatably supported in each tool holder for operation upon the work and each disposed in a plane at an angle to the axis of the work, and a pattern disk adapted to be operatively associated with both rocking beds for moving the same back and forth so that the grinding wheels give the desired circumferential contour to the work.

16. In a machine of the character described, a work holder for rotatably supporting a piece of work, means for moving said holder in accordance with the lead of the thread on the work, a pair of rocking beds one to each side of said work holder, a tool holder on each rocking bed, a grinding wheel rotatably supported in each tool holder for operation upon the work and each disposed in a plane at an angle to the axis of the work, a pattern disk adapted to be operatively associated with both rocking beds for moving the same back and forth so that the grinding wheels give the desired circumferential contour to the work, and means for throwing at least one of said beds at will out of the control of said pattern disk.

17. In a machine of the character described, a work holder mounted for sliding movement, a pair of movable beds, movable in planes substantially at right angles to the axis of the work, a grinding wheel rotatably mounted on each bed, means for moving said beds during the grinding operation whereby said grinding wheels give the desired contour to the work, and means for moving said beds so that the grinding wheels clear the work on the reverse stroke of said work holder.

18. In a machine of the character described, a slidable work holder for rotatably supporting a piece of work, a pair of rocking beds fulcrumed on axes generally parallel to the axis of the work holder, a tool holder mounted on each bed, a grinding wheel rotatably mounted in each holder, and with its axis extending generally in the direction of the axis on which the rocking bed is mounted, a rocking lever pivoted to each bed, and one pattern disk, at least, cooperating with the levers for rocking said beds whereby the grinding wheels give the desired contour to the work.

19. In a machine of the character described, a slidable work holder for rotatably supporting a piece of work, a pair of rocking beds one to each side of said holder and mounted for rocking movement in planes at right angles to the axis of the work holder, a tool holder on each rocking bed, a grinding wheel rotatably supported by each tool holder with its axis extending generally in the direction of the axis of the work holder, a rocking lever pivoted to each rocking bed, simultaneously actuated means cooperating with said levers for rocking said beds so that the grinding wheels will clear the work on the reverse stroke of said work holder, and a pattern disk cooperating with said rocking levers for rocking said rocking beds during the grinding operation so that the grinding wheels will give the desired contour to the work.

20. In a machine of the character described, a slidable work holder for rotatably supporting a piece of work, a pair of rocking beds one to each side of said holder, a grinding wheel supported on each of said rocking beds for operation upon the work, a rocking lever pivoted to each bed, cams cooperating with the outer ends of said levers for moving the grinding wheels into and out of operative relation to the work, and pattern means cooperating with the inner ends of said levers for rocking said beds whereby the grinding wheels give the desired contour to the work.

21. In a machine of the character described, a fixed bed having a table, a work holder including a rotatable spindle mounted for reciprocation on said table, a rocking bed to each side of said table, knife edges on which said beds are fulcrumed, a tool holder mounted for longitudinal and transverse adjustment on each bed, a grinding wheel angularly adjustable in each holder, a rocking lever pivoted to each rocking bed, pattern means supporting the adjacent ends of said levers, intermittently rotated cams supporting said levers at their outer ends, and means controlled by said work holder for actuating said pattern means and cams.

22. In a machine for grinding threaded members and the like and in combination, a fixed bed, a longitudinally movable work holder thereon for rotatably supporting a piece of work to be ground, means for moving said holder in accordance with the lead of the thread on the work, a pair of independent beds on said fixed bed one to each side of said holder and movable at right angles to the axis of rotation of the work, a tool holder adjustably mounted on each movable bed, and a grinding wheel mounted on each tool holder with its axis extending generally in the direction of the axis of the work.

23. In a machine for grinding threaded members and the like, a work holder for rotatably supporting a piece of work, means for moving the work holder in accordance with the lead of the thread to be ground, a

pair of rocking beds one on each side of said work holder, a grinding wheel rotatably mounted on each rocking bed and disposed in planes corresponding to the lead of the thread, means for axially adjusting said grinding wheels, and means for rocking said beds.

24. In a machine for grinding threaded members and the like, a work holder for rotatably supporting a piece of work, means for moving the work holder in accordance with the lead of the thread to be ground, a pair of rocking beds one on each side of said work holder, a grinding wheel rotatably mounted on each rocking bed and disposed in planes corresponding to the lead of the thread, means for axially adjusting said grinding wheels, a rocking lever pivoted to each rocking bed, and means for rocking said levers to move said wheels transversely of the work.

25. In a machine for grinding threaded members and the like, a work holder for rotatably supporting a piece of work, means for moving the work holder in accordance with the lead of the thread to be ground, a pair of rocking beds one on each side of said work holder, a grinding wheel rotatably mounted on each rocking bed and disposed in planes corresponding to the lead of the thread, means for axially adjusting said grinding wheels, a rocking lever pivoted to each rocking bed, means for rocking said levers to withdraw the grinding wheels from the work on the reverse stroke of the work holder, and means cooperating with said rocking levers for rocking said rocking beds during the grinding operation so as to effect the desired circumferential contour on the work.

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