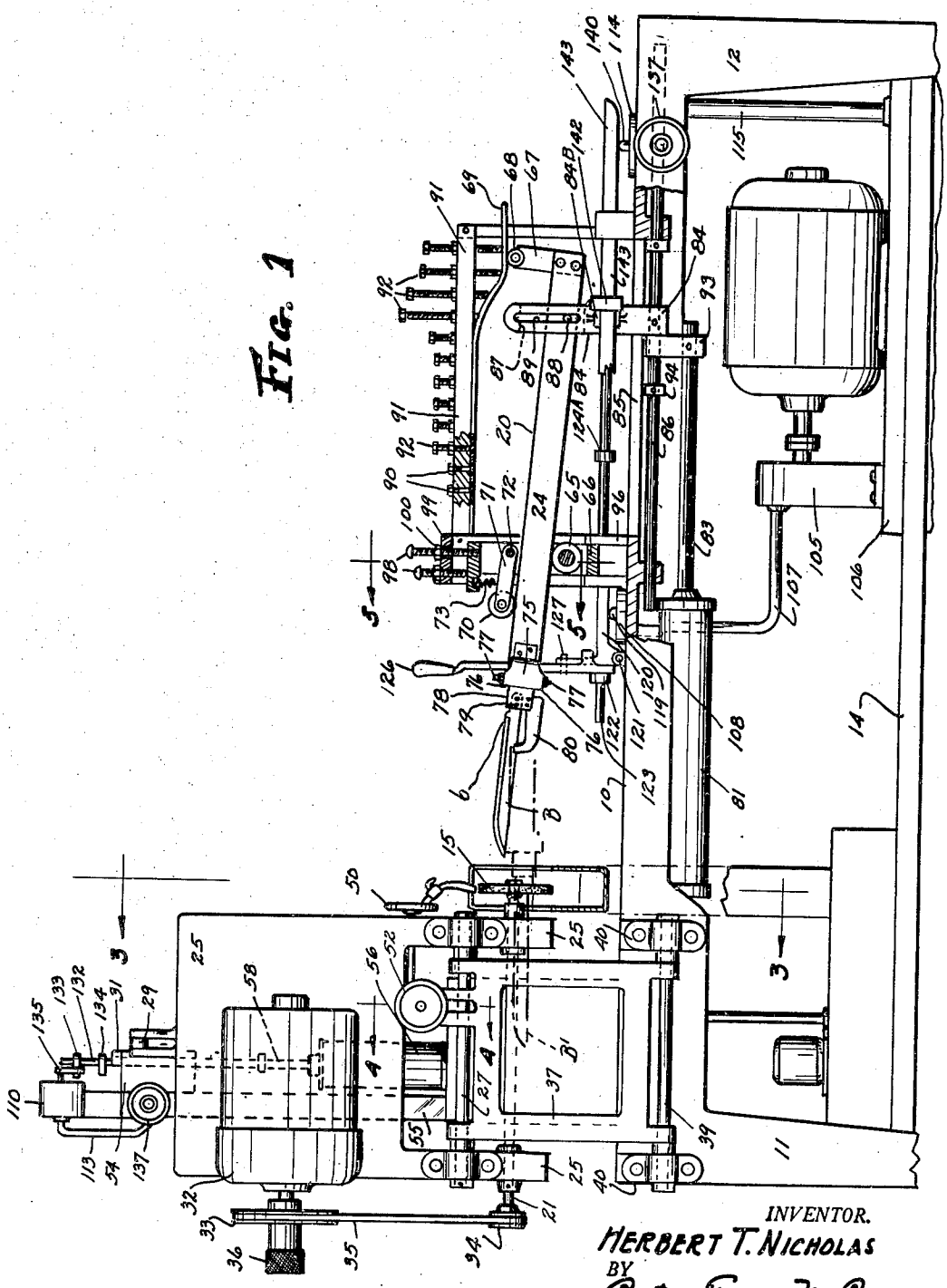
July 5, 1949. H. T. NICHOLAS 2,475,455

BLADE FINISHING MACHINE

Filed May 28, 1946

7 Sheets-Sheet 1

Fig. 1



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BLADE FINISHING MACHINE

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7 Sheets-Sheet 2

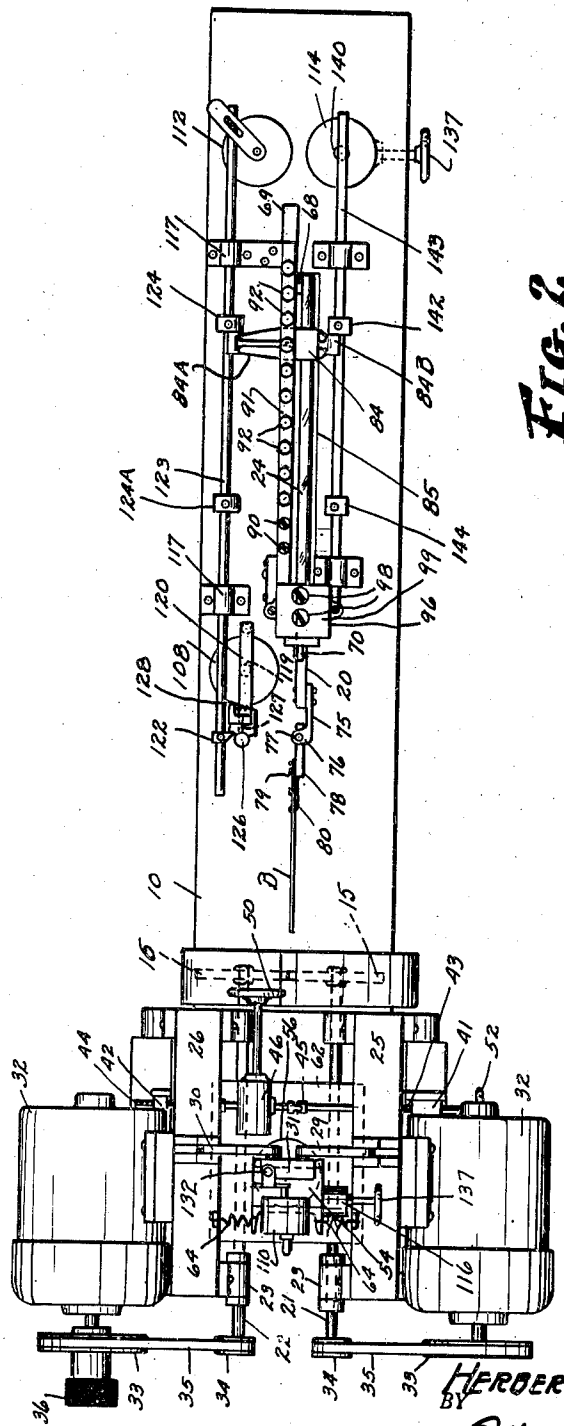


FIG. 2

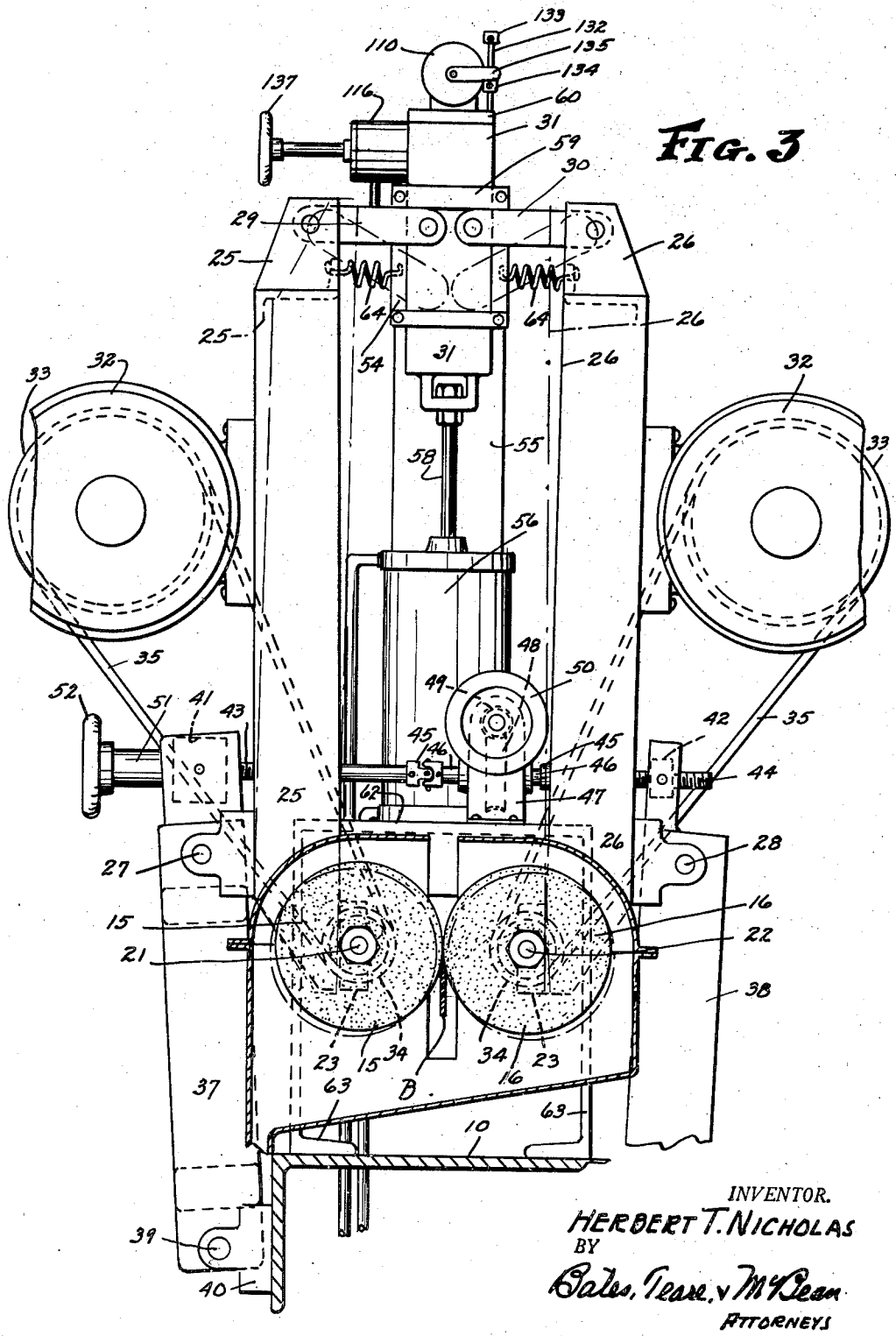
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BLADE FINISHING MACHINE

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FIG. 3



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BLADE FINISHING MACHINE

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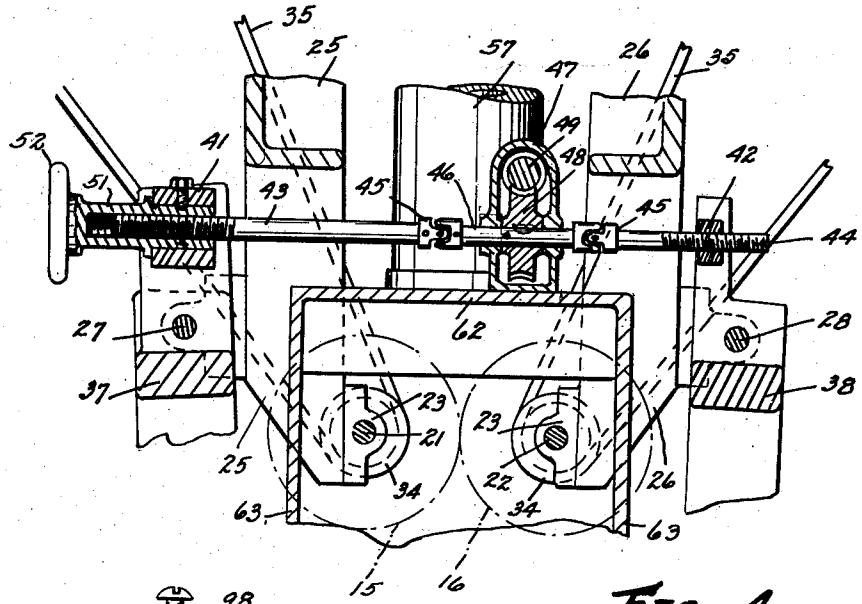


FIG. 4

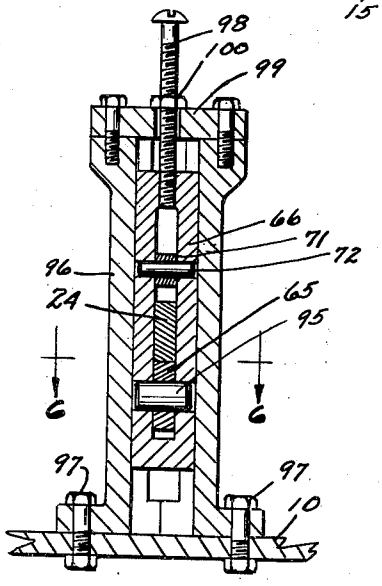


FIG. 5

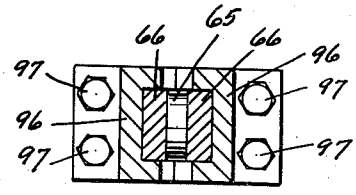


FIG. 6

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BLADE FINISHING MACHINE

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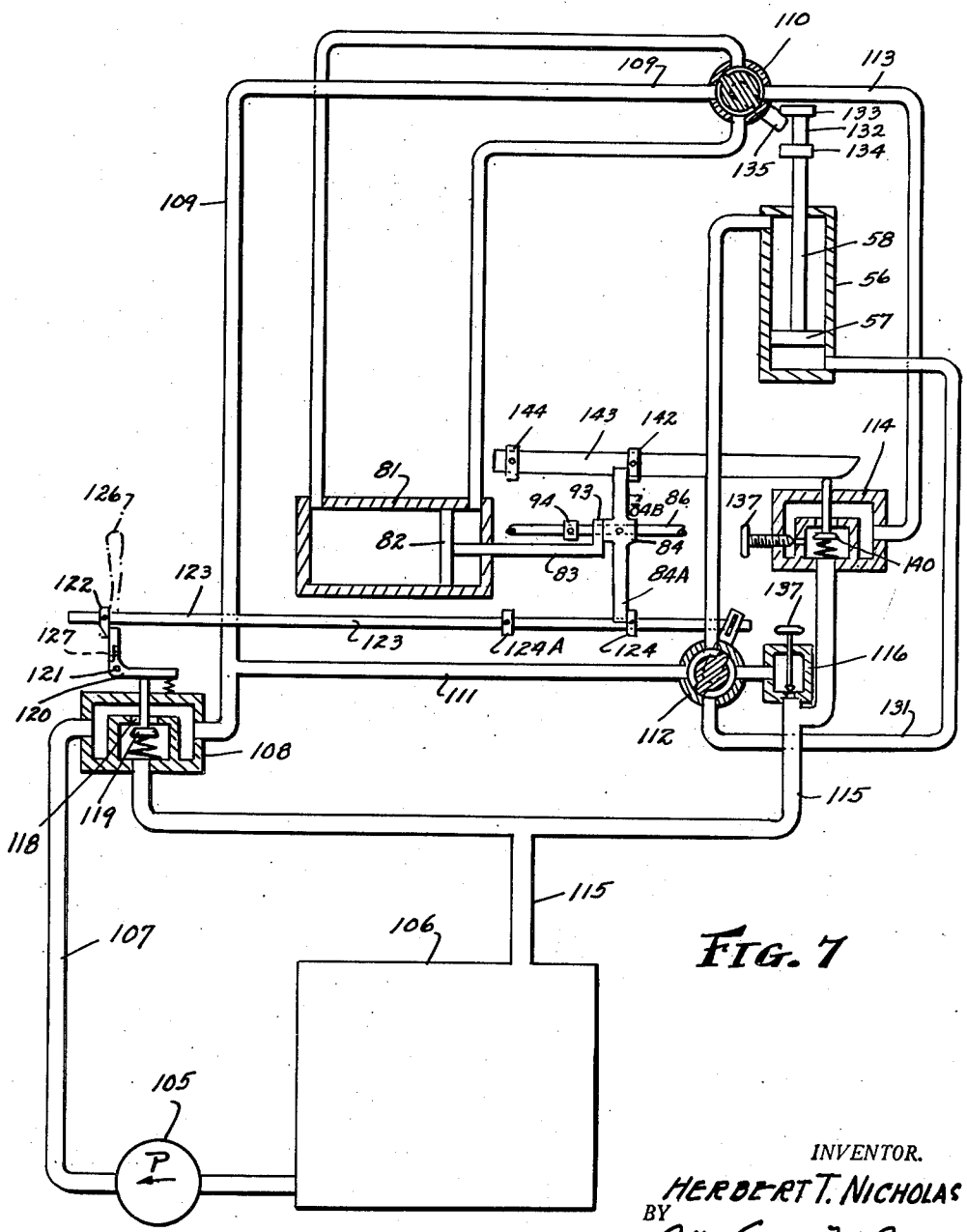


FIG. 7

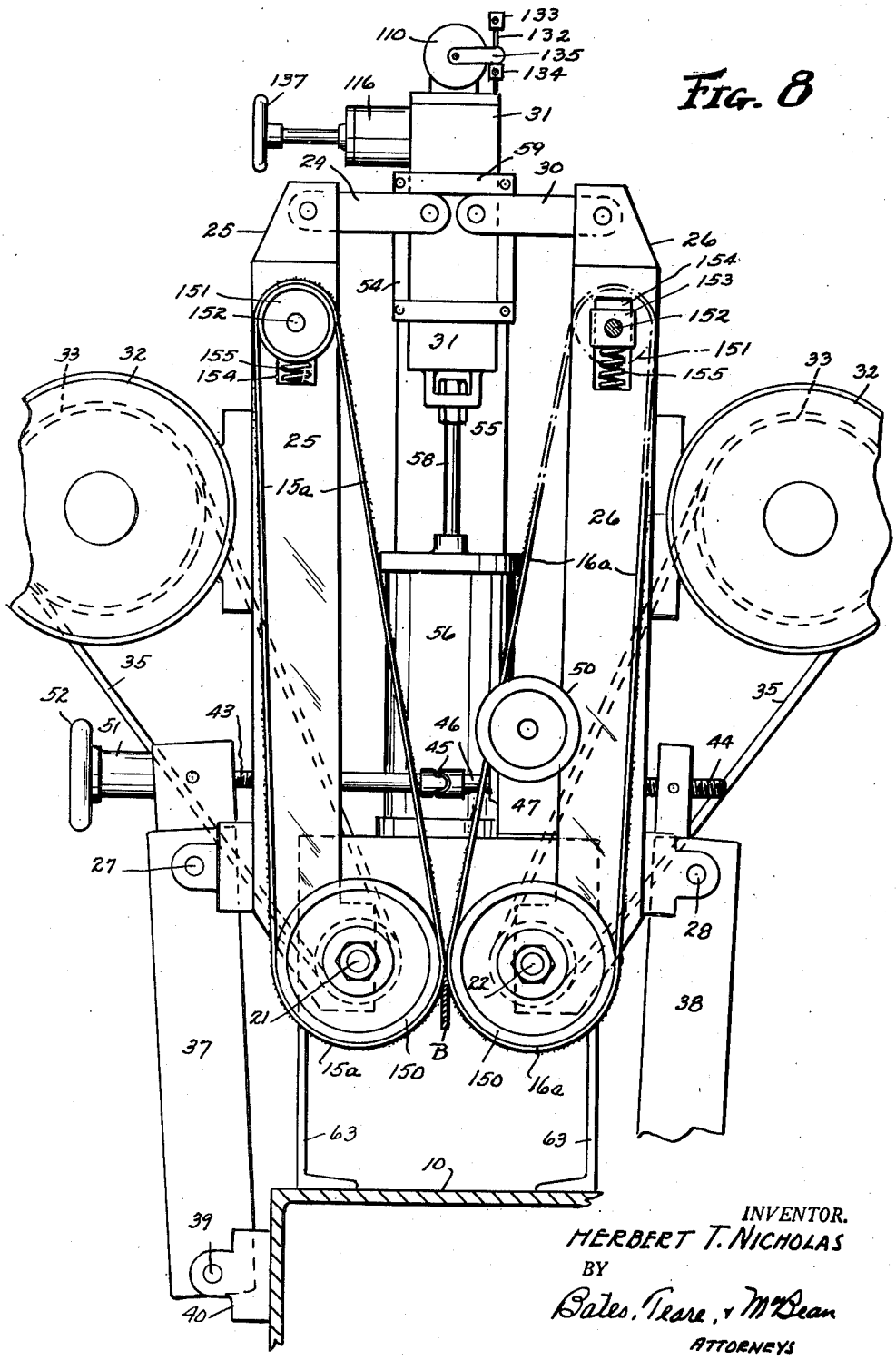
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BLADE FINISHING MACHINE

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FIG. 8



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BLADE FINISHING MACHINE

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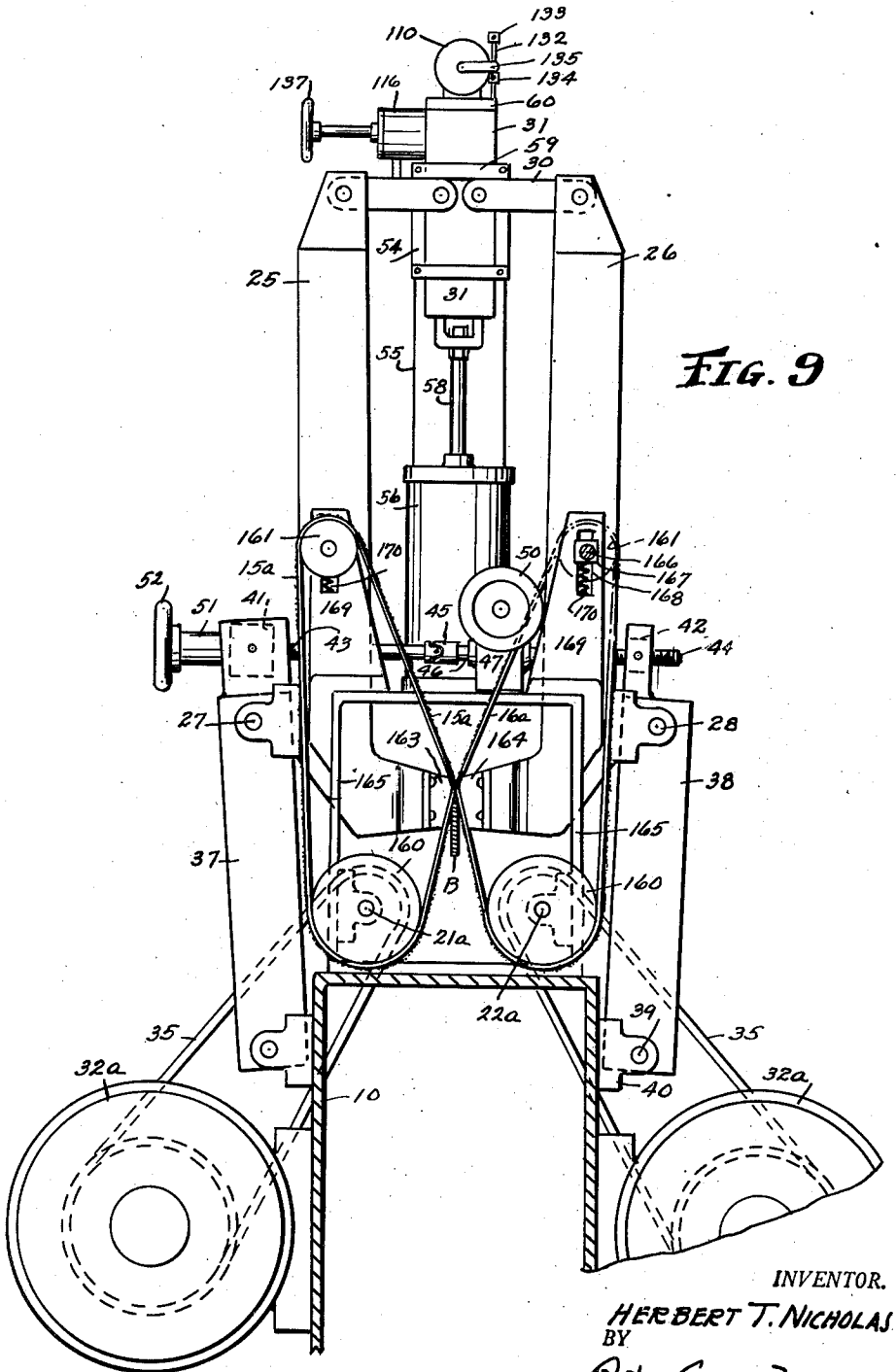


FIG. 9

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2,475,455

UNITED STATES PATENT OFFICE

2,475,455

BLADE FINISHING MACHINE

Herbert T. Nicholas, Huron, Ohio, assignor to Nicholas Equipment Company, Bellevue, Ohio, a partnership

Application May 28, 1946, Serial No. 672,869

18 Claims. (Cl. 51—85)

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This invention relates to an improved blade finishing machine, such as an improved machine for grinding, polishing, or buffing knife blades or the like. The invention is also concerned with an improved machine for hollow grinding, buffing or polishing knife blades. Accordingly, these are the general objects of the present invention.

A more specific object of the present invention is to provide an improved blade finishing machine which will facilitate the finishing of the entire length of a blade including a relative straight portion and a curved portion adjacent the point, in one continuous operation.

A further object of this invention is to provide an improved blade grinding machine which will be particularly well adapted for hollow grinding knife blades, and which machine will hollow grind, in one continuous operation, both the relatively straight portion of a blade and the relatively curved portion thereof adjacent the point.

Another object of the present invention is to provide a machine for grinding knife blades which will hollow grind knife blades in such manner as to provide the desired blend line and width of concavity in one operation regardless of the contour of the blade to be ground.

A further object of the invention is to provide a finishing machine for finishing knife blades, which machine may be quickly set up for blades of differing contours.

A further object of the invention is to provide a simple and compact machine which will simultaneously hollow grind or otherwise finish both sides of knife blades at a relatively high rate of speed.

Other objects and advantages of the invention will become more apparent from the following description, reference being had to a preferred embodiment of the invention illustrated in the accompanying drawings. The essential and novel features of the invention will be summarized in the claims.

In the drawings, Fig. 1 is a side elevation of a knife blade grinding machine embodying this invention, certain portions of the mechanism being broken away to more clearly illustrate the internal construction thereof; Fig. 2 is a plan view of the machine illustrated in Fig. 1; Fig. 3 is a vertical section as indicated by the lines 3—3 on Fig. 1 but illustrating the mechanism actively operating on a blade; Fig. 4 is a fragmentary vertical section taken along the lines 4—4 on Fig. 1 and illustrating a method of adjusting the grinding wheels; Fig. 5 is a sectional detail through the work holder supporting mechanism, the plane

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of section being indicated by the lines 5—5 on Fig. 1; Fig. 6 is a sectional detail, the plane of which is indicated by the lines 6—6 on Fig. 5; Fig. 7 is a diagram of the hydraulic operating mechanism and the mechanism used for controlling the operation thereof; and Figs. 8 and 9 are views similar to Fig. 3, but illustrating modified forms of blade finishing mechanisms.

Referring now to the drawings in detail, and particularly to Figs. 1 and 2, it will be seen that the improved knife blade grinding machine comprises an elongated base or table 10 provided with suitable legs 11 and 12 and cross bracing 14. Mounted above the table, and at the left hand side thereof, are a pair of blade finishing members such as the abrasive wheels 15 and 16. These wheels are mounted with their axes in substantially the same horizontal plane and are spaced above the top of the table 10. The right hand side of the table 10 is provided with a work holder 20 arranged to removably receive a workpiece, such as a knife blade "B." During the finishing operation the finishing wheels 15 and 16 are spaced horizontally to rotate in a common vertical plane with their peripheries spaced apart a comparatively short distance. For grinding operations the desired distance between the grinding wheels is generally from about five to twenty thousandths of an inch. Thus a knife blade "B" which has been moved into position with the heel "b" of the blade between the two wheels, as indicated in Fig. 3, will be finished as the blade is drawn across the bite of the wheels. Mechanism is provided to separate the finishing wheels following the finishing operation so that an unfinished blade may freely pass between the wheels, from the full line position in Fig. 1, until the heel of the blade is positioned therebetween, as indicated by the dot and dash position B' in Fig. 1. The mechanism then functions to return the finishing wheels to finishing position. Whereupon the work holder 20 is moved generally to the right to finish the flat portion of the blade and then continuing to the right while swinging the toe of the blade upwardly in a curved path to finish the curved or toe portion and the point of the blade.

The finishing wheels 15 and 16 are generally formed of or charged with an abrasive material. The particular formation and abrasive material being dependent upon the type of finishing operation to be performed. They may comprise fabric buffing or polishing wheels, or as shown they may comprise abrasive grinding wheels. The grinding wheels 15 and 16 shown in

Figs. 1 to 4 inclusive are particularly well adapted for hollow grinding operations. If desired, the abrasive members may comprise endless tapes or belts. In Figs. 8 and 9 I have shown arrangements of the mechanism utilizing endless flexible bands 15*a* and 16*a*. These bands are provided with finishing or abrasive surfaces adapted for the type of finish desired, as for instance, grinding, buffing, polishing and the like.

The finishing wheels 15 and 16, of Figs. 1 to 6 inclusive, comprise abrasive grinding wheels and are drivingly secured to the ends of respective shafts 21 and 22 which are journaled in bearings 23 carried by downwardly extending portions of respective spaced spindle and motor supporting arms 25 and 26. These arms are pivotally mounted on spaced horizontal shafts 27 and 28 supported by the main frame 10 as will be hereinafter more fully described. The spindle and motor supporting arms 25 and 26 extend substantially vertically and are spaced apart a distance sufficient to enable the peripheries of the grinding wheels 15 and 16 to coact to hollow grind opposite faces of the blade "B." The upper ends of the arms are connected by toggle links 29 and 30 with a vertically reciprocable slide 31 mounted intermediate the arms as will be hereinafter more fully described. The arrangement of the slide and toggle links is such that, as the upper ends of the arms 25 and 26 are spread by the toggle action, the lower ends thereof will approach each other to move the grinding wheels to a grinding position as illustrated in Fig. 3. When, however, the toggle slide is moved downward, the toggle links assume the dotted line position of Fig. 3 moving the lower ends of the arms outward, thus separating the grinding wheels to enable a knife blade "B" to pass freely therebetween.

Each grinding wheel is independently driven. As shown in the drawings, particularly Figs. 1, 2 and 3, each arm 25 and 26 carries a motor 32 the armature shaft of which is provided with a pulley 33. The pulleys 33 are drivingly connected by respective drive belts 35 with pulleys 34 on respective spindle shafts 21 or 22. At least one of the motor pulleys 33 is connected to its spindle pulley 34 by a V-shaped driving belt, and one of these pulleys is of the type having a pair of discs movable toward or away from each other by a suitable mechanism contained within the pulley hub 36. Thus the cutting speed of the wheels may be readily synchronized. This type of variable speed pulley is generally well known at the present time and hence will not be illustrated or described in detail herein.

As heretofore mentioned, the peripheries of the grinding wheels, when the wheels are in their grinding positions, are spaced from each other. For grinding operations this spacing is generally from five to twenty thousandths of an inch. To enable the position of the wheels to be adjusted toward and away from each other to compensate for wear on the grinding wheels, the pivot shafts 27 and 28 of the motor and spindle supporting arms are mounted for adjustment toward and away from each other. As shown in the drawings, the pivot shafts 27 and 28 are carried in the upper ends of respective brackets 37 and 38. These brackets are illustrated as being yokes, the lower ends of which are pivotally mounted on shafts 39 carried by bearings 40 secured to the frame 10. The upper ends of the brackets are provided with pivoted blocks 41 and 42 for receiving horizontally extending screws or rods 43 and 44 respectively. These rods, as shown in Fig. 4, are

connected by universal joints 45 with the output shaft 46 of a gear reduction unit mounted in a housing 47. This housing is secured to a platform 62 positioned intermediate the arms 25 and 26 and supported by spaced channels 63 which in turn are secured to the table 10. The gear reduction unit comprises a worm gear 48 and an associated worm 49 having a manually operable hand wheel 50 (Figs. 1 and 3). Thus when the hand wheel 50 is turned, the lower ends of the arms 25 and 26 will be swung toward or away from each other as is desired to separate or bring the peripheries of the grinding wheels together.

The grinding wheels are arranged to be centered relative to the work holder. As illustrated in Fig. 4, the left hand portion of the rod 43 is threadingly mounted in a sleeve 51. This sleeve is provided with an operating knob 52 and is rotatably mounted in the block 41. The sleeve 51 engages the block 41 sufficiently snug to prevent its moving under influence of the rotation of the rod 43, and is prevented from axial movement by a set screw 61 carried by the block 41 and engaging an annular groove formed in the periphery of the sleeve. Inasmuch as the spindle arm pivot shafts 27 and 28 are located relatively close to the grinding wheels 15 and 16, an extremely accurate adjustment of the grinding wheels is possible.

The toggle links 29 and 30, heretofore mentioned, are pivotally mounted on a toggle slide 31 and operate to move the grinding wheels 15 and 16 toward and from each other. This slide is mounted in a vertical guide or way 54 carried by a vertically extending frame member 55 which is secured to the platform 62 and which extends upwardly therefrom. The slide 31 is reciprocated in its guide by a hydraulic ram mechanism comprising a vertically extending cylinder 56 mounted on the platform 62 and provided with a piston 57 (Fig. 7) having a piston rod 58 which is connected to the lower end of the slide. Thus as the piston is reciprocated the grinding wheels are moved toward and from each other.

The toggle links 29 and 30 are so arranged that they are slightly past dead center when they are in their uppermost position, at which time the grinding wheels are in the grinding position. This eliminates chattering of the grinding wheels. The upward movement of the toggle links is limited by a cross bar 59 which extends across the guide 54 and against which the links abut. The downward movement of the slide 31 is limited by a bar 60 secured to the top of the slide and arranged to engage the cross bar 59 on the guide. A pair of springs 64 maintain a constant inward pressure of the upper ends of the spindle frames.

The work holder 20 is best illustrated in Figs. 1 and 2, as there shown it comprises an elongated bar 24 supported by a roller 65 mounted in a frame 66 carried by the bed 10 as will be hereinafter more fully described. The right hand end of the bar 24 is provided with an upwardly extending arm 67 which carries a roller 68 adapted to coact with a cam 69 to control the rocking movement of the bar during the grinding or finishing of the curved surfaces and the point of the blade. The bar 24 is maintained in contact with the roller 65 and the cam 69 by a roller 70 carried by a link 71 pivotally mounted on the roller frame 66 as at 72 and urged into contact with the bar by a spring 73.

The workpieces B are removably mounted on the left hand end of the bar 24 and extend toward the grinding wheels 15 and 16. Secured to

the forward end of the bar is a bracket 75 having a pair of spaced horizontal ears 76. These ears each carry a vertically extending pivot pin 77 which engages a work receiver 78. The work receiver 78 is provided with a pair of pins 79 to engage openings in the knife blade, and with a forwardly extending workpiece rest or clamp 80. Any suitable spring clamp may be used to retain the workpiece in position on the receiver. The pivot pins 77 permit a limited movement of the workpiece or blade about a vertical axis as the blade passes between the grinding or finishing wheels 15 and 16 thereby compensating for slight variations in the blade.

The work holder 20 is reciprocated by a hydraulic mechanism to pass the blade "B" between the finishing wheels 15 and 16. This mechanism comprises a longitudinally extending hydraulic cylinder 81 provided with a piston 82 (Fig. 7) having a piston rod 83 to which a driving arm 93 is secured. This arm reciprocates a rod 86 as will be hereinafter more fully described. This rod is slidably mounted in the frame 10 and adjustably secured thereto is a fork 84. This fork extends upwardly through a slot 85 in the bed 10 of the machine and its upper end is provided with a slot indicated in the drawings at 87 through which the bar 24 extends. A pin 88 carried by and extending through the bar 24 cooperates with a transversely extending slot 89 in the fork and completes the driving connection between the fork and bar. Thus as the bar 24 is reciprocated it is free to swing up and down in the driving fork.

The follower cam 69, which controls the contour of the blade, comprises an elongated bar and is secured as by bolts 90 to the under side of a frame member 91. A plurality of adjusting screws 92 are carried by the bar 91 and coact with the cam 69 to accurately maintain it in position.

The vertical position of the work holder and blade is controlled, in part, by the position of the roller 65. As shown in the drawings, particularly in Figs. 1 and 5, the roller 65 lies in a slot of the roller frame 66 and is rotatably mounted on a pin 95 carried by such frame. The frame 65 is slidably mounted for vertical movement in a roller frame guide 96 which is secured to the bed 10 by bolts 97. The vertical position of the roller frame and its guide is controlled by a pair of adjusting bolts 98, one of which is threadingly mounted in a cap 99 of the frame 96 and engages the upper surface of the roller frame 66 as illustrated in Fig. 1. The other bolt 98 passes freely through the cap 99 and is secured to the frame and is provided with a nut 100 to limit the downward movement of the frame while the other bolt limits the upward movement thereof.

The operation of the mechanism is as follows: Assuming the parts to be in the position shown in Fig. 1, and the grinding or finishing wheels 15 and 16 separated as indicated by the dot and dash line positions on Fig. 3, the mechanism is placed in operation by the movement of a handle 126, by the operator. As hereinafter more fully described, this operation renders the hydraulic mechanism active, whereupon fluid under pressure is admitted to the cylinder 81 to cause the blade to move between the two finishing or grinding wheels 15 and 16 until the heel "b" of the blade is between the two wheels, whereupon the vertical or toggle operating cylinder 56 becomes active to cause the finishing or grinding wheels to move toward each other and into finishing or grinding contact with the blade "B." The cylinder 81 then becomes active.

The initial action of the cylinder 81 has no effect upon the work holder due to a lost motion connection between the driving arm 93 and the slide rod 86. This provides a time interval during which the finishing or grinding wheels act on the blade to insure proper finishing or grinding of the heel of the blade. This lost motion connection is best illustrated in Fig. 1. As there illustrated, the arm 93 has a sliding connection with the rod 86 and is interposed between an adjustable collar 94 carried by the rod and the fork 84 which is also adjustably secured to the rod. When the cylinder 81 is actuated to move the blade to the left to position the blade with its heel "b" between the finishing or grinding wheels, the arm 93 coacts with the collar 94. When the cylinder 81 becomes active to move its piston rod toward the right, the arm 93 moves from engagement with the collar 94 into engagement with the fork 84 before the movement of the piston is imparted to the slide rod 86 or the work holder 20. This provides a brief interval of time after the finishing or grinding wheels have moved into finishing or grinding position during which interval the blade remains stationary. This insures complete finishing or grinding of the heel of the blade.

After the heel of the blade has been fully ground or finished the arm 93 contacts the fork 84 and moves the work holder 20 toward the right (Fig. 1), the workpiece moving under control of the cam 69 so that the entire blade is ground or finished evenly, the contour of its finished or ground edge being controlled by this cam. When the grinding or finishing operation is completed the rate of travel of the blade is rapidly increased as it is drawn from the finishing wheels to facilitate its replacement by a fresh blade, and as the finished blade reaches the end of its withdrawing stroke a control valve is operated to release the fluid pressure thereby stopping the mechanism to enable the operator to substitute a new blade.

The hydraulic mechanism is best illustrated in Fig. 7. As there shown a fluid pressure pump 105 draws fluid from a reservoir 106 and forces it through a conduit 107 to a main control valve 108. Fluid under pressure passes from the valve 108 through a pressure line 109 to a reversing valve 110 which controls the flow of fluid to the cylinder 81 to actuate the work holder. Likewise, fluid under pressure flows from the main control valve 108 through a conduit 111 to a reversing valve 112 which controls the flow of fluid to the cylinder 56, which controls the positioning of the grinding or finishing wheels. Fluid exhausting from the cylinder 81 passes from the reversing valve 110 through a conduit 113 to a control or regulating valve 114, and thence through conduit 115 to the storage reservoir. Fluid passing from the cylinder 56 passes through its reversing valve 112 to a control or regulating valve 116 which is also connected with the discharge conduit 115.

The main control valve 108 is of a type which establishes communication between the pressure line 107 and the reservoir 106 thus releasing the pressure in the system. This valve is diagrammatically shown in Fig. 7 as comprising a housing provided with a valve port 118 which is normally closed by a spring pressed valve member 119. Thus normally fluid under pressure flows through the valve member to the pressure conduits 109 and 111. However, when the valve

member 119 is depressed, the fluid escapes through the conduit 115 to the reservoir 106.

The valve member 119 is actuated by a bell crank 120 pivoted to the frame as at 121. This crank is arranged to be engaged by a cam 122 adjustably mounted on a bar 123. This bar is slidably mounted in brackets 117 carried by the table 10 and is actuated by an arm 84A of the driving fork 84 heretofore described. As the fork 84 approaches the end of its blade withdrawing stroke, it engages an adjustable stop 124 carried by the bar 123, moving the bar to the left (Figs. 2 and 7). This movement of the bar actuates the bell crank 120 and causes it to depress the valve member 119 of the control valve 108, thus releasing the fluid pressure in the system and stopping the hydraulic mechanism.

After a blade to be finished is placed in the work holder 20, the operator starts the hydraulic mechanism by actuating the lever 126. This lever is pivoted on a transverse pivot 127 carried by the bell crank 120 and is normally held in position to be engaged by the stop or cam 122 by a spring 128 (Fig. 2). The operator by grasping the lever 126 and rocking it about its pivot 127 frees it from engagement with the cam 122, whereupon the spring pressed valve member 119 closes the valve port 118. Accordingly, fluid pressure is applied to the reversing valves 110 and 112. This application of fluid pressure has no effect upon the piston 57 as it is in its lower position at this time. However, the reversing valve 110 is so positioned that fluid pressure is applied to the right hand end of the piston 82 moving it to the left (Figs. 1 and 7). As this piston reaches the left hand limit of its stroke, the arm 84A, of the driving fork 84 heretofore mentioned, engages an adjustable stop 124A carried by the bar 123 and moves the bar to the left. This movement of the bar changes the position of the reversing valve 112 whereupon fluid pressure flows through the conduit 131 to the lower end of the cylinder 56, thus forcing its piston 57 upwardly.

The movement of the piston 57 controls the reversing valve 110 for the cylinder 81. As illustrated in Fig. 3 the toggle slide 31, which is connected to the piston 57 by the piston rod 58, carries a rod 132. This rod is provided with a pair of spaced adjustable stops 133 and 134 which are arranged to engage and actuate the control lever 135 of the reversing valve 110. Thus, as the piston 57 rises to the upper limit of its stroke, the finishing wheels 15 and 16 are brought together and the stop 134 acts on the valve 110 to cause a reversal of the flow of fluid to the cylinder 81 whereupon the piston 82 of such cylinder moves toward the right (Figs. 1 and 2) causing the workpiece to be drawn to the right between the coacting finishing wheels 15 and 16.

The regulating valves 114 and 116 are placed in the exhaust lines of respective reversing valves 110 and 112 and serve to regulate the rate of travel of the pistons 57 and 82 by controlling the back pressures thereon. To this end each valve includes a needle valve controlled by a manually operable knob 137.

The regulating valve 114 is arranged to permit a comparatively rapid movement of the work holder when the finishing wheels are not operating on a knife blade. As illustrated the valve 114 is provided with a spring pressed valve member 140 which normally closes a port 141 between its inlet and outlet passages. As soon as the blade clears the finishing wheels an adjustable stop 142 carried by a bar 143 is engaged by an arm 84B of the driving fork 84. Continued movement of the fork carries the bar 143 to the right causing it to cam the valve member 140 to an open position, thus increasing the rate of flow of exhausting fluid from the cylinder 81 through the regulating valve. The valve 140 remains open until the work holder has moved to the left to bring an unfinished blade almost to the finishing position, whereupon a second stop 144 adjustably mounted on the bar 143 is engaged by the driving fork arm 84B withdrawing the bar and freeing the valve member 140 thereby slowing the movement of the work holder to the desired finishing speed.

As heretofore mentioned I may use endless flexible bands 15*a* and 16*a* in place of the finishing wheels 15 and 16. Such bands are preferably the same width as that of the wheels and are arranged to be moved toward and from each other in substantially the same manner as heretofore described in connection with the finishing wheels 15 and 16. These bands may be provided with work finishing surfaces commensurate with the type of operation to be performed, polishing, buffing, grinding or the like.

In Fig. 8 I have shown a modification using a pair of flexible bands 15*a* and 16*a*. This construction is similar to that heretofore described and is particularly well adapted for use in hollow grinding, buffing, polishing and the like. The bands 15*a* and 16*a* are each shown as being mounted on respective spindle supporting arms 25 and 26. Each band is looped about a pair of wheels or drums 150 and 151. The drums 150 are mounted on the respective spindle 21 or 22, while the drums 151 are mounted adjacent the upper end of the spindle arm 25 or 26. The drums 151 are journaled on spindles 152 carried by blocks 153 slidably mounted in ways 154 formed in the respective brackets. Springs 155 act on the blocks 153 to maintain the bands tight. Suitable means, not shown, may be provided to control the tension of the bands. The bands are driven by the drums 150, which in turn are driven as heretofore described in connection with the finishing wheels 15 and 16.

In Fig. 9 I have shown the mechanism adapted for utilizing abrasive coacted endless bands instead of the finishing wheels 15 and 16. This arrangement is particularly adapted for other than hollow finishing operations. Basically the mechanism is substantially the same as that heretofore described. However, in this form of the invention, the finishing bands 15*a* and 16*a* are each looped about a pair of pulleys or drums 160 and 161 which are supported by relatively stationary frame members, and the coacting stretches of the bands are moved into and out of the path of the workpiece by shoes 163 and 164 carried by respective arms 25 and 26.

In the construction shown in Fig. 9 the spindles 21*a* and 22*a* are mounted on supports 165 which are secured to the frame 10. Each spindle is provided with a wheel or drum 160 about which the lower end of the respective abrasive bands 15*a* or 16*a* is looped. The upper ends of these bands are looped about respective drums 161 which are mounted on spindles 166 carried in blocks 167 mounted in guideways 168 formed in stationary frame members 169. Springs 170 act on the blocks 167 to tension the bands. The spindles 21*a* and 22*a* are driven by motors 32*a* which are secured to the frame 10 and which are drivingly connected with the spindles as heretofore described in connection with

the motors 32. In this form of the invention the lower ends of the arms 25 and 26 are provided with removable shoes 163, 164 which engage the coacting stretches 175 of the abrasive bands 15a, 16a and move such stretches toward and away from each other to bring them into and out of engagement with a blade "B." In this construction the contour of the finished surface of the blade depends upon the contour of the shoes 163, 164.

From the foregoing description it will be seen that I have provided a compact mechanism for finishing opposite faces of a knife blade in one operation and I have arranged the mechanism to facilitate the finishing of different types of blades with a minimum change. The apparatus is also so arranged and controlled as to accurately finish the curved surface of the blade and the point without danger of rounding the point. Likewise it will be seen that the apparatus may be radially adapted for either hollow or flat blade grinding or finishing operations.

I claim:

1. In a blade finishing machine a pair of abrasive finishing members, hydraulic operating means to move said abrasive members so that their coacting surfaces move to and from each other, a work holder mounted for movement to and from the members in a direction parallel with the coacting surfaces of said members, hydraulic means to reciprocate said work holder, and means including a reversing valve controlled by the operation of the work holder for controlling the flow of fluid to the first named hydraulic means, and means including a second reversing valve controlled by the actuation of the abrasive member operating means for controlling the flow of fluid to the second named hydraulic means.

2. In a blade finishing machine a pair of blade finishing members, hydraulic operating means to move said members toward and from each other, a work holder reciprocally mounted for movement to and from the bite of the members, hydraulic mechanism to reciprocate said work holder, and means including a reversing valve controlled by the operation of the work holder for controlling the flow of fluid to the hydraulic means, means including a second reversing valve controlled by the actuation of the member operating means for controlling the flow of fluid to the hydraulic mechanism, and regulating valves associated respectively with said hydraulic means and said hydraulic mechanism to regulate the flow of fluid therefrom.

3. In a knife blade finishing machine, a pair of abrasive members, means supporting said members for movement to cause their abrasive surfaces to move toward and away from each other, means including a hydraulic cylinder and piston to move said members, a work holder movable to and from the abrasive members in a direction substantially parallel with the abrasive surfaces thereof, a hydraulic cylinder and piston for moving said work holder, fluid pressure means, fluid conduits between said pressure means and said hydraulic cylinders, means including a fluid pressure reversing valve in the conduit between the pressure means and the first-named cylinder actuated by the work holder mechanism to control the flow of fluid to and from the first named cylinder, and a second reversing valve in the conduit between the pressure means and the second named hydraulic cylinder actuated by the abrasive member moving means to control the flow of fluid to and from the second named hydraulic

cylinder, a discharge conduit connected with said reversing valves, a regulating valve interposed between each reversing valve and said discharge conduit to control the flow of fluid being discharged from their respective cylinders, and means actuatable by the movement of the work holder to actuate the regulating valve for the last named reversing valve to increase the flow of fluid from its respective cylinder when the workpiece is withdrawn from coaction with said abrasive members and to render said regulating valve active to decrease the flow of fluid when the workpiece has been fully inserted between said abrasive members.

4. A blade finishing machine comprising a pair of peripherally coacting finishing members, means including a toggle mechanism to move the members toward and from each other into and out of finishing position, said means being arranged to lock said toggle when the members have been moved into finishing position, a work holder, means to move the work holder to pass a workpiece between said members while said members are spaced and to withdraw the workpiece across the bite of said members while the members are in finishing position, power means to operate both of said means, means actuated by the first named means to control the application of said power means to the second named means, means actuated by the second named means to control the application of the power means to the first named means, and means to rock the work holder toward the bite of said members during the finishing operation.

5. In a blade finishing machine, a pair of finishing wheels mounted with their axes in substantially the same horizontal plane and arranged to have their peripheries simultaneously act on a workpiece, a pair of pivoted member for supporting respective wheels, a slide, links interconnecting said slide with respective pivoted members, means to reciprocate the slide to cause the members to swing about their pivots to thereby move the periphery of the finishing wheels toward and away from each other, a work holder mounted movably, means to move the work holder to move a workpiece between the separated wheels into finishing position and to withdraw the workpiece past the wheels after they have been moved toward each other into finishing position, and means to swing the workpiece toward the bite of said wheels during the finishing operation to conform the finishing to a curved contour of the blade.

6. In a knife blade grinding machine, a frame including an elongated bed, a blade finishing mechanism mounted in one end of said bed and including a pair of members having abrasive surfaces arranged to be simultaneously moved across a blade passed between them in a direction substantially parallel with their abrasive surfaces, a work holder mounted at the other end of the machine and movable toward and from said members in a direction substantially parallel with their coacting abrasive surfaces and in alignment with their bite, said finishing mechanism including a pair of brackets mounted on spaced pivots for movement about axes substantially parallel to the plane of movement of said work holder, said brackets extending upwardly from said frame, means interconnecting said brackets to move the upper ends of the brackets toward and away from each other simultaneously, means to move one bracket toward the other bracket independent of the movement of the other bracket, a pair of abra-

sive member supporting arms pivotally mounted intermediate their ends to the upper ends of respective brackets and extending in a substantially vertical direction, a motor carried by each arm and drivingly connected with its respective abrasive member to move the abrasive surface thereof across a blade, and a toggle mechanism connected to the upper ends of said arms to simultaneously move the arms about their pivots to cause the abrasive surfaces of said members to move toward and away from each other.

7. In a knife blade finishing machine, an abrasive blade finishing member, means to move a workpiece across the surface of said member in a plane substantially parallel with such surface, said means including a work holder comprising a bar, means supporting said bar intermediate its ends for reciprocating and rocking movements, an elongated cam, means carried by said bar adjacent one end thereof to coact with said cam, and resilient means coacting with the other end of the bar to hold the bar in contact with said supporting means and said cam.

8. In a knife blade finishing machine, a blade finishing member, means to move a workpiece across the face of said finishing member, said means including a work holder, a bar supporting said work holder, a roller supporting said bar intermediate its ends, a cam to control the swinging movement of said bar about said roller, resilient means coacting to hold the bar in contact with the roller, a pivotal connection between said bar and said work holder to permit a limited pivotal movement of said work holder relative to the bar in a plane transverse to the plane in which it swings about said roller, and means to reciprocate the bar.

9. In a knife blade finishing machine, a frame, a pair of coacting blade finishing members mounted thereon, means to draw a knife blade substantially horizontally across the bite of said members to finish said blade, said means including a vertically extending guideway mounted on said frame, a carriage mounted in said guideway for vertical movement, means to adjust the position of said carriage in said guideway, a bar supported intermediate its ends by said carriage for movement toward and from the bite of said members and for swinging movement in a substantially vertical plane parallel with the bite of said members, an elongated cam, a roller on said bar to coact with said cam, resilient means to retain the bar in contact with said carriage and said roller in contact with said cam, means to move said bar toward and from the bite of said members, a work holder, a pivotal connection between one end of said work holder and said bar, the axis of said pivot extending in a substantially vertical direction, and means at the other end of said work holder for supporting a workpiece.

10. In a knife blade grinding machine, a frame including an elongated bed, a grinding mechanism mounted in one end of said bed and including a pair of grinding wheels having their peripheries arranged to simultaneously act on a blade passed between them in a direction substantially parallel with their axes, a work holder mounted at the other end of the machine and movable toward and from said wheels in a direction substantially parallel with their axes and in alignment with their bite, said grinding mechanism including a pair of brackets mounted on spaced pivots for movement about axes substantially parallel to the plane of movement of said work holder, said brackets extending upwardly from said frame, means interconnecting said brackets to move the upper ends of the brackets toward and away from each other simultaneously, means to move one bracket toward the other bracket independent of the movement of the other bracket, a pair of grinding wheel supporting arms pivotally mounted intermediate their ends to the upper ends of respective brackets and extending in a substantially vertical direction, said grinding wheels being mounted on the lower ends of respective arms with their axes substantially parallel with the first named axes, a motor carried by each arm and drivingly connected with its respective grinding wheel, and a toggle mechanism connected to the upper ends of said arms to simultaneously move the arms about their pivots to cause the periphery of the grinding wheels to move toward and away from each other.

11. In a knife blade finishing machine, a frame including an elongated bed, a finishing mechanism mounted in one end of said bed and including a pair of wheels, a pair of endless abrasive coated belts, one end of each belt being looped about a respective wheel, means to tension said belts, said belts being arranged so that the abrasive surfaces of a portion of the belts extending about the respective wheels coact to simultaneously act on a blade passed between such surfaces in a direction substantially parallel with the axes of said wheels, a work holder mounted at the other end of the machine and movable toward and from said wheels in a direction substantially parallel with their axes and in alignment with their bite, said finishing mechanism including a pair of brackets mounted on spaced pivots for movement about axes substantially parallel to the plane of movement of said work holder, said brackets extending upwardly from said frame, means interconnecting said brackets to move the upper ends of the brackets toward and away from each other simultaneously, means to move one bracket toward the other bracket independent of the movement of the other bracket, a pair of belt supporting arms pivotally mounted intermediate their ends to the upper ends of respective brackets and extending in a substantially vertical direction, said belt supporting wheels being mounted on the lower ends of respective arms with their axes substantially parallel with the first named axes, a motor carried by each arm and drivingly connected with its respective belt supporting wheel, and a toggle mechanism connected to the upper ends of said arms to simultaneously move the arms about their pivots to cause the coacting portions of the surfaces of the belts to move toward and away from each other.

12. In a knife blade finishing machine, a pair of coacting abrasive members, a pair of pivoted arms carrying said members, power operated means to move said arms about their pivots to separate the abrasive surfaces of the said members and to move the abrasive surfaces of such members towards each other, a workholder mounted for reciprocation in a direction substantially parallel with the coacting abrasive surfaces of said members, power operated means to reciprocate said workholder, and means actuatable by said last named power operated means to control the operation of said first named power operated means to cause said abrasive surfaces to separate consequent upon the movement of the workholder a predetermined distance in one direction and to move said abrasive surfaces toward each other consequent upon the movement

of the workholder a predetermined distance in another direction.

13. In a knife blade finishing machine, a pair of coacting abrasive surfaced finishing wheels, a pair of pivoted arms carrying said wheels, power operated means to move said arms about their pivots to separate the peripheries of the finishing wheels and to move the peripheries of such wheels towards each other, a workholder mounted for movement toward and away from the bite of said wheels to draw a blade across the bite thereof, power operated means to move said workholder, means actuatable by the said last named power operated means to cause said first named power operated means to move said arms and separate said wheels consequent upon the movement of said workholder a predetermined distance in a direction away from the bite of said wheels and to move said wheels toward each other consequent upon the movement of said workholder a predetermined distance in a direction toward the bite of said wheels, and means whereby said distances may be selectively predetermined.

14. In a blade finishing machine, a pair of coacting blade finishing wheels, a workholder, power operated means to move said wheels toward each other to engage a workpiece carried by said workholder and to move said wheels away from each other out of engagement with the workpiece, power operated means to move the workholder to cause a blade to pass between the wheels until the heel of the edge of the blade is positioned between the wheels, power operated means under control of said first named means to move said wheels together consequent upon the positioning of the heel of said blade, means to cause a pause in the movement of the workholder after the blade wheels have moved into contact with the heel of the blade to thereby insure complete finishing of the heel of the blade, and controlled by said second named power operated means to thereafter reverse the direction of movement of said workholder to cause the workholder to draw the blade across the bite of the wheels to finish the edge of the blade.

15. In a knife blade grinding machine a pair of grinding wheels arranged so that their peripheries simultaneously grind opposite sides of a blade as the blade is moved in a direction substantially parallel with the axis of the wheels, a workholder, power operated means to move the workholder to cause the blade to move into and out of contact with said wheels, power operated means to separate said wheels, control means responsive to the position of the workholder to cause said last named means to become active to cause the separation of said wheels when the workholder has moved a workpiece out of contact therewith and to bring said wheels together to a grinding position after the workpiece has been fully inserted between the wheels, a manually resettable means acting automatically to stop the movement of the workholder operating means when a workpiece is fully withdrawn from contact with the wheels, and operating means responsive to the position of said workholder to cause said resettable means to become active.

16. In a knife blade finishing machine, a pair of looped abrasive belts, means to mount said belts with a stretch of each belt facing but spaced from a corresponding stretch of the other belt, resilient means to tension each belt, a pair of pivoted arms, means carried by said arms to engage said belt stretches, power operated means adapted to move said arms about said pivots and move said belt stretches toward and away from each other, a workholder mounted for reciprocation in a direction parallel with the surfaces of the coacting stretches of said belts, power operated means to reciprocate said workholder, means actuated by said last named power operated means to control the operation of said first named power operated means, and means actuated by said first named power operated means to control the operation of said second named power operated means.

17. A machine of the character described, comprising a pair of movable abrasive members, operating means to move the members toward and from each other, control means for said operating means, a workholder, operating means to move the workholder toward and from said members to cause the work to move into and out of contact therewith, a control means for said last named operating means, means actuated by the movement of the workholder away from said members to operate the first named control means to cause said members to separate, means actuated by the movement of the workholder towards said members to operate said first named control means to cause said members to approach each other, and means actuated by said first named operating means consequent upon the movement of said members a predetermined distance toward or away from each other to actuate said second named control means.

18. In a machine of the character described, a pair of movably mounted abrasive members, power operated means to move said members toward and away from each other, a workholder movable to and from said abrasive surfaces in a direction substantially parallel with the abrasive surfaces thereof, reciprocable means for actuating said workholder, power operated means for operating said reciprocable means, control means actuated by said reciprocable means to control the operation of said first named power operated means, a control means actuated by said first named power operated means to control the operation of said second named power operated means, a common source of power for said power operated means, and a manually resettable means actuated by said reciprocable member to stop the application of power to both of said power operated means.

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