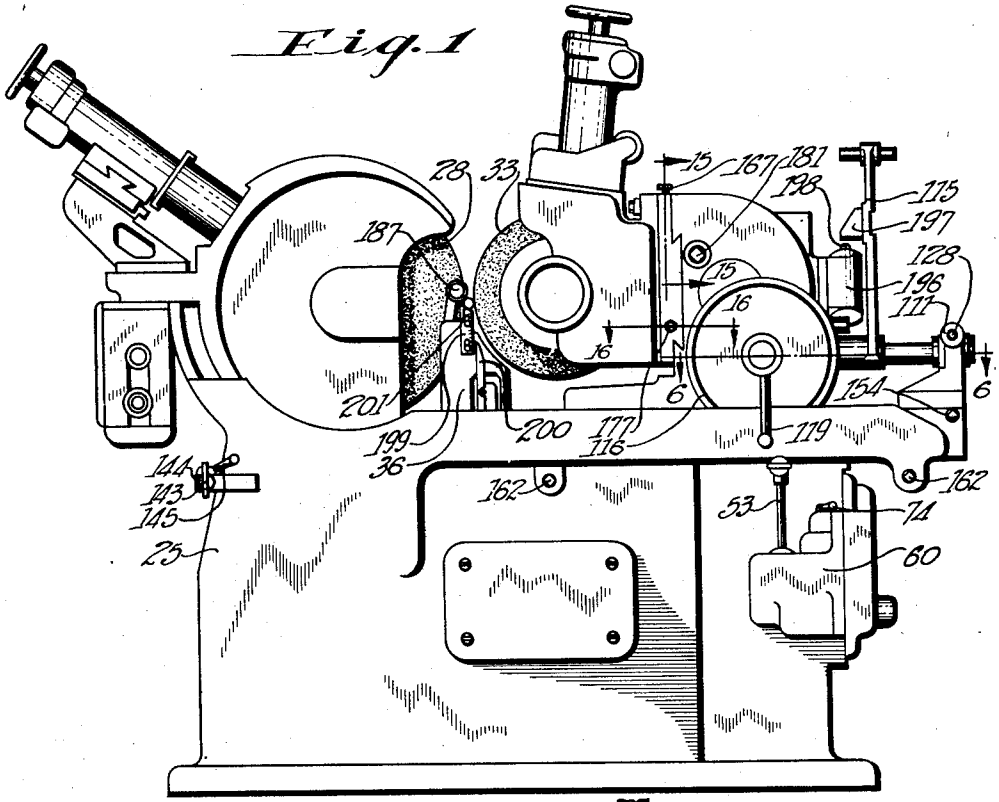
Dec. 12, 1933. S. EINSTEIN ET AL 1,938,757

GRINDING MACHINE

Filed Sept. 22, 1930 7 Sheets-Sheet 1

Fig. 1



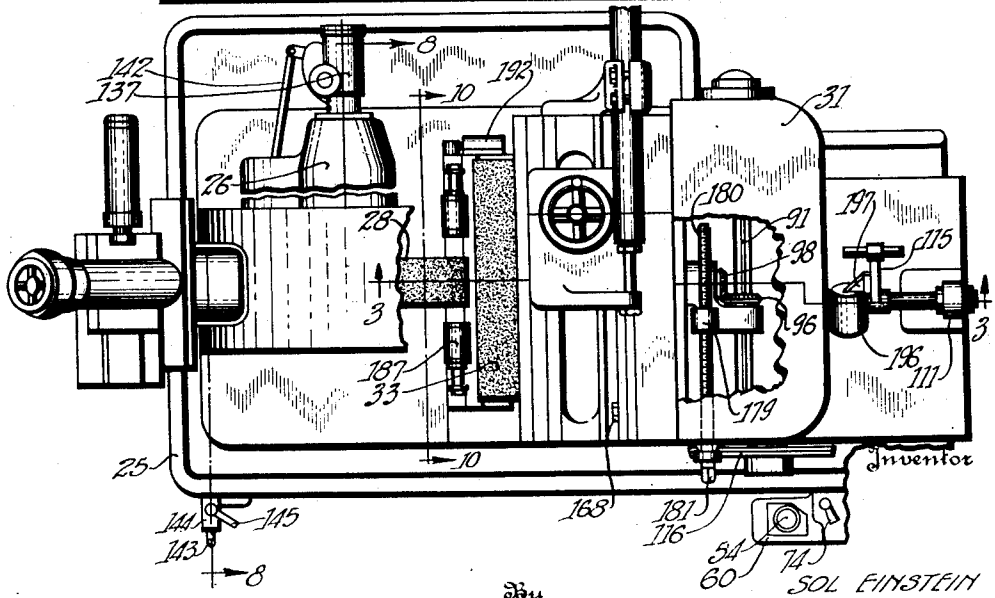


Fig. 2

By SOL EINSTEIN
FREDERICK S. HAAS
H. K. Parsons Attorney

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GRINDING MACHINE

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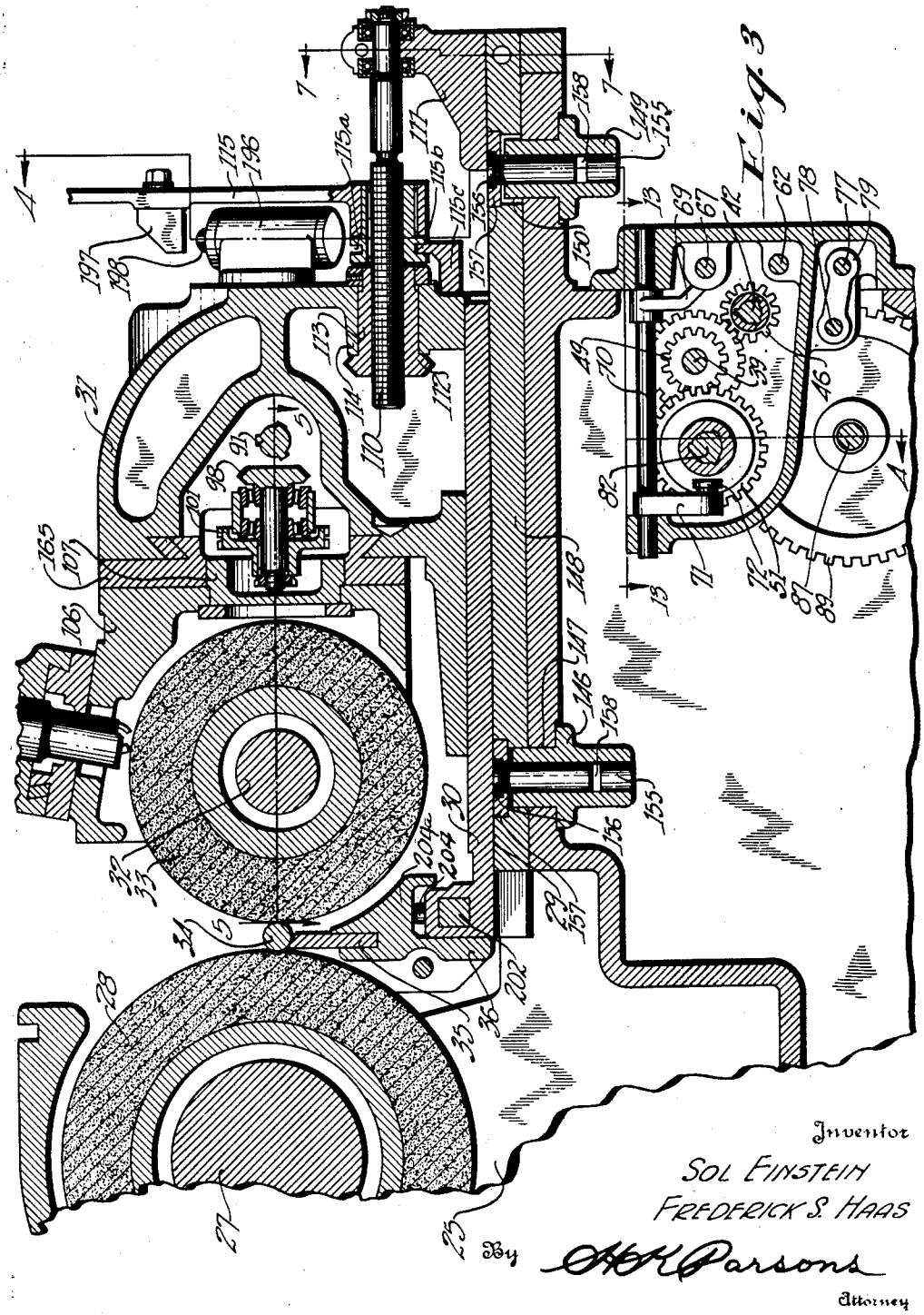


Fig. 3

Inventor
SOL EINSTEIN
FREDERICK S. HAAS
By H. K. Parsons
Attorney

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GRINDING MACHINE

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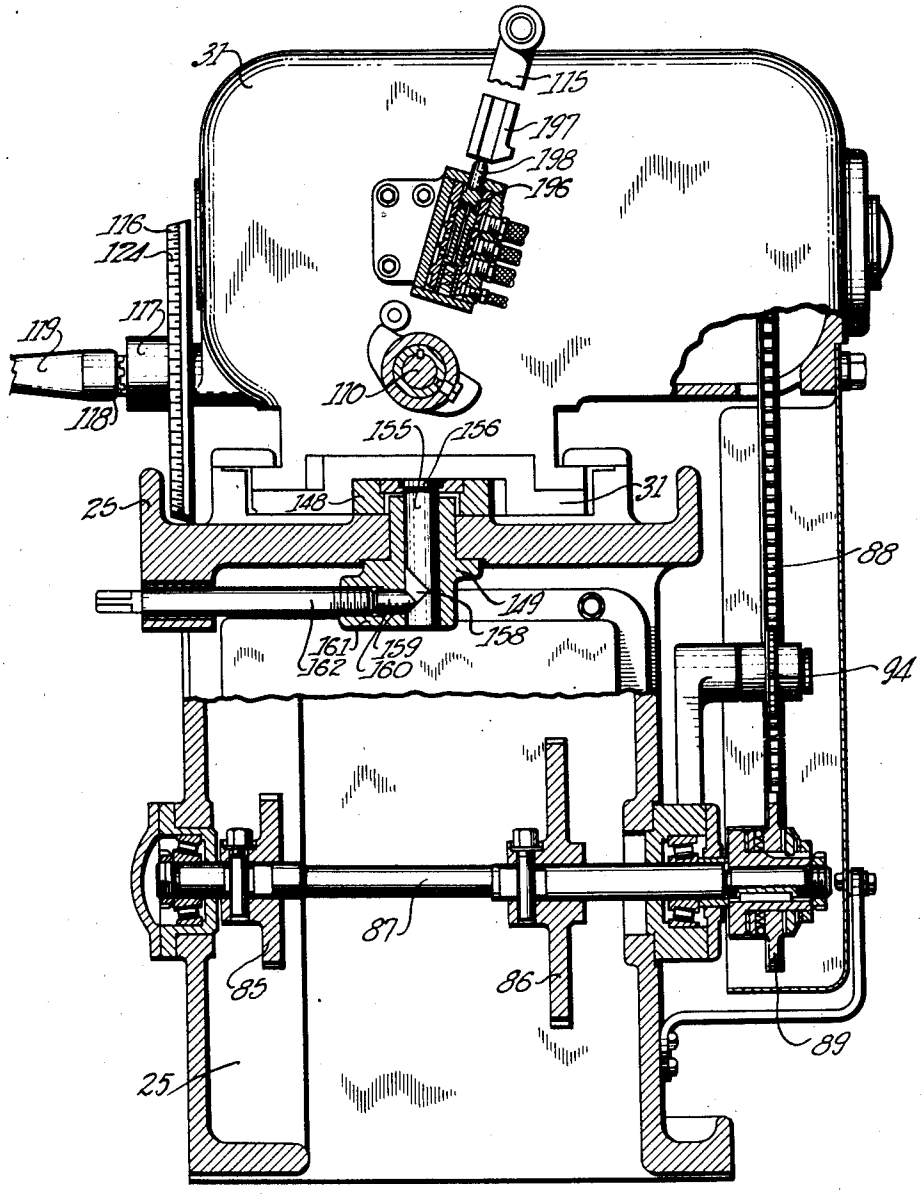


Fig. 4

Inventor

SOL EINSTEIN

FREDERICK S. HAAS

By H. K. Parsons

Attorney

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GRINDING MACHINE

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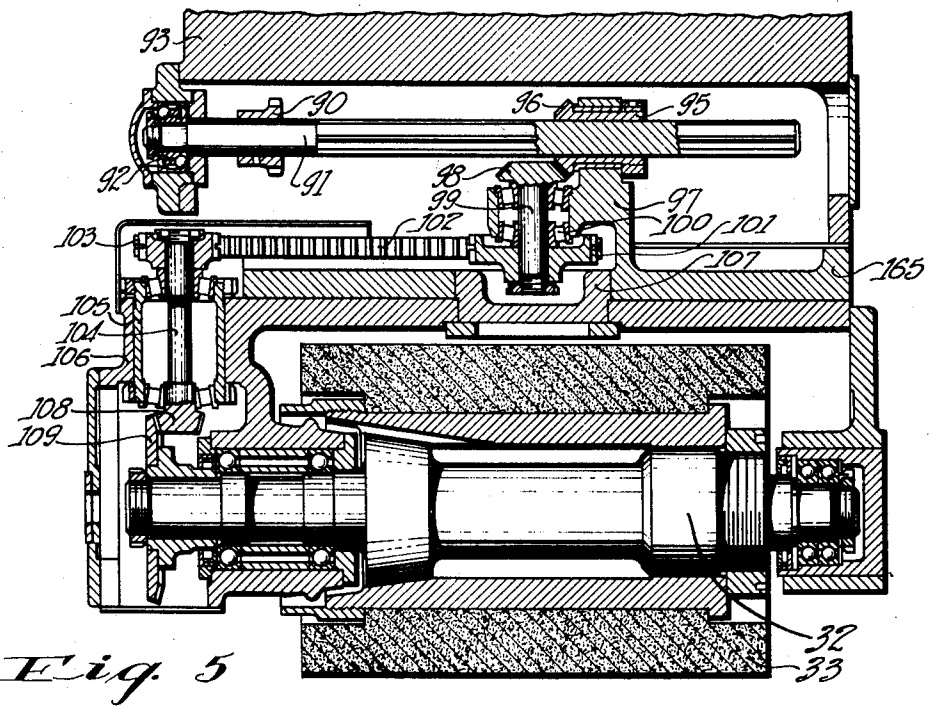


Fig. 5

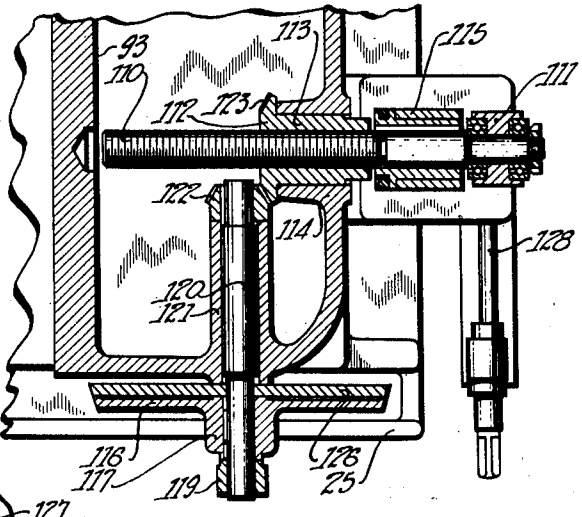


Fig. 6

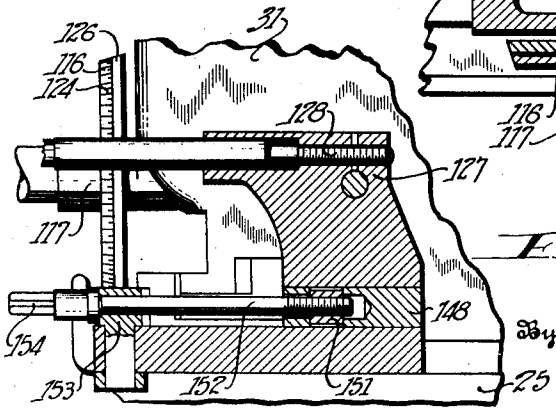


Fig. 7

Inventor
SOL EINSTEIN
FREDERICK S. HAAS
By H. K. Parsons
Attorney

Dec. 12, 1933. S. EINSTEIN ET AL 1,938,757

GRINDING MACHINE

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Fig. 8

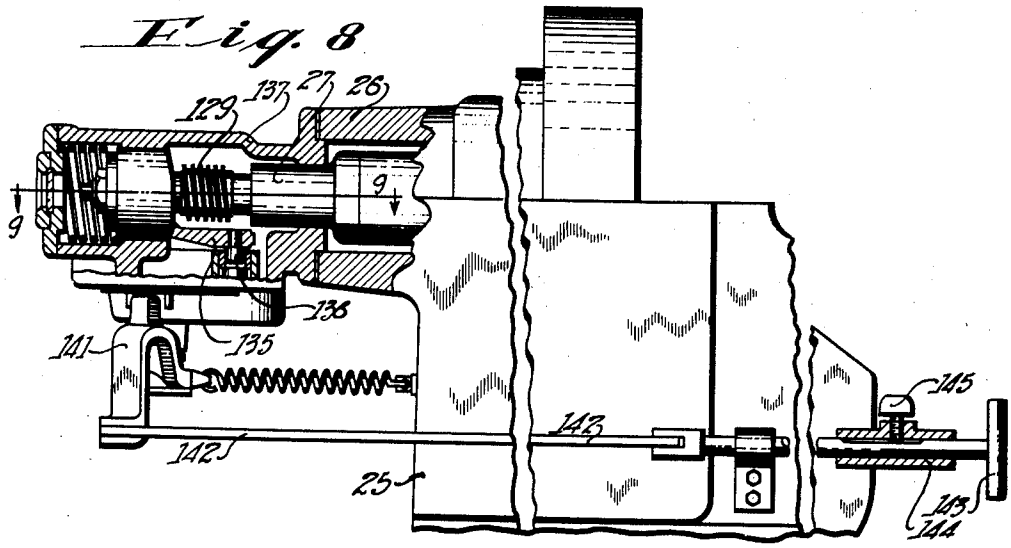


Fig. 9

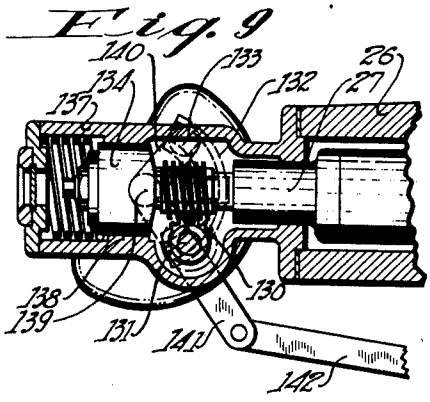


Fig. 10

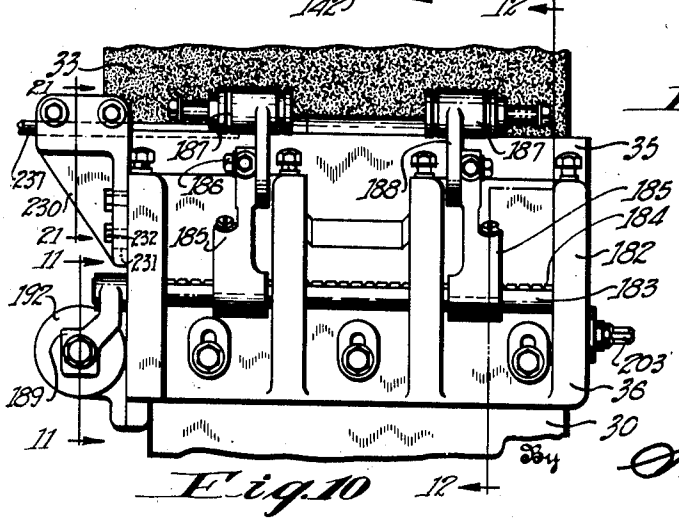
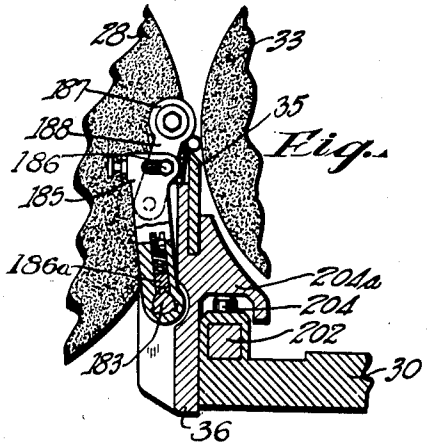
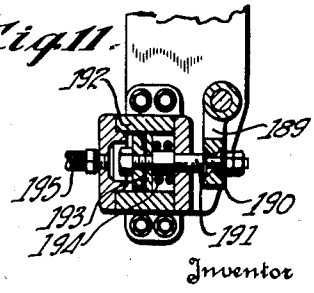


Fig. 11





Inventor

SOL EINSTEIN

FREDERICK S. HAAS

By H. K. Parsons

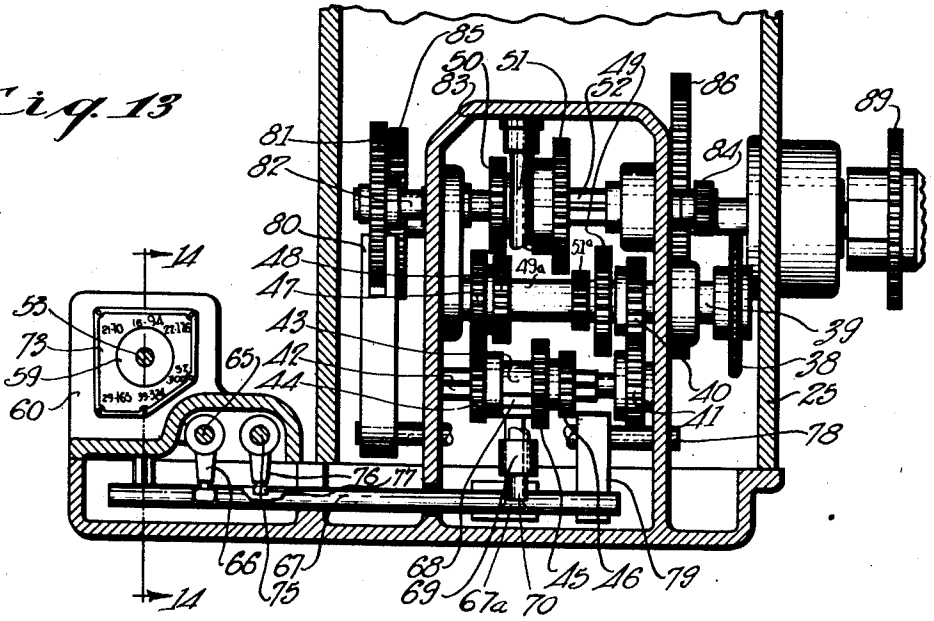
Attorney

Dec. 12, 1933. S. EINSTEIN ET AL 1,938,757

GRINDING MACHINE

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Fig. 13



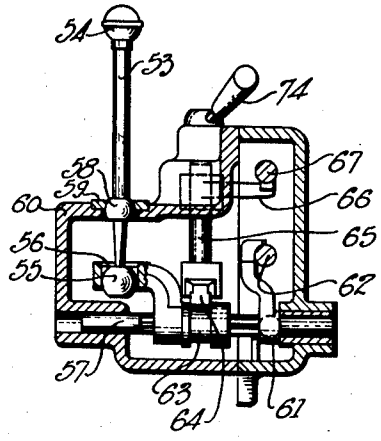


Fig. 14

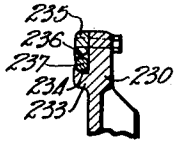


Fig. 21

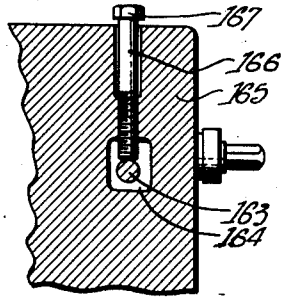


Fig. 15

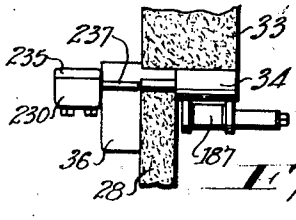


Fig. 22

Inventor

SOL EINSTEIN

FREDERICK S. HAAS

By H. K. Parsons

Attorney

Dec. 12, 1933. S. EINSTEIN ET AL 1,938,757

GRINDING MACHINE

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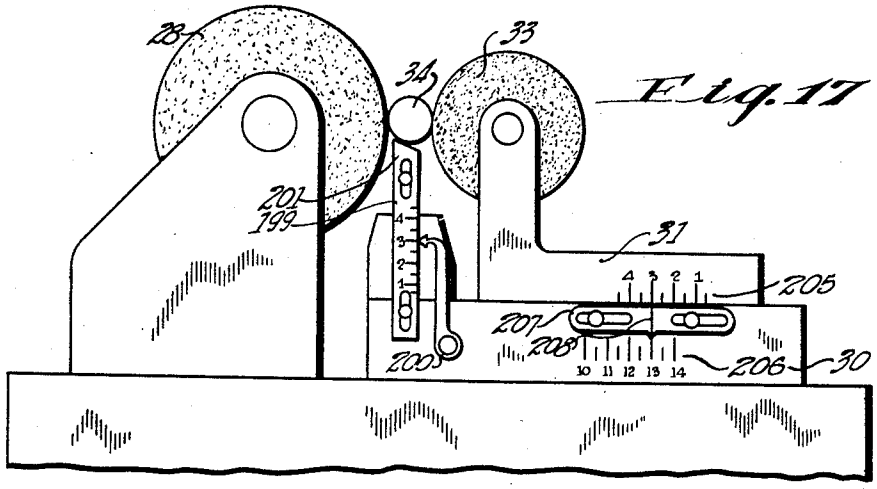


Fig. 17

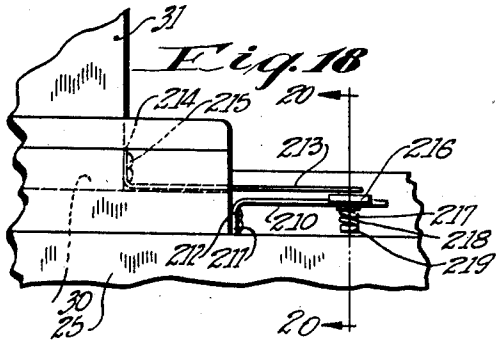


Fig. 18

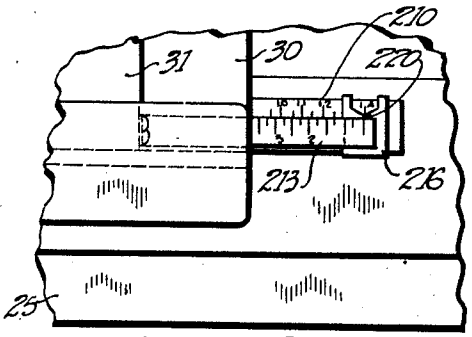


Fig. 19

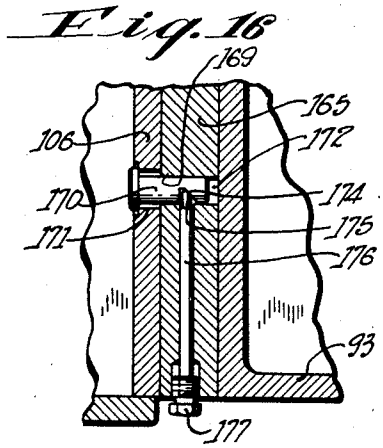


Fig. 16

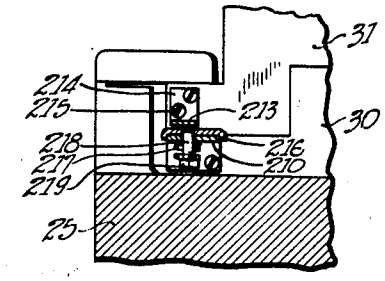


Fig. 20

Inventor

SOL EINSTEIN

FREDERICK S. HAAS

By H K Parsons

Attorney

Patented Dec. 12, 1933 1,938,757

UNITED STATES PATENT OFFICE

1,938,757

GRINDING MACHINE

Sol Einstein and Frederick S. Haas, Cincinnati, Ohio, assignors to Cincinnati Grinders Incorporated, Cincinnati, Ohio, a corporation of Ohio

Application September 22, 1930
Serial No. 483,477

32 Claims. (Cl. 51—103)

This invention relates to improvements in grinding machines and especially to improvements in what is commercially known as centerless grinders.

One of the principal objects of the present invention is to provide a greatly improved centerless grinder that may be used for the performance of grinding operations on substantially all types of work and for the performance of through-feed and in-feed grinding operations.

Another object of the invention is the provision of an improved centerless grinder having the parts constructed and arranged in such a manner that it can with a minimum of effect be adjusted to different sizes and types of work whereby small lots of parts may be economically and expeditiously machined or ground.

Another object of the invention is the provision of a machine of the centerless grinder type in which the necessity of retrueing the grinding and regulating wheels thereof is eliminated each time it is desired to finish or grind a different size of work thereby increasing the productive hours of the machine and reducing the operating cost thereof.

Other objects and advantages of the present invention should be readily understood by reference to the following specification considered in conjunction with the accompanying drawings and it is to be understood that any modifications may be made within the exact structural details there shown and described within the scope of the appended claims without departing from or exceeding the spirit of the invention.

In the drawings:

Figure 1 is a front elevation of a centerless grinder embodying the improvements of this invention.

Figure 2 is a top plan view of the device shown in Figure 1.

Figure 3 is a longitudinal sectional view through the wheels and grinding throat of the machine as seen from line 3—3 of Figure 2.

Figure 4 is a vertical sectional view through the rear portion of the machine showing certain parts in elevation substantially as seen from line 4—4 of Figure 3.

Figure 5 is a fragmentary sectional view of certain of the parts for driving one of the wheels as seen from line 5—5 of Figure 3.

Figure 6 is a fragmentary sectional view taken on line 6—6 of Figure 1.

Figure 7 is a fragmentary sectional view taken on line 7—7 of Figure 3.

Figure 8 is a sectional view partly in elevation taken on line 8—8 of Figure 2.

Figure 9 is a sectional view taken on line 9—9 of Figure 8.

Figure 10 is a view transversely through the grinding throat as seen substantially from line 10—10 of Figure 2.

Figure 11 is a sectional view on line 11—11 of Figure 10.

Figure 12 is a sectional view on line 12—12 of Figure 10.

Figure 13 is a horizontal development of the gear box as seen from line 13—13 of Figure 3.

Figure 14 is a sectional view on line 14—14 of Figure 13.

Figure 15 is a sectional view on line 15—15 of Figure 1.

Figure 16 is a sectional view on line 16—16 of Figure 1.

Figure 17 is an enlarged diagrammatic view illustrating the scales for setting the several parts of the machine.

Figure 18 is a fragmentary side elevational view of modification of the invention.

Figure 19 is a plan view of the parts shown in Figure 18.

Figure 20 is a sectional view taken on line 20—20 of Figure 18.

Figure 21 is a sectional view taken on line 21—21 of Figure 10.

Figure 22 is a plan view of certain parts of the machine adjusted relative to one another to perform a certain grinding operation.

In the past, centerless grinders have been known and used for the performance of either through-feed or in-feed grinding operations. By through-feed grinding is meant the passing of work pieces in a stream through the grinding throat which has the grinding wheel and regulating or work rotation controlling wheel fixed relative to one another. By in-feed grinding is meant the enlarging of the grinding throat sufficiently to permit the introduction therein of the work followed by a contraction of the throat to reduce the work to the desired size and produce the necessary finish whereupon the grinding throat is enlarged to effect a withdrawal of the work therefrom. However, to convert these machines from one type of grinding to another certain parts were either added or removed or had to be replaced by other parts. Also when changing the machine for operation on a different size of work from that just worked on the wheels had to be retrued to effect the proper contact between the work and wheels. By the device illustrated in the

drawings the foregoing objections have been eliminated and there has been provided a machine that can readily be adjusted to perform either of the above operations or that can be instantly adjusted to operate on different sizes of work without trueing the faces of the wheels since all sizes of work will contact with the same transverse work contact path on the wheels.

Referring to the drawings in which similar reference characters are employed to denote the same or similar parts throughout the several views, the reference numeral 25 indicates the main support or bed from which bearings 26 rise for rotatably supporting a spindle or shaft 27 to which grinding wheel 28 is secured. The bed 25 is further formed with ways 29 for the lower slide 30 which in turn supports for movement relative thereto a slide 31 supporting a spindle 32 for a regulating wheel 33. The said wheels 28 and 33 have their operative peripheries spaced from one another to form a grinding throat in which work to be operated upon is placed. The said work 34 is peripherally supported by a work rest blade 35 carried by bracket 36 adjustably secured to the lower slide 30. The work rest blade 35 has an operative angled surface 37 inclining toward the active surface of the wheel 33 and forming a work trough therewith. The grinding wheel 28 is adapted to be rotated at a high grinding rate of speed in a clockwise direction whereby its operative face adjacent the work rest blade 35 travels downwardly relative thereto. The regulating wheel 33 is likewise rotatable in a clockwise direction but at a relatively slow work controlling rate of speed with its operative surface adjacent the work rest blade and the grinding wheel travelling upwardly or opposite to that of the proximate point of the grinding wheel.

The grinding wheel is rotated at a constant high speed while the regulating wheel is adapted to be rotated at various speeds depending upon the kind and type of work to be controlled thereby and the said wheel may be rotated at a rapid speed during the trueing thereof. The source of power for effecting such rotation of the regulating wheel may be an individual motor, line shaft, or the like, as desired, for effecting a rotation of sprocket 38, see Figure 13, keyed or otherwise secured to shaft 39. A gear 40 is secured in said shaft and meshes with a gear 41 fast on splined shaft 42 relative to which gear sleeve 43 may be adjusted while maintaining driving connection therewith through the said spline. Gear sleeve 43 has gears 44, 45 and 46 adapted to mesh respectively with gears 47, 48 and 49 carried by a sleeve 49*a* which is loosely mounted about shaft 39 and acts as intermediate gears for gears 50 and 51 slidably splined to drive sleeve 52. The gear 50 is adapted to engage gear 47 to receive motion therefrom while the gear 51 meshes with gear 51*a* on the gear sleeve 49*a* for a similar purpose. By reference to Figure 13, the various ratios of the gears will be noted so that the gears 50 and 51 and sleeve 52 are driven at various speeds. The foregoing gears are shifted through a universally movable handle 53 having a knob 54 at one end thereof and an enlarged end 55 received in a shifter socket 56 splined to shifter rod 57. The movement of the rod 53 is obtained through a ball support 58 fixed thereto intermediate its end and received in a socket 59 of housing or casing 60 secured to the forward face of the main support or bed 25.

The spline shifter rod 57 has secured thereto on one end for movement therewith a lever 61 having its upper end received in a notch in shifter rod 62. The shifter socket 56 is provided with a circumferential groove 63 receiving the enlarged end of an arm 64 secured to the lower end of rock shaft 65. A second arm 66 is secured to the upper end of the rock shaft 65 having its forward end received in a notch in shifter rod 67. The shifter rod 62 is provided with a fork 68 received in a circumferential slot or way formed in the sleeve 43 of gear unit 44—45—46. The shifter rod 67 has formed near its opposite end a notch 67A receiving, see Figure 13, one end of arm 69 carried by horizontal rock shaft 70. A shifter arm 71 is secured to the other end of the rock shaft 70 and has a roller 72 received in a groove formed in the sleeve of sliding gear unit 50—51.

A plate 73 is carried by the casing or housing 60, see Figure 13, on which is indicated the various speeds at which the regulating wheel may be driven. The said speeds are obtained by shifting gear shift lever 53 to six different positions, as marked. It will be noted that a high and a low series of speeds are indicated thereon, the said series being obtained by actuating lever 74 to either of two positions. The said lever 74 is secured to a vertical rock shaft 75 having an arm 76 secured to the lower end thereof. This arm 76 is received in a slot of a shifter rod 77, see Figure 13, connected with a second shifter rod 78 by a link 79. The said shifter rod 78 has secured to its one end a fork 80, see Figure 13, straddling the sides of gear 81. This gear 81 is secured to a shaft 82 rotatable and slidable through bearings of gear box 83, as well as slidable through the splined sleeve 52 but keyed thereto for movement therewith. A pinion 84 is secured to the other end of the shaft 82. The gear 81 and pinion 84 are adapted to mesh respectively with gears 85 and 86 fast on counter shaft 87, see Figures 4 and 13. The gears 81 and 85 are adapted to mesh with one another to obtain the higher series of speeds while the gears 84 and 86 are in mesh with one another to produce the lower series of speeds.

Assuming the lever 74 to be actuated to its outward position thereby rotating the rock shaft 75 in a clockwise direction for correspondingly shifting the arm 76 to effect a movement of shifter rods 77 and 78 to the left, as seen in Figure 13, for correspondingly shifting fork 80 and gear shaft 82 thereby meshing pinion 84 with gear 86 for rotating the counter shaft 87 at one of the speeds of the low series. The shifter lever 53 may now be actuated to the point for obtaining the desired speed which will be on either the upper or lower side of the transverse axis, as seen in Figure 13. Assuming the desired speed to be indicated on the upper side of the plate, as seen in Figure 13, the knob 54 would be actuated in that direction thereby reversely actuating the enlarged head 55 of the shifter lever 53 and moving the shifter socket 56 axially of the shaft 64 toward the right. This movement of the shifter socket 56 will actuate arm 64 and shaft 65 for shifting the rod 67 to the right as seen in Figure 13, through the arm 66, which axial shifting of rod 67 rocks the horizontal rock shaft 70 through the arm 69 and shifts gear unit 50—51 to the right along the sleeve 52, as seen in Figure 13, thereby meshing gears 51 and 51*a* to rotate the shaft 82 at a slow speed. The shifter 53 is now positioned at the particular point where the desired speed is indicated. Assuming the speed desired is in

the upper right hand corner of the plate 73 the shifter knob is placed at such a point thereby through the shifter socket 56 and splined shaft 57 rocking the arm 61 and axially shifting the rod 62 to the left, as seen in Figure 13. This movement of the rod 62 through shifter fork 68 engages gears 45 and 49 to obtain the highest of the low speed series on that side of the indicator plate 73. By shifting the shifter rod to any other point indicated on the plate a corresponding speed may be obtained.

Rotation of the counter shaft 87 is transmitted to the regulating wheel spindle 32 through a sprocket chain 88 trained about sprocket 89 fast on the end of the said counter shaft 87. The sprocket chain 88 is in turn extended about sprocket 90 fast on drive shaft 91 journaled at one end in anti-friction bearing 92 carried by the housing 93 of upper slide 31. A tightener 94 is pivotally carried by the bed 25 for taking up any slack that may develop in the drive chain 88, as well as for maintaining proper engagement between the chain and the sprockets 89 and 90 when the upper slide 31 and housing 93 are moved relative to the bed. The drive shaft 91 has its other end slidable through a sleeve or hub 95 of bevel gear 96 rotatably journaled in a boss 97 extending from the slide 165. A second bevel gear 98 meshing with the drive gear 96 has a stem 99 rotatably journaled in anti-friction bearings 100 carried by boss 97 and extends at right angles thereto. A sprocket 101 is secured to the outer end of the stem 99 about which a chain 102 extends for driving a second sprocket 103 secured to shaft 104. Shaft 104 is slidably journaled in a bearing sleeve 105 carried by swiveled housing 106 which is angularly adjustable about a bearing 107 axially aligned with the driving gear and stem 98—99. The shaft 104 carries at its inner end a bevel pinion 108 meshing with a complementary bevel gear 109 fast on the end of spindle 32.

From the foregoing it will be noted that the various speeds of the counter shaft 87 are transferred to and utilized for rotating the spindle 32 and the regulating wheel carried thereby at the various necessary or desirable speeds. It will further be noted that the said regulating wheel may be rotated at a high or rapid rate to effect a retrueing or redressing operation thereon. The drive from the countershaft to the spindle 32 is so arranged that the said spindle, by means to be later described, may be tilted to have its axis extend at an angle to the axis of the grinding wheel spindle without any interference therefrom. Also the regulating wheel and its spindle may be axially adjusted relative to the housing 95, by means also later to be described, without breaking the driving connections, since the axial adjustment of the said spindle and wheel will carry with it the driving bevel gear 96 which is constantly meshed with drive shaft 91 throughout its range of adjustment.

To effect a stock removal from the work on the work rest blade, the regulating wheel 33 is actuated longitudinally of the slide 30 to feed the said work into the grinding wheel. For this purpose an adjusting screw 110 is rotatably but not translatably journaled in a bracket 111 carried by the bed plate 148. The threaded end of the screw 110 is received in a gear nut 112 which has its sleeve 113 rotatably journaled in bearing 114 formed in the housing 93 of the regulating wheel unit 31. A manually actuable lever 115 is splined to the adjusting screw 110 for rotating the said screw a definite amount thereby advancing and retracting the regulating wheel toward the grinding wheel a prescribed amount to effect a definite stock removal from the work. This lever or handle 115 is employed after the parts have been adjusted to their desired positions for operation on a series of work pieces which are to be finished to the same size and form. For adjusting the parts resort is had to a handle or lever 119 loosely mounted on a shaft 120 journaled in a bearing 121 formed integral with the housing 93. A disk 116 is keyed or otherwise secured to the shaft 120 for movement therewith and the said disk carries suitable indicia or graduations 124 cooperating with zero point or mark 125 on a companion disk 126 fixed against movement to the housing 93. A hub 117 extends from the disk 116 and is formed in its forward end with clutch teeth adapted to be engaged by the clutch teeth 118 of handle or lever 119 whereby said disk 116 and shaft 120 are actuated. The shaft 120 extends through the bearing 121 and carries at its inner end a bevel pinion 122 meshing with a bevel gear 123 formed integral with the sleeve or gear nut 112. From this it will be seen that if clutch 118 were engaged with the clutch hub 117 the rotation of handle 119 would effect a rotation of bevel pinion and gear 122 and 123 for effecting a rotation of the nut 112. This movement of nut 112 would result in a longitudinal travel of the regulating wheel 33 and slide 31 toward the grinding wheel since the adjusting screw 110 is prevented from axial movement. To prevent rotation of adjusting screw 110 when the handle 119 and disk 116 are being employed a friction device or clamp is mounted on the rear end thereof. This friction device or clamp comprises a split journal 127 at the upper end of the support 111 and a clamp screw 128 extends therethrough.

In order that the oscillating infeed lever 115 will be at all times within convenient reach of the operator and will bear the same relation to the regulating wheel slide and parts carried thereby it is adapted to be moved longitudinally of the screw. To this end the hub of the lever 115 is provided with a circumferential groove 115*a* receiving a tongue 115*b* on a latch member 115*c* secured by any suitable or desirable means to the upper slide 31. From this it will be seen that no interference is offered to the oscillation of the lever but the same relation between the lever and parts operated thereby is at all times maintained.

In practice it is desirable that a slight axial movement be given the grinding wheel to break up grain lines and produce the desired finish on the work. To this end the grinding wheel spindle 27 has secured thereto or formed integral therewith a worm 129 meshing with a worm wheel 130 on vertical shaft 131. The said shaft 131 is provided at its lower end with an eccentric received in a channeled arm 132 for actuating same about adjustable pivot 133. The extreme end of the spindle 27 is journaled in a sleeve 134 from which tongue 135 extends. The said tongue 135 is connected at 136 with the oscillating arm 132 whereby the said oscillations of the arm are converted into reciprocations of the sleeve and since the said sleeve is connected to the spindle the reciprocations of the sleeve are imparted to the spindle. A housing or casing 137 is secured to the spindle bearing 26 for enclosing the foregoing parts and the housing has formed interiorly thereof a bearing 138 for the sleeve 134.

A shaft 139 extends through and beyond the housing or casing 137 supporting interiorly thereof a link 140 extending from the arm 132 and the shaft 139 has secured to it exteriorly of the casing 137 a lever 141 for oscillating the said shaft about its axis for adjusting through the link 140, the operative position of the arm 132. A link 142, see Figures 8 and 9, is pivotally connected to the arm 141 and the link 142 has pivoted to its other end an operating handle 143 which extends through bearing 144, secured to the housing 25. A clamp screw 145 secures the handle 143 in adjusted positions thereby locking the spindle reciprocating parts at the desired point to obtain the necessary reciprocations of spindle 27 and grinding wheel 28. The handle 143 and clamp lock 145 are brought around the side of the bed 25 to the front thereof within convenient reach of the operator so that he may have access thereto for adjusting the operative stroke of the spindle for stopping said oscillations without leaving his working position.

To insure the active faces of the grinding and regulating wheels extending parallel to one another and to correct any inaccuracies in horizontal parallelism thereof there has been provided a means for adjusting one of the wheels relative to the other in a horizontal plane. To this end the bed 25 has secured thereto and extending thereabove a trunnion or pivot sleeve 146 received in a bore 147 formed in bed plate 148 which bed plate has formed thereon the ways 29 for the lower slide 30. A similar sleeve 149 is carried by the bed 25 at its rear end, this sleeve, however, is received in a relatively large bore 150 formed in the rear end of the bed plate 148. As seen in Figure 7, the said bed plate 148 is notched to receive a nut 151 threadedly connected with adjusting screw 152 which is rotatably journaled in a bearing 153 carried by the bed 25. The outer end of the screw 152 has an angled portion 154 for an actuating wrench whereby the screw is rotated. From this it will be seen that the bed plate 148 and the parts carried thereby, namely: the slides 30 and 31 may be adjusted in a horizontal plane through the screw 152 about the bearing sleeve 147 an amount determined by the clearance of bore 150 with the sleeve 149. To secure the bed plate in its adjusted position a clamp bolt 155 extends through each of the sleeves 146 and 149 and each bolt has formed at its upper end a head 156 cooperating with clamp plate 157. As seen in Figure 4, the said clamp bolts 155 have formed near their lower ends V-shaped notches 158 receiving points 159 of pins 160. The said pins 160 are adapted to be actuated through bearings 161 formed integral with the sleeves 146 and 149 and the said bearings 161 have formed co-axial with the pins 160 threaded bores receiving the threaded ends of clamp screws 162 which screws have journaled at their outer ends in the bed 25. From the foregoing it will be noted that for any reason should the active faces of the wheels be out of parallelism the same may be corrected by actuating the slides carrying the regulating wheel about the pivot sleeve or bearing 147 until the said active faces are again equally spaced from one another at all points throughout their length.

As shown in Figure 2, the grinding and regulating wheels 28 and 33 are of unequal width, the grinding wheel 28 being considerably narrower than the regulating wheel 33. By this construction a substantial work receiving trough is formed by the surface of regulating wheel 33 and angled top 37 of a blade 35, which extends the full length of the regulating wheel face, eliminating any necessity for guide members for guiding the work to the grinding throat between the grinding and regulating wheels as was necessary in the past. The parts are utilized in the position shown in Figure 2 for performing through-feed grinding operations in which the work is introduced into the grinding throat and axially fed therethrough. For effecting the said feeding of the work through the throat, the housing supporting the regulating wheel spindle 32 is adjusted about the axis of bearing member 107 to position the axis of spindle 32 obliquely to the axis of the grinding wheel spindle 27 thereby to exert a feed component on the work simultaneously with the control of the rotation thereof. For this purpose the regulating wheel spindle housing 106 has extending from it a pin 163 received in a cored opening 164 formed in slide 165 which is adjustable transversely of the housing 93 for a purpose later to be described. The said slide 165 has threaded therethrough a screw 166 having its head 167 extending thereabove. By reference to Figure 5, it will be noted that the major portion of the weight lies on the left hand side of the center of bearing 107 thereby tending to rotate the housing 106 and parts carried thereby in a counter clockwise direction and maintaining contact between the pin 163 and end of the screw 166. From this it will follow that if the screw 166 is adjusted upwardly, as seen in Figure 16, the housing 106 will rotate in a counter clockwise direction while if the said screw were adjusted downwardly the reverse motion would be imparted to the housing 106. The housing 106 is clamped or locked in its adjusted position by means of bolts 168 at the upper end thereof and by a clamp 169 extending through the slide 165 and shown more clearly in Figure 16. The clamp 169 comprises a headed stud 170 extending through an enlarged opening 171 formed in the rear wall of the housing 106 and through a smaller opening 172 in the slide 165 having the head 173 thereof engaging the said rear wall of the housing 106 around the opening 171. The stud shank within the opening 172 has a tapered notch 174 near its inner end cooperating with a wedge shaped nose 175 formed on the inner end of pin 176. The outer end of the said pin 176 abuts a clamp screw or bolt 177 whereby the said pin 176 is actuated inwardly toward the stud 170 for axially urging the said stud through the camming action of the tapered sides of nose 175 and the angled sides of the notch 174.

For performing in-feed grinding operations, by which is meant the placing of work pieces within the grinding throat, contracting the said throat to feed the work into the grinding wheel, subsequently opening the throat and removing the work from the same side of the throat by which it was introduced, the regulating wheel unit is adjusted about the bearing 107 to have the axis of the spindle extending parallel with the axis of the grinding wheel spindle. This type of grinding operation is generally performed on shouldered, tapered or other formed work. When grinding or finishing shouldered work having a cylindrical portion extending from the shoulder it is necessary that the forward edges of the grinding and regulating wheels be aligned with one another. To this end the regulating wheel housing 106 and parts carried thereby, as noted above, are secured to the slide 165, which, see Figure 1, has a dove-tailed tongue extending

therefrom received in a complementary formed guideway in the forward face of housing portion 93 of slide 31. The slide 165, as noted above, has projecting from it the lug 97 which in addition to supporting the beveled gears 96 and 98 has a threaded boss 179 receiving the threaded end of an adjusting screw 180. The outer end 181 of the screw 180 has an angular cross section for receiving the operating end of a suitable crank or the like for effecting a rotation thereof whereby the slide 165 and housing 106 are adjusted relative to the fixed housing 93.

From the foregoing it will be seen that the regulating wheel and its spindle are mounted for adjustment relative to the grinding wheel in an axial direction, as well as in a vertical plane, for placing the axes of the spindles obliquely to one another. It will further be noted that the adjustment of the regulating wheel and its spindle in a direction axially of the grinding wheel spindle may take place regardless of the angular relation existing between the axes of the grinding and regulating wheel spindles at the time of the adjustment. Also, that the regulating wheel and its spindle may be adjusted in a vertical plane at any point in the path of movement of the regulating wheel axially of the grinding wheel. The heads 167 and 181, respectively, of adjusting screws 166 and 180 are within convenient reach of the operator so that the above adjustments may be made by him without leaving his normal station and in a minimum of time.

In order to grind a projecting portion of a cylindrical work piece, as shown in Figure 22, for example, it is necessary that the said work be supported by the blade 35 and held in contact with the regulating wheel for controlling its rotation with the grinding wheel in position to engage the projecting portion of the work. A mechanism is disclosed in Figures 10, 11 and 12 for holding the work in engagement with the regulating wheel in which the bracket 36 is provided having bearings 182 through which oscillating bar 183 extends. The said bar is provided with a series of notches 184 for securing thereto in adjusted positions arms 185 for movement therewith. The arms 185 have extending through an enlarged portion thereof a yieldable lock member 186A, see Figure 12, cooperating with the notches 184 for locking the arms 185 relative to the bar. Pressure rolls, or the like, 187 are carried by the arms 188 which are adjustably secured to the arms 185 by means of bolts or the like 186 extending through suitable elongated perforations. To oscillate the bar 183 it is provided on one end with a link 189 connected through a self-aligning bearing 190 with the outer end of piston rod 191 which extends into cylinder 192 having the piston 193 secured thereto. A spring 194 surrounds the piston rod 191 interiorly of the cylinder and abuts on opposite ends with the piston 193 and one of the heads of the cylinder 192. A conduit 195 extends from the other end of the cylinder 192 to an operating cylinder 196 secured to the rear of housing 93 of the upper slide 31. The pressure rolls 187 are employed during the performance of an in-feed grinding operation and are, therefore, coupled up for automatic movement with the in-feed lever 115 which is mounted for movement adjacent the end of the housing or slide 31. For the purpose of automatically clamping and releasing the work by the pressure rolls 187 the said in-feed lever 115 is provided with a dog 197 cooperating with valve plunger 198 within the valve cylinder 196 for coupling the hydraulic pressure with the cylinder 192 through the conduit 195 for actuating the piston within the said cylinder.

In all in-feed grinding operations the work is held in position relative to the active faces of the wheels on the work rest blade to prevent the shoulder on the work from engaging the sides of the wheels. To this end, as shown in Figure 10, the work rest block or bracket 36 has secured thereto a bracket 230 having an elongated slot 231 formed therein through which bolts or the like 232 extend for securing the bracket in adjusted positions. Referring to Figure 21 it will be noted that the bracket 230 has formed on one face thereof a lip 233 having an inclined face 234. Secured to the bracket 230 above the lip 233 is a block or strip 235 having formed thereon an inclined face 236 inclining in the opposite direction to the direction of inclination of face 234. As will be noted the face of the bracket 230 and the faces 234 and 236 extend at angles to one another to form a groove of substantially triangular cross section. A stop pin or member 237 is clamped between the lip 233 and the block or strip 235 and the angle relation of the faces of the slot forms a three point clamp against the stop 237 rigidly securing same in adjusted position. While performing an in-feed grinding operation the regulating wheel may have its axis slightly canted to exert a feed component or thrust on the work to hold same against the stop.

To readily adjust the parts for the grinding of different sizes of work, suitable scales have been provided. As shown in Figures 1 and 17, for determining the height of the work rest blade 35 the forward edge thereof has adjustably secured thereto a scale 199 carrying indication marks for various diameters within the range of the machine. The said graduation marks cooperate with a pointer 200 secured to and carried by the work rest block 36. The said scale 199 is provided with an inclined upper surface 201 corresponding with the inclined portion of the work rest blade 35 so that when the said blade is resurfaced it is only necessary to attach the scale thereto having the inclined tops of the scale and blade coincident and adjust the blade and scale relative to the pointer to the desired diameter of work to be ground and lock the blade in its adjusted position.

For effecting the said vertical adjustment of the work rest blade 35 the block or bracket 36 has extending therethrough a bar 202 adjustable by screw 203 for raising the pins 204 which engage the bracket 204*a* of the said work rest blade 35. From the foregoing it will be seen that the blade 35 may be adjusted in a minimum of time and to the desired position relative to the axes of the grinding and regulating wheels. From this it will be seen that the axis of the work will, at all times and irrespective of the size of the work, bear the same relation to the axes of the grinding and regulating wheels and will contact said wheels at the same point thereby eliminating the necessity for retrueing the surfaces of the wheels each time a different size work piece is to be operated upon.

Cooperating with the work height scale 199 is a pair of scales 205 and 206, the former carried by the upper slide 31 while the latter is secured to the lower slide 30. The lower slide 30 in addition is provided with an adjustable pointer or zero plate 207 which is movable to determine the position at which the upper and lower slides are to be locked to perform a given grinding operation on the work. To determine this position of set-

ting of the two slides the said plate 207 has indicated thereon a zero point 208 while the scale 206 carries the several possible diameters of the regulating wheel and the scale 205 carries the several diameters of work capable of being ground or finished by the machine.

By reference to Figure 17 the operation of the machine through the use of the setting dials should be readily apparent since it is only necessary to adjust the work rest blade to a position so that the diameter of the work indicated on scale 199 secured to the blade registers with the pointer or finger 200. If a new regulating wheel is being placed on the regulating wheel spindle then the zero plate or scale 207 is loosened relative to the lower slide 30 and adjusted longitudinally until the marker thereon registers with the size of the wheel now being placed on the spindle. Assuming this size to be 13" in diameter the scale 207 would be shifted along the lower slide until its marker registered with the graduation on the scale 206 and locked in this position. The lower slide would then be held stationary and the upper slide 31 adjusted relatively thereto at this time the scale 205 would be used and it would be set relative to the marker 208 in accordance with the diameter of the work to be ground. Assuming the work to be 3" in diameter this upper slide 31 would be adjusted until the graduation indicating such a diameter is positioned opposite the zero marker 208. The scales 205 and 199 are both set the same so that the work size is indicated on each of said scales while the indication on scale 206 is that of the regulating wheel. When changing a machine to operate on a different size of work piece the scale or zero plate 207 is left in its present position and only the upper slide 31 adjusted relative to the lower slide to align the new work diameter size on the plate 205 with the marker 208 whereupon the work rest blade is likewise adjusted to align its new work diameter size with the pointer 200. From time to time it becomes necessary to retrue the active face of the regulating wheel which naturally reduces the said wheel in diameter. As was noted above, the disk 116 carries suitable graduations for indicating the amount of feeding movement being given to the regulating wheel unit toward the grinding wheel. This movement, as indicated by the graduations 124, will gradually increase or it will be evident from the position of said graduations that the zone of reciprocation imparted to the regulating wheel unit by the handle 119 and in-feed lever 115 is constantly shifting toward the grinding wheel. If desirable and preferably the zero plate 207 should be shifted so that the marker 208 on its plate indicates the reduced diameter of the wheel. At this time the upper slide 31 should be adjusted to align the diameter of the work as indicated on the plate 205 with the said marker 208 thereby at all times keeping the two slides in proper relation so that when setting the machine for a different size or kind of work it need not be necessary to measure the regulating wheel to determine its diameter but that a simple glance at the plate will indicate its size.

In Figures 18—19—20 is shown a modification in that the means for adjusting the slides relative to one another for setting-up the work carrier and feeding unit are carried solely by the upper and lower slides. A scale 210 having at one end thereof a flange 211 is secured to the lower slide 30 by suitable screws or the like 212 extending through the flange into the said lower slide. A second scale 213 having a flange 214 thereon, similar to the flange 211, is secured to the upper slide 31 also by means of screws or the like 215 extending through the said flange 214 into the upper slide 31. A rider 216 is mounted on the scale 210 for movement relative thereto and the said rider is held in adjusted position by spring 217 surrounding a bolt or the like 218 depending from the rider. A nut 219 carried by the bolt 218 adjusts the tension of the spring 217. The said scale 210 carries suitable indicia for indicating the possible diameter of regulating wheels to be used with the machine and this indicia cooperates with a marker or zero point 220 formed on the rider 216. The scale 213 also carries suitable indicia indicating the various sizes of work within the capacity of the machine which indicia cooperates with the zero marker 220. As shown in Figure 19 the rider 216 is in the position for a 14" diameter of wheel for operation on a one-half inch diameter work.

It is believed that the operation of the scales will be readily understood by reference to the above use of scales 199, 205 and 206, it being understood that the scale 199 associated with the work rest blade must be used with the scales 210 and 213 for properly adjusting the machine.

The operation of the machine as a whole after it has been set-up with regard to the size of regulating wheel and work being employed should be clearly understood from the foregoing description. It is to be noted, however, that all of the controls for effecting the various operations and adjustments are all within convenient reach of the operator from the operating position at the forward end of the grinding throat. It will also be noted that the machine is capable of performing grinding operations throughout a wide range of diameters and a multiplicity of operations which in the past required special machines or that necessitated the expenditure of large amounts of time to convert from one type grinding to another or required the addition of attachments and extra parts to adapt them for the said different styles of grinding operations.

What is claimed is:

1. In a centerless grinder the combination of a bed, a spindle rotatably supported thereby for rotation about a fixed axis, a second spindle rotatably carried by the bed, means supporting the spindle for adjustment in a direction of the axis of the first spindle, means for adjusting the support and spindle in a vertical plane to dispose the axes of the spindles obliquely to one another, and additional means for adjusting the second spindle and its support in a horizontal plane to adjust the axes of the spindles parallel to one another.

2. In a device of the class described the combination of a bed, a bed plate carried thereby, a trunnion operatively coupling the bed and bed plate, means supporting a spindle on the bed plate, means supporting a second spindle on the bed, an adjusting screw carried by the bed operatively coupled with the bed plate for arcuately adjusting the bed plate about the trunnion to align the axes of the spindles in parallelism, and means for locking the bed plate in its adjusted position.

3. In a device of the class described the combination of a bed, a bed plate carried thereby, a trunnion operatively coupling the bed and bed plate, means supporting a spindle on the bed plate, means supporting a second spindle on the bed, an adjusting screw carried by the bed operatively coupled with the bed plate for arcuately adjusting

the bed plate about the trunnion to align the axes of the spindles in parallelism, means for locking the bed plate in its adjusted position, said means comprising vertically shiftable clamp bolts having cam faces formed thereon intermediate their ends, and wedge shaped clamp screws cooperating with the cam faces on the bolts for actuating said bolts axially of themselves.

4. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade within the grinding throat having an active, inclined, operative surface inclining toward the face of the regulating wheel to form a work receiving trough therewith, a block beneath the grinding throat supporting the work rest blade and having bearings integral therewith, a shaft oscillatably supported by the bearings, arms adjustably mounted on the shaft, pressure rolls adjustably carried by the arms for engagement with the work on the work rest blade to hold same in frictional engagement with the regulating wheel, a lever on the end of the oscillatable shaft, a piston secured to the end of the lever, an hydraulic pressure source for actuating the piston for oscillating the shaft, and means for controlling the flow of the pressure source.

5. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a spindle for each wheel, means for axially adjusting each spindle, means for adjusting the axis of one of the spindles in a vertical plane to obliquely dispose the axes of the spindles relative to one another, and additional means for adjusting one of the spindles in a horizontal plane to align the spindles in parallelism.

6. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween having an entering portion on the operator's side of the grinder, means for reciprocating the grinding wheel spindle including a handle within convenient reach of the operator, means for feeding one of the wheels toward the other to effect a stock removal from a work piece within the grinding throat including a lever within convenient reach of the operator, means for axially and angularly adjusting the regulating wheel including manually actuable adjusting screws within convenient reach of the operator, and means for rotating the regulating wheel at variable speeds including a shifter lever within convenient reach of the operator.

7. In a centerless grinder the combination of a bed, a grinding wheel carried thereby and operable at a high grinding rate of speed, a slide carried by the bed translatable relative thereto, a work rest blade carried by the slide adjacent the grinding wheel for supporting a work piece in engagement with the wheel, a second slide carried by the first and movable with and relative to said first slide, a regulating wheel carried by the second slide rotatable at a slow work controlling rate of speed and engaging the work, and means associated with the slides for indicating the relative adjustment thereof one with respect to the other.

8. In a centerless grinder the combination of a bed, a grinding wheel carried thereby and operable at a high grinding rate of speed, a slide carried by the bed translatable relative thereto, a work rest blade carried by the slide adjacent the grinding wheel for supporting a work piece in engagement with the wheel, a second slide carried by the first and movable with and relative to said first slide, a regulating wheel carried by the second slide rotatable at a slow work controlling rate of speed and engaging the work, means associated with the slides for indicating the relative adjustment thereof one with respect to the other, and means associated with the work rest blade for indicating its vertical position relative to the wheels whereby said wheels and work rest blade may be readily set up for different sizes of work.

9. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade subtending the grinding throat and vertically adjustable relative thereto and having an angled operative surface inclining toward the surface of the regulating wheel, a slide adjustably, detachably secured to the work rest blade, and means fixed as respects the blade and grinding throat for co-operation with the scale for determining the vertical adjustment thereof and to indicate the diameter of work being operated upon.

10. A regulating wheel unit for use with a centerless grinder comprising a bed, a slide carried thereby and movable relative thereto, a second slide carried by the first movable therewith and relative thereto, a regulating wheel rotatably supported by the second slide, and a pair of scales one carried by each of the slides for indicating the relative position of the slides in accordance with the diameter of the regulating wheel and the diameter of the work to be operated upon.

11. A regulating wheel unit for use with a centerless grinder comprising a bed, a slide carried thereby and movable relative thereto, a second slide carried by the first movable therewith and relative thereto, a regulating wheel rotatably supported by the second slide, a pair of scales one carried by each of the slides for indicating the relative position of the slides in accordance with the diameter of the regulating wheel and the diameter of the work to be operated upon, adjustable means between the scales cooperating with the said scales for setting the slides at the desired adjustment, and means for locking the said means in adjusted positions.

12. In a device of the class described for operation on circular work pieces of different diameters the combination of a support member, a work rest blade and a regulating wheel on said supporting member each adjustable relative thereto and in angularly related directions to one another, and means determining the necessary adjustment of work rest blade and regulating wheel to maintain the position of the transverse contact path on regulating wheel constant for work of different diameters.

13. In a centerless grinder the combination with a grinding wheel, of a regulating wheel unit movable toward and from the grinding wheel to feed a work piece supported and controlled thereby into the grinding wheel comprising a supporting member, a scale thereon reading in terms of wheel diameter, an indicator positionable for effective diameter of the wheel at a given instant, a wheel carrying slide on the supporting member, and a scale on the slide indicating in terms of work diameter the degree of adjustment of the slide necessary to maintain a given transverse contact path of the wheel in contact with work of various diameters.

14. In a centerless grinder the combination of

a bed, a grinding wheel rotatably supported thereby, a slide carried by the bed for movement relative thereto toward and from the grinding wheel, a second slide carried by the first for movement relative thereto, a work rotation controlling wheel carried by the second slide, the proximate points of the wheels engaging the work on opposite sides thereof, a work rest blade carried by one of the slides for supporting a work piece while in engagement with the wheels, a pointer carried by the work rest blade supporting slide, an adjustable scale carried by the work rest blade cooperating with the pointer for indicating the vertical adjustment of the blade corresponding to the diameter of the work being operated upon, a pair of additional scales one carried by each of the slides for indicating the relative adjustment of the slides in accordance with the diameter of regulating wheel being used and the diameter of work being operated upon, and means for at all times advising the operator of the diameter of regulating wheel being employed to facilitate subsequent adjustments of the slides.

15. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a block subtending the grinding throat, a work rest blade carried thereby for supporting a work piece in engagement with the wheels, bearings on the block, an oscillatable shaft journaled in the bearings, a piston operatively coupled with the shaft for oscillating same relative to its bearings, arms adjustably secured axially of the shaft, pressure rolls carried by the arms for engagement with the work on the work rest blade to hold said work in frictional engagement with one of the wheels, and means for actuating the piston for oscillating the shaft toward the wheel to urge the work thereagainst.

16. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a block subtending the grinding throat, a work rest blade carried thereby for supporting a work piece in engagement with the wheels, bearings on the block, an oscillatable shaft journaled in the bearings, a piston operatively coupled with the shaft for oscillating same relative to its bearings, arms adjustably secured axially of the shaft, pressure rolls carried by the arms for engagement with the work on the work rest blade to hold said work in frictional engagement with one of the wheels, means for actuating the piston for oscillating the shaft toward the wheel to urge the work thereagainst, and yielding means for reversely oscillating the shaft to free the work of the pressure rolls.

17. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a block subtending the grinding throat, a work rest blade carried thereby for supporting a work piece in engagement with the wheels, bearings on the block, an oscillatable shaft journaled in the bearings, a piston operatively coupled with the shaft for oscillating same relative to its bearings, arms adjustably secured axially of the shaft, pressure rolls carried by the arms for engagement with the work on the work rest blade to hold said work in frictional engagement with one of the wheels, means for actuating the piston for oscillating the shaft toward the wheel to urge the work thereagainst, yielding means for reversely oscillating the shaft to free the work of the pressure rolls, and means for adjusting the arms axially of the oscillating shaft comprising notches formed in the shaft and yieldable locking pins carried by the arms cooperating with the notches in the shaft.

18. In a centerless grinder the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade subtending the grinding throat for supporting a work piece in engagement with the wheels, and means for actuating one of the wheels toward the other to feed the work on the work rest blade into the grinding wheel comprising a slide rotatably supporting the wheel, a nut rotatably but not translatably carried by the slide, an adjusting screw rotatably but not translatably carried by the bed, a manually actuable lever on the adjusting screw for movement axially thereof but not rotatable relative thereto, and means for adjusting the lever axially of the screw through the slide actuated thereby.

19. In a device of the class described the combination of a bed, a rotatable shaft carried by the bed, and means for rotating the shaft at a plurality of speeds comprising a gear box secured to the bed, a drive shaft journaled in the gear box, a prime mover for rotating the drive shaft, an intermediate shaft journaled in the gear box, means transmitting motion from the drive shaft to the intermediate shaft, a sleeve gear unit loosely mounted on the drive shaft having a plurality of gears thereon, a gear unit slidably carried by the intermediate shaft for engagement with the gears of the sleeve gear unit, a driven shaft slidably journaled in the gear box, a slidable gear unit carried by the driven shaft, a gear shift lever having universal movement in a horizontal plane for connecting the slidable gear unit on the intermediate shaft and the sliding gear unit on the driven shaft with the gears on the gear sleeve for rotating the driven shaft at a plurality of speeds, a countershaft having gears thereon, gears on the driven shaft for engagement with the gears on the countershaft for rotating the countershaft at the driven shaft's speeds, and means for adjusting the driven shaft to mesh the several gears thereof with the gears of the countershaft for rotating the said countershaft at an additional number of speeds.

20. In a device of the class described the combination of a bed, a spindle rotatably carried by the bed, a grinding wheel secured to the spindle for movement therewith, means for reciprocating the spindle and grinding wheel comprising an oscillating arm, means connecting the arm with the spindle for changing the oscillations of the arm into reciprocations of the spindle, a lever for varying the operative position of the oscillatable arm, a handle at the front of the bed for varying the position of the lever, a link connecting the handle with the lever, and means for locking the handle in its adjusted positions.

21. In a device of the class described the combination of a bed, a slide carried thereby and translatable relative thereto, an adjusting screw for effecting the translations of the slide rotatably but not translatably journaled in the bed, a nut rotatably but not translatably carried by the slide having threaded engagement with the adjusting screw, means carried by the slide for rotating the nut to effect movement of the slide and nut longitudinally of the screw, and additional means for rotating the screw to effect movement of the slide, said means being movable with the slide longitudinally of the screw.

22. In a device of the class described the combination of a support member, a work rest blade and a regulating wheel on the slide adjustable relative thereto, means determining the necessary adjustment of work rest and regulating wheel to maintain the position of the transverse contact path on regulating wheel constant for work of different diameters, and additional means to indicate adjustment necessary to compensate for wear on regulating wheel.

23. In a centerless grinder the combination of a bed, a grinding wheel rotatably mounted thereon, an opposed regulating wheel forming with the grinding wheel a grinding throat, a work rest blade subtending the grinding throat and having an angular operative surface, and means for adjusting the parts to maintain the position of the contact path of the work on the regulating wheel constant for different diameters of work comprising a slide on which the regulating wheel is journaled, a second slide carried by the bed and supporting the regulating wheel slide, a scale member secured to the regulating wheel slide having graduation marks thereon reading in terms of work diameter, a second scale member beneath the first scale and secured to the second slide having graduations thereon reading in terms of regulating wheel diameter, and a rider on one of said scales having an indicator adapted to simultaneously register with the graduations on the two scales for simultaneously indicating the size of the regulating wheel being employed and the size of the work piece to be operated upon.

24. In a centerless grinder the combination of a bed, a grinding wheel rotatably mounted thereon, an opposed regulating wheel forming with the grinding wheel a grinding throat, a work rest blade subtending the grinding throat and having an angular operative surface, and means for adjusting the parts to maintain the position of the contact path of the work on the regulating wheel constant for different diameters of work comprising a slide on which the regulating wheel is journaled, a second slide carried by the bed and supporting the regulating wheel slide, a scale member secured to the regulating wheel slide having graduation marks thereon reading in terms of work diameter, a second scale member beneath the first scale and secured to the second slide having graduations thereon reading in terms of regulating wheel diameter, a rider on one of said scales having an indicator adapted to simultaneously register with the graduations on the two scales for simultaneously indicating the size of the regulating wheel being employed and the size of the work piece to be operated upon, and yielding means associated with the rider for maintaining it in its adjustable positions.

25. In a centerless grinder the combination of a bed, a grinding wheel rotatably mounted thereon, an opposed regulating wheel forming with the grinding wheel a grinding throat, a work rest blade subtending the grinding throat and having an angular operative surface, and means for adjusting the parts to maintain the position of the contact path of the work on the regulating wheel constant for different diameters of work comprising a slide on which the regulating wheel is journaled, a second slide carried by the bed and supporting the regulating wheel slide, a scale member secured to the regulating wheel slide having graduation marks thereon reading in terms of work diameter, a second scale member beneath the first scale and secured to the second slide having graduations thereon reading in terms of regulating wheel diameter, a rider on one of said scales having an indicator adapted to simultaneously register with the graduations on the two scales for simultaneously indicating the size of the regulating wheel being employed and the size of the work piece to be operated upon, yielding means associated with the rider for maintaining it in its adjustable positions, means mounting the work rest blade on the lower slide for adjustment relative thereto, a scale member detachably and adjustably secured to the work rest blade reading in terms of work diameter, and a fixed pointer carried by the second slide cooperating with the graduations on the work rest scale for determining its adjustment in accordance with the diameter of the work to be operated upon and in accordance with the setting of the work diameter scale carried by the regulating wheel slide.

26. In a centerless grinder of the class described the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade subtending the grinding throat for supporting the work while in simultaneous engagement with the grinding and regulating wheels, a block supporting the blade for vertical adjustment relative to the grinding throat, journal bearings operatively associated with the block, a shaft oscillatably journaled in the bearings, arms carried by the shaft and adapted to be adjustably locked axially of the shaft, a piston and cylinder mechanism operatively coupled with the shaft for effecting its oscillation in a direction to shift the pressure rollers into engagement with the work while on the work rest blade, and yielding means for oscillating the shaft in a reverse direction to free the work of the pressure rollers.

27. In a centerless grinder of the class described the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade subtending the grinding throat for supporting the work while in simultaneous engagement with the grinding and regulating wheels, a block supporting the blade for vertical adjustment relative to the grinding throat, journal bearings operatively associated with the block, a shaft oscillatably journaled in the bearings, arms carried by the shaft and adapted to be adjustably locked axially of the shaft, a piston and cylinder mechanism operatively coupled with the shaft for effecting its oscillation in a direction to shift the pressure rollers into engagement with the work while on the work rest blade, and yielding means for oscillating the shaft in a reverse direction to free the work of the pressure rollers, each of said arms being formed of two parts pivoted to one another whereby the pressure rollers may be circumferentially adjusted as respects the axis of the shaft.

28. In a centerless grinder of the class described the combination of a pair of opposed grinding and regulating wheels forming a grinding throat therebetween, a work rest blade subtending the grinding throat for supporting the work while in simultaneous engagement with the grinding and regulating wheels, a block supporting the blade for vertical adjustment relative to the grinding throat, journal bearings operatively associated with the block, a shaft oscillatably journaled in the bearings, arms carried by the shaft and adapted to be adjustably locked axially of the shaft, a piston and cylinder mechanism operatively coupled with the shaft for

effecting its oscillation in a direction to shift the pressure rollers into engagement with the work while on the work rest blade, and yielding means for oscillating the shaft in a reverse direction to free the work of the pressure rollers, each of said arms being formed of two parts pivoted to one another whereby the pressure rollers may be circumferentially adjusted as respects the axis of the shaft, said arm locking means comprising a plurality of notches formed along the shaft, and yieldable detents carried by the arms co-operating with said notches.

29. In a centerless grinder of the class described the combination of a bed, a pair of opposed grinding and regulating wheels mounted thereon and forming a grinding throat therebetween, a slide supporting the regulating wheel for movement toward and from the grinding wheel to vary the width of the grinding throat, a second slide mounted on the first in which is journaled the regulating wheel, means for shifting the said second slide transversely of the first to axially adjust the position of the grinding and regulating wheels, a driven shaft rotatably journaled in the first slide, a transmission mechanism carried by the second slide and including the regulating wheel, and a sliding driven gear on the driven shaft connected with the regulating wheel transmission means whereby the regulating wheel is properly rotated throughout the transverse adjustment thereof.

30. In a centerless grinder of the class described the combination of a bed, a pair of opposed grinding and regulating wheels mounted thereon and forming a grinding throat therebetween, a slide supporting the regulating wheel for movement toward and from the grinding wheel to vary the width of the grinding throat, a second slide mounted on the first in which is journaled the regulating wheel, means for shifting the said second slide transversely of the first to axially adjust the position of the grinding and regulating wheels, a driven shaft rotatably journaled in the first slide, a transmission mechanism carried by the second slide and including the regulating wheel, a sliding driven gear on the driven shaft connected with the regulating wheel transmission means whereby the regulating wheel is properly rotated throughout the transverse adjustment thereof, and a variable drive mechanism for rotating the driven shaft.

31. In a centerless grinder of the class described the combination of a bed, a pair of opposed grinding and regulating wheels mounted thereon and forming a grinding throat therebetween, a slide supporting the regulating wheel for movement toward and from the grinding wheel to vary the width of the grinding throat, a second slide mounted on the first in which is journaled the regulating wheel, means for shifting the said second slide transversely of the first to axially adjust the position of the grinding and regulating wheels, a driven shaft rotatably journaled in the first slide, a transmission mechanism carried by the second slide and including the regulating wheel, a sliding driven gear on the driven shaft connected with the regulating wheel transmission means whereby the regulating wheel is properly rotated throughout the transverse adjustment thereof, a variable drive mechanism disposed at the end of the bed for rotating the driven shaft, a lever for actuating the shiftable members of the variable drive mechanism which is disposed on the forward side of the bed, and means connecting the control lever with the variable transmission drive.

32. In a centerless grinder the combination of a bed, a spindle rotatably supported thereby, a second spindle rotatably carried by the bed, means supporting one of said spindles for adjustment in a direction of extent of the axis of the first spindle, means for adjusting the support and spindle in a vertical plane to dispose the axes of the spindles obliquely to one another, and additional means for adjusting the spindle and its support in a horizontal plane to adjust the axes of the spindles parallel to one another.

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FREDERICK S. HAAS.