E. W. CLARK.

CYLINDER GRINDING MACHINE.

APPLICATION FILED MAY 13, 1915.

**1,244,703.**

Patented Oct. 30, 1917.

3 SHEETS—SHEET 1.

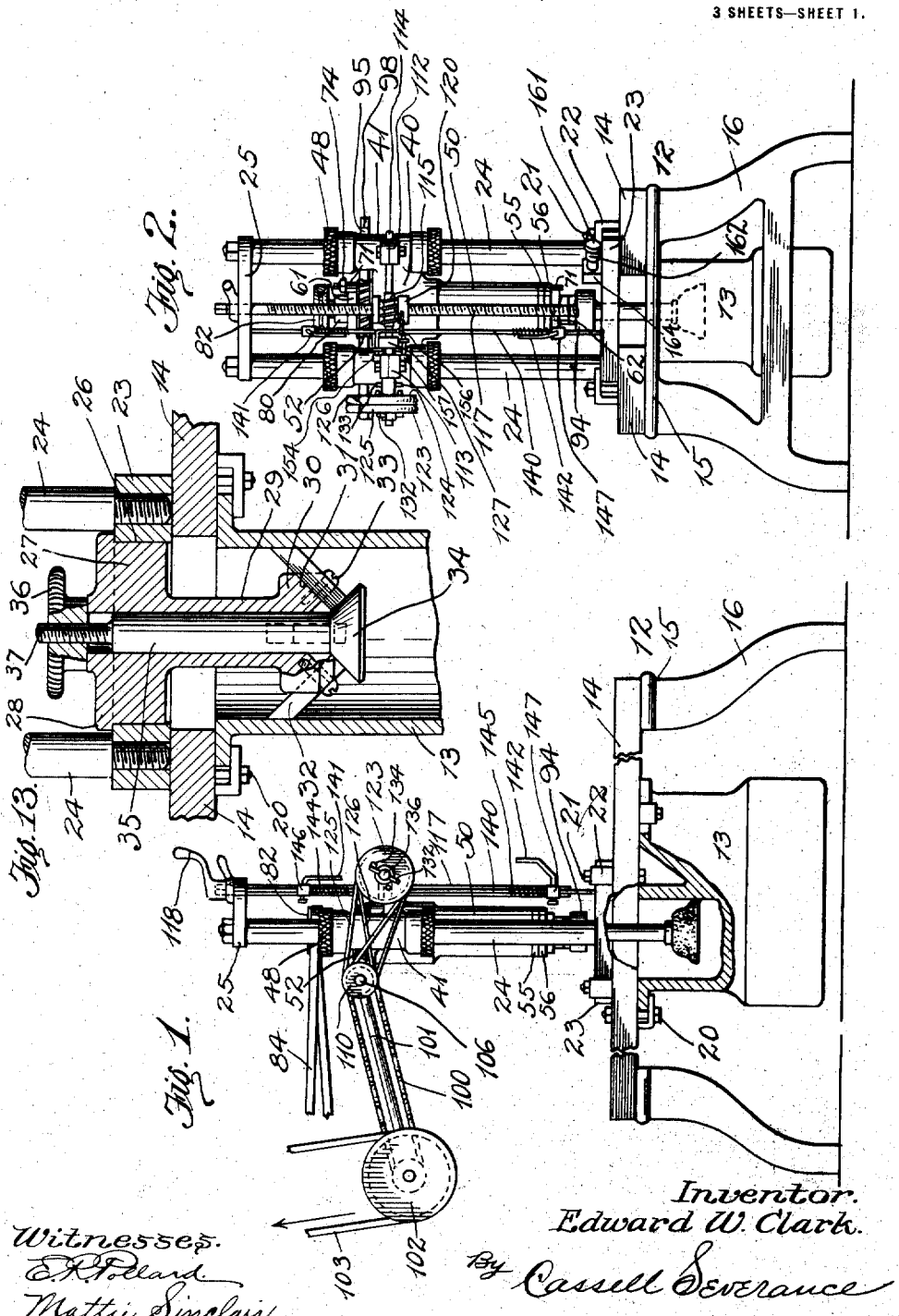


Fig. 2.

Fig. 3.

Fig. 1.

Witnesses.
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Fig. 4.

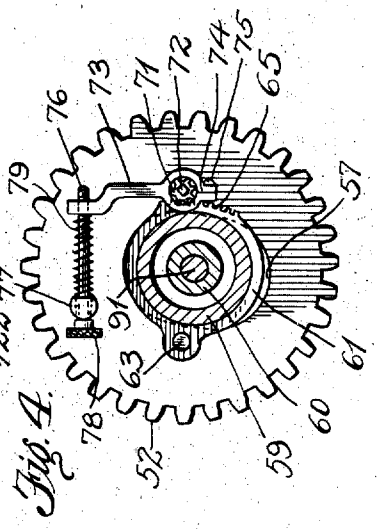



Fig. 5.

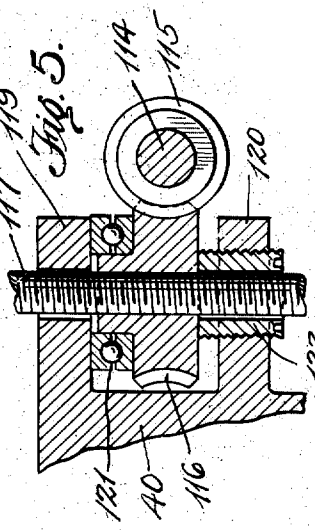



Fig. 14.

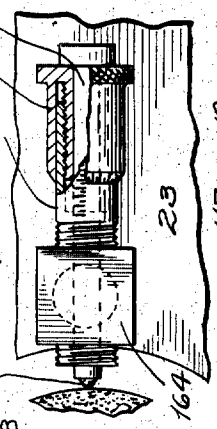



Fig. 7.

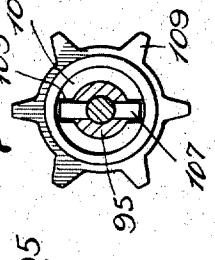



Fig. 6.

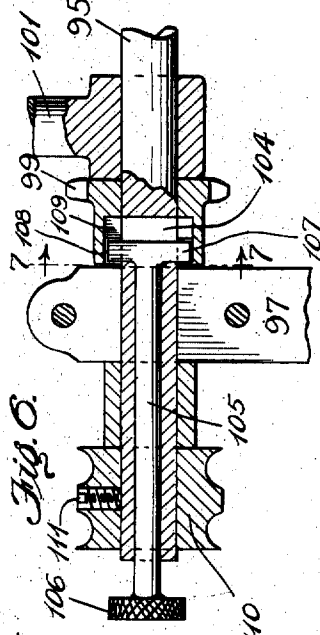
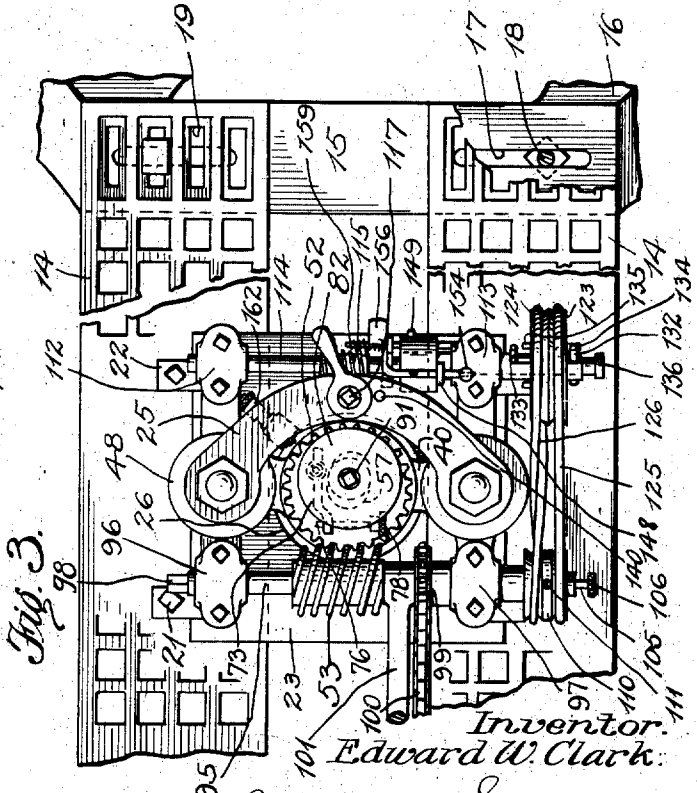



Fig. 3.




Witnesses.

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3 SHEETS—SHEET 3.

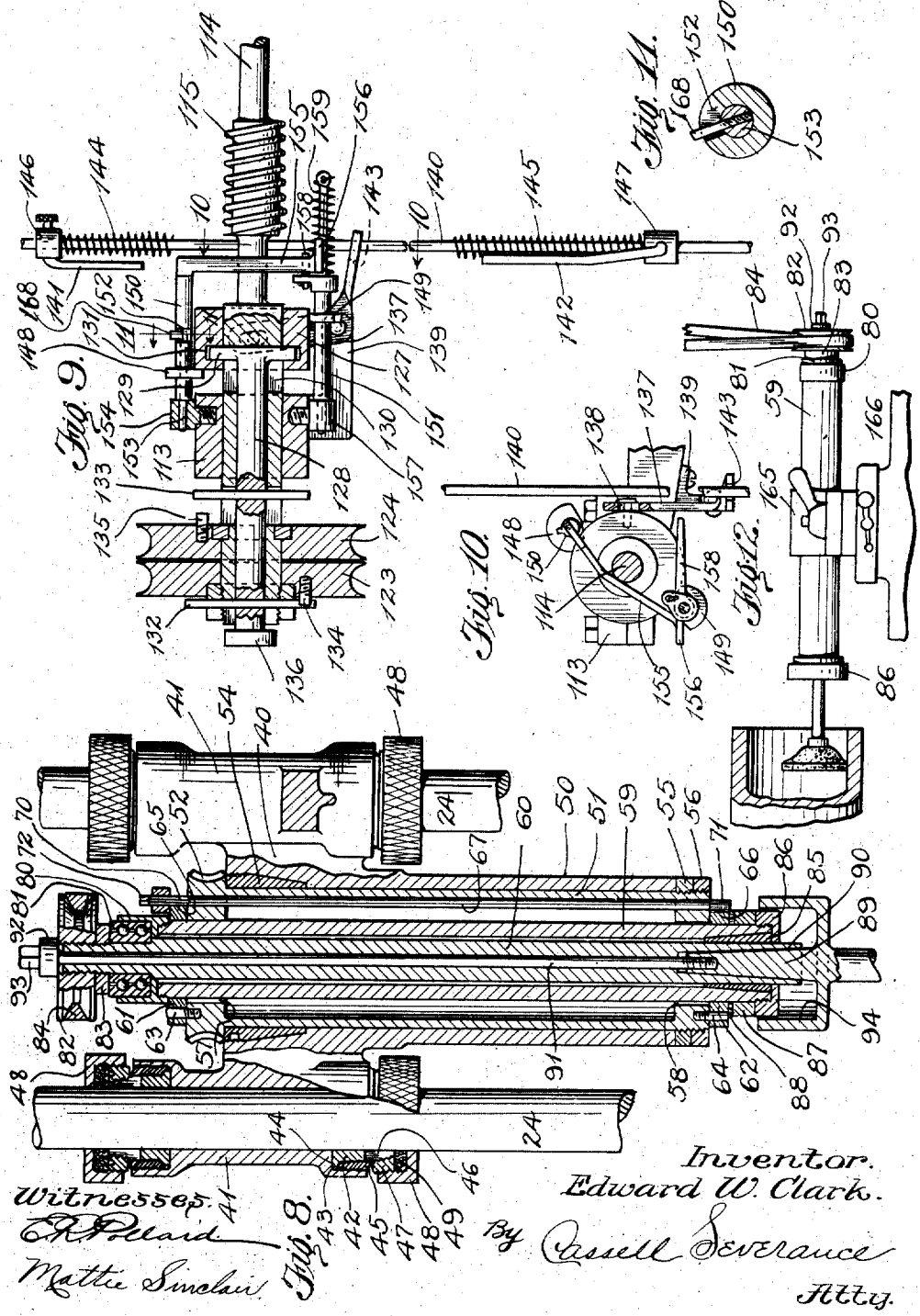


Fig. 9.

Fig. 11.

Fig. 10.

Fig. 12.

Fig. 8.

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# UNITED STATES PATENT OFFICE.

EDWARD W. CLARK, OF LOS ANGELES, CALIFORNIA, ASSIGNOR OF ONE-HALF TO ALVIN WELLS, OF LOS ANGELES, CALIFORNIA.

## CYLINDER-GRINDING MACHINE.

1,244,703. Specification of Letters Patent. Patented Oct. 30, 1917.

Application filed May 13, 1915. Serial No. 27,757.

*To all whom it may concern:*

Be it known that I, EDWARD W. CLARK, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented certain new and useful Improvements in Cylinder-Grinding Machines, of which the following is a specification.

This invention relates to improvements in grinding and boring machines, and especially to machines of a portable character which may be placed on any of the cylinders of an engine for grinding or boring the same and may be readily moved from cylinder to cylinder upon a multiple cylinder engine for grinding or boring all of the cylinders.

It is an object of the invention to provide a machine of the character mentioned with a stand carrying the grinding mechanism having a sufficiently broad base to offer a firm support, and to provide a base therefor upon which the stand may be clamped after the grinding mechanism has been properly centered over the cylinder to be ground, the said base being first placed over and rigidly fastened to the engine or cylinder.

It is also an object of the invention to provide a grinding and boring machine with a tool carrying mandrel adjustable to various distances from the center or axis of a concentrically moving outer mandrel, the adjusting means for the tool carrying mandrel, being capable of quick action for approximate adjustments, while additional fine adjustments are secured by slower acting mechanism.

It is a further object of the invention to provide a grinding mechanism in which a reciprocating feed device for moving the grinding tool longitudinally of the cylinder may be automatically reversed at the extremes of the reciprocating movements, whereby the mechanism does not require constant attention.

With these and other objects in view the invention comprises certain novel constructions, combinations and arrangements of parts as will be hereinafter more fully described and claimed.

In the accompanying drawings forming a part of this specification:

Figure 1 is a side elevation of a grinding and boring mechanism made in accordance with this invention and shown as centered over one of the cylinders of an engine, the cylinder being broken away to show a grinding tool in position.

Fig. 2 is a front elevation of the said mechanism.

Fig. 3 is a top plan view of the tool carrying and operating portion of the device, portions of the supporting base being shown as broken away and the parts appearing upon an enlarged scale.

Fig. 4 is a top plan view of the mandrel mechanism and showing the mechanism at the upper end thereof for adjusting the eccentricity of the inner or tool carrying mandrel.

Fig. 5 is a detail sectional view upon an enlarged scale showing the feed screw for moving the mandrels carrying the grinding and boring tools back and forth, the parts being upon an enlarged scale.

Fig. 6 is an enlarged detail sectional view through the reversing mechanism controlling the movement of the worm gear which operates the mandrel raising and lowering mechanism.

Fig. 7 is a detail sectional view taken upon the line 7—7 of Fig. 6.

Fig. 8 is a longitudinal central sectional view through the mandrel mechanism of the device, adjacent portions of the frame or carriage in which it is mounted being also shown.

Fig. 9 is a view partially in section and partially in elevation of the automatic reversing feed mechanism and the trip mechanism therefor.

Fig. 10 is a detail sectional view taken upon the line 10—10 of Fig. 9.

Fig. 11 is a detail sectional view upon an enlarged scale taken upon the line 11—11 of Fig. 9.

Fig. 12 is a detail view in side elevation of the mandrel mechanism mounted upon a lathe.

Fig. 13 is an enlarged central sectional view through the centering mechanism employed and applied to the bottom of the standard which carries the grinding mechanism, the centering mechanism being shown as extending into a cylinder.

Fig. 14 is a detail view partially in plan and partially in section of a diamond centering device for centering the grinding tool.

In the accompanying drawings the preferred forms of the mechanism parts constituting the improvements of the present in-

vention have been illustrated and the details and features of the invention will now be more specifically described with reference to the said drawings. The present invention is an improvement upon my previous application for a patent filed December 10, 1914, and bearing Serial No. 876,487, the parts set forth in this application being adapted to accomplish substantially the same results with a more simple mechanism and more quickly adjustable parts.

Referring to the said drawings 12 indicates a base frame which may be set over the cylinders 13 of an engine, the said base frame having elongated grids 14 adjustably connected with end cross pieces 15. The cross pieces 15 are provided with supporting legs or standards 16. The ends of the pieces 15 have elongated slots 17 therein adapted to receive clamping bolts 18. The heads of said bolts may be inserted in any one of the series of slots 19 formed in the ends of the said grids 14 according to the distance desired between the grids. The parts are readily adjustable for adapting the stand for use in connection with engine cylinders or other devices which it is desired to grind, finish or bore. The grids 14 are formed with a large number of holes therein so that an engine flange may be easily clamped thereto by clamping bolts 20. The surfaces of the grids are made preferably smooth and true so that when the base of the mechanism carrying stand or frame is mounted thereon, the axis of the mechanism will be accurately perpendicular to the surface of the grids and when the said stand is centered and clamped in position above an engine cylinder as by clamping bolts 21 and angle brackets 22, the cylinder will be accurately ground. It will be understood that the grids 14 do not require any close or accurate adjustment with respect to each other, it only being necessary to bring them approximately to the desired positions so that the stand may be supported thereby, for proper centering as to the work to be performed, after which it is clamped rigidly in place.

Adjustably resting upon the grids 14 is a mechanism carrying stand having a base plate 23 from which rise stout standards 24. The base plate 23 is accurately finished with respect to the standards 24 so that when said base plate rests upon the upper surfaces of the grids 14, the said standards are accurately perpendicular to the surfaces of said grids. The upper ends of the standards 24 are braced and positively held with respect to each other by a curved brace plate or yoke 25, the curved formation of the brace being employed so that the mandrels below may be put in place or removed from their guiding means which normally holds them in operative position between the standards.

The base plate 23 not only forms a means for holding the grinding and drilling mechanism in true position, but by reason of a central opening 26 formed therein affords means for quickly centering the said mechanism with respect to its work. The said opening 26 is carefully made and finished so that it is eccentric with the outer mandrel of the grinding mechanism and so that if said opening is centered with respect to a cylinder to be bored, the boring mechanism will be accurately centered with respect to said cylinder. The said base plate 23 is provided with a removable centering attachment made up of a flanged disk 27 as perfectly fitting the opening 26 as possible, and mechanism adapted to extend into and engage the interior of the bore or cylinder to be ground or finished, the flange 28 of said disk preventing it from falling from place. Depending from the disk 27 is a hollow projection 29 having an enlarged end portion 30, in which are formed inclined seats or sockets 31 to receive spacing and centering pieces 32. The heads of screws 33 on either side of the pieces 32 overhang the said pieces and hold them movably in the sockets 31. The inner ends of the spacing pieces 32 bear against a tapered flaring head 34 formed upon an adjusting bolt 35 which is mounted in the bore of the disk 27 and the hollow projection 29. A thumb nut 36 applied to the upper reduced threaded portion 37 of the bolt 35 is employed for adjusting the said bolt and by means of the flaring head 34 thereof, the spacing pieces 32. It will be readily understood by reference to Fig. 13 of the drawings that with the centering attachment in place in the opening 26, and the spacing pieces 32 in the bore of a cylinder, the thumb nut 36 may be manipulated, and the base plate 23 of the mechanism stand shifted until all of the spacing pieces 32, preferably four in number, touch the walls of the cylinder, and the boring mechanism thus quickly and accurately centered with respect to said cylinder. The base plate 23 may then be tightly clamped upon the grids by the bolts 21 and the mechanism will be in position for accomplishing the grinding or boring operation desired. The centering attachment is then lifted from place and laid aside.

Movably mounted upon the standards 24 is a cross head 40 having sleeve portions 41 which movably fit upon the said standards 24. The sleeves 41 are preferably provided with means at their upper and lower ends for making a very close fit upon the standards 24 and yet be capable of sliding back and forth thereon. Thus each end of each sleeve is preferably provided with a bushing 42 having a flange 43 adapted to be held in a socket 44 in the end of a sleeve

by any suitable means, as for instance babbitting 45. A portion of the bushing 42 projects beyond the babbitting and is provided with a number of slots 46 and a ring nut 47 engages screw threads upon the slotted edge of said bushing for drawing the said bushing snugly about the standard 24. If desired also a gland ring 48 may be screwed upon the outer threaded edge of the said ring 47, packing or wicking 49 being held in place between the parts and crowded against the standard 24, all as clearly shown in Fig. 8 of the drawing. It will be evident however that other kinds of packing means or glands may be employed in the sleeves 41, without departing in the least from the spirit of the invention, the one illustrated and described however, being an economical and effective means for the purpose desired.

The cross head 40 is provided with an elongated cylindrical casing 50 within which is revolubly mounted an outer mandrel 51. The upper end of said mandrel is provided with a gear wheel 52, adapted to mesh with a driving worm 53. The upper end of said mandrel 51 usually engages a bearing bushing 54 while the lower end projects a short distance below the casing 50, the projecting portion having exterior screw threads adapted to be engaged by a ring nut 55 and a locking ring nut 56 whereby the mandrel is held against longitudinal movement in the casing 50.

The end walls of the hollow mandrel 51 are provided with openings 57 and 58 which accommodate a cylindrical casing 59 which carries an inner or tool carrying mandrel 60. The axis of the mandrel 60 is coincident with the axis of the casing 59, so that an adjustment of said casing to and from the axis of the outer mandrel 51, will control the eccentricity of the grinding tool arbor and the size of the bore or of the interior of the cylinder that may be operated upon. In order to swing the casing 59 toward or away from the axial center of the mandrel 51, hollow yokes or quadrants 61 and 62 are pivoted upon the upper and lower ends of the mandrel 51, the pivot pins 63 and 64 holding the same being set outside the openings 57 and 58 in such a position that when the quadrants are swung inwardly, the casing 59 may be so moved in said openings 57 and 58 as to bring the axis of the inner mandrel into coincidence with the axis of the outer mandrel 51, and when said quadrants are swung outwardly, the said casing 59 may be moved closer and closer to the peripheral wall of the outer mandrel 51, giving the boring tool the proper eccentric adjustment to grind or bore a cylinder or other article to the desired size.

The said quadrants 57 and 58 afford a means of quickly adjusting the inner mandrel, and each of said quadrants is provided with a toothed rack 65 and 66, struck upon arcs with the pins 63 and 64 as centers, the axes of said pins being coincident. An adjusting shaft 67 made somewhat longer than the outer mandrel 51 and having bearings in the end walls of said mandrel, is provided with gear teeth 70 and 71 adapted to mesh with the teeth of the said racks 65 and 66, the structure being such that when a wrench or handle is applied to the squared end 72 of said shaft 67 and the shaft turned, the said quadrants will be turned upon their pivot pins simultaneously, and exactly to the same degree. The position of the inner mandrel with respect to the outer mandrel may be quickly adjusted and yet with a certainty of always preserving the parallel relation between the axes of the two mandrels. In order to obtain a further very fine adjustment of the inner mandrel, the gear portion 70 of the shaft 67 is elongated so as to project above the quadrant 61 and have applied thereto a lever or arm 73. One end of said arm is usually formed with a split band portion 74 which may be tightened upon the gear portion 70 for turning the shaft 67, by the application of a screw driver to a screw 75. The outer end of the arm 73 has a screw threaded aperture therein adapted to be engaged by an adjusting screw 76, the other end of which loosely engages an aperture in a stud 77 projecting from the upper end of the outer mandrel 51. A knurled head 78 on the end of the said screw 76 permits of turning the same to move the said arm 73 for securing fine shades of adjustment in the shaft 67 and the quadrants 61 and 62. A spring 79 interposed between the outer end of the arm 73 and the stud 77, and carried by the said screw 76, normally forces the arm 73 away from the stud 77, to the extent permitted by the head 78. It will be readily understood that a quick although fine adjustment of the inner mandrel may be readily had through the operation of the mechanism just described. By loosening the screws 75, the shaft 67 may be readily turned irrespective of the arm 73 for quickly throwing the quadrants and bringing the inner mandrel approximately to the position desired, after which by tightening the screw 75 and manipulating the screw 76, a finer adjustment may then be had.

For removably holding the inner mandrel 60 within the casing 59, suitable bearings are arranged at the upper and lower ends of said casing. At the upper end, the casing 59 is provided with an exteriorly threaded end portion, extending sufficiently above the quadrant 61 to receive an interiorly threaded flange of a collar 80, within which are arranged ball bearings 81. The mandrel

60 is somewhat reduced in diameter within the bearing and the inner member of said bearing is rigidly secured thereto. The said reduced portion extends above the said bearing 81 and is screw threaded to receive a pulley 82 by which the mandrel is rotated, a washer or spacing ring 83 being interposed between the ball bearing and the said pulley. A belt 84 of any suitable kind extends from the said pulley to any suitable source of power.

The lower end of the casing 59, is usually fitted in a bearing bushing 85 fitted into the lower end of said casing and a screw cap ring 86 engaging exterior threads on the casing 59 holds the bushing in place. A spacing ring 87 and an anti-friction washer 88 between the said ring 86 and the lower quadrant 62, insures the keeping of the said quadrant flatly against the lower end of the outer mandrel 51. The boring or grinding tool is usually made with a tapered end portion 89 upon its stem or shank, adapted to fit into a tapered socket 90 in the lower end of the mandrel 60. The said mandrel 60 is centrally bored so as to receive a tool holding shaft or rod 91, which is screw threaded at its lower end to engage a threaded opening in the tapered end 89 of the tool shank. The upper end of the said shaft or draw rod 91 has a head 92 bearing against the pulley 82 and provided with a squared portion 93 by which it may be turned. A grinding or boring tool may readily be removed or put in place by a manipulation of the draw rod 91. In order to prevent oil from running upon the grinding tool, an oil collecting cup 94 is preferably carried by the shank or tool, its upper edge usually just receiving the cap ring 86, as clearly shown in Fig. 8 of the drawing. The difficulty heretofore experienced with vertically arranged grinding and boring mandrels, due to the running of the oil from the parts, down upon the carborundum or other grinding tools, is thus entirely obviated.

The worm 53 which drives the outer mandrel is carried by a transverse shaft 95 which engages bearings at 96 and 97 carried by brackets projecting laterally from the sleeves 41. One end of the said shaft 95 is usually squared at 98 to receive a wrench or socketed handle by which it can be turned by hand when desired. Generally, however, the said shaft 95 is turned by a sprocket wheel 99 which is connected by a sprocket chain 100 with another sprocket wheel spaced therefrom by a rod 101, a pulley 102 being adapted to turn said sprocket wheel and engage a driving belt 103 which extends to any suitable source of energy not illustrated. The arrangement is such, as will be noted by reference to Fig. 1 that the sleeves 41 may rise and fall upon the standards 24 without interrupting the driving of the mandrel. A similar connection with a source of power, not shown, may be provided for the belt 84, whereby the constant driving of the inner mandrel will not be interfered with by the raising and lowering of the mechanism on the standards 24. The connection between the sprocket wheel 99 is such that it may be disconnected and allowed to run free thereon when desired, or when it is wished to adjust the parts by hand, through the application of a handle or wrench to the squared end 98 of the shaft 95. To facilitate such action, the shaft 95 is provided with a slot 104 within a portion of the gear 99 and the outer end of said shaft is provided with a bore to receive a clutch rod 105. The outer end of the said rod is provided with a head 106 by which the rod may be adjusted. The inner end of said rod is provided with a cross head 107, the ends of which project laterally into an annular recess 108 formed in the hub of the sprocket wheel 99, when the said rod 105 is pulled to the outward limit of its movement, and which engage oppositely arranged recesses 109 also in said hub, when the said rod 105 is pushed inwardly, whereby the sprocket wheel 99 will be locked upon the shaft 95 and cause the shaft to turn therewith, all as will be readily understood by reference to Figs. 6 and 7 of the drawing.

The bored end of the shaft 95 is also provided with a double pulley 110 for driving the mechanism employed in raising and lowering the sleeves 41 and the cross head 40. Said pulley 110 is usually rigidly secured to the shaft 95 by means of a set screw 111.

Upon the other side of the sleeves 41 from the brackets carrying the bearings 96 and 97 are other brackets carrying bearings 112 113, in which is journaled a horizontal transverse shaft 114. To the center of said shaft 114 is secured a worm 115 adapted to mesh with a worm gear wheel 116, the hub of which has a threaded engagement with a vertically arranged feed shaft 117. The upper end of the feed shaft 117 is supported upon the central part of the yoke plate 25, so that it may be turned therein without raising and lowering the feed shaft and the upper end of the said shaft may be squared so that a wrench or handle 118 may be applied thereto for turning the same by hand when desired to adjust the position of the parts temporarily. The lower end of the feed shaft 117 extends to a point within a short distance of the base plate 23, and is screw threaded for the greater portion of its length. The shaft except when the adjustment is by hand, does not rotate but the turning of the worm gear 116 through the power driven shaft 114 and the worm 115, causes said gear to travel up and down the shaft carrying the cross head 40 with it. The said worm gear 116 is

mounted between projecting lugs 119 and 120 upon the cross head 40 and ball bearings 121 are interposed between said gear and the lug 119 for supporting the cross head on the said gear without appreciable friction. A screw threaded ring 122 carried by the lug 120 engages the lower face of the gear 116 sufficiently to hold it against the bearings 121, but not so as to interfere with the turning of the said gear, as will be readily understood by reference to Fig. 5 of the drawings.

One end of the shaft 114 is enlarged, a portion of the enlargement engaging the bearing 113. The said enlarged shaft portion also carries actuating pulleys 123 and 124, the former of which is connected by a straight belt 125 with one of the grooves of the pulley 110, while the latter is connected by a cross belt 126 with the other groove of the said pulley 110. The pulleys 123 and 124 will thus revolve in opposite directions and through suitable connecting means will rotate the shaft 114 first in one direction and then the other. An automatic clutch mechanism is provided for shifting the connections employed for causing the turning of the shaft 114 by means of the pulleys 123 and 124 successively. The enlarged portion of the shaft 114 is provided with a movable ring or collar 127, which is adapted to shift a clutch rod 128 located in a bore in the enlarged portion of the shaft. The inner end of the rod 128 is provided with oppositely projecting arms forming a cross head 129 which project through the slots 130 formed in the enlarged portion of the shaft 114, and sufficiently beyond said slots to engage an inner annular groove 131 formed upon the shifting collar 127. The rod 128 may thus turn the shaft 114 but may be shifted longitudinally by the movement of the collar 127. The said rod 128 also carries cross pins or rods 132 and 133 outside the pulleys 123 and 124 and adapted to be moved so as to come in contact with one or more pins 134 and 135 which project from the outer faces of the pulleys 123 and 124 respectively. The said pins 132 and 133 project through slots formed in the enlarged portion of the shaft 114 and are spaced apart sufficiently so that when one is brought in engagement with the pin or pins of one pulley, the other will be moved out of the path of the pin or pins of the other pulley, and vice versa. The outer end of the rod 128 usually projects beyond the shaft 114 and is provided with a head 136 for moving the rod by hand when desired. The said shifting rod 128 is usually operated automatically however by the shifting of the collar 127. For this purpose a bell crank lever 137 having a pin and slot engagement at 138 with the collar 127, is mounted upon a bracket 139 which projects from the bracket carrying the bearing 113. One end of the bell crank lever projects toward a rod 140 carrying tripping projections 141 and 142. The said bell crank lever is slotted at 143 so as to receive the said rod 140 and so as to engage springs 144 and 145 carried by said rod. The rod is fixed upon the mechanism stand, its lower end being fastened to the base plate 23 while its upper end is fastened to the yoke plate 25. The tripping pieces or projections 141 and 142 are carried by sleeves 146 and 147 which are clamped in desired positions upon the rod 140 by suitable set screws, and the outer ends of the said springs 144 and 145 are fastened to and held by the said sleeves.

The shifting collar 127 is positively held in its shifted positions by latch pieces 148 and 149, which are carried by rock shafts 150 and 151. The shaft 150 is provided with a longitudinal central bore extending inwardly from one end thereof to a transverse segmental slot 152 arranged about centrally of the length of the said shaft. A rod or smaller shaft 153 carried by a stud 154 on the bearing 113, projects into the bore of said shaft 150, and a pin 168 is inserted through the slot 152 and screwed into an aperture in said smaller shaft 153, whereby the rocking movement of the shaft 150 is limited. The outer end of the shaft 150 carries an operating arm 155 having a broad end portion 156 adapted to strike the projection 142 when the grinding mechanism has reached the lower extreme of its movement and the shaft 150 will be rocked so as to turn the latch piece 148 out of the way of the shifting collar 127 and permit the bell crank 137 to throw the collar to the other extreme of its movement. The spring 145 will have been compressed by the descent of the bell crank lever, before the latch piece 148 released the collar 127, so that the bell crank will shift the collar with a positive throw under the impulse of the spring 145. The collar will be caught by the rocking latch piece 149 carried by the shaft 151. One end of the said shaft 151 is reduced in diameter and inserted in an aperture in a stud 157 also carried by the bearing 113. The outer end of the shaft 151 is provided with an arm 158 which extends into alinement with the trip projection 141. A spring 159 is mounted upon a reduced projection of said shaft 151 and is connected at its inner end with a projection on the arm 158, the said spring tending to lift the said arm and to rock the latch member 149 into position for holding the collar 127 in one of its adjusted positions. It will be noted in this connection that the collar holds the latch projections from being rocked into latching position, by reason of the said latches engaging the peripheral surface of the said collar, until it has been moved far enough either way to permit the latches to snap

past its edges, under the impulse of the weight of the arm 155 in one instance, and under the action of the spring 159 in the other instance. When the boring mandrels have moved to their upper positions between the standards 24, the bell crank lever will first compress the spring 144 and then the trip projection 141 will be engaged by the arm 158 for rocking the latch piece 149 and releasing the collar 127. The bell crank will immediately throw the collar to the other extreme of its movement, with a snappy action under the impulse of the spring 144. By means of the mechanism just described, the boring or grinding tool may be set to work and started downwardly in a cylinder. When the tool has passed downwardly through the cylinder, the tripping devices set forth will automatically shift the collar 127 and the rod 128 whereby the shaft 114 will be released from engagement with one of its driving pulleys and be connected with the other, whereby its movement will be reversed and the grinding or boring tool will be carried upwardly through the cylinder again. Thus the reversal of the grinding mechanism will be automatically accomplished, and no harm can come to the mechanism for lack of attention on the part of an attendant.

The mechanism is also preferably provided with a diamond for keeping the periphery of the grinding tools employed even and true. As shown in Figs. 2, 3 and 14 of the drawings, a diamond device is mounted upon the base plate 23 of the mandrel carrying stand, said diamond as 160 is carried by a rod or stem 161 which is removably inserted in a double sleeve or micrometer ring 162. The inner portion of the micrometer ring is provided with exterior screw threads adapted to engage the interiorly threaded surface of a micrometer screw 163. One end of the micrometer screw 163 is exteriorly threaded and engages a threaded aperture in a stud 164 which rises from the base plate 23. The smooth end of the micrometer screw is provided with a longitudinally arranged scale and the beveled edge of the micrometer ring is provided with an annular scale so that the diamond may be accurately adjusted to a very fine degree. The diamond can be set so as to true the grinding tools from time to time as will be readily understood by reference to Fig. 14 of the drawings.

The mounting of the inner mandrel and the cylindrical casing 59 carrying the same, is such that the parts can be very easily removed from the outer mandrel and used for grinding purposes where an eccentric motion is not required, as in the case of a lathe. It is only necessary to remove the cap ring 86 and slip off the washer 87 and the gasket 88 in order to be able to withdraw the casing 59 endwise from the outer mandrel and from the quadrants 61 and 62, the boring tool with its oil cup, having of course, been first disconnected from the mandrel 60. The casing 59 may then be put into an ordinary sleeve clamp 165 upon the bed of a lathe 166 as shown in Fig. 12, and any kind of a grinding tool may be operated in a horizontal position for grinding or boring an article turned by the head of a lathe. The ring 86 is of course screwed upon the end of the casing 59 again to hold the bushing 85 in place. The adaptability of the tool mandrel to vertical or horizontal use will thus be evident.

The operation of the various portions of the device will be readily understood from the above description. In using the mechanism on an ordinary automobile engine for example, the cylinders of the engine are clamped upon the other side of the grids 14 as shown in Fig. 1. The mandrel carrying stand is then moved into position upon the upper faces of said grids and the centering device is put into the opening 26 in the base plate 23. After the manipulation of the centering device to accurately center the mandrel mechanism over the cylinder to be ground, the centering device is removed after having clamped the base plate 23 tightly upon the grids. The inner mandrel is then adjusted to give the boring or grinding tool the proper eccentric movement and the belt 84 is set in operation. The belt 103 is also set in operation for actuating the reversible feed mechanism by which the grinding tool is moved downwardly and then upwardly within the cylinder one or more times. The grinding tool is then withdrawn from the cylinder and the base plate 23 is unclamped and centered quickly over another cylinder, the operation being repeated.

The automatic operation of the feed mechanism saves the time that would be required by the constant need of attention of an operator. It will be evident also that many of the details of construction may be altered without departing from the spirit of the invention. The machine is simple in structure and easy to move from cylinder to cylinder so that a number of cylinders can be accurately ground and finished in a short space of time.

What is claimed is:

1. A portable grinding mechanism having a base adapted to be clamped upon an article to be ground, a mechanism stand adapted to be shifted with respect to the said base for centering it upon the article to which the base is clamped, the fitting of the stand upon said base insuring the accurate movement of the grinding tools with respect to the work, and means for holding and operating the grinding tools.

2. A portable grinding mechanism com-

prising a frame having a work supporting grid affording a true surface upon which a mechanism may be adjusted, a mechanism stand having a base adapted to fit accurately upon the face of said grid and adapted to move over the same for centering the grinding mechanism with respect to the article to be ground, means for clamping the stand in centered position upon said grid and mechanism carried by said stand for accomplishing the grinding and boring of the work carried by said grid.

3. A grinding mechanism having a tool rotating and shifting mandrel device, a stand carrying the same and having a base accurately finished in a plane at right angles to the axis of the mandrel device and a work supporting base frame having a stand supporting grid affording a true surface upon which the stand may be clamped for holding it accurately with respect to the work.

4. A grinding mechanism having a tool operating mandrel device, a shifting stand carrying the same, a work supporting frame having adjustable apertured plates thereon to which the work may be clamped, and means for clamping the shifting stand upon said plates in accurate relation to the work.

5. A portable grinding mechanism comprising a base frame having end standards with slots therein, apertured plates having slotted portions adapted to be adjustably clamped upon said end standards and having apertures permitting of the clamping of articles to be bored, to said plates, a tool operating mechanism, a stand adapted to slide upon said apertured plates for centering the tool operating mechanism with respect to the article to be bored and means for clamping the said stand upon said apertured plates.

6. A grinding mechanism comprising a portable stand having upright guides and a base carrying the same and arranged at right angles to said guides, a cross head adjustable on said guides, means for raising and lowering the cross head on said guide, a tool operating mandrel mechanism carried by said cross head, means for operating the same, and means for holding the portable stand upon an article to be ground, the holding of the stand base accurately upon the said article, insuring an accurate movement of the grinding means with respect to said article.

7. A cylinder grinding mechanism having a tool rotating mechanism, a base plate carrying the said mechanism and having an aperture centered with respect thereto, a centering device adapted to fit in said aperture and having means projecting into a cylinder for bringing the center of the aperture in the base plate into coincidence with the axis of the cylinder, whereby the tool rotating mechanism will be properly centered for operation within the cylinder, and a supporting grid clamped to the article to be ground and affording an accurate surface to receive said base plate.

8. A grinding mechanism having a shifting base, means for clamping the same with respect to an article to be ground, standards rising from said base, a cross head adjustable upon said standards and carrying a mandrel mechanism, a feed mechanism for raising and lowering the mandrel mechanism and means for automatically reversing the said feed mechanism.

9. A portable grinding mechanism having a frame adapted to be held over the article to be ground, upright standards secured to said frame, a feed shaft suspended from said standards, a cross head adapted to be raised and lowered upon said standards and operated by said shaft to a predetermined position and a tool driving mechanism carried by said cross head.

10. A portable grinding mechanism having a standard frame adapted to be held over the article to be ground and having upright guides, a cross head movable upon upright guides and automatically operated means for lowering and raising the cross head to a predetermined extent and a tool driving mechanism, means for limiting the movement of said mandrel mechanism carried by said cross head.

11. A cylinder grinding mechanism comprising a portable stand having parallel uprights therein, a mandrel mechanism movable upon said uprights and having guiding sleeves engaging the same, a mandrel turning shaft journaled upon said sleeves, a feed operated shaft upon said sleeves, means for operating the mandrel turning shaft, means for communicating movement from said shaft for turning the feed shaft in either direction, a feed screw operated by said feed shaft for raising and lowering the mandrel mechanism and means for reversing the rotation of the feed screw.

12. A cylinder grinding mechanism having a tool carrying mandrel, an outer mandrel supporting the same, means thereon for obtaining a quick adjustment of the tool carrying mandrel with respect to the axis of the said outer mandrel, auxiliary means for obtaining an additional fine adjustment of the tool carrying mandrel and means for rotating the said mandrels.

13. A cylinder grinding mechanism comprising an outer mandrel having openings in the ends thereof for accommodating an eccentric adjustment of an inner mandrel, an inner mandrel movable in said openings, pivoted members upon the outer mandrel adapted to move the inner mandrel to and from the axis of the outer mandrel, means for swinging the said pivoted members

simultaneously to secure the proper adjustment of the inner mandrel, means for rotating the outer mandrel for giving the inner mandrel an eccentric throw and means for rotating the inner mandrel for operating a grinding or boring tool.

14. A grinding mechanism for cylinders comprising a tool carrying mandrel, an outer hollow mandrel carrying the same, quadrants pivoted upon the outer mandrel and carrying the inner mandrel, said quadrants having segmental racks thereon, a shaft having gears adapted to engage the racks of said quadrants simultaneously to adjust the tool carrying mandrel with respect to the outer one, an arm adapted to be clamped to said shaft for further adjusting the quadrants, means for adjusting and holding said arm, and means for operating the said mandrels.

15. A cylinder grinding machine having an outer mandrel and an inner tool carrying mandrel and means for swinging the inner mandrel from a center outside the axis of the outer mandrel for moving the inner mandrel away from or toward the axis of the outer mandrel, and thereby alter the range of movement of the inner or tool carrying mandrel.

16. A cylinder grinding machine having an outer mandrel and an inner tool carrying mandrel, means for swinging the inner mandrel toward or away from the axis of the outer mandrel from a point outside the said axis to vary the eccentric position of the tool carrying mandrel and means for holding the inner mandrel in its adjusted positions.

17. A cylinder grinding machine having an outer mandrel and an inner mandrel extending through the same, rings pivoted upon the ends of the outer mandrel near the periphery thereof and having apertures for receiving and holding the inner mandrel, said rings having segmental racks upon their edges, a shaft journaled in the ends of the outer mandrel and having gears formed upon the ends thereof to mesh with said racks, the gear portion of the shaft at one end thereof having an arm adapted to be clamped thereto after the rings have been adjusted approximately to the desired positions, and a screw for operating the said arm for obtaining very fine degrees of adjustment of the inner mandrel.

18. A cylinder grinding machine having an outer mandrel, an inner mandrel for operating grinding or boring tools, a casing inclosing the inner mandrel and having bearings for revolubly mounting the same, quadrants upon each end of said casing having projections pivoted upon the ends of the outer mandrel outside the axis of the same, for adjusting the said casing and the inner mandrel toward or away from the axis of the outer mandrel whereby a suitable gyratory movement may be given the inner mandrel, gear teeth upon said quadrants, a shaft having corresponding meshing gear teeth for moving the quadrants simultaneously, an adjustable arm adapted to turn said shaft whereby approximate adjustments and then adjustments of finer degrees may be had of the inner mandrel and means for removably holding a grinding tool on said inner mandrel.

19. A cylinder grinding machine having an outer mandrel and an inner mandrel adjustably mounted therein and capable of removal for use outside the outer mandrel, means for securing a grinding tool to the inner mandrel, a grinding tool and an oil cup carried thereby and adapted to collect any drippings of oil from the mandrel mechanism and prevent the same from reaching the grinding tool when the tool is operated in vertical position.

20. A cylinder grinding mechanism having an outer mandrel and an inner mandrel, a casing carrying an inner mandrel and adapted to be adjusted to concentric and eccentric positions with respect to the axis of the outer mandrel, a gear for turning the outer mandrel, an actuating worm meshing therewith, a shaft carrying said worm, power means for turning said shaft, the said means being capable of accommodating itself to different positions in which the mandrel may be operated, a pulley connected with the inner mandrel and means for driving it also capable of accommodating itself to the movements of the inner mandrel.

21. A cylinder grinding mechanism comprising a frame having vertical guides, a casing adapted to move longitudinally with respect to said guides, a feed screw extending parallel to the direction of movement of the said casing, a gear moving on said feed screw and having a bearing upon said casing and means for turning said gear to move the casing back and forth along said feed screw.

22. A cylinder grinding mechanism having a guiding and supporting stand, a mandrel carrying casing movable in said stand, tool operating mandrels in said casing, a feed screw supported in said stand, a gear engaging said feed screw and movably supporting the said casing thereon, a worm engaging said gear, a shaft carrying said worm and mechanism capable of turning the said shaft first in one direction and then the other for raising and lowering the said casing.

23. A cylinder grinding mechanism having a supporting stand, a mandrel carrying casing movable therein, tool operating mandrels in said casing, a depending feed screw supported upon said stand, a casing supporting gear movable on said feed screw, a

worm for operating the gear to raise and lower the casing, a shaft carrying said worm, a plurality of pulleys carried by said shaft and driven in opposite directions, means for connecting one or the other of said pulleys with said shaft, according to the direction in which it is to be turned for raising or lowering the casing and means for turning the said pulleys in opposite directions with respect to each other.

24. A cylinder grinding mechanism having a supporting frame, a tool operating mandrel mechanism movably mounted thereon, gearing for moving said mechanism in said frame, a shaft for operating said gearing, oppositely driven pulleys on said shaft, shifting means for connecting the said shaft with one or the other of the said pulleys and a trip mechanism for accomplishing the shifting of said means.

25. A cylinder grinding mechanism having a supporting frame, a tool operating mandrel mechanism adapted to be moved up and down said frame, a feed mechanism for raising and lowering said mechanism, a shaft for operating said feed mechanism and having pulleys thereon capable of turning the shaft in opposite directions, means for driving the pulleys in opposite directions, a reciprocating clutch adapted to connect the pulleys with the said shaft at different times, a collar for shifting said clutch, means for holding said collar at the extremes of its movement and means for tripping the holding means when the mandrel mechanism has reached given points in the course of its movement, whereby its movement will be reversed.

26. A cylinder grinding mechanism having a supporting frame, a tool operating mechanism adapted to be moved up and down in said frame, a feed mechanism for raising and lowering said mandrel mechanism, a shaft for operating the same, actuating pulleys loosely mounted on said shaft, a mechanism for driving said pulleys in opposite directions, a reciprocating clutch member, a collar for moving the same, a lever for moving said collar, springs for actuating said lever to insure a complete throw of the collar and clutch in either direction, detents adapted to hold the collar in its adjusted positions and tripping means for moving said detents and releasing the collar in automatically shifting the said clutch and reversing the movement of the feed mechanism.

27. A cylinder grinding mechanism having a supporting frame, a tool operating mechanism adapted to move up and down in the same, a feed mechanism for raising and lowering the tool operating mechanism, a shaft for driving said feed mechanism, pulleys oppositely driven on said shaft, a clutch mechanism for alternately connecting the pulleys with said shaft, a bell crank lever for shifting said clutch, rocking detents for controlling the clutch, a trip device carrying rod in said frame, trip devices adapted to rock the said detents when the movement of the tool operating mechanism on the frame is to be reversed, and springs upon said rod adapted to be compressed alternately by the said bell crank lever in its upper and lower positions for insuring a proper throw of the clutch mechanism.

28. A cylinder grinding mechanism having a mechanism carrying stand, a mandrel mechanism for operating a grinding tool and adapted to be moved up and down in said stand, gearing for rotating the mandrel mechanism, a shaft for operating said gearing, a double power transmitting pulley on said shaft, a feed mechanism for moving the mandrel mechanism up and down in the frame, a counter shaft for operating said feed mechanism, independent pulleys mounted on said counter shaft, a straight belt connecting one of said pulleys with the said double pulley, a cross belt for connecting the other independent pulley with said double pulley, and means for connecting one or the other of the independent pulleys with the said counter shaft in accordance with the direction in which it is to be driven, for raising or lowering the mandrel mechanism.

In testimony whereof, I have hereunto set my hand, in presence of two witnesses.

EDWARD W. CLARK.

Witnesses:
CASSELL SEVERANCE,
EARLE R. POLLARD.