May 9, 1933. A. STORM ET AL 1,907,938

PISTON TURNING AND GRINDING MACHINE

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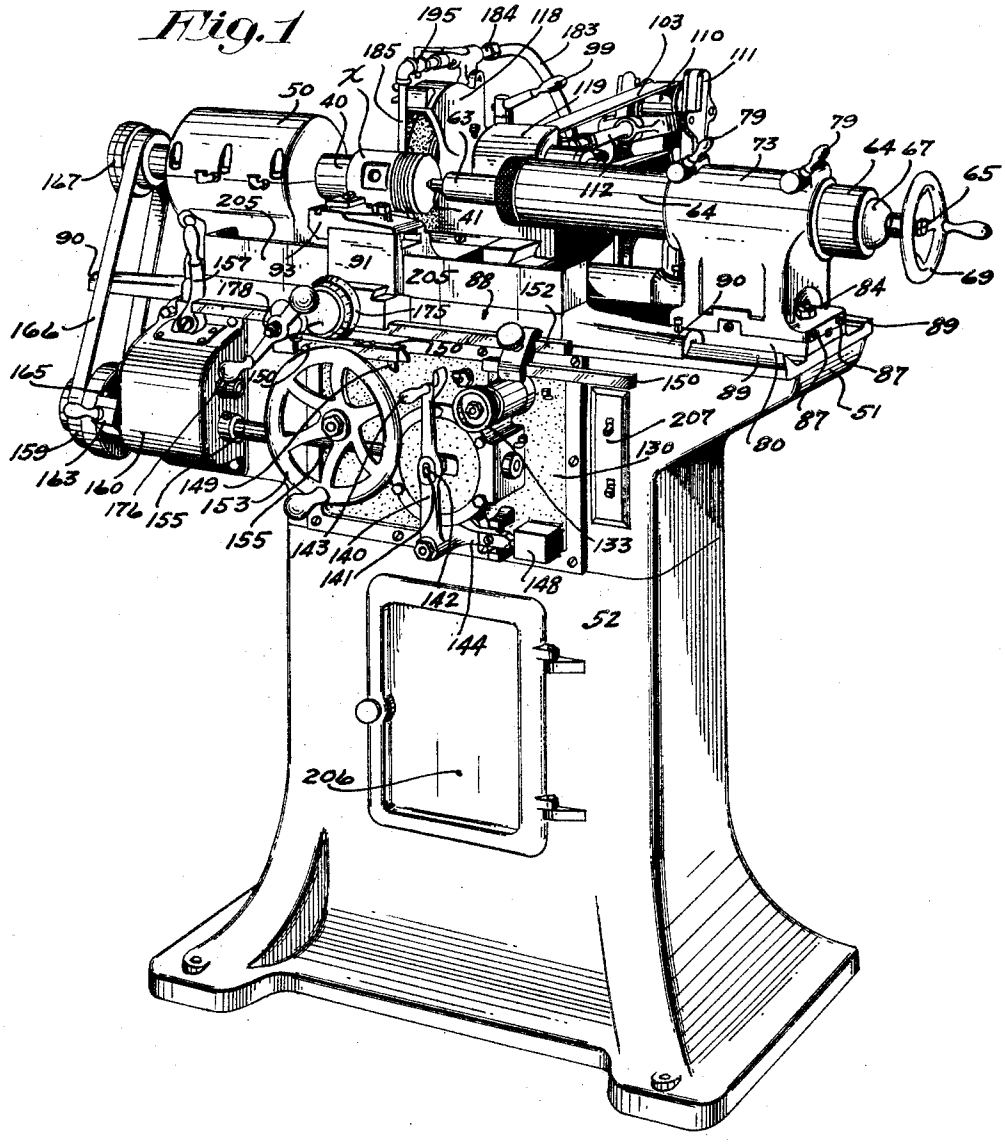
Fig. 1



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By their Attorneys
Merchant and Evans

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PISTON TURNING AND GRINDING MACHINE

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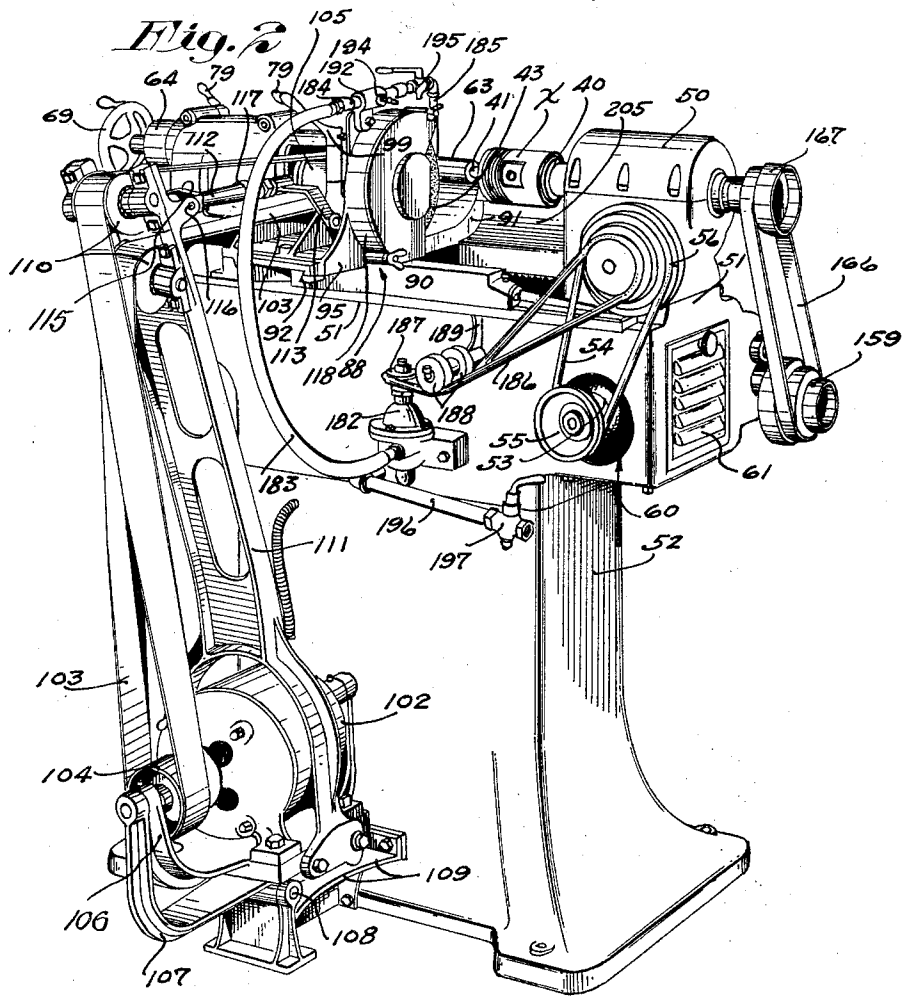
Fig. 2



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May 9, 1933. A. STORM ET AL 1,907,938

PISTON TURNING AND GRINDING MACHINE

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Fig. 3

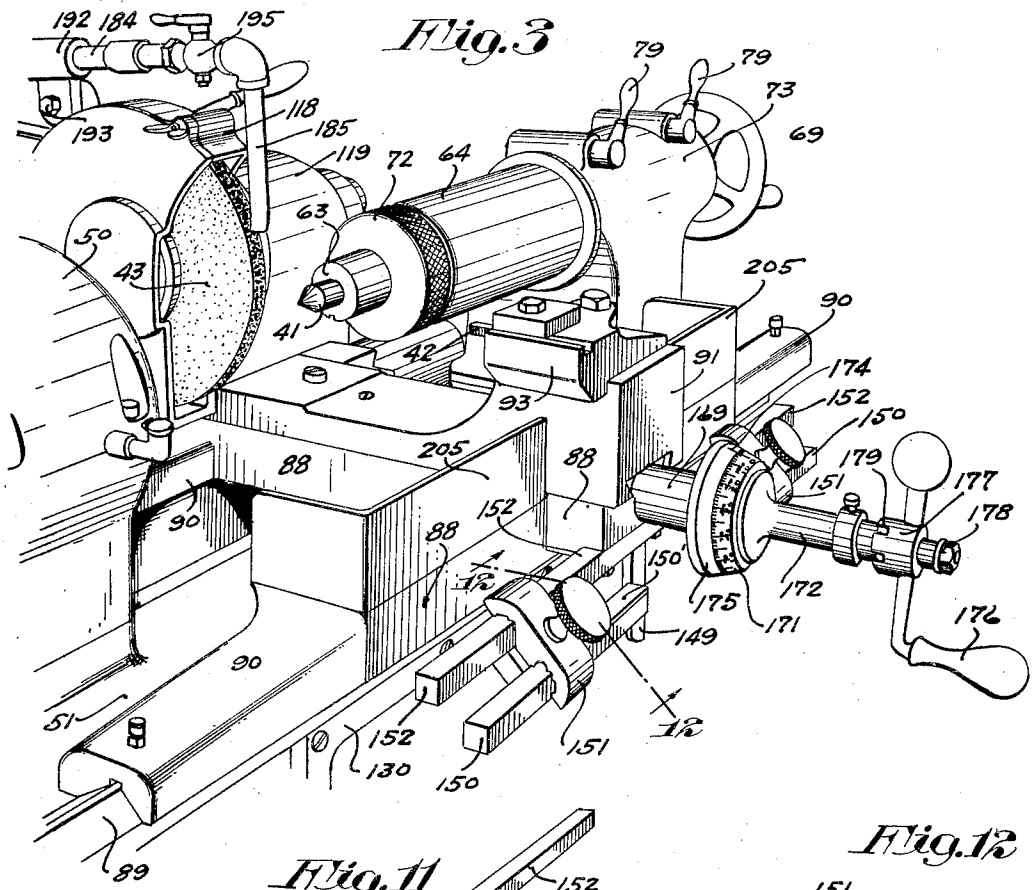


Fig. 11

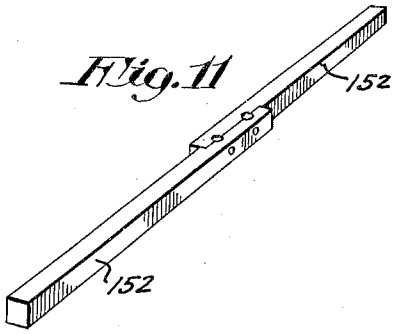
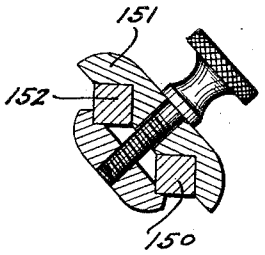


Fig. 12



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May 9, 1933. A. STORM ET AL 1,907,938

PISTON TURNING AND GRINDING MACHINE

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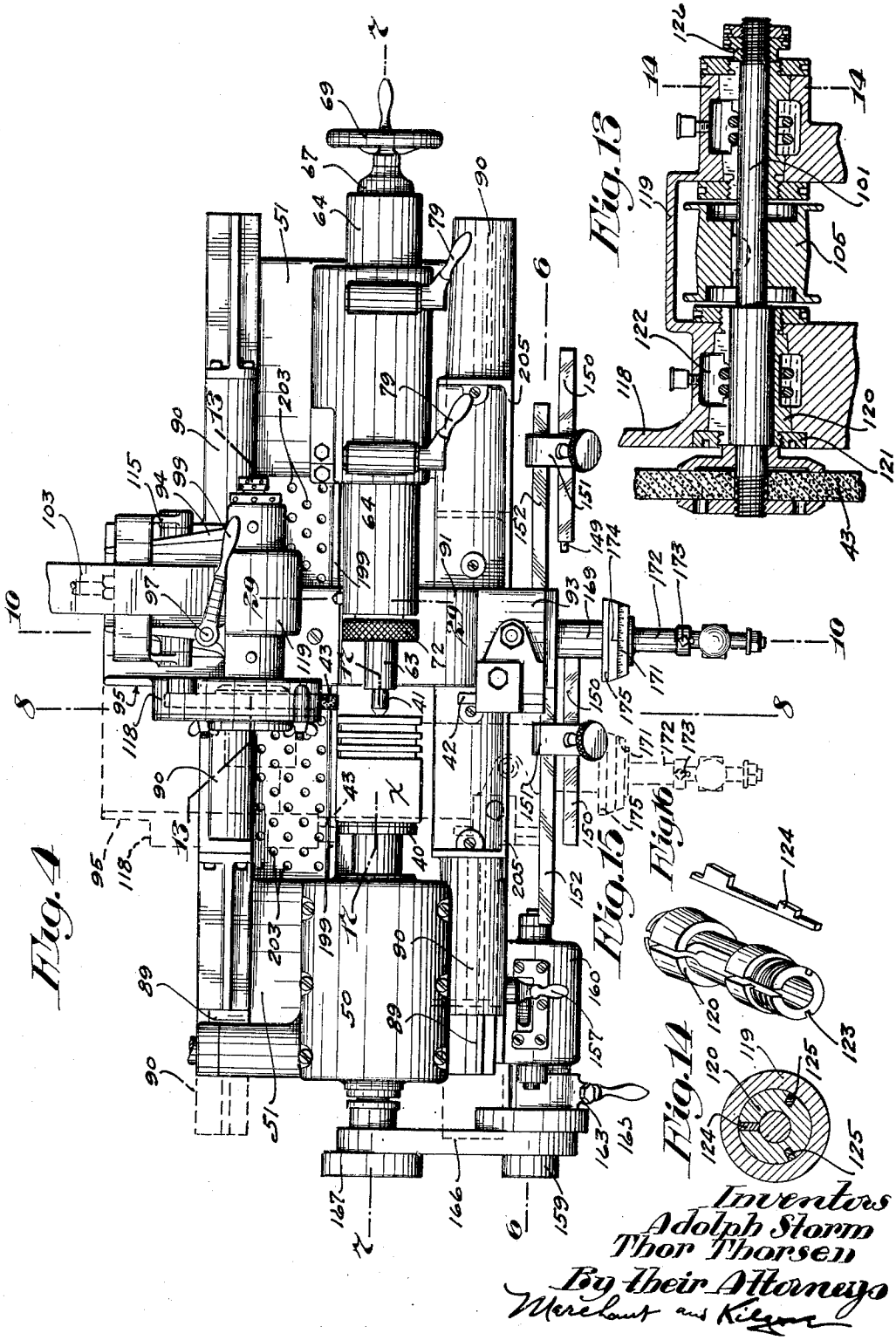

Fig. 4

Fig. 13

Fig. 15

Fig. 16

Fig. 14

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May 9, 1933. A. STORM ET AL 1,907,938

PISTON TURNING AND GRINDING MACHINE

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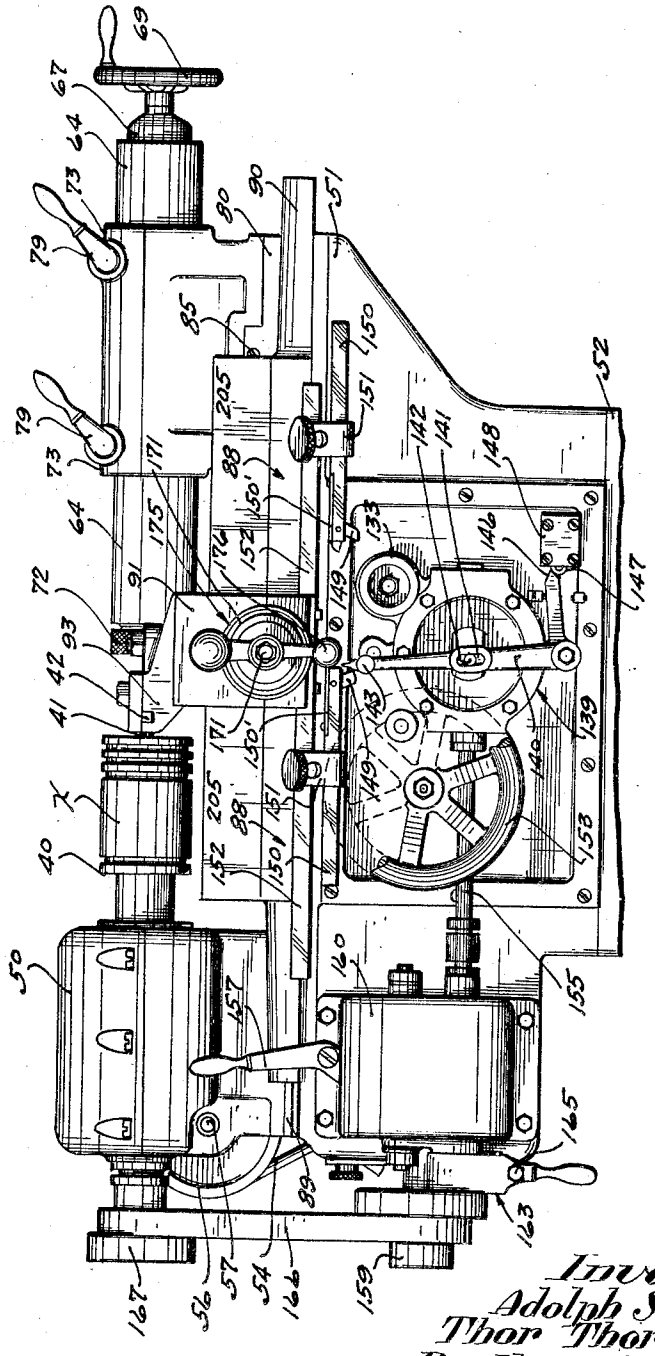
Fig. 5



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PISTON TURNING AND GRINDING MACHINE

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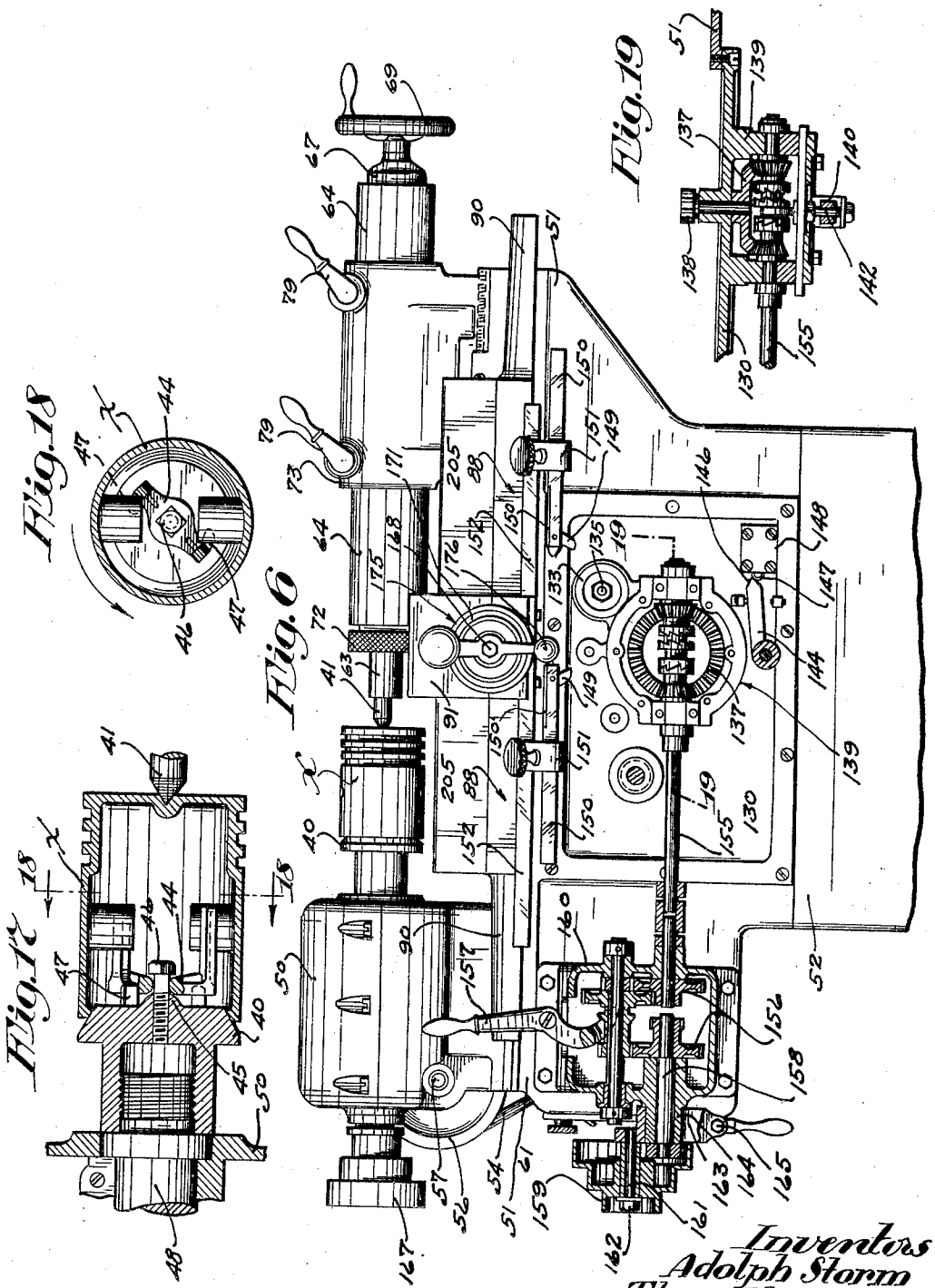

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PISTON TURNING AND GRINDING MACHINE

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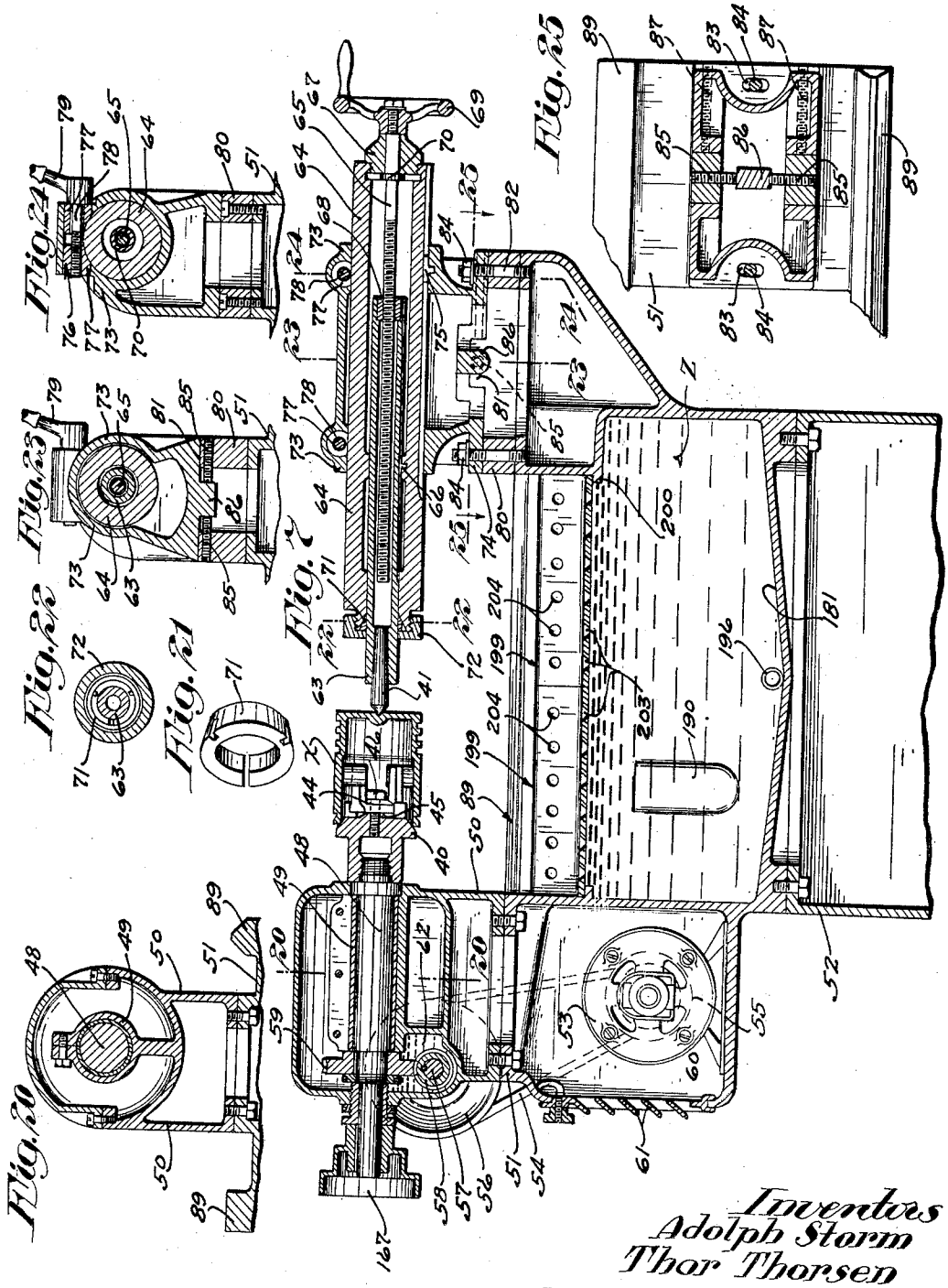

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PISTON TURNING AND GRINDING MACHINE

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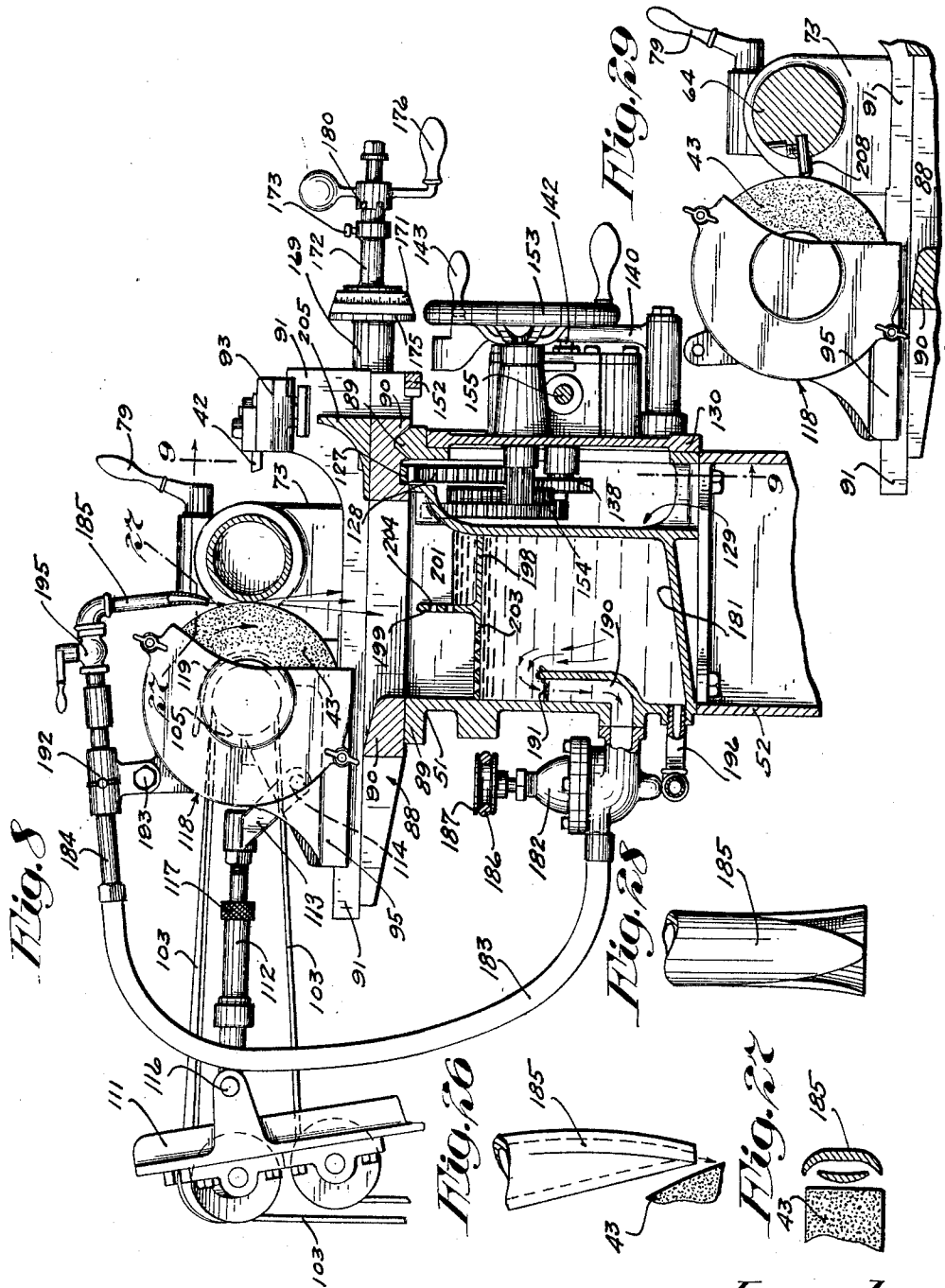

Fig. 8

Fig. 29

Fig. 28

Fig. 26

Fig. 27

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PISTON TURNING AND GRINDING MACHINE

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Fig. 9

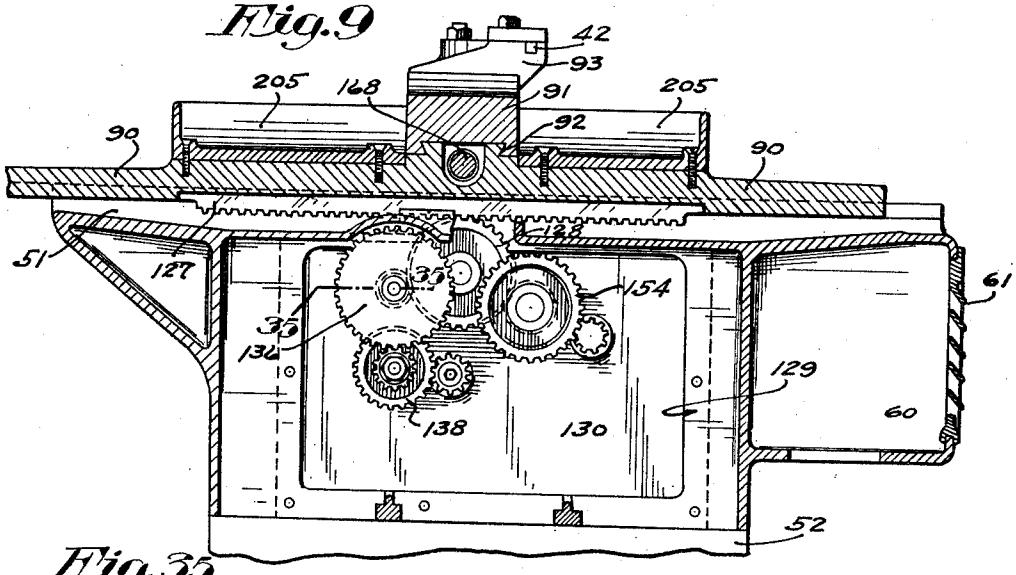
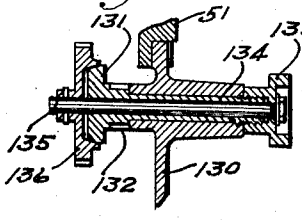


Fig. 35



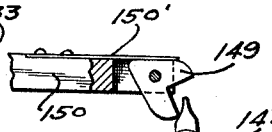
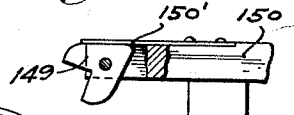


Fig. 36



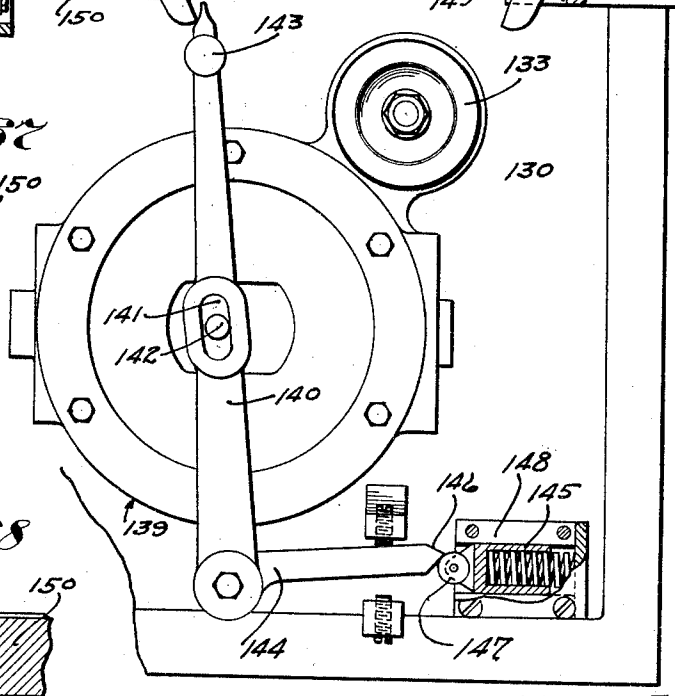


Fig. 37

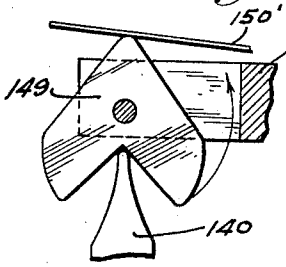
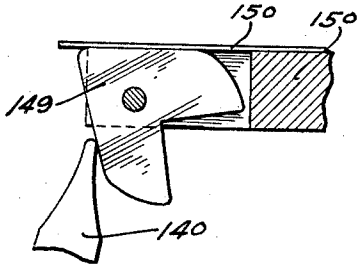


Fig. 38



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May 9, 1933. A. STORM ET AL 1,907,938

PISTON TURNING AND GRINDING MACHINE

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Fig. 10

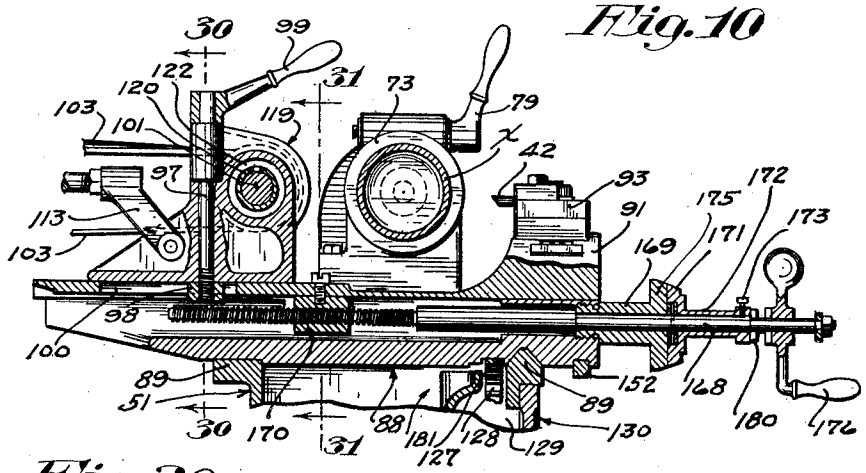


Fig. 30

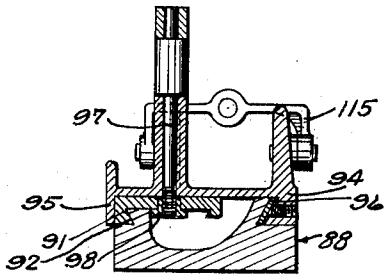


Fig. 31

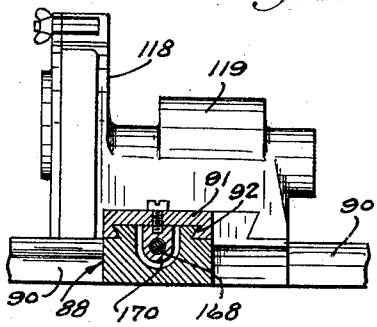


Fig. 33

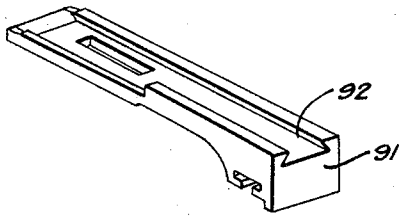


Fig. 32

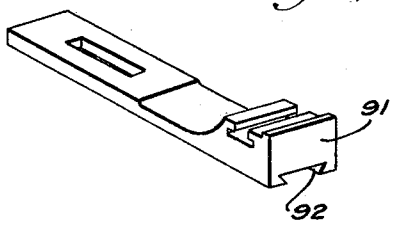
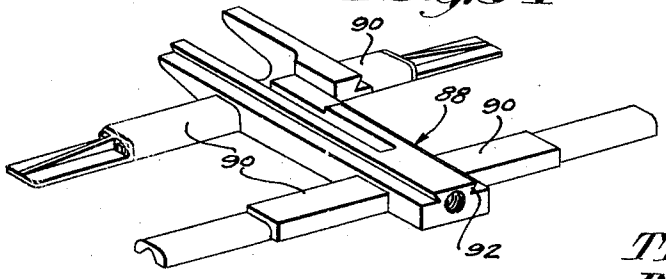


Fig. 34



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Patented May 9, 1933 1,907,938

UNITED STATES PATENT OFFICE

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PISTON TURNING AND GRINDING MACHINE

Application filed March 21, 1930. Serial No. 437,741.

Our present invention has for its object to provide a highly efficient piston turning and grinding machine intended for general use but especially designed for use by piston jobbers and garagemen who carry in stock semi-finished pistons to be turned and ground to the required diameter as needed.

To the above end, generally stated, the invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

It is now the general practice for piston jobbers and garagemen to carry in stock not only a supply of semi-finished pistons for different makes and sizes of engines but a supply of pistons of different sizes for each make or size of engine. By the use of our piston turning and grinding machine, it is only necessary to carry in stock a supply of pistons of the largest diameter for a given engine or type of piston and then turn and grind the pistons to the required diameter when needed.

In the accompanying drawings, which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a front perspective view of the piston turning and grinding machine;

Fig. 2 is a rear perspective view of the machine;

Fig. 3 is a fragmentary front perspective view of the tailstock end of the machine, on an enlarged scale;

Fig. 4 is a plan view of the machine with some parts shown in different positions by means of broken lines;

Fig. 5 is a front elevation of the machine with a portion of its base broken away;

Fig. 6 is a view corresponding to Fig. 5 with the exception that certain parts are sectioned on the line 6—6 of Fig. 4;

Fig. 7 is a view principally in longitudinal central section taken on the line 7—7 of Fig. 4;

Fig. 8 is a fragmentary view principally in section taken on the line 8—8 of Fig. 4;

Fig. 9 is a fragmentary view principally in transverse vertical section taken on the line 9—9 of Fig. 8;

Fig. 10 is a fragmentary view principally in transverse vertical section taken on the line 10—10 of Fig. 4;

Fig. 11 is a perspective view of the trip bar removed from the machine;

Fig. 12 is a detail view with some parts sectioned on the line 12—12 of Fig. 3, on an enlarged scale;

Fig. 13 is a fragmentary detail view principally in longitudinal vertical section taken on the line 13—13 of Fig. 4, on an enlarged scale;

Fig. 14 is a detail view in section taken on the line 14—14 of Fig. 13;

Fig. 15 is a perspective view of one of the bearings removed from the grinder head spindle;

Fig. 16 is a perspective view of one of the fillers removed from the bearing, shown in Fig. 15;

Fig. 17 is a fragmentary detail view principally in section taken on the line 17—17 of Fig. 4, on an enlarged scale;

Fig. 18 is a detail view with some parts sectioned on the line 18—18 of Fig. 17;

Fig. 19 is a fragmentary detail view principally in section taken on the line 19—19 of Fig. 6;

Fig. 20 is a fragmentary detail view principally in section taken on the line 20—20 of Fig. 7;

Fig. 21 is a perspective view of the cone wedge removed from the tailstock spindle, on an enlarged scale;

Fig. 22 is a detail view principally in section taken on the line 22—22 of Fig. 7;

Fig. 23 is a fragmentary detail view principally in section taken on the line 23—23 of Fig. 7;

Fig. 24 is a fragmentary detail view principally in section taken on the line 24—24 of Fig. 7;

Fig. 25 is a fragmentary detail view partly in plan and partly in horizontal section taken on the line 25—25 of Fig. 7;

Fig. 26 is a fragmentary detail view of the nozzle and emery wheel;

Fig. 27 is a fragmentary detail view in

section taken on the line 27—27 of Fig. 8, on an enlarged scale;

Fig. 28 is a rear elevation of the nozzle, as shown in Fig. 26;

Fig. 29 is a fragmentary view with some parts sectioned on the line 29—29 of Fig. 4 with the dressing tool adjusted for action on the emery wheel;

Fig. 30 is a detail view principally in section taken on the line 30—30 of Fig. 10;

Fig. 31 is a view partly in elevation and partly in section taken on the line 31—31 of Fig. 10;

Fig. 32 is a perspective view of the cross slide removed from the machine;

Fig. 33 is a bottom perspective view of the cross slide, as shown in Fig. 32;

Fig. 34 is a perspective view of the carriage and its guides removed from the machine;

Fig. 35 is a detail view principally in section taken on the line 35—35 of Fig. 9;

Fig. 36 is a view principally in elevation showing the reverse clutch trip mechanism, on an enlarged scale; and

Figs. 37 and 38 are detail views showing different positions of the right hand trip member, on an enlarged scale.

This machine is designed to hold a semi-finished piston X on a live center 40 and a dead center 41 to be turned with a turning tool 42 to, say within .005" of the required size, and thereafter finished with an emery wheel 43.

The live center 40 is of novel construction and is in the form of a truncated cone against which the outer annular edge of the skirt of the piston X loosely impinges, see Figs. 7, 17 and 18. The dead center 41 has a conical point which extends into a correspondingly formed seat in the head of the piston X at the axis thereof and holds said piston pressed against the live center 40 which, due to the peculiar formation thereof, automatically axially aligns the piston X with the centers 40 and 41.

To cause the piston X to revolve with the live center 40 said center is provided with a U-shaped dog 44 secured at its transverse portion to a boss 45 on the truncated portion of the live center 40, at the axis thereof, by a wobble joint 46. This dog 44 is held to revolve with the live center 40 by a pair of diametrically opposite lugs 47 on the truncated portion of the live center 40 with which the transverse portion of said dog engages.

The prongs of the dog 44 engage the internal bosses Y, surrounding the wrist pin seats in the piston X, at opposite sides and cause the piston X to revolve with the live center 40. Obviously, the wobble joint 46 permits the dog 44 to automatically adjust itself on the bosses Y, in case they are not in true diametrically opposite arrangement, during the self-centering movement of the piston X on the live center 40. It may be here stated that a plurality of live centers of different sizes will be provided with the machine for different sizes of pistons.

The live center 40 at its base is screwed onto the inner end of a headstock spindle 48 in axial alignment therewith and impinges against a collar thereon as a base of resistance. This spindle 48 is journaled in a long bearing 49 formed with the base section of a hollow headstock 50 rigidly secured to a bed 51 mounted on a hollow base 52, see Figs. 7 and 20. The upper half of the headstock 50 is removable to afford access to the interior of said headstock and is held in place by screws.

The headstock spindle 48 is driven from an electric motor 53 by a round belt 54 which runs over a relatively small cone pulley 55 on the shaft of the motor 53 and a relatively large cone pulley 56 on a drive shaft 57 having a worm 58 which meshes with a worm gear 59 on the spindle 48. The motor 53 is mounted in a compartment 60 in the bed 51 below the headstock 50, see Figs. 2 and 7.

Access may be had to the motor compartment 60 through a large opening in the respective end of the bed 51 normally closed by a louver 61. The shaft of the motor 53 extends through a large opening in the back of the compartment 60 and the aligned pulleys 55 and 56 are at the back of the machine. The drive shaft 57 is journaled in bearings in the front and back of the base section of the headstock 50 and the worm 58 and worm gear 59 run in a bath of oil in a pocket 62 in the compartment 60, see Fig. 7.

The dead center 41 is removably mounted in the inner end of a tailstock spindle 63 axially aligned with the headstock spindle 48 and held in place by a long tapered fit. On account of the small size of the dead center 41 it is not practical to move the same axially beyond the spindle support to the full capacity of the machine. For this reason the support for the spindle 63 to wit: A tailstock is provided with an adjustable extension in the form of a long cylindrical tubular bar 64 of large diameter and having a pair of axially spaced internal seats in which said spindle is mounted. This spindle 63 is axially adjusted in the tailstock extension 64 by means of a long feed screw 65 and which spindle 63 is held against turning movement in said bar by a key and keyway 66, see Fig. 7. The feed screw 65 is turnably mounted in a bearing 67 screwed into the rear end of the bar 64 and has threaded engagement with a nut-acting member 68 secured in the outer end of the spindle 63. A hand wheel 69 is applied to the outer end of the feed screw 65 by which

said screw may be turned. This hand wheel 69 and a fixed collar 70 on the feed screw 65 engage opposite ends of the bearing 67 and hold the feed screw 65 against endwise movement.

The spindle 63 may be secured to the bar 64 in any of its longitudinal adjustments by a lock comprising a cone shaped wedge 71, fitted in an internal tapered seat in the inner end of the spindle 63, and a cooperating knurled hand nut 72. Said wedge 71 is transversely divided, encircles the spindle 63 to be contracted thereon by the nut 72, which has screw-threaded engagement with the inner end of the bar 64 and impinges against the base of the wedge 71. By turning the nut 72 onto the bar 64 the wedge 71 will be moved axially into its seat and thereby contracted onto the spindle 63 to frictionally hold the same where adjusted in the bar 64.

The tailstock extension bar 64 is mounted in a pair of axially spaced bearings 73 in the inner end portion of the tailstock 74 to be moved by hand axially toward or from the live center 40 with a free sliding movement. This bar 64 is held from turning in the bearings 73 by a key and keyway 75. It will be noted by reference to Fig. 24, that the bearings 73 are continuous and unbroken throughout the entire diameter of the bar 64 so that there is no give therein and hold said bar while the same is being axially adjusted in true axial alignment with the live center 40. The hand wheel 69 in addition to affording means by which the feed screw 65 may be turned also affords convenient means by which the bar 64 may be moved.

Two clamps 76, one in each bearing 73, are provided for rigidly securing the bar 64 in different longitudinal adjustments in the tailstock 74. Each clamp 76 comprises a pair of axially aligned cylindrical wedges 77 on a rod 78 having on one end a crank-acting handle 79. The pairs of wedges 77 are mounted in cylindrical seats in the tops of the bearings 73 for endwise movement toward and from each other transversely of the bar 64. The wedges 77 of each pair are arranged to impinge against diametrically opposite surfaces on the bar 64, see Figs. 7 and 24. The rod 78 has screw-threaded engagement with the outer wedge 77 and the inner wedge 77 is loose on said rod and engages the hub of the handle 79 as a base of resistance. A movement of the handles 79 to set the clamps 76 moves the wedges 77 thereof axially toward each other into frictional clamping engagement with the bar 64.

Interposed between the bed 51 and tailstock 74 is a tailstock base block 80 to which said tailstock is connected by a pair of aligned tongue and groove guides 81 for straight line sliding movement transversely of the bed 51. The base block 80 is rigidly secured by screws to the bed 51, see Fig. 24. The tailstock 74 is secured to the bed 51 and frictionally clamped onto the block 80 by a pair of studs 82 anchored to the bed 51, extending through bores in said block and transverse slots 83 in the tailstock 74. Nuts 84 on the studs 82 impinge against the tailstock 74 and frictionally clamp said tailstock onto the block 80. The purpose of the slots 83 is to permit the required movement of the tailstock 74 in respect to the studs 82 during the transverse adjustment of said tailstock on the block 80 to horizontally axially align the dead center 41 with the live center 40, see Figs. 7 and 25.

For transversely adjusting the tailstock 74 on the block 80, there is provided a pair of opposing adjusting screws 85 having threaded engagement with the members of the guides 81 on the block 80 and impinge at their inner ends at opposite sides of a depending lug 86 on the bottom of the tailstock 74, see Figs. 23 and 24. The base block 80 may be planed to the proper thickness to vertically align the dead center 41 with the live center 40. A long pair of set screws 87 having screw-threaded engagement with the base of the tailstock 74 impinge against the members of the guides 81 on the block 80 and hold said tailstock where adjusted by the adjusting screws 85, see Figs. 7 and 25.

A carriage 88 is mounted on a pair of front and rear ways 89 which extend longitudinally on the bed 51 to traverse the full distance between the headstock 50 and tailstock 74. Long pairs of guides 90 form extensions on the carriage 88, slide on the ways 89 and hold said carriage to traverse in a direct line parallel to the aligned axes of the spindles 48 and 63, see Figs. 3, 4 and 8.

A cross slide 91 is mounted on the carriage 88 to traverse at right angles to the traverse of said carriage and is connected thereto by a dovetailed guide 92, see Figs. 9 and 31. On the front end of the cross slide 91 is a tool holder 93 in which the turning tool 42 is clamped with its cutting edge at substantially the same height as the axis of the piston X and forward of said piston, see Figs. 3 and 8.

A grinder head 94 is mounted in part on the rear end portion of the carriage 88 and the corresponding end portion of the cross slide 91 for adjustment toward or from the turning tool 42. A square guide 95 and a V-guide and gib 96 on the grinder head 94 hold said head on the cross slide 91 and carriage 88 for straight line sliding movement parallel to the line of travel of said slide during the adjustment of the grinder head 94 toward or from the turning tool 42, see Figs. 30 and 34.

To rigidly lock the grinder head 94 to the

cross slide 91 where adjusted for common movement with said slide, there is provided a lock bolt 97 and a cooperating nut-acting member 98, see Figs. 10 and 30. This lock bolt 97 is perpendicular to the cross slide 91, is turnably mounted in a seat therefor in the grinder head 94 and has on its upper end a head, which impinges against the top of said grinder head as a base of resistance, and a crank-acting handle 99 by which said rod may be turned in its nut-acting member 98. The nut-acting member 98 is in the form of an inverted T, the body of which slides in a longitudinally extended groove 100 in the cross slide 91 and the top of which engages the under side of said slide as a base of resistance, see Fig. 30. Obviously, by turning the lock bolt 97 in its nut-acting member 98 the grinder head 94 is frictionally clamped onto the cross slide 91.

The emery wheel 43 is mounted on the left hand end of a spindle 101 which extends parallel to the axes of the spindles 48 and 63 and is journaled in a pair of spaced bearings in the grinder head 94, see Fig. 13. Said emery wheel 43 is driven at a high rate of speed from an electric motor 102 by a flat belt 103 which runs over a large pulley 104 on the shaft of said motor and a relatively small pulley 105 keyed to the spindle 101 between the bearings therefor.

The motor 102 is mounted on a cradle 106 pivoted at its ends to the ends of a U-shaped cradle support 107 for swinging movement parallel to the traverse of the carriage 88. This cradle support 107, in turn, is pivoted at 108 to a bracket 109 bolted to the base 52 at the back thereof for swinging movement in the direction of travel of the cross slide 91, see Fig. 2. The intermediate portion of the belt 103 runs over a pair of vertically spaced idle guide pulleys 110 journaled on the upper end of a long upright rocker arm 111 the lower end of which is bifurcated, straddles the motor 102 and is rigidly bolted to the sides of the motor cradle 106 to rock therewith, see Fig. 2.

The rocker arm 111 is connected by a link 112 to the grinder head 94 to partake of the movements of the carriage 88 and cross slide 91 to hold the guide pulleys 110 in a constant relation to the pulleys 104 and 105, see Figs. 2, 8 and 10. On the front end of the link 112 is a yoke 113 the prongs of which are connected by a pair of axially aligned horizontal pivots 114 to the grinder head 94 and on the rear end of said link is a yoke 115 the prongs of which are connected by a pair of axially aligned horizontal pivots 116 to the rocker arm 111. The link 112 is made up of two telescopically connected members frictionally connected by a clamping nut 117 in different longitudinal adjustments to vary the operative length of said link. The purpose of making the link 112 longitudinally adjustable is to provide a belt tightener for the belt 103. The pivots 114 and 116 permit the required vertical angular movements of the link 112 in respect to the grinder head 94 and rocker arm 111 during the adjustment of the cross slide 91.

It may be here stated that the bracket 109, motor cradle support 107, motor cradle 106, rocker arm 111 and guide pulleys 110 afford a universal drive and which drive always keeps the belt 103 in a constant relation to the pulleys 104 and 105 and under the same tension. A guard 118 is provided for the emery wheel 43 and a guard 119 is provided for the pulley 105 and both of said guards are secured to the grinder head 94, see Figs. 2, 4 and 8.

Referring again to the adjustable bearings 120 for the spindle 101, said bearings have tapered fit with the seats therefor in the grinder head 94, are longitudinally split for contraction on the spindle 101 by axial movement in said seats toward each other. Inner and outer nuts 121 are applied to the ends of the bearings 120 impinge against opposing surfaces on the grinder head 94. The inner nuts 121 are for drawing the bearings 120 axially inward to contract the same on the spindle 101 to take up wear and the outer nuts 121 hold the bearings 120 against end thrusts. Annular oil pockets 122 for holding a lubricant for the spindle 101 and bearings 120 are formed in said bearing and the seats therefor intermediate of their ends, see Fig. 13.

To increase the flexibility of the bearings 120 so that they may be readily contracted onto the spindle 101, the same have formed therein circumferentially spaced longitudinal grooves 123. To prevent the escape of the lubricant from the pockets 122 through the longitudinal slits in the bearings 120 fillers 124 are fitted therein and for a like purpose fillers 125 are fitted in the grooves 123. The spindle 101 is held against end thrust by the mounting for the emery wheel 43 and nuts 126 on the other end of the spindle 101 and which mounting and nuts engage the outer ends of the bearings 120, see Figs. 14, 15 and 16.

The carriage 88 is reciprocated by a rack 127 on the bottom thereof and its front guides 90 and a cooperating gear 128 in a gear compartment 129 in the front of the bed 51 to which access may be had through a large opening in the front wall of said bed. This opening in the bed 51 is normally closed by a cover plate 130 detachably secured by screws to the bed 51 and which plate will hereinafter be called an apron, see Figs. 8, 9 and 10. The gear 128 is journaled on the apron 130 and is revolved from the driven member of a friction cone feed clutch 131 by an intermediate pinion 132 on the hub of said member, see Figs.

9 and 35. This feed clutch 131 is operated by a clutch knob 133 having screw-threaded engagement with a tubular spindle 134 formed with the hub of the driven member of said clutch and journaled in a long bearing on the apron 130. The clutch knob 133 is connected to the driving member of the feed clutch 131 by an operating rod 135 which extends through the spindle 134 and clutch 131. By turning the clutch knob 133 on the spindle 134 the driving member of the feed clutch 131 is frictionally drawn onto the driven member of said clutch by the rod 135.

Formed with the driving member of the feed clutch 131 is a spur gear 136 which is rotated from a reverse clutch 137 by a train of gears 138 journaled on the apron 130 within the gear compartment 129. The reverse clutch 137 is mounted in a box 139 on the outer face of the apron 130. The purpose of this clutch 137 is to reverse the direction of travel of the carriage 88 and which clutch may be either manually or automatically operated by means of an upright lever 140 pivoted at its lower end to the apron 130 and intermediately connected at 141 to the shifter member 142 of said clutch. This lever 140 is provided with a handle 143 by which it may be manipulated to manually operate the reverse clutch 137, see Figs. 5, 6, 8 and 9.

The reverse clutch lever 140 is yieldingly held in either of its extreme positions by a right angle extension 144 fixed to the pivoted end of said lever, extends in a plane parallel to the movement thereof, and a cooperating spring-projected plunger 145. Said extension 144 on its free end has a V-shaped cam 146 in the plane of the movement of said extension and the plunger 145 has an antifriction roller 147 with which said cam engages. When the high point of the cam 146 is in contact with the periphery of the roller 147 the lever 140 is midway between its two extreme positions, see Figs. 5, 36, 37 and 38.

When the reverse clutch lever 140 has moved a little past its central position the reverse clutch 137 is disengaged and the carriage 88 stopped. At this point the cam action of the roller 147 on one side of the cam 146 causes the lever 140 to complete its movement. This movement of the lever 140 actuates the reverse clutch 137 and the direction of the rotation of the train of gears 138, and hence, the direction of travel of the carriage 88. The spring-projected plunger 145 is mounted in a case 148 on the apron 130.

To automatically operate the reverse clutch lever 140 there is provided a feed trip comprising a pair of trip members 149 pivoted on the inner ends of a pair of longitudinally aligned trip bar extensions 150 which, in turn, are secured by clamps 151 to a two-part trip bar 152. This trip bar 152 extends parallel to the line of travel of the carriage 88 and is rigidly secured intermediate of its ends to the carriage 88, see Fig. 3. The clamps 151 may be adjusted longitudinally on the trip bar 152 or the trip bar extensions 150 may be endwise adjusted in said clamps to vary the distance between the trip members 149, and hence, the length of travel of the carriage 88.

The free or upper end of the reverse clutch lever 140 is V-shaped in the plane of movement of said lever and the trip members 149 are pivoted within the bifurcated inner ends of the trip bar extensions 150. Flat springs 150′ on the trip bar extensions 150 yieldingly hold the trip members 149 in operative positions. These trip members 149 will yield and allow the lever 140 to move into a position, as shown in Fig. 37, and then be reset by the lever 140 during the reverse movement of the carriage 88.

When it is desirous of stopping the carriage 88 at the limit of its travel in one direction and not reverse the respective trip member 149 is manually set in a position, as shown in Fig. 38, to form an abutment for the lever 140 and operate the same to move the reverse clutch 137 into neutral position without reversing the same.

To manually operate the carriage 88 independent of the feed clutch 131, there is provided a hand wheel 153 having a spindle journaled in a bearing in the apron 130 and connected by a train of gears 154 to the gear 128 which meshes with the rack 127, see Figs. 1, 8 and 9.

The reverse clutch 137 is driven by a shaft 155 either at low or high speed from a variable speed transmission mechanism indicated as an entirety by the numeral 156, with the exception of its shifter lever 157, for operating its sliding gears, and spindle 158 for a cone pulley 159. A gear case 160 for the variable speed transmission mechanism 156 is mounted on the bed 51 directly below the headstock 50 and the shaft 155 is journaled in bearings in the box 139 for the reverse clutch 137 and the gear case 160. The pulley 159 has a bushing 161 journaled on a stud 162 eccentrically secured to a split collar 163 parallel to the spindle 158 and which collar is turnably mounted on a hub 164 on the gear case 160. This collar 163 is frictionally clamped by a bolt 165 to the hub 164 and provided with a handle by which it may be manipulated.

The pulley 159 is driven by a flat belt 166 from a cone pulley 167 on the outer end of the headstock spindle 48. The purpose of mounting the pulley 159 on the collar 163 is to adjust the same about the axis of the spindle 158 to place the belt 166 under the desired tension, or, in other words, the split

collar 163 affords a belt tightener for the belt 166, see Figs. 4, 5 and 6.

From the above description, it is evident that the carriage 88 is operated from the headstock spindle 48 by the cone pulleys 159 and 167, belt 166, transmission mechanism 156, shaft 155, reverse clutch 137, train of gears 138, spur gear 136, gear 128, rack 127 and feed clutch 131.

The relative speed of traverse of the carriage 88 with the R. P. M. of the headstock spindle 48 can be changed by changing the feed belt 166 to the different steps of the cone pulleys 159 and 167 for the different sizes and kinds of pistons as may be required. Said speed of the carriage 88 may also be changed from a relatively slow traverse for turning the piston X with the turning tool 42 to a fast traverse for grinding said piston with the emery wheel 43 by manipulating the lever 157 to shift the sliding gears of the transmission mechanism 137.

The cross slide 91 is traversed on the carriage 88 by means of a long feed screw 168 journaled in a long bearing 169 on said carriage, projects forward therefrom and has screw-threaded engagement with a nut block 170 on the bottom of said slide, see Fig. 10. Mounted on the screw 168 outward of the bearing 169 is a dial 171 having a long forwardly projecting sleeve bearing 172 that is rigidly secured by a set screw 173 to said feed screw in different circumferential adjustments. This dial 171 is graduatel to read .0005″ traverse of the cross slide 91 or .001″ of the diameter of the piston to be turned or ground, see Fig. 3.

A zero mark 174 by which the dial 171 is set is indicated on a fixed head 175 on the outer end of the bearing 169. Obviously, the set screw 173 permits the dial 171 to be circumferentially adjusted in respect to the head 175 to bring its zero point into registration with the zero point 174 on said head. The feed screw 168 is held against endwise movement by the engagement of the dial 171 with the head 175 and a shoulder on said feed screw which engages the inner end of the bearing 169. For revolving the feed screw 168 the same is provided with a crank-acting hand piece 176 having a hub 177 turnably mounted on the outer end of said feed screw with freedom for axial sliding movement and is held against removal therefrom by a washer and nut 178 on the outer end of the feed screw 168.

A clutch is provided for connecting the hand piece 176 to the feed screw 168 and which clutch is in the form of a pair of diametrically opposite notches 179 in the hub 177 and a pin 180 which extends transversely through the feed screw 168 close to the bearing sleeve 172. When the hand piece 176 is not in use the clutch 179—180 is disengaged so that said hand piece is free to swing on the feed screw 168.

Formed in the bed 51 between the headstock 50 and the tailstock 74 and rearward of the gear compartment 129 is a deep tank 181 for holding a piston cooling fluid Z during the grinding thereof by the emery wheel 43. This fluid Z is forced, by a centrifugal pump 182 through a hose 183, a pipe section 184 having a depending nozzle 185 onto the piston X where the same is contacted by the emery wheel 43. The pump 182 is driven by a round belt 186 which runs over one of the steps in the cone pulley 56 and a grooved pulley 187 on the shaft of said pump and which pump is bolted to the back of the bed 51, see Fig. 8. The intermediate portion of the belt 186 runs over a pair of guide pulleys 188 loosely journaled on a bracket 189 on the back of the bed 51.

The intake of the pump 182 is in registration with the discharge end of a conduit 190 formed on the back of the tank 181 within the same with its intake materially above the bottom of said tank and is covered by a screen 191. The pipe section 184 is horizontally disposed transversely of the machine and mounted in a sleeve-like holder 192 for endwise sliding and turning movements and which sleeve is pivotally attached at 193 to the guard 118 for the emery wheel 43. This pivot 193 permits the pipe section 184 to be tilted in a vertical plane to raise or lower the nozzle 185 and said pipe section may be endwise adjusted in the holder 192 to position the nozzle 185 so as to discharge, as shown in Fig. 8. A set screw 194 having threaded engagement with the holder 192 impinges against the pipe section 184 and holds the same where adjusted. The nozzle 185 at its connection with the pipe section 184 is provided with a hand controlled cut-off valve 195.

By reference to Figs. 26, 27 and 28 it will be noted that the nozzle 185 is designed to discharge a fan shaped jet over the full width of the emery wheel 43 at its point of contact with the piston X and onto the piston at a considerable distance on each side of said wheel for cooling the piston X and carries off solids ground from the piston X and emery wheel 43.

The bottom of the tank 181 is hopper shaped longitudinally of the machine and inclined toward the rear thereof, see Figs. 7 and 8. Leading from this low point in the tank 181 is a drain pipe 196 having a cut-off valve 197, see Figs. 2 and 9.

Fitted in the top of the tank 181 above the level of the fluid Z is a pan 198 having a central longitudinally extended partition 199. The sides and ends of the pan 198 are formed by the walls of the tank 181 and which pan loosely rests on ledges 200

formed with the end walls of said tank, see Fig. 7. The front section of the pan 198 affords a settling chamber 201 for solids and the rear section thereof affords a collecting chamber 202 for the fluid Z and the bottom of said pan for this compartment 202 is provided with a multiplicity of drain holes 203 through which the fluid Z collected therein is returned to the tank 181, see Fig. 8.

Formed in the partition 199 near the top thereof is a horizontal row of holes 204 through which the fluid Z precipitated in the settling chamber 201 is drained into the compartment 202. The fluid Z disharged from the nozzle 185 is precipitated in both chambers 201 and 202 and the shavings cut by the turning tool 42 are collected into the settling chamber 201. The purpose of this chamber is to prevent the shavings from the compartment 202 from being carried into the tank 181 with the fluid Z.

The bed 51 both in front and back of the headstock 50 and tailstock 74 and back of the tank 181 is sloped to drain into said tank and a guard 205 is secured to the front carriage guide extensions 90 for directing the fluid Z back into the tank 181 and to prevent splash, see Figs. 4 and 8.

As previously stated, the base 52 is hollow and provided in its front wall with a relatively large opening which affords access to the interior of said base and normally closed by a hinged door 206, see Fig. 1.

A double switch, indicated as an entirety by the numeral 207, is provided the one for starting and stopping the headstock motor 53 and the other for starting and stopping the grinder head motor 102. This double switch is mounted in the front of the bed 51 at the right of the apron 130 where the same may be conveniently reached by the operator, see Fig. 1.

A dressing tool for the emery wheel 43 is mounted in a holder 208 which, in turn, is mounted in a radial seat in the tailstock extension bar 64 near the inner end thereof and held by a set screw, see Fig. 29. In truing the emery wheel 43, by means of the dressing tool the carriage 88 is traversed and the slide adjusted to cause said dressing tool to make a cut of the proper depth.

Operation

The operation of the above described piston turning and grinding machine may be briefly described as follows:

The tailstock extension bar 64 is first slid longitudinally in the tailstock 74 and set the proper distance from the live center 40 and then locked where adjusted by manipulating the handles 79. The semi-finished piston X is then placed between the centers 40 and 41 with its skirt on the live center 40 and the dog 44 in engagement with its bosses Y, as shown in Figs. 7 and 17, and the hand wheel 69 operated to adjust the dead center 41 into the seat therefore in the head of said piston and thereby clamp the piston X between the centers 40 and 41. During this clamping action the piston X automatically centers itself on the conical live center 40 so that the same is in true axial alignment with the headstock spindle 48 and tailstock spindle 63.

The motor 53 is started by manipulating the proper switch 207 to revolve the headstock spindle 48, and hence, the piston X. This mounting of the piston X in the machine is very quickly and easily accomplished without close adjustments on the part of the operator. The longitudinal adjustment of the tailstock extension bar 64 requires only an endwise sliding movement thereof and said bar always remains in true axial alignment with the live center 40 and its spindle 48, and as previously stated, the piston self centers itself on said live center.

The trip members 149 are next adjusted to alternately operate the reverse lever 140 to reverse the direction of travel of the carriage 88. This adjustment is made by manually manipulating the hand wheel 153 to operate the carriage 88 and position the turning tool 42 at one end of said piston. The respective trip bar extension 150 is then adjusted to position its trip member 149 to operate the lever 140 and reverse the clutch 137 and thereafter the hand wheel 153 is manipulated to operate the carriage 88 and position the turning tool 42 at the other end of said piston where the other trip bar extension 150 is adjusted and its trip member 149 positioned to operate the lever 140 and reverse the clutch 137.

The reverse lever 140 is manually operated by means of its handle 143 to set the reverse clutch 137 in position to cause the carriage 88 to travel in the proper direction to make the first cut and the lever 157 is manually operated to set the variable speed transmission mechanism to operate the carriage 88 at slow speed. Next the hand piece 176 is moved axially onto the feed screw 168 to connect the clutch 179—180 and said hand piece manipulated to revolve said feed screw and move the cross slide 91 in a direction to carry the turning tool 42 toward the piston X for engagement with the periphery thereof and which movement of said cross slide carries the emery wheel 43 away from the piston X.

With the turning tool 42 contacting with the periphery of the piston X the dial 171 is circumferentially adjusted on the feed screw 168, which is permitted by loosening the set screw 173, to bring its zero point into registration with the fixed zero point 174 on the head 175. The carriage 88 is then moved by means of the hand wheel 153 a

distance sufficient to carry the turning tool 42 outward of the respective end of the piston X and the hand piece 176 operated and set by the dial 171 to cause the turning tool 42 to make a cut on the piston X of the desired depth. The feed clutch 131 is then set by operating the clutch knob 133 which completes the driving connections from the headstock spindle 48 to the carriage 88.

The automatic mechanism for operating the reverse clutch 137 having been set, as previously described, causes the carriage 88 to travel a distance slightly greater than the length of the piston X so that each movement thereof carries the turning tool 42 beyond the respective end of the piston X. A single cut made by the cutting tool 42 is usually sufficient to reduce the semi-finished piston X to within approximately .005 of the required diameter so that thereafter the piston may be finished to the required diameter by the grinding wheel 43.

At the completion of the turning of the piston X by the turning tool 42 the clutch knob 133 is manipulated to release the clutch 131 and stop the reciprocatory movement of the carriage 88 and thereafter the hand piece 176 is manipulated to draw the turning tool 42 away from the piston X and carries the emery wheel 43 into contact therewith. The hand wheel 153 is then manipulated to move the carriage 88 a distance sufficient to carry the respective end of the piston X past the emery wheel 43 and the hand piece 176 operated to set the emery wheel 43 by the dial 171 to make a cut on the piston X of the desired depth.

The clutch knob 133 is again manipulated to set the clutch 131 and start the reciprocatory movement of the carriage 88 and at the completion of each reciprocation thereof the emery wheel 43 is reset by the dial 171 to cause said wheel to make a predetermined cut and the finished cut reduces the piston X to the desired diameter. At the time the grinding action is started by the emery wheel 43 the cut-off valve 195 is opened so that the fluid Z is discharged by the nozzle 185 onto the cutting surface of the emery wheel 43 and the surface of the piston X to be ground thereby.

What we claim is:

1. In a machine of the class described, a headstock and a tailstock each having a center, a reciprocatory carriage between the headstock and tailstock, a cross slide on the carriage, a turning tool and a grinding wheel on the cross slide, means for adjusting the cross slide for alternately positioning the turning tool and grinding wheel in respect to the work and for feeding the same thereto, a motor mounted for universal movement, and a universal drive from the motor to the grinding wheel.

2. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a grinding wheel on the cross slide, a rocker arm mounted for compound movement in the directions of travel of the carriage and cross slide, a motor mounted to move with the rocker arm, and driving connections from the motor to the grinding wheel including a belt and guide pulleys therefore on the rocker arm.

3. The structure defined in claim 2 which further includes an operating connection from the cross slide to the rocker arm.

4. The structure defined in claim 2 which further includes an operating connection from the cross slide to the rocker arm, said operating connection being adjustable to tension the belt.

5. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a motor, driving connections from the motor to the carriage including a reverse clutch, and trip mechanism for the reverse clutch including a reverse lever and a pair of spaced trip members arranged to be alternately engaged by the clutch lever during the reciprocation of the carriage and operate the same, at least one of the trip members being adjustable to cause the clutch lever to position the clutch in neutral position.

6. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a motor, driving connections from the motor to the carriage including a reverse clutch, and trip mechanism for the clutch including a reverse lever, a fixed trip bar on the carriage a pair of endwise spaced trip bar extensions, clamps connecting the extensions to the trip bar, said clamps being longitudinally adjustable on the trip bar and the extensions being longitudinally adjustable in the clamps and yielding trip members on the extensions arranged to alternately engage the clutch lever during the reciprocation of the carriage and operate the same.

7. The structure defined in claim 5 in which at least one of the trip members may be set to cause the clutch lever to position the clutch in neutral position.

8. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a turning tool and a grinding wheel on the cross slide, means for operating the cross slide to alternately position the turning tool and grinding wheel for action on the work, a tank beneath the turning tool and grinding wheel for holding a cooling fluid, a pan in the top of the tank having a settling compartment and an overflow compartment, the former being arranged to discharge into the latter and said latter drain into the tank, and a pump and connections

including a nozzle for taking the cooling fluid from the tank and discharging the same through the nozzle onto the work being ground.

9. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a turning tool and a grinding wheel on the cross slide, means for operating the cross slide to alternately position the turning tool and grinding wheel for action on the work, a tank beneath the turning tool and grinding wheel for holding a cooling fluid, a pan in the top of the tank having a settling compartment and an overflow compartment, the former being arranged to discharge into the latter and said latter drain into the tank, a pump having an intake leading from the tank, a hose leading from the pump and having a nozzle carried by the cross slide and arranged to discharge on the work being ground.

10. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a turning tool and a grinding wheel on the cross slide, means for adjusting the cross slide for alternately positioning the turning tool and grinding wheel in respect to the work and for feeding the same thereto, a motor, a universal drive from the motor to the grinding wheel, and connections from the slide to the universal drive for holding the universal drive in a predetermined relation to the cross slide during movements of the slide and the carriage.

11. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a turning tool and a grinding wheel on the cross slide, means for adjusting the cross slide for alternately positioning the turning tool and grinding wheel in respect to the work and for feeding the same thereto, a motor, driving connections from the motor to the grinding wheel including a belt and guide pulleys therefore, a movable support for the guide pulleys, and connections from the cross slide to the support for moving the support with the slide and the carriage.

12. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a cross slide on the carriage, a pair of tools on the cross slide, one of which is rotatable, means for adjusting the cross slide for alternately positioning the tools for action on the work, a motor mounted for universal movement, and a universal drive for the motor to the rotatable tool.

13. In a machine of the class described, work supporting and turning means, a reciprocatory carriage, a motor, driving connections from the motor to the carriage including a reverse clutch, a trip mechanism for the reverse clutch including a reverse lever, and a pair of spaced trip members arranged to be alternately engaged by the clutch lever during the reciprocation of the motor to operate the same.

14. The structure defined in claim 13 which further includes yielding means operative on the clutch lever to hold the clutch in either of its two operative positions.

In testimony whereof we affix our signatures.

ADOLPH STORM.
THOR THORSEN.