

Aug. 14, 1951

S. L. CASELLA ET AL

2,563,918

HYDRAULIC TOOL SLIDE FOR LATHES AND THE LIKE DEVICE

Filed June 19, 1947

7 Sheets-Sheet 1

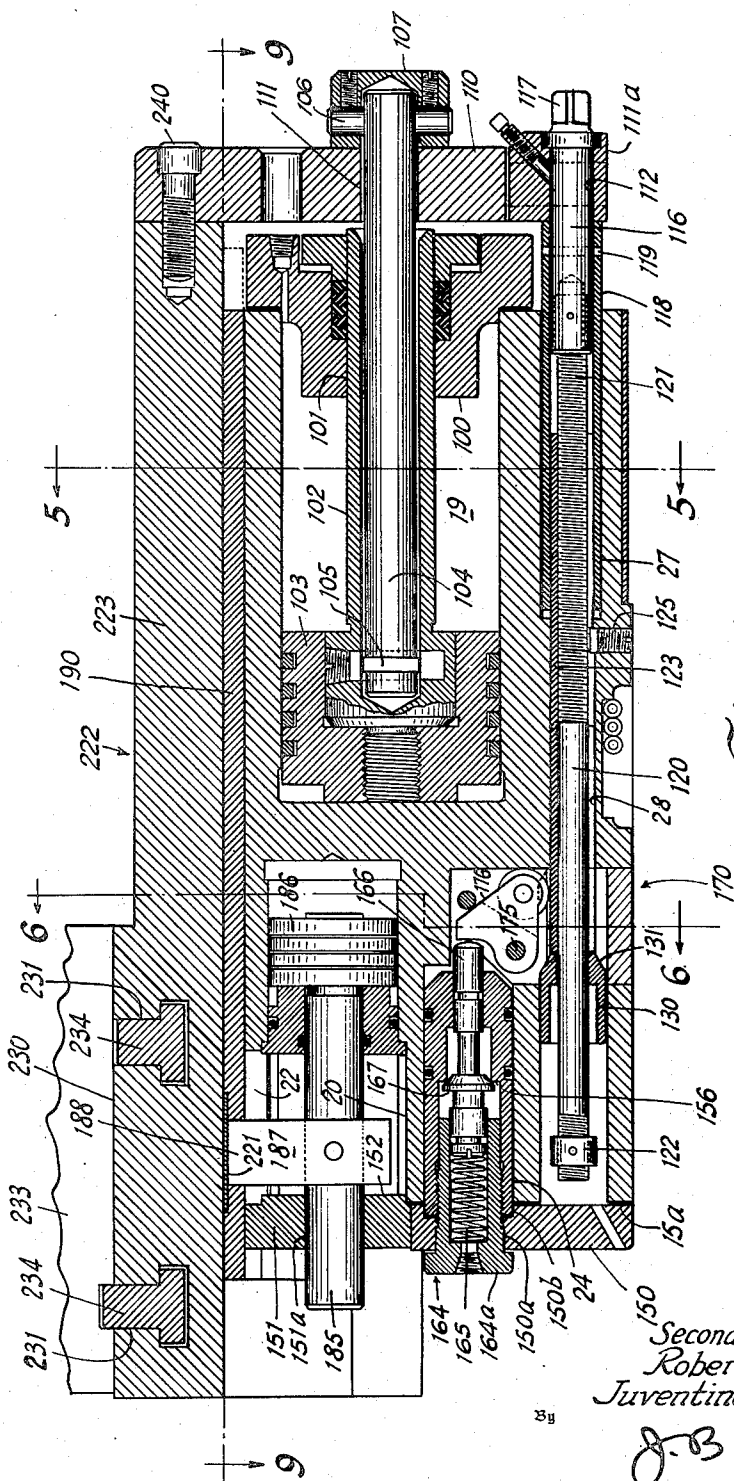


Fig. 1

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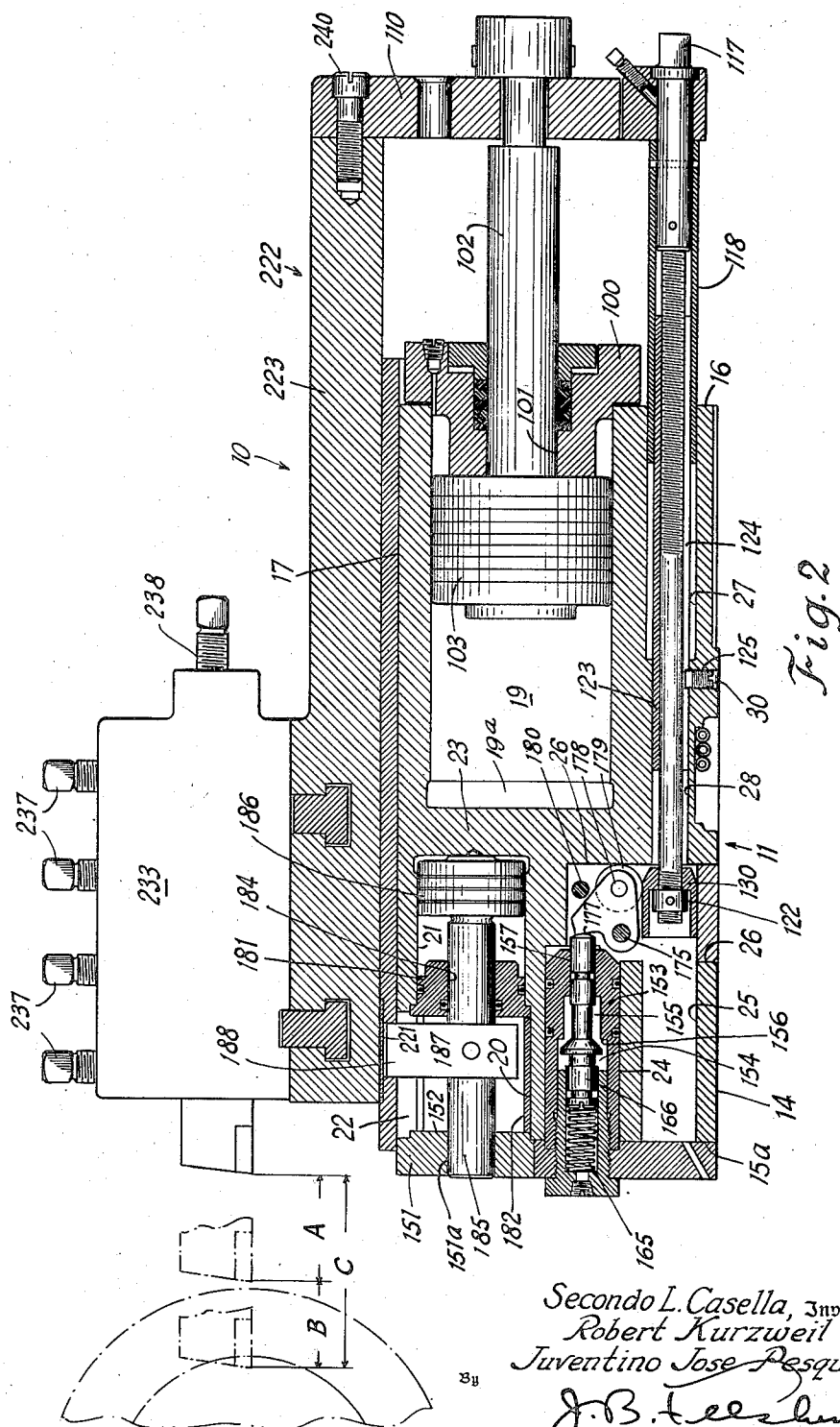
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7 Sheets-Sheet 3

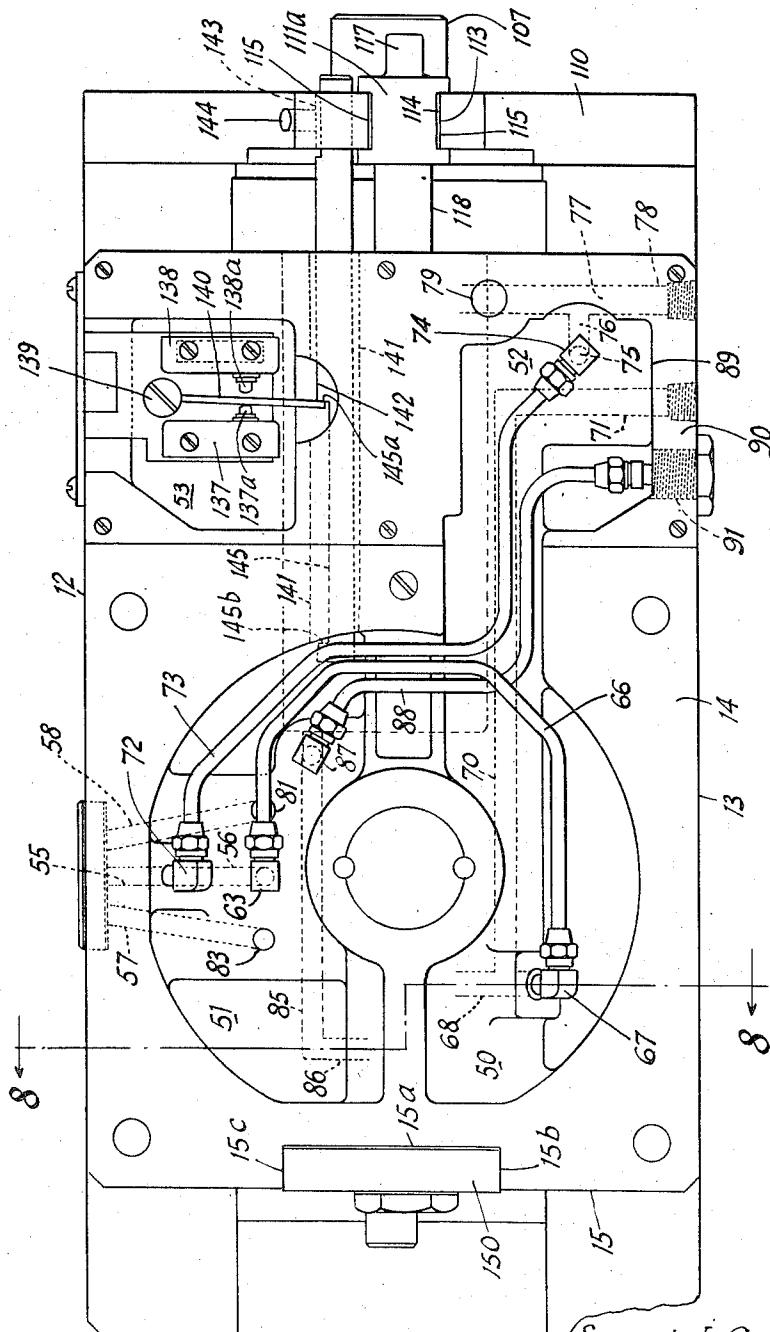


Fig. 3

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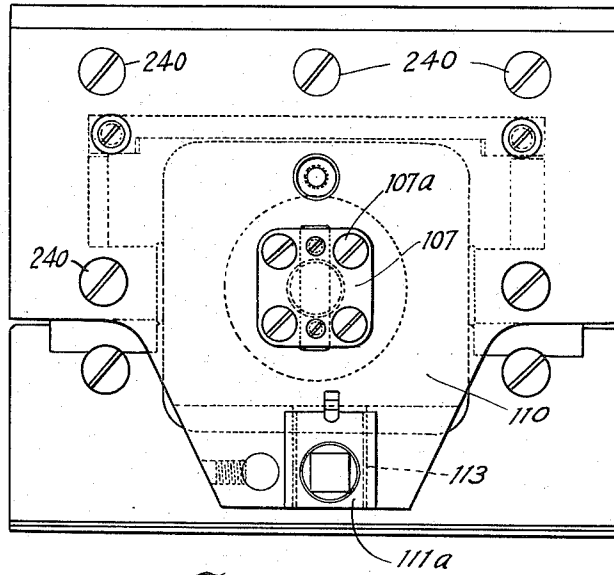


Fig. 4

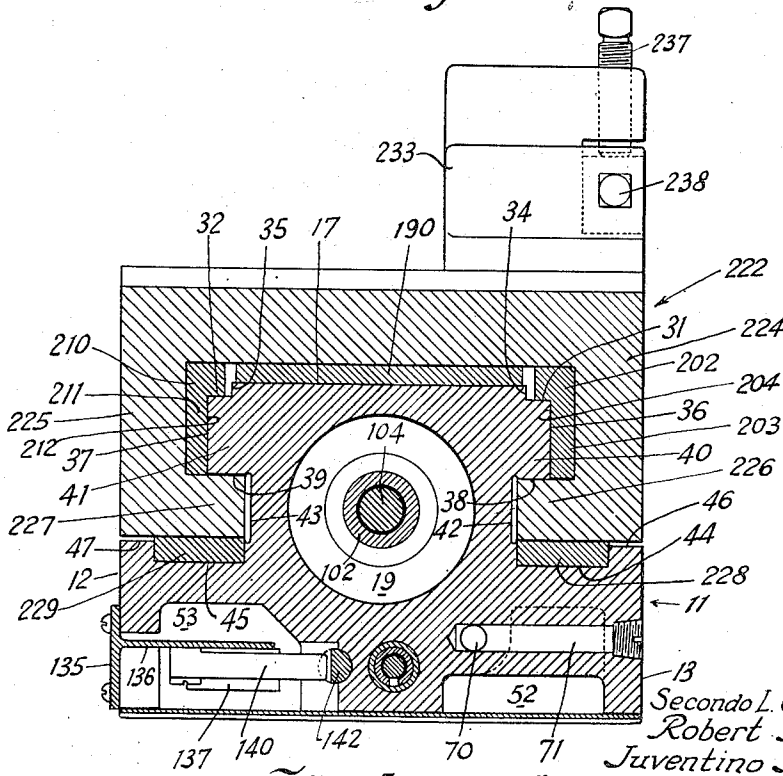


Fig. 5

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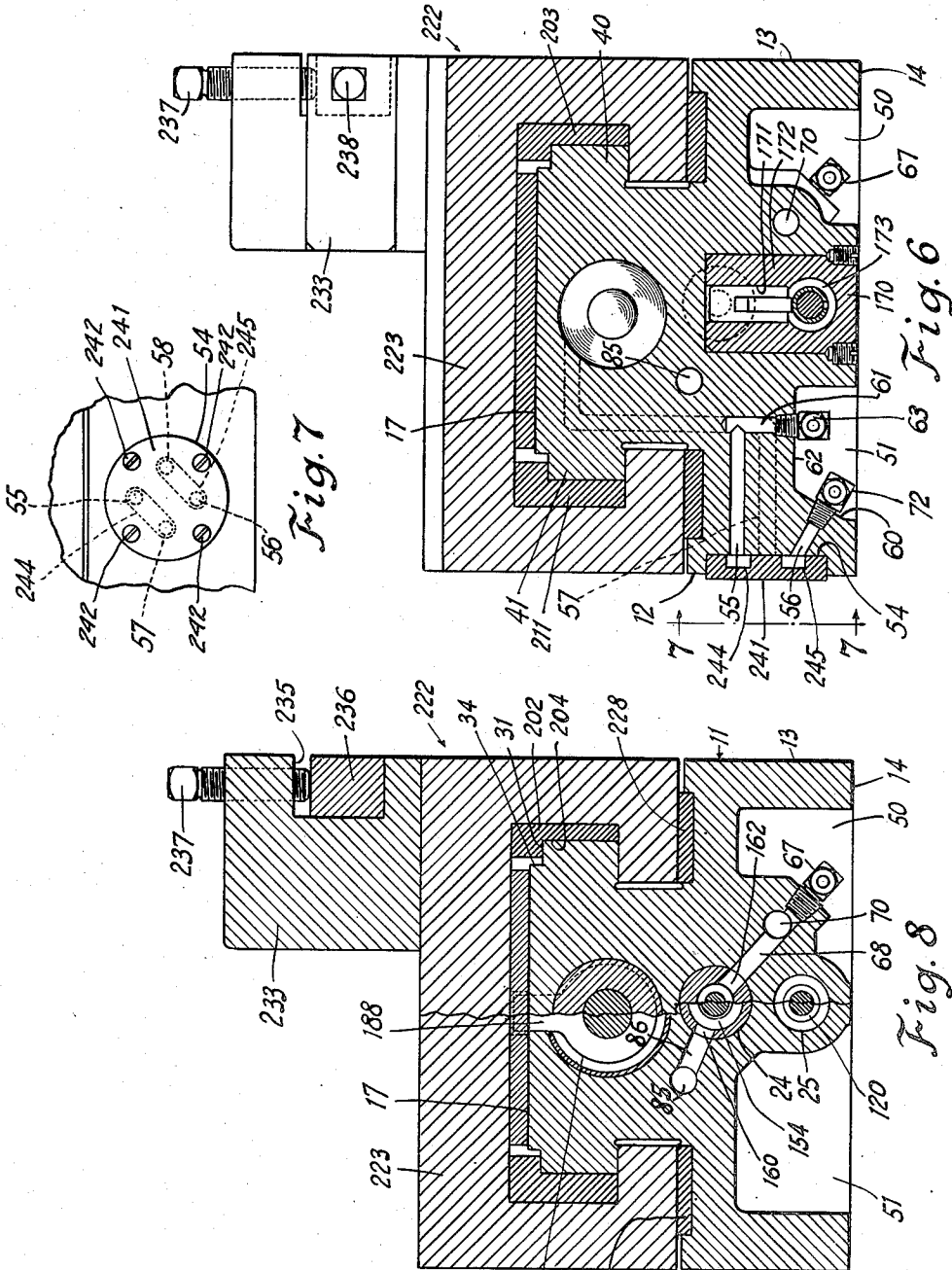
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HYDRAULIC TOOL SLIDE FOR LATHES AND THE LIKE DEVICE

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7 Sheets-Sheet 5



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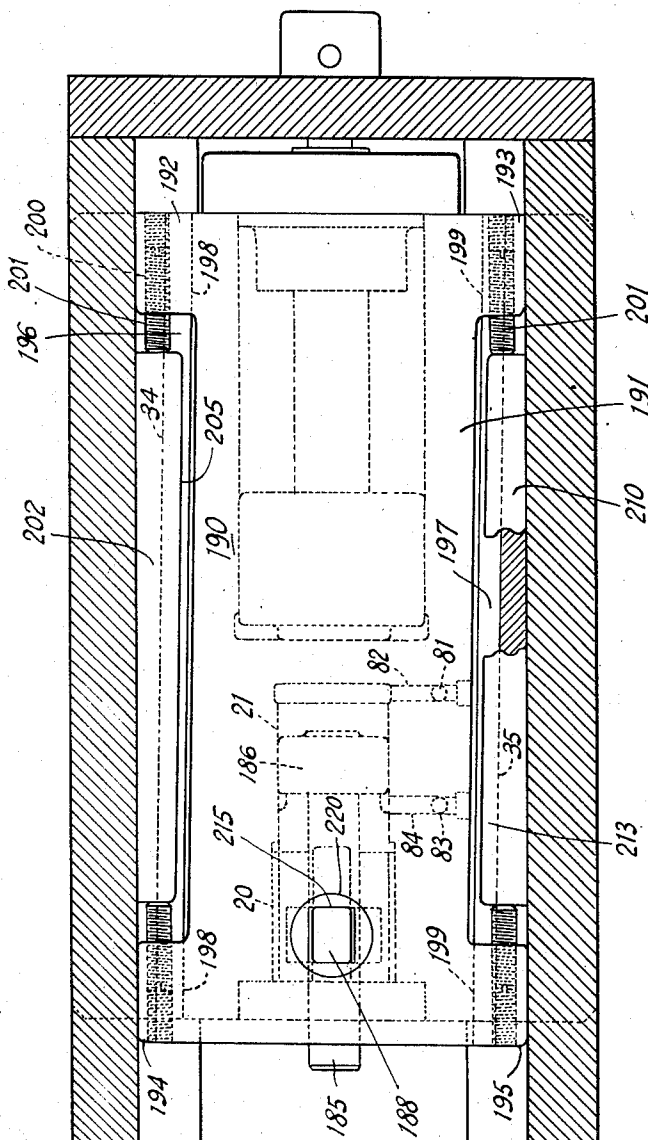
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HYDRAULIC TOOL SLIDE FOR LATHES AND THE LIKE DEVICE

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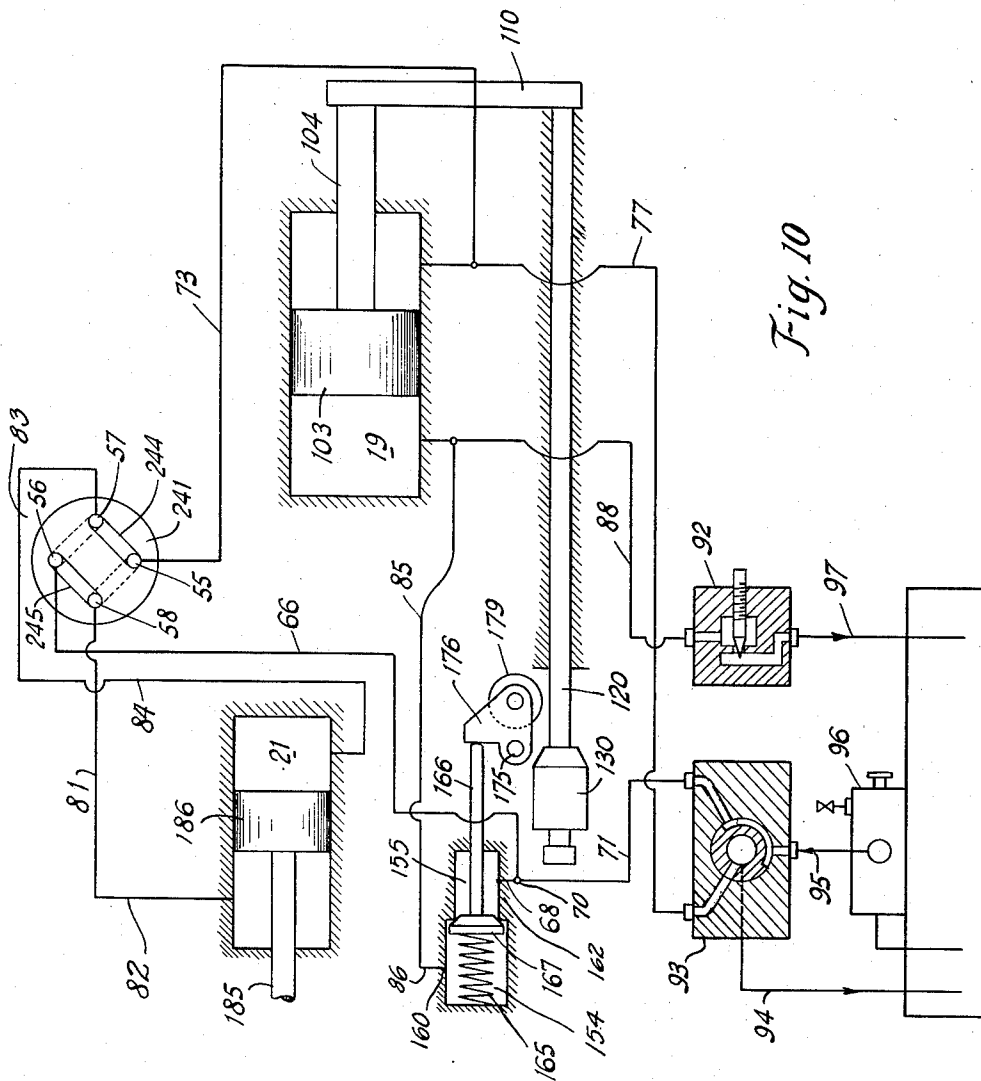
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HYDRAULIC TOOL SLIDE FOR LATHES AND THE LIKE DEVICE

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UNITED STATES PATENT OFFICE

2,563,918

HYDRAULIC TOOL SLIDE FOR LATHES AND
THE LIKE DEVICES

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Application June 19, 1947, Serial No. 755,746

8 Claims. (Cl. 82—24)

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This invention relates to hydraulic tool slides for lathes, and the like device.

An object of this invention is to provide a tool slide of the character described, having means to automatically cause a tool slide to approach the work rapidly, turn the work at a relatively slower feed speed, and then retract rapidly.

Another object of this invention is to provide a tool slide of the character to describe having means to automatically shift the tool transversely with respect to feed motion in a direction away from the turned surface of the work, at the end of the turning operation, to relieve the tool during its retraction.

Another object of this invention is to provide a strong, compact and durable tool slide of the character described, which shall be relatively inexpensive to manufacture, which is adjustable with respect to the relative distances of the approach and turning operations, which is also adjustable with respect to the direction of relief either to the right or left, which is fully automatic in operation and which is practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter described, and of which the scope of application will be indicated in the following claims.

In the accompanying drawing, in which is shown various possible illustrative embodiments of this invention;

Fig. 1 is a longitudinal, cross-sectional view through a device embodying the invention and showing the position of the parts when the tool slide is at the end of the cutting or turning operation and ready to retract;

Fig. 2 is a view similar to Fig. 1, and showing the position of the tool slide in fully retracted position, and also showing in dot-dash lines the position of the cutting tool at the end of fast approach and also at the end of the feed or cutting or turning operation;

Fig. 3 is a bottom plan view of the device shown in Figs. 1 and 2;

Fig. 4 is an outer end view of the device shown in Fig. 1 and 2;

Fig. 5 is a cross-sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 1;

Fig. 7 is a view taken along the plane 7—7 of Fig. 6;

Fig. 8 is a cross-sectional view taken on line 8—8 of Fig. 3;

Fig. 9 is a cross-sectional view taken on line 9—9 of Fig. 1;

5 Fig. 10 is a diagrammatic view illustrating the hydraulic control system for the movement of the slide.

Referring now in detail to the drawing, 10 designates a tool slide embodying the invention. The same comprises a body 11 which may be fixed to the bed of the lathe in any suitable manner. Said body 11 has parallel vertical side surfaces 12 and 13, a bottom surface 14, parallel end surfaces 15 and 16, and a top surface 17 parallel to the bottom surface. Surface 15 is formed with a vertical groove forming a depressed surface 15a parallel to surface 15. At the sides of said groove are parallel surfaces 15b, 15c. Said body 11 is formed with a cylindrical opening 19 extending from its outer surface 16 along the longitudinal midsection of the body. The opening 19 is enlarged at its inner end, as at 19a.

Said body is furthermore formed with a cylindrical opening 20 extending from the surface 15a, likewise located on the vertical longitudinal midsection of the body. Extending from the opening 20 is a cylindrical co-axial opening 21. Extending from opening 20 to the top surface 17 is a longitudinal slot 22. The axis of openings 20, 21 is preferably above the axis of opening 19. Opening 21 terminates short of opening 19, thereby leaving a wall 23 between said openings.

35 The body 11 is furthermore formed with a cylindrical opening 24 extending from said surface 15a. Opening 24 is parallel to opening 20 and at one side thereof and disposed therebelow.

Also extending from surface 15a is a cylindrical opening 25, parallel to opening 24 and aligned therewith and disposed therebelow. Extending upwardly from the bottom surface 14 is a cylindrical opening 26 which communicates with said openings 24 and 25.

45 Said body 11 is furthermore formed with an opening 27 extending from the surface 16 co-axial with opening 25. Extending from opening 27 is an opening 28, co-axial therewith, and of smaller diameter, and communicating with opening 26 and hence with opening 25. Extending upwardly from the bottom surface 14 is a vertical screw threaded opening 30 communicating with opening 28.

55 The body 11 is narrower at the top than at the bottom and is formed adjacent its top surface with a pair of depressed aligned shoulder surfaces

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31 and 32. Surfaces 31 and 32 are in the same plane and below the plane of the top surface 17. Between surfaces 31, 32 and the top surface 17 are parallel surfaces 34 and 35 respectively, said surfaces being inclined to the longitudinal mid-section of the body. At the sides of the upper portion of the body and below the surfaces 31, 32 are parallel surfaces 36, 37. Said surfaces 36, 37 are parallel to the surfaces 34, 35 respectively, and are hence inclined in the same direction. Below the surfaces 36, 37 are inwardly extending under surfaces 38, 39 which are in the same plane, thereby forming wings 40 and 41 in the upper part of the body.

Extending downwardly from surfaces 38, 39 are surfaces 42, 43 respectively. Extending outwardly from surfaces 42, 43, are upwardly and inwardly extending gib surfaces 44 and 45 respectively. The gib surfaces form depressed grooves in surfaces 46 and 47 which are the top surfaces of the bottom wider portion of the body.

The underside of the body 11 is formed with recesses 50 and 51 adjacent one end, and with recesses 52 and 53 adjacent the other end. Side surface 12 of the body is formed with a circular depression 54. The body 11 is furthermore formed with four passages leading to the depressed surface 54. Said passages are numbered 55, 56, 57 and 58. Passage 56 leads to a surface 60 in recess 51. Passage 55 communicates with a passage 61 extending downwardly to a surface 62 in depression 51.

Screwed to the lower screw threaded end of the passage 61 is a nipple 63 connected by a tube 66 to a nipple 67 screwed into one end of a passage 68 in the body 11 and leading to the opening 24. Looking at Fig. 8, it will be noted that passage 68 is inclined upwardly and inwardly. The body is furthermore formed with a longitudinal passage 70 which interconnects passage 68 with a passage 71, which leads to the side surface 13 of the body. Screwed to the inner end of passage 56 is a nipple 72 connected by tube 73 to a nipple 74. Nipple 74 is screwed into one end of a passage 75 in the body connected by a passage 76 to a passage 77 which leads to cylindrical opening 19 adjacent its open end. Said passage 77 also extends to side surface 13, as at 78, where it is put in communication with the hydraulic system. Said passage also extends to the bottom surface 14, as at 79, where it is plugged.

Passage 58 extends to passage 81 leading upwardly within the body and connected to a horizontal passage 82 leading to the inner end of cylindrical opening 21. Passage 57 connects to passage 83 leading upwardly to passage 84 which leads to the outer end of cylindrical opening 21.

The body is furthermore formed with a longitudinal passage 85, which leads to one end of cylindrical opening 19. At one end of passage 85 is a passage 86 which leads to the inner end of opening 24. Said passage 85 also extends to the bottom or recess 51, said opening being fitted with nipple 87 connected by a tube 88 which extends to the surface 89 in depression 52. Between surface 89 and surface 13 is a wall 90 formed with a through passage 91 to which the tube 88 is connected.

Passage 91 is connected to a flow control valve 92 of any suitable well known construction, the same being of the type through which the flow of liquid may be controlled or constricted to a suitable degree. Passage 78 leads to one of the outlet ends of a four way valve 93, whereas, passage 71 may be connected to another outlet end of said

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valve 93. Valve 93 is connected by a tube 94 to a return tank, and by conduit 95 to a pump 96. The flow control valve 92 may be connected by passage 97 to the return tank. The four way valve 93 may be of well known construction being controlled by solenoid which may be controlled by limit switches, as will be explained hereinafter.

Attached to the end surface 16 is a stuffing box or closure member 100 for closing the cylindrical opening 19. Said closure member is formed with an axial through opening 101.

Slidably mounted within opening 101 is a tubular piston rod or member 102, to the inner end of which is fixed a piston 103 contacting the inner surface of the cylindrical opening 19. Extending through the tube 102 is a link 104, pivoted at its inner end to the inner end of the tube 102, as by pivot pin 105. The link 104 extends beyond tube 102 and pivoted to the outer end thereof, as by pivot pin 106 parallel to pin 105 is a block 107 fixed to a slide plate 110 by screws 107a. The link 104 is of smaller diameter than the diameter of the inside of the tube 102, thereby permitting swinging of the link 104 about the pivot pin 105 for the purpose hereinafter appearing.

Link 104 loosely passes through opening 111 in slide plate 110. Mounted on the plate 110 is a plate 111a formed with a through opening 112, co-axial with opening 27. Plate 110 is formed with a notch 113 extending upwardly from its lower edge to receive said plate 111a. The side edges of plate 111a are formed with vertical grooves 114 to receive parallel tongues 115 on plate 110.

Rotatably mounted in opening 112 is a pin 116. Pin 116 has a square wrench head 117 on its outer end. Fitted over the inner end of pin 116 is a sleeve 118, pinned thereto, as at 119, for movement therewith. Sleeve 118 projects into opening 27 and has sliding, as well as rotating movement with respect thereto. The inner end of pin 116 has a threaded opening and extending into said opening, is screwed one end of a longitudinal rod 120. Longitudinal rod 120 has a screw threaded portion 121 adjacent the pin 116 engaging corresponding internal threaded portions in sleeve 123. Rod 120 is fixed for rotation with pin 116 by pinning or in any other suitable manner.

The rod 120 passes through openings 27, 28, 26 and into opening 25, as shown in Figs. 1 and 2 of the drawing. Attached to the end thereof is a stop collar 122.

It will be noted that rod 120 is of smaller diameter than the internal diameter of the tube 118. Screwed onto threaded portion 121 is a sleeve 123, which is received between the rod 120 and sleeve 118. One end of sleeve 123 projects into opening 28. Sleeve 123 is formed with a longitudinal slot 124. Screwed into the threaded opening 30 in the bottom of the body is a set screw 125, which projects into slot 124 to prevent rotation of sleeve 123.

It will now be understood that when a wrench 65 is applied to the wrench head 117 and the pin 116 is rotated, sleeve 123 will be adjusted longitudinally for the purpose hereinafter appearing.

Received on rod 120 is a cam sleeve 130. The cam sleeve has a central opening through which the rod passes. It is formed with a tapered cam surface 131. Said cam sleeve 130 is interposed between sleeve 123 and the collar 122.

It will be noted that when plate 110 moves to the left, sleeve 123 moving therewith will contact and move the cam sleeve 130 to the left from

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the position shown in Fig. 2 to the position shown in Fig. 1, for the purpose hereinafter appearing.

Attached to the underside of the body, and disposed within the recess 53 is a bracket 135, provided with a wall 136 projecting into the recess and disposed parallel to the underside thereof. Attached to said wall are a pair of parallel microswitches 137 and 138. Attached to said plate is a pivot pin 139 and swiveled to said pivot pin is a switch arm 140, disposed between the microswitches and adapted to selectively engage plungers 137a and 138a on the microswitches 137 and 138, respectively. The body 11 is formed with a longitudinal opening 141. Extending there-through is a rod 142, passing also through an opening 143 in plate 110. A set screw 144 passing through a threaded opening in plate 110 engages a flat on rod 142 to fix said rod to plate 110 for movement therewith. Said rod 142 is formed with a longitudinal groove 145, into which one end of the switch arm 140 projects.

As the plate 110 moves to the left, looking at Fig. 3 of the drawing, shoulder 145a at one end of groove 145, engages the switch arm 140 and actuates switch plunger 137a. When plate 110 moves to the right, shoulder 145b at the opposite end of groove 145, will contact said switch arm 140 to actuate the plunger 138a. Said microswitches 137, 138 are elements in the electric circuit for the control of a cycle of operations done in the general set-up of the lathe.

Within the lower end of the groove formed by the surfaces 15a, 15b and 15c is an end plate 150 which is attached to surface 15a in any suitable manner. Said plate 150 extends from the lower surface 14 upwardly to a point just below the opening 20. It is formed with a through opening 150a, counterbored at its inner surface, as indicated at 150b. Opening 150a is co-axial with opening 24 and the diameter of the counterbored portion 150b is the same as the diameter of said opening 24.

Also attached to the upper end of surface 15a is a plate 151 contacting the upper edge of plate 150. Plate 151 is formed with a through opening 151a co-axial with openings 20, 21. Said plate 151a is furthermore formed with an annular boss 152 projecting into opening 20.

Within opening 24 is a valve housing 153, the rear end of which is received within the counterbored portion 150b. Valve housing 153 is formed at its rear end with an opening 154, from which there extends an opening 155 of smaller diameter. Between openings 154, 155 is a valve seat 156. Extending from opening 155 is a through opening 157. The valve housing is formed with a through opening 160 communicating with opening 154 and registering with passage 86 and hence located to the left side of the valve seat 156, as shown in Figs. 1 and 3 of the drawing. Said valve housing is also formed with an opening 162 communicating with opening 155 and registering with passage 68 and hence located on the opposite side of the valve seat 156. The valve housing 153 is internally screw threaded, at its rear end, and screwed therein is a sleeve 164, having a head 164a contacting the outer surface of plate 150, and hence clamping the valve housing 153 against movement. The sleeve 164 is hollow and disposed therein is a coil compression spring 165.

Slidably received within the socket of the sleeve 164 is a pop valve 166, normally urged to the right by the spring 165, as shown in Figs. 1 and 2

of the drawing. Valve 166 is formed with an annular valve portion 167 adapted to be seated on the annular valve seat 156 by pressure of the spring 165.

Disposed within opening 26 of the body is a plug 170 formed with a vertical through slot 171, thereby forming a pair of spaced walls 172 on opposite sides of said slot. Said plug 170 is formed with a through opening 173 co-axial with opening 25 and communicating with the lower end of slot 171.

Mounted on the side walls 172 and traversing the slot 171 is a pivot pin 175. Pivoted thereon is a lever 176 having an arm 177 contacting one end of the pop valve 166. Said lever is slotted at its lower end and carries a pivot pin 178 traversing the slot and carrying a roller 179 adapted to contact sleeve 123 and the cam sleeve 130. When the roller 179 contacts the sleeve 123, as shown in Fig. 1 of the drawing, the pop valve is moved to the right and the valve seat 156 is closed, thus shutting off communication between openings 154 and 155. However, when the slide plate 110 moves to the right and the cam sleeve 130 rotates the lever 176 in a counterclockwise direction from the position shown in Fig. 1 to the position shown in Fig. 2, the pop valve opens and communication is established between openings 154 and 155. The side walls 172 of the plug 170 are interconnected by a transverse stop pin 180 which limits movement of the lever in a counterclockwise direction about its pivot.

Within one end of opening 21 is a fixed stuffing box 181, which closes one end of the opening 21. Between plate 151 and the stuffing box 181 and disposed within the opening 20 is a slotted spacing sleeve 182 holding the stuffing box against movement. The sleeve 182 is formed with a slot registering with slot 22. The stuffing box 181 is formed with an axial through opening 184. Extending through the opening 151a in plate 151 and opening 184 in the stuffing box 181 is a piston rod 185. At one end of the piston rod 185 is a piston 186 disposed within cylindrical opening 21. Mounted on the piston rod 185 and disposed between plate 151 and stuffing box 181 is a dog 187, having an upwardly extending lug 188 passing through slot 22 and projecting above the upper surface of the body 11.

Mounted on the upper surface 17 of body 11 is a gib carrier 190. Said gib carrier comprises a top plate portion 191 formed at one end with wings 192 and 193 and at the opposite end with wings 194 and 195. Thus between wings 192 and 194 is a longitudinal slot 196 and between wings 193 and 195 is a longitudinal slot 197. The wings 192 and 194 are formed with inner tapered surfaces 198 closely approaching the tapered surface 34 of body 11, above the shoulder 31. Wings 193 and 195 have inner tapered surfaces 199 closely approaching the tapered surfaces 35 of the body 11 above the shoulder 32. Said wings 192, 193, 194, 195 are each formed with a longitudinally extending through screw threaded opening 200. Screwed into each opening 200 is a screw 201 projecting inwardly into the slot 196 or 197 as the case may be.

Within slot 196 is a gib 202 having a downwardly extending wall 203 formed with a tapered inner surface 204 contacting the tapered surface 36 at one side of the body. Said gib 202 also has an inwardly extending flange 205 having an undersurface contacting the surface or shoulder 31 of the body. The screws 201 which pass through the wings 192 and 194 contact opposite ends of

the gib 202 so that movement of the gib carrier 190 will cause movement of the gib 202.

Likewise within slot 197 is a gib 210 provided with a downwardly extending wall 211 having an inner surface 212 contacting the tapered surface 37 of the body. Said gib is also formed at its upper end with an inwardly extending flange 213 having an under surface contacting surface or shoulder 32 of the body. The screws 201 which pass through the wings 193, 195 contact opposite sides of the gib 210 so that the gib must follow movement of the gib carrier 190. The gibs 202, 210 have outer surfaces parallel to the longitudinal axis of the body 11. The gib carrier 190 is formed with a through opening 215 through which the upper end or lug 188 of dog 187 projects, so that movement of the piston rod 185 and piston 186 to the right or left causes movement of the gib carrier plate and the gibs 210 therewith. The top surface of the gib carrier 190 may be formed with a shallow depression 220 to receive plate 221 which covers the upper end of the lug 188.

It will now be understood that as the gib carrier 190 is moved to the right, the gibs 202 and 210 are likewise moved to the right. When the gib carrier 190 is moved to the left, both gibs are also moved to the left.

Above the body 11 and gib carrier 190 is a slide 222 which comprises a top wall 223. Extending downwardly from the sides of top wall 223 are walls 224 and 225 having outer surfaces which may be flush with the surfaces 12 and 13, and having parallel inner surfaces parallel to the axis of body 11 and contacting the outer parallel surfaces of the gibs 202 and 210. The inner surfaces of walls 224 and 225 are parallel to the outer surfaces thereof and hence likewise parallel to surfaces 12 and 13. Extending inwardly from the lower ends of the side walls 224 and 225 are walls 226 and 227 contacting the under surfaces 36 and 39 of the body and spaced above surfaces 46 and 47. Within the recesses 44 and 45 of the body are gibs 228 and 229, the upper surfaces of which contact the under surfaces of said walls 226 and 227.

Wall 223 has a raised platform 230 at its inner end. The platform portion is formed with transverse inverted T-shaped grooves 231. Mounted on said platform is a tool carrier 233 provided with lugs 234 received within the grooves 231. The tool carrier 233 may be provided with a longitudinal tool receiving groove 235 at one side thereof to receive a turning tool 236. The tool 236 may be clamped in place by a plurality of vertical screws 237 and a horizontal end screw 238. The slide plate 110 is attached to one end of the slide 222 by means of screws 240, as shown in Figs. 1 and 2 of the drawing.

Received within the circular depression 54 is a directional selector valve plate 241 which may be attached against rotation by means of screws 242 in either of two positions. One position is shown in Fig. 7. In such position, the plate 241 is formed on its inner surface with a pair of parallel grooves 244 and 245. Groove 244 interconnects passages 55 and 57, whereas groove 245 interconnects passages 56 and 58. The valve plate 241 may be shifted through an angle of 90 degrees and then again fixed in place by the screws 242. In such position groove 245 will interconnect passages 56 and 57, whereas, groove 244 will interconnect passages 55 and 58.

Cylinder 19 may be termed a feed cylinder. Cylinder 21 may be termed tool relief cylinder, whereas, the valve 241 is a direction selector

valve controlling the direction of shift of the tool slide, so that the relief is either to the right or left as selected, as will appear hereinafter.

The operation of the device will now be further described.

In the forward stroke of piston 103 hydraulic pressure comes from the four way valve 93 to passage 77 moving piston 103 forward or to the left looking at the drawing. Passage 77 is also connected through conduit 73 to passage 55 and through the selector valve 241 to the tool relief cylinder 21. During the first part of the forward stroke, cam sleeve 130 keeps the lever 177 up and holds the hydraulic pop valve 166 open and spring 165 compressed. The oil flows from the feed cylinder 19 through passage 85 and 86 and opening 160 to opening 154, and through the open valve and openings 155 and 162 and passages 68 and 71, back to the 4-way valve 93. Piston 103 is connected to the slide 222 through the link or rod 104 hinged between the piston and the slide plate 110 by the parallel pivot pins 105 and 106. Said slide plate 110 also carries the adjustable rod or pin 116. By turning the square head 117 of said pin, sleeve 123 can be set to any location within the range of the slide. As the piston 103 moves to the left pin 116 also moves to the left and so does sleeve 123. When said sleeve hits the cam sleeve 130, the roller 179 and lever 176 drop down, and the hydraulic combination valve 166 is closed. The oil or other hydraulic medium is now forced to flow from cylinder 19, through conduit 88 to the flow control valve 92 and through line 97 back to the tank. Flow control valve 92 is of usual construction and has an adjustable orifice adjusting the amount of oil and feed rate in inches per minute. The tool relief piston 186 is moved in either direction at the time when the pressure in line 73 reaches a predetermined point. This pressure may be reached during the fast approach cycle in case the friction in the slide is sufficiently high or the pressure will build up at the end of the fast approach and at the beginning of the feed cycle because of the restriction in the flow control valve and because the cylindrical pop valve 166 has been closed. Thus the first part of the forward stroke is the fast approach stroke until the pop valve 166 closes. Thereafter, the tool feeds at a slower rate during the turning operation. The fast approach is indicated in Fig. 2 by letter A. The slower feed stroke is indicated by letter B.

When the pressure in line 73 reaches said predetermined point, piston 186 will move the gib carrier 190 and hence will also move the two tapered gibs 202 and 210 to shift the slide 222 for bringing the tool 236 to proper turning position. When said predetermined pressure is built up in line 73, oil under pressure passes through passage 55, groove 244 to passage 57, passage 81 and passage 82 entering cylinder 21 to move said piston 186 to the left thereby allowing oil from said cylinder out through passages 84, 83, groove 245, passage 56, conduit 66 and passages 70 and 71 back to the four way valve 93 and tank. Should the plate 241 be shifted through an angle of 90 degrees to connect groove 245 from passage 55 to 58, pressure to go to passages 58, 83, 84 to the left side of piston 186 to move the same to the right instead of to the left, thereby reversing the side direction of movement for the tool 236 relative to its longitudinal movement.

The amount of tool side shift is controlled by the stroke of the tool relief piston 186, and the

amount of taper on the two gibs 202 and 210. The direction of tool relief can be selected either to the left or to the right relative to the forward stroke of the tool slide, by rotating the plate 241 through an angle of 90 degrees as described hereinabove.

At the end of the feed stroke, the limit switch arm 140 is actuated through the electric control system by contact with shoulder 145a of pin 142, thereby causing the solenoid, which controls the four way valve 93, to operate, so that the pressure goes to passage 71 instead of passage 77. Passage 77 will then be connected through the valve 93 to the tank. Pressure on line 71 will move the relief piston 186 to the right, until it reaches the end of the stroke, at which time pressure in line 71 will be raised sufficiently to overcome force of spring 165, opening valve 167 to allow oil flow through passage 85, causing piston 103 to move likewise to the right. This is so because the pressure goes through passages 71, 70, 68, 162, openings 155 and 154, opening 160, passages 86 and 85 to cylinder 19. The gib carrier with the two tapered gibs will thus be shifted in a proper direction and provide tool relief. The function of the combination valve 166 at that moment is that of a back pressure or sequence valve, allowing pressure to a cylinder, after the operation of another cylinder has been completed. The return stroke indicated by letter C in Fig. 2 is fast since the return line 77 is now open to tank and free flow is provided.

It will thus be seen that there is provided a device in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiment above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. In combination, a body, a gib carrier on said body, a pair of tapered gibs on said body, means connecting said tapered gibs to the gib carrier for movement therewith, said body including a feed cylinder, a piston in said cylinder, a slide mounted on said gib carrier and having inner parallel surfaces contacting surfaces on the gibs parallel to the axis of the body, a slide plate attached to one end of the slide, a link interconnecting said piston with said slide plate, said tapered gibs having parallel surfaces contacting parallel surfaces on the body inclined to the axis of said body, and means for moving the gib carrier and gibs longitudinally of the body for causing said slide to shift transversely relative to said body.

2. In combination a body formed with a cylindrical opening, a piston within said opening, said body having a tapered surface inclined to the longitudinal axis of the body, a gib having a surface parallel to the longitudinal axis of the body, a slide having a surface contacting the parallel surface of the gib, a link interconnecting said piston with said slide, said body being formed with a second cylindrical opening, a second piston within said second cylindrical opening, means to connect said second piston to said gib, for movement therewith, and means for reciprocating said pistons in predetermined sequence.

3. In combination a body formed with a cy-

lindrical opening, a piston within said opening, said body having a tapered surface inclined to the longitudinal axis of the body, a gib having a surface parallel to the longitudinal axis of the body, a slide having a surface contacting the parallel surface of the gib, a link interconnecting said piston with said slide, said body being formed with a second cylindrical opening, a second piston within said second cylindrical opening, means to connect said second piston to said gib, for movement therewith, and means for reciprocating said pistons in predetermined sequence, said last means comprising a valve, means connected to said first piston to actuate said valve, conduit means connected to said first cylindrical opening on one side of the piston therein, a conduit connecting the first conduit to the second cylindrical opening on one side of the piston therein, a conduit connected to the second cylindrical opening on the opposite side of said piston therein, means controlled by movement of the first piston to alternately provide fluid pressure to the first mentioned conduit and the last mentioned conduit, said valve including a valve seat and a movable member adapted to be seated on the valve seat, said last mentioned conduit being connected to said valve at one side of the valve seat, a conduit interconnecting said valve seat on the opposite side of the valve seat to a flow control valve and means to connect the conduit which connects to the flow control valve to said first cylindrical opening on the opposite side of the piston therein.

4. In combination, a body formed with a cylindrical opening, a piston therein, a slide mounted on said body, means to connect said piston to said slide, a valve housing including a valve seat and valve chambers on opposite sides of said seat, a slidable valve member adapted to close said seat to cut off communication between said chambers, a pivoted lever engaging said valve member and adapted to unseat said valve member, a cam engaging said lever, a shaft connected to said piston for movement therewith and slidably engaging said cam, means on said shaft to move said cam in one direction and means adjustably mounted on said shaft adapted to move said cam in an opposite direction, a conduit connected to said cylindrical opening on one side of the piston therein, a conduit connected to the valve chamber on one side of said valve seat, a conduit connecting the valve chamber on the opposite side of the valve seat with said cylindrical opening on the other side of the piston therein, means connecting the cylindrical opening at said other side of the piston therein to a flow control valve, and means controlled by movement of said piston to alternately apply fluid under pressure to the first and second mentioned conduits.

5. In combination, a body, a gib carrier slidably mounted on the top surface of said body, said body having opposite parallel surfaces tapered with respect to the longitudinal axis of the body, a pair of gibs having surfaces contacting said tapered surfaces, said gibs having parallel surfaces parallel to the longitudinal axis of the body, adjustable means to interconnect the gib carriers to the gib so that movement of the gib carrier will cause movement of said gibs, a slide mounted on said gib carrier and having surfaces contacting the surfaces of the gibs parallel to the axis of the body, said body having inwardly extending grooves at opposite sides thereof, said slide having inwardly extending

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flanges projecting into said grooves, said body being formed with a cylindrical opening, a piston within said opening, a stuffing box attached to the body and closing said opening, said stuffing box being formed with an axial opening, a sleeve fixed to the piston and passing through said opening in the stuffing box, a slide plate attached to the slide and disposed at right angles thereto and a link interconnected to said piston and slide plate about parallel pivot pins, said link passing through said sleeve, said body being formed with a second cylindrical opening, a stuffing box closing said opening, a piston within said second cylindrical opening, the last mentioned stuffing box being formed with an axial through opening, a piston rod attached to the second piston and passing through the axial opening in the second mentioned stuffing box, said body being formed with a longitudinal slot and means connected to the last mentioned piston rod and passing through said longitudinal slot and engaging said gib carrier, and means for causing reciprocation of said pistons in predetermined sequence.

6. In combination, a body, a gib carrier slidably mounted on the top surface of said body, said body having opposite parallel surfaces tapered with respect to the longitudinal axis of the body, a pair of gibs having surfaces contacting said tapered surfaces, said gibs having parallel surfaces parallel to the longitudinal axis of the body, adjustable means to interconnect the gib carriers to the gib so that movement of the gib carrier will cause movement of said gibs, a slide mounted on said gib carrier and having surfaces contacting the surfaces of the gibs parallel to the axis of the body, said body having inwardly extending grooves at opposite sides thereof, said slide having inwardly extending flanges projecting into said grooves, said body being formed with a cylindrical opening, a piston within said opening, a stuffing box attached to the body and closing said opening, said stuffing box being formed with an axial opening, a sleeve fixed to the piston and passing through said opening in the stuffing box, a slide plate attached to the slide and disposed at right angles thereto and a link interconnected to said piston and slide plate about parallel pivot pins, said link passing through said sleeve, said body being formed with a second cylindrical opening, a stuffing box closing said opening, a piston within said second cylindrical opening, the last mentioned stuffing box being formed with an axial through opening, a piston rod attached to the second piston and passing through the axial opening in the second mentioned stuffing box, said body being formed with a longitudinal slot and means connected to the last mentioned piston rod and passing through said longitudinal slot and engaging said gib carrier, and means for causing reciprocation of said pistons in predetermined sequence, and means for reversing the sequence of movement of the second piston relative to the first piston.

7. In combination, a body, a gib carrier slidably mounted on the top surface of said body, said body having opposite parallel surfaces tapered with respect to the longitudinal axis of the body, a pair of gibs having surfaces contacting said tapered surfaces, said gibs having parallel surfaces parallel to the longitudinal axis of the body, adjustable means to interconnect the gib carriers to the gib so that movement of the gib carrier will cause movement of said gibs,

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a slide mounted on said gib carrier and having surfaces contacting the surfaces of the gibs parallel to the axis of the body, said body having inwardly extending grooves at opposite sides thereof, said slide having inwardly extending flanges projecting into said grooves, said body being formed with a cylindrical opening, a piston within said opening, a stuffing box attached to the body and closing said opening, said stuffing box being formed with an axial opening, a sleeve fixed to the piston and passing through said opening in the stuffing box, a slide plate attached to the slide and disposed at right angles thereto and a link interconnected to said piston and slide plate about parallel pivot pins, said link passing through said sleeve, said body being formed with a second cylindrical opening, a stuffing box closing said opening, a piston within said second cylindrical opening, the last mentioned stuffing box being formed with an axial through opening, a piston rod attached to the second piston and passing through the axial opening in the second mentioned stuffing box, said body being formed with a longitudinal slot and means connected to the last mentioned piston rod and passing through said longitudinal slot and engaging said gib carrier, and means for causing reciprocation of said pistons in predetermined sequence, and means for reversing the sequence of movement of the second piston relative to the first piston, means for moving said pistons including means for moving the first piston at varying rates of speed in one direction.

8. In combination, a body, a gib carrier slidably mounted on the top surface of said body, said body having opposite parallel surfaces tapered with respect to the longitudinal axis of the body, a pair of gibs having surfaces contacting said tapered surfaces, said gibs having parallel surfaces parallel to the longitudinal axis of the body, adjustable means to interconnect the gib carriers to the gib so that movement of the gib carrier will cause movement of said gibs, a slide mounted on said gib carrier and having surfaces contacting the surfaces of the gibs parallel to the axis of the body, said body having inwardly extending grooves at opposite sides thereof, said slides having inwardly extending flanges projecting into said grooves, said body being formed with a cylindrical opening, a piston within said opening, a stuffing box attached to the body and closing said opening, said stuffing box being formed with an axial opening, a sleeve fixed to the piston and passing through said opening in the stuffing box, a slide plate attached to the slide and disposed at right angles thereto and a link interconnected to said piston and slide plate about parallel pivot pins, said link passing through said said sleeve, said body being formed with a second cylindrical opening, a stuffing box closing said opening, a piston within said second cylindrical opening, the last mentioned stuffing box being formed with an axial through opening, a piston rod attached to the second piston and passing through the axial opening in the second mentioned stuffing box, said body being formed with a longitudinal slot and means connected to the last mentioned piston rod and passing through said longitudinal slot and engaging said gib carrier, and means for causing reciprocation of said pistons in predetermined sequence, and means for reversing the sequence of movement of the second piston relative to the first piston,

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means for moving said pistons including means for moving the first piston at varying rates of speed in one direction, and further including means to adjust the distance at which the first piston moves at one rate of speed and the distance through which it moves at another rate of speed.

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