July 31, 1951 R. M. GAMBLE 2,562,266

TURRET LATHE

Filed July 26, 1945 7 Sheets-Sheet 1

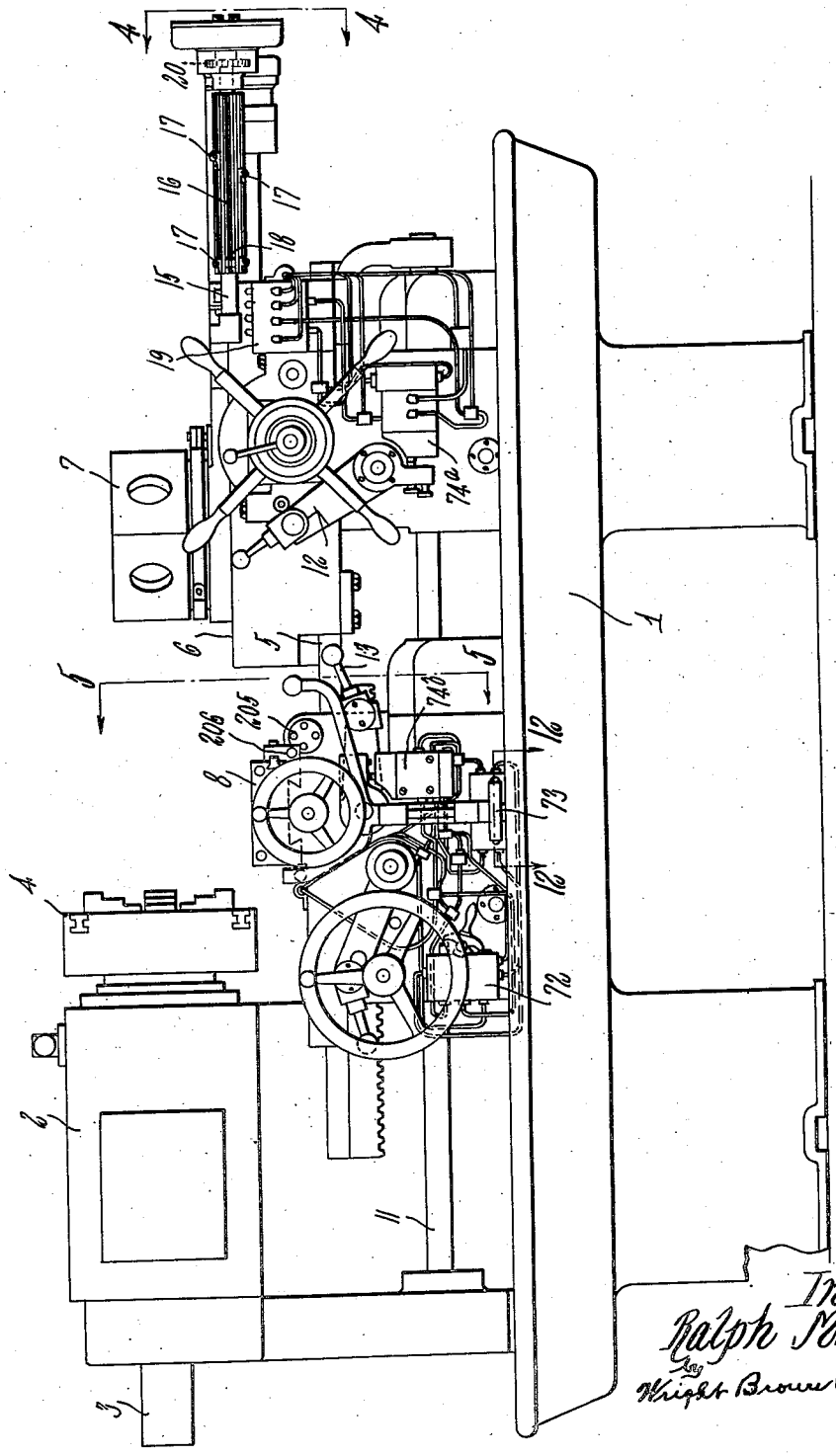


Fig. 1.

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TURRET LATHE

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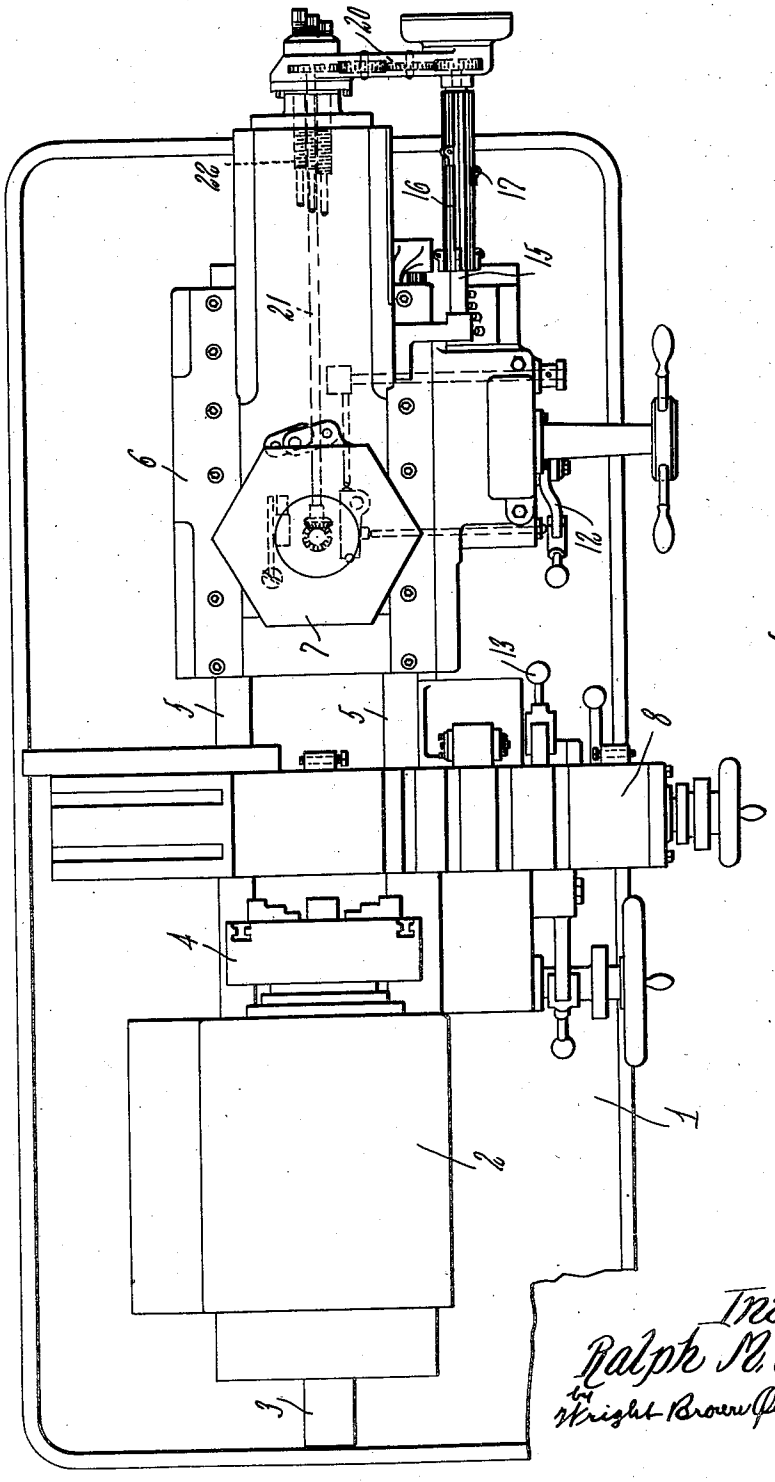


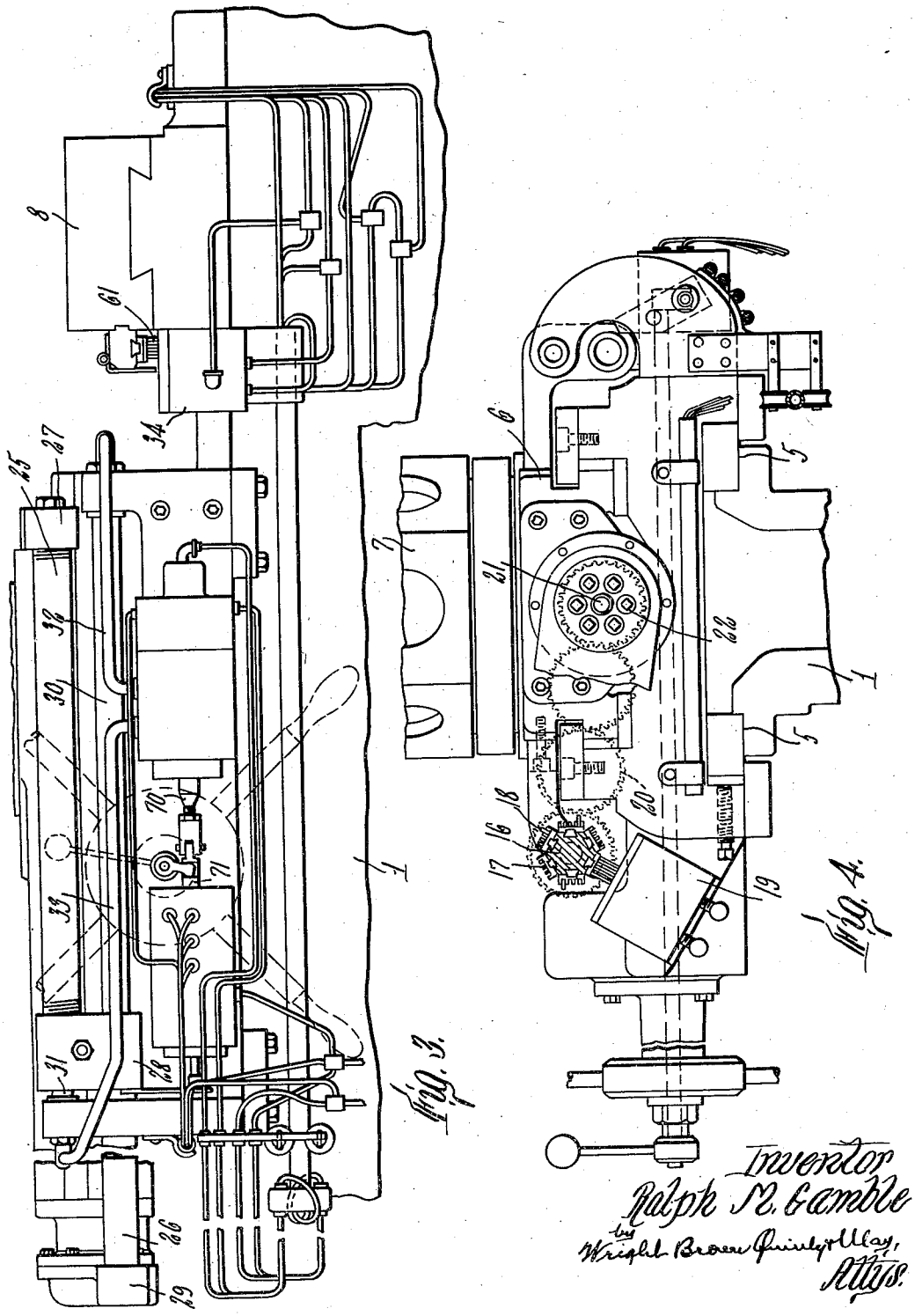
Fig. 2.

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TURRET LATHE

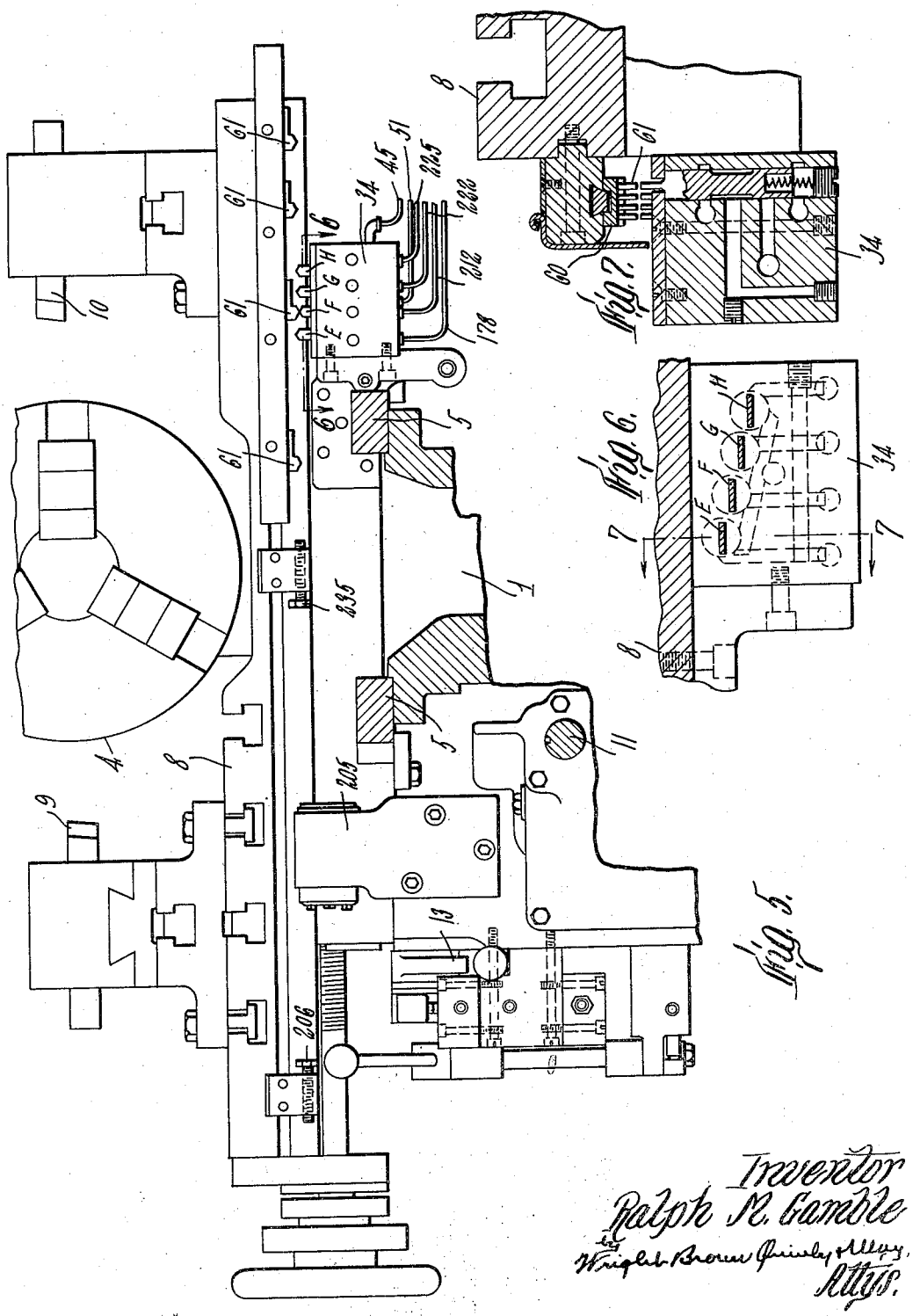
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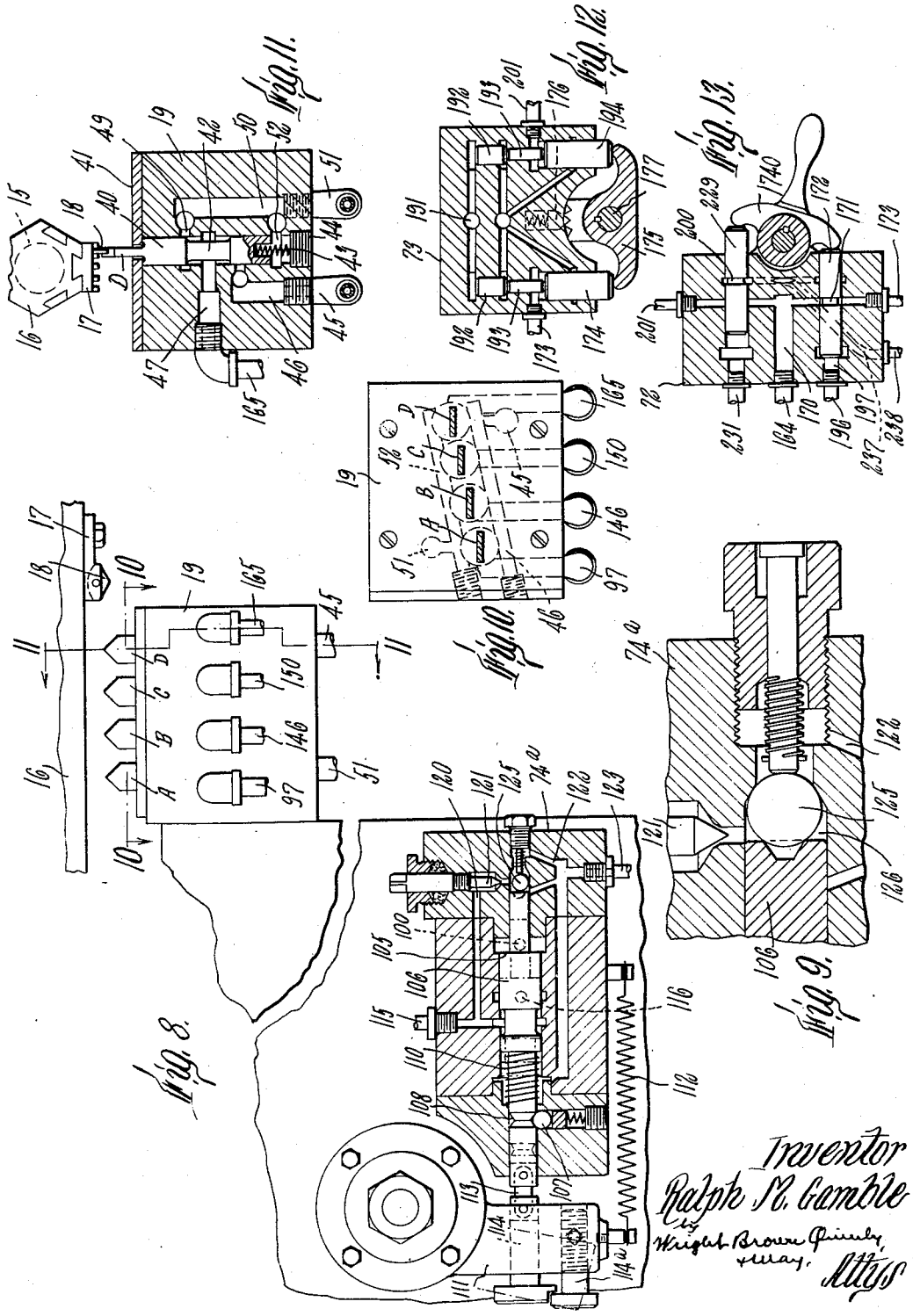


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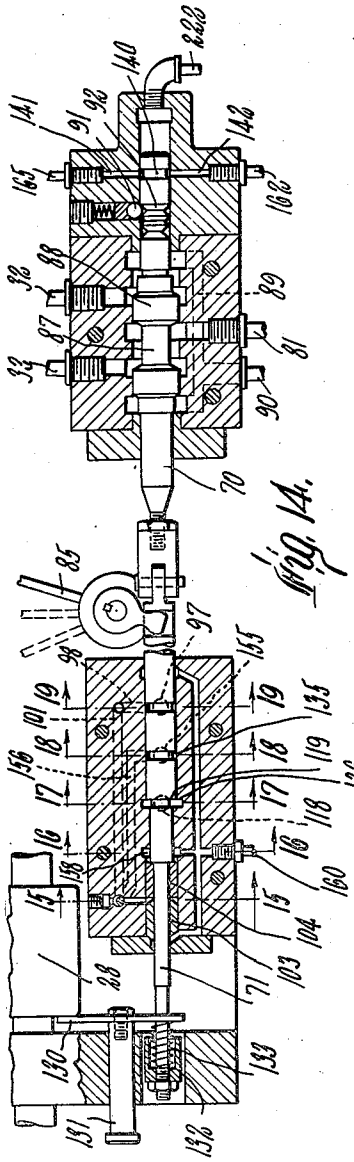


Fig. 14.

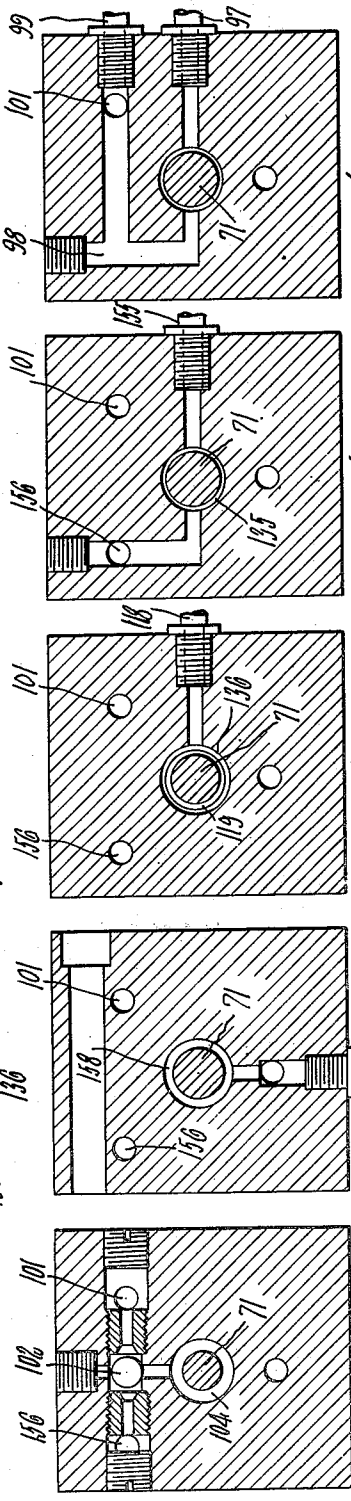


Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

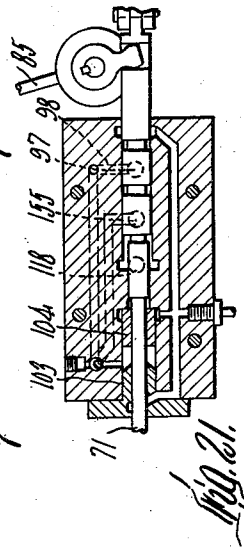


Fig. 19.

Fig. 21.

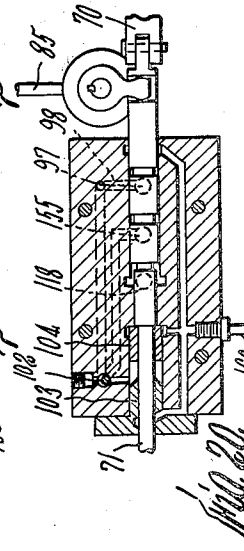


Fig. 20.

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TURRET LATHE

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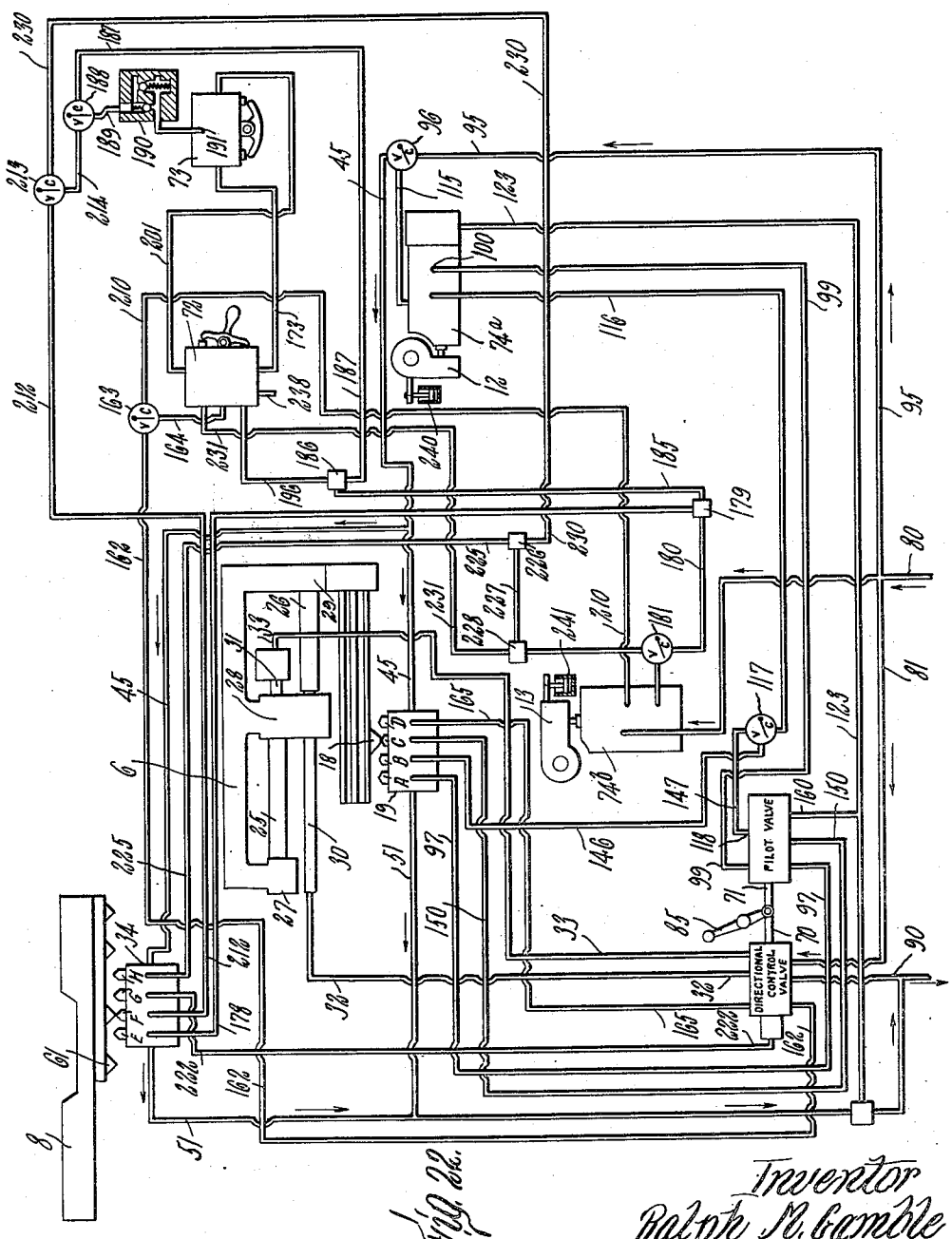


Fig. 22.

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Patented July 31, 1951 2,562,266

UNITED STATES PATENT OFFICE

2,562,266

TURRET LATHE

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Application July 26, 1945, Serial No. 607,159

4 Claims. (Cl. 29—42)

1

This invention relates to turret lathes and has for an object to provide a hydraulic system for actuating mechanical controls to provide an automatic cycle of operations. This takes advantage of all the desirable features of the mechanical controls, such, for example, as precision control and smoothness of feed, and yet provides for automatic cycle control. Thus the machine may be provided with a turret ram and a cross slide, both with mechanical actuating means, together with hydraulic controls for the actuating means by which the operations may be automatic, semi-automatic, or if desired with the hydraulic mechanism inoperative and the mechanical actuating means under manual control.

A further object of the invention is to provide for fluid pressure pulse operation of the controls rather than continuous pressure so that it is unnecessary to maintain high pressure conditions in the major portion of the hydraulic system, thus avoiding troublesome leakage problems.

For a complete understanding of this invention, reference may be had to the accompanying drawings, in which

Figures 1 and 2 are front elevation and top plan views, respectively, of a turret lathe embodying the invention.

Figure 3 is a fragmentary rear elevation of the machine to a larger scale than Figure 1.

Figures 4 and 5 are detail sectional views to a larger scale on lines 4—4 and 5—5, respectively, of Figure 1.

Figure 6 is a detail sectional view to a larger scale on line 6—6 of Figure 5.

Figure 7 is a detail sectional view on line 7—7 of Figure 6.

Figure 8 is a view partly in front elevation and partly in section through the ram knock-off actuating means and to a larger scale than Figure 1.

Figure 9 is a view similar to a portion of Figure 8, but to larger scale and showing a threaded plug in section.

Figures 10 and 11 are detail sectional views on lines 10—10 and 11—11, respectively, of Figure 8.

Figure 12 is a detail sectional view to a larger scale on line 12—12 of Figure 1.

Figure 13 is a detail sectional view of the carriage feed reverse unit.

Figure 14 is a longitudinal sectional view through the pilot and directional ram control valves in forward position, the actuating mechanism being shown in elevation.

Figures 15 to 19, inclusive, are detail sectional views to a larger scale on the correspondingly numbered section lines of Figure 14.

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Figures 20 and 21 are views partly in elevation and partly in section of the pilot valve in neutral and in retire positions, respectively.

Figure 22 is a diagram of the hydraulic connections.

As shown best in Figure 1, the machine comprises a bed 1 supporting at one end in a headstock 2, a rotary headstock spindle 3 having a suitable work-holding chuck 4 at its forward end. The bed 1 has ways 5 along which is slidable lengthwise of the spindle 3, a ram 6 on which the tool-holding turret 7 is supported for indexing motion about a vertical axis.

The machine is also provided with a cross carriage 8 mounted for forward and backward motion, and as shown in Figure 5, adapted to carry forward the rear tools 9 and 10, respectively, which may be brought into action, the forward tool by moving the carriage rearwardly from an intermediate idle position, and the rear tool by moving the carriage forwardly from this same position. Suitable mechanical drive means for feeding the ram toward the spindle and for moving the carriage 8, first quickly from the intermediate idle position, and then slowly for feed of the tool against the work may be provided, these being driven from the rotary feed shaft 11 in the well known manner. Suitable provision is made for releasing the slow feed motion of the ram when the tool carried by the turret then in operative relation to the work approaches the work axis to a predetermined point, and means is also provided for returning the carriage to mid position under fast speed. All this may be as disclosed in the Lovely Patent No. 2,006,144 granted June 25, 1935, for Feed Knock-Off Mechanism for Lathes. The feed knock-off mechanism for the ram includes the lever 12, and the feed knock-off mechanism for the carriage includes the lever 13, these corresponding to and being identical with the corresponding parts shown in the Lovely patent.

The present invention provides, besides the mechanisms shown in this patent, hydraulic mechanism for producing a forward quick motion of the ram before the slow mechanical feed is thrown into action, and for retiring the ram in fast motion on termination of the slow feed. It also has hydraulic mechanism for throwing out the fast feed of the ram, and throwing in the slow forward feed, and for causing the knock-off of the ram feed to throw in the hydraulic fast retire mechanism. It also includes hydraulic mechanism for actuating the clutches for the mechanical carriage motion to change from fast to slow feed, and when the knock-off operates,

to throw in the fast motion to retire the carriage to central position.

The mechanism for controlling the ram, and also for initiating the hydraulic control of the cross carriage, includes a lay shaft 15 which is carried by the ram and is journaled for rotation and is connected to the turret so as to be indexed with the indexing of the turret. As shown herein, the turret 7 is provided with six faces, and likewise the lay shaft 15 is provided with a six-faced bar 16 which is fixed to turn therewith.

On each of these faces of the lay shaft 16 there may be secured in adjustable axial positions therealong, a dog holder 17 having four slots spaced laterally of each other and in any selected of which a dog 18 may be secured, the arrangement being such that each of the four dog positions on a carrier at one of the faces of the member 16 is alined with one of four hydraulic valves arranged in staggered relation in a stationary valve casing 19 as shown best in Figure 10. The lay shaft 15 is indexed in time with the indexing of the turret 7, and for this purpose it is connected through a train of gears shown in Figure 2 and in dotted lines in Figure 4 at 20, to a shaft 21, which as shown in Figure 2, is connected to rotate with the turret 7. Also rotatable with the rotatable shaft 21 is a series of adjustable stop screws 22 which may be set to impinge upon the knock-off actuating mechanism for the turret ram motion to limit the forward stroke of the turret for each turret position independently of all the others. This knock-off mechanism is fully shown and described in the Lovely Patent No. 2,006,144 hereinbefore mentioned. As is usual practice in connection with turret lathes, means are provided for indexing the turret by the retire motion of the ram adjacent to its limit of such retire motion. This means, for example, may be that shown in the Lovely and Cheever Patent No. 2,094,993, granted October 5, 1937, for Lathes.

Hydraulic means are provided for producing a rapid motion of the ram between its retire position and the position where the tool is approaching the work, and it is desirable that the slow feed begin. This means is shown best in Figure 3 and diagrammatically in Figure 22. It comprises a pair of hydraulic cylinders 25 and 26 secured at opposite ends to the ram at the brackets 27, 28 and 29, the bracket 28 being common to both cylinders. Within the cylinders are the stationary piston rods 30 and 31 which communicate with the pipes 32 and 33. The piston rods are hollow, and have pistons (not shown) riding in the respective cylinders. These hydraulic cylinders are thus single acting cylinders, hydraulic pressure being admitted to one and exhausted from the other alternately to move the ram in opposite directions.

All of the valves in the casing 19 and actuated by any of the dogs 18 on the lay shaft are alike, and similar valves in a casing 34 are also employed in connection with the control of the carriage motions, as will later appear. One of these valves is shown in section in Figure 11. It comprises a valve plunger having a stem projecting through a slot in the valve cover plate 41. There are four of these valves which may be actuated at suitable times by dogs 18 on the lay shaft, and the stems for these valves are marked, respectively, A, B, C and D. The plunger 40 of each valve has a neck portion 42 intermediate its ends and is normally pressed upward by a spring 43 reacting between its base and a closure plug 44 in the bottom of the valve casing. Fluid under pressure is admitted through the pipe 45 and passage 46, but when the valve stem 40 is lifted, it cannot pass further. On depression of the valve 40, however, communication is made around the neck 42 of the valve through the passage 47 into a connecting pipe. As soon as the valve is allowed to rise again, pressure in the passage 47 is vented out through the passages 49 and 50 to the drain 51, this drain also leading through the passage 52 beneath the valve 40. Similarly the cross slide 8 is provided with dog carriers 60, each having four places for the selective attachment of dogs 61 across its width, and which can impinge upon the hydraulic valves having the stems E, F, G and H.

Beside these dog controlled valves, there is provided a directional control valve 70, shown in detail in Figures 14 to 21, a pilot valve 71 (shown in detail in Figure 14), a feed shifter unit valve 72 (shown in Figure 13), a fast motion hydraulic actuator 73 (shown in detail in Figure 12), and two identical knock-off actuated valves 74*a* and 74*b*, the valve 74*a* being actuated by the ram knock-off, and the ram 74*b* by the carriage knock-off.

Ram control mechanism and cycle

Hydraulic pressure is derived from a suitable source (not shown) which feeds through the pipe 80 (see Figure 22). This pressure leads from the pipe 80 through the pipe 81 to the directional control valve. Assuming that the lathe is tooled and ready to operate and with the ram at rest just after indexing in a position to advance in fast motion, the lever 85 being in central neutral position, shown in Figure 20, the operator shifts the lever 85 of the pilot valve 71 to advance position shown in full lines in Figure 14. This also moves the directional control valve 70 into the position shown, this valve being coupled to the pilot valve. In this position of the parts communication is opened from the pressure pipe 81 around the neck 87 of the directional control valve to the pipe 33 leading into the fast motion ram advance cylinder 25. At the same time, the fast motion retire cylinder 26 is discharged through the pipe 32 past the directional valve shoulder 88, through the valve passage 89 to the drain pipe 90. This causes the ram to advance in fast motion. A spring detent 91 engaging in an annular recess 92 of the directional control valve 70 retains the feed lever 85 and the pilot and directional control valves 71 and 70 in this position.

As the tool on the turret then in operative position comes near to the work, a dog 18 on the lay shaft engages and depresses the valve stem A. Pressure from the pipe 80 reaches the valve casing containing the stems A, B, C and D through a pipe 95, check valve 96, and pipe 45. Depression of the stem A opens communication from this pressure pipe to the pipe 97, which connects with the passage 47 of this valve, and to the casing of the pilot valve 71 where it passes through the valve passages 98 (see Figure 19) out through the pipe 99, to the ram feed lever 74*a* where it enters at 100. It also passes through the passage 101 of the pilot valve casing past the ball check valve 102 (see Figure 15) and into the central bore of the valve casing between the closure plug 103 and the sleeve piston 104. Pressure on the left hand end of the sleeve piston 104 pushes the pilot valve to the mid or neutral position shown in Figure 20, and moves the directional control valve to its central position which shuts off both

pipes 32 and 33 leading to the ram cylinders and connects both fast motion cylinders to the passage 89 and the drain 90. This cuts out the high speed hydraulic feed. The pressure reaching the valve 74a lifts the ram knock-off lever 12 into position to throw in the slow feed mechanical clutch, this being the position of the parts shown dotted in Figure 8, the fluid pressure entering through the passage 99 acting on the right hand annular shoulder 105 of the valve rod 106 to such a point past the spring detent 107. As the actuating dog leaves the valve stem A, this stem is pushed upwardly by its spring 43 (see Figure 11), allowing the pressure in the chamber 47 and its pipe connections to drain off the passage 50 into the drain pipe 51, the pressure thus being relieved on the right hand face of the feed lever engaging unit valve 106. The spring 110 returns this valve to its neutral position shown in full lines in Figure 8 with the detent 107 engaging in the annular groove 108. The feed lever 111 is connected to the valve stem 106 by a link 113 connected to a stem 114 slidable through the lever 111, the extent of motion relative thereto being limited by the stop screw 114a, the head of which may engage in a notch in the outer end of the stem 114. At the end of the ram feed, the feed knock-off causes the feed lever 111 to fall, this motion being aided by the spring 112, and this forces the piston 106 to its extreme right hand position shown in Figure 9. This admits pressure from the pressure line 95 through the check valve 96 and the line 115 to the port 116 of the valve 74a which leads through the check valve 117 into the pilot valve at 118. This acts on the left hand face of the valve shoulder 119 which moves the pilot valve to the extreme right, which acts to connect the directional control valve so as to open pressure to the retire cylinder pipe 32 and discharge from the forward cylinder pipe 33 out through the passage 89 to the drain 90. This causes the ram to retire in fast motion. It is then necessary to return the feed lever engaging valve 106 to neutral position as determined by the detent 107. Pressure at all times passes from the pressure line 115 and the passage 120 through the adjustable needle valve 121, and is usually drained through the passage 122 to the drain pipe 123. However, when the feed knock-off moves the valve 106 to its extreme right hand position, the ball check 125 seals the drain 122, as shown in Figure 9, and pressure gradually builds up in the cylinder 126 to move the piston 106 back to the neutral position, uncovering the drain 122. After the valve 106 is moved to this neutral position, shutting off the supply of pressure to the line 116, the pressure in this line bleeds off through the check valve 117, line 118, and the skip station operating valve having the valve shank B.

The ram is now retiring in fast motion. When the ram approaches its outer limit of motion, it indexes the turret, as is well known in the art, and just before it reaches its final retire position, the ram element 28 strikes an abutment 130 which is provided with a stem 131 slidable through a portion of the machine frame. This abutment 130 strikes upon a collar 132 secured to the pilot valve which extends through a hole through the abutment 130. A spring 133 is interposed between the abutment 130 and the collar 132. The parts are so positioned, however, that the positive contact of the abutment 130 on the collar 132 serves to move the pilot valve, together with the feed lever and the directional control valve, to their

intermediate positions, and the spring 133 thereafter continues the motion of the pilot and directional control valves to their forward positions in full lines in Figure 14. This conditions the parts for the start of the cycle, including the fast forward motion of the ram and the subsequent slow feed followed by retraction at high speed, as previously described.

It might be noted that while the control valves in the casing 19 would be actuated on both directions of motion of the ram, they are ineffective to accomplish anything on the retire stroke, for the reason that in the reverse position of the pilot valve and directional control valves, the flow of fluid under pressure to accomplish the various functions done on the forward stroke is blocked. This is for the reason that, except during the forward positions of these valves, the grooves 135 and 136 are out of alinement with their inlet ports so that no liquid can pass, and also the groove 140 of the directional control valve is out of alinement with a pair of passages 141 and 142 through the valve casing. This latter pair of passages 141 and 142 form part of the hydraulic circuit controlling the carriage motions as will later appear.

Skip station cycle

It may be desired to advance the ram in fast motion far enough to clear the turret indexing mechanism and then retire the ram in fast motion so as to produce an indexing action without utilizing a tool position of the turret, thus to skip one turret position in effecting feed of the ram. Where this is desired, a dog is placed on the lay shaft at the forward desired limit of motion of the lay shaft to depress the stem B. This supplies pressure from the pipe 45 through line 146, check valve 117, pipe 147 to the face 118 of the pilot valve which moves the pilot valve and the directional control valve to the extreme right hand position, thus connecting the fast motion cylinders 25 and 26 in ram retire condition. The pressure against the face 118 is immediately drained when the operating valve is closed as the ram is retiring with the lay shaft and dogs. The ram then in its outer stroke indexes the turret and starts forward again, having skipped one turret position, and the normal cycle is again resumed.

Cycle stop mechanism

It is sometimes desirable to advance the ram in fast motion to a desired position whereupon the fast motion is stopped, but the slow feed is not thrown in, and for this purpose a cycle stop valve stem C may be employed. When a dog placed on the lay shaft contacts and depresses the stem C, pressure is admitted from the line 45 to the line 150, which enters the pilot valve at 155. In the forward position of the pilot valve, this passes through the port 156, past the ball valve 102 in behind the sleeve piston 104, which has the effect to move the pilot valve and the directional control valve to the central stop or neutral position. Pressure does not reach the feed line 101 so that the feed engaging unit is not energized and thus the fast motion is stopped without engagement of the feed. With the lever 85 in stop position the groove 135 is out of alinement with the passage 156 so that the pressure from the stop cycle operating valve is blocked. The pressure in the chamber 158 is drained off through the pipe 160.

Cross slide actuating controls

When it is desired to start the motion of the cross slide from its central neutral position, a dog is placed on the lay shaft to cooperate with the valve plunger D. When this valve is depressed, a pulse pressure is applied to the pipe 165 which passes to the directional control valve and through the groove 142, pipe 162, through line check valve 163 into the feed shifter unit 72. It will be noted that this can take place only when the directional control valve is set for ram advance, as otherwise the passage 141 would be closed off, since the valve 140 would be out of registry therewith. The ram is thus in condition to continue in fast motion to a cycle stop station or to a feeding station, and it is possible, if desired, to feed the ram concurrently with the feeding of the cross slide. If the ram is fed concurrently, it will be retired in fast motion and advanced in fast motion to a cycle stop position until the end of the carriage cross slide operation.

The feed shifter unit 72 is shown in section in Figure 13. Pressure enters it through the pipe 164 and passes through the valve passage 170 around the port 171 of the plunger 172 and out through the pipe 173 to the fast motion hydraulic actuator 73 where it acts upon a piston 174 which rocks the fast motion lever 175 into the position for forward carriage feed where it is held by the spring detent 176. This fast motion lever 175 is connected to a rock shaft 177 by the rocking of which the fast forward motion clutch of the tool slide is thrown in, that is, the motion which brings the forward tool on the carriage toward the work. This occurs until a stop dog 61 at one of the carriers 60 impinges upon the stem E of the carriage control valve 34. Depression of this valve stem E applies a pressure pulse from the pressure line 45 to the line 178 which passes the T coupling 179 through the pipe 185, through the T coupling 186, the pipe 187, the check valve 188, the pipe 189 and double check valve 190 to the fast motion actuator 73 at the port 191 (see Figure 12). The pressure here acts upon a pair of pistons 192, which acting through the plungers 193, moves the piston 174 and the reverse carriage feed piston 194 to the mid or neutral position shown, throwing out the high speed clutch for the carriage forward feed, the clutch being held out in this neutral position by the detent 176. The pressure impulse produced by depression of the valve stem E also passes from the T fitting 179 by pipe 180, check valve 181 to the carriage feed lever knock-off 74b. This carriage lever knock-off is identical with the ram knock-off valve, the pressure acting to force the piston in the direction as heretofore described in connection with the ram-knock-off, to set the carriage knock-off to slow feed position. Also from the T 186 pressure is applied through the pipe 196 to the passage 197 of the feed shifter unit 72 (Figure 13), throwing the plunger 172 to the right, rocking the rocker 174a which controls the forward and back feed clutch for the carriage feed motion, this closing the pressure port 170 from the pipe 173 and the plunger 172 and opening from the pressure port 170 through the plunger port 200 to the pipe 201. This conditions the feed shifter unit so that at its next actuation the carriage is reversed in direction at feeding speed.

The carriage now proceeds in slow mechanical feed until the carriage knock-off spool 205 is moved rearwardly by impingement thereon of the abutment 206, this as more fully shown and described in the Lovely Patent No. 2,006,144, resulting in the release of the carriage knock-off. The release of this knock-off throws out the slow feed clutch and moves the knock-off valve to the extreme outer position, heretofore described in connection with the ram knock-off, which admits a pressure impulse to the pipe 210. This impulse passes through the check valve 163, into the pipe 164 of the feed control unit 72, the pressure passage 170, and out through the pipe 201 which leads to the right hand plunger 194 of the carriage fast motion mechanism, and throws the lever 175 in clockwise direction to throw in the high speed reverse carriage clutch. The return fast motion continues until the cross slide is centered, as determined by the depression by a center stop dog 61 of the valve stem F, which admits a pressure impulse to the pipe 212, check valve 213, line 214, check valve 188, line 189, the double check valve 190, and the pipe 191 to the carriage fast motion mechanism in position to shift the carriage fast motion rock shaft 177 to neutral position as previously described, so that the cross slide stops with the valve plunger F depressed. This completes one-half of the automatic cycle for the cross slide. This means that a continuous pressure will be applied on both pistons 174 and 194 through pressure applied to the pistons 192. It will be noted that the pistons 174 and 194 are larger than the pistons 192 since it is necessary that the pulse pressure applied to either piston 174 or 194 overcome the pressure against pistons 192 to move the fast motion lever for desired fast motion.

The second half of the cycle causes the back tool to move forwardly, first in fast motion and then in slow motion, and then to be retracted in fast motion to the starting or mid-position of the slide. The starting of this second half of the carriage cycle is produced by the action of another dog 61 on the carriage which contacts and depresses the valve stem G just before engagement of the center stop dog with its operative valve stem F. This produces a pressure impulse into the pipe 222 leading to the outer end of the direction control valve (see Figure 14), which forces this directional control valve to the left to its ram advanced position, throwing the operating handle 85 to the full line position shown, this valve having previously been left in the central stop or neutral position where it was held by the detent 91. This causes the ram to advance until another stop dog 18 on the lay shaft depresses the valve stem D, supplying a pressure pulse to the pressure pipe 165 through the directional control valve 140, to the pipe 162 as previously described, this acting through the check valve 163 and the pipe 164 to reach the feed shifter unit which is now in such position, as previously described, that the fluid is delivered through the pipe 201, continuing the return in fast motion of the carriage until the return stop dog on the cross slide depresses the valve stem H. Depression of the valve stem H supplies a pressure impulse to the pipe 225 which passes through the T 226, the line 230, line check valve 213, line 214, line check valve 188, double check valve 190 and fast motion lever operating mechanism, as previously described, to cause the pistons 192 to move the fast motion lever 175 to neutral position while at the same time the fluid

pulse in the T 226 passes through line 227, T 228, line 231, feed shifter unit 72 to force the plunger 229 to the right, rocking the feed shifter lever into the position shown in Figure 13. This shifts the gears to give a back feed direction. The carriage is now feeding in return direction and when the abutment 235 (Figure 5) strikes the feed knock-off spool 205, the slow feed is thrown out as previously described and the movement of the cross slide is reversed to a fast motion forward to continue to the center neutral point where it stops, depressing the valve stem F.

Referring to Figure 13, it will be noted that the pressure is drained from each of the passages 200 and 171 when they are out of operative position through the drain passage 237 and drain pipe 239.

It is sometimes desirable to provide a time delay at the end of the feed and before the commencing of the retire fast motion of the ram or of the cross slide. This may be easily attained by well known mechanism, and as shown herein for this purpose, dash pots, indicated somewhat diagrammatically at 240 and 241 on Figure 22, have been provided. This time delay is of advantage in removing the spring from the cutting tools so that the tools cut to their maximum depth before being retired. The particular slow speed mechanism has not been indicated herein since it is already old and well known in the art, and commonly provision will be made for selecting any of a considerable variety of speeds, depending upon the particular requirements of the operation to be performed, this also being well known in the art.

From the foregoing description of an embodiment of this invention, it should be evident to those skilled in the art that various changes and modifications might be made without departing from the spirit or scope of the invention.

I claim:

1. In a machine tool having a work support and a tool support, mechanically actuated means for moving one of said supports toward the other of said supports in slow feed, and means for releasing said slow feed when said movable support reaches a predetermined feed position, a source of hydraulic pressure, hydraulic fast motion mechanism for moving said movable support in fast motion advance and retire, means actuated by said movable support when said movable support reaches a predetermined position in its advance motion for producing a pressure impulse from said source, means actuated by said pressure impulse to throw out the fast motion advance hydraulic mechanism and to throw in said slow motion mechanically actuated feed, means actuated by said slow motion feed release means for producing a second pressure impulse from said source, and means actuated by said second pressure impulse to throw in said hydraulic fast motion mechanism to retire said movable support in fast motion.

2. In a turret lathe having a headstock provided with a rotary work holding spindle, a ram movable toward and from said spindle, an indexing tool holding turret carried by said ram, mechanically actuated means for moving said ram toward said headstock in slow feed, and means for releasing said slow feed when said ram reaches a predetermined feed position, a source of hydraulic pressure, hydraulic fast motion mechanism for moving said ram in fast motion advance and retire with reference to said headstock, means actuated by said ram when said ram reaches a predetermined position in its advance motion for producing a pressure impulse from said source, means actuated by said pressure impulse to throw out the fast motion advance hydraulic mechanism and to throw in said slow motion mechanically actuated feed means, means actuated by said slow motion feed release means for producing a second pressure impulse from said source, and means actuated by such second pressure impulse to throw in said hydraulic fast motion mechanism to retire said ram.

3. In a lathe, a headstock, a tool carrier movable toward and from work carried by said headstock, hydraulic mechanism for moving said carrier in fast motion toward and from said headstock, a movable valve mechanism for determining the direction of motion of said hydraulic moving mechanism, a mechanical slow feed mechanism for moving said carrier toward said headstock, a knock-off for throwing out said slow feed mechanism when said carriage reaches a predetermined feed point relative to said headstock, mechanism actuated by said carrier as it is moved hydraulically toward said headstock and reaches a predetermined point to throw out said hydraulic mechanism and to throw in said slow feed mechanism, means actuated by said knock-off when it throws out said slow feed to condition said valve mechanism for fast hydraulic return of said carrier, and means actuated by said carrier when it reaches a predetermined retire position to throw out said hydraulic mechanism.

4. In a lathe having a headstock, a rotary work carriage spindle journaled in said headstock, a ram movable to advance and retire relative to said headstock, a source of hydraulic pressure, and a tool carrier turret carried by said ram, hydraulic means for moving said ram in fast motion, an axially movable valve controlling the direction of motion of said ram in fast motion and having end positions opening pressure from said source to move said ram in one direction while discharging pressure previously effective to move said ram in the opposite direction and an intermediate neutral position cutting off all fluid pressure effects to move said ram, means actuable by said ram at its retire limit of motion for moving said valve to ram-advance position, mechanical means for advancing said ram in slow feed toward said headstock, hydraulic means actuated by said ram at a predetermined position to throw out said hydraulic advance fast motion and throw in said slow mechanical feed, and means actuated by said ram at a predetermined feed limit to throw out said slow feed and throw in said hydraulic fast motion in retire direction.

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