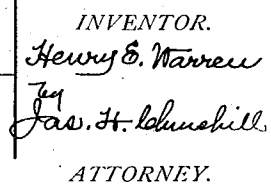
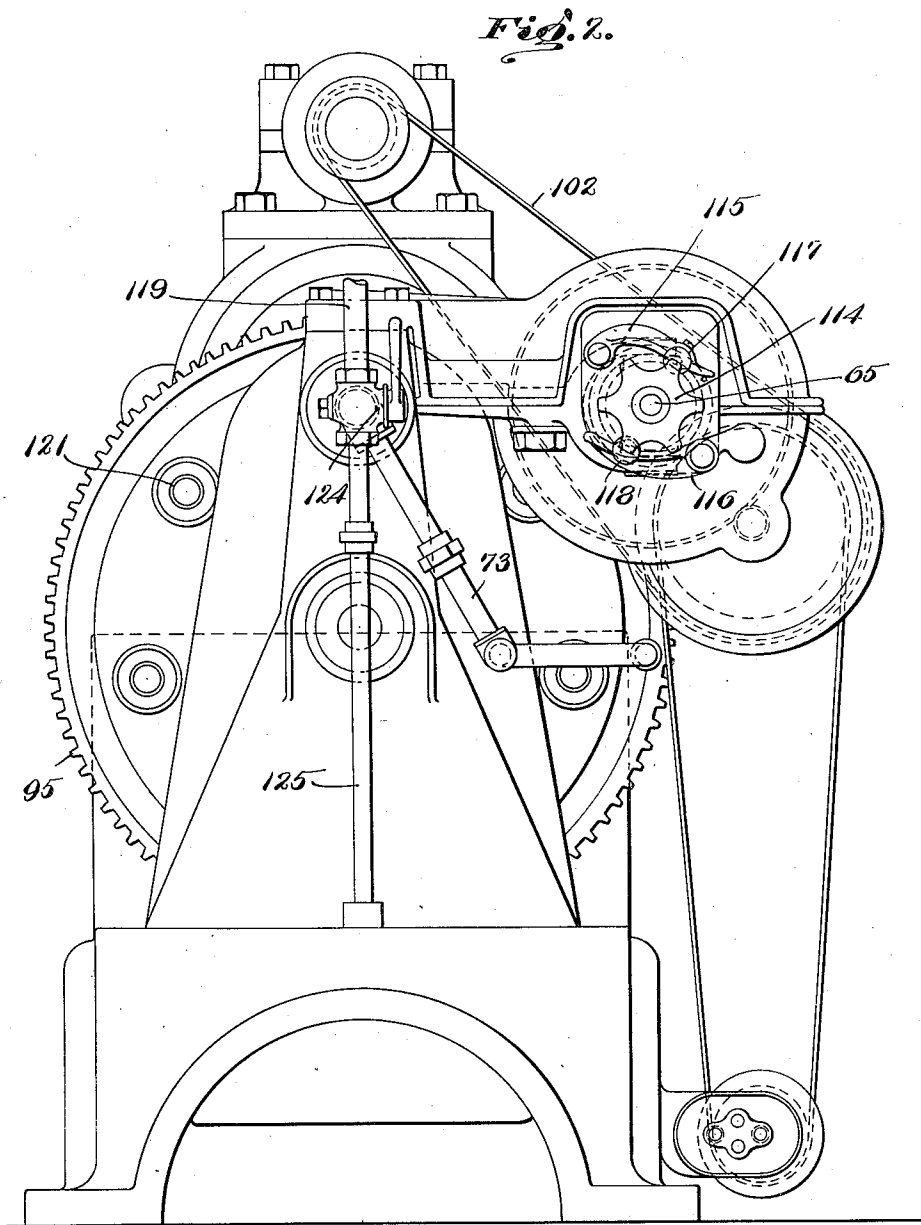


1,244,664.

6 SHEETS—SHEET 1.





INVENTOR.

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BY

Jas. H. Schuchert

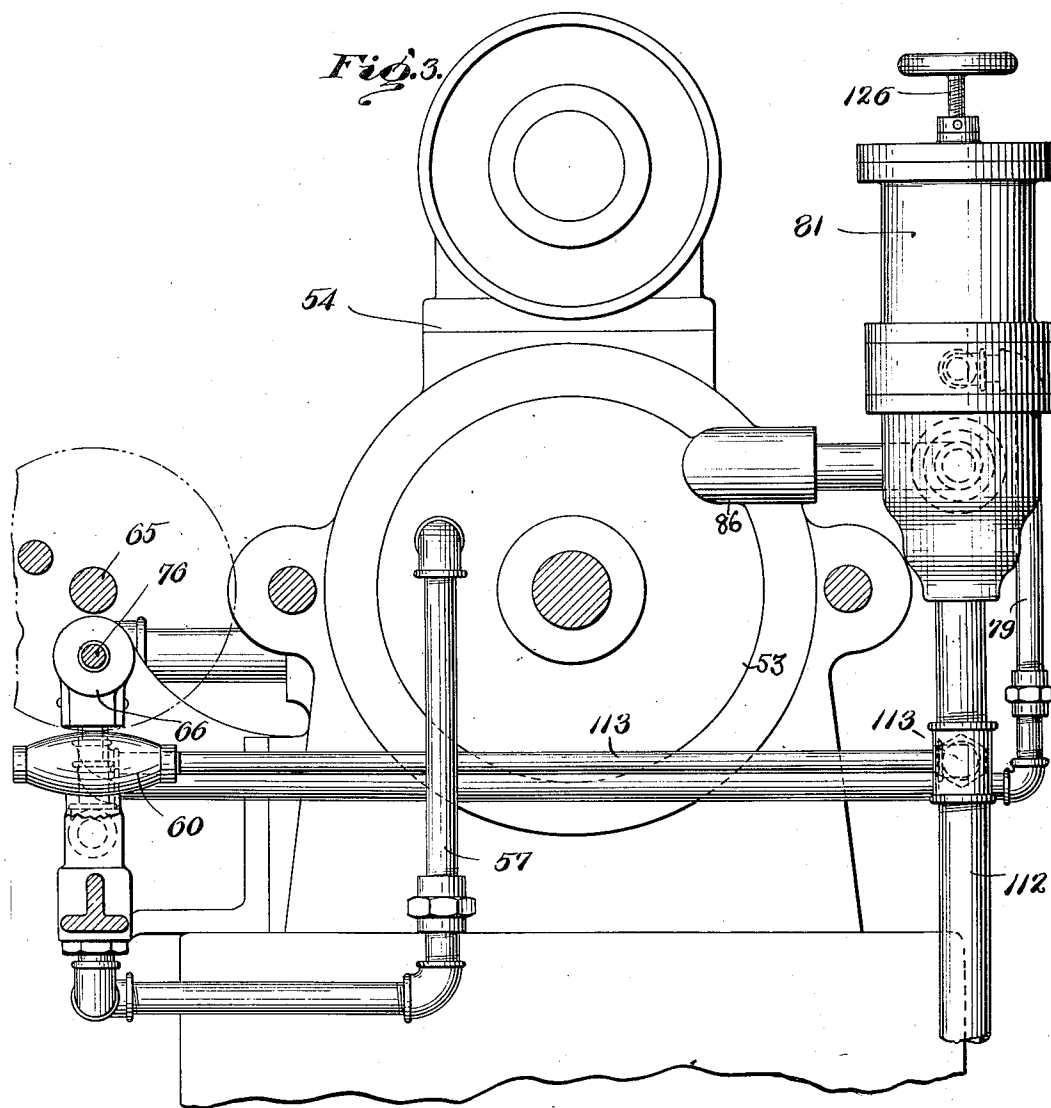
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FLUID OPERATED LATHE.
APPLICATION FILED JAN. 28, 1916.

Patented Oct. 30, 1917.

6 SHEETS—SHEET 3.



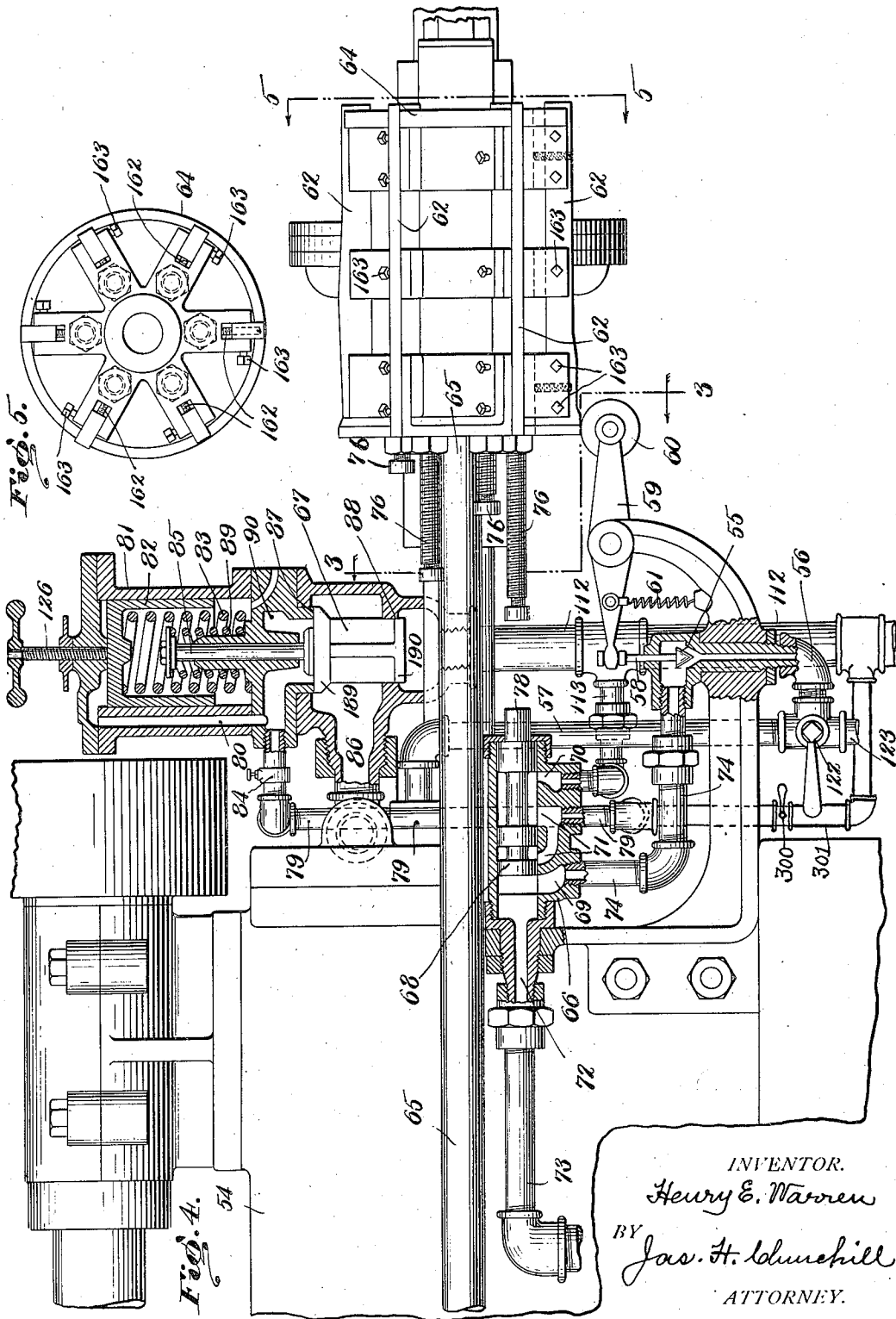
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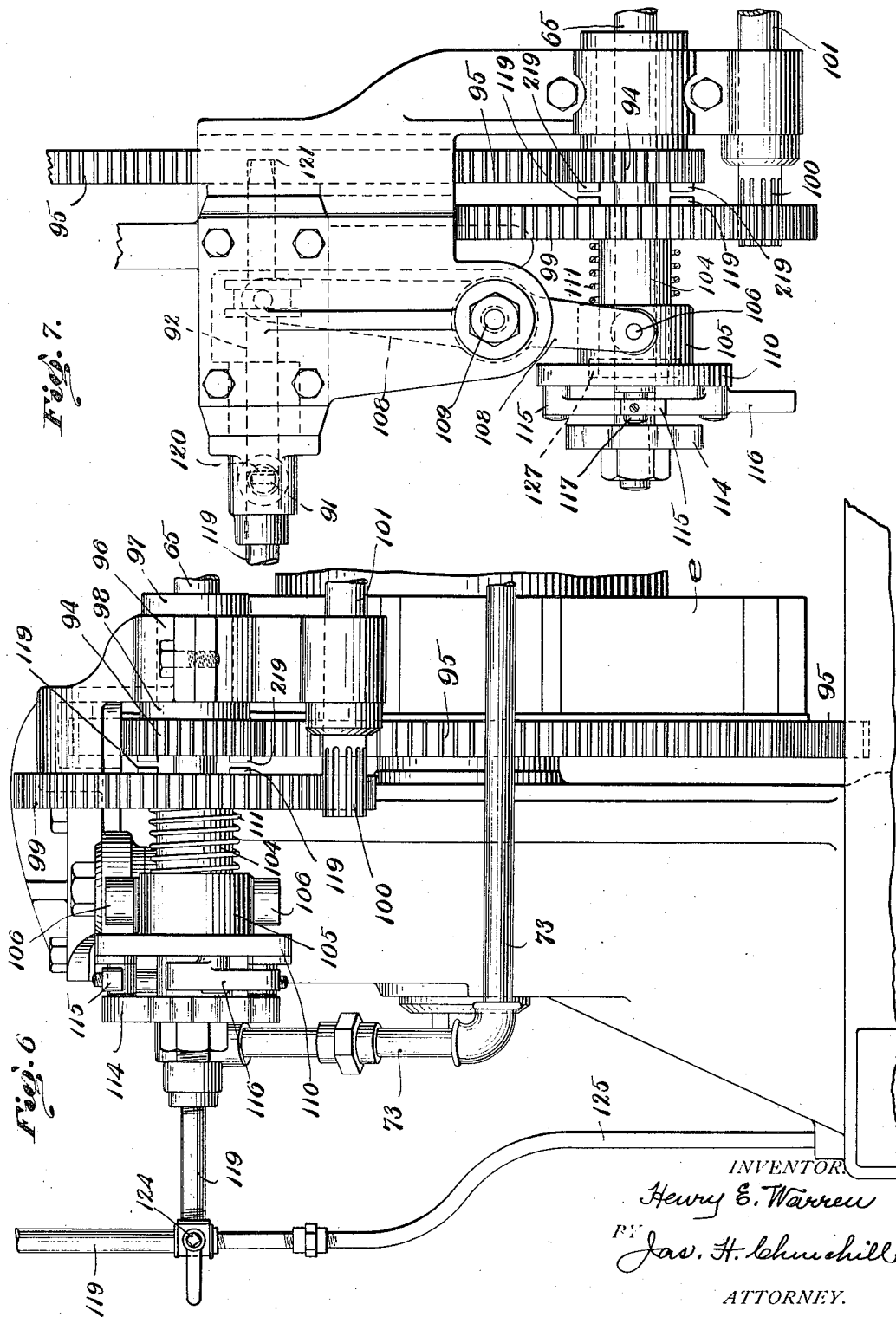
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6 SHEETS—SHEET 5.



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6 SHEETS—SHEET 6.

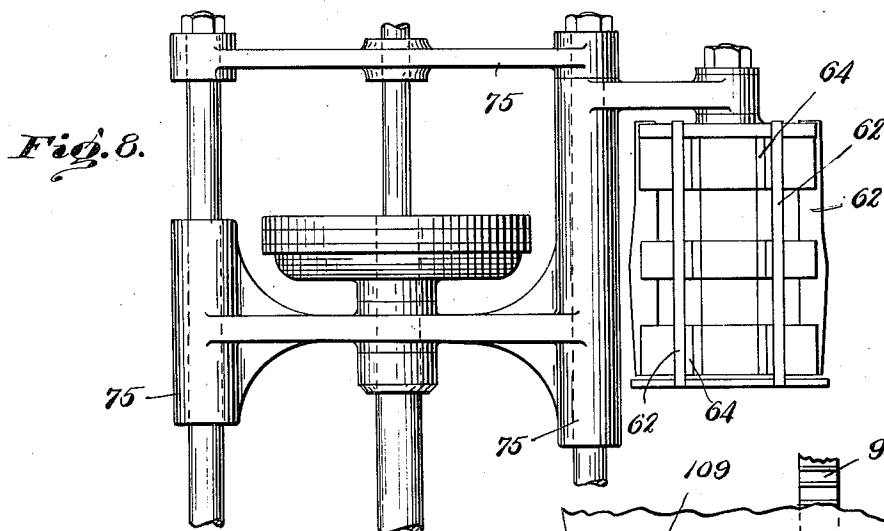


Fig. 9.

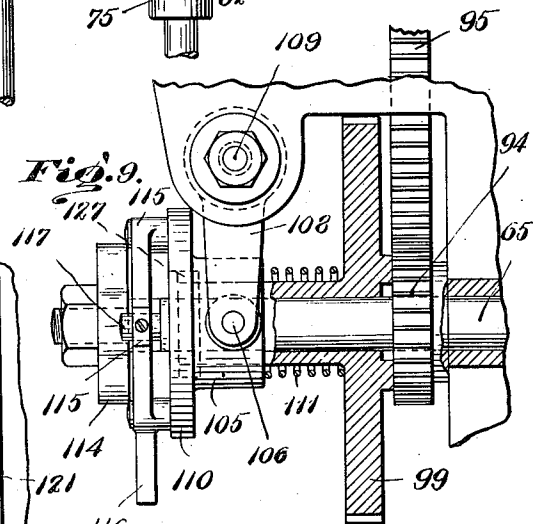
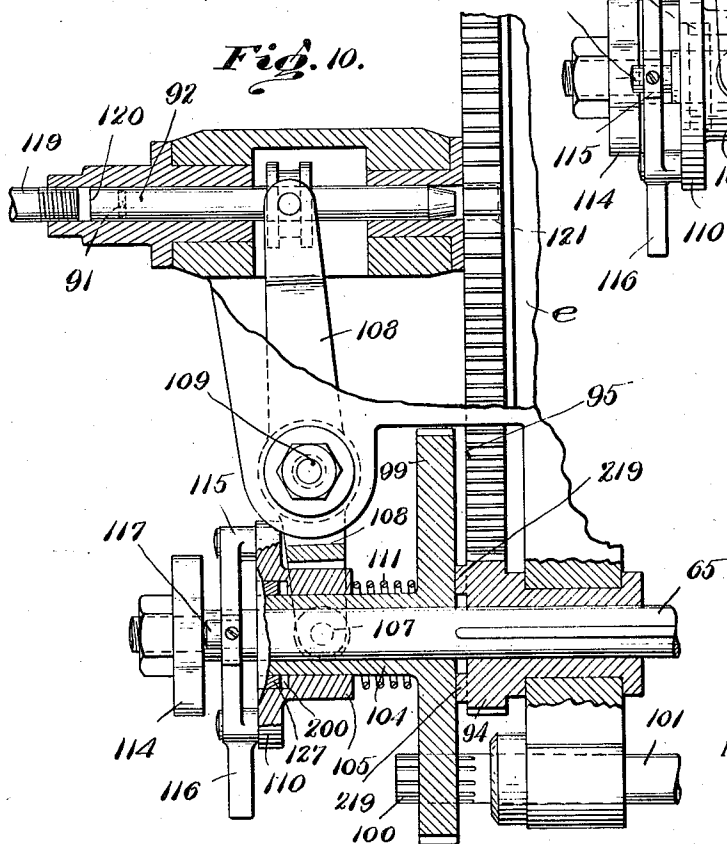


Fig. 10.



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UNITED STATES PATENT OFFICE.

HENRY E. WARREN, OF ASHLAND, MASSACHUSETTS.

FLUID-OPERATED LATHE.

1,244,664.

Specification of Letters Patent.

Patented Oct. 30, 1917.

Application filed January 28, 1916. Serial No. 74,905.

To all whom it may concern:

Be it known that I, HENRY E. WARREN, a citizen of the United States, and a resident of Ashland, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Fluid-Operated Lathes, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to fluid operated lathes and more particularly to the operating mechanism thereof.

The invention is herein shown as embodied in a fluid operative lathe in which a spindle carrying the work is moved toward and from an intermittently rotatable turret carrying the tools.

The particular features of the invention will be pointed out in the claims at the end of this specification.

Figure 1 is a side elevation with parts broken away of a lathe embodying the invention.

Fig. 2, an end elevation looking toward the right in Fig. 1.

Fig. 3, a section on the line 3—3 Fig. 4.

Fig. 4, an enlarged elevation with parts in section of the right hand end of the lathe viewing Fig. 1.

Fig. 5, an end elevation of the control drum shown in Fig. 4 looking toward the left on the line 5—5.

Figs. 6 and 7, enlarged details in elevation of the left hand portion of the lathe shown in Fig. 1.

Fig. 8, a detail in plan of the follower and control drum, and

Figs. 9 and 10 details in section and elevation of the locking pin operating mechanism and the clutch for the rotatable turret.

In the present instance the invention is shown as embodied in a fluid operated lathe in which the work *a* is secured by a hydraulically operated chuck *b* to a spindle *c*, which is axially movable toward and from one of a series of operating tools *d* carried by a rotatable turret *e*, and is capable of being revolved while it is being moved axially.

In the present instance, the spindle *c* is caused to revolve by the wide face pinion 50 and the gear 51, which latter is fast to the spindle.

The axial movement of the spindle toward the turret may be designated "forward", and

motion in the opposite direction as "backward."

The spindle *c* is enlarged at its rear end, see Fig. 1, to form a piston 40 of the internal diameter of the cylinder 54, which forms with the spindle an annular chamber 42 of materially less area than the piston 40.

The spindle *c* is fed forward by admitting fluid under pressure between the rear end of the spindle and the head 53 of the cylinder 54. This fluid enters through the needle valve 55 and the pipe connections 56, 57, see Fig. 4.

The rate of feed of the fluid to the cylinder 54 is controlled by the amount the needle valve 55 is opened, the stem of which is connected, as herein shown, to the lever 59 carrying the roller 60.

A spring 61 tends to hold the valve 55 closed, while adjustable feed bars 62 force the valve open by pressure against the roller 60. These feed bars may be cam shaped on their outer surfaces or edges which engage the roller 60, so as to vary the opening of the needle valve and thereby vary, if desired, the rate of movement of the spindle on its forward stroke, according to the particular kind of work to be performed on said forward stroke.

The feed bars 62 are carried by a drum 64 and are adjustable radially on said drum as herein shown, see Fig. 5, by adjusting screws 162 and are secured in their adjusted positions by set screws 163.

The drum 64 is mounted on a shaft 65, which is operatively connected, as will be described, to the turret *e*, so that for each turret position a different feed bar will make contact with the roller 60, and consequently the rate of spindle feed may vary not only with the turret position, but also with the spindle position, since the feed bars may have any desired outline. For the purpose of definitely limiting the stroke of the spindle *c* in a forward direction for each turret position, I provide a primary stop valve indicated as a whole by 66, and a secondary timing return valve 67. The valve 66 consists as herein shown, of a cut-off piston 68 moving across ports 69 and 70. Other ports 71 communicate at all times with annular spaces around the piston 68.

Fluid under pressure is admitted to valve 66 through the passage 72 connected with the pipe 73. When the piston 68 is in the

position shown in Fig. 4, fluid can flow freely from the supply pipe 73 through passage 72, port 69, and pipe 74 to the needle valve 55.

5 The drum 64 moves longitudinally with the spindle *c*, these two members being connected by means of a traveler 75, see Fig. 8. Consequently, as the spindle *c* moves forward one of the threaded stops 76, which are
10 carried by the drum 64 and adjustable thereon, will engage the end 78 of the piston valve 68 and cause the latter to open connection between the ports 69 and 71 so that the fluid can flow from pipe 73 into port 69 and
15 then by the valve into port 71 and at the same time throttle but not close the connection between the pipes 73 and 74.

This will result in stopping the forward motion of the spindle *c* and will allow fluid
20 to flow through pipe 79 and port 80 to the upper end of the cylinder 81, containing a valve operating piston 82, which fluid, pressing down upon said piston 82 will compress a spring 83.

25 The rate at which the fluid can flow through the pipe 79 is regulated by the throttle valve 84, in pipe 79, and thereby the time interval required for the piston 82 to move down and strike the end of the
30 valve stem 85.

When the piston 82 strikes the upper end of the valve stem 85, the latter will be moved downward, thus instantly opening a passageway for fluid from the cylinder 54 back
35 of the spindle through the passageway 86 across the valve seat 87. This fluid added to that already entered through the throttle valve 84, will rapidly depress the piston 82 still farther. A free escape for fluid from
40 the cylinder 54 is now provided at the lower end of the valve 67 at point 88, and the spindle *c* will rapidly run back.

It should be noted, that the valve 67, when in the position shown in Fig. 4, is
45 pulled upward by the spring 89, and is also forced upward by fluid pressure acting on the under surface of the head 189 of the valve, which area is in excess of the lower end 190 of the valve, so that when the piston 82 is up and the valve 37 is once seated,
50 the latter tends to remain seated by the force of the spring 89 added to the differential fluid pressure which acts in opposite directions on the opposite ends of the
55 valve, with an excess in the upward direction against the head 189 of said valve. Just as soon, however, as the valve 67 is opened very slightly, pressure obtained from the fluid in the port or passage 86, will accumulate above the valve head 189 in space
60 90, and will then produce an excess pressure downward in spite of the spring 89, even if the piston 82 is not resting against the upper end of the valve stem 85. As a result, the valve 67, when it once begins to

open, will go wide open rapidly without requiring the piston 82 to follow the stem 85. In other words, the valve 67 is initially moved mechanically by the piston 82 and then is moved to its wide open position by
70 the fluid pressure in the cylinder 54 behind the spindle. When the valve 67 is opened wide, it will remain so until the spindle *c* has reached its extreme backward position. Since there will be no more fluid to discharge through the passage 86, when the
75 spindle *c* reaches its extreme backward position, the pressure will fall to practically zero around the valve 67, and the spring 89 will move the valve to its closed position 80 shown in Fig. 4.

This action of the spring 89 is aided in the machine by shutting off entirely the fluid supply, which takes place, when the locking
85 pin 92 for the turret *e*, see Fig. 7, is withdrawn as will be described, so as to close a port 91 in the main supply pipe 119, with which the pipe 73 is connected through said port.

With the parts in the condition just described, the spindle *c* is in its rearmost position and the piston valve 68 has opened a passage for fluid from pipe 73 to port
90 69; the needle valve 55 is open, and the exhaust or reversing valve 67 is closed; consequently so far as these valves are concerned, the spindle *c* may begin to move forward. It is only prevented from so doing by the port 91 being closed by the locking pin 92 in its withdrawn position, see Fig. 10.

It will thus be seen that the locking pin 92 for the turret has a double function, namely as a lock for the turret and as a shut off valve to control the supply of
100 fluid to the cylinder 54 behind the spindle. Since the piston valve 68 has been forced to its starting position shown in Fig. 4 by the fluid pressure in pipes 73, 72, the port 70 is uncovered, so that fluid above the piston 82 may discharge into the exhaust pipe
105 112 through port 80, pipe 79, ports 71 and 70 and pipe 113.

The mechanism for the purpose of operating and indexing the turret *e* will now be described. The shaft 65, which carries at
115 one end the cam drum 64 for controlling the rate of feed of the spindle *c*, is extended the length of the machine and is connected by gear 94 as shown in Fig. 7 directly to the large gear 95, which is fastened to the turret *e*.

The gear 94 is loosely splined to the shaft 65, so that it transmits motion of rotation to said shaft, but it is prevented from moving axially by the bearing 96 and the collars 67, 98, fast to the hub of the gear 94 on opposite sides of said bearing.

Loose upon the shaft 65 is a clutch gear 99, which meshes with a wide face pinion 100 on a shaft 101, which is driven by a belt 130

102, see Fig. 1, from the main driving shaft 103 of the machine.

Loose upon the hub 104 of the clutch gear 99, see Figs. 7 and 10 is the collar 105 provided with a flange 110, said collar being connected by pins 106, 107, to the forked arm of the locking pin lever 108 having the fulcrum point 109.

The flange 110 has a recess 200, see Fig. 10, in the center of its outer face, into which is fitted loosely a ring or collar 127 fast upon the hub 104. Between the collar 105 and the gear 99 is a spring 111, which tends to hold these parts in the position shown in Fig. 7.

Fastened upon the shaft 65 is a star wheel 114, which is fast on the shaft and rotates and moves axially therewith.

Mounted upon the face of the flange 110 are weighted levers 115, 116, see Fig. 3, carrying interference rolls 117, 118. When the parts are in the position shown in Fig. 2 and the control shaft 65 travels backward with the spindle *c*, the star wheel 114 will strike against the ends of the interference rolls 117, 118, and will thereby force the flanged collar 110—105 in the same direction for a short distance, until the spindle *c* reaches the end of its backward stroke. In consequence, the clutch gear 99 will have its teeth or horns 119 forced by the spring 111 into the path of travel of like teeth or horns 219 on the gear 94, and at the same time, the locking pin 92 will be withdrawn from its socket or hole 121 in the face of the turret *e* by the lever 108, thereby unlocking the turret. Simultaneously the fluid supply for the forward stroke of the spindle *c* will be cut off by the locking pin closing the port 91, see Fig. 10, so that no fluid can flow into the pipe 73 from the main supply pipe 119, consequently no forward motion of the spindle *c* is possible as long as the turret remains unlocked.

Owing to the gear 99 being clutched to the gear 94, motion of rotation is transmitted from the shaft 101 to the turret gear 95 and also to the control shaft 65. The ratio of gear 94 to 95 is such that for every turret position, there will be a different position of the cam drum 64. If there are six turret positions, I prefer to make the shaft 65 travel either $5/6$ or $7/6$ of a revolution to keep the gears 94, 95, of convenient dimensions and to reduce the torque on the clutch jaws 105 when the turret travels $1/6$ of a revolution, although, of course, it is feasible by using different gear ratios to have the control drum 64 and the turret *e* travel synchronously or in some other convenient ratio. As the shaft 65 begins to rotate, the star wheel 114 will be moved to a position, where teeth or points thereof will no longer bear against the interference rolls 117, 118, or in other words, said teeth or

points will be moved out of line with said rolls, and the spaces between teeth of the star wheel will be brought opposite the said rolls, and when this takes place, the fluid pressure in the pipe 119 acting against the end 120 of the locking pin 92, will force the latter toward the turret face and through the lever 108 move the flanged collar 110—105 in the opposite direction and bring the interference rolls 117, 118 between the teeth of the star wheel, so that, as the latter continues to revolve, the rolls 117, 118 will ride over the said teeth without producing any further tendency to move the flange 110 in an axial direction. As soon as the next pin hole or socket 121 in the turret has been brought into line with the locking pin 92, the latter will be forced quickly home by the pressure acting against the end 120 of the locking pin, and the turret will be firmly locked against rotation, while simultaneously, owing to the motion of the flanged collar 110—105 in the direction toward the left viewing Fig. 7, the gear 99 will be unclutched from the gear 94, which disconnects the driving power from the turret. At the instant, when the locking pin 92 is forced to the bottom of its socket 121, the port 91 is opened and fluid under pressure is supplied to the cylinder 54 behind the spindle as above described, and the latter at once begins to move forward for the next operation of the machine.

For the purpose of convenient manipulation, I provide a valve 122, see Fig. 4, which may be turned so as to disconnect the needle valve 55 from the inlet pipe 57 for the cylinder 54 and thereby stop the motion of the spindle *c*, or this valve may be turned so as to discharge fluid from the cylinder 54 by means of the pipe 123, and thereby bring about a backward movement of the spindle *c*. I also provide a three way valve 124 in the fluid supply pipe 119, see Figs. 1 and 6, for the purpose of shutting off the supply of fluid pressure before it reaches the locking pin 92, and opening an exhaust for fluid behind the locking pin through a pipe 125, so that the locking pin 92 may readily be withdrawn from its socket 121 by hand and the feed of the spindle *c* stopped at the same time.

For the purpose of more complete control of the time interval which must elapse after the forward travel of the spindle *c* is stopped by the valve 68 and the return valve 67 is opened, I provide an adjusting screw 126, see Fig. 4, which limits the upward travel of the piston 82, and thereby determines the amount of fluid necessary to push this piston down against the valve stem 85.

The spindle *c* is moved backward by fluid pressure admitted at all times into the annular chamber 42 in front of the piston 40 through a pipe 250 which may lead directly

from the main supply pipe 119 to the cylinder 54.

For the purpose of making the machine non-active, I provide a valve 300 in a pipe 301 connecting the pipe 79 with the exhaust pipe 112. When the machine is working automatically the valve 300 is closed. When it is desired to render the machine non-automatic, the valve 300 may be opened and in this case the spindle will stop in its forward position and will not return, as fluid pressure can then escape directly from the pipe 79 to the exhaust 112 and will not flow to the cylinder 81.

I have herein shown one embodiment of the invention but it is not desired to limit the invention to the particular construction herein shown.

Claims:

1. In an automatic hydraulic lathe, in combination, a cylinder and a piston therein, and means for stopping and reversing the movement of said piston, consisting of a primary valve governing the flow of fluid into said cylinder, a stop to actuate said valve and movable with said piston, and a secondary valve hydraulically actuated from the primary valve after a time limit and controlling the flow of fluid out of said cylinder.

2. In an automatic hydraulic lathe, in combination, a cylinder and a piston therein, means for stopping and reversing the movement of said piston, consisting of a primary valve governing the flow of fluid into said cylinder, a stop to actuate said valve and movable with said piston, a secondary valve hydraulically actuated from the primary valve after a time limit and controlling the flow of fluid out of said cylinder, and means to adjust the said time interval.

3. In a lathe, in combination, hydraulically-actuated means for feeding the work with relation to a tool, a movable mechanism for carrying said tool, a locking pin co-operating with said movable mechanism for holding it against movement and hydraulically forced into its locking position, and means whereby the withdrawal of said pin shuts off the hydraulic feed mechanism.

4. In a turning and boring machine, in combination, a cylinder and a piston movable therein, and a hydraulic control mechanism for said piston consisting of an adjustable feed valve to control the flow of fluid to said cylinder, a primary stop valve to control the flow of fluid to the said feed valve, and a hydraulically operated return valve to control the flow of fluid out of said cylinder.

5. In a turning and boring machine, in combination, a cylinder and a piston movable therein, stop and return valves controlling movement of said piston in one

direction, means for mechanically operating said valves to limit the movement of said piston in one direction, and means for automatically resetting said valves.

6. In a turning and boring machine, in combination, a cylinder and a piston movably therein, stop and return valves controlling movement of said piston in one direction, means for mechanically operating said valves to limit the movement of said piston in one direction, and means for automatically resetting said valves mechanically disconnected externally.

7. In a turning and boring machine, in combination, a cylinder, a piston movable therein, and a fluid control mechanism for said piston consisting of a valve controlling the outlet of fluid from said cylinder, means for normally holding said valve in its closed position, fluid-operated means for opening said valve, and a valve controlling the operation of said fluid-operated means and normally reset by fluid pressure.

8. In a turning and boring machine, in combination, a cylinder, a piston movable therein, and a fluid-control mechanism for said piston consisting of a valve controlling the outlet of fluid from said cylinder, means for normally holding said valve in its closed position, fluid-operated means for opening said valve, and a valve controlling the operation of said fluid-operated means.

9. In a fluid-operated lathe, a rotatable turret, a valve, a shaft rotatable and axially movable, a plurality of stops movable with said shaft axially to operate said valve individually, a clutch mechanism for coupling said shaft with said turret, and means movable with said shaft axially to operate said clutch.

10. In a turning and boring machine, a cylinder, an axial movable and rotatable spindle therein, means for rotating said spindle while it is being moved axially a valve controlling the rate of admission of fluid into said cylinder which effects said axial movement of said spindle, and a device provided with a plurality of cam surfaces individually coöperating with said valve to govern the opening of the same, means for effecting bodily movement of said device toward and from said valve, and means for rotating said device.

11. In a turning and boring machine, a rotatable turret, an axially movable spindle, a valve controlling the rate of flow of fluid, a shaft rotatable and axially movable, a plurality of devices attached to said shaft and coöperating individually with said valve, means for connecting said shaft with said spindle to effect axial movement of the said shaft by axial movement of said spindle, and means for coupling said shaft with said turret to cause the shaft to rotate with the turret.

12. In a turning and boring machine, a cylinder, means for controlling the supply of fluid to said cylinder, a fluid operated valve controlling the exhaust of fluid from said cylinder, a valve controlling the operation of said exhaust valve and normally rendered inactive by fluid pressure, and means for mechanically moving said controlling valve to render fluid pressure active upon the fluid operated valve to open the same.
13. In a turning and boring machine, a cylinder, a piston axially movable and rotatable in said cylinder, a valve controlling the admission of fluid into said cylinder, means for rotating said piston while it is moving axially, a follower movable with said piston, a rotatable drum movable with said follower and provided with a plurality of cam surfaces individually cooperating with said valve, and means for rotating said drum intermittently.
14. In a turning and boring machine, a cylinder, a valve controlling the admission of fluid therein, a rotatable turret, a shaft axially movable, means movable with said shaft for operating said valve when the said shaft is moved in one direction, means movable with said shaft for effecting rotation of said turret when the said shaft is moved in the opposite direction, and means for moving said shaft.
15. In a boring and turning machine, a cylinder, a piston movable in said cylinder, a valve controlling the exhaust from said cylinder, a valve controlling the action of fluid upon said exhaust valve, and a device movable with said piston for operating said control valve to permit the exhaust valve to be opened.
16. In a boring and turning machine, a cylinder, a piston movable in said cylinder, a valve controlling the exhaust from said cylinder, a valve controlling the action of fluid upon said exhaust valve, and a rotatable element provided with a plurality of devices which cooperate with said controlling valve individually, said rotatable element being movable with said piston toward and from said controlling valve.
17. In a boring and turning machine, a cylinder, means for supplying fluid pressure to said cylinder, a rotatable turret, and a device for locking said turret and controlling the supply of fluid to said cylinder.
18. In a boring and turning machine, a rotatable turret, a clutch controlling rotation of said turret, a cylinder, a piston movable in said cylinder, and means movable with said piston for operating said clutch to permit rotation of said turret.
19. In a boring and turning machine, a rotatable turret, a clutch controlling rotation of said turret, a cylinder, a piston movable in said cylinder, and means movable with said piston for operating said clutch to permit rotation of said turret, and a locking device for said turret operatively connected with said clutch to disconnect the latter when said turret is held by said locking device.
20. In a boring and turning machine, a rotatable turret, means for rotating it, means for controlling rotation of said turret, a cylinder, a piston movable therein, a valve for controlling admission of fluid into said cylinder, a shaft movable axially with said piston, means movable with said shaft for operating said valve, and means movable with said shaft for rendering the turret controlling means effective.
21. In a boring and turning machine, a tool, and a work holder, one of said parts being movable toward and from the other, and means for stopping and reversing said movable part, said means consisting of a primary valve responsive to movement of said movable part, and a secondary valve controlled by the primary valve.
22. In a boring and turning machine, a tool, and a work holder, one of said parts being movable toward and from the other, and means for controlling said movable part consisting of a feed valve, a reversing valve, and a valve controlling the operation of said reversing valve and responsive to movement of said movable part.
23. In a fluid operated lathe, a turret, a valve, a plurality of stops adapted to contact with said valve individually, and means to position said stops with respect to said valve by said turret and a second valve controlled by said first-mentioned valve.
24. In a fluid operated lathe, an axially movable spindle, a valve controlling movement of said spindle, a rotatable turret, a plurality of devices adapted to operate said valve individually, means to position said devices with respect to said valve by said turret and a second valve controlled by said first-mentioned valve.
25. In a turning and boring machine, a turret and a spindle cooperating therewith, one of said parts being movable axially toward the other and one of said parts being rotatable, a shaft rotatable and axially movable, means for connecting said shaft with the axially movable part to effect axial movement of said shaft, and means for coupling said shaft with the rotatable part to effect rotation of said shaft.
- In testimony whereof, I have signed my name to this specification.

HENRY E. WARREN.