W. K. MILLHOLLAND, JR.

TURRET LATHE.

APPLICATION FILED MAR. 8, 1911.

1,099,308.

Patented June 9, 1914.

8 SHEETS—SHEET 1.

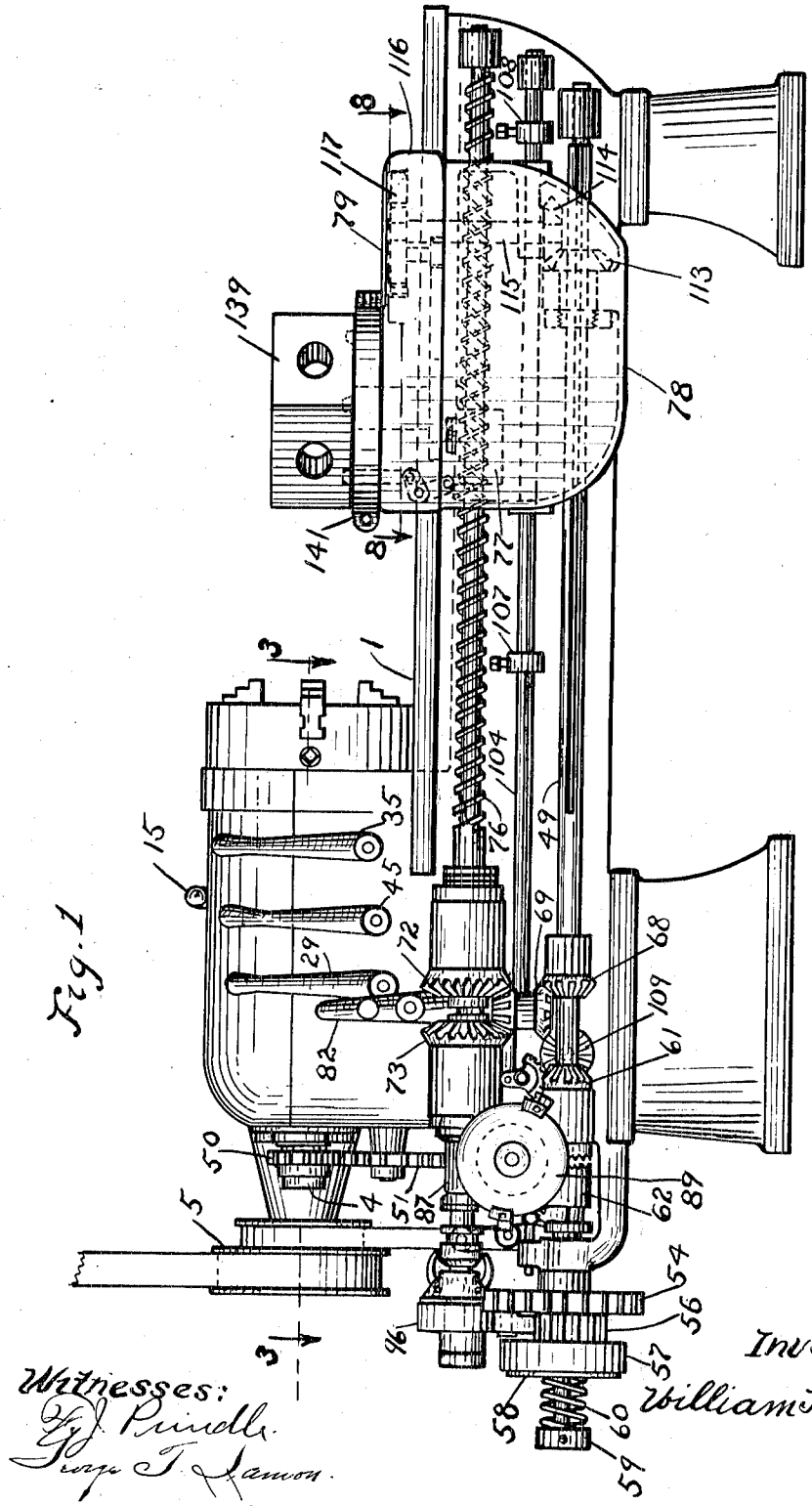


Fig. 1

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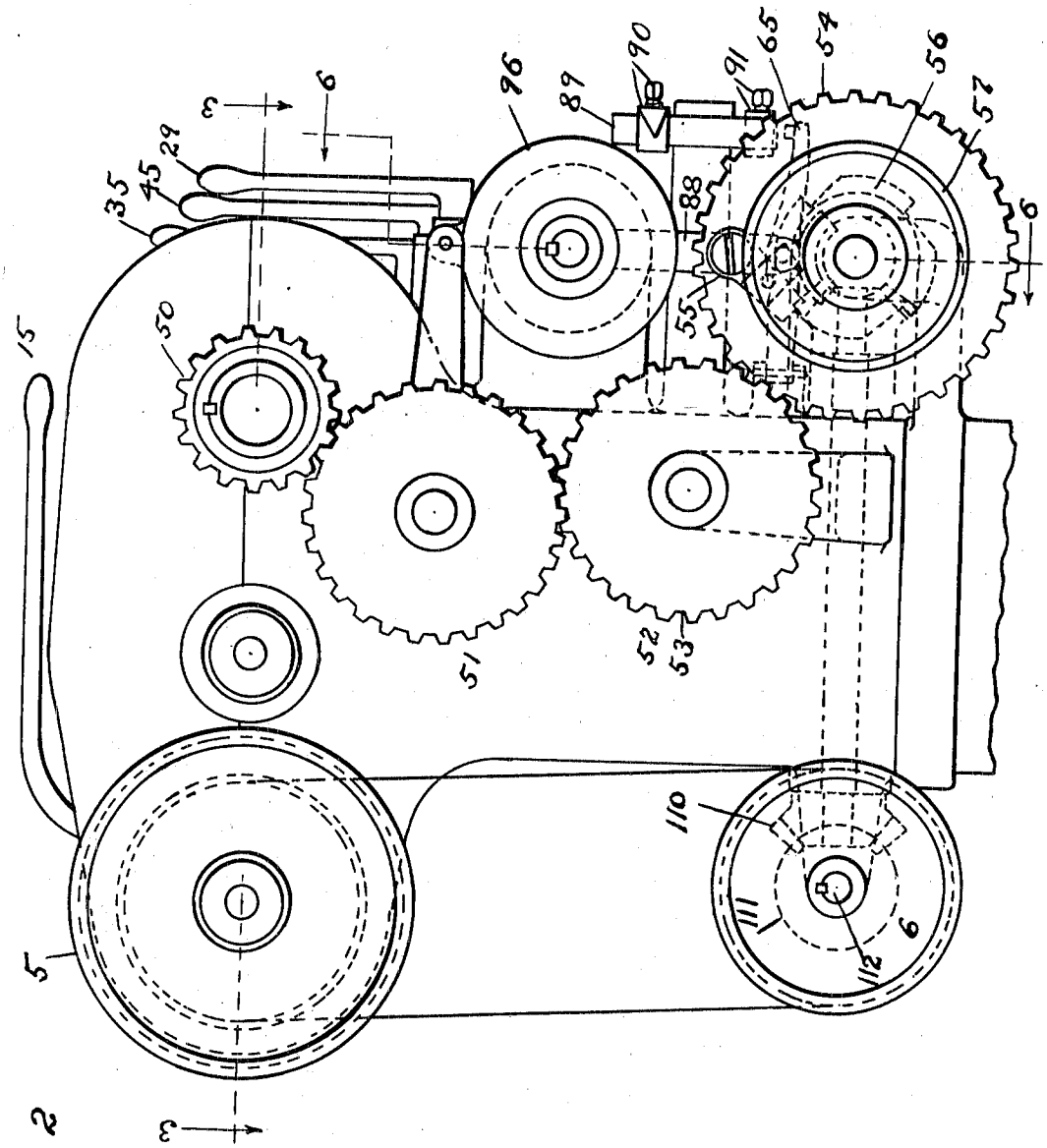


Fig. 2

Witnesses:
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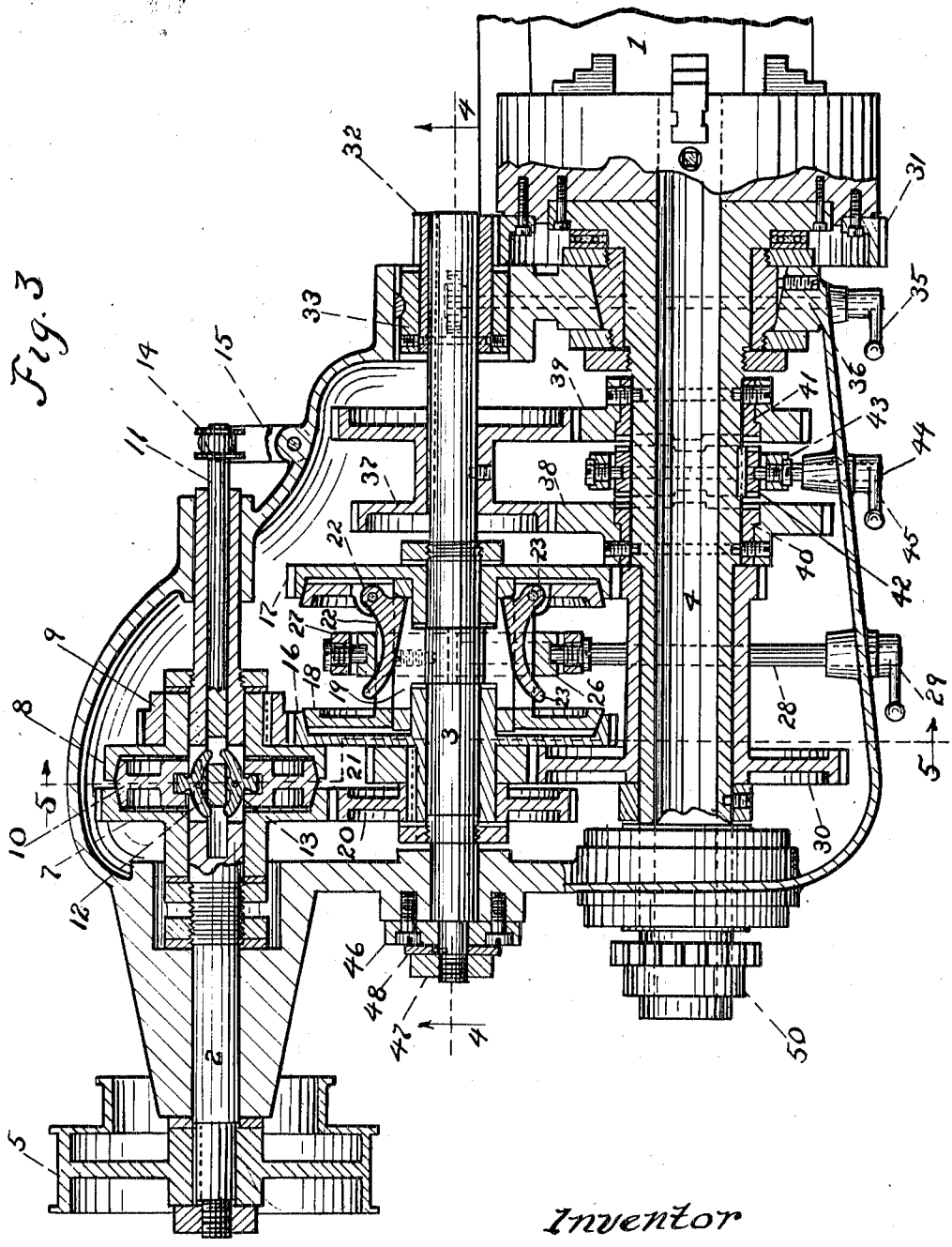
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8 SHEETS—SHEET 3.

Fig. 3



Witnesses:

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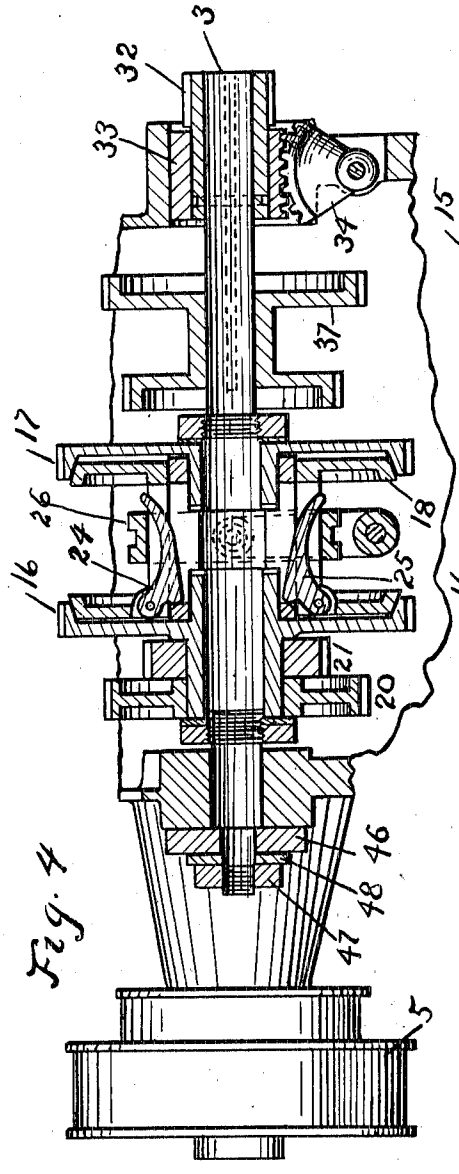


Fig. 4

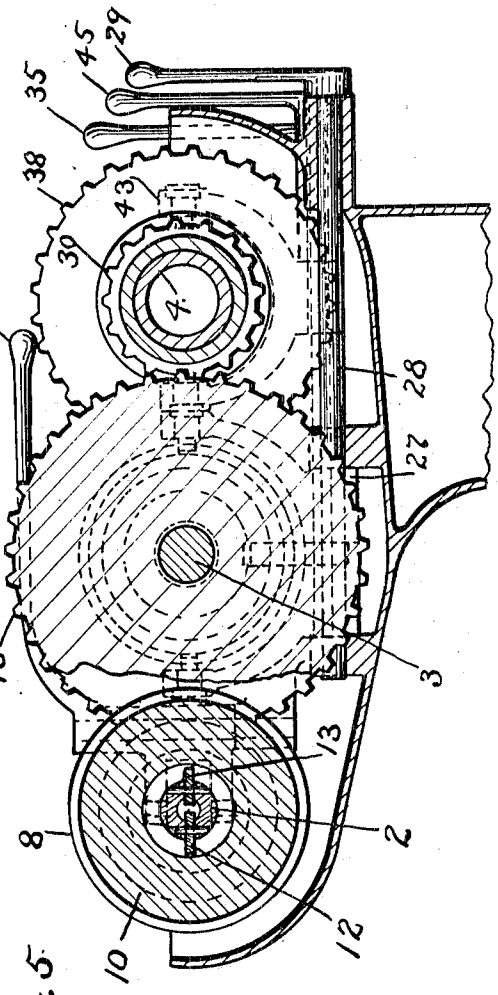


Fig. 5

Witnesses!
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8 SHEETS—SHEET 5.

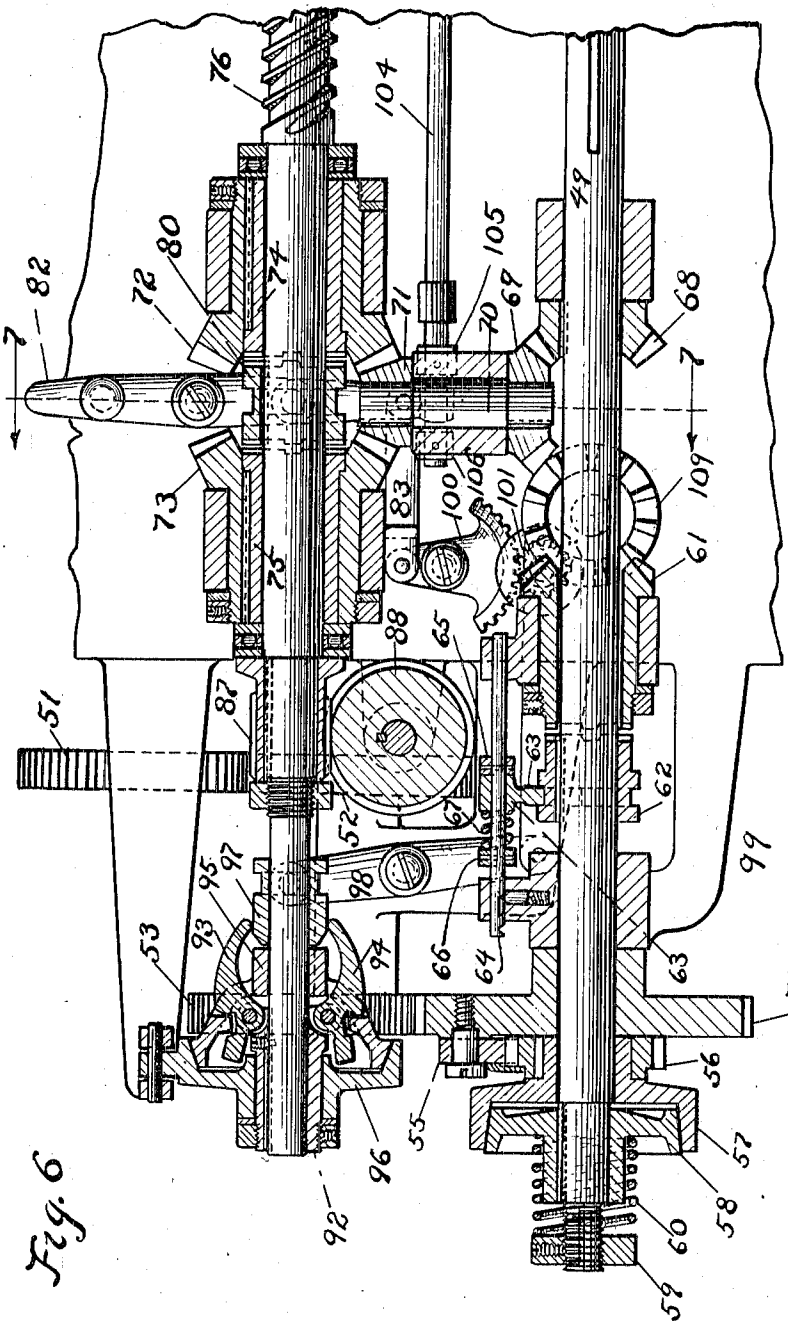


Fig. 6

Witnesses.

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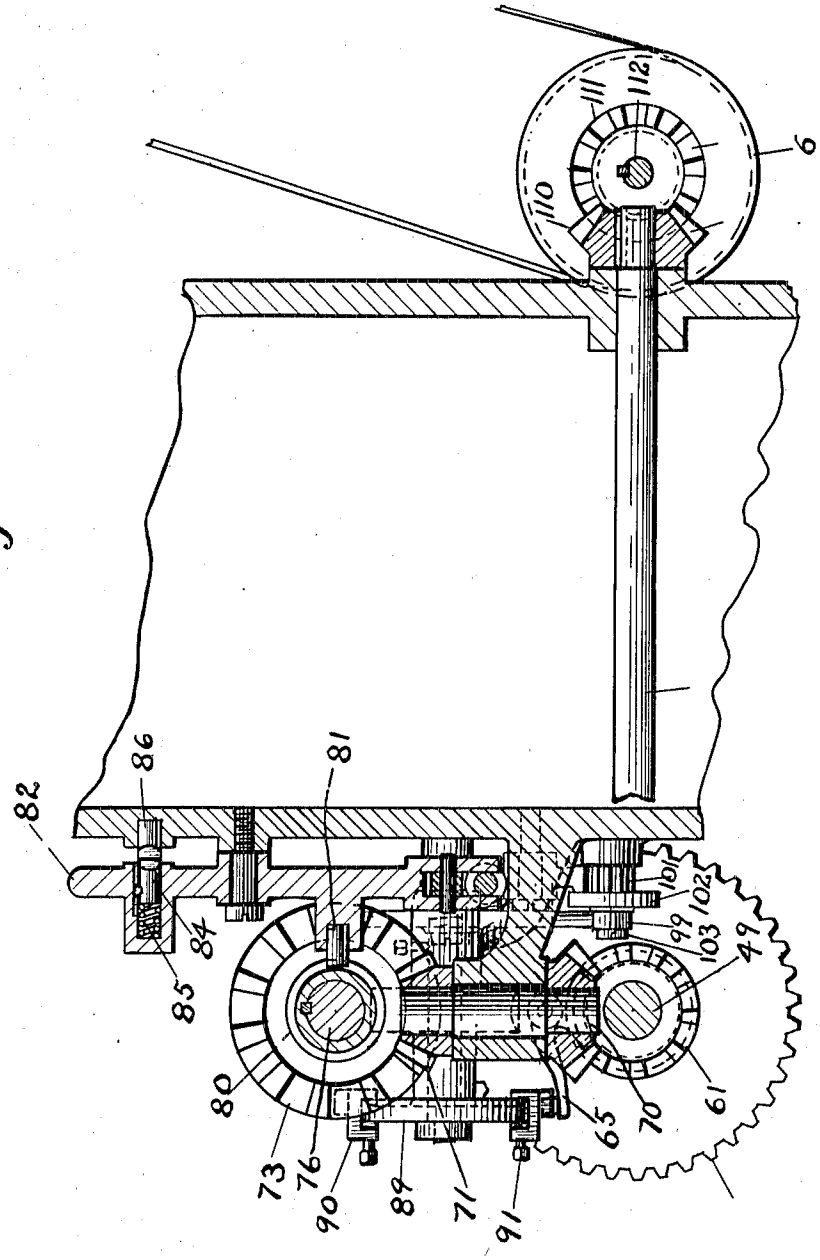
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8 SHEETS—SHEET 6.

Fig. 7



Witnesses!

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8 SHEETS—SHEET 7.

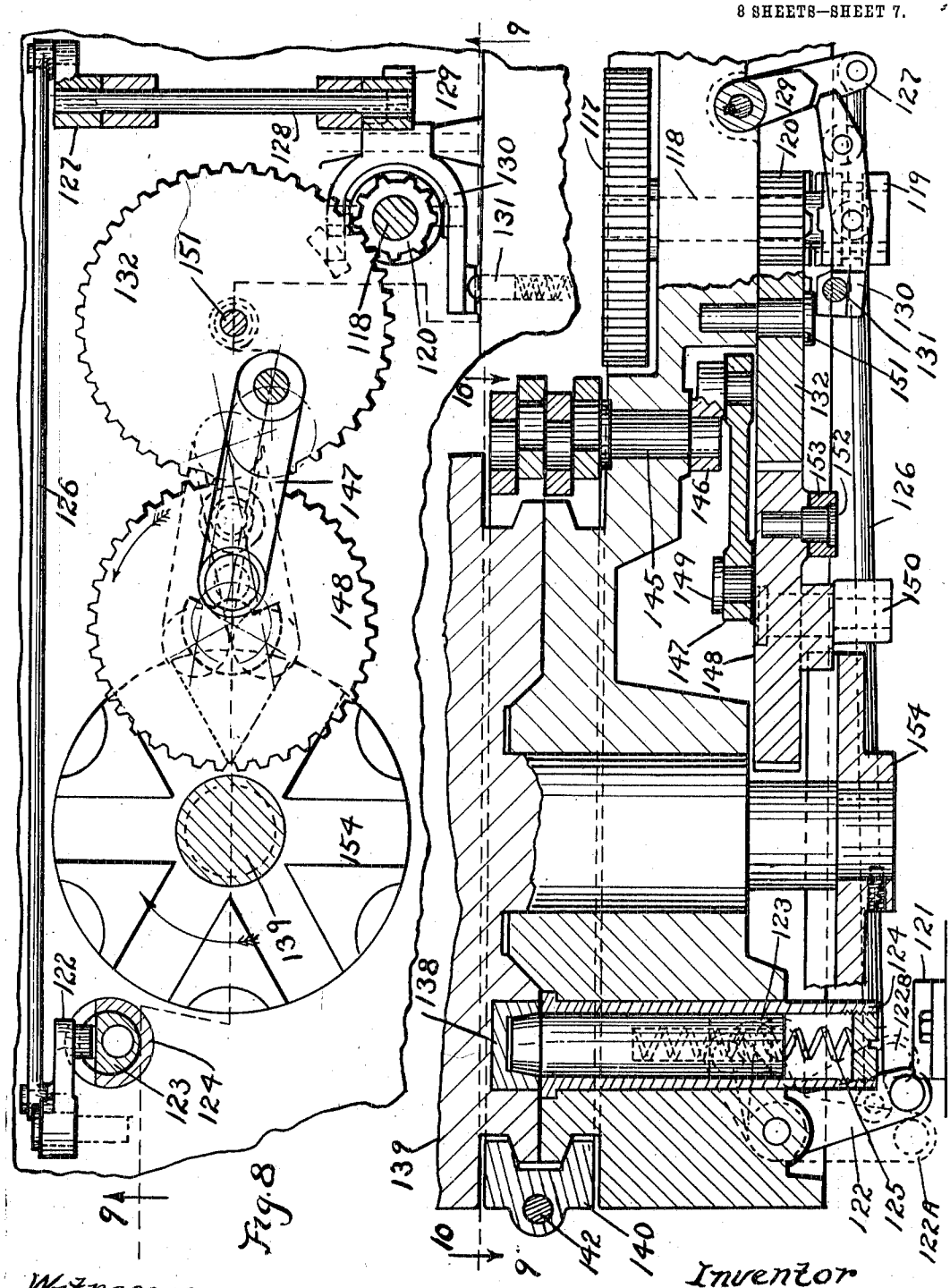


Fig. 8

Fig. 9

Witnesses:
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APPLICATION FILED MAR. 8, 1911.

1,099,308.

Patented June 9, 1914.

8 SHEETS—SHEET 8.

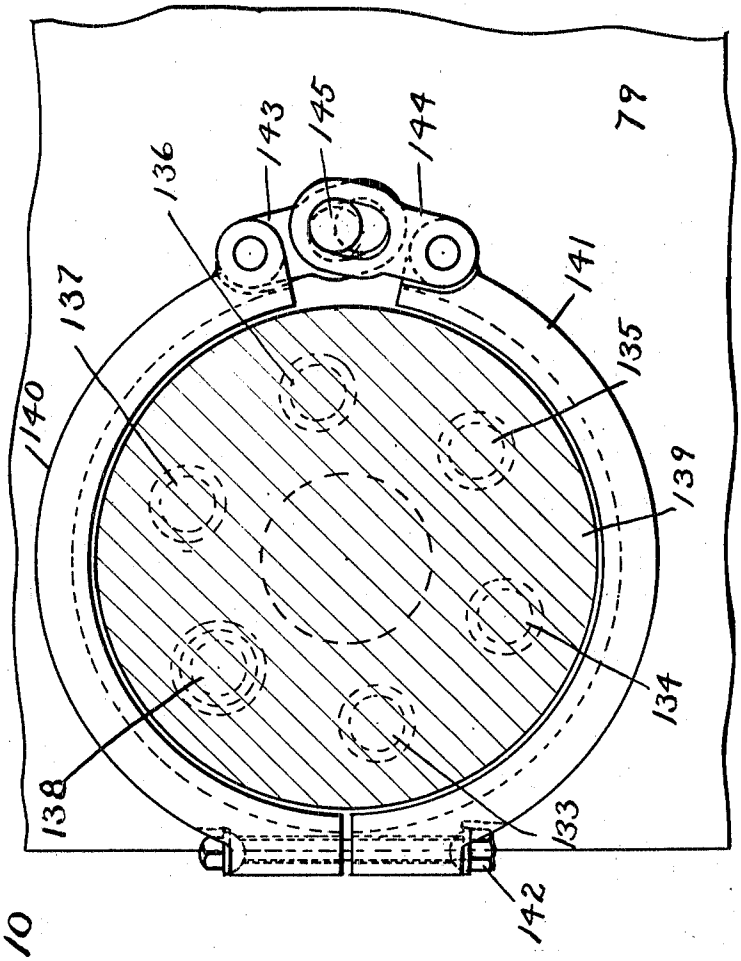


Fig. 10

Witnesses:
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UNITED STATES PATENT OFFICE.

WILLIAM K. MILLHOLLAND, JR., OF CLEVELAND, OHIO.

TURRET-LATHE.

1,099,308. Specification of Letters Patent. Patented June 9, 1914.

Application filed March 8, 1911. Serial No. 613,191.

To all whom it may concern:

Be it known that I, WILLIAM K. MILLHOLLAND, Jr., residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Turret-Lathes, of which the following is a specification.

My invention relates to turret lathes and similar machines and comprises, first, means for driving the work at greatly varying speeds; second, means for automatically traversing the turret backward and forward on the bed at greatly varying speeds; third, means for automatically reversing the motion of the turret at any pre-determined point; fourth, means for automatically controlling the operation of the turret so that it will remain stationary for a number of revolutions of the spindle and then resume its motion; fifth, means for automatically rotating the turret by power; sixth, means for automatically registering the turret by power; seventh, means for automatically clamping and unclamping the turret by power.

The features of my invention are more fully set forth in the description of the accompanying drawings making a part of this specification, in which—

Figure 1 is a front elevation of the turret lathe. Fig. 2 is a rear end elevation. Fig. 3 is a transverse horizontal section through the spindle, intermediate shaft, and drive shaft, on Fig. 2 and Fig. 1. Fig. 4 is a vertical section through intermediate shaft on Fig. 3. Fig. 5 is a vertical transverse section through spindle, intermediate shaft, and drive shaft on Fig. 3. Fig. 6 is a vertical transverse section through reversing mechanism and driving mechanism for feed rod and feed screw and holding mechanism for preventing rotation of feed screw when reversing clutch is not in engagement, on Fig. 2. Fig. 7 is a vertical section on Fig. 6 through reversing mechanism and driving mechanism for rapidly rotating the feed shaft by means of the secondary shaft. Fig. 8 is a horizontal transverse section through mechanism for automatically rotating the turret and registering by power on Fig. 1. Fig. 9 is a vertical transverse section through mechanism for automatically rotating, automatically registering and automatically clamping and unclamping turret by power,—on Fig. 8. Fig. 10 is a horizontal section through turret post showing ring with annular groove for clamping and unclamping turret—on Fig. 9.

The principal characteristics of my turret-lathe are, first, a driving shaft, intermediate shaft and spindle, and a system of gearing and clutches mounted on said drive shaft, intermediate shaft and spindle whereby a large number of speeds may be obtained for driving the spindle.

The second characteristic of my improved lathe is the employment of a feed shaft, whose primary object is to move the tool carriage at various rates of speed; this feed shaft has appliances for being driven from the main spindle of the machine for feeding the tool carriage or by a secondary shaft driven from the drive shaft of the machine for moving the tool carriage rapidly back and forth.

A third characteristic of my invention is the employment of a shaft which I term the "stop shaft" which operates appliances for stopping the tool carriage travel, holding the tool carriage stationary until the spindle revolves a number of revolutions, then reversing the direction of travel of the tool carriage.

A fourth characteristic of my machine relates to the power mechanism for revolving the turret, registering, clamping and unclamping the same automatically.

A fifth characteristic of my lathe relates to the use of friction devices for relieving the feeding and reversing mechanism of undue shocks.

I will first describe the mechanism for driving the spindle at various rates of speed.

Referring to Fig. 3, 1 is the bed or main frame of the machine, supporting at one end and carrying in suitable journals, drive shaft 2, intermediate shaft 3 and spindle 4. On the end of drive shaft 2 is mounted and splined to said drive shaft, a two step pulley 5 so arranged as to permit one step to be

belted to a source of power and the other step belted to pulley 6 shown in Fig. 2. Loosely mounted on drive shaft 2 is gear 7 and disk 8; disk 8 is provided with an outwardly projecting hub to which is splined gear 9. Interposed between gear 7 and disk 8 and splined to the drive shaft 2, slidable endwise thereon, is spider 10, provided with conical friction surfaces adapted to engage with corresponding surfaces in gear 7 and disk 8.

The drive shaft 2 is provided with an internal recess in which rod 11 slidable endwise works. The end of the rod 11 working in the drive shaft 2 is provided with a suitable slot for the necessary operation of dogs 12 and 13 which are pivoted in a suitable slot in the drive shaft 2. The dogs 12 and 13 are provided each with an end outwardly projecting and bearing against the sides of an annular groove in spider 10 and are also provided with two inwardly projecting ends adapted to engage with end of rod 11 and one end of the slot in rod 11. Carried on the external end of rod 11 is spool 14 against the sides of which projecting pins carried in forked lever 15 bear. Moving lever 15 causes a corresponding endwise motion of rod 11 which, acting on corresponding inwardly projecting ends of dogs 12 and 13 forces them apart causing the outwardly projecting ends to bear against the corresponding sides of annular groove in spider 10, and thereby bearing spider 10 into frictional engagements with gear 7, or disk 8 according to the direction of motion of rod 11.

Drive shaft 2 is suitably provided with means of adjustment for wear on friction surfaces of gear 7 and disk 8 and wear on the face of the thrust bearing of bed 1.

Loosely mounted on intermediate shaft 3 are gears 16 and 17 provided with conical friction surfaces adapted to engage with corresponding friction surfaces of double ended friction spider 18 interposed between gears 16 and 17, which is splined to finger ring 19 and movable endwise thereon. Gear 16 carries on its outwardly projecting hub and splined thereto, gears 20 and 21. Gear 16 meshes with gear 9 and gear 20 meshes with gear 7, said gears 9 and 7 mounted on drive shaft 2. It is evident that if drive shaft 2 is revolved and lever 15 moved so that friction surface of spider 10 bears into frictional engagement with the corresponding friction surface of gear 7, gear 20 will be driven according to the ratio of gears 7 and 20; if however spider 10 is borne into engagement with the corresponding friction surface of disk 8, gear 16 will be driven according to the ratio of gear 9 and gear 16. Gears 16 and 17 are both provided with inwardly projecting hubs adapted to abut against corresponding shoulders on finger ring 19 which is rigidly secured to intermediate shaft 3. When double ended friction spider 18 is withdrawn from frictional engagement with gears 16 or 17 their inwardly projecting hubs will prevent the friction surfaces from remaining in contact with the corresponding friction surface of double ended friction spider 18.

Double ended friction spider 18 is provided with four slots, ninety degrees apart more or less; in each slot works a finger suitably pivoted at one end to double ended friction spider 18. The fingers are arranged in pairs and preferably the fingers of a pair work directly opposite each other, one pair being pivoted at one end (Fig. 3) and the other pair at the other end of double ended friction spider 18, the other pair as shown in Fig. 4. The object is to balance the fingers. Finger ring 19 is also provided with four slots in which the corresponding fingers work. The fingers 22, 23, 24, 25 are provided with a short end or heel adapted to bear against the corresponding end of slot in finger ring 19, and with a long end which may be depressed into the corresponding slot in double ended friction spider 18 and finger ring 19 without interference.

Ring 26 splined to double ended friction spider 18 and movable endwise, is provided with a continuous groove in its periphery against the sides of which the ends of projecting screws carried in fork 27 bear. Fork 27 is rigidly connected to rod 28 properly supported in bearings provided on the bed, and rod 28 is in turn rigidly secured to lever 29. The long ends of fingers 22, 23, 24, 25 project outwardly and above ring 26 when in the normal position. When ring 26 is caused to move endwise, the corresponding side of ring 26 comes into engagement with the long ends of corresponding pairs of fingers in its path of motion.

It is evident that if lever 29 is operated in such a manner as to slide ring 26 toward gear 16 the long ends of the fingers shown in Fig. 3 will be depressed into the corresponding slots in double ended friction spider 18 and finger ring 19, the fingers being pivoted in double ended friction spider 18; the heels bearing against the corresponding ends of the slots in finger ring 19 act as points of fulcrum and bear the corresponding friction end of double ended friction spider 18 into engagement with the corresponding friction surface of gear 16, thereby causing intermediate shaft 3 to be rotated with gear 16. In a like manner if lever 29 is operated in the reverse direction, the opposite friction end of double ended friction spider 18 will bear into engagement with the corresponding friction surface of gear 17 and will lock gear 17 with intermediate shaft 3.

Double back gear sleeve 30 is loosely mounted on the spindle 4, the large gear end meshing with gear 21 and small gear end meshing with gear 17. It is evident that if gear 16 is caused to rotate double back gear sleeve 30 will also be caused to rotate and transmit motion to gear 17, and if gear 17 is locked to the intermediate shaft 3, the intermediate shaft 3 will be caused to rotate according to the difference in gear ratios.

The end of spindle 4 is flanged for rigidly bolting or screwing on a chuck body or face plate on which is rigidly mounted gear 31 meshing with gear 32 splined to intermediate shaft 3 and slidable endwise thereon out of mesh with gear 31. Gear 32 is loosely mounted in bushing 33 which carries a key and is slidable endwise in a proper bearing on the bed. Gear 32 bears a continuous groove, against the sides of which projecting ends of suitable screws carried in bushing 33 bear. Bushing 33 is provided with a proper rack cut in the lower portion adapted to mesh with segment gear 34 shown in Fig. 4 working in a suitable slot in the bearing supporting bushing 33.

Lever 35 is rigidly connected to rod 36 working in suitable bearings on the bed and rod 36 in turn is rigidly secured to segment gear 34. If lever 35 is operated in a proper manner, gear 32 will be withdrawn from engagement with gear 31. With gear 32 in mesh with gear 31, spindle 4 will be rotated with intermediate shaft 3 according to the ratio of gear 32 and gear 31. Rigidly secured to intermediate shaft 3 is double gear 37 having a large gear on one end and a smaller gear on the other end, meshing with corresponding gears 38 and 39, rigidly secured to clutch sleeves 40 and 41 respectively, which in turn are loosely mounted on the spindle 4 which is provided with two continuous grooves against the sides of which, projecting ends of screws carried in the hubs of gears 38 and 39 respectively, bear.

Splined to the spindle 4 and slidable endwise and interposed between gears 38 and 39 and adapted to engage with the corresponding teeth in clutch sleeves 40 and 41 respectively, is clutch 42. Clutch 42 bears a continuous groove, against the sides of which the projecting ends of screws carried in fork 43 bear. Fork 43 is rigidly connected to rod 44 working in suitable bearings provided on the bed, and rod 44 in turn is rigidly secured to lever 45. When lever 35 is operated so that gear 32 is moved out of mesh with gear 31 and lever 45 is operated so that the teeth of clutch 42 are brought into engagement with the corresponding teeth of clutch sleeve 40, spindle 4 will be rotated according to the ratio of gear 38 and the corresponding gear end of double ended gear 37. In like manner, if lever 45 is operated in the reverse direction, spindle 4 will be rotated according to the ratio of gear 39 and the corresponding gear end of double gear 37.

It is evident from the foregoing description that by a proper manipulation of levers 15, 29, 35 and 45 in proper combination that, no two gear ratios being equal, a greatly varying number of speeds may be obtained, the object of which is to provide different speeds for various kinds of work and for various operations on individual pieces, and have these varying speeds readily attainable so as to economize time.

Intermediate shaft 3 is provided with a thrust bearing on the opposite end from which gear 32 is carried. Collar 46 is rigidly secured to the bed 1. The intermediate shaft 3 is provided with a shoulder to abut against collar 46 and a small end extending through the collar 46 bearing an adjustable nut 47, interposed between the nut 47 and collar 46, is washer 48 splined to intermediate shaft whereby the thrust is taken both ways on collar 46. Intermediate shaft 3 is also provided with suitable means for adjusting and taking up the wear on the friction surfaces of gears 16 and 17 and double ended friction spider 18.

Spindle 4 is provided with a suitable thrust bearing for taking the thrust due to heavy cuts, thereby eliminating loss in power due to friction from this source. The portion of the bed carrying the drive shaft 2, intermediate shaft 3 and spindle 4, is provided with a thin wall or pan for holding oil in which the gearing works and is also provided with a suitable cover, which together, with the panned part of bed completely incloses the gearing.

In Fig. 2 and Fig. 6 motion is transmitted to feed shaft 49 suitably supported in bearings extending out from the bed, direct from the main spindle 4 as follows: Gear 50 rigidly secured to end of spindle 4 meshes with gear 51 which in turn transmits motion to gears 52 and 53. Gear 53 meshes with gear 54 loosely mounted on feed shaft 49 and gear 54 carries pawl 55 suitably pivoted and eccentrically disposed, which is adapted to engage with ratchet 56 rigidly secured to the hub of friction disk 57. Friction disk 57 is loosely mounted on feed shaft 49 and is provided with a conical friction surface adapted to engage with the corresponding surface of spider 58. Threaded to the end of feed shaft 49 and adjustable thereon is nut 59, and interposed between nut 59 and spider 58 is coiled spring 60; by adjusting nut 59, spring 60 will be under different compressions, thereby giving a means of adjustment for different frictions between spider 58 and disk 57.

It is evident that, gear 54 being rotated in the proper manner, pawl 55 will engage with ratchet 56 and thereby cause feed shaft 49 to be rotated with the spindle 4 according to the difference in gear ratios. The object of the friction drive to feed shaft 49 is to provide a safety device for relieving the mechanism required to operate the turret carriage—which will be described later—from all undue shocks whether in reversing the motion of turret carriage or in case of accident to turret or tools.

Referring to Fig. 6: Loosely mounted on feed shaft 49 is bevel gear 61 which is properly supported in bearings extending out from the bed, and is provided with teeth on its hub end adapted to engage with the corresponding teeth of clutch sleeve 62 which is splined to feed shaft 49 and slidable endwise thereon. Clutch sleeve 62 is provided with a continuous groove against the sides of which clutch fork 63 bears. Clutch fork 63 is slidable endwise on rod 64 which in turn is slidable endwise in suitable bearings, supported on the bed. Rigidly secured to rod 64 is shipper 65 and collar 66, clutch fork 63 abuts against the hub of shipper 65 on one side and spring 67 on the other; spring 67 in turn abuts against collar 66.

If clutch fork 63 is caused to move toward bevel gear 61 sufficiently, the teeth of clutch sleeve 62 will be brought into engagement with the corresponding teeth of bevel gear 61. In case the teeth of clutch sleeve 62 are not in correct relation to the teeth of bevel gear 61 and the teeth abut, spring 67 will be compressed until the teeth are in correct relation, then spring 67 will force them into engagement, rod 64 being provided with suitable means for holding the teeth in engagement and also out of engagement.

Referring to Figs. 6 and 7 bevel gear 68 splined to feed shaft 49 meshes with bevel gear 69 which is splined to gear shaft 70. Gear shaft 70 is supported in a suitable bearing on the bed and splined on its other end is bevel gear 71 meshing with bevel gears 72 and 73 supported in suitable bearings extending out from the bed. Bevel gears 72 and 73 are splined to clutch sleeves 74 and 75 respectively which in turn are loosely mounted on feed screw 76. One end of feed screw 76 is journaled in clutch sleeves 74 and 75 mounted in bevel gears 72 and 73 respectively. The other end is journaled in a suitable bearing at the other end of the bed. Referring to Fig. 1 engaging with feed screw 76 is a nut 77 journaled in the apron 78 with means provided for rigidly securing it thereto; the apron 78 is rigidly secured to the turret carriage 79 which in turn is mounted on ways on the bed and is adapted to slide endwise thereon.

Referring to Fig. 6 and Fig. 7, interposed between clutch sleeves 74 and 75 is clutch 80 splined to feed screw 76 and slidable endwise thereon, with teeth adapted to engage with corresponding teeth in clutch sleeves 74 and 75 respectively. Clutch 80 has a continuous groove against the sides of which the end of pin 81 rigidly held in a projecting boss of lever 82 bears. Lever 82 is pivoted to the bed in proper manner and its lower end is forked, to which link 83 is pivoted and the upper end carries a boss with a hole suitable for pin 84 with a spring 85 behind it, to work in. Pin 84 is flatted on two opposite sides so as to form a wedge on the end projecting out of the hole in lever 82. It also carries a key working in a proper keyway in the hole in lever 82. Securely fixed in the bed in proper relation to pin 84 is pin 86 with opposite sides flatted off in a corresponding manner. Pins 84 and 86 are arranged so that the sides of the wedges are in correct relation to each other.

When lever 82 is in a central position, pin 84 is forced back into the hole in lever 82 and compresses the spring 85. If lever 82 is moved either way from the central position, spring 85 acting against pins 84 and 86 tends to force lever 82 over into a position not central. If lever 82 is moved away from the central position until the teeth of clutch 80 are in proper engagement with the corresponding teeth of clutch sleeve 75, feed screw 76 will be caused to rotate and if lever 82 is moved away from the central position in the reverse direction until the corresponding teeth of clutch 80 and clutch sleeve 74 are in proper engagement, feed screw 76 will be caused to rotate in the reverse direction.

It is evident that when lever 82 is in its central position, there is no tendency for the feed screw 76 to be rotated, except by some force other than mentioned so far.

Feed screw 76 is provided with proper thrust bearings for taking the thrust of feed screw which is of quick pitch. Rigidly secured to feed screw 76 is worm 87 meshing with worm gear 88 which is loosely mounted on a shaft rigidly supported in a proper manner on the bed and provided with proper means for taking end thrust of the worm gear 88. Mounted on the hub of worm gear 88 is a disk 89 provided with a proper means for holding dogs 90 and 91 when bolted onto its periphery. Dogs 90 and 91 are adjustable on the periphery of the disk 89. The circumference of the disk 89 bears a certain relation to the travel of the turret carriage 79 along the bed, the disk 89 making nearly a complete revolution for the greatest travel of the turret carriage 79. If the motion of the screw 76 is reversed, the same relation exists; that is, for every inch or fraction thereof travel of the turret carriage 79, the disk 89 mounted on worm gear 88 travels accordingly but at a

lesser rate due to a lower ratio of motion of the worm gear 88 to the feed screw 76.

Rigidly secured to the feed screw 76 is sleeve 92, carrying dogs 93 and 94 suitably pivoted thereon. Dogs 93 and 94 are provided with heels which bear against corresponding shoulders on spider 95 and also work in suitable slots provided in spider 95. Dogs 93 and 94 are counterweighted on one end to balance centrifugal force which acting on the long end or lever end would have a tendency to force the heels against shoulders of spider 95 when the feed screw 76 is revolved. Spider 95 is splined to feed screw 76 and is slidable endwise thereon and is provided with a conical friction surface adapted to engage with a corresponding surface in disk 96. Disk 96 is loosely mounted on sleeve 92 and is rigidly held in a stationary position by an arm projecting out from the bed, the disk 96 acting as a bearing, for sleeve 92 and thus supporting the end of feed screw 76. Sleeve 92 is provided with means for taking up the wear on spider 95 and disk 96. Splined to feed screw 76 slidable endwise thereon is spool 97 provided with an external beveled surface adapted to engage with the long ends of dogs 93 and 94 respectively. Spool 97 is provided with a continuous groove against the sides of which a pin carried in the upper end of lever 98 and the end projecting into the groove in spool 97 bears. Lever 98 is suitably pivoted to a bracket extending out from the bed.

If the upper end of lever 98 is caused to move toward spider 95 sufficiently, the beveled end of spool 97 will come into engagement with the long ends of dogs 93 and 94, spreading the ends apart until the long ends of dogs 93 and 94 come to rest on the cylindrical part of spool 97 which will cause spider 95 to be forced and held into engagement with disk 96 thereby locking feed screw 76 stationary to the bed, withdrawing the spool 97 from engagement with dogs 93 and 94, releases the pressure on spider 95—and consequently the friction—and allows feed screw 76 to be revolved. One end of link 83 is pivoted between the forked ends of lever 82, the other end is forked and pivoted to the upper end of segment gear 100 which in turn is suitably pivoted to a projecting boss on the bed. Meshing with segment gear 100 is pinion 101 properly supported in a suitable bearing on the bed. Rigidly secured to pinion 101 is disk 102 bearing an eccentrically disposed pin 103 to which is pivoted one end of link 99, the other end of link being forked and pivoted to the lower end of lever 98. Stop shaft 104 carried in proper bearings on the bed is slidable endwise and carries on its end collars 105 and 106 rigidly secured thereto. The end of stop shaft 104 bearing collars 105 and 106 passes between the forked end of lever 82. The collars 105 and 106, arranged one on either side of the lever 82 bear against the edges of the forked end which is properly shaped. The collars 105 and 106 are so arranged as not to interfere with link 83.

Referring to Fig. 1, apron 78 is provided with properly protruding bosses through which stop shaft 104 passes, these bosses also act as supports for stop shaft 104 and as a means of abutment for collars 107 and 108 which are carried on stop shaft 104 on opposite ends of apron 78. Collars 107 and 108 are slidable endwise along stop shaft 104 and are provided with proper means for quickly and solidly clamping them to stop shaft 104 at positions along stop shaft 104 which are optional with the operator.

It is evident that if spindle 4 (Fig. 3) is revolved, feed shaft 49 will also be revolved which in turn will operate feed screw 76. Referring to Fig. 6 if lever 82 is in a position so that the teeth of clutch 80 are in engagement with the corresponding teeth of clutch sleeve 74, according to the train of gearing shown and feed screw 76 being a right hand screw, turret carriage 79 (Fig. 1) will be traversed toward the chuck; and traversed away from the chuck if the teeth of clutch 80 are in engagement with the corresponding teeth of clutch sleeve 75.

Referring to Fig. 1. If turret carriage 79 is traversed toward the chuck sufficiently, a protruding boss on apron 78 will abut against collar 107 whose position has previously been determined by the operator, causing stop shaft 104 to be moved longitudinally toward the chuck with the turret carriage 79 until the teeth of clutches 80 and 74 are out of engagement.

Referring to Fig. 6. When clutches 80 and 74 are out of engagement, lever 82 has moved into a position slightly off central in the opposite direction and spring pin 84, (Fig. 7) acting on pin 86 tends to force the lever 82 farther over until the corresponding teeth of clutch 80 and clutch sleeve 75 are in engagement. The previous motion of lever 82 acting through link 83 operates segment gear 100 which in turn rotates pinion 101. Pinion 101 and segment 100 are so proportioned that when segment 100 is actuated through proper leverage, segment 100 rotates pinion 101 one half of a turn more or less.

Referring to Figs. 6 and 7, eccentric pin 103 is so located on disk 102 that when the teeth of clutch 80 are in engagement with the corresponding teeth of either clutch sleeve 74 or 75, spider 95 is not in engagement with disk 96 and feed screw is free to rotate, but if the teeth of clutch 80 are not in engagement with corresponding teeth of clutch sleeves 74 or 75, spider 95 and disk

96 are in engagement and consequently feed screw 76 is held against rotation.

Feed screw 76, being a quick pitch screw has a tendency to overhaul when feeding turret carriage 79 (Fig. 1) against a heavy cut, so consequently if the feed screw 76 is gripped and held against rotation during the time clutch 80 is out of engagement, the position of turret carriage 79 (Fig. 1) will be fixed during that time, so that the tool operating on the work will neither dig into or back off when the feeding is stopped, this being an important point in the production of accurate work.

Feed screw 76 in practice operates at a slower rate than spindle 4 (Fig. 3) during the time the tools are cutting, in order to give a proper feed. Therefore if the number of teeth on clutch 80 are proportioned in relation to the ratio of the rotation of the spindle 4 to feed screw 76, feed screw 76 can be held stationary for one or more revolutions according to the ratio of spindle 4 to feed screw 76 and number of teeth in clutch 80.

Feed screw 76 acting through worm 87 rotates worm gear 88 and disk 89 which causes dog 90—worm 87 being left handed—to come in contact with shipper 65; this forces clutch 62 into engagement with the corresponding clutch teeth on bevel gear 61. Bevel gear 61 is driven by train of bevel gears 109, 110 and 111, bevel gear 111 being splined to secondary shaft 112, supported in proper bearing on the bed, to which is splined pulley 6, which in turn is connected by belt to the corresponding step of drive pulley 5.

The train of gearing and connection with drive pulley 5 is such that when the clutch teeth of bevel gear 61 are in engagement with the corresponding teeth of clutch 62, feed shaft 49 is caused to rotate at a considerably faster speed than necessary for feeding and in the same direction as when driven direct from the spindle 4, Fig. 3. Feed shaft 49 being rotated in such a manner, ratchet 56 will be rotated away from pawl 55 and pawl 55 will not come into engagement with the corresponding teeth of ratchet 56, until the clutch 62 is thrown out of engagement with bevel gear 61, when feed shaft 49 will tend to stop rotating until pawl 55 comes into engagement with ratchet 56 when the feed shaft 49 will again be driven from the spindle 4, Fig. 3. The pawl and ratchet, since they are effective to rotate feed shaft 49 by spindle 4 when in engagement and ineffective for the purpose when not in engagement, constitute a clutch of one of various forms, this form being preferably though not exclusively used between the feed shaft and spindle. Dogs 90 or 91 are so adjusted on the disk 89 by the operator that when the motion of turret carriage 79, Fig. 1, is reversed, clutch 62 will be forced into engagement with the corresponding teeth on bevel gear 61, thereby causing feed shaft 49 to be driven at a faster speed, causing feed screw 76 to be rotated rapidly, thereby traversing turret carriage 79 (Fig. 1) away from the work in a rapid manner. The boss on turret carriage 79 (Fig. 1) abutting against collar 108 operates stop shaft 104 and reverses travel of the turret carriage 79 and turret carriage 79 will be traversed toward the work in a rapid manner until the tools in the turret carriage 79 are almost ready to start cutting, when dogs 90 or 91 which have been previously adjusted by the operator, will come in contact with the reverse side of shipper 65 forcing clutch 62 out of engagement with bevel gear 61, when pawl 55 will come into engagement with ratchet 56 and the feeding will again be resumed.

In Fig. 1, bevel gear 113 is splined to feed shaft 49, is slidable endwise, and works in a suitable bearing carried in the apron 78. Meshing with bevel gear 113 is bevel gear 114 splined to shaft 115 which is carried in suitable bearing in the apron 78 and projects upwardly into carriage 79 and splined on its upper end is gear 116 working in a proper recess, and meshing with gear 117 (Fig. 9). Gear 117 is splined to the upper end of shaft 118 which is properly supported in carriage 79. Referring to Figs. 8 and 9, the lower end of shaft 118 is enlarged to which clutch 119 is splined and slidable endwise thereon. Interposed between the enlarged end of shaft 118 and the face of the bearing, and loosely mounted on the shaft 118, is clutch gear 120 with teeth adapted to engage the corresponding teeth of clutch 119.

It is evident that when feed shaft 49 (Fig. 1) is rotated, bevel gear 113 will be rotated, which in turn will rotate shaft 115 through means of bevel gear 114, shaft 115 will rotate gear 116 meshing with gear 117, and clutch 119 will be rotated with shaft 118. Stop 121 is adjustable endwise, and works in a suitable slot on bed between the ways and is provided with suitable means for being rigidly clamped to the bed at positions along the slot optional with the operator. Stop 121 is adapted to engage a boss projecting from the depending end of bell crank 122 suitably pivoted in the turret carriage 79; the upper end of the bell crank 122 also carries a projecting boss which bears against the bottom of a proper slot provided in lock bolt 123.

The slot in lock bolt 123 is provided with the proper amount of clearance at the upper end so that the projecting boss of bell crank 122, adapted to engage with the lower end of the slot—will not interfere when bell crank 122 rides over the stop 121 when the turret carriage 79 moves toward the chuck. Lock

bolt bushing 124 is also provided with a suitable working slot for the upper projecting boss of bell crank 122. The lower end of lock bolt 123 is recessed in a manner not to interfere with the slot, and working in the recess is spring 125 whose upper end bears against the bottom of the recess in lock bolt 123 and lower end bears against the face of a screw threaded into bushing 124. When the turret carriage 79 moves away from the chuck sufficiently stop 121 will come into engagement with lower projecting boss of bell crank 122. Bell crank 122 will be caused to assume position shown dotted 122^A and lock bolt 123 will be withdrawn from engagement with the bushing in the turret. The turret carriage 79 continues to move until the bell crank 122 rides over the top of stop 121, when lock bolt 123 will be free to move upward into engagement with the bushing in the turret, as it is presented. The motion of turret carriage 79 being reversed, bell crank 122 will again come into engagement with stop 121 but from the opposite direction and the projecting boss on the depending end of bell crank 122 will ride over stop 121—taking the position shown dotted 122^B, and the projecting boss on the upper end will not come into engagement with the upper end of the lock bolt slot or lock bolt bushing slot.

Pivoted suitably at the lower end of bell crank 122 is rod 126, the other end being pivoted to lower end of crank 127 which is rigidly secured to shaft 128 suitably supported in bearings carried in the turret carriage 79. On the other end of shaft 128 is splined trip 129 the lower end of which is adapted to engage with a projecting end on yoke 130. Yoke 130 is suitably pivoted in the turret carriage 79 and carries projecting pins in the forked ends adapted to engage with the sides of a continuous groove in clutch 119. One end of the forked part of yoke 130 is provided with a wedge shaped boss, adapted to engage with pin 131 working in a suitable hole in the turret carriage 79 with a spring behind it which always tends to force it against one or other of the wedge shaped sides of the boss according to the position of the yoke 130. The other end of forked part of yoke 130 is provided with a suitable boss adapted to engage with a proper shaped cam projecting downward from the bottom of gear 132.

The upper end of lock bolt 123 is conical and is adapted to engage with corresponding holes in bushings 133, 134, 135, 136, 137, 138 shown in Fig. 10, which are carried in turret 139, which is revolubly mounted on turret carriage 79. Turret 139 is preferably of a hexagon shape with six faces provided for carrying tools. There can be less than six or more than six faces. The faces of turret 139 carry tool holders and are presented perpendicular to the line of travel, of turret carriage 79 at which point the lock bolt 123 forced upward by spring 125 enters into the bushing which is presented at that point in turret 139 corresponding to the face, the conical end of the lock bolt 123 engaging with corresponding surface of turret bushing tending to hold the exact position of the turret face perpendicular with the line of travel.

Turret 139 is provided with a post projecting downward into a suitable bearing on turret carriage 79. Turret 139 is provided with a conical bearing surface adapted to engage with a corresponding surface on turret carriage 79 acting as means of retaining alinement, and is also provided with a flat surface which bears against a corresponding surface on turret carriage 79, the conical and flat surfaces combining to form the turret seat.

Referring to Figs. 9 and 10: For clamping the turret 139 rigidly to its seat, I have provided a split clamp ring of segments 140 and 141 provided with an inner beveled groove adapted to engage with corresponding externally beveled flanges on the turret 139 and turret seat of the turret carriage 79. Segments 140 and 141 are held together by bolt 142 which also provides a means of adjustment for taking up wear. Pivoted to the other ends of the segments 140 and 141 are links 143 and 144 which are provided with suitable forked ends which lie into each other, and are provided with elongated holes in which the cams or eccentrics of eccentric pin 145 carried in a suitable support on the turret carriage 79 work. The corresponding eccentrics are arranged alternately being in the same relation for the hole in each side of forked end of corresponding links. Eccentric pin 145 is so adjusted in relation to the links 143 and 144 that revolving it 100 degrees more or less will cause the eccentrics bearing against the holes in links 143 and 144 to draw segments 140 and 141 together thereby clamping the turret 139 securely to its seat, reversing the direction of rotation of eccentric 145, 100 degrees more or less, release the segments 140 and 141 from engagement with the turret 139 and turret carriage 79.

Referring to Figs. 8 and 9. Splined to the lower end of eccentric pin 145 is crank 146 the crank 146 carrying a projecting hub, and pivoted to this hub is link 147, the other end of link 147 being pivoted to gear 148 by a stud 149 eccentrically disposed and carried by gear 148. Gear 148 is loosely mounted on stud 150 suitably supported in the turret carriage 79, and meshes with gear 132 loosely mounted on stud 151 suitably supported in turret carriage 79; gear 132 in turn meshes with gear 120. Gear 148 carries on its lower side stud 152 eccentrically disposed, on

which is loosely mounted roll 153 which is adapted to engage intermittently with radial slots or grooves in the upper face of disk 154 which is splined to the lower end of the projecting post of turret 139. The slots in disk 154 are equally spaced and correspond in number to the faces of the turret 139; that is, for a six faced turret there are six slots, etc. Gear 148 carries a circular cam segment with its center corresponding to the center of the gear, adapted to engage intermittently with corresponding circular openings in the periphery of disk 154; the number of openings corresponding to the number of slots and the location being central between slots.

The operation of the indexing, etc., of the turret 139 is as follows: As the turret carriage 79 travels away from the chuck, the lower end of bell crank 122 engages with stop 121 on the bed causing the lock bolt 123 to be withdrawn from its seat in the turret bushing at the same time rod 126 connected to the bell crank 122 is operated which brings trip 129 into engagement with the end of yoke 130 depressing it sufficiently to move the wedge shaped part of the fork upward over the center of the pin 131. Pin 131 forces the fork end upward which brings clutch 119 into engagement with corresponding clutch teeth of gear 120 thereby causing gear 120 to be rotated; rotating gear 120 drives gear 132 which in turn drives gear 148. Figs. 8, 9 and Fig. 10 show the parts of the turret mechanism in the normal position or when the turret 139 is properly indexed and clamped. For a hexagon turret, when gear 148 is caused to rotate and moves in a direction shown by the arrow, during the first 120 degrees of motion, eccentric 145 will be caused to rotate 100 degrees more or less and thereby unclamp the turret 139 from its seat. When gear 148 has rotated through 120 degrees, roll 153 comes into engagement with a slot in disk 154, at the same time the circular cam carried on the bottom of the gear 148 rotates out of the way, thereby unlocking the turret 139 and leaving it free to rotate through 60 degrees with the rotation of gear 148 through an additional 120 degrees. When the turret 139 has rotated 60 degrees another bushing in the bottom of the turret is presented, into which the end of lock bolt 123 engages, thereby locating the turret face perpendicular with the line of travel of turret carriage 79. The slots in disk 154 being radial, roll 153 comes into engagement on a tangent, the relation changing with position of the roll 153 in the groove finally the roll 153 leaving the slot at a tangent. This causes an accelerating and a retarding motion of the turret 139 while indexing, thereby relieving the indexing mechanism and lock bolt 123 from shock while starting, indexing and stopping. While turret 139 is indexing, eccentric pin 145 is caused to oscillate slightly tending to further unloosen the clamping and then come back to the same position again. The further 120 degrees motion of gear 148 after roll 153 leaves the slot in disk 154 causes eccentric pin 145 acting on the clamp ring to clamp the turret securely to its seat on the turret carriage. Gear 132 being of equal number of teeth with gear 148 will make one revolution with gear 148 and the cam on the bottom of gear 132, and the boss on yoke 130 will come into engagement thereby forcing clutch 119 out of engagement with gear 120 and thereby forcing the wedge shaped boss over the center of pin 131 which will hold clutch 119 out of engagement with pinion 120 until the lock bolt 123 is again withdrawn from engagement with the bushing in the turret 139.

There are numerous advantages to be obtained by the use of the various lathe mechanisms here shown. The lathe is adapted to do a large range of work, heavy as well as light work, more expeditiously and accurately then other machines which have heretofore been used. In fact the lathe is adapted to rapidly, accurately and economically bore, turn, face, thread, and finish a large range of castings or pieces from bars which are usually held in position by a chuck.

Among the advantages obtained are the employment of a single belt connection to a source of power for operating the entire mechanism of the machine, a system of gearing and clutches operated by hand levers, for quickly and conveniently obtaining different rates of speed for the different operations on the work held in the chuck, and the automatic operation of the turret carriage and turret carrying the tools.

The use of a single connection of the machine to a source of power insures greater flexibility and less expense in applying power, while the quick changes of speed readily obtainable for rotating the work insure efficient means of obtaining the best speeds for the tools on the different operations; which together with the automatic operation of the turret carriage and turret which are adjustable so as to accomplish the idle motions with the minimum loss of time and the working motions to the greatest advantage, insure the continued maximum output of the machine and also permits of one man operating several machines and thereby producing several times as much work as he could ordinarily when operating a machine without the automatic features.

Having described my invention, what I claim is—

1. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; alternatively

effective or ineffective means for rotating the feed shaft by the spindle; means for rotating the feed shaft independently of the spindle and at higher speed than by the spindle; and mechanism for alternatively connecting or disconnecting the last-named means and the feed shaft.

2. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; alternatively effective or ineffective means for rotating the feed shaft by the spindle; means for rotating the feed shaft independently of the spindle and at higher speed than by the spindle; a clutch for alternatively connecting or disconnecting the last-named means and the feed shaft; and automatically operative means for actuating said clutch.

3. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; alternatively effective or ineffective means for rotating the feed shaft by the spindle; means for rotating the feed shaft independently of the spindle and at higher speed than by the spindle; a clutch for alternatively connecting or disconnecting the last-named means and the feed shaft; a feed screw; means for alternatively connecting or disconnecting the feed shaft and feed screw; and means operated by the feed screw for actuating said clutch.

4. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; alternatively effective or ineffective means for rotating the feed shaft by the spindle; means for rotating the feed shaft independently of the spindle and at higher speed than by the spindle; a clutch for alternatively connecting or disconnecting the last-named means and the feed shaft; a feed screw; a second clutch adapted to connect the feed shaft and feed screw to alternatively rotate the latter in opposite directions; means operated by the feed screw for actuating the first clutch; a carriage reciprocable by the feed screw; and means operated by the carriage for actuating the second clutch.

5. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; alternatively effective or ineffective means for rotating the feed shaft by the spindle; means for rotating the feed shaft independently of the spindle and at higher speed than by the spindle; a clutch for alternatively connecting or disconnecting the last-named means and the feed shaft; a feed screw; a second clutch adapted to connect the feed shaft and feed screw to alternatively rotate the latter in opposite directions; means operated by the feed screw for actuating the first clutch; a carriage reciprocable by the feed screw; means operated by the carriage for actuating the second clutch; a turret mounted on the carriage; means for rotating the turret; means for locking the turret; a third clutch for alternatively connecting or disconnecting the rotating and the locking means and the feed shaft; and means operated by the carriage for actuating the third clutch.

6. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating the feed shaft by the spindle; and means for alternatively connecting or disconnecting the drive shaft and feed shaft, the drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle.

7. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating the feed shaft by the spindle; a clutch for alternatively connecting or disconnecting the drive shaft and feed shaft, the drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle; and automatically operative means for actuating said clutch.

8. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating the feed shaft by the spindle; a clutch for alternatively connecting or disconnecting the drive shaft and feed shaft, the drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle; a feed screw; means for alternatively connecting or disconnecting the feed shaft and feed screw; and means operated by the feed screw for actuating said clutch.

9. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating the feed shaft by the spindle; a clutch for alternatively connecting or disconnecting the drive shaft and feed shaft, the drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle; a feed screw; a second clutch adapted to connect the feed shaft and feed screw to alternatively rotate the latter in opposite directions; means operated by the feed screw for actuating the first clutch; a carriage reciprocable by the feed screw; and means operated by the carriage for actuating the second clutch.

10. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating

the feed shaft by the spindle; a clutch for alternatively connecting or disconnecting the drive shaft and feed shaft, the drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle; a feed screw; a second clutch adapted to connect the feed shaft and feed screw to alternatively rotate the latter in opposite directions; means operated by the feed screw for actuating the first clutch; a carriage reciprocable by the feed screw; means operated by the carriage for actuating the second clutch; a turret mounted on the carriage; means for rotating the turret; means for locking the turret; a third clutch for alternatively connecting or disconnecting the rotating and the locking means and the feed shaft; and means operated by the carriage for actuating the third clutch.

11. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; a member rotatable by the spindle and adapted to rotate the feed shaft; and means for alternatively rotating the feed shaft independently of the spindle at a higher speed than by the spindle, such rotation being adapted to render said member ineffective.

12. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; a member loosely mounted on the feed shaft and rotatable by the spindle; pawl and ratchet mechanism connecting said member with the feed shaft to rotate the latter; and means for alternatively rotating the feed shaft independently of the spindle and at higher speed than by the spindle, such rotation being adapted to render said pawl and ratchet mechanism ineffective.

13. In a machine of the class described, the combination of a spindle; means for rotating the spindle; a feed shaft; a member loosely mounted on the feed shaft and rotatable by the spindle; pawl and ratchet mechanism connecting said member with the feed shaft to rotate the latter; means for alternatively rotating the feed shaft independently of the spindle and at higher speed than by the spindle, such rotation being adapted to render said pawl and ratchet mechanism ineffective; a clutch for alternatively connecting or disconnecting said means and the feed shaft; a feed screw; means for alternatively connecting or disconnecting the feed shaft and feed screw; and means operable by the feed screw for actuating said clutch.

14. In a machine of the class described, the combination of a drive shaft; a spindle; a feed shaft; means rotatively connecting the drive shaft and spindle; alternatively effective or ineffective means for rotating the feed shaft by the spindle; a gear loose on the feed shaft driven from the drive shaft; a clutch for securing said gear on the feed shaft, said drive shaft being adapted to rotate the feed shaft at higher speed than by the spindle; a feed screw; and a member operated by said feed screw and adapted to move the clutch alternatively to engaging or disengaging position.

15. In a machine of the class described, the combination of a feed shaft; means for rotating the feed shaft; a feed screw; a carriage reciprocable by the feed screw; two oppositely disposed gears loose on the feed screw; a clutch for alternatively securing said gears to the feed screw; a pinion meshing with said gears; gearing connecting said pinion with the feed shaft; a rod periodically reciprocable by the carriage; and means connecting the rod with the clutch.

16. In a machine of the class described, the combination of a feed shaft; means for rotating the feed shaft; a feed screw; a carriage reciprocable by the feed screw; two oppositely disposed gears loose on the feed screw; a clutch for alternatively securing said gears to the feed screw; gearing connecting said gears with the feed shaft; a rod periodically reciprocable by the carriage; means connecting the rod with the clutch; a brake for the feed screw; and means for operating the brake by said rod.

17. In a machine of the class described, the combination of a feed shaft; means for rotating the feed shaft; a reciprocable carriage; means operable by the feed shaft for reciprocating the carriage; a turret mounted on the carriage; a rotatable member; means connected with said member and adapted to rotate the turret; means connected with said member and adapted to clamp the turret to the carriage; a clutch for alternatively connecting or disconnecting said rotatable member and the feed shaft; a lock normally engaging said turret; and a member operable by reciprocation of the carriage and adapted to disengage the lock and actuate the clutch.

18. In a machine of the class described, the combination of a carriage; means for reciprocating the carriage; a revoluble turret mounted on the carriage and provided with a plurality of radial recesses; a revoluble member adapted to engage said recesses successively; a lock normally engaging said turret; a rotatable member; means for rotating said rotatable member; means for revolving the revoluble member by the rotatable member; means connected with the revoluble member and adapted to clamp the turret to the carriage; and mechanism operable by reciprocation of the carriage for disengaging said lock and for alternatively connecting or disconnecting said rotatable member and said rotating means.

19. In a machine of the class described, the combination of a carriage; means for

reciprocating the carriage; a revoluble turret mounted on the carriage; means for revolving the turret; an extensible member secured to the carriage and adapted to clamp the turret; and mechanism operable by said revolving means for extending and contracting said member.

In testimony whereof, I have hereunto set my hand.

W. K. MILLHOLLAND, JR.

Witnesses:
JOHN H. NEWEY,
W. A. MALM.