Jan. 6, 1953

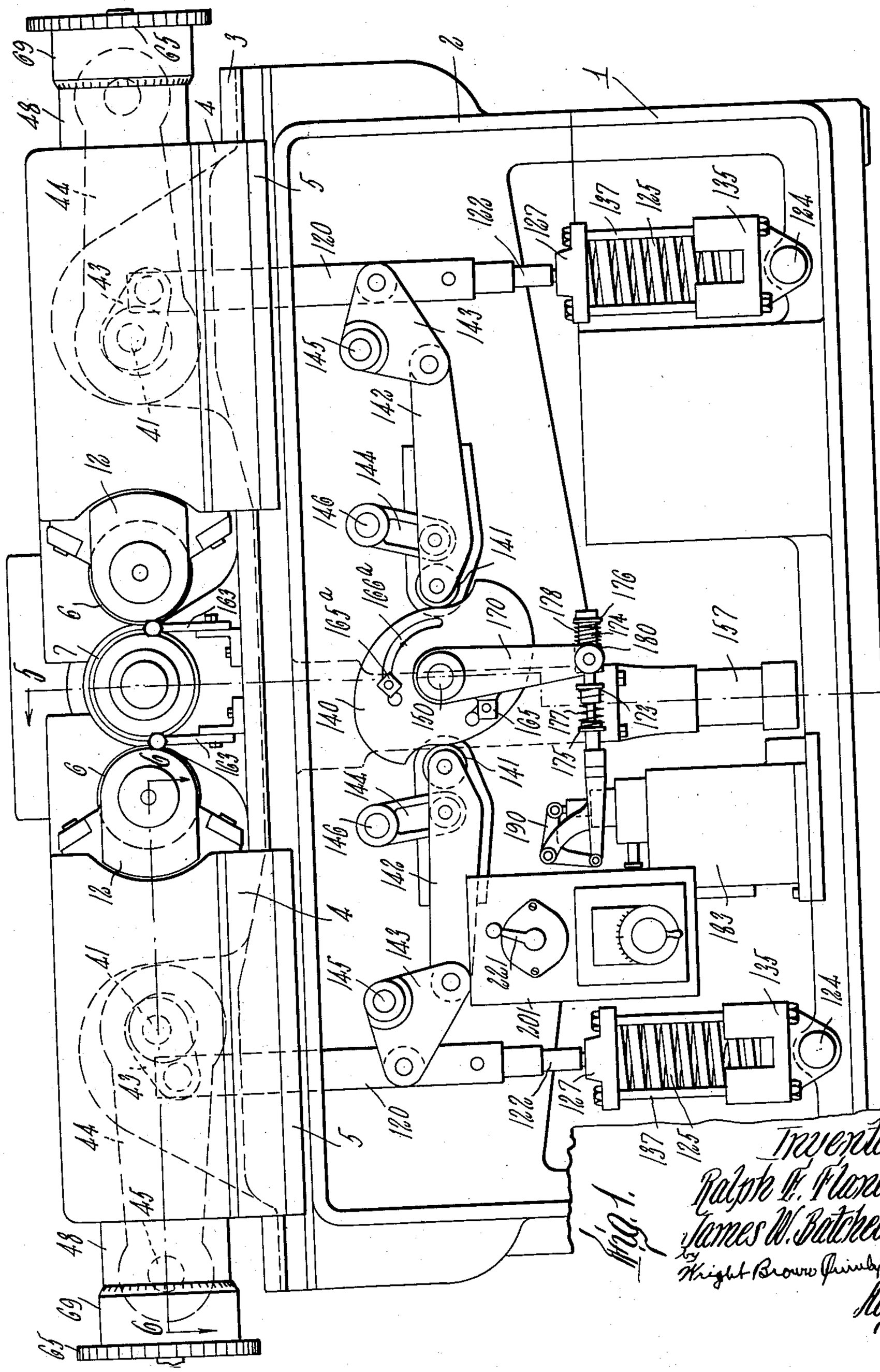
R. E. FLANDERS ET AL

2,624,218

THREAD ROLLING MACHINE

Filed Feb. 4, 1946

6 Sheets-Sheet 1



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6 Sheets-Sheet 2

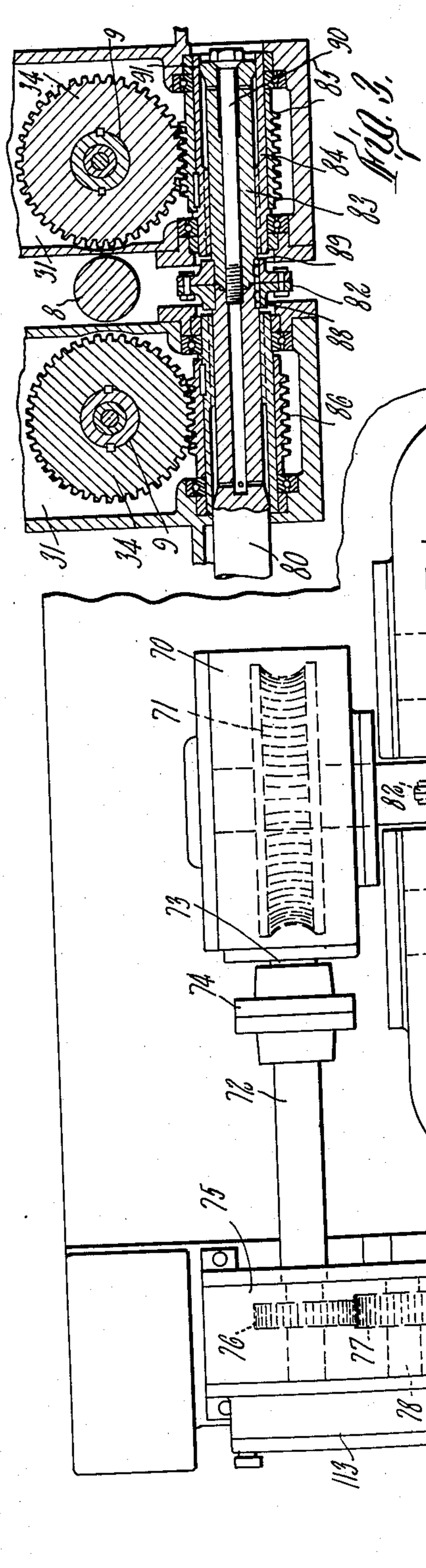

Fig. 2.

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THREAD ROLLING MACHINE

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6 Sheets-Sheet 3

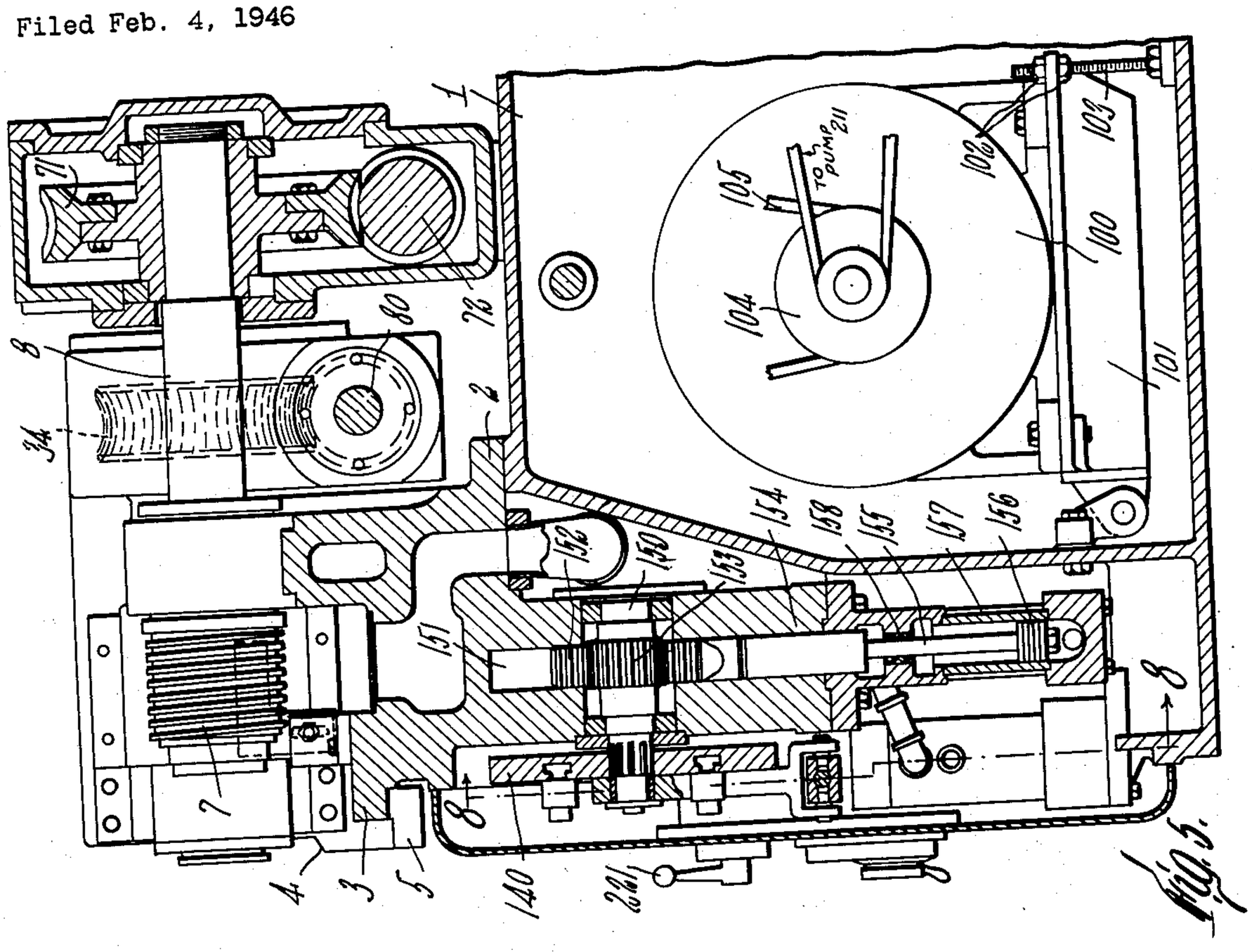

Fig. 5.

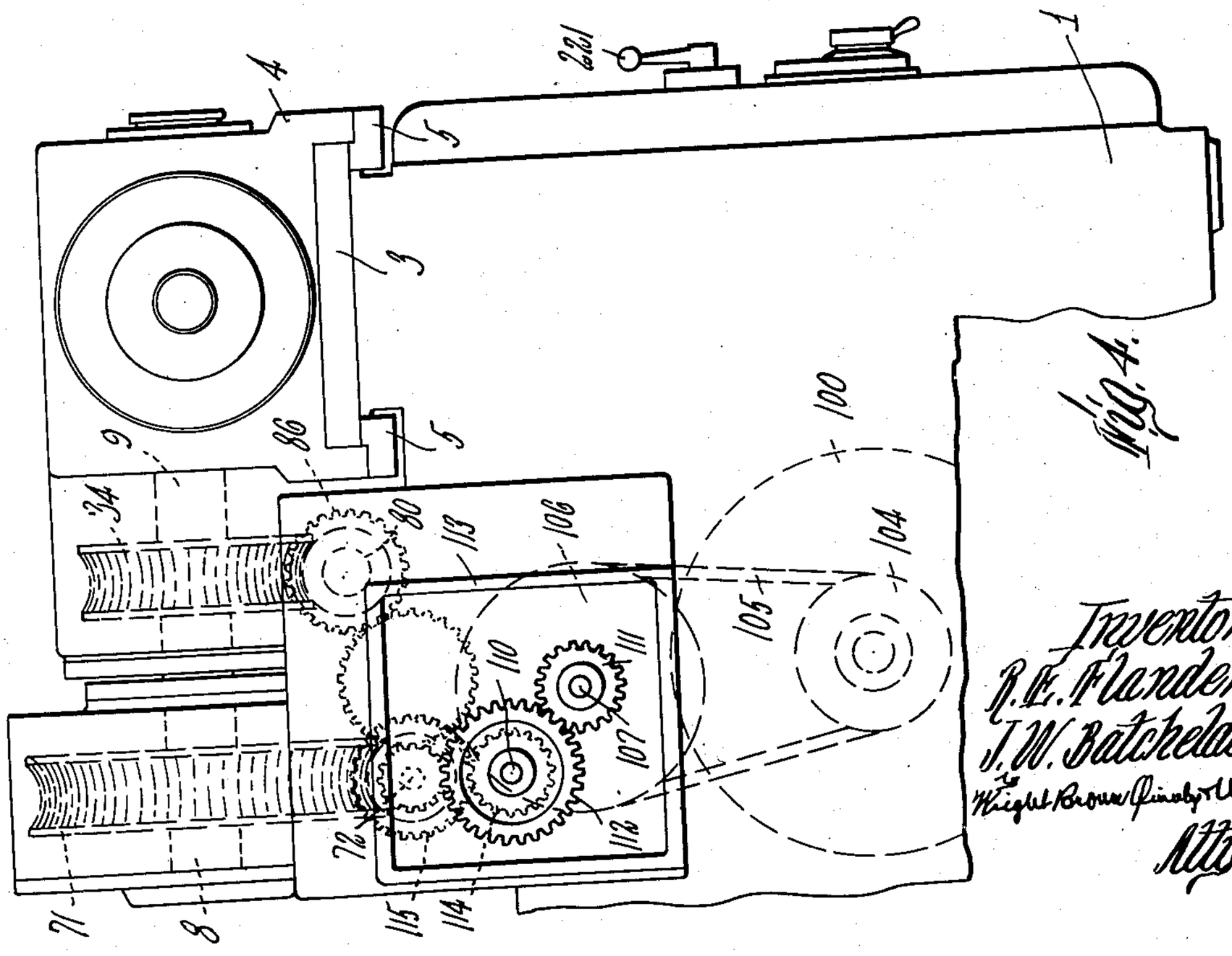

Fig. 4.

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THREAD ROLLING MACHINE

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6 Sheets-Sheet 4

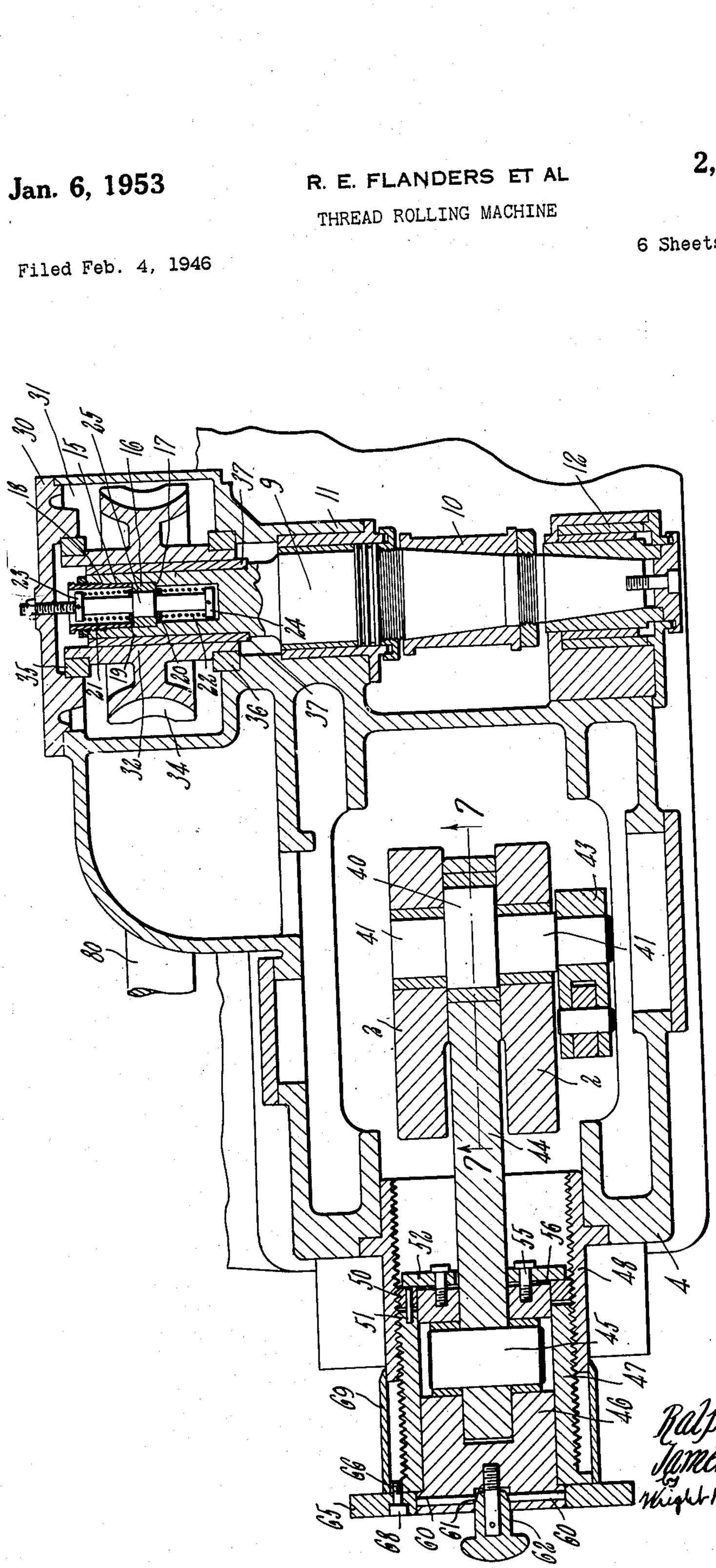

Fig. 6.

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THREAD ROLLING MACHINE

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6 Sheets-Sheet 5

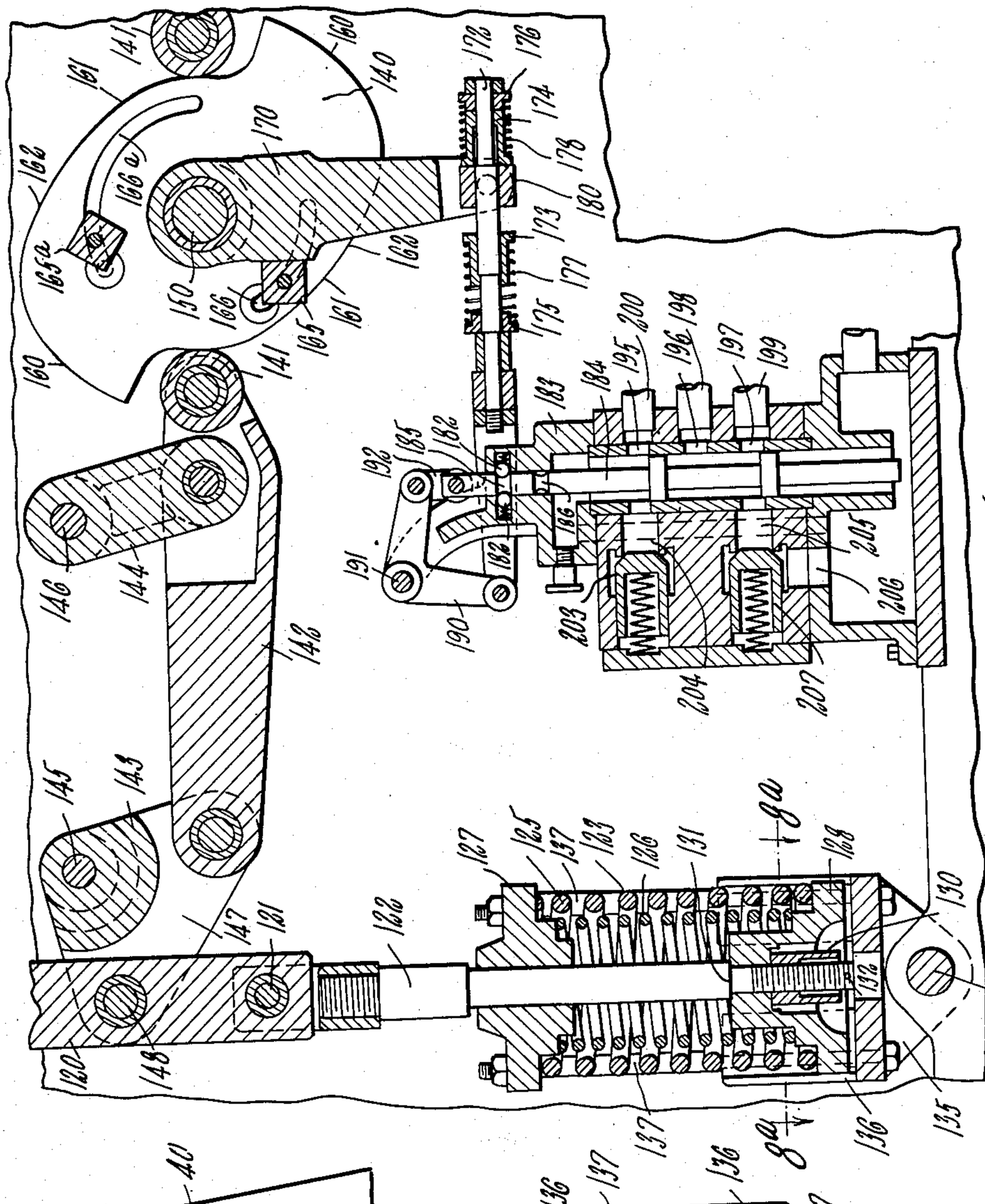

Fig. 8.

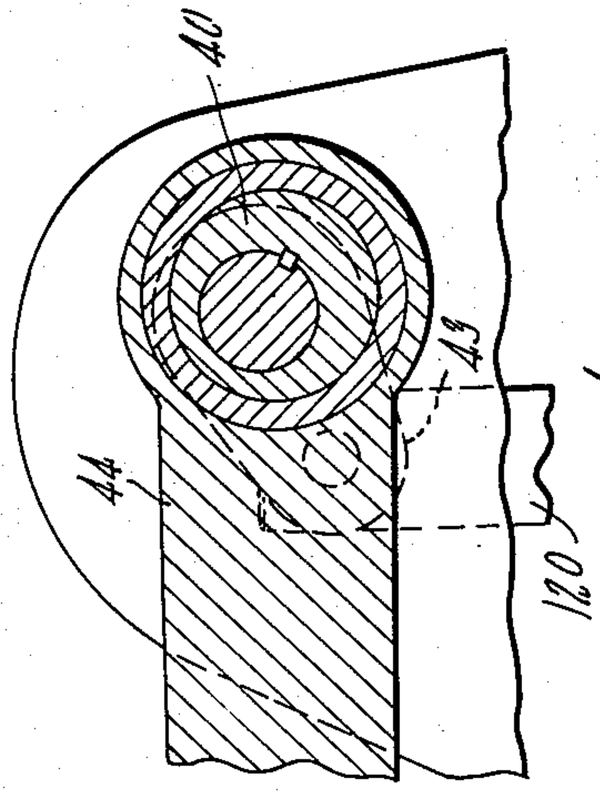

Fig. 7.

Fig. 8a

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6 Sheets-Sheet 6

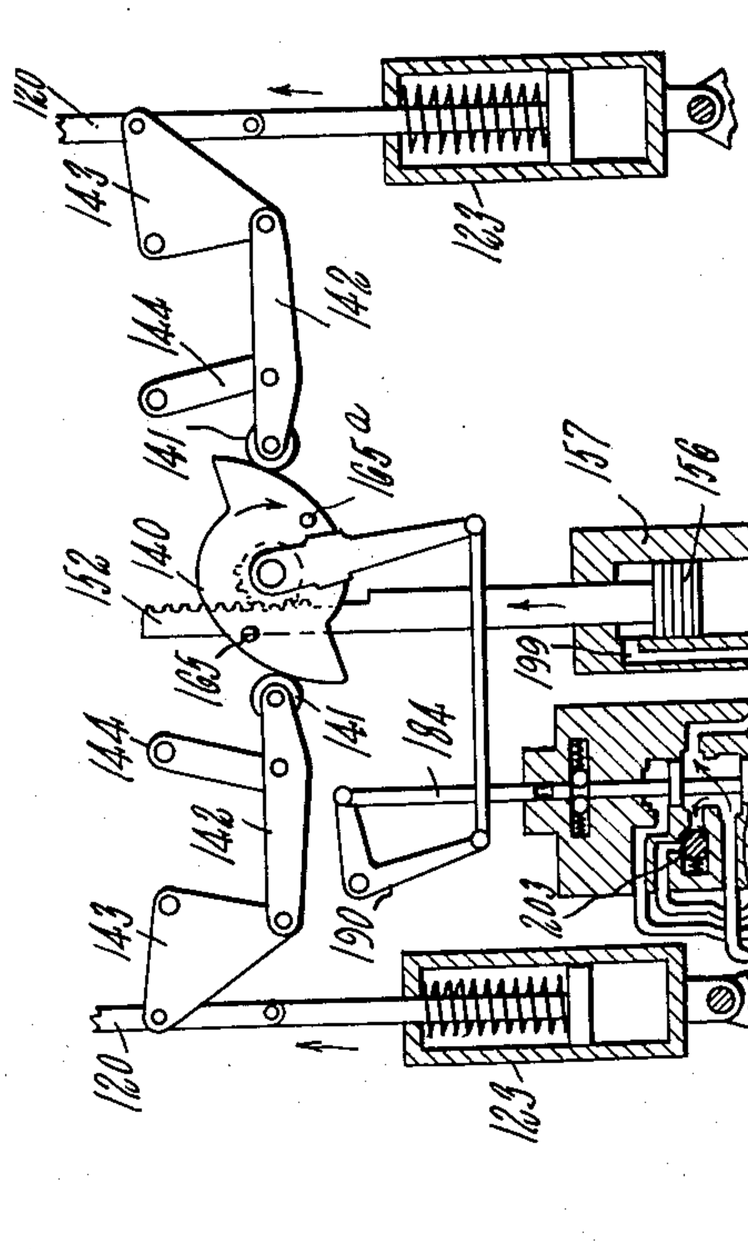

Fig. 10.

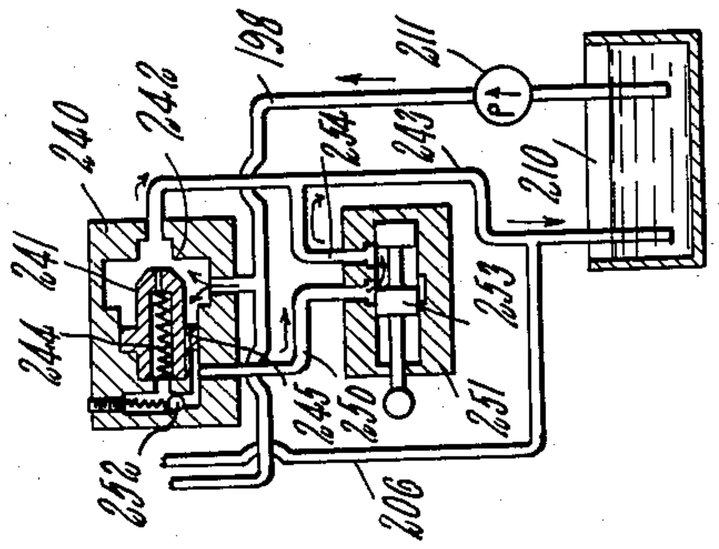

Fig. 11.

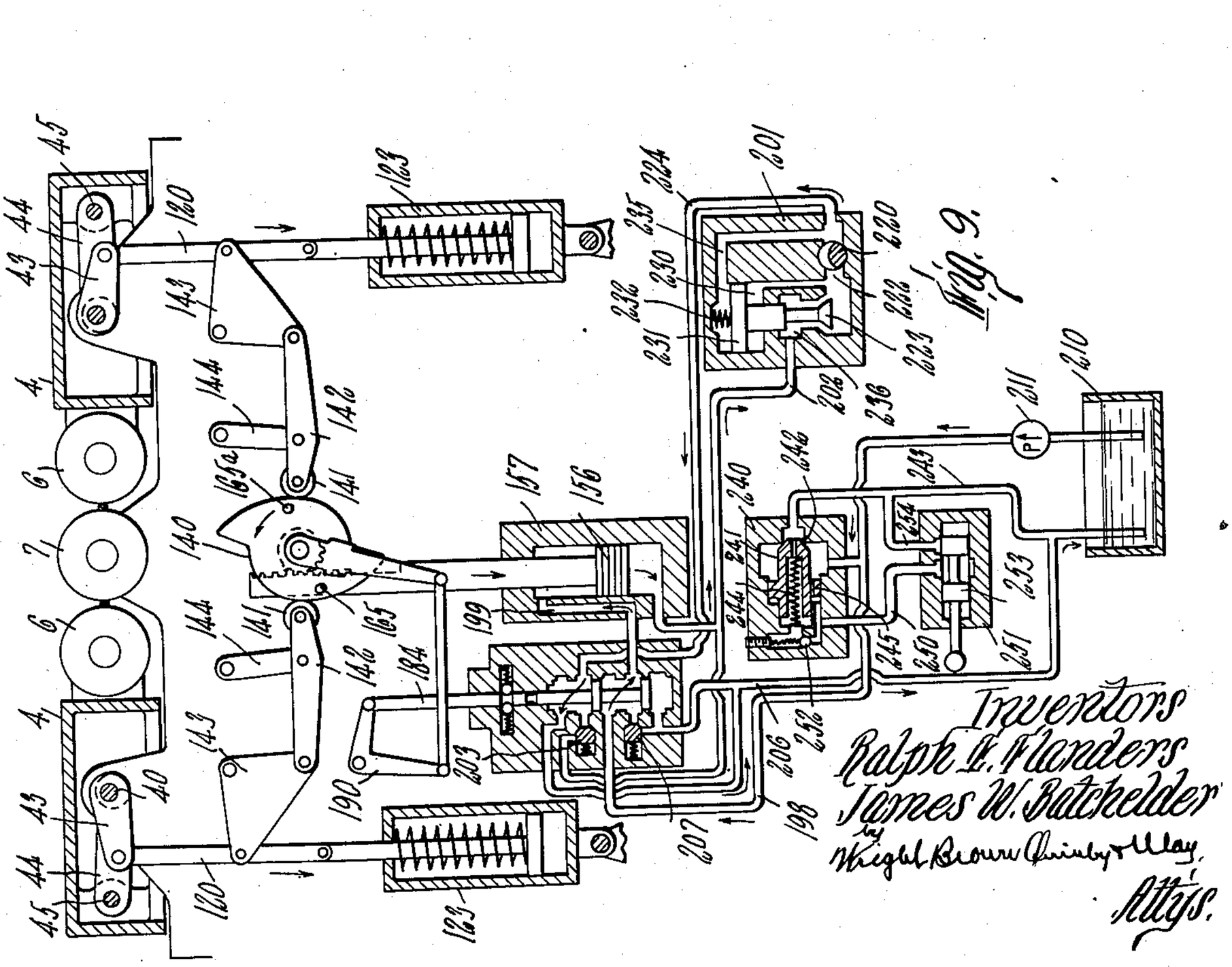

Fig. 9.

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2,624,218

UNITED STATES PATENT OFFICE

2,624,218

THREAD ROLLING MACHINE

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Application February 4, 1946, Serial No. 645,314

10 Claims. (Cl. 80—6)

1

This invention relates to machines for rolling threads, and more particularly to such machines which employ cylindrical dies.

One object of the present invention is to increase the capacity of the machine by utilizing opposing thread rolling penetrating forces to act simultaneously on more than one work blank during the rolling operation.

A further object is to positively control the rate of penetration of the dies into the work blanks over a wide range of adjustment.

A further object is to provide a mechanical over-load relief protection against over-stressing of the mechanism or of the dies due, for example, to occasional oversize blanks.

A still further object is the provision of a penetration energy storage system so arranged that the power required to cause the dies to penetrate the work is drawn from the motor or prime mover during the feeding interval of the cycle, at which time the motor would otherwise be substantially idle. The energy storage system is so arranged that the penetrating energy is delivered at a time when the motor is fully occupied in revolving the dies and acts to augment the penetrating power exerted by the rotation of the dies.

A further important object of the invention is to cause this energy storage means to release its energy to coincide approximately with the requirement that the penetrating force increases as the penetration progresses.

Another object of this invention is to utilize the mechanism for accomplishing the three last objects in a single mechanical system in order to simplify the mechanism and to increase its dependability in operation.

Still another object of the invention is to provide means which greatly facilitates the setting of the positions of the dies to any given diameter of work, such means being adjustable while the machine is in operation.

A further object is to provide for widely varying the frequency of the penetration strokes without stopping the machine, the adjustment for this purpose being independent of the speed of rotation of the dies.

Still another object is to combine the speed varying changes of hydro-mechanical systems with the inherent characteristics of toggle mechanism, the latter possessing the desirable characteristic of increased mechanical advantage as dead center is approached, which corresponds nicely with requirements of increased penetrating force with increased penetration depth.

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

Figure 1 is a front elevation partly broken away of a thread rolling machine embodying the invention.

Figure 2 is a top plan view of the same.

Figure 3 is a detail sectional view on line 3—3 of Figure 2.

Figure 4 is a left end elevation of the same partly broken away.

Figures 5 and 6 are sectional views on lines 5—5 and 6—6, respectively, of Figure 1.

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

Figure 8 is a detail sectional view on line 8—8 of Figure 5, the parts being shown near the end of a rolling operation.

Figure 8*a* is a detail sectional view on line 8*a*—8*a* of Figure 8.

Figure 9 is a diagrammatic view of the actuating mechanism turing the penetrating stroke.

Figures 10 and 11 are fragmentary diagrammatic views showing certain of the parts in die-withdrawing and machine-stopped positions, respectively.

Referring first to Figures 1 to 5, at 1 is indicated a bed, to the upper and front faces of which is secured a frame 2. Both ends of the frame at the top are provided with parallel ways or rails 3 upon which are mounted a pair of carriages or die heads 4. These carriages are held down to the rails with hold-down gibs 5 (see particularly Figure 4). The front gibs are adjustable to take up lost motion.

Each of the carriages or die heads 4 has journaled therein, transverse to its direction of motion, a shaft 9 (see Figure 2) supporting a cylindrical thread rolling die 6, and these dies 6 are arranged about the axis of a similar die 7 carried by a shaft 8 arranged parallel to the shafts 9 and situated between them. Each of the dies 6 may be carried on a conical adapter 10 of the type shown in the Batchelder application for Letters Patent Serial No. 557,350, filed October 5, 1944, and now abandoned, for Thread Rolling Die Construction. Each of the shafts 9 is journaled at its largest diameter portion in the bearing 11 and at its forward end in an outboard bearing 12 which engages the tapered forward end of the shaft 9.

The shafts 9 are permitted limited end play in order to permit automatic adjustment to correct minor inaccuracies in phasing between the central die 7 and the carriage-carried dies 6. To this

end the rear end of each of the shafts 9 is recessed at 15, and within the recess a bearing 16 is mounted, this bearing being seated against an annular shoulder 17 in the recess, and held there by a sleeve 18 threaded into the outer portion of the recess. The bearing member 17 has bearing against opposite end faces thereof, collars 19 and 20 against which springs 21 and 22 bear. These springs at their extreme ends bear against collars 23 and 24, pinned to a rod 25 which is adjustably secured as by being threaded into a cap 30 covering over the outer face of a chamber 31. Within the chamber 31 in bearings 35 and 36 is journaled the hub 32 of a worm wheel 34, this worm wheel being keyed to the shaft 9 as by the long key 37. Thus by rotation of the corresponding worm wheel the shaft 9 may be rotated while at the same time this shaft is permitted some end play, the springs 21 and 22 tending to center the shaft 9.

Suitable means are provided for forcing the carriages 4 toward and from each other, the forcing of the carriages toward each other acting to force the outer rotary dies 6 toward the intermediate die 7 and thread work pieces placed between these dies. The total amplitude of motion of each of the carriages 4 is on the order of a ¼ of an inch, and in order that the initial settings of the dies 6 with reference to the die 7 may be made in accordance with the size of the work piece and the size of the dies, the means for forcing the carriages toward and from each other are adjustably secured thereto.

The forcing means for each of the carriages 4 comprises an eccentric 40 having journal extensions 41 mounted in suitable bearings in the frame 2 and adapted to be rocked as by turning of a crank arm 43 connected to one of the journals 41. An eccentric rod 44 is journaled on each eccentric 40 and near its outer end it is provided with a journal portion 45 extending from opposite sides thereof. The journal portions 45 are journaled in a cylindrical block 46 which is surrounded by an externally threaded sleeve 47. This sleeve 47 is threaded into an outer sleeve 48 which is fixed to each carriage 4. By rotation of the inner sleeve 47, the block 46 may be adjusted axially relative to the sleeve 48 and the carriage 4, and thereby the limits of the path of motion of the carriage 4 may be adjusted as desired. In order to take up backlash between the sleeves 47 and 48, an externally threaded ring 50 may be engaged with the threads of the outer sleeve 48 and connected for rotation with the inner sleeve 47, as by suitable pins 51 which extend through the ring 50 and into the sleeve 47. A ring 52 around the eccentric rod 44 is secured to the inner end of each block 46 as by screws 55, shims 56 being interposed between the two. These shims are chosen of such thickness that the ring 52 may engage the threaded ring 50 when the threaded ring 50 is in such angular position that it takes up the slack between the threads of the sleeve 48 and the sleeve 47 and the ring 50. By this means lost motion between the sleeves 47 and 48 may be taken up, while the relative adjustment axially between these sleeves determines the inner and outer limits of motion of the corresponding carriage 4 when it is reciprocated by the rocking of the eccentric 40.

The adjustment between the sleeves 47 and 48 may be fixed when desired, means for doing so comprising oppositely disposed radially arranged locking pins 60 extending through radial openings in the block 46, the inner ends of the rod 60 bearing against the inclined face 61 of a screw

plug 62 threaded into the outer end of the block 46. By tightening this screw 62, the inclined faces 61 riding against the inner ends of the rod 60 force these rods outwardly with their outer ends into tight engagement with a ring 65 secured to an outwardly directed flange 66 on the sleeve 47, as by screws 68. A tubular shield 69 overlies the inner sleeve 47 and overlaps the sleeve 48 and may have graduations thereon which may be brought into registry with a datum line marked on the outer sleeve 48, as shown best in Figure 1. This means provides a micrometer adjustment for the end positions of the carriages so that accurate adjustment of thread sizes on the work is readily accomplished.

Means are provided for rotating the dies to thread the work. As shown best in Figure 2, the central die carrying shaft 8 is provided within a housing 70 with a worm wheel 71 secured thereto and a drive shaft 72 is connected as by a coupling 74 to a worm shaft 73 having a worm meshing with the worm wheel 71. The outer end of the drive shaft 72 extends into a gear box 75 and carries a gear 76 meshing with a gear 77 on a stub shaft 78 in the gear box, this shaft 77 also meshing with a gear 79 on a drive shaft 80 positioned forwardly of the drive shaft 72 and having connections for driving the die shafts 9. Such connections are shown in Figure 3. The shaft 80 is connected through a coupling 82 with a second hollow shaft 83, the coupling 82 permitting the angular relationships between the shafts 80 and 83 to be adjusted. Shaft 83 is slidably keyed to a sleeve 84 to which is keyed a worm gear 85. The sleeve 84 is journaled in the wall of the chamber 31 which houses the worm wheel 34 with which the worm gear 85 meshes. Similarly the end portion of the shaft 80 is connected to drive a worm 86 journaled in the frame portion of the other chamber 31 where it meshes with the other worm wheel 34. The coupling 82 is held between shoulders 88 and 89 of the shafts 80 and 83 as by a bolt 90 extending loosely through a central perforation 91 in the shaft portion 83 and threaded into the shaft 80, suitable clearance being provided around the bolt for the passage of lubricant extending to the keyed connections, the head of the bolt 90 closing off the outer end of the shaft 83. This arrangement provides for rotation of all of the dies while permitting the dies 6 to be moved from and toward the central die by the sliding motion of the carriages.

The dies are rotated and the entire machine is driven by a motor 100 supported on the hinge table 101 which is adjustable as by manipulation of the nuts 102 on anchor bolts 103. The motor 100 is provided with a belt pulley 104 about which a belt 105 passes, this belt also engaging over a pulley 106 carried by the shaft 107. This shaft 107 and a shaft 110 have change gears 111 and 112 thereon in a change gear box 113 which forms an extension of the gear box 75, and a gear 114 on the shaft 110 meshes with a gear 115 on the shaft 72.

The carriages 4 are moved from and toward each other and relative to the intermediate die by rocking of the eccentrics 40 as previously described. As they approach die closed position their centers approach alinement with lines connecting the axes of their bearings in the rods 44 and the rod pivots 45 as a toggle, thus exerting increasing pressure as the dies penetrate the work. The mechanism for so rocking these eccentrics is shown particularly in Figures 7, 8, 9

and 10. The eccentrics 40 are rocked by the rocking of the arms 43, these arms being pivoted to the upper ends of links 120. The lower end of each link 120 is pivoted at 121 to the upper end of a plunger 122 which is connected to a spring loading device indicated generally at 123, and the lower end of which is anchored by being pivotally secured as at 124 to the frame. This spring device may be constructed as shown in Figures 8 and 8a. As there shown, a pair of concentric coil springs 125 and 126 are located between top and bottom cap plates 127 and 128 having annular shoulders against which the ends of the springs bear. The plunger 122 extends slidably through the cap plate 127 and also extends through the cap plate 128 beneath which it has threaded thereon a long nut 130 which holds the cap plate 128 against an annular shoulder 131 of the plunger 122. A cotter pin 132 extending through a hole through the plunger 122 beneath the nut 130 may be employed to hold the nut 130 in position. The pivot 124 passes through an anchor member 135 having upstanding posts 136 connected by bolts 137 with the top cap plate 127. The cap plate 127 and the anchor member 135, together with the bolts 137, act as a cage within which the springs 125 and 126 are positioned.

This spring mechanism constitutes an energy storage system which provides all the power for moving the corresponding carriage toward the central die and is tensioned by the motor when the motor is only lightly otherwise loaded when the carriage is moved to open position. It thus provides a mechanical overload relief protection against over-stressing of the mechanism or of the dies. Means for so tensioning the spring devices comprises a central cam 140 with which cooperates a pair of followers 141 at the inner ends of a pair of links 142. Each of the links 142 is pivotally suspended on the links 143 and 144 which are fulcrumed at 145 and 146, respectively, to the machine frame. The link 143 has a lateral extension 147 which is pivoted at 148 to the link 120. The parts are so related that as the links 142 are pushed away from the axis of the cam 140, both of the links 120 are lifted, causing the plungers 122 to be lifted and load the spring devices, and at the same time the arms 43 are rocked in a direction to retract the carriages from the central die. The cam 140 is secured to an actuating shaft 150 (see Figure 5) journaled in the frame 2, this frame being recessed at 151 for the reception of a rack bar 152 which engages a pinion 153 fixed to or integral with the shaft 150. This rack bar extends downwardly through suitable bearings 154 of the frame 2 and its lower portion is secured to or formed integral with a piston rod 155 carrying a piston 156 axially movable within a hydraulic cylinder 157. At the upper end of the cylinder 157, the piston rod 155 passes through a stuffing box 158.

The cam 140 is provided with a pair of concentric large diameter portions 160, a pair of small diameter concentric portions 161, and inclined connecting portions 162 between the large and small diameter concentric portions. When the cam follower rolls 141 are riding on the small diameter concentric portions, as shown in Figure 8, no motion of the links 142 occurs as the cam swings, and the carriages are then in their advanced positions. As the cam followers 141 ride upon the inclined cam portions 162, the links 142 are forced outwardly and the spring mechanisms are loaded and the carriages are moved outwardly. When the followers 141 are riding upon the large diameter concentric portions 160, the spring mechanisms are held loaded and the carriages are stationary in their retracted positions.

The length of time during which the carriages are held retracted and advanced is determined by stops 165 and 165a adjustable in arcuate slots 166 and 166a in the cam 140, these stops limiting the extent of rocking of the cam by impingement against opposite sides of a valve actuating arm 170 journaled on the shaft 150 and depending therefrom and which acts to reverse the direction of rocking of the cam as will later appear. Engagement of the stops on one or the other side of the arm 170 acts to swing the arm 170 in one or the other direction and acts to move a reversing valve actuating rod 172 through a load and fire mechanism. The load and fire mechanism comprises a pair of sleeves 173 and 174 slidable on the rod 172 between a pair of collars 175 and 176 secured thereto, the sleeves 173 and 174 being normally and yieldingly held spaced from their respective collars by coil springs 177 and 178. The arm 170 at its lower end engages a block 180 slidable on the rod 172 between the sleeves 173 and 174, and as this collar 180 impinges on one or the other of the sleeves 173 or 174 and moves it laterally along the rod 172, it compresses the corresponding spring 177 or 178 and then engages and moves the corresponding collar 175 or 176 and the rod 172, overcoming the latching effect of a pair of spring pressed balls 182 arranged in sockets in the upper end of a valve casing 183 and engaging a valve stem 184 provided with a pair of spaced annular grooves 185 and 186 within which the balls 182 may engage. As soon as the balls 182 release the stem 184, the compressed spring 177 or 178 snaps the stem 184 to the other latched position which reverses the valve as will be described. The valve stem 184 is connected to the actuating rod 172 through a bell crank lever 190 fulcrumed at a fixed point 191, one arm of the bell crank lever being connected to the rod 172 and the other connected through a link 192 to the valve rod 184. The valve rod 184 rides within the valve casing 183, which is provided with three lengthwise arranged ports 195, 196 and 197. The valve port 196 connects to a source of fluid pressure through a pipe 198. The valve port 197 leads through a pipe 199 to the top of the hydraulic cylinder 157 above the piston 156. The upper port 195 leads through a pipe 200 to a valve casing 201 from which extends a pipe 202 to the lower end of the cylinder 157 beneath the piston 156. A pair of check valves 203 and 207 normally close ports 204 and 205, respectively, opposite to the ports 195 and 197, the latter of these ports 205 leading to a discharge passage 206. Fluid under pressure is taken from the supply tank 210 shown diagrammatically in Figures 9 and 11 by a pump 211, which may be coupled to the shaft of the motor 100, and forced into the pipe 198. The discharge pipe 206 leads to the tank 210.

Assuming that the work pieces have been rolled and the stop 165 shown in Figure 8 contacts the arm 170 and turns it counterclockwise, this compresses the right hand spring 178. When positive contact is established between the sleeve 174 and the collar 176, the rod 172 is pulled to the right and through the bell crank lever 190 the valve rod 184 is pulled upwardly from the position shown in Figures 8 and 9 to the position of Figure 10. In this position of the parts the valve spool 215 blocks the fluid flow from the

pressure pipe 198 to the port 197 and opens pressure to the upper check valve 203 which allows the fluid to pass through the pipe 202 and beneath the piston 156. This causes the piston to rise, revolving the cam 140 in clockwise direction which spreads the cam followers 141 apart, compresses the spring mechanisms, and opens the die heads. These die heads are opened a distance sufficient for the removal of the finished work piece and remain in that position a sufficient time for the succeeding work piece to be positioned between the dies and onto the vertically adjustable stock support 163 while the cam followers are riding upon the large diameter concentric portions 160 of the cam 140.

After the cam has been revolved in this clockwise direction for a sufficient time, the other stop 165*a* engages the right hand side of the shift lever 170, depressing the left hand load and fire spring 177. When this has been fully compressed and the valve stem starts to be moved positively, the spring 177 throws it to its opposite position shown in Figure 9. This causes the pressure line 198 to be opened through the pipe 199 to the upper end of the cylinder 157 which causes the piston to descend and revolves the cam 140 in counterclockwise direction. Besides the fluid flowing to the top of the cylinder, it also escapes past the check valve 207 to the reservoir.

The speed of descent of the piston and consequent rate of penetration of the work by the dies is controlled by regulating the rate of discharge from beneath the piston 156 which passes through the pipe 202 into the adjustable flow control valve casing 201. This casing 201 is provided with a throttle valve 220 which may be adjusted by manipulating a handle 221 on the front panel of the machine. This valve may be caused to more or less throttle a passage 222 leading from beneath the valve 223 to the line 224. This line 224 leads to the main valve casing, and in the position of the parts shown in Figure 9, it opens above the spool valve 215 and discharges into the passage and pipe 224 which leads back into the discharge pipe 206. Between the throttle valve 222 and the valve 223, a passage 230 extends beneath the piston 231 which is connected to operate the valve 223. Above the piston 231 a light spring 232 is positioned, this tending to open the valve 223. Above the piston 230 is a passage 235 leading to a point beyond the throttle valve 220. As the throttle valve 220 is more or less closed, it increases the back pressure between this valve and the valve 223 which acts to lift the piston 231, reaching it through the passage 230 and through the valve passage 236. This more or less throttles the port controlled by the valve 223 and thus determines the rate of flow to the discharge.

Means are provided for limiting the pressure of the fluid delivered by the pump to the hydraulic mechanism, and this means may also be utilized to stop the operation of the machine when desired. Referring to Figures 9 and 11, the pressure pipe 198 opens into a pressure relief valve casing 240. A valve 241 in this casing is spring pressed toward a seat 242 leading to the discharge pipe 243 back to the supply tank 210. The valve 241 is spring pressed to closed position as by the spring 244 and a bleeder passage 245 extends through this valve to its back face where it communicates through a pipe and passage 250 leading to a dump valve casing 251. The pressure may be built up through this passage 245 and past a check valve 252 back of the valve 241, this aiding the spring 244 in holding the valve

closed. Should the pressure on the right hand face of the valve 241 exceed a predetermined amount, this valve will be pressed to the left, opening the valve to the discharge pipe 243 so long as the pressure is above that for which the valve is set. However, by reducing the pressure on the left hand face of the valve through dump valve 251, the valve 241 may be opened and pressure released from the pipe 198. This dump valve, as shown in Figures 9 and 11, is a reciprocating spool valve 253 which in the position shown in Figure 9, obstructs passage from the pipe 250 to a pipe 254 leading to the discharge pipe 243, but by moving this valve 253 to the right into the position shown in Figure 11, the pipes 250 and 254 are placed in communication so that the pressure control valve 241 is opened and the hydraulic mechanism is rendered inoperative to actuate the piston 156.

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 this invention.

We claim:

1. A thread rolling machine including a bed, a pair of carriages movable from and toward each other on said bed, a rotatable thread rolling die journaled for rotation on each carriage transverse to their lines of motion, a rotatable thread rolling die mounted on said bed between said carriage mounted dies and cooperating with each of said carriage mounted dies to roll threads in work pieces placed therebetween, means connecting said dies for rotation in phased relation including means for adjusting such phasing, means for moving each of said carriages toward and from each other, actuating means for said moving means including springs for actuating said moving means to move said carriages toward each other, and a rocking cam and a pair of followers on opposite sides of said cam for actuating said moving means to separate said carriages and for loading said springs, said cam having for cooperation with each follower a pair of concentric portions of different diameters and an inclined portion joining said concentric portions, means for rotating said dies including a prime mover for rocking said cam in opposite directions, and means for adjustably determining the limits of rocking motion of said cam.

2. A thread rolling machine including a bed, a pair of carriages movable from and toward each other on said bed, a rotatable thread rolling die journaled for rotation on each carriage transverse to their lines of motion, a rotatable thread rolling die mounted on said bed between said carriage mounted dies and cooperating with each of said carriage mounted dies to roll threads in work pieces placed therebetween, means connecting said dies for rotation in phased relation including means for adjusting such phasing, means for moving each of said carriages toward and from each other, actuating means for said moving means including springs for actuating said moving means to move said carriages toward each other, and a rocking cam and a pair of followers for actuating said moving means to separate said carriages and on opposite sides of said cam for loading said springs, said cam having for cooperation with each follower a pair of concentric portions of different diameters and an inclined portion joining said concentric portions, means for rotating said dies including a prime mover for rocking said cam in opposite

directions, and means for adjustably determining the limits of rocking motion of said cam and means for controlling the speed of rocking of said cam to thereby adjust the duration of die-closed and die-opened conditions.

3. A thread rolling machine including a pair of cooperating thread rolling dies, means for moving one of said dies toward and from the other comprising a rock shaft having an eccentric portion, a follower for said eccentric portion operatively connected to said movable die, the eccentricity of said portion being so angularly arranged as to approach dead center position with respect to said follower when said movable die is nearest to the other of said dies, a crank for rocking said shaft, a link engaging said crank and movable substantially lengthwise, said crank being substantially perpendicular to said link when said eccentric is near to said dead center position, a spring bearing at one end on the opposite end of said link, means anchoring the opposite end of said spring, and means engaging said link between said spring and crank and actuable to move said link axially, motion of said link in direction to store energy in said spring acting to rock said eccentric in direction to move said movable die away from the other of said dies.

4. A thread rolling machine including a pair of cooperating thread rolling dies, means for moving one of said dies toward and from the other comprising a rock shaft having an eccentric portion, a follower for said eccentric portion operatively connected to said movable die, the eccentricity of said portion being so angularly arranged as to approach dead center position with respect to said follower when said movable die is nearest to the other of said dies, a crank for rocking said shaft, a link engaging said crank and movable substantially lengthwise, said crank being substantially perpendicular to said link when said eccentric is near to said dead center position, a spring bearing on the opposite end of said link, and means engaging said link between said spring and crank actuable to move said link axially in direction to store energy in said spring and to move said movable die away from the other of said dies, said engaging means being actuated to free said spring to move said link in the reverse direction and close said moving die toward the other of said dies.

5. A thread rolling machine including a pair of cooperating thread rolling dies, means for moving one of said dies toward and from the other comprising a rock shaft having an eccentric portion operatively connected to said movable die, the eccentricity of said portion being so angularly arranged as to approach dead center position with respect to said follower when said movable die is nearest to the other of said dies, a crank for rocking said shaft, a link engaging said crank and movable substantially lengthwise, said crank being substantially perpendicular to said link when said eccentric is near to said dead center position, a spring bearing on the opposite end of said link, and means engaging said link between said spring and crank actuable to move said link axially in direction to store energy in said spring and to move said movable die away from the other of said dies, said engaging means being actuated to free said spring to move said link in the reverse direction and close said moving die toward the other of said dies, mechanism for actuating said engaging means, a rock cam having a pair of concentric portions and an interposed inclined portion for actuating said mechanism, and means for rocking said rock cam alternately in opposite directions.

6. A thread rolling machine comprising a pair of rotary cylindrical thread rolling dies cooperating to roll threads in a work piece placed therebetween, means to rotate said dies in phased relation, moving mechanism including spring means moving one of said dies toward the other die to cause said dies to penetrate the work and including cam means actuable to move said one die away from the other die to permit the insertion of said work blank and to retract and store energy in said spring means, and common means for actuating said rotating means and said moving mechanism.

7. A thread rolling machine comprising a pair of rotary cylindrical thread rolling dies cooperating to roll threads in a work piece placed therebetween, means supporting one of said dies for motion toward and from the other of said dies, spring means, operative connections between said movable die and said spring means causing said spring means to press said movable die toward the other of said dies, and power means connected to said connections and actuable to move said movable die away from said other die and simultaneously to store energy in said spring means and operatively connected to said dies to rotate said dies.

8. A thread rolling machine, comprising a pair of cylindrical thread rolling dies cooperating to roll threads in a work piece placed therebetween, reciprocating means connected to said dies for moving said dies toward each other upon forward reciprocation to cause said dies to penetrate the work piece and upon backward reciprocation enabling said dies to move from each other to relieve the work piece from said dies and to condition said dies for the next thread rolling operation, power means for rotating said dies and for causing backward reciprocation of said reciprocating means and dies, and means actuated by said backward reciprocation of said reciprocating means for storing energy and for releasing said energy to cause the forward reciprocation of said reciprocating means and said dies, whereby said power means acts to rotate said dies under the heavy load during the thread rolling operation while the die penetrating power is augmented by said energy storing means and acts to store energy in said storing means when rotating said dies under relatively lighter load between thread rolling operations.

9. A thread rolling machine, comprising a pair of cylindrical thread rolling dies cooperating to roll threads in a work piece placed therebetween, reciprocating means connected to said dies for moving said dies toward each other upon forward reciprocation to cause said dies to penetrate the work piece and upon backward reciprocation enabling said dies to move from each other to relieve the work piece from said dies and to condition said dies for the next thread rolling operation, power means for rotating said dies and for causing backward reciprocation of said reciprocating means and dies, and means actuated by said backward reciprocation of said reciprocating means for storing energy and for releasing said energy to cause the forward reciprocation of said reciprocating means and said dies, whereby said power means acts to rotate said dies under the heavy load during the thread rolling operation

while the die penetrating power is augmented by said energy storing means and acts to store energy in said storing means when rotating said dies under relatively lighter load between thread rolling operations, said energy storing means including a spring that is compressed during said backward reciprocation of said reciprocating means.

10. A thread rolling machine including a pair of cooperating thread rolling dies, means for moving one of said dies toward and from the other comprising a rock shaft having an eccentric portion, a follower for said eccentric portion operatively connected to said movable die, the eccentricity of said portion being so angularly arranged as to approach dead center position with respect to said follower when said movable die is nearest to the other of said dies, a crank for rocking said shaft, a link engaging said crank and movable substantially lengthwise, said crank being substantially perpendicular to said link when said eccentric is near to said dead center position, a spring bearing on the opposition end

of said link, and means engaging said link between said spring and crank actuable to move said link axially in direction to store energy in said spring and simultaneously to move said movable die away from the other of said dies.

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