E. R. SEWARD.

METAL WORKING MACHINE.

APPLICATION FILED AUG. 27, 1904.

927,432.

Patented July 6, 1909.

7 SHEETS—SHEET 1.

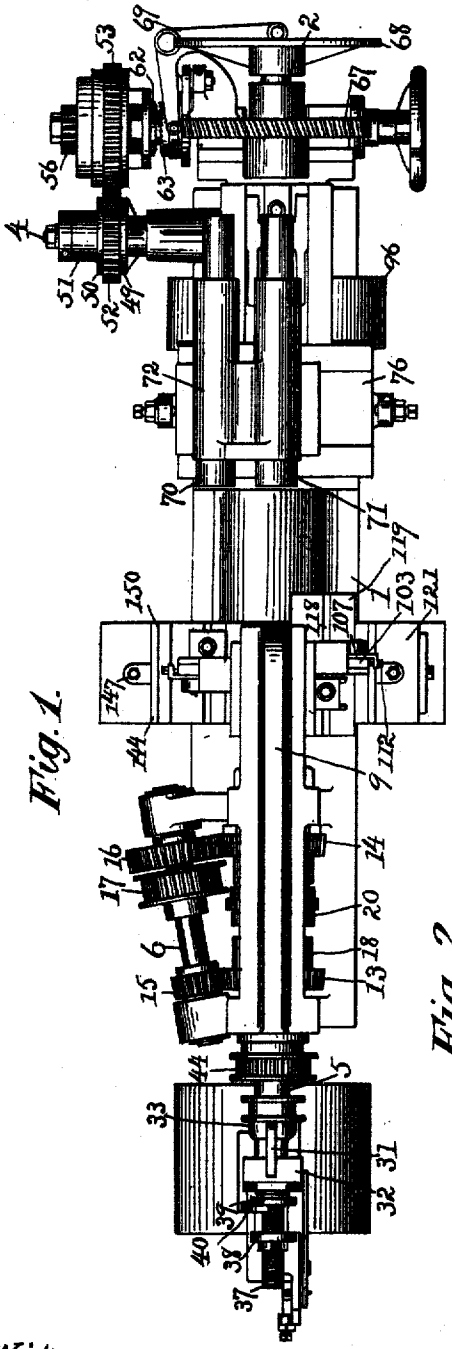

Fig. 1.

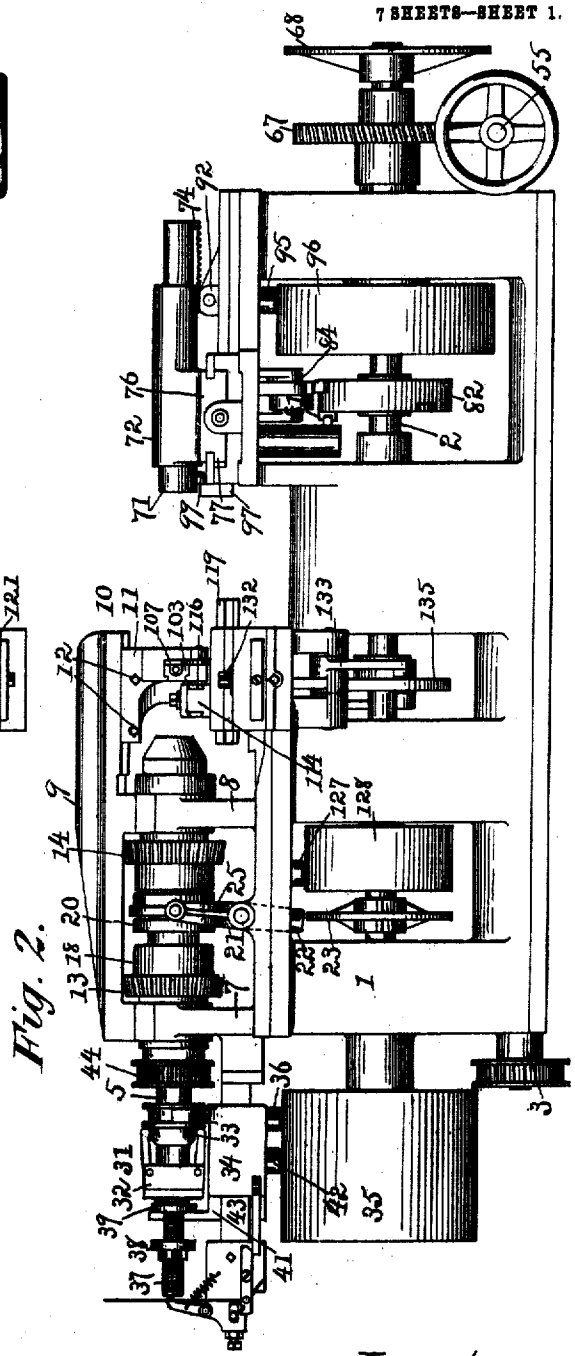

Fig. 2.

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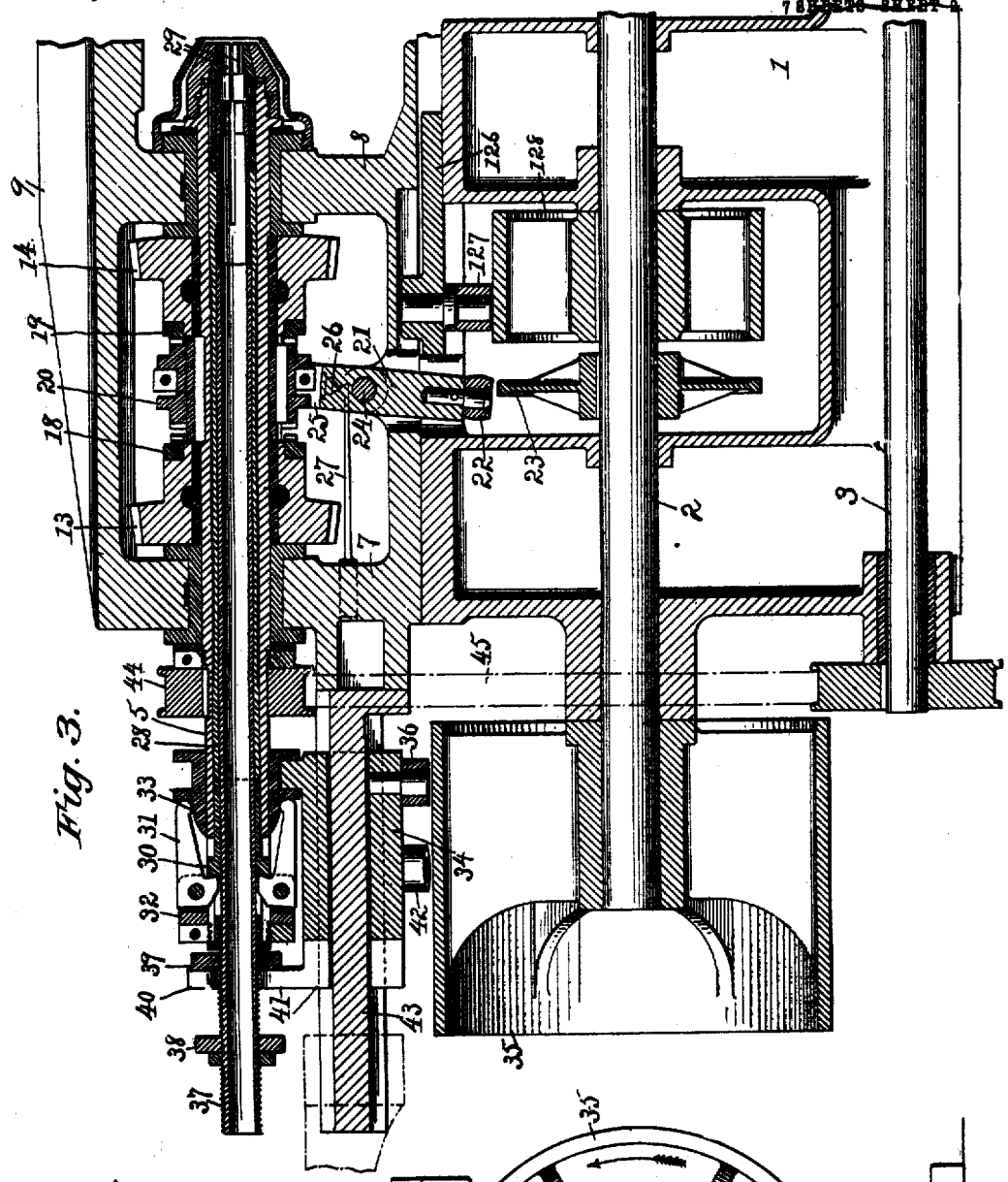

Fig. 3.

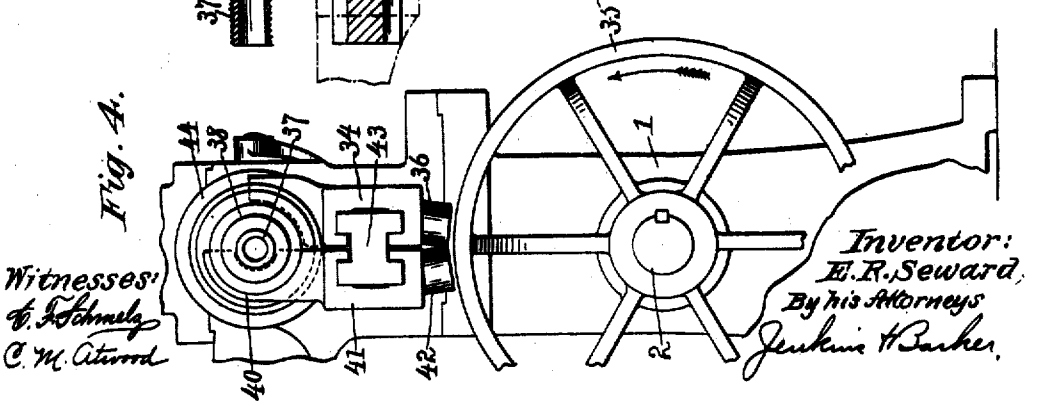

Fig. 4.

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7 SHEETS—SHEET 3.

Fig. 7.

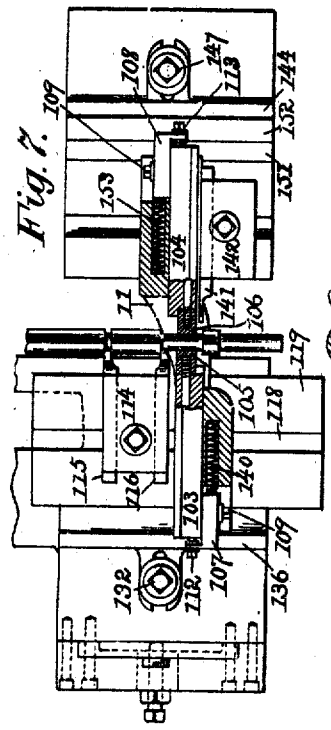


Fig. 6.

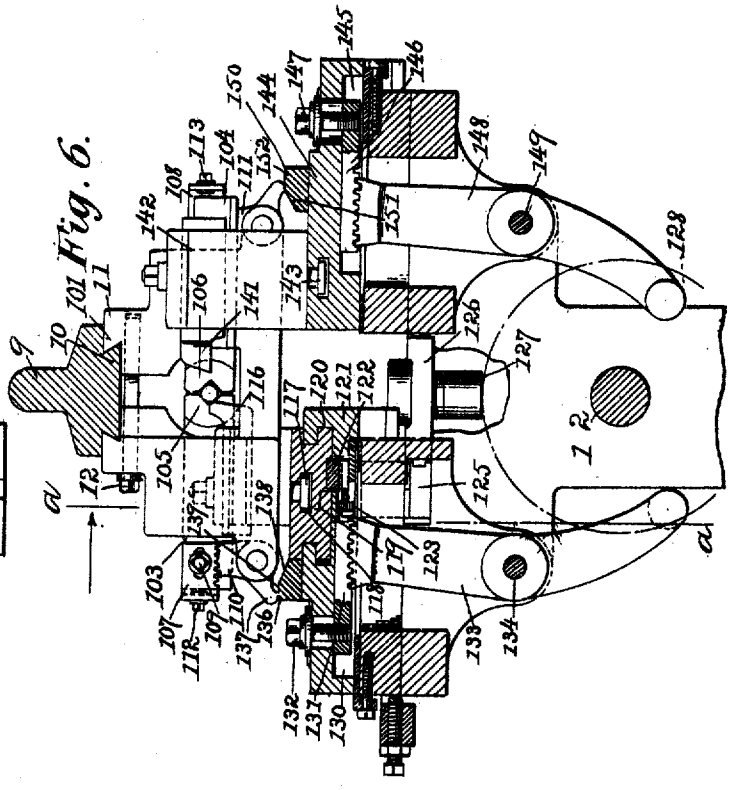
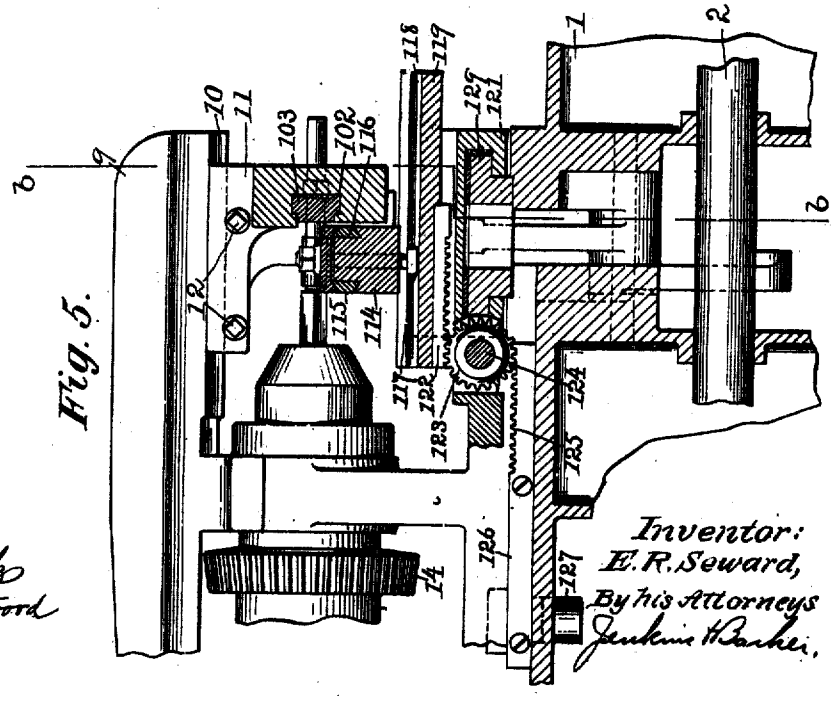


Fig. 5.



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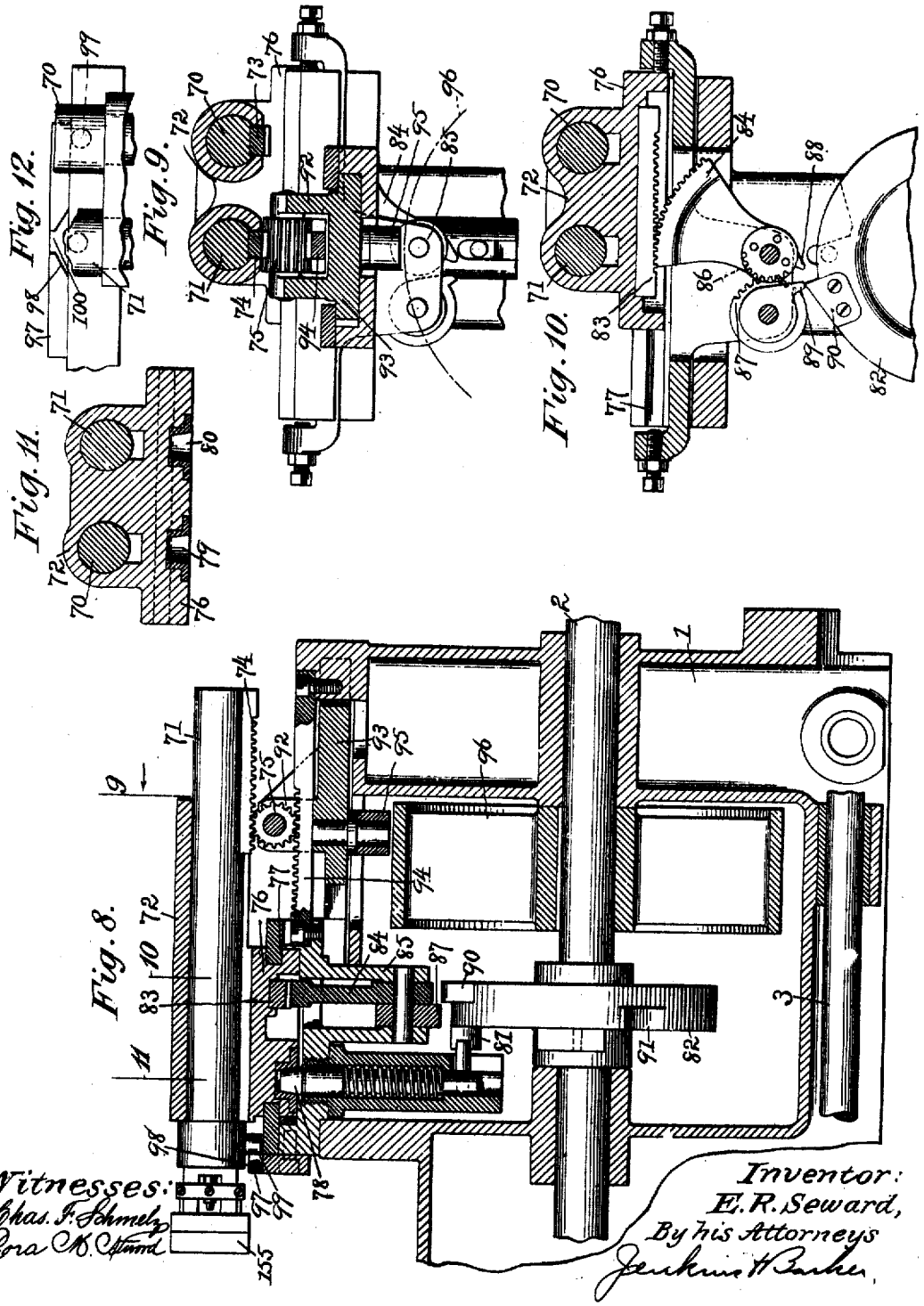

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7 SHEETS—SHEET 5.

Fig. 15.

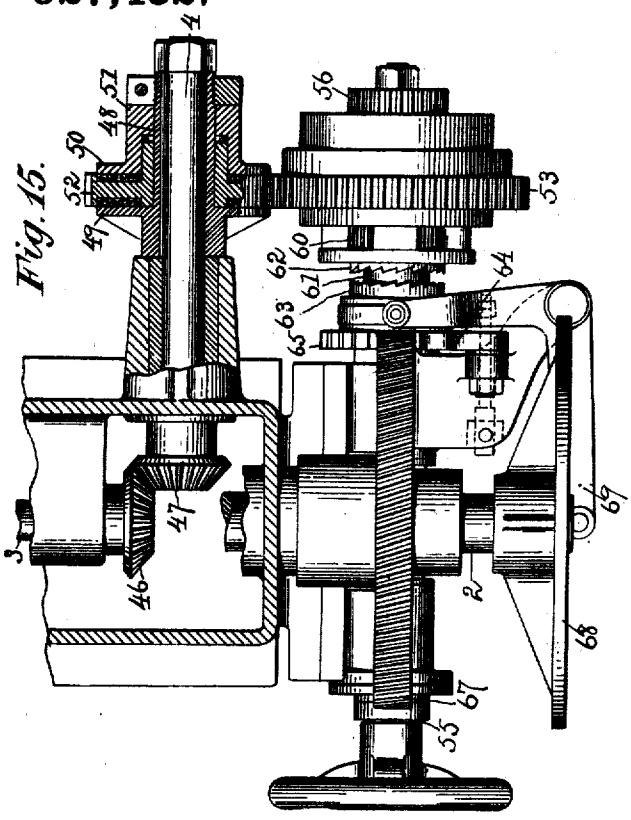


Fig. 14.

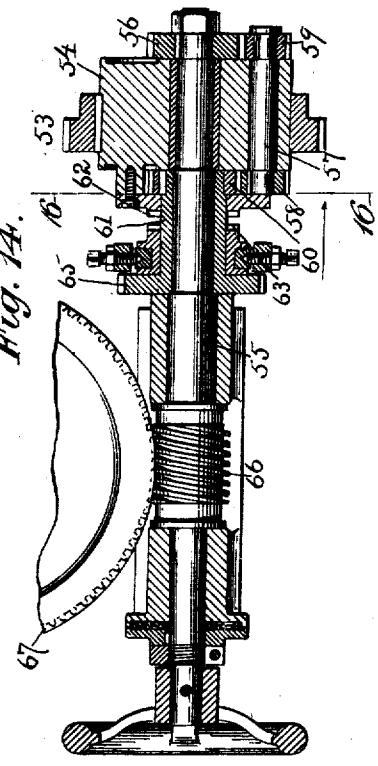


Fig. 16.

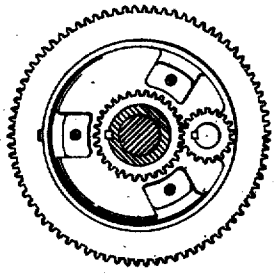
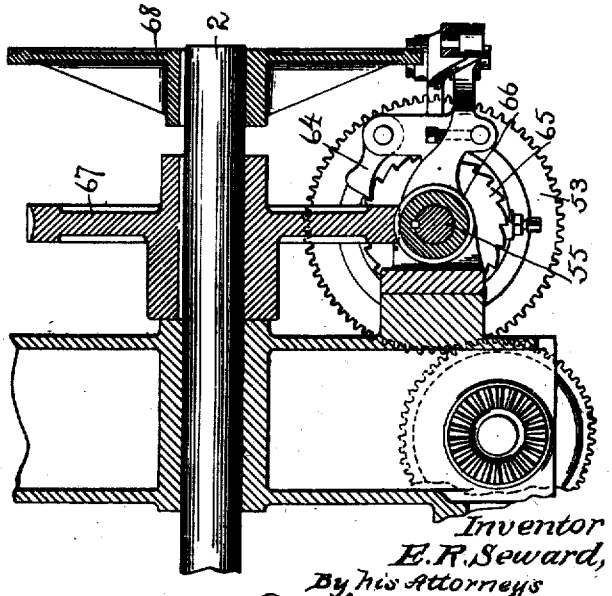


Fig. 13.



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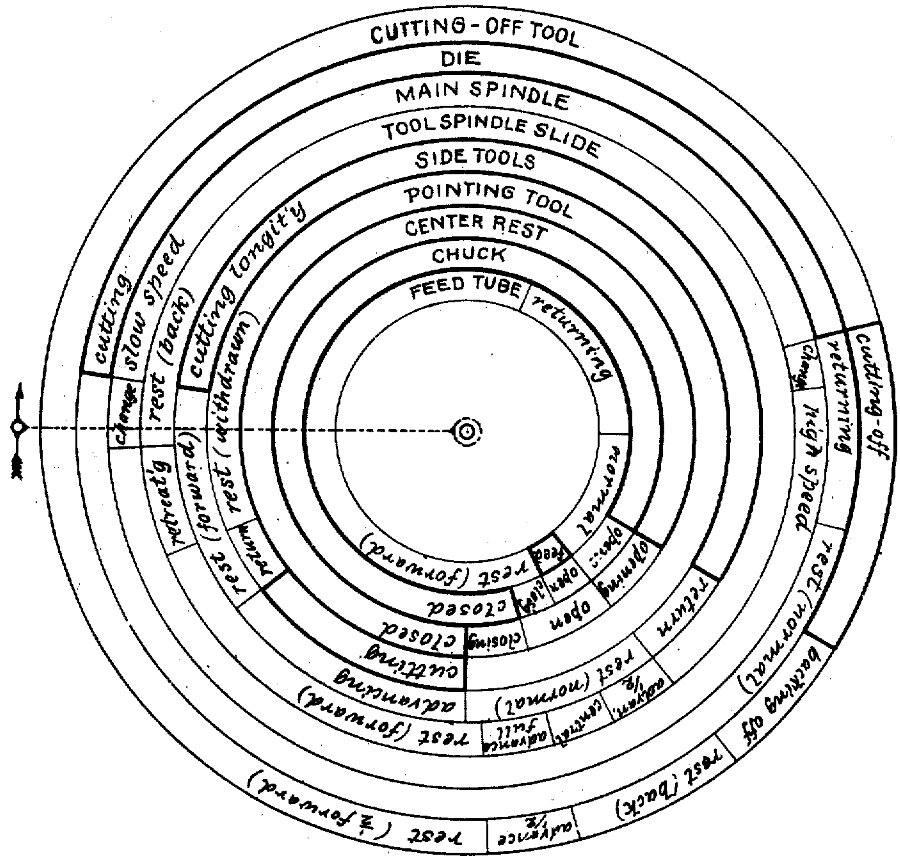
7 SHEETS—SHEET 6.

Fig. 17.



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927,432. Patented July 6, 1909.

7 SHEETS—SHEET 7.

Fig. 18.

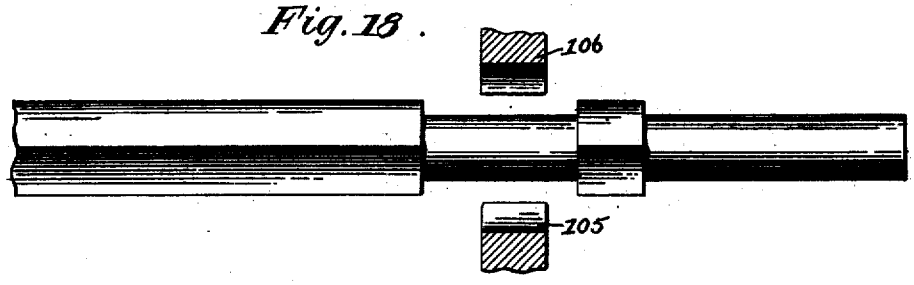


Fig. 19

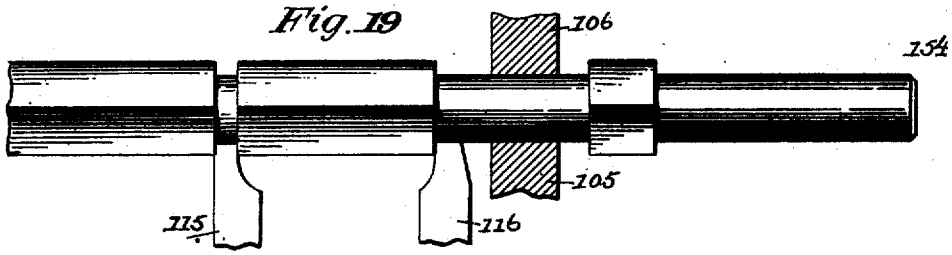


Fig. 20

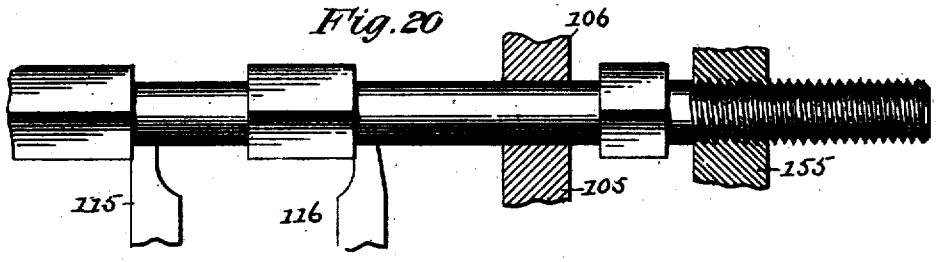
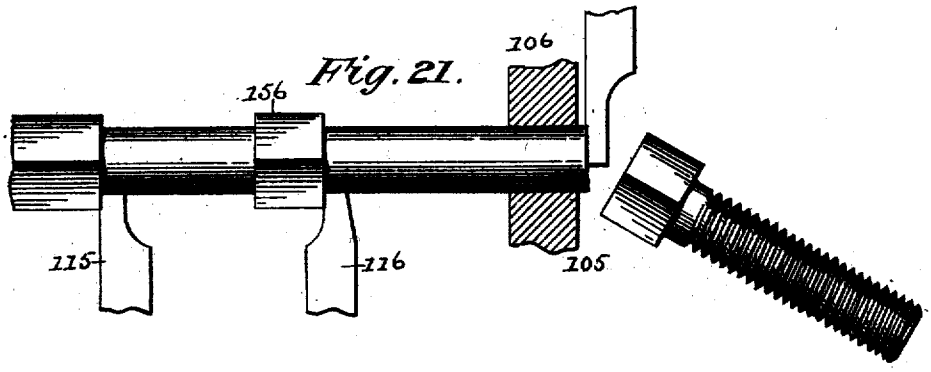


Fig. 21.



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By his Attorneys
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UNITED STATES PATENT OFFICE.

ERNEST R. SEWARD, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE HARTFORD MACHINE SCREW COMPANY, OF HARTFORD, CONNECTICUT, A CORPORATION OF CONNECTICUT.

METAL-WORKING MACHINE.

No. 927,432. Specification of Letters Patent. Patented July 6, 1909.

Application filed August 27, 1904. Serial No. 222,410.

To all whom it may concern:

Be it known that I, ERNEST R. SEWARD, a citizen of the United States, and a resident of Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Metal-Working Machines, of which the following is a specification.

The invention relates primarily to metal working machines and more particularly to a machine of this class in which the operation of the several parts is entirely automatic.

The machine herein shown is designed for a particular purpose, namely, that of forming "set screws" or similar parts, although of course the device is not at all limited to such purposes. The operation of the machine with reference to forming a set screw is herein described for convenience.

The object of the invention is to provide an automatic machine of simple construction which will operate with great precision in the working of metals for various purposes.

A further object is to provide a machine in which the speeds of the various parts of the mechanisms may be varied at predetermined instants to provide very rapid operation.

A still further object is to provide a positive operating mechanism for each of the several sets of mechanism which together comprise the machine.

A still further object is to provide a center rest for the material operated upon which will automatically open at predetermined instants to permit the passage of the stock finished or partially finished through the rest.

One important feature of the device is an arrangement by which a turret head is entirely dispensed with, and the several tools for operating upon the stock are brought into position by rectilineal movements.

An important feature resides in the combining of several operating tools so arranged as to do their work simultaneously upon the stock without interfering one with the other, and a novel and important feature of the machine is providing an arrangement by which positive drives may be secured both to the main shaft and throughout the machine at the same time, permitting an angular disposition of the machine with reference to the countershaft, which will preclude the possibility of interference of the stock with other machinery. Provision is also made for frictionally driving certain portions of the mechanism to preclude the possibility of breakage.

One feature of the machine is the arrangement by which the feed slides are moved through a comparatively long distance with a comparatively short movement of the operating mechanism therefor.

Referring to the drawings—Figure 1 is a plan view of the machine, the tool holders being shown without tools. Fig. 2 is a general view in elevation of the parts shown in Fig. 1, portions being omitted for the sake of clearness. Fig. 3 is a longitudinal sectional view through the spindle and appurtenant parts, on enlarged scale, as are all of the following figures. Fig. 4 is an end view taken from the left of Fig. 3 with the parts broken away. Fig. 5 is a longitudinal section on the line *a* of Fig. 6. Fig. 6 is a cross sectional view adjacent to the center rest showing the center rest slides and appurtenant parts, on line *b* of Fig. 5. Fig. 7 is a partial plan view of the center rest and tool slides with parts broken away to show construction. Fig. 8 is a longitudinal section view through one of the tool spindles and appurtenant parts. Fig. 9 is a cross sectional view on the line 9 of Fig. 8 taken through the tool spindles and rest. Fig. 10 is a cross sectional view on the line 10 of Fig. 8. Fig. 11 is a cross sectional view on the line 11 of Fig. 8, looking toward the adjacent end of the machine. Fig. 12 is a detail plan view showing the cam gate and forward end of the operating spindle and slide. Fig. 13 is a detail view in longitudinal section through the parts shown at the extreme right of Fig. 2 and comprising the fast and slow speed mechanism. Fig. 14 is a view of the parts shown in Fig. 13 looking from the right of said figure and taken in section along the variable

speed shaft. Fig. 15 is a partial horizontal section view through the feed shaft cross shaft and connections for the variable speed mechanism. Fig. 16 is a sectional view on the line 16 of Fig. 14. Fig. 17 shows a chart or diagram defining the cycle of operation of the various parts of the mechanism. Fig. 18 is an enlarged view showing the stock as operated upon by the tools, with the center rest open to permit passage of the stock. Fig. 19 is a view of the stock with the center rest closed and the cutting tools cutting forward to size the stock. Fig. 20 shows the tools as they are fed axially of the stock, with the screw cutting dies at the end of their operation. Fig. 21 illustrates the stock and position of the tools as the cutting off tool severs the finished article.

As already defined, one of the principal objects of the machine is to produce an automatic mechanism for performing various operations as nearly as possible by simultaneous action upon a single piece of stock, and the machine as herein described illustrates its adaptation for automatically forming set screws or cap screws.

In the accompanying drawings the numeral 1 denotes the base or support provided with suitable bearings for a cam shaft 2 and a feed shaft 3 and cross shaft 4. Upon this base or support are mounted the several driving parts for the main spindle and the turning and cutting off tools as well as the tool head which bears the tool spindles and tools for performing certain operations upon the stock.

Upon the left of the base, as viewed in Figs. 1 and 2, is supported the main spindle 5 with its driving shaft 6 and appurtenant parts, which are carried in uprights 7—8 provided with requisite bearings for said shafts. Upon the caps or heads of the uprights 7—8 there is disposed a support 9 provided at its forward end with a slide-way 10 of angular form arranged to receive the center rest support 11, the latter being secured in any desired position of adjustment by clamp screws 12. The main spindle 5 is of sectional form including several concentric members, and upon the outer tube members are arranged bevel gears 13—14 of the same diameter and number of teeth which mesh with gears 15—16 secured to the main driving shaft 6. Bevel gears are used between the shaft 6 and the main spindle 5 and it will be noted that the shaft and spindle 5 are angularly disposed in order to permit an angular disposition of the machine with reference to a counter shaft. This brings the main driving shaft 6 into a position parallel with the counter shaft whereby a chain or positive drive may be used between a sprocket on the counter shaft and a sprocket wheel 17 upon the main driving shaft 6. With this arrangement the stock of one machine will not interfere with other machines, though they are located below and operated from the same counter-shaft. Both the gears 13—14 are loosely mounted upon the outer tube of the spindle 5 upon suitable bearings, and the adjacent faces of each of these gears are provided with clutch members 18—19 preferably of the tooth form. Either one or the other of these is engaged by an axially shifting clutch 20 having a clutch surface upon each end and controlled by a clutch lever 21 provided with a roll 22 and acted upon by cams suitably arranged upon the cam disk 23 secured to the cam shaft 2. This cam lever 21 is pivoted as at 24 to the frame of the machine and has a yoke 25 which encircles the clutch member 20 to shift it. Secured to the yoke is a cam 26 coöperating with a spring 27 having a cam face at its outer end. The function of this spring is to give a quick and positive movement to the clutch 20 for shifting it into and out of position with either of the gears 13—14. It is to be noted that a lost motion is provided between the yoke 25 and the clutch 20 in order to permit the high point of the cam 26 to be brought over the corresponding cam upon the spring 27. The purpose of this is to secure positive and continuous rotation of the several parts. If the clutch 20 were shifted from the gear 14 to the gear 13 by ordinary means of a cam and without lost motion and the spring disengagement of the clutch member 19 would take place prior to the engagement of the clutch member 18, the driving shaft would for an instant fail to transmit motion to the spindle and connected parts. By using the cam 26 and spring with the lost motion described, the change from one clutch position to the other is so rapid as to preclude the possibility of retarding movement of the rotating parts. Within the outer tube of the main spindle 5 is a chucking tube 28 having at one end chuck jaws 29 and at its rear end shoulders 30 which are engaged by chucking levers 31 pivoted to a collar 32 and actuated by a cam 33, which in turn is connected with a slide 34 arranged to be reciprocated by suitable cams upon a cam disk 35 through the medium of a roll 36.

Within the chucking tube 28 is a feed tube 37 provided with stop collars 38—39 between which there is arranged a projection 40 from the feed slide 41. This feed slide is reciprocated by suitable cams upon the cam disk 35 through the medium of a roll 42. Both the chucking slide 34 and feed slide 41 are mounted upon the same slide-way 43, which extends to a considerable distance and bears the several parts of a stop mechanism hereinafter described. The feed tube 37 at its forward end is split to provide a frictional grasp upon the stock, and this has an important function with respect to the operation of the stop motion.

Keyed to the main spindle 5 is a sprocket wheel or drum 44, which through a chain indicated in dotted outline as at 45, Fig. 3, drives the feed shaft 3. This feed shaft extends forward through suitable bearings in the base and terminates in a bevel gear 46 which meshes with a bevel gear 47 upon the cross shaft 4. This cross shaft 4 has keyed upon it a sleeve 48 with an upwardly extending flange 49, which coöperating with a flange 50 upon a sleeve 51 provides a frictional grasp for holding a spur gear 52. This gear 52 is loosely mounted on the sleeve 48 and the adjacent faces of the gear and disks 49—50 are padded with a resilient material, as leather. The sleeve 51 is adjustable axially of the sleeve 48 and thus the amount of friction may be increased or decreased.

The gear 52 meshes with and drives a gear 53 which is secured to a drum or spider 54 carrying sun and planet gears, which provide a variable speed for the shaft 55. This variable speed may be of any desired type, but as shown herein there is a gear 56 keyed to the shaft 55 and a shaft 57 bears at either end gears 58—59 which mesh respectively with a gear 60 fast on the ratchet sleeve 61 and the gear 56 fast on the shaft 55. The drum 54 bears a clutch 62 which is engaged by a clutch member 63 for providing the high speed drive on the shaft 55. When this clutch is in the position shown in Figs. 14 and 15 the low speed drive is secured, the pawl 64 holding the ratchet 65 against backward movement and compelling a forward drive at slow speed through the gear 56. The shaft 55 is provided with a worm 66 which meshes with a worm wheel 67 mounted upon the cam shaft 2. Thus a drive is effected from the main spindle to the cam shaft through the fast and slow motion just described and used for purposes hereinafter set forth. The cam shaft 2 has at its outer end a cam disk 68, which through suitable cams operates a lever 69 that controls the shifting of the clutch member 63 and consequently the operation of the fast and slow speed mechanism. This fast and slow speed mechanism is shown in detail in Figs. 14 to 16 inclusive.

It is to be noted that there is a different reduction between the gears 15—16 of the main drive shaft and their respective mating gears 13—14 of the spindle, and as the clutch 20 is shifted to engage either the gear 13 or the gear 14 with the main spindle the speed of said spindle is varied, and these variations in the speed of the spindle are transmitted through the feed shaft with a corresponding increase and decrease of speed on the cam shaft, although, of course, the speed of the cam shaft is independently varied by the fast and slow speed motion just above described.

At the opposite end of the base 1 from the spindle are arranged the tool slides and spindles. As shown herein, there are two tool spindles 70—71 both borne in a housing or bearing 72 so arranged that they may be reciprocated independently of each other and may be shifted transversely of the machine with the housing 72. This housing 72 practically forms duplex bearings for the tool spindles 70—71 and each of these spindles at its under side is provided with a rack 73—74 which engages and meshes with a spur gear 75 as they are shifted transversely into position to engage said gear.

The housing 72 is mounted in a transverse slide 76 working in slide-ways 77, and a spring-pressed locking-bolt 78 is arranged to engage lock bolt recesses 79—80 to insure proper positioning and holding of the slide 76 and contained tool spindles in either one of the two positions. This locking bolt is withdrawn by cams 81 arranged upon the cam disk 82 secured to the cam shaft 2. The under side of the slide 76 bears a rack 83 which meshes with a segmental rack 84 pivoted to a dependent portion 85 of the frame and bearing concentric with its pivotal point a segmental gear 86. This gear in turn meshes with a segmental gear 87 and both the gear segments 86—87 are provided with extending levers 88—89 so disposed as to be engaged by cams 90—91 secured to the cam disk 82. It is obvious that the cams 90—91 will upon engagement with the levers 88—89 reverse the direction of movement of the segmental rack lever 84 and thus shift the slide 76 with the housing and tool spindles transversely of the machine and across the center line of the main spindle 5. Just before the time the cam 90 or 91 shifts the slide 76 the locking bolt 78 is withdrawn by the cam 81 and during the movement of the slide is released to engage the proper index opening through 79 or 80.

A unique arrangement is provided for securing an axial feed of the tool spindles 70—71. Each of these spindles at its under side as above stated is provided with a rack 73—74 which meshes with a pinion 75. This pinion is borne in a bracket 92 formed on a slide 93 and meshes with a rack 94 secured to the frame of the machine. The slide 93 through a roll 95 is moved at predetermined instants by suitable cams upon the cam drum 96 secured to the cam shaft 2. It will thus be seen that a reciprocation of the slide 93 will cause a rotation of the pinion 75 owing to its being in mesh with the stationary rack 94 and thus a double amount of movement will be transmitted to the tool spindles through the inter-engagement of their respective racks.

To insure the rack teeth of the spindles being in proper alinement to slide into engagement with the pinion 75 a cam bar 97 is ar-

ranged at the forward end of the frame and provided with cam surfaces 98. Each of the tool spindles is provided with a pin 99 arranged to engage the cam bar to position the tool spindle positively and bring its rack teeth into proper alinement to be slid into mesh with the gear 75. A cam gate 100 is arranged in the cam bar 97 to permit the forward movement of either of the spindles when they are in proper position and held by the locking bolt 78 which has entered one of the indexing openings 79 or 80. It will thus be seen that the tool spindles are reciprocated in an axial direction by the movement of the slide 93 and are moved transversely by the slide 76. When either of the spindles is retracted if it should fail to come into exact registering position with its rack alined to slide into the gear 75 the transverse movement of the slide 76 through the coöperation of the pins 99, cam surfaces 98, and cam bar 97, will bring said spindle with its rack into positive alinement.

Having now described the main spindle which carries the stock and the tool spindles oppositely disposed thereto, one of the most essential parts of the machine will be described. This consists of the center rest turning and cutting off tools. The support 9 is securely fastened to the tops of the supports 7—8 and extends forward overlying the inner end of the spindle 5 and chuck for holding the stock to be turned. At the under side and forward end of this support 9 is arranged an angularly formed slide-way 10 upon which the center rest support 11 may be slid to any desired position of adjustment, it being provided with a slide-way 101. Clamp screws 12 extend through the support 11, which being split at its upper end provides a clamp for securing it after adjustment along the slide-way of the support 9. This support 11 of the center rest is entirely dependent from the supporting member 9, and thus the lower part of the machine bed may be left open and clear to allow the passage of chips and cuttings, and the center rest itself may be adjusted independently of any of the other mechanism.

Arranged in suitable guide-ways 102 is a pair of slides 103—104 which at their adjacent ends are provided with jaws 105—106. The slides 103—104 are each provided at their outer ends with adjustable blocks 107—108, which are slotted and provided with set screws 109 for securing any desired throw of the slides and jaws. Each of these blocks has a toothed rack formed on its lower edge and segmental levers 110—111 which intermesh therewith. For securing a direct adjustment of the rack blocks with reference to the slides adjusting screws 112—113 are provided. These bear against the ends of the slides and by loosening the binding screws 109 the adjusting bolts 112—113 may be moved to secure the necessary direct adjustment.

Positioned between the center rest support and the chuck of the spindle 5 is a tool post 114 which as shown herein carries two cutting tools, one arranged on either side thereof, as at 115—116. This tool post 114 is provided with a clamp stud 117 projecting into a slot or recess 118 in a slide 119. This slide is borne in slide-ways 120 extending parallel with the axis of the spindle and formed in a slide-block 121 which is arranged to have a movement transverse to that of the slide 119.

On the lower side of the slide 119 is arranged a rack 122 and this meshes with a pinion 123 mounted on a suitable bearing 124 in the machine frame. The pinion 123 also meshes with a rack 125 formed on a slide 126, and is of a considerable width in order to permit a movement of the rack 122 across the pinion without disengagement of the teeth. The slide 126 is provided with a roll 127 and suitable cams upon a cam disk 128 move the slide 126 and rack 125 at predetermined moments.

In lieu of the arrangement above described for permitting a double movement of the tool post the slide 126 may be directly connected to the slide 119 without the interposition of racks and pinions. Another arrangement contemplated is to mount the pinion 123 in the slide 121 with its bearing 124 secured to the slide 121 and arranged to slide through the pinion. The pinion in this case is stationary with respect to the rack 125 and the rack 122, while the bearing 124 slides with reference to the pinion 123. It will thus be seen that the slide 119 which bears the tool post 114 may be moved axially of the work carried in the chuck of the spindle 5. To secure a transverse movement of the tool post and tools the slide 121 is borne in suitable slide-ways 129 formed transversely to the slide-ways 120. On the under side of the slide 121 and in a recess 130 there is an adjustable rack 131 arranged to be secured in any desired position of adjustment by a clamp nut 132. Intermeshing with this rack 131 is a segmental rack lever 133 pivoted to the frame as at 134 and at its lower end arranged to be engaged by suitable cams carried upon the cam disk 135. Through this means the slide 121 is reciprocated and carries with it the tool post 114 and contained tools. This movement is for the purpose of feeding the tools forward to secure the proper size cut. After they have been fed forward and reduced the stock to the required diameter the slide 126 is moved by its cam and the tools are fed along the stock to the required distance to give the proper cut. The action of these tools is hereinafter more fully described.

Along the top side of the slide-block 121 is

arranged a hardened cam block 136. Both this cam block and the slide are of a considerable length, and the block itself underlies the lower end 137 of the segmental rack lever 110. The block 136 is provided with a cam face 138 and has a horizontal surface 139 at its uppermost edge. As the side 121 is forced outward the end 137 of the lever 110 rides down the cam face 138 and a spring 140 forces the center rest slide 103 backward away from the stock. The opposite center rest slide 104 is operated in the same manner, as hereinafter described.

A cutting off tool 141 is carried in a tool block 142 which through a clamp bolt 143 is secured in any position of adjustment along the tool slide 144. This tool slide, as in the case of the slide 121, is provided with a recess 145 within which is adjustably secured a rack block 146, this rack being held in its various positions of adjustment by a locking bolt 147. The rack 146 is engaged by a segmental rack lever 148 pivoted as at 149 and with its lower end arranged to be engaged by a cam upon the cam disk 135.

Upon the upper surface of the tool slide 144 is a cam block 150 having a cam surface 151 and an upper horizontal face 152. This cam block 150 is substantially the same as the cam block 136 and controls the movement of the rack lever 111 and consequently the movement of the center rest slide 104. This slide is also provided with a spring 153 which retracts said slide as the lower end of the lever 111 rides down the cam face 151.

As the center rest support with its slides, operating levers therefor and appurtenant parts, is hung and entirely supported from the member 9 it is apparent that the movements of the center rest slide are controlled entirely by the cam blocks 136 and 150, and the retracting springs 140 and 153. As the cam blocks 136 and 150 are provided with inclined surfaces 138 and 151 and have plain, horizontal surfaces at their upper faces, after these cams have operated to throw the levers 110—111 in continued movement of the slides 121 and 144, they will not affect in any way the position of the center rest slides. This is essential in order to provide a proper movement for the tools which are carried in tool posts mounted upon the tool post slides. So far as known, this arrangement of tools combined with an opening center rest is a feature heretofore unknown and the import of it is apparent. For instance, as illustrated in the accompanying drawings, Figs. 18 to 21, the necessity for such a device is illustrated. The machine as here illustrated is arranged for automatically forming set screws from square stock. This stock is of course fed forward by the feed tube through the chuck of the spindle 5 the proper distance. The timing of the cams on the cam disk 135 is such that they act upon the levers 133 and 148, carrying the tool slides 121 and 144 toward each other and thus through the cam blocks 136 and 150. The center rest slides 105—106 are forced against the stock which has been turned to round cross section by the tools 115—116. As illustrated in Fig. 18 the center rest slides are shown open. In Fig. 19 the slides are shown closed, with the jaws about the stock.

During the movement of the center rest slides the slide 121 moves forward with its tools 115—116 and the movement of the slide 121 is continued until said tools have cut their way into the stock the required distance to give the proper size as to diameter. While these tools are sizing the stock a pointing tool carried on the spindle 70 at the opposite end of the machine is moved forward by the cams on the cam drum 96 through the medium of the pinion 75 and rack 73 to form a point on the end of the stock, as illustrated at 154, Fig. 19.

As soon as the pointing tool has performed its work it is retracted and the slide 76 is shifted by the cam drum 82 and its cams operate upon the segmental lever 84 and segmental gears 86—87, the locking bolt 78 of course being first withdrawn by the cam 81. During this size cutting by the tools 115—116 and the pointing of the point by the pointing tool carried on the tool spindle 70, the clutch 20 has been in mesh with the clutch member 19 on the gear 14. The spindle 5 has thus been running on the high speed, and of course the feed shaft 3 and cross shaft 4 have been running on proportionately high speed. The change speed mechanism between the cross shaft and the cam shaft, however, has been running on the low speed and thus the cam shaft has been running at a comparatively slow speed. As soon as the pointing tool spindle has been retracted and the lock bolt 78 withdrawn, the cam 68 of the fast and slow speed mechanism shifts the lever 69, throwing in the high speed of the change speed mechanism, thus speeding up the cam shaft to secure a quick shift of the slide 76 and tool spindles 70—71 carried therein.

As soon as the slide with the spindles 70—71 has been shifted to bring the spindle 71 into position for action, the cam of the cam disk 68 again shifts the lever 69 throwing on the low speed of the change speed mechanism and provides a comparatively slow movement of the cam shaft 2. At the same instant the clutch 20 has been shifted by the cams of the cam disk 23 throwing said clutch into engagement with the clutch member 18 on the gear 13, giving a slow speed on the main spindle and stock which is being turned. The spindle 71 bears an automatic opening and closing die 155, as illustrated in Fig. 8. This die is now moved forward with the tool spindle 71 through the action of its rack 74 coöperating with the pinion 75, rack 94 and

cams on the cam drum 96 and engages and cuts a thread upon the stock as illustrated in Fig. 20.

During the several movements above described the cutting tools 115—116 have been fed along the stock by cams arranged upon the cam drum 128 which have moved the slide 126 and parts carried thereby. When the thread cutting die has moved forward a predetermined distance its jaws are released and with its spindle 71 it is retracted. At or about the time the jaws of the die opened the cam disk 23 through its cams shifts the lever 21 and throws the clutch 20 into engagement with the clutch member 19 of the gear 14. The main spindle 5 with its stock is thus run at high speed and the cutting of the tools 115—116 along the stock is completed on this speed. During this last cutting on the high speed the cutting off tool 141 has been moved forward by a movement of the tool slide 144 actuated by the lever 148 through cams upon the cam disk 135. This movement carries the cutting off tool 141 by the center of the stock, severing the bolt already formed, as illustrated in Fig. 21 and at the same time leaving a smooth finish on the end of the stock.

At or about the instant the cutting off tool passes over the center of the stock and severs the completed bolt therefrom, the cam disk 68 shifts the lever 69, throwing in the high speed of the change speed mechanism and producing a high speed upon the cam shaft. The high speed clutch of the main spindle being in the high speed of this spindle is maintained until the threading die again comes into operation. When the cutting off tool has performed its work the turning tools have completed their operation and as there are two tools spaced at a predetermined distance from each other the stock has been turned down with the head 156 left between the tools. As soon as the turning tools 115—116 reach the position shown in Fig. 20 and the cutting off tools start to retract the tools 115—116 are also retracted by a movement of the slide 121. When this slide reaches its backward position the slide 126 is moved carrying the slide 119 and turning tools back to their initial position ready to start a new sizing cut as soon as the slide 121 moves forward.

During the retraction of both the cutting off and the turning tools and the movement of said turning tools to their initial position, the jaws 105—106 with the center rest slides 103—104 are released and retracted by their springs 140 and 153. While the tools have been acting upon the stock the feed tube slide 41 has been moved by a cam on the cam drum 35 and the projection 40 has come into engagement with the collar 38 and moved the feed tube backward ready for a forward feeding movement. While the cutting off tool and turning tools are being retracted the chucking tube 28 is released and as soon as the center rest slides are withdrawn from the stock the feed tube is forced forward by its slide 41 carrying the stock through the chucking tube and positioning it adjacent to the tools ready for a new cut. The operation of the machine has now been described for all normal positions. So long as there is a bar of stock in the feed tube the cycle of operations will be repeated as above defined. To prevent accidental operation, such for instance, as would occur when the stock is exhausted, a special stop motion is provided. When the stock is nearly exhausted there is always liability of a short head being formed on the stock and fed forward in position to be engaged by the center rest jaws. Should this occur unavoidable breakage of parts would be the result.

The stop motion device described and shown is not claimed herein as a part of the invention. This stop motion forms the subject matter of a divisional application filed May 6th, 1907, Serial No. 371,959.

What I claim as my invention and desire to secure by Letters Patent is:—

1. In a metal working machine to be driven from a countershaft, a main spindle mounted upon and extending longitudinally of the machine including stock feeding and chucking devices, a main driving shaft angularly arranged with respect to the main spindle and with its axial line crossing the axial line of the spindle, bevel gears between the angularly disposed driving shaft and the main spindle for driving the latter, and means for driving the main driving shaft.

2. In a metal working machine, in combination with a reciprocating actuating rack, a transversely reciprocating slide, a tool slide bearing a rack and borne by said transversely reciprocating slide, and a pinion mounted appurtenant to said transversely reciprocating slide and in mesh with the actuating rack and the rack of the tool slide.

3. In a metal working machine, in combination with a main spindle, a laterally movable slide bearing a plural number of tool spindles, means for reciprocating said slide, a pinion for separately reciprocating each of said tool spindles, means for rotating the spindle, and means for locating said spindles to cause their racks to accurately engage the pinion in the lateral movement of the slide.

4. In a metal working machine, in combination with a reciprocating slide, a cam wheel bearing two sets of cams for reciprocating the slide in opposite directions, a segmental lever engaging said slide at one end and having a trip for engaging one set of cams of the cam wheel, and a pivoted trip positively connected with the first named trip and arranged to be actuated by the second set of cams.

5. In a metal working machine comprising a main spindle, a laterally movable tool slide bearing tool spindles and means for reciprocating said tool spindles; a rack upon the tool slide transversely arranged to the line of the tool spindles, a segment engaging said rack, a segmental gear engaging said segment, a cam disk provided with trips to engage either the segment or segmental gear to move the slide in opposite directions, and connections intermediate said cam disk and slide for locking and releasing the slide in proper time relation to its movement.

6. In a metal working machine in combination with a reciprocating slide, a cam wheel bearing two sets of cams for reciprocating the slide in opposite directions, a segmental lever engaging said slide at one end and having a trip for engaging one set of cams of the cam wheel, a pivoted trip positively connected with the first named trip and arranged to be actuated by the other set of cams, and a locking bolt controlled by the cam wheel for locking and releasing the reciprocating slide.

7. In a metal working machine in combination with a main spindle, a laterally movable slide, reciprocating tool spindles mounted on said slide and each provided with a rack, a stationary rack operatively arranged with reference to said spindles, a movable slide bearing a pinion, said pinion meshing with the stationary rack and arranged to engage the racks of the reciprocating tool spindles as the tool slide is moved laterally, means for moving the slide and spindles, a cam shaft and connections for moving the pinion slide.

8. In a metal working machine in combination with a main spindle, a laterally movable slide, reciprocating tool spindles mounted on said slide and each provided with a rack, a stationary rack operatively arranged with reference to said spindles, a movable slide bearing a pinion, said pinion meshing with the stationary rack and arranged to engage the racks of the reciprocating tool spindles as the tool slide is moved laterally, means for moving the slide and spindles, a cam shaft, connections for moving the pinion slide, and a locking device operatively connected with said cam shaft for locking said slide at predetermined points of its transverse movement.

9. In a metal working machine, in combination with a main spindle adapted to feed up the stock, a tool slide bearing a tool for reducing said stock, a tool slide bearing a tool for severing a finished piece, means for operating said slides, jaws for engaging the work between said tools, and means for opening and closing said jaws.

10. In a metal working machine, in combination with a main spindle adapted to hold and feed stock, a tool for operating upon the stock, a support overlying the spindle, a center rest support depending therefrom, jaws mounted to slide in the center rest support, and means for opening and closing said jaws.

11. In a metal working machine, in combination with a main spindle adapted to hold and feed stock, a tool slide mounted on the base of the machine, means for reciprocating the tool slide, a support overlying the main spindle, a center rest support depending from said support, sliding jaws mounted in the center rest support, and connections between the tool slide and jaws for operating the latter.

12. In a metal working machine in combination with a main spindle adapted to hold the stock, a center rest comprising a fixed support, jaws movable in said support, a tool slide and tool appurtenant to each jaw for operating upon the stock and means for actuating the jaws of the center rest in their opening and closing movements dependent upon the movements of the tool slides.

13. In a metal working machine in combination with a main spindle adapted to hold the stock, a center rest comprising a fixed support, jaws movable in said support, a tool slide and tool having a movement transverse to the line of the spindle and operatively mounted with reference to one of said jaws, a tool slide and tool having movements transverse to and coincident with the line of the spindle and operatively mounted with reference to the second of said jaws, and means for actuating the jaws of the center rest in their opening and closing movements dependent upon the transverse movements of the tool slides.

14. In a metal working machine in combination with a main spindle adapted to hold the stock, a center rest comprising a fixed support, jaws movable in said support, a tool slide and tool having a movement transverse to the line of the spindle and operatively mounted with reference to one of said jaws, a tool slide and tool having movements transverse to and coincident with the line of the spindle and operatively mounted with reference to the second of said jaws, and means for actuating the jaws of the center rest in their opening and closing movements dependent upon the transverse movements of the tool slides and holding said jaws in closed position during the longitudinal movement of the tool slide.

15. In a metal working machine in combination with a main spindle adapted to hold the stock, a center rest comprising a fixed support, jaws movable in said support, an adjustable rack appurtenant to each of said jaws, segmental rack levers meshing therewith, a tool slide operatively mounted with reference to each of said levers and a

cam upon each of said tool slides to engage the segmental levers, whereby the movement of the jaws is controlled by the movements of the tool slides.

16. In a metal working machine in combination with a main spindle adapted to hold stock, a support overlying and fixed with reference to the spindle, center rest jaws mounted to slide in said support, tool slides and automatic means coöperating with the tool slides for opening and closing said center rest jaws.

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