L. F. & R. SCHULZE.

METAL WORKING MACHINE.

APPLICATION FILED FEB. 17, 1910.

1,209,046.

Patented Dec. 19, 1916.

5 SHEETS—SHEET 1.

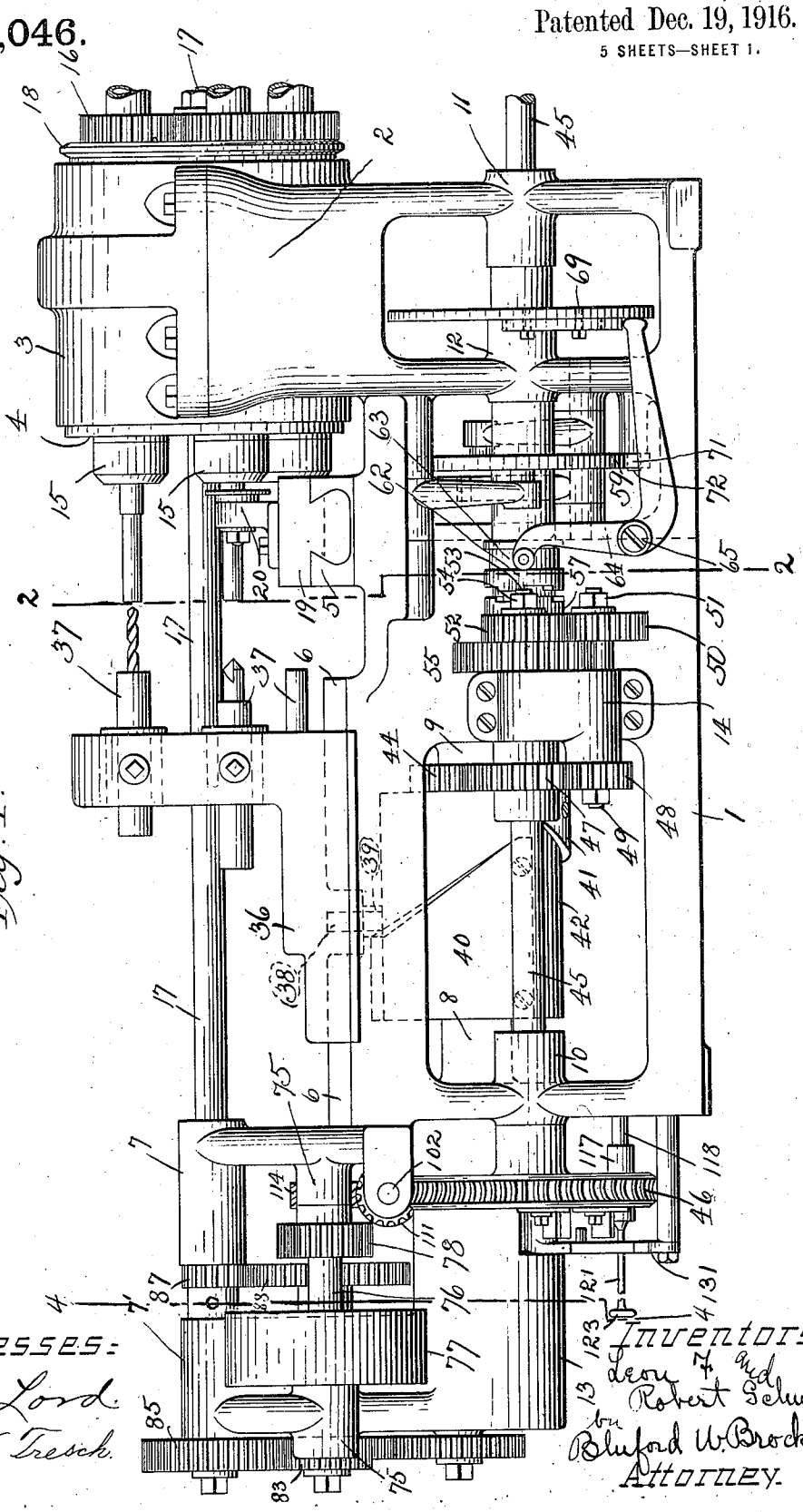


Fig. 1.

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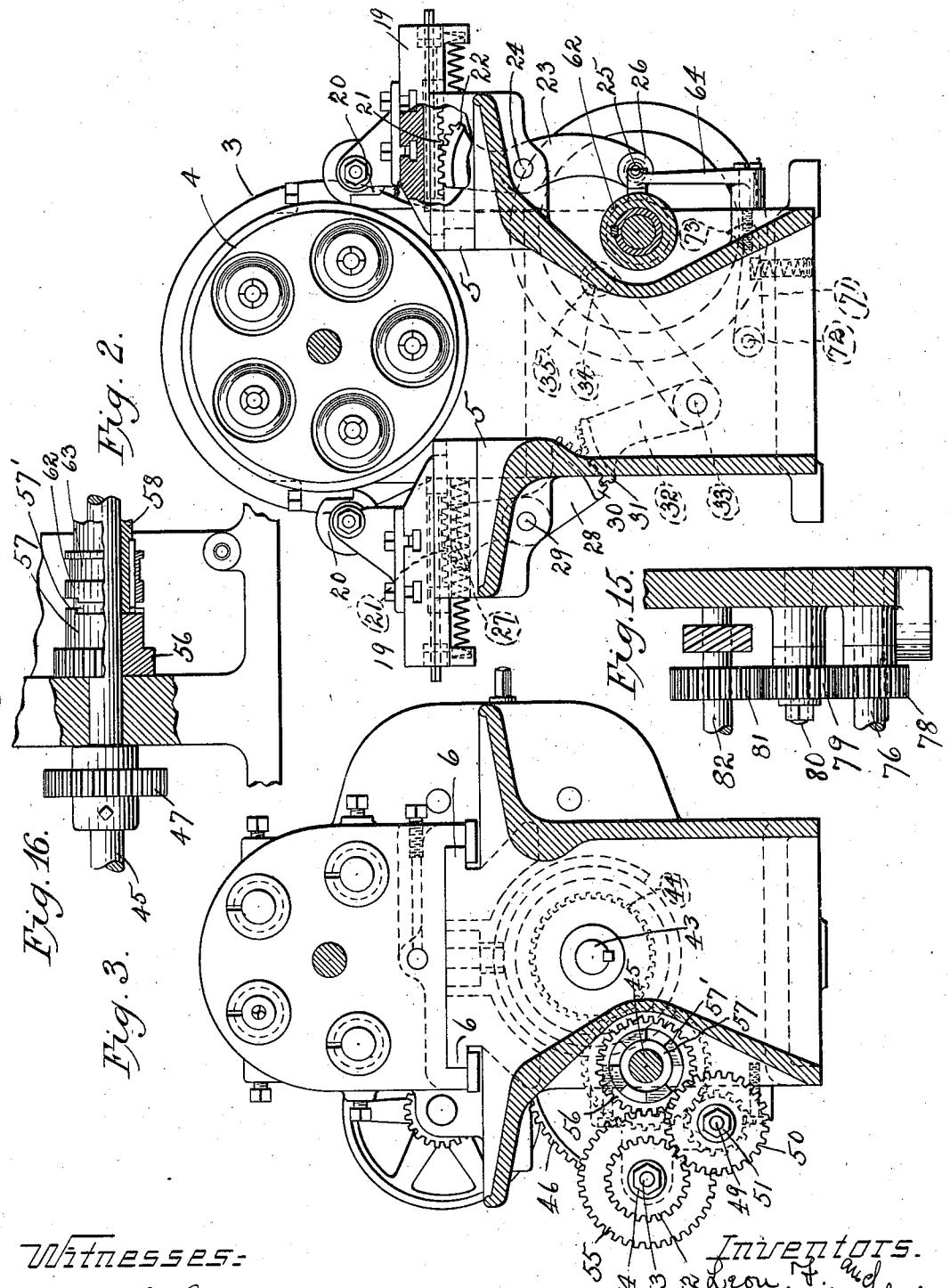


Fig. 2.

Fig. 15.

Fig. 16.

Fig. 3.

Witnesses:

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Fig. 4.

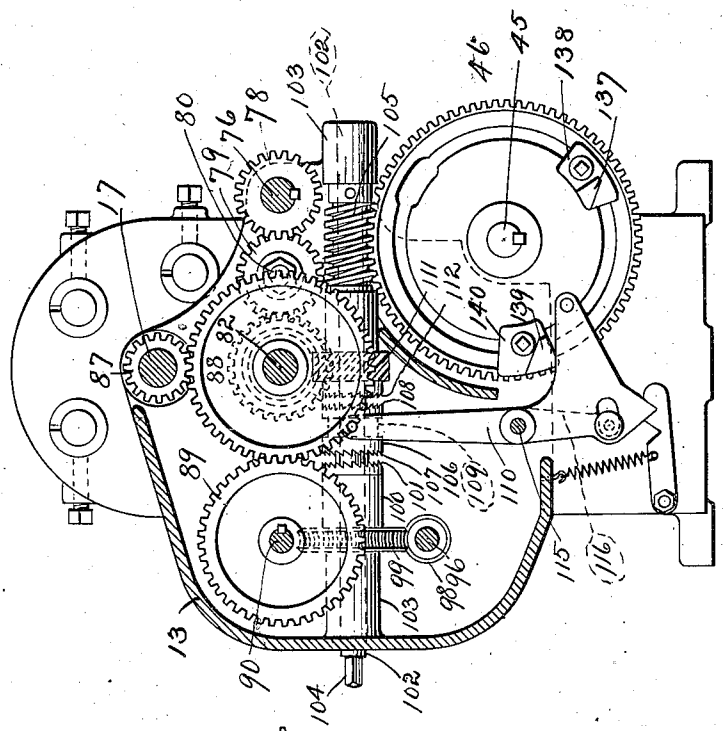
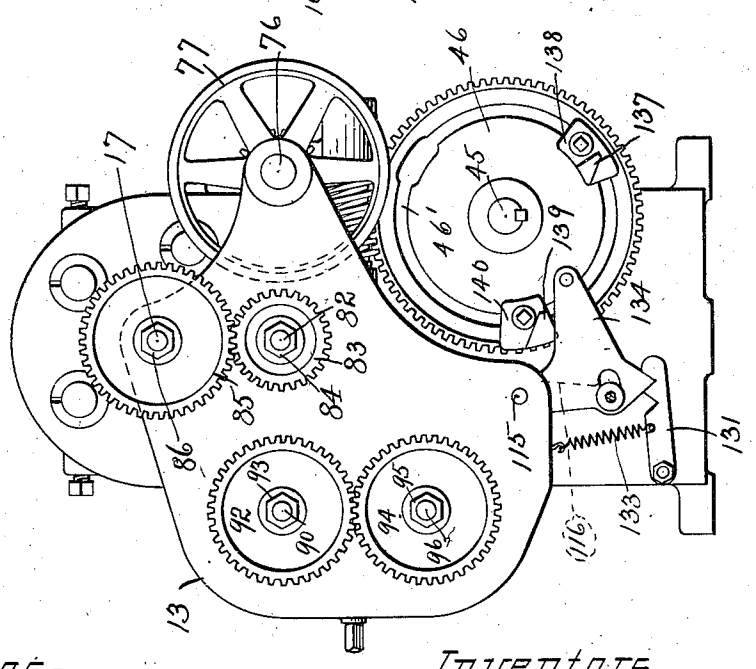


Fig. 5.



Witnesses:-

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5 SHEETS—SHEET 4.

Fig. 7.

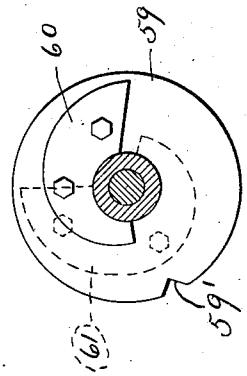


Fig. 8.

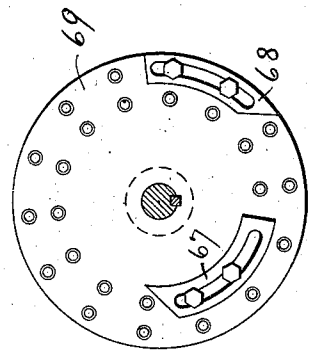
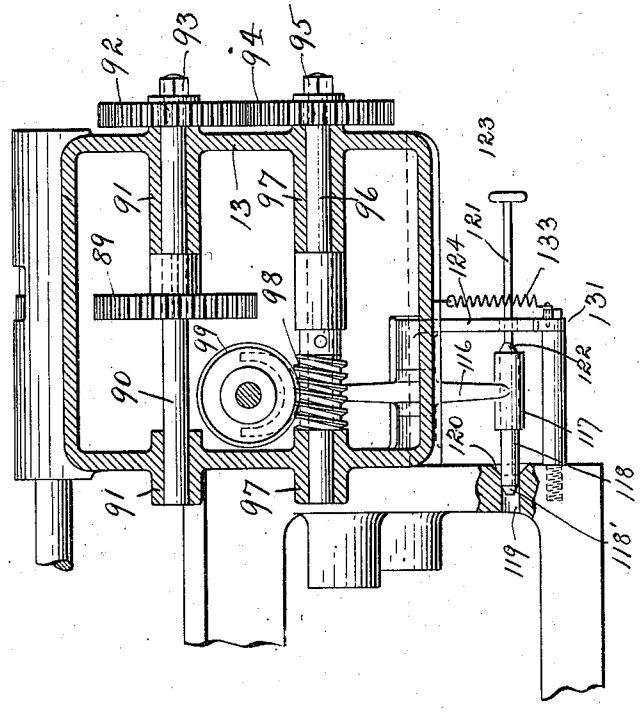


Fig. 6.



Witnesses:-

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5 SHEETS—SHEET 5.

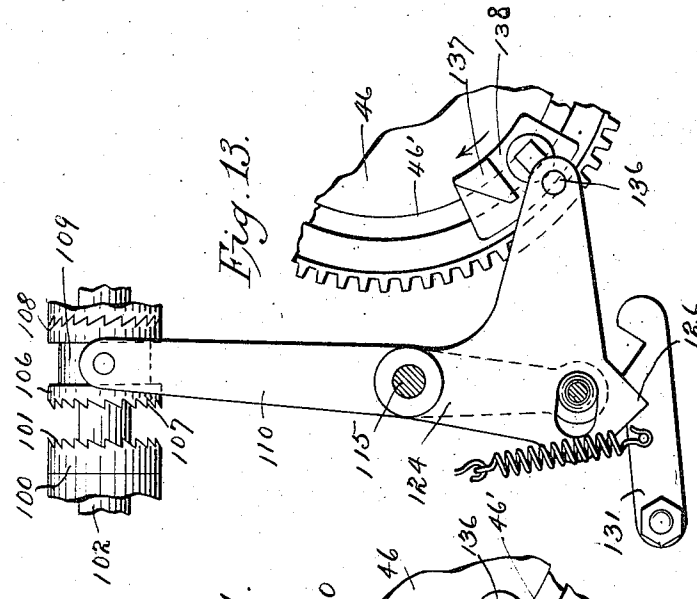


Fig. 13.

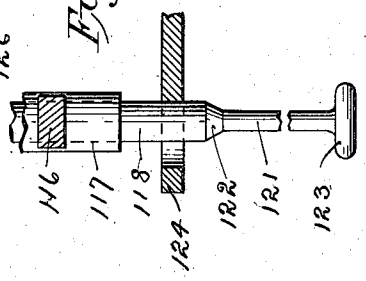


Fig. 14.

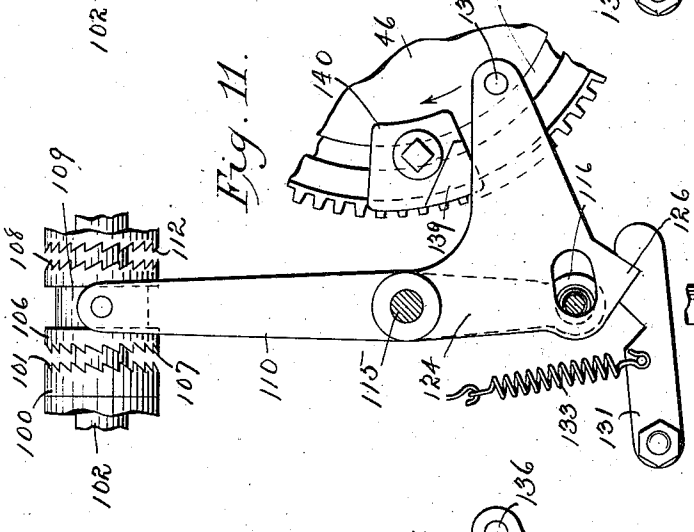


Fig. 11.

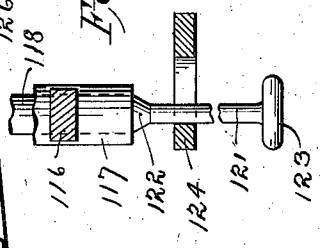


Fig. 12.

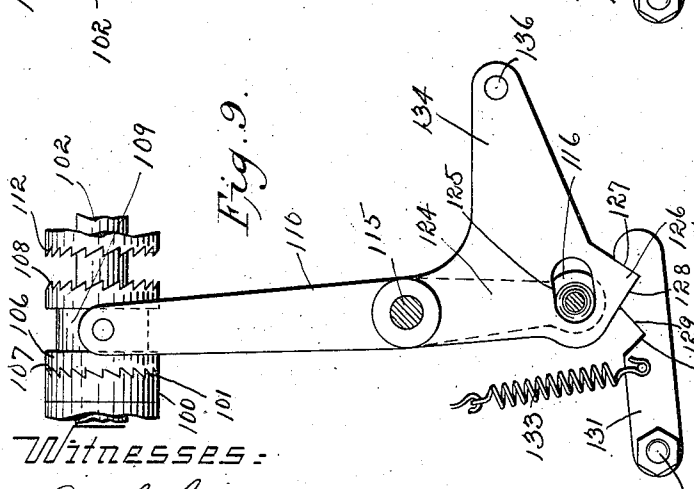


Fig. 9.

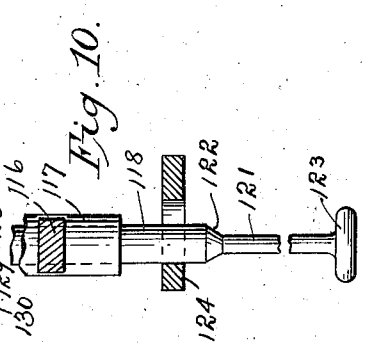


Fig. 10.

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UNITED STATES PATENT OFFICE.

LEON F. SCHULZE AND ROBERT SCHULZE, OF CLEVELAND, OHIO.

METAL-WORKING MACHINE.

1,209,046. Specification of Letters Patent. Patented Dec. 19, 1916.

Application filed February 17, 1910. Serial No. 544,514.

To all whom it may concern:

Be it known that we, LEON F. SCHULZE and ROBERT SCHULZE, citizens of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Metal-Working Machines, of which the following is a specification.

This invention relates generally to metal working machines and particularly to automatic screw machines of both the single and multi-spindle type.

More specifically the invention relates to an improvement in the driving mechanism for the entire machine including the mechanism for driving the stock holding and rotating devices, and the means for driving the tool feed, and in arranging these parts in a manner such that lost time may be eliminated and positive operation may result.

Invention resides in providing a metal working machine having a driving mechanism and two or more sets of tools with suitable means whereby both sets of tools may be driven from the driving element, and with further means whereby one set of the tools may be supplied with variable feeding devices so that the rate of feed of such set of tools may be varied with respect to the rate of feed of the remaining tools. More specifically this feature of the invention lies in providing a metal working machine having a stock holding and rotating device, driving mechanism and longitudinally and transversely movable tools, with means whereby both sets of tools may be driven from the driving mechanism and one set, here shown to be the transversely movable tools, may be supplied with variable feeding devices whereby the rate of feed of this particular set of tools may be varied with respect to the other set, namely, the longitudinally movable tools.

Further invention resides in the supplying of power from a general source to the stock holding and rotating mechanism by variable gearing and to the tool feeding mechanism by other gearing arranged in a manner such that the tools are always operated at a constant fast speed for their idle motion and at a variable speed for their slow or working motion, but that irrespective of the variations in the speed of the stock with respect to the general source of power the rate of feed of the tools per revolution of the stock remains the same, so that after obtaining the predetermined rate of feed for the slow motion this rate will not be varied but remains fixed irrespective of changes in the speed of the stock with respect to the source of power.

Still further invention resides in the arrangement in a metal working machine, having stock holding and rotating devices, a driving element, and suitable tools, together with a fast and slow speed gearing between the driving element and such tools, of means whereby power may be transmitted to either the high or slow speed set of gears in accord with the proper step in the cycle of operations of the machine and without regard as to which train of gearing the feeding mechanism was previously coupled with. Specifically this feature of the invention contemplates two sets of gearing between the driving element and the feeding mechanism, together with a suitable coupling device, such as clutch mechanism, and an operating device for controlling such clutch mechanism all arranged in a manner such that the proper train of gears, either the fast or slow speed, is thrown into connection with the feeding mechanism in accord with the proper step in the cycle of operations of the machine, or in other words, assuming that power has been shut off with the fast speed gearing coupled to the feeding mechanism and the operator should manipulate the machine by hand so that the cycle of operations passed from the step of fast speed feeding to the step of slow speed feeding then this controlling mechanism for the clutch is such that he can only start the power through the step of slow feeding. This principle is employed, so that, as above stated, irrespective of where the machine was previously stopped the operator may only start the feeding mechanism at that speed which is in accord with the proper step in the cycle of operations of the machine.

Invention also resides in the arrangement of suitable mechanism for coupling the working tools with the fast and slow speed driving mechanism.

The invention may be further briefly summarized as consisting in the construction and combinations of parts hereinafter set forth in the following description, drawings and claims.

Referring to the drawings, Figure 1 is a side elevation of the machine constructed ac-

cording to our invention; Fig. 2 is a section upon the line 2—2 looking toward the right of Fig. 1; Fig. 3 is a section upon substantially the same line and looking to the left of Fig. 1; Fig. 4 is a section upon the line 4—4 of Fig. 1; Fig. 5 is an end elevation of the machine; Fig. 6 is a sectional view of the gear casing at the left end of the machine as shown in Figs. 1 and 5; Fig. 7 is a detail of one side of the cam wheel and cam for feeding the transverse tools; Fig. 8 is a detail view of the cam wheel and cam for operating the cross feed controlling device; Fig. 9 is a detail view somewhat enlarged of the high and low speed clutch controlling device; Fig. 10 is a sectional plan view of parts of this mechanism and showing the operating bolt in operative position; Fig. 11 is a view of the same mechanism showing the clutch and clutch lever in inoperative or mid position; Fig. 12 is a sectional plan view similar to Fig. 10 but showing the locking pin as it appears in inoperative position; Fig. 13 is a view similar to Fig. 9 showing the clutch member thrown to the right with the actuating lever and the other parts in position; Fig. 14 is a sectional plan view of the parts as shown in Fig. 13; Fig. 15 is a plan view of the gearing between the main driving element and the constant speed shaft; and Fig. 16 is a detail view of the clutch mechanism for the transverse tools.

In carrying out our invention any preferred form and construction of metal working machine may be provided with our invention so long as it possesses the necessary characteristics, but we have shown one form in the drawings which meets the requirements very effectively and the several parts will be taken up successively and described and a final summary will be given of the complete operation.

Frame.—The frame 1 for holding the several parts is similar in all substantial particulars to that set forth in our prior pending application, Serial No. 468,280, filed December 19, 1908, "Metal working machines," and in this embodiment it is provided with a half-round supporting member 2 to which is secured a cap 3, these two parts forming a suitable support and bearing for the spindle head 4. The frame is further provided with transverse tool guides 5 and longitudinally movable tool guides 6 and at the end opposite to the spindle with spindle driving shaft supporting bearings 7 and 7′, and with cam drum driving shaft bearings 8 and 9, and feed shaft bearings 10, 11 and 12.

The frame 1 is still further provided with a gear casing 13 at the left end as shown in Fig. 1, and with a gear supporting bracket 14 secured to the side of the frame, as shown in Figs. 1 and 3.

Spindle head and spindles.—The spindle head 4 is of the type set forth in our prior application referred to, and has a plurality of openings for receiving the spindles 15 each of which is provided with suitable stock feeding and clutching mechanism, not shown except so far as it appears in end elevation in Fig. 2, and with operating mechanism which is not shown and does not form a part of this invention. Each of these spindles is driven by a suitable gear 16 as set forth in our prior application, and these are in turn driven by a suitable gear upon the spindle driving shaft 17 which is mounted at the opposite end of the machine in the bearings 7 and 7′ carried by the frame. The spindle head is adapted to be driven by a sprocket 18 from a suitable mechanism which forms the subject matter of our prior application and does not form any part of this invention, but any suitable means may be provided for rotating the head step by step, as is common in machines of this type, and therefore needs no further explanation or illustration.

Transverse tools and slides.—Slidably mounted in the transverse tool guides 5 are transverse tool slides 19 which are adapted to receive transverse tools 20, and each of these slides is provided upon its under side, as shown in Fig. 2, with a rack 21. The right-hand transverse tool slide 19, as shown in Fig. 2, is adapted to be shifted by a segment 22 forming part of a lever 23 fulcrumed on a pin 24 secured in the frame. At the lower end of this lever 23 is a pin 25 carrying a friction roller 26 adapted for engagement by a suitable cam to be described.

The left-hand transverse tool-slide 19, as shown in Fig. 2, has its rack 21 engaged by a segment 27 of a lever 28 fulcrumed upon a pin 29 secured in the frame and having another gear segment 30 at its opposite end which meshes with a gear segment 31 forming part of a bell crank lever 32 pivoted upon a pin 33 secured in the frame. On the free arm of this bell crank lever 32 is a pin 34 carrying a friction roller 35 to be engaged by a cam to be later described.

Longitudinal slide and its operating mechanism.—Slidably mounted upon the guides 6 is a longitudinally movable carriage 36 which is adapted to support the several longitudinally movable tools 37 and it is moved by mechanism common in the art and set forth in our application filed December 19, 1908, Serial No. 468,280, and comprising a pin 38 projecting through the frame and within the same and there carrying a friction roller 39 adapted for engagement with cams 40 and 41 carried by a cam drum 42 mounted upon a cam drum shaft 43 which is mounted centrally within the frame, as shown in Fig. 3, the cams being shown in dotted lines in this figure and partially in dotted lines and full lines in Fig. 1. This

cam and its drum is driven by a spur gear 44 rigid with it and mounted upon the shaft 43 which receives its motion from the main cam shaft to be described.

Main cam shaft and associated parts.— Rotatably mounted in the bearings 10, 11 and 12 is the main feed shaft 45, which receives its motion through a worm wheel 46 at the left end as shown in Fig. 1, and has secured to it and in alinement with the cam drum gear 40 a spur gear 47 meshing with the spur gear 44 and with another spur pinion 48 secured to a shaft 49 mounted in and extending through the gear bracket 14. This shaft 49 has on its opposite end a spur gear 50 removably secured thereto by means of a nut 51 and meshing with a change gear 52 loosely mounted on a stud 53, also secured in the bracket 14 and held on said stud 53 by means of a nut 54. This gear 52 is connected to the gear 55 by any suitable means and this gear 55 is adapted to drive a spur gear 56 carried by a clutch sleeve 57 having upon the end thereof clutch teeth 57′. This clutch sleeve 57 is loose upon the main feed shaft 45. In juxtaposition to the end of the sleeve 57 and next to the teeth 57′ is another sleeve 58 carrying a cam disk 59, shown in detail in Fig. 7 and Fig. 16 and carrying on one face thereof a cam 60 adapted for engagement with the roller 26 carried by the lever 23 which operates the right-hand transverse tool slide, as shown in Fig. 2, while on its opposite face is a cam 61 adapted to engage the roller 35 which is connected to the bell crank lever 32 which operates the other transverse tool slide 19. Loosely splined upon this sleeve 58 is a clutch member 62 having a groove 63 adapted for engagement by the end of a bell crank lever 64 fulcrumed upon a pin 65 secured to the frame and having its free arm 66 adapted for engagement by cams 67 and 68 carried by the transverse feed clutch cam wheel 69 rigidly secured to the main feed shaft 45. The clutch 62 is provided upon its face with clutch teeth 70 which are adapted when in proper position to engage with the clutch teeth 57′ of the clutch sleeve 57.

It is essential that the cam disk 59 should make at least one cycle of movements sometime during the time required by the main feed shaft 45 to make one revolution, and the cams 67 and 68 are therefore adjusted to bring about the starting and stopping of the motion of this cam disk 59 at some time within that period and since in almost all adjustments of the machine for various kinds of work the period of time occupied by the cam disk 59 in making one cycle is less than that occupied by the main feed shaft 45 in making one revolution, some means must be provided for holding the disk 59 against accidental movement and in readiness for the next cycle of operation, and this is brought about by a notch 59′ cut in the periphery of the disk 59, and engaged by a spring latch 71 mounted upon a stud 72 carried by the frame and having a point 73 adapted to engage in the notch 59′. A spring 74 carried by the frame bears against this latch and forces it toward the periphery of the disk.

By the foregoing arrangement it will be seen that when the main feed shaft 45 is rotated the longitudinally movable carriage will be moved forward and backward at the proper time by mechanism which has been described, and at the same time power will be transmitted through gears 47 and 48, change gears 50 and 52, gear 54 and gear 55 mounted upon the clutch sleeve 57, and if the clutch member 62 has its teeth in engagement with the clutch teeth 57′ by reason of the cam 68 on the cam wheel 69 having raised the arm 66 of the bell crank lever 64, then the power will be transmitted from the clutch member 62 to the sleeve 58 and to the transverse feed cam wheel 59 with the result that the cams 60 and 61 will cause the feeding of the transverse tools forward as the case may be. The springs 19′ cause these transverse slides to move backward into their normal position and out of operation when they are released by their cams.

It is obvious that the feature of varying the ratios of the gears 50 and 52 will operate to vary the feed of the transverse tools with respect to the longitudinally movable tools, and it is further quite obvious that this may be arranged in the reverse manner such that the speed of the longitudinal tools may be varied in a somewhat similar manner to the transverse tools without departing from the spirit and scope of the broad invention.

It will be seen from the description thus far that the spindles are driven by the spindle driving shaft 17 and the longitudinally movable tools, as well as the transversely movable tools, are fed from the main feed shaft 45. The spindle head is rotated by the main feed shaft 45 also, but, as before stated, this intermittent rotation forms the subject matter of the invention set forth in our prior patent and application so that it is not taken up at this time.

Power and change speed mechanism including clutch operating device.

This mechanism includes the primary driving element in this instance a pulley as well as suitable change speed gearing and clutch mechanism for controlling the same and for transmitting the fast and slow speed to the feeding mechanism. The function of the fast speed transmitted to the feeding mechanism is to cause the tools to be fed at a constant fast speed during their return and idle motion, while the function of the

slow speed transmitted to the feeding mechanism is to cause the tools to be fed slowly and this gearing is variable in order that the rate of feed of the tools during the working operation may be changed or varied to conform to different kinds of materials and work.

Power mechanism.—Mounted in suitable bearings 75 carried by the frame is a main driving shaft 76 having secured thereto a driving pulley 77 and spur gear 78. This spur gear 78 meshes with a spur gear 79 mounted upon a stud 80 secured to the frame, as shown in Fig. 4 and Fig. 15, and this spur gear 79 meshes with a spur gear 81 secured to a constant speed shaft 82, shown in Figs. 1, 4 and 5. This constant speed shaft 82 in turn is provided with a change gear 83 removably held in place by a nut 84 and driving a change gear 85 mounted upon the spindle driving shaft 17 and removably secured thereto by means of a nut 86.

From the description thus far of the power mechanism, it will be seen that the shaft 82 is driven at constant speed from the pulley and the shaft 17 is driven therefrom by gears 83 and 85 which may be varied in ratio one with respect to the other to cause the spindle driving shaft to rotate faster or slower as the case may be and as different work, materials or tools may require.

The transmission of power from the power mechanism of the machine already described to the main feed shaft 45 is accomplished by two sets of gearing one for bringing about the slow motion of the feed shaft and the other which brings about the fast motion and they will be described separately in order to clearly bring out their distinct functions.

Rigidly secured to the shaft 17 is a spur pinion 87 meshing with a gear 88 mounted loosely upon the constant speed shaft 82 and in turn meshing with a spur gear 89 rigid upon a counter shaft 90 supported in bearings 91 in the gear case 13 and extending out at the end of the machine, as shown in Figs. 5 and 6, where it is provided with a change gear 92 removably secured to the shaft by means of a nut 93 and meshing with another change gear 94 removably secured in place by a nut 95 upon the auxiliary worm shaft 96. This worm shaft 96 is mounted in bearings 97 in the gear case 13 and it has secured to it a worm 98 which meshes with a worm wheel 99 having a hub 100 provided with clutch teeth 101 upon the face thereof. This hub and worm wheel are loosely mounted upon the main worm shaft 102 which is mounted in suitable bearings 103 in the frame and has upon the left end thereof a squared portion 104 for receiving a hand crank. This worm shaft 102 extends tangentially with respect to the worm wheel 46 carried by the main feed shaft 45 and is provided with a worm 105 meshing with the worm wheel 46 and adapted to drive the same. This worm shaft 102 is further provided with a clutch member 106 loosely splined to it and having clutch teeth 107 adapted to coöperate with the clutch teeth 101, and clutch teeth 108 adapted for cooperation with another clutch member to be described. This clutch member 106 is still further provided with a groove 109, which is provided with suitable throwing means to be described.

It will be seen from the foregoing that when the clutch member 106 has its teeth 107 in engagement with the teeth 101 power will then be transmitted from the spindle driving shaft 17 through the spur pinion 87, gear 89 upon the counter shaft 90, change gears 92 and 94, auxiliary worm shaft 96, worm 98, worm wheel 99 through the clutch referred to, to the main worm shaft 102, when the worm 105 will drive the worm wheel 46 and the main feed shaft 45 at slow speed, this motion continuing as long as the clutch teeth 107 and 101 are in engagement.

The fast motion of the feed shaft 45 is brought about through a fast motion conveyed to the main worm shaft 102, and this gearing comprises a spiral gear 111 loosely mounted upon the main worm shaft 102 and having its hub provided with clutch teeth 112 which are adapted to coöperate with clutch teeth 108 carried by the clutch member 106. This spiral gear 111 is driven by a spiral gear 114 carried by the constant speed shaft 82 and shown best in Figs. 1 and 15.

It will be seen from this description of the fast gearing that the constant speed shaft 82 will transmit through the spiral gears the fast motion to the main worm shaft 102 and through the worm 105 and the worm wheel 46 the main feed shaft 45 will receive fast motion, which, therefore, is constant irrespective of changes which may be made in the slow speed gearing as previously described.

Clutch throwing mechanism.—When it is desired to have the feeding mechanism idle, or in other words when the main feed shaft 45 is to be idle, the lever 110 assumes a vertical position with both of its sets of clutch teeth out of engagement with the coöperating clutch teeth 101 and 112 and it is thrown from this position to the right or left, as the case may be, by the following mechanism. This lever 110 is fulcrumed upon a suitable pin 115 mounted in the frame and has a lower end portion 116 shown in dotted lines in Figs. 4, 5, in full lines in Fig. 6, and in dotted lines in Figs. 9, 11 and 13. This portion 116 of the lever carries a sleeve member 117 which receives a locking bolt 118 which, when the lever 110 is in vertical

position, is adapted to engage an opening 119 in the frame-work of the machine. This opening has a tapered mouth as shown at 120 for facilitating the entry of the bolt no matter what the position of the lever 110 may be, and when the tapered end 118′ of this bolt is brought into engagement with the tapered mouth 120 of the opening 119, it will cause the lever 110 to be shifted so as to bring the clutch member 106 into its mid position and out of engagement with either set of clutch teeth 101 or 112. This bolt is also provided with a reduced portion 121 and a tapered portion 122 from the main portion 118 to the reduced portion 121. A knob 123 is arranged on the end of the reduced portion to be engaged by the hand in manipulating the bolt into engagement with the opening 119.

Swiveled upon the pin 115 and in juxtaposition to the lever 110 is a throwing lever 124 which has therein a slot 125 equal in width to the diameter of the large part or main portion of the bolt 118. This slot is in the form of an arc of a circle having its center at the fulcrum point of the two levers 110 and 124, so that, as the lever 124 is moved about its fulcrum, the bolt 118 may move therein freely. The lever 124 is still further provided upon its lower end with a V-shaped point or projection 126 which is adapted to engage in one of two notches formed by walls 127, 128, 129 and 130 of a tappet or latch member 131 pivoted upon a stud 132 carried by the frame. A spring 133 tends to hold this tappet or latch member in engagement with the point or projection 126. This structure is clearly shown in Figs. 5, 6, 9, 11 and 13. The arrangement of the slot in the arm and of the relative position of the point or projection 126 and the notches formed by the walls mentioned in the tappet or spring latch 131 is such that when the throwing lever 124 has its projection 126 in the notch formed by the walls 127 and 128, or the notch to the right, the left end of the slot 125, as shown in the figures, is in engagement or just touching either the main portion of the bolt 118 or its reduced portion according to the position of the bolt and this position determines the position of the lever 110 so that if the bolt is locked into the opening 119, then the wall at the left end of the slot 125 does not engage the reduced portion 121 of the locking bolt, and when the projection is in the notch formed by the walls 129 and 130, the right end wall of the slot 125 does not engage the reduced portion so that irrespective of the slot 124 or irrespective of its position, it has no effect upon the lever 110, and since, as before stated, this lever is in neutral position when the bolt is locked, there is no power transmitted to the main feed shaft, and it may be rotated by hand by means of a hand crank (not shown) applied to the squared end 104 of the main worm shaft, but assuming that the lever 110 is in neutral vertical position and the lever 124 is to the right, as shown in Fig. 9 and the bolt 118 be pulled out from engagement with the opening 119 in the frame, then the tapered portion 122 of this bolt engages the left end wall of the slot and causes the upper end of the lever 110 to be shifted sufficiently to the left to cause the engagement of the clutch teeth 101 and 107, thus bringing about, in this instance, the slow drive of the main feed shaft. Upon the shifting of the throwing lever 124 to the left from the position shown in Fig. 9 the right-hand wall of the slot 125 will engage the bolt after the point 126 of the lever 124 has moved up the wall 128 and over the top into the next notch formed by the walls 129 and 130, when the spring operating upon the tappet 131 will cause the tappet to force the face 129 against the inclined face of the projection 126 and will force the lever 124 quickly to the left carrying the bolt 118 to the left and shifting the lever 110 to the right causing the coupling of the clutch teeth 113 and 112 and bringing about the fast movement of the main feed shaft. The slot 125 is of a length such that the projection 126 must pass over the point formed between the two notches in either direction before the end wall of the slot engages the bolt so that the upper end of the lever or the clutch member is not moved out of engagement with one set of clutch teeth until the tappet 131 shifts the lever 124 quickly in a direction to bring about the opposite coupling of the clutch.

The lever 124 is provided with an arm 134 having a pin 136 adapted to be engaged by a cam 137 carried by a plate 138 secured in a slot 46′ in the face of the worm wheel 46 and this cam 137 engages the pin 136 and shifts the lever 124 to the left. Another cam 139 is mounted on a plate 140 which is also secured in the groove 46′ on the face of the worm wheel 46. This cam 139 engages the pin 136 and shifts the lever 124 to the right until the projection 126 passes over the point on the tappet formed between the two notches as just described.

It will be noted from the foregoing construction that when the bolt 118 is locked in the frame so that the clutch member is thrown out of operation and the machine is operated by hand during the setting up and adjustment, etc., that the lever 124 will be thrown from one side to the other by the cams 137 and 139 and the clutch will not be operated, and when the feeding mechanism is again to be connected to the power the operator pulls the bolt from its connection with the frame so that the tapered portion 121 engages the end wall of the slot in the throwing lever with the result that the

clutch lever is thrown to the right or left in the manner previously described, but the position into which this clutch lever is thrown depends upon the particular end wall of the slot which is engaged by the tapered portion 121, and this feature is under the control of the throwing lever which will always be in the proper position by reason of the fact that this throwing lever is controlled in its movement by the cams carried by the worm wheel on the feed shaft, and if there has been any hand operation of the feeding mechanism so that for example the throwing lever passes from the fast speed position at the left to the slow speed position at the right, then the bolt, when pulled out, may only shift the clutch lever so that the clutch member is thrown to the left, in which case slow speed or the working speed will be conveyed to the feed shaft.

Complete operation.—Assuming that stock has been supplied to each one of the spindles and that suitable longitudinally movable tools have been mounted in the longitudinally movable carriage and transverse cutting tools have been suitably mounted in the transverse tool slides and that power is supplied to the driving pulley 77, then power is transmitted to the constant speed shaft 82 and through the proper change speed gears 83 and 85 to the spindle driving shaft 17, which, through the gears 16, transmits the proper rotation or driving to the spindles. We will also assume that the bolt 118 has its end engaged in the opening 119 in the frame. The stock is then rotating at the proper speed for work according to the material, this being determined by the use of the proper change speed gears 83, and 85, but there is no feeding of the longitudinally movable carriage and transverse tool slides. The operator then grasps the knob 123 of the bolt 118 and pulls it out until the main portion of the bolt is within the slot 125 and brings about the shifting of the clutch to the left or right as the case may be due to the tapered portion of the bolt moving the clutch lever as described. In the instance shown in Fig. 13, the pulling of the bolt outward would cause the clutch member to be thrown to the left since the tapered portion of the bolt would move the lower end of the member 110 to the right. The feeding mechanism for both the longitudinally movable carriage and the transverse tools is then operating at slow or working speed. This continues until in the instance referred to and as set forth in Fig. 5, the cam 137 engages the pin 136 on the arm 134 of the lever 124 when the latter will be moved slowly and the point or projection 126 will travel up the face 128 of the tappet 131 until the point passes over the point formed between the two notches when the right end wall of the slot 125 will engage the bolt 118 and the spring tension exerted upon the tappet will cause the face 129 to cam the lever 124 to the left quickly and bring about the coupling of the clutch teeth 113 with the clutch teeth 112 and causing the fast motion of the parts. This fast motion is one which is used in the returning of the tools and in the operations preparatory to feeding. This fast motion continues until the cam 139 engages the pin 136 and shifts the lever 124 in the opposite direction. This cycle of operation continues until the operator shifts the bolt 118 out of engagement with the lever 124 and into engagement with the opening 119 in the frame.

If the operator should desire to adjust the feed of the transversely movable tools relative to the feed of the longitudinally movable tools, this may be done by supplying gears of the proper ratio for the desired speed in place of the change gears 50 and 52. This, of course, is done when the machine is set up and before the feed is thrown into operation by the clutch mechanism already described. During operation the rotation of the feed shaft 45 causes the rotation of the cam disk 69 and the rotation of this disk causes its cams 67 and 68 to engage the arm 66 of the bell crank lever 64 and shift it in a manner such that the clutch member 62 is shifted back and forth at the proper time. When the clutch member 62 is shifted to the left, as shown in Fig. 1, the power is transmitted from such clutch member 62 to the sleeve 58 and to the transverse cam wheel 59, with the result that the cams 60 and 61 will cause the feeding of the transverse tools forward at the proper time, while the shifting of the clutch member 62 in the opposite direction with its teeth out of engagement with the clutch teeth 57′ will, of course, disconnect the transmission of power to the cross feed cam wheel 59 so that the transverse tools remain idle until the clutch member is again shifted, through the mechanism described, to the left.

Having described our invention, we claim:—

1. In a metal working machine, stock holding and rotating mechanism, a single driving element, two sets of tools, a common feeding element for both sets of tools, reciprocating mechanism between one set of tools and said feeding element, driving mechanism between the driving element and the common feeding element, means whereby variable speed devices may be substituted in said driving mechanism, driving mechanism between the common feeding element and the second set of tools, and means whereby variable speed devices may be substituted in this driving mechanism to the second set of tools.

2. In a metal working machine, stock holding and rotating mechanism, a single

driving element, a longitudinally movable tool, transversely movable tool, a common feed shaft for both tools, driving connections between the common feeding element and the longitudinally movable tools, driving mechanism between the driving element and the common feed shaft, means whereby variable speed devices may be substituted in such mechanism, a complete reciprocating mechanism for the transverse tools and operated by the feed shaft, and means whereby variable speed devices may be substituted between the reciprocating mechanism and the common feeding shaft.

3. In a metal working machine, in combination, a stock spindle, a spindle driving shaft, longitudinally movable tools, transversely movable tools, a feed shaft therefor, a driving element, gearing between said driving element and the spindle driving shaft, means whereby the speed of the feed shaft may be varied through such gearing, a fast speed train of gearing between the driving element and the tool feed shaft whereby the latter is driven at constant speed during the idle motion of the tools, a slow speed train of gearing between the driving element and the tool feed shaft for the working operation, means whereby gears of varying ratios may be substituted in the slow speed train of gearing, suitable feed connections between the tool feed shaft and the longitudinally movable tools, suitable gearing between the tool feed shaft and the transversely movable tools, means whereby gears of varying ratios may be substituted in this train of gearing between the tool feed shaft and the transversely movable tools, and means for coupling and uncoupling the driving element with the fast and slow speed train of gears for operating the tool feed shaft.

4. In a metal working machine, in combination, a stock spindle, means for driving the same, a driving element, a longitudinally movable tool, a transversely movable tool, a feed shaft for both tools, a fast and slow speed train of gearing between the driving element and the tool feed shaft, means for automatically coupling and uncoupling the same at the proper time, suitable gearing between the tool feed shaft and the transversely movable tool, and means whereby gears of varying ratios may be substituted in this train of gearing.

5. In a metal working machine, in combination, a plurality of stock spindles, a single driving element, gearing between the driving element and the stock spindles whereby they are driven, a longitudinally movable tool, a transversely movable tool, a feed shaft for both tools, fast and slow speed trains of gears between the driving element and the tool feed shaft, means between the tool feed shaft and the longitudinally movable tool for causing the operation of the same, a train of gearing between the tool feed shaft and the transversely movable tool, means for throwing the same into and out of operation automatically, and means whereby gears of varying ratios may be supplied in this train of transversely movable tool gearing to vary the feed of the transversely movable tool relative to the feed of the longitudinally movable tool.

6. In a metal working machine, stock holding and rotating mechanism, a single driving element, a longitudinally movable tool, transversely movable tool, a common feed shaft for both tools, driving connections between the common feeding element and the longitudinally movable tools, driving mechanism between the driving element and the common feed shaft, means whereby variable speed devices may be substituted in such mechanism, a complete reciprocating mechanism for the transverse tools and operated by the feed shaft, means whereby variable speed devices may be substituted between the reciprocating mechanism and the common feeding shaft, and means for coupling and uncoupling the driving mechanism for the transversely movable tools.

7. In a metal working machine, in combination, a plurality of stock spindles, a single driving element, gearing between such element and the stock spindles, longitudinally movable tools, transversely movable tools, a feed shaft for all of said tools, a fast and slow speed train of gears between the driving element and the tool feed shaft, a cam shaft provided with cams for shifting the transversely movable tools, a clutch member for driving the cam shaft, another clutch member connected to the tool feed shaft by a train of gears, a coupling clutch member between said two clutch members, means for automatically operating the same, and means whereby gears of varying ratios may be substituted in the train of gears leading from the tool feed shaft to the second mentioned clutch member whereby the feed of the transversely movable tools may be varied with respect to the movement of the longitudinally movable tools.

8. In a metal working machine, in combination, stock holding and rotating mechanism, a driving element, suitable tools, a feed shaft therefor, a fast speed train of gearing adapted to be driven at a constant speed by said driving element, a slow speed train of gearing adapted to be driven by the driving element, means for uncoupling the driving element from the feed shaft and means for insuring the coupling of the tool feed shaft with the proper train of gearing in accord with the step of the cycle of op-

eration of the machine upon the application of power of the feeding mechanism in starting.

9. In a metal working machine, in combination, stock holding and rotating mechanism, a driving element, suitable tools, a feed shaft therefor, a fast speed train of gearing for operating the tool feed shaft and adapted to drive the same at a constant speed, a slow speed train of gearing adapted to be driven by the driving element and arranged to operate the tool feed shaft, coupling mechanism included in these trains of gearing and adapted to cause the drive to be transmitted through such gearing to the feed shaft, and a member under the control of the feeding mechanism and adapted when starting the machine to govern the coupling mechanism whereby the proper train of gearing to operate the tool feed shaft in accord with the step in the cycle of operation of the machine.

10. In a metal working machine, in combination, stock holding and rotating mechanism, a driving element, suitable tools, a tool feed shaft, two trains of gears between the driving element and the tool feed shaft, each of said trains performing a separate function, suitable clutch mechanism for connecting either of said trains of gearing with the tool feed shaft, a member for controlling the clutch mechanism to cause the proper train of gearing to be thrown into operation at the proper time when starting the machine, and devices operated by the tool feed shaft for governing said member to bring about the coupling of the proper train of gears at the proper time.

11. In a metal working machine, in combination, stock holding and rotating mechanism, a driving element, suitable tools, a tool feed shaft, two trains of gears between the driving element and the tool feed shaft, each of said trains performing a separate function, suitable clutch mechanism for connecting either of said trains of gearing with the tool feed shaft, a member for controlling the clutch mechanism in starting to cause the proper train of gearing to be thrown into operation at the proper time, and cams operated by the tool feed shaft for governing said member to bring about the coupling of the proper train of gears at the proper time.

12. In a metal working machine, in combination, a stock spindle, a driving element, suitable gearing therebetween, a suitable tool, a feed member therefor, suitable gearing between this feed member and the driving element, a clutch included in said gearing, a clutch shifting lever for said clutch lever, a lever for throwing said clutch lever and having its pivot coincident with that of the clutch lever, a connection between the throwing lever and the clutch lever whereby there is lost motion between the two, means for shifting the throwing lever slowly until the lost motion between it and the clutch lever is taken up, and a spring actuated element adapted to then shift the throwing lever and cause the rapid movement of the clutch lever.

13. In a metal working machine, in combination, a stock spindle, a driving element, suitable gearing therebetween, a suitable tool, a feed member therefor, suitable gearing between this feed member and the driving element, a clutch included in said gearing, a lever for said clutch, a throwing lever for said clutch lever and having its pivot coincident with that of the clutch lever, a connection between the throwing lever and the clutch lever whereby there is lost motion between the two, means for shifting the throwing lever slowly until the lost motion between it and the clutch lever is taken up, and a spring actuated member having a cam face adapted to engage the throwing lever and cause it to rapidly throw the clutch lever.

14. In a metal working machine, in combination, a stock spindle, a driving element, a tool, a feed shaft therefor, suitable gearing between the feed shaft and the driving element, a clutch included in said gearing, a clutch lever, a throwing lever for the clutch lever and having its pivot coincident with that of the clutch lever, a bolt carried by one of said levers and passing through a slot in the other whereby there is lost motion between the two, means for shifting the throwing lever slowly, and a spring actuated device for finally causing the rapid movement of the throwing lever and thus causing it to throw the clutch lever with the same rapid motion.

15. In a metal working machine, in combination, a stock spindle, a driving element, suitable gearing therebetween, a suitable tool, a feed member therefor, suitable gearing between this feed member and the driving element, a clutch included in said gearing, a lever for said clutch, a throwing lever for said clutch lever and provided with a slot, a bolt slidably mounted in the clutch lever and passing through the slot in the throwing lever and adapted to govern the operation of the clutch lever by the throwing lever, means for shifting the throwing lever slowly in both directions until the lost motion between this throwing lever and the clutch lever is taken up, and a spring actuated member for causing a final quick movement of the throwing lever.

16. In a metal working machine, in combination, a stock spindle, a driving element, suitable gearing therebetween, a suitable tool, a feed member therefor, suitable gearing between this feed member and the driving element, a clutch included in said gear-

ing, a lever for said clutch, a throwing lever for said clutch lever, and provided with a slot, a sleeve carried by the clutch lever, a bolt slidably mounted in said sleeve and adapted when in one position to engage the frame and hold the clutch lever in neutral position, and when in another position to engage in the slot of the throwing lever, means for shifting the throwing lever slowly in both directions until the lost motion is taken up between the end of the slot and the bolt, and a spring actuated member adapted to engage the throwing lever and cause it to quickly shift the clutch lever.

17. In a metal working machine, in combination, a stock spindle, a driving element, suitable gearing therebetween, a suitable tool, a feed member therefor, suitable gearing between this feed member and the driving element, a clutch included in said gearing, a lever for said clutch, a throwing lever for said clutch lever and adapted to always assume the proper position with respect to the feeding of the tools, a bolt carried by the clutch lever and adapted when in one position to lock the clutch lever against movement and when in another position to engage the throwing lever and shift the clutch lever into the proper position relative to the feed, and means for causing a final quick movement of the clutch lever.

18. In a metal working machine, in combination, stock holding and rotating mechanism, a driving element, suitable tools, feeding mechanism, fast and slow speed gearing between the driving element and the feeding mechanism, means for uncoupling both the fast and slow speed gearing from the feeding mechanism, and means for insuring the recoupling of the feeding mechanism with the proper gearing in accord with the step in the cycle of operation of the machine.

In testimony whereof we affix our signatures in presence of two witnesses as follows.

LEON F. SCHULZE.
ROBERT SCHULZE.

Witnesses:
F. D. SHOOK,
C. H. TRESCH.