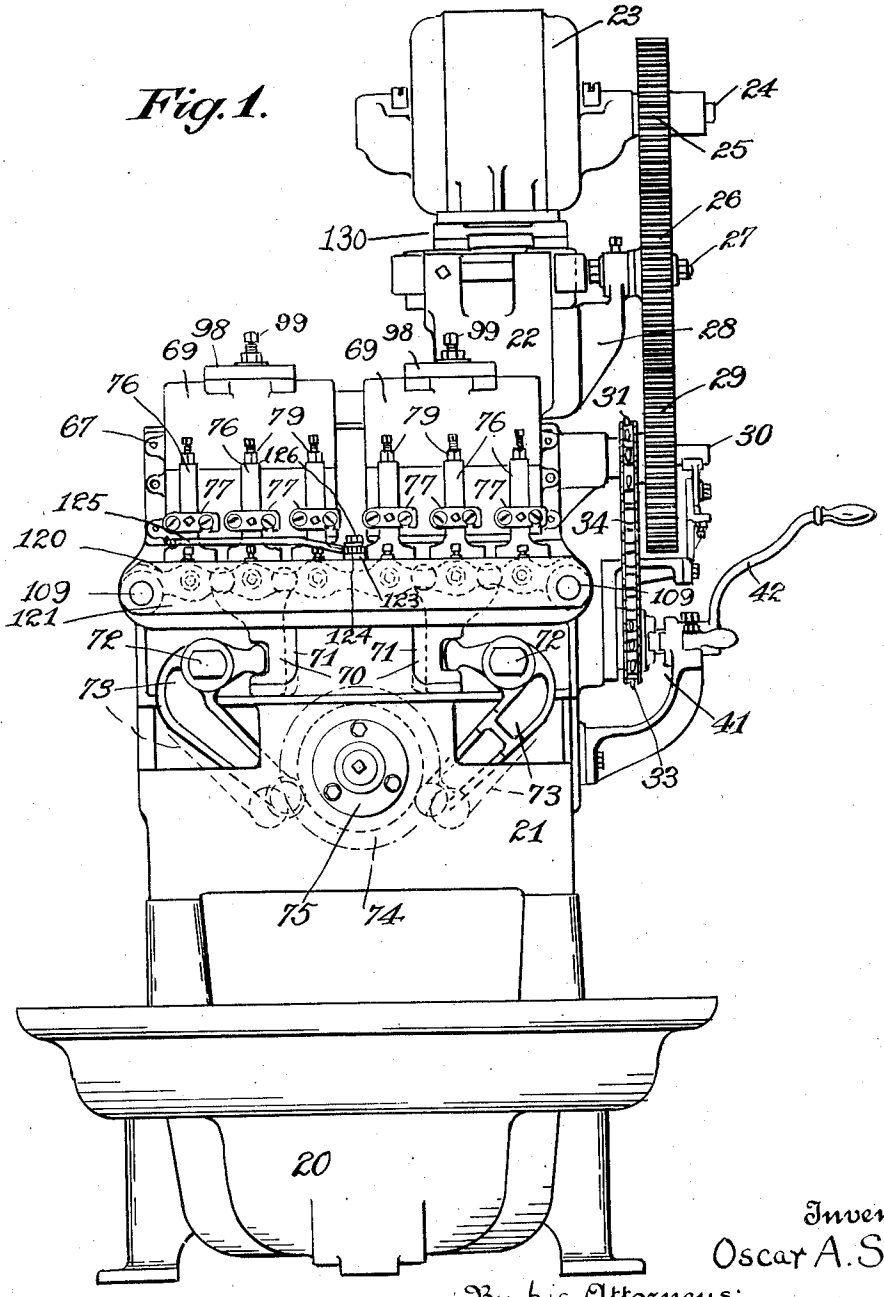
Mar. 3, 1925. 1,528,226

O. A. SMITH

MULTIPLE SPINDLE LATHE

Filed Oct. 26, 1921 5 Sheets-Sheet 1

Fig. 1.



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Weed & Gray

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MULTIPLE SPINDLE LATHE

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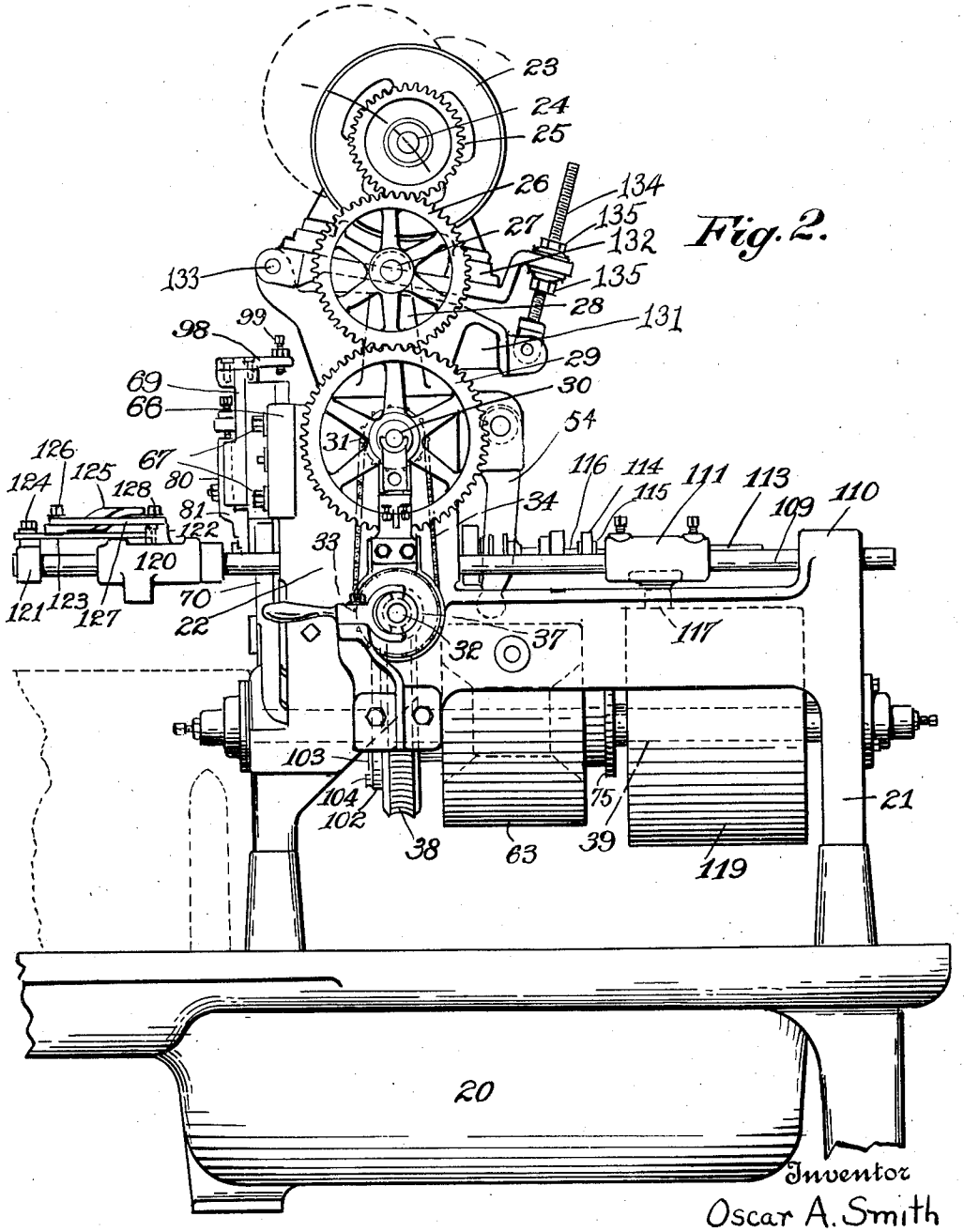


Fig. 2.

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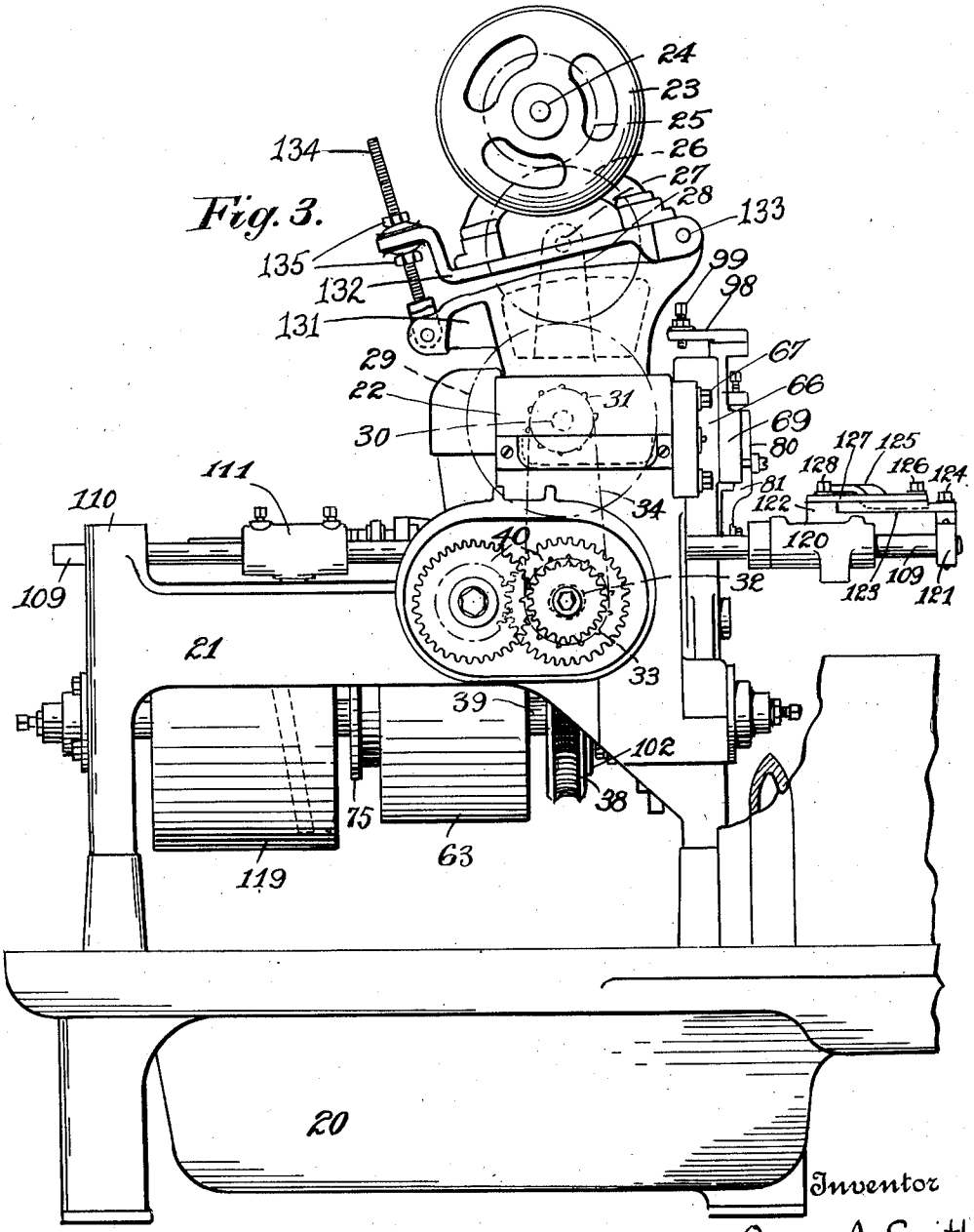
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MULTIPLE SPINDLE LATHE

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Fig. 3.



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O. A. SMITH

MULTIPLE SPINDLE LATHE

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Fig. 4.

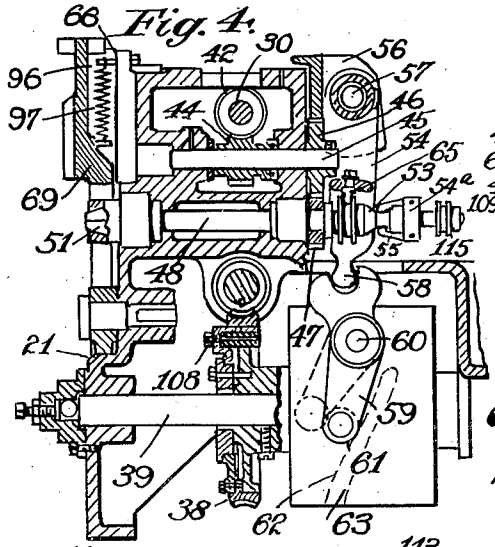


Fig. 5.

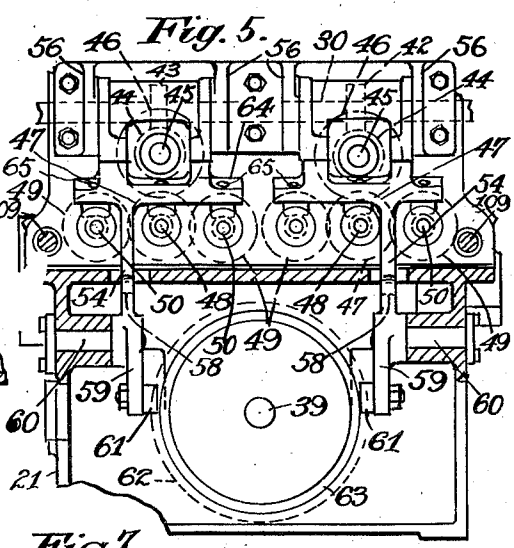


Fig. 6.

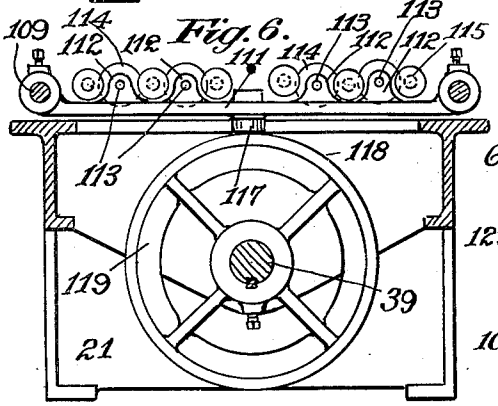


Fig. 7.

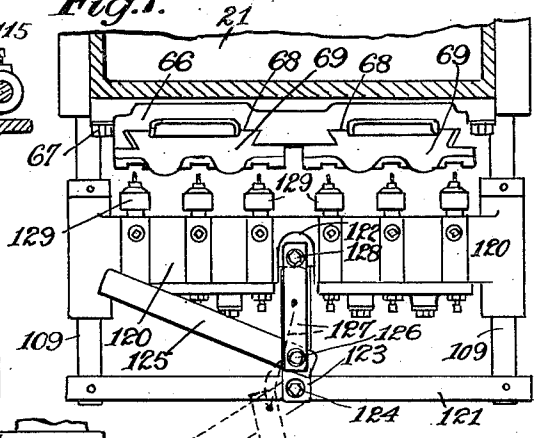


Fig. 8.

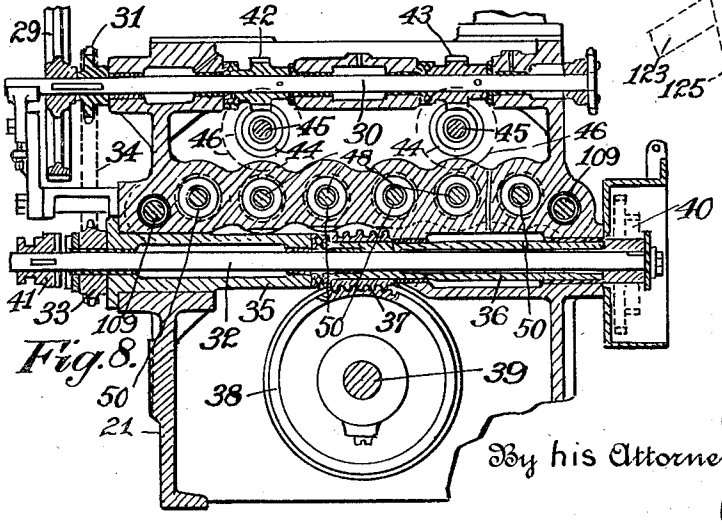
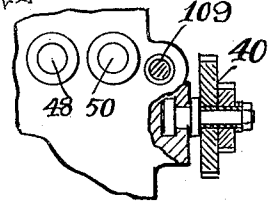


Fig. 9.



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O. A. SMITH

MULTIPLE SPINDLE LATHE

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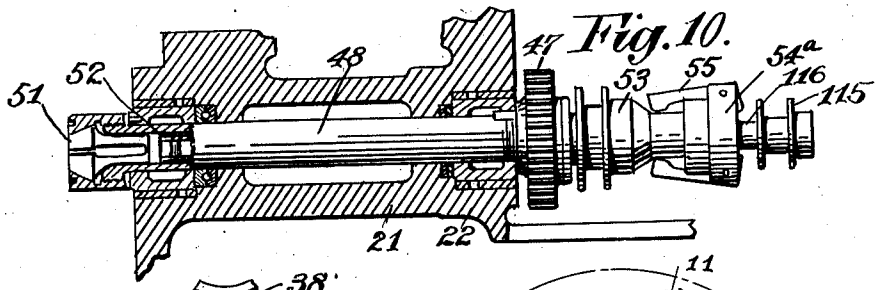


Fig. 10.

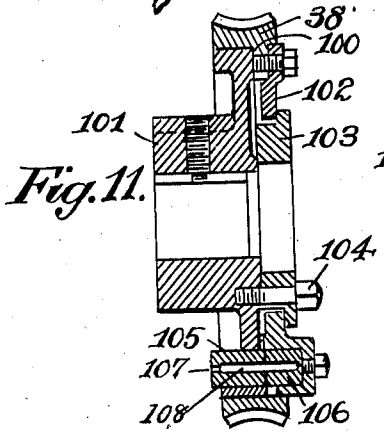


Fig. 11.

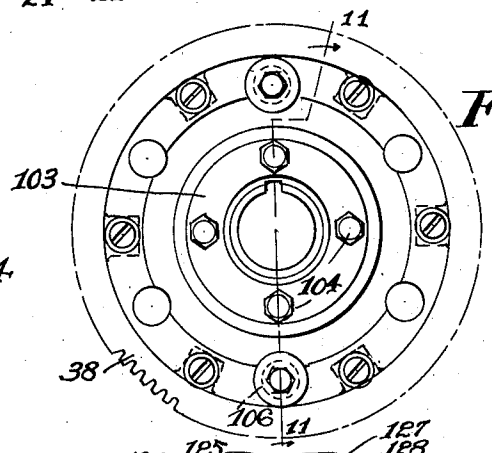


Fig. 12.

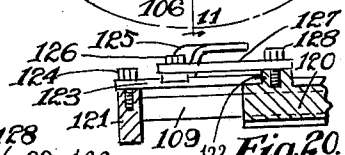


Fig. 20.

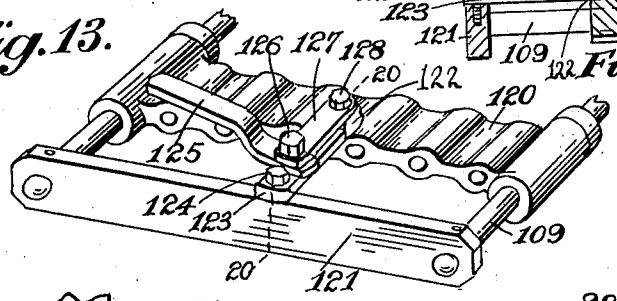


Fig. 13.

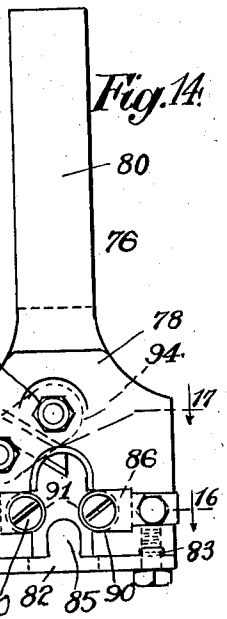


Fig. 14.

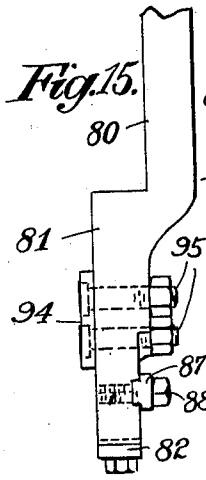


Fig. 15.

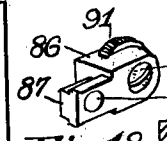


Fig. 16

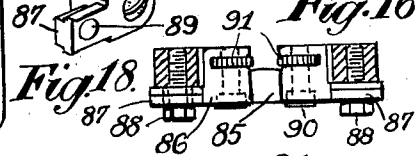


Fig. 18.

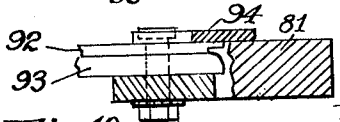


Fig 19.

Fig. 17.

Inventor

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Patented Mar. 3, 1925. 1,528,226

UNITED STATES PATENT OFFICE.

OSCAR AUGUST SMITH, OF EAST CLEVELAND, OHIO, ASSIGNOR TO THE NATIONAL ACME COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

MULTIPLE-SPINDLE LATHE.

Application filed October 26, 1921. Serial No. 510,412.

To all whom it may concern:

Be it known that I, OSCAR A. SMITH, a citizen of the United States, residing at East Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Multiple-Spindle Lathes, of which the following is a specification.

This invention relates to multiple spindle machines, the object thereof being to provide an automatic machine of this kind having six parallel spindles, and which is comparatively simple in construction and operation, compact and economical, and efficient in use.

Another object of this invention is the provision of an improved machine of this class so constructed and organized that a larger number of operations may be performed upon the work than heretofore in a definite period of time, and at the same time a larger output obtained.

A further object of this invention is the provision of a multiple spindle machine provided with a tool slide so organized that it can be readily connected and disconnected with the operating mechanism thereof, whereby it may have a shiftable movement or be shifted independently of said operating mechanism. In other words as shown the present machine is provided with means for automatically reciprocating an end tool slide, and also with means for controlling the movement thereof, both of said means constructed for simultaneous movement at predetermined times, and one thereof shiftable relatively to the other at other times. As a result of the foregoing therefore the tool slide may be released or shifted into inoperative position at any time during the operation of the machine without necessitating the stopping of the machine, thereby facilitating and permitting for instance ready access to and removal of either the end tools or vertical slide tools, or other parts as desired.

Hence many advantages reside in the present improved end tool slide construction. For example ready and facile access to the tools is permitted at all times during operation of the machine, inasmuch as it will be obvious that where all the operating mechanisms for pulling the end and side tools to the work are located adjacent to the rear of the machine, instead of the front where the tools are operating, and where the end tools may be shifted out of operation without otherwise disturbing the various mechanisms, a considerable saving in time and expense during use results.

A further object of this invention is to provide a multiple spindle machine combining mechanism for accomplishing a large number of steps in the complete operation of turning out a finished article such as a knurled nut, such mechanism including an improved combined side tool and work stop so constructed to operate in conjunction with the drills of the end tool slide as to perform all of the necessary steps in a single cycle of operation.

As will hereinafter be seen, the present improved machine, is constructed preferably for the purpose of making knurled nuts such as those used in battery terminals and all the tools are adapted to operate upon the six spindles simultaneously for the purpose of performing the various steps. The various tools in this machine are controlled by a single camming means and comprise stop mechanism, mechanism for knurling, mechanism for beading or grooving, cut-off mechanism, and mechanism for drilling the nuts, all of said mechanisms being operative conjunctively and simultaneously upon the several spindles.

Other objects of this invention will appear in the following description thereof, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters indicate corresponding parts in the several views and wherein Fig. 1 is a front elevation of the machine; Fig. 2 is a side elevation thereof; Fig. 3 is a side elevation thereof illustrating the opposite side of the machine; Fig. 4 is a longitudinal view, partly in section and partly broken away illustrating particularly the wedge operating mechanism; Fig. 5 is a cross section partly broken away illustrating particularly the wedge operating mechanism shown in Fig. 4; Fig. 6 is a rear end view partly in section illustrating the combined drill and feed operating slide; Fig. 7 is a fragmentary top plan view illustrating the end tool slide; Fig. 8 is a sectional view taken through the worm and main drive shafts; Fig. 9 is a detail end view illustrating in section the change gear mechanism

of the worm shaft; Fig. 10 is a detail view partly in section illustrating the work spindle and operating parts; Fig. 11 is a detail sectional view of the safety mechanism for the cam shaft taken on line 11—11 of Fig. 12; Fig. 12 is a detail end view of the construction shown in Fig. 11; Fig. 13 is a detail perspective view illustrating the improved end tool slide; Fig. 14 is a front view of the combination side tool and work stop; Fig. 15 is a detail side view thereof; Fig. 16 is a cross section taken substantially on line 16—16, Fig. 14, and in the direction of the arrows; Fig. 17 is a sectional view taken on line 17—17, Fig. 14 and in the direction of the arrows; Fig. 18 is a detail view of a knurling tool; Fig. 19 is a view of a product of the machine; and Fig. 20 is a cross section of the drill slide on line 20—20 of Fig. 13.

This invention is an improvement in part over my prior patent for multiple spindle lathes, No. 1,318,116, patented October 7, 1919, and in general the present invention comprises a suitable framework adapted to form a housing or bearing for the various operating parts, the same including in the present instance six work spindles, an improved main end tool slide adapted to be shifted or reciprocated relatively thereto, and having independent means for releasing or locking the same in operative position, improved top tool slides shiftable relatively to the work spindles and including adjustable tools and adjustable work stops, a pair of wedge operating mechanisms operating upon the six work spindles, a single camming means for controlling the main end tool slides and the feeding of the stock, and a single cam shaft for operating the same and the wedge operating mechanism.

In its preferred form this improved machine comprises a suitable pan 20 and bed 21, the latter having an upwardly extending portion 22 adapted to form a housing or bearing for certain of the operating parts. The machine may be driven by any suitable motive power such as an electric motor 23 suitably carried by the framework, the armature shaft 24 thereof carrying a gear 25 meshing with a gear 26 carried by a stud 27 mounted in the bearing extension 28. Gear 26 is adapted to mesh with the gear 29 of the main driving shaft 30 mounted in suitable bearings transversely of the machine. Adjacent to the inner side of the gear 29 the main driving shaft is provided with a suitable sprocket gear 31. Beneath the main driving shaft 30 and preferably in substantial parallelism therewith transversely of the machine, is mounted a worm shaft 32 carrying a sprocket gear 33 driven from the gear 31 by means of a sprocket chain 34, as illustrated particularly in Figs. 1 and 8. As will be seen the worm shaft 32 is carried between the work spindles and the cam shaft hereinafter described, one end thereof being carried in bearing or bracket 35 and the opposite end thereof in sleeve 36 having a bearing in the bore of the bed. A worm 37 is keyed to the sleeve 36 and is adapted to mesh with a worm gear 38 mounted upon the cam shaft 39. As will be seen the worm shaft 32 is provided at one end with a suitable change gear set 40, this construction being such as to permit the worm shaft 32 to drive through the change gears the sleeve 36 and hence worm 37 at different speeds as desired. A detail description of the change gears is not deemed necessary herein as the same is fully described in my prior patent hereinbefore mentioned. Upon the opposite end of the worm shaft 32 is mounted a suitable clutch mechanism indicated in general at 41. Inasmuch as this mechanism is well known in National Acme machines and described in my prior patent hereinbefore mentioned a detail description herein is not deemed necessary. The cam shaft 39 may be operated or turned over if necessary from the worm shaft by means of a handle or hand lever 42, suitably attached to the end of the shaft adjacent to the clutch mechanism 41.

Referring particularly to Figs. 4, 5, 8, and 10, it will be seen that the main driving shaft 30 is provided in spaced relation with a pair of worm gears 42 and 43 meshing respectively with a pair of gears 44 carried by a pair of spindle driving shafts 45 suitably mounted in bearings in the extended portion 22 of the framework. At their outer free ends the shafts 45 are each provided with a spur gear 46 adapted to mesh with a smaller spur gear 47 fastened to a work spindle 48. It will be seen, referring particularly to Fig. 5, that each gear 47 on its work spindle located at either side of the machine meshes with a pair of gears 49 carried by a pair of work spindles 50 mounted at opposite sides of each work spindle 48 hereinbefore described. Six work spindles are therefore provided in the present machine, each mounted in suitable bearings in the framework, two thereof being driven directly from the spindle driving shafts 45, and may be termed driving work spindles, and four thereof being driven in pairs directly from the driving work spindles. The work spindles may be constructed in any suitable manner and in the present instance comprise chucking mechanism 51, push tube 52, wedge 53, a finger holder or block 54[a], and fingers 55 for operating in a predetermined manner the push tube and thereby the chucking mechanism for gripping or releasing the work. This mechanism is well known in National Acme machines and therefore a detail description is deemed unnecessary. As will be seen particularly from Figs. 4

and 5 the wedges 53 for the six spindles are operated by means of a pair of cam controlled wedge operating levers, each lever so constructed as to operate upon three spindles. To the rear of the bearing or housing extension 22 of the framework is bolted or otherwise secured a bracket 56. Pivoted in suitable extensions formed as a part of this bracket by means of pins 57, are a pair of downwardly extending wedge operating levers 54, the lower ends thereof extending down between each outer pair of work spindles and to a suitable distance below the same, and so constructed as with a semi-circular head 58 to cooperate with suitable slots formed at the upper ends of a pair of cam controlled levers 59, pivoted as at 60 in the framework, and having rollers 61 adapted to cooperate with suitable cams 62 carried on the cam drum 63, the latter being mounted for rotary movement upon the cam shaft 39. As will be seen from Fig. 5, the wedge operating levers 54 comprise a horizontal portion 64, the same forming a support for the wedge operating shoes 65, three thereof being carried by each operating lever and located directly above corresponding work spindles so as to enter suitable grooves in the wedges 53. Thus it will be readily observed that upon rotation of the cam drum 63, the levers 59 will be shifted as indicated in dotted lines in Fig. 4 thereby shifting the swinging wedge operating levers 54 and causing the shoes 65 to shift their corresponding wedges 53 relatively to the finger block 54a, thus operating the chucking mechanism for the work spindles.

Bolted as at 67 to the front end of the bed extension 22 directly above the work spindles 48 and 50 is a side tool slide rest 66 (see Figs. 1, 2, 3, and 7). In this slide rest 66 are machined two dovetail slideways 68 (see Fig. 7) for the reception of two slides 69 which are maintained in the slideways in any suitable and conventional manner. Each of these slides is provided with a downwardly extending portion 70 (see Fig. 2), each projecting between a pair of spindles and to a suitable distance below the same, the lower ends thereof being provided with squared portions or hooks 71. Carried by a pair of studs 72 (see Fig. 1) is a pair of pivoted slide operating levers 73, each of which has an end projecting into the squared or hooked portions 71 of the downwardly extending members 70 of the slide 69, and the lower ends of these levers are in contact with suitable cams 74, suitably carried by a disc 75 on the cam shaft 39. It will be readily seen that the slides 69 are shifted upwardly and downwardly from the cam shaft 39 by means of levers and cams 74, the purpose thereof being to bring the top tool slides into suitable position for the tools thereof to engage the work and also at predetermined times to carry such tools away from the work.

Directly above each work spindle and mounted in suitable grooves provided therefor in the tool slides 69 are housed the knurling, forming, and cut-off tool holders 76 here shown as six in number corresponding to the six work spindles. These holders are secured to the slides by means of suitable clamps 77 and clamp screws. The combination knurling, forming, and cut-off tool and work stop 78 is secured to the lower end of each of these holders 76, the latter being adjusted by means of an adjusting screw 79 at the upper end thereof for the purpose of adjusting the depth of cut and operation of the tools.

This combination tool and work stop as illustrated particularly in Figs. 14 to 18 inclusive comprises a suitable shank portion 80 terminating at its lower end in an enlarged portion 81. At the lower end of the body portion 81 is mounted a work stop 82, the same having suitable tongues 83 cooperating with tongue-ways formed in the body portion, the parts being secured together for transverse adjustment by means of suitable slots and screws 84. Thus it will be readily seen that the position of the stop slide 82 may be readily and effectively adjusted relatively to the tool holder and the work. This stop slide 82 is provided with an integral upwardly extending stop 85 which is adapted to act as a work stop proper. Above the stop slide the body portion 81 is cut away or recessed at each side of the center thereof for the purpose of housing a pair of adjustable slides 86. The latter are provided with suitable guide members 87 adapted to cooperate with guideways formed in the holder, the slides being secured to the body portion as by means of bolts 88 and slots 89 for adjustment relatively to each other. In suitable slots formed in the inner ends of these slides and rotatably carried as by means of suitable pivot screws 90, are knurling tools 91, the same being adjustable relatively to each other in accordance with the size of the work. Carried in a suitable angular slot directly above one of these knurling slides are a pair of tools 92 and 93, one thereof comprising a cut-off tool and one thereof a forming tool. These tools are held in position by a suitable clamp plate 94 releasably held in position by means of suitable bolts 95. Fig. 14 shows the outer side of the combination tool or in other words the side opposed from the front face of the spindle, the stop 85 in the present instance being shown in position so that the outer face will be substantially flush with the outer faces of the knurling slides 86, the inner face of the stop being located outside the vertical plane of the knurling tools 91 as illustrated in Fig. 16.

It will be understood of course that by loosening the bolts 88, the knurling rollers may be adjusted in any suitable relative position, and that by loosening the clamping plate 94, the forming and cut-off tools 93—92 may be adjusted as desired. Also by loosening the bolts 84 the stop slide 82 will be adjusted relatively to the work, it being of course understood that it is provided with suitable slots to permit such adjustment (slots not shown). This improved combination tool however, forms the subject matter of a divisional application Serial No. 529,930 filed January 17, 1922. In a suitable recess 96 of the slide rest (see Fig. 4) are located return tension springs 97, the upper ends of which are fastened to the slide rest 66 by suitable pins, and the lower ends fastened or connected to the slides 69, the purpose of these springs being to take up the shock of the tools when cutting on the stock and thus act as cushioning means for steadying the cut.

To the upper portion of each slide 69 is bolted a stop plate 98, the same having each a rearwardly extending portion projecting over the slide rest 66 as illustrated in Fig. 3 and located in each of these rear extended portions 98 in an adjustable screw 99, the same being adjusted to permit the proper downward shiftable movement of the slides 69, thereby acting as an adjustable means for limiting the downward travel of the slides when the forming tools have cut the required depth.

The present machine is provided with suitable safety mechanism for preventing damage thereto, the same comprising means located on the cam shaft and effective when excessive strain is placed upon the cam shaft 39 to relieve the same and prevent the breakage of any of the operating parts of the machine. This safety mechanism is clearly shown in Figs. 4, 11, and 12 and is particularly described in my prior patent hereinbefore mentioned. The same is located on the cam shaft 39 and cooperates with the worm wheel 38 so that when undue strain is placed upon the mechanism the worm wheel can rotate freely relatively to the cam shaft. The worm wheel proper consists of a bronze ring or rim having suitable teeth on its periphery to mesh with the worm 37 of the worm shaft 39. This worm wheel is provided with an inwardly extending flange 100 and one side of the ring fits upon a hub 101, the flange 100 resting against the front face thereof. A driving plate 102 is bolted to the worm wheel ring and has a suitable bore freely fitting over a flanged clamp plate 103, the latter being bolted as at 104 to the hub 101. At a suitable distance apart and into the front face of the hub or disc 101 are inserted two hardened bushings 105 and into the driving plate are also inserted a pair of bushings 106. These opposed bushings have bores 107 for the reception of safety pins 108. The construction of the safety mechanism having been described in my prior patent further detailed description herein is not deemed necessary, it being of course understood that if a strain greater than the pins 108 will stand is placed upon the mechanism the pins will sheer and as a result the worm wheel will rotate relative to the hub 101 without rotating the cam shaft 39.

Located a suitable distance beyond each side of the outer work spindles and parallel with the same is a pair of endwise movable shafts or rods 109, the same being designated as pull rods, draw-bars or drill table pull rods. These rods are housed for sliding movement to the rear end of the machine in bearings 110 carried by the bed 21, the same being also supported by bearings in the bed adjacent to each side of the end tool slides. Mounted on the rear of the pull rods 109 (see Figs. 2, 3, and 6) between the rear ends of the work spindles and the rear bearings 110 for the pull rods and secured to the pull rods by suitable set screws is a combined drill and feed operating slide 111. This slide is provided with 4 sets of upwardly extending bearings 112, each set being located in a line midway between an adjacent pair of work spindles, and into each set of bearings is fitted a feed slide bar 113. On the inner end of each of these is fastened a disc 114 of suitable width and diameter to fit into the grooved portions of the spools 115 (Figs. 2 and 10) on the end of the feed tubes 116 of the work spindles. The disc 114 may preferably be adjustably mounted as illustrated and described in my prior patent in order to permit the proper amount of feed to the feed tube carrying the bars of stock to be operated upon. Secured to the bottom of slide 111 centrally thereof is a stud and roller 117 (see Figs. 2 and 6) adapted to cooperate with suitable cam mechanism 118 carried on the cam drum 119, it being understood of course that such camming mechanism is so constructed as to permit the reciprocation of the slide 111 at the proper time and in the proper manner. The reciprocation of the slide 111 is transmitted to the pull rods 109 resulting therefore in the reciprocation of the drill table hereinafter described. Simultaneously with this operation the slide bars 113 are shifted back and forth thereby shifting the feed tubes 116 in the same manner.

Referring particularly to Figs. 7 and 13 it will be seen that the drill table 120 is slidably mounted upon the pull rods or draw-bars 109 adjacent to the front thereof. Secured to the ends of the pull rods is a tie bar 121. Substantially midway between the side bearings of the end tool slide and se-

cured to the top thereof is a post 122. Pivotally secured by means of a bolt or other connection 124 to the top of the connecting tie bar 121 substantially midway between the ends thereof is a lock lever 123. Fixed to the lever 123 intermediate the connection 124 and the outer free end thereof is an operating lever 125, the fixed or rigid connection of the parts permitting levers 123 and 125 to have a conjunctive lateral swinging movement, as illustrated in dotted lines in Fig. 7. A connecting lever 127 is also pivotally secured in position to the operating lever by means of the bolt 126, and is pivotally connected to the post 122 by means of a bolt 128. From this construction it will be seen that the connecting link 127 and the lock lever 123 may be of any suitable length in accordance with the desired position of the tool slide upon the pull rods when locked in position. As illustrated in Figs. 13 and 20 the lock lever 123 is shown in locking position whereby the slide 120 will be firmly held in position upon the pull rods. In this position the free end of the locking lever abuts against the inner side of the post 122. When it is desired to shift the tool slide out of operative position independently of the operation of the machine and independently of the pull rods 109, it is merely necessary by swinging the handle 125 rearwardly to swing the lever 123 out of alinement with the pivot 124 and the post 122, this movement resulting in shifting the connecting link 127 to one side and rearwardly as illustrated in dotted lines in Fig. 7, thereby carrying with it the tool slide 120.

Thus it will be seen that the lever 125 together with associated parts may be operated to shift the tool carriage 120 relatively to the reciprocating draw-bars 109. This mechanism which is operated by the lever 125 may be operated to reciprocate the tool slide on the draw-bars, and it will be noted that it operates the tool slide independently of the main reciprocating means 109. Furthermore when the lever 125 is shifted to the position shown in Fig. 7 the link 123 operates to lock the tool carriage in position on the draw-bars 109 so that the tools will be held in position for operation on the work. When however the lever 125 is swung rearwardly to the dotted line position of Fig. 7, the tool carriage 120 will be unlocked from the draw-bars 109 and at the same time will be shifted rearwardly in the direction of reciprocation thereof, thus varying the longitudinal position of the tool carriage with relation to the work and also with relation to the rods or bars 109.

The drill table 120 is provided with suitable bores shown as six in number in line with the work spindles and in these bores are located drill holders 129. In the present improvement the work spindles rotate while the drills slide from and toward the work without rotating. The present machine is shown provided with tools for making nuts but it is of course understood that tools suitable for the work to be done may be substituted, as for instance, other tools may be substituted for the drills and drill holders.

In operation the vertical tool slides 69 with the combination tools travel downwardly a suitable distance to carry the stops 85 into proper operative position so that when the work bars are fed forward they will come to a stop against these adjustable stops of the combination tools. At this time the downward travel of the vertical slides 69 is arrested until the work bars have been gripped by the chucking mechanism. Thereupon the vertical slides 69 continue their travel downward so as to carry the knurling tools which have been adjusted laterally for size over the work bars to knurl the same. At this time the downward travel of the slides 69 is again arrested and at this point the end tool or drill slide travels forward carrying the drills or end tools into the ends of the work a suitable distance and then recedes. Thereupon the vertical slides again continue downward and the cut-off blades come in contact with the work bars severing the finished knurled nuts from the work bars. The continued downward travel of the vertical slides 69 carries the beading or grooving blades into contact with the ends of the work bars protruding from the work spindles and form the beads or grooves in the work bars for the succeeding nuts to be operated upon after the bars are fed forward again. Of course it is understood that these cut-off and forming tools or blades must be adjusted and spaced away from each other a proper distance and that the blades are formed to a suitable shape for the desired work and that the knurling tools are adjusted the proper spaced distance relative to each other and also to the stop portion of the tool to perform their proper work, and that the several movements of the vertical slides are governed by suitably shaped cams on the cam drum 75 of the cam shaft 39 while the to and fro movements of the drill or end tool slide is likewise governed by suitable cams on the cam drum 119 of the cam shaft 39. It is not deemed necessary herein to illustrate these cams or describe the relative timing thereof since various forms of cams or cam strips which may be used are well known in the art.

Thus it will be seen that the present improved machine is adapted to combine in one cycle of operation a large number of steps, for instance in the present instance, the drilling of a nut, the forming of a groove on its periphery, the knurling of the same, and finally the cutting off of the nut from the stock bar. Furthermore by so or-

ganizing the machine that six spindles can be controlled by a single camming means, and the feed of six stock bars and the operation of six end tools by a single camming means, while at the same time combining all of these mechanisms in a compact structure, the output of this improved machine is very materially increased, the time and expense of operation decreased, thereby securing all the advantages of economy, efficiency, and effectiveness of operation.

In the present improvement the motor is carried by a two-part support or platform 130, one of which is adjustable relatively to the other. As shown the lower part of this platform or motor supporting means, 131, is the fixed portion, while the upper part 132 thereof is pivotally connected thereto at 133 for adjustable swinging movement relatively thereto, such adjustment being effected by means of a threaded adjusting bolt 134 and suitable lock nuts 135. The intermediate gear between the main driving gear and the driven gear as hereinbefore described, is carried by a stub shaft fixed relatively to the adjustable part of the platform. By adjusting the top part of this platform in a manner which will be readily obvious, it will be seen that different sized intermediate gears may be used in order to vary the speed and also to compensate for wear on the gears.

Although I have described my invention in its preferred form it is to be understood that by describing in detail herein any particular form, structure, or arrangement, I do not limit myself to the construction herein shown and described except in so far as defined in the claims and embraced within the scope thereof, nor is it intended to limit the invention beyond the requirements of the prior art.

I claim as my invention:

1. In a metal working machine the combination of work supporting means, tool holding means adapted to carry a tool in position to engage the work, means for rotating the work and tool one relatively to the other, means for reciprocating the tool holding means and work one relatively to the other, and means operative independently of said reciprocating means for varying the longitudinal position of the tool holding means and work, one relatively to the reciprocating means.

2. In a metal working machine, the combination of work supporting means, tool holding means adapted to carry a working tool in position to engage the work, means for rotating the work and tool one relatively to the other, means for reciprocating the tool holding means and work supporting means one relatively to the other, and means for shifting the tool and work one away from the other and shiftable in one direction for locking the tool and work one to said reciprocating means.

3. In a metal working machine the combination of work supporting means, a tool holder adapted to carry a tool in position to engage the work, means for rotating the work and tool one relatively to the other, means for pulling the tool toward the work, and means connected to said last means for independently shifting said tool holder and also operative to lock the tool holder and said last means together.

4. In a metal working machine the combination of work supporting means, a working tool supported in position to engage the work, means for rotating the work and tool one relatively to the other, means for shifting the tool relatively to the work into engagement and a common means for unlocking said tool and shifting means and for shifting one relatively to the other.

5. In a metal working machine the combination of work supporting means, a tool supported in position to engage the work, means for reciprocating the tool and work one relatively to the other, and means for independently shifting the tool and work one relative to said reciprocating means in the direction of reciprocation thereof.

6. In a metal working machine, the combination of work supporting means, an endwise working tool supported in position to engage the work, means for rotating the work and tool one relatively to the other, means for pulling the tool relatively to the work into engagement, and means for varying the position of said tool and pulling means and connected to the latter.

7. In a metal working machine, the combination of work supporting means, a working tool supported in position to engage the work, means for rotating the work and tool one relatively to the other, means for pulling the tool relatively to the work into engagement, and a lever connected to said last means for changing the position of said tool and pulling means.

8. In a metal working machine, the combination of work supporting means, an endwise working tool supported in position to engage the work, means for rotating the work, means for pulling the tool relatively to the work and into engagement therewith, and a single manually controlled locking means operative to lock said tool and pulling means in predetermined position and also to unlock the same and shift said tool relative to the pulling means.

9. In a metal working machine the combination of work supporting means, a top tool slide, a tool holder supported by said slide, a tool carried thereby for predetermined engagement with the work, and a work stop also carried by said tool holder.

10. In a metal working machine, the com-

bination of work supporting means, a top tool slide, a shiftable tool holder supported by said slide, and adapted to carry a plurality of successively operating tools, and a work stop carried by said tool holder.

11. In a metal working machine the combination of work supporting means, a top tool slide, a tool holder connected to said tool slide, one or more tools mounted on said tool holder in relatively fixed position, a work stop also mounted on said tool holder, and means for reciprocating said top tool slide.

12. In a metal working machine, the combination of work supporting means, a top tool slide, a tool holder supported by said slide, three or more means mounted upon said holder in normally fixed relation for predetermined engagement with the work, and means for shifting said tool slide whereby all of said means will successively engage the work.

13. In a metal working machine the combination of work supporting means, a top tool slide, a tool holder supported thereby, a tool carried thereby for predetermined engagement with the work, and a work stop slide member adjustably carried by the tool holder and having a stop portion projecting therefrom.

14. In a metal working machine, the combination of work supporting means, a top tool slide, a tool holder supported thereby, three or more work engaging elements carried by said tool slide, and means for shifting said tool holder thereby to shift said elements into engagement with the work.

15. In a metal working machine, the combination of work supporting means, a top tool slide, a side working tool holder supported thereby, a plurality of tools including a work stop carried by said tool holder, and means for progressively shifting said slide in one direction thereby to shift said tools into operative engagement with the work.

16. In a metal working machine, the combination of work supporting means, a top tool slide, tool holding means supported by said slide, three or more work engaging elements carried by said tool holding means and including a work stop, and camming means for shifting said slide thereby to shift said elements into engagement with the work.

17. In a metal working machine the combination of work supporting means, tool holding means, a tool carried thereby, and a pair of means for reciprocating said tool and work one relatively to the other in the same reciprocatory path, one of said means operative independently of the other.

18. In a metal working machine, the combination of work supporting means, a working tool supported in position to engage the work, means for rotating the work and tool one relatively to the other, and means for shifting the tool relatively to the work into and out of engagement and including camming mechanism, and a lever for locking and unlocking said tool and shifting means and also effective for shifting the tool independently of said shifting means.

19. In a metal working machine the combination of work supporting means, tool holding means, an endwise working tool carried thereby, a pair of means for reciprocating the tool and work one relatively to the other in the same reciprocatory path, one thereof operating independently of the other, and means for locking said pair of means together for operation of the tool upon the work.

20. In a metal working machine the combination of work supporting means, a plurality of working tools supported in position to engage the work, means for rotating the work and tools one relatively to the other, means for shifting the tools relatively to the work and into and out of engagement therewith, and means for varying the position of said tools with relation to said shifting means, said shifting means also operative to feed the work through said work supporting means.

21. In a metal working machine, the combination of a plurality of work spindles, a plurality of working tools shiftable relatively thereto, a common means for shifting said tools and feeding the work through said spindles, and means for varying the position of said tools relatively to said shifting means.

22. In a metal working machine, the combination of a plurality of work spindles and a plurality of working tools, means for rotating the spindles and tools one relatively to the other, means for feeding the stock through said spindles from the rear thereof toward the tools and also operative to pull the work spindles and tools one relatively to the other into effective engagement, such means including two pair of feed bars, each feed bar operative upon a pair of spindles, and each pair of feed bars operative upon a single spindle.

23. In a metal working machine, the combination of a driving shaft, a spindle driving shaft directly connected thereto, a work spindle directly connected to said spindle driving shaft, means for feeding the work through said work spindle, a working tool supported for engagement with said work, and means for shifting said tool and spindle one relatively to the other.

24. In a metal working machine, the combination of a driving shaft, a spindle driving shaft directly connected thereto, a spindle connected to said spindle driving shaft, means for feeding the work through said spindle, a working tool supported for en-

gagement therewith and operatively controlled by said last means.

25. In a metal working machine, the combination of a driving shaft, a pair of spindle driving shafts directly connected thereto, a pair of work spindles directly connected to said spindle driving shafts, and a pair of spindles connected directly to said last spindles.

26. In a metal working machine the combination of work supporting means, a tool holder, a plurality of tools carried thereby, means for shifting the tool holder and work supporting means one relatively to the other, and means for simultaneously shifting all of said tools relatively to the work independently of the operation of said shifting means.

27. In a metal working machine the combination of work supporting means, a pair of feed bars, a tool holder mounted upon said bars, and means for varying the position of said tool holder and feed bars.

28. In a multiple spindle machine the combination of a plurality of rotatable work spindles, means for rotating the spindles, a plurality of slidingly supported endwise working tools corresponding in number with said work spindles, means operative to shift said tools and pull the same into engagement with the work, a tool slide, a plurality of tool holders having side working tools corresponding in number with the spindles and carried by said tool slide, means for shifting said side working tools into engagement with the work, and work stops carried directly by said tool holders.

29. In a multiple spindle machine, the combination of a plurality of rotatable work spindles, means for rotating the spindles, a plurality of slidingly supported endwise working tools corresponding in number with said work spindles, means operative to shift said tools into engagement with the work, a plurality of tool holders corresponding in number with the work spindles and supported above the same, three or more tools carried by each tool holder and means for successively shifting the tools into engagement with the work.

30. In a multiple spindle machine, the combination of a plurality of rotatable work spindles, means for rotating the spindles, a plurality of slidingly supported endwise working tools corresponding in number with said work spindles, means operative to shift said tools into engagement with the work, a plurality of tool holders corresponding in number with the work spindles and supported above the same, three or more tools and a work stop carried by each tool holder and means for successively shifting the tools into engagement with the work.

31. In a multiple spindle machine, the combination of a work spindle, a vertically slidable tool holder having a tool for operating upon the work, means for rotating said tool and spindle one relatively to the other, means for feeding the work through the spindle and also for shifting the tool holder, a work stop carried by said tool holder, and means for shifting said work stop conjunctively with said tool holder.

32. In a multiple spindle machine the combination of a work spindle, a vertically slidable tool holder shiftable relatively to the work and carrying a plurality of tools, means for rotating the spindle means for feeding the work through the spindle, and a work stop carried by said tool holder and adapted to cooperate with the work at predetermined times.

33. In a multiple spindle machine, the combination of a work spindle, an endwise working tool for operating upon the work, means for shifting said tool relatively to the work and including mechanism for feeding the work through the spindle, means for locking and unlocking said tool and shifting means, a side working tool for operating upon the work, means for shifting the same, and a work stop carried by one of said tools.

34. In a multiple spindle machine, the combination of a work spindle, an endwise working tool for operating upon the work, means for shifting said tool relatively to the work and including mechanism for feeding the work through the spindle, a side working tool holder supported adjacent to the work and comprising a plurality of progressively operating tools, means for shifting the same, and a work stop carried by said tool holder.

35. In a multiple spindle machine, the combination of a work spindle, an endwise working tool for operating upon the work, means for shifting the tool relatively to the work, said means including mechanism for feeding the work through the spindle, mechanism for locking and unlocking said tool and shifting means, a side working tool for operating upon the work, means for shifting the same and a work stop carried by said tool.

36. In a multiple spindle machine the combination of a series of three rotary spindles, a rotary shaft for driving said spindles, a gear carried by each spindle, one gear located intermediate the other two gears and meshing therewith, a gear carried by said shaft and meshing with said intermediate gear, a series of three work engaging tools, and means for simultaneously reciprocating said spindles and tools one toward and from the other.

37. In a metal working machine the combination of work supporting means, tool holding means adapted to carry a plurality of tools in position to engage the work,

means for reciprocating said tool holding means and work one relatively to the other, and means operative independently of said reciprocating means for varying the longitudinal position of the tool holding means and work one relatively to the other.

38. In a metal working machine the combination of work supporting means, tool holding means adapted to carry a plurality of tools in position to engage the work, means for reciprocating said tool holding means and work one relatively to the other, and means operative independently of said reciprocating means for varying the position of the tool holding means and work one relatively to the other and to said reciprocating means, and also effective to lock the same to said reciprocating means.

39. In a metal working machine the combination of work supporting means, tool holding means, a tool carried thereby, a pair of means for reciprocating said tool and work one relatively to the other in the same reciprocatory path, one thereof operative independently of the other, means for automatically operating one of said means, and means for manually operating the other.

40. In a metal working machine the combination of work supporting means, tool holding means, a pair of means for reciprocating one relatively to the other in a predetermined path, one of said reciprocating means operative to vary the position of said tool holding means and work supporting means relatively to the other reciprocating means.

41. In a multiple spindle machine the combination of more than four work spindles, more than four end working tools alined with said spindles, means for rotating the spindles and tools one relatively to the other, means for reciprocating the spindles and tools one relatively to the other, more than four slidingly supported side working tools, means for reciprocating said tools and work spindles one relatively to the other, and means for varying the position of said end working and side working tools one with relation to one of said reciprocating means.

42. In a multiple spindle machine, the combination of two sets of three spindles, six endwise working tools, means for rotating the spindles and tools one relatively to the other, means for shifting the spindles and tools one relatively to the other, two sets of three slidingly supported side working tools supported above said work spindles, means for shifting said tools into and out of engagement with the work, and means for locking and unlocking said tools and shifting means.

43. In a multiple spindle machine, the combination of a plurality of rotatable work spindles, means for rotating said spindles, a sliding tool carriage supported for shiftable movement toward and from said spindles and carrying a plurality of tools, means for shifting said sliding carriage, and means connected to said sliding carriage for rendering said last means ineffective.

44. In a multiple spindle machine, the combination of a plurality of rotatable work spindles, means for rotating said spindles, a sliding tool carriage supported for shiftable movement toward and from said spindles and carrying a plurality of tools, means for shifting said sliding carriage and including one or more pull rods and a cam, and means connected to said carriage for rendering said last means ineffective.

45. In a multiple spindle machine, the combination of a plurality of rotatable work spindles, means for rotating said spindles, a sliding tool carriage supported for shiftable movement toward and from said spindles and carrying a plurality of tools, means for shifting said sliding carriage and including one or more pull rods, a slide connected to said pull rods, means for operating said slide, means for feeding stock through the work spindles and also connected to said slide for operation thereby, and means for releasing said sliding tool carriage from said operating means.

46. In a machine of the class described, the combination of work supporting means, tool holding means adapted to carry a tool in position to engage the work, means for rotating the work and tool one relatively to the other, means for reciprocating the tool and the work one relatively to the other, said means including a motor and a series of gears, and means for adjustably supporting said motor thereby to raise and lower the same.

47. In a metal working machine, the combination of work supporting means, tool supporting means, and means for operating the same and comprising a motor, a two-part platform for supporting said motor, one part hinged to the other part, means for adjusting said hinged part and thereby the motor, and a series of gears connected with said motor for operating said tools and work.

48. In a machine of the class described, the combination of a motor supporting platform comprising a fixed part and a hinged part carrying a motor, means for adjusting the hinged part relatively to the fixed part, work supporting means and tool supporting means, and means connecting said motor with the work supporting means and tool supporting means for operating the same.

49. In a machine of the class described, the combination of more than four rotary work spindles, more than four end working tools, means for rotating the work spindles,

means for pulling the end working tools into engagement with the work carried by the spindles, more than four top working tools, and means for reciprocating said top working tools relatively to the work spindles, each of said top working tools including a stop.

50. In a machine of the class described, the combination of more than four rotary work spindles, more than four end working tools, means for rotating the work spindles, means for pulling the end working tools into engagement with the work carried by said spindles, more than four side working tools, and means for reciprocating said side working tools relatively to the work spindles, each of said side working tools including one or more side working tools and a stop.

51. In a metal working machine, the combination of work supporting means, a sliding tool carriage and a plurality of working tools supported thereby in position to engage the work, means for rotating the work and tools one relatively to the other, means for shifting the tool carriage relatively to the work, and means for locking and unlocking the tool carriage from said last means and comprising a lock lever pivoted to said last means, a link connecting said lock lever and tool carriage, and means for shifting said lock lever.

52. In a metal working machine the combination of work supporting means, a pair of feed rods having transverse connecting means, a tool holder slidably mounted on said rods, and means connected to the tool holder and said connecting means for shifting the tool holder upon said feed rods.

53. In a metal working machine the combination of work supporting means, a tool holder, means for reciprocating the tool holder and work supporting means one relatively to the other, and means shiftable in one direction for shifting the tool holder and work supporting means one away from the other, and shiftable in an opposite direction for locking the tool holder and work supporting means, one with said reciprocating means.

54. In a metal working machine the combination of work supporting means, a tool holder, means for reciprocating the tool holder and work supporting means one relatively to the other, and means connecting said tool holder and work supporting means one with said reciprocating means and shiftable in one direction for shifting the tool holder and work supporting means one away from the other, and shiftable in the opposite direction for locking the tool holder and work supporting means, one with said reciprocating means.

Signed at Cleveland, Ohio, this 21st day of October, 1921.

OSCAR AUGUST SMITH.