July 31, 1923. 1,463,505

N. F. FRETTER

LATHE

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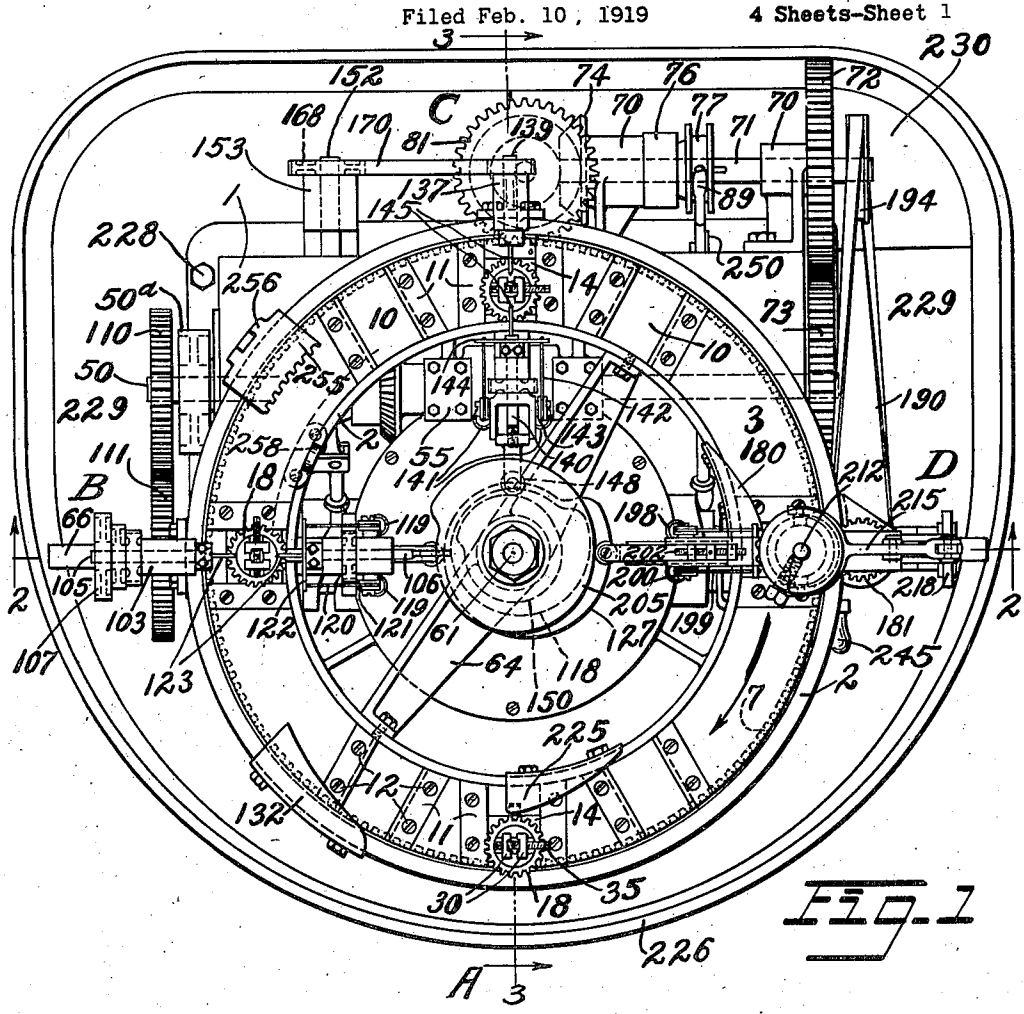


Fig. 1

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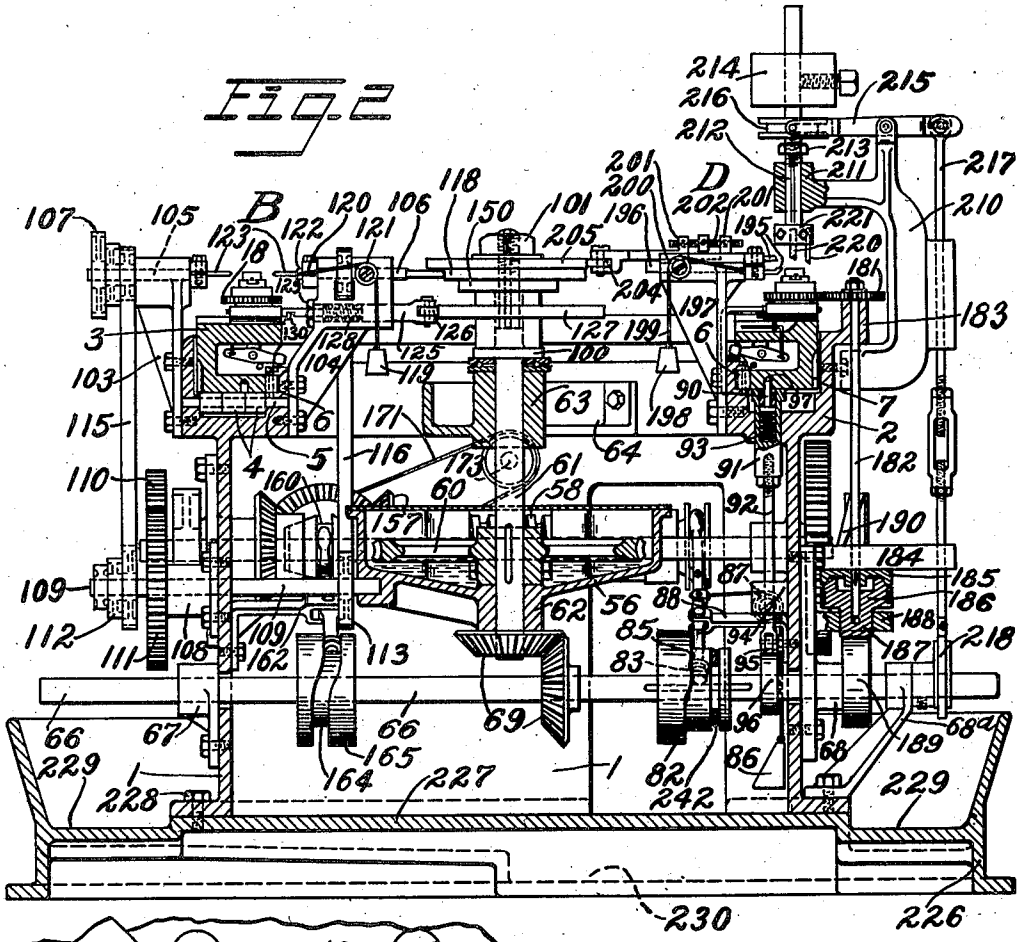
July 31, 1923. 1,463,505

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Filed Feb. 10, 1919 4 Sheets-Sheet 2

Fig. 2



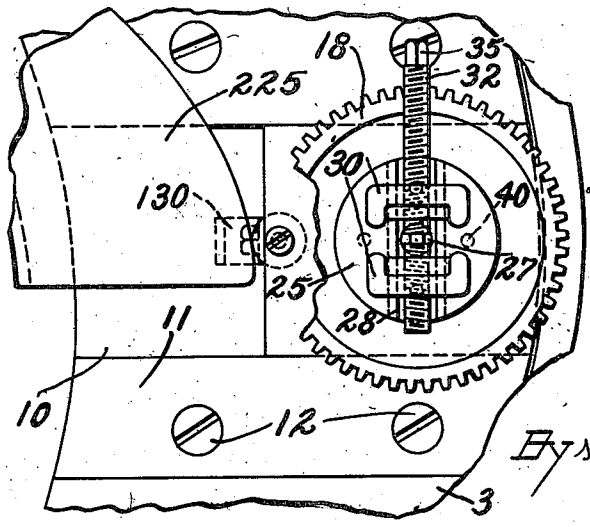


Fig. 8

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July 31, 1923. 1,463,505

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Filed Feb. 10, 1919 4 Sheets-Sheet 3

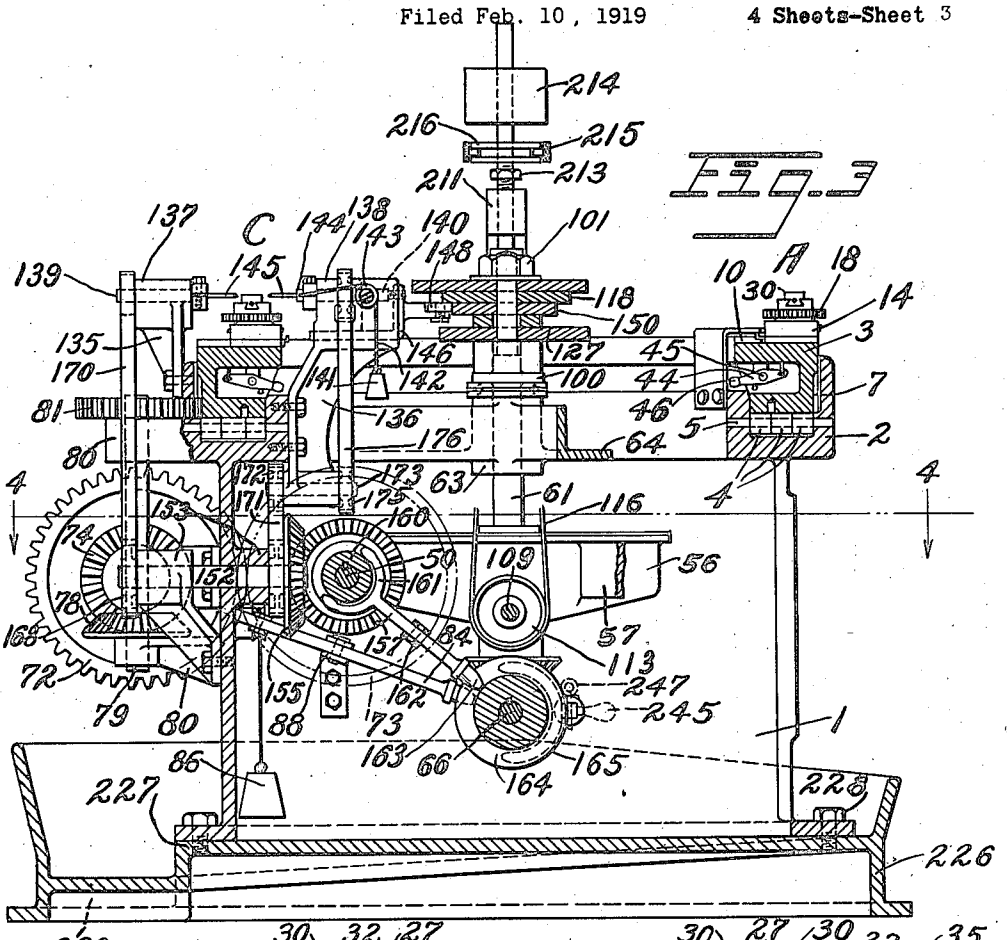


Fig. 3

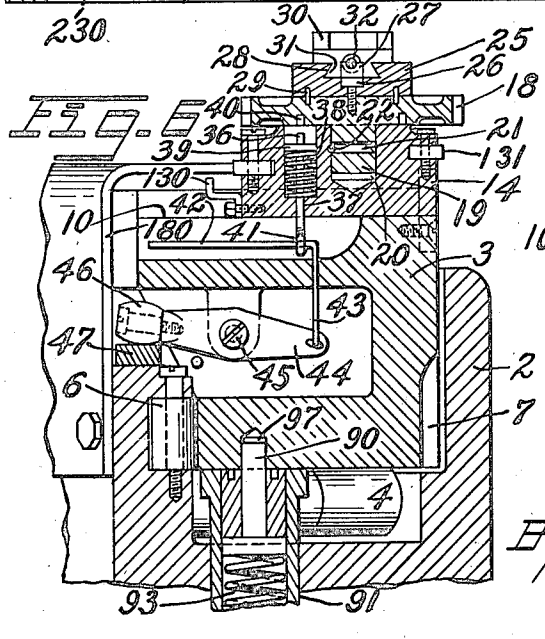


Fig. 6

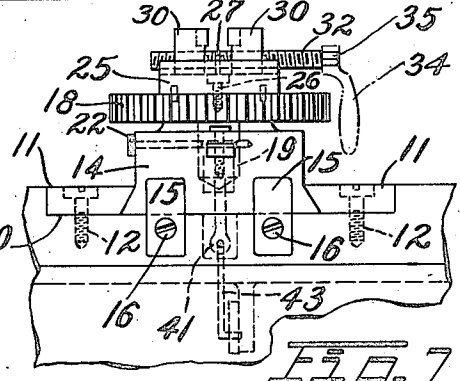


Fig. 7

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1,463,505

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Filed Feb. 10, 1919

4 Sheets-Sheet 4

Fig. 4

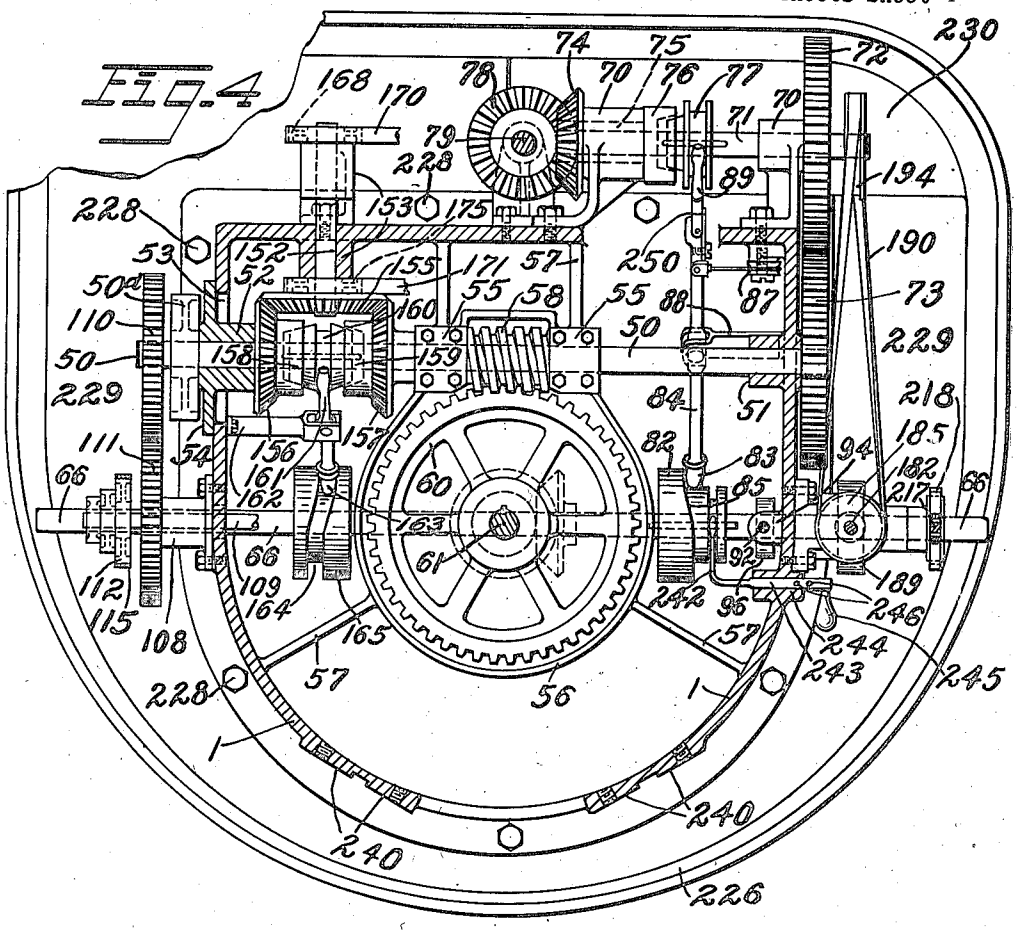
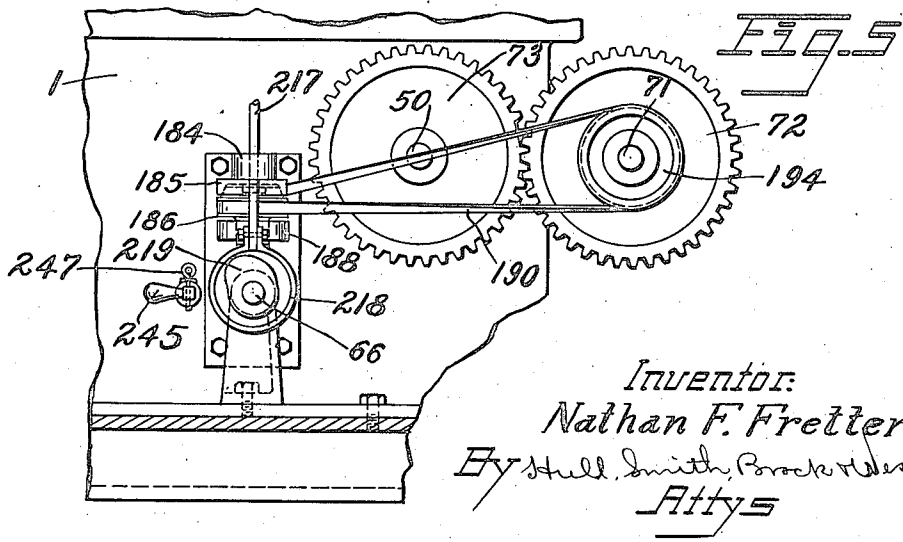


Fig. 5



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Patented July 31, 1923. 1,463,505

UNITED STATES PATENT OFFICE.

NATHAN F. FRETTER, OF CLEVELAND, OHIO.

LATHE.

Application filed February 10, 1919. Serial No. 275,992.

To all whom it may concern:

Be it known that I, NATHAN F. FRETTER, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Lathes, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to lathes of the same general character as those disclosed in my copending applications Serial Nos. 186,859 and 229,896, filed respectively August 18, 1917, and April 22, 1918.

The general objects of my present invention are to provide a substantial and durable machine of the aforesaid character that is adapted to the handling of various kinds of work; that is very convenient of use; whereon successive operations may be performed upon an article without the attention of the operator further than to insert the unfinished or crude article in the machine and remove the finished or completed piece of work therefrom; and wherein all working parts are easily accessible.

My present machine is distinguished from its predecessors essentially by the employment of a plurality of tools (as a pair of opposed taps or drills) at certain ones of the several stations, and by operating these tools from a common centrally actuating element. A further aim of my invention is to provide means for moving the work into contact with one of the opposed tools, said tool being stationary as to longitudinal movement, while projecting the other tool toward and into contact with the work, the relative speeds of the moving parts being such as to cause the opposed tools to progress upon the work uniformly.

A further object is to provide in a machine of this character an adjustment between a tool and its actuating element for the purpose of accommodating tools of different sizes, or for taking up the wear of the tool, or to compensate for irregularities or inaccuracies in the actuating element.

A further object is to provide a work holder which may be locked in a fixed position at certain stations so that active tools may operate upon the work; while, at another station, the holder is automatically unlocked and rotated while the work is subjected to the action of passive tools.

Further and more general objects are to obtain the maximum of efficiency while adhering to simplicity of design and construction.

To these ends my invention may be defined as consisting of the combinations of elements set forth in the claims annexed hereto and illustrated in the accompanying drawings forming a part hereof and wherein Fig. 1 is a plan view of my improved lathe; Fig. 2 is a transverse, vertical section through the machine substantially on the line 2—2 of Fig. 1; Fig. 3 is a view similar to Fig. 2 but in a plane at right angles thereto, as indicated by the line 3—3 of Fig. 1; Fig. 4 is a horizontal section on the line 4—4 of Fig. 3; Fig. 5 is an elevational detail taken from the right hand side of the machine as viewed in Figs. 1 and 4; Fig. 6 is a sectional detail through the turret and adjoining parts at station D, the same being an enlargement of the parts occurring at the right hand side of Fig. 2; Fig. 7 is an elevation of the parts shown in Fig. 6; as though viewed from the right; and Fig. 8 is a plan view of a work holder and associated parts.

For convenience of description I shall refer to the locations of the several sets of tools, as they progress clockwise about the machine, as stations B, C, and D; and where the work is introduced into and removed from the machine, I shall term station A.

The housing 1 of the machine is shown as of semi-cylindrical form forwardly of its transverse center, and as of rectangular form to the rear thereof (see Fig. 4) while it terminates at its lower end in a base flange and at its upper end in a circular upwardly opening channel 2 within which a ring turret 3 is adapted to rotate. The turret rides upon horizontally disposed rollers 4 that are carried by pins 5 which have their ends supported within the side flanges of the channel 2. Vertically disposed rollers 6 are set into the inner wall or flange of the channel to receive the lateral pressure of the turret. The periphery of the turret is shown as provided with gear teeth 7 which are arranged to mesh with a driving gear, as I shall presently explain. As many sets of rollers 4 may be distributed about the channel 2 as are deemed necessary to properly support the turret.

Workholders are situated at suitable dis-

tances apart about the turret (in the present instance the work holders being spaced 90° from each other). At each of these points (or wherever it may be desired to locate a work holder) the upper face of the turret is grooved radially, as indicated at 10, particularly in Figs. 7 and 8, and along each side of the groove, and contained therewithin, is a rail 11 that is held in place by screws 12. The opposed edges of the rails 11 are undercut to provide a dovetail channel (or its equivalent) and a block 14, complementarily formed at its lower end, is slidably supported within the groove. The block is held against undue outward movement by stops 15 that are shown as secured to the turret by screws 16, the turret and block being recessed so that when the stops occupy the recesses, their outer surfaces are flush with the corresponding surfaces of the turret and block.

18 is a driving member or gear having a central stud 19 which is journaled within a bore 20 of the block 14, the stud being shown as integral with the gear and as having a circumferential groove 21 which receives a screw or pin 22 that is driven transversely through the block and serves to retain the stud against withdrawal from the bore.

A work holder surmounts each of the gears 18 and the same is in the nature of a vise, the bed 25 whereof is secured to the gear by a screw 26 having a notched head 27 that reposes at the middle of a dovetail channel 28 formed in the top surface of the bed 25. The bed may be secured against turning with respect to the gear by dowel pins 29.

Opposed jaws 30 have dovetail portions 31 that are guided within the channel 28 of each bed 25, and the jaws are connected together and adapted to be moved toward and from each other by a screw 32. This screw is reduced in diameter between the jaws, and the reduced portion occupies the notch in the head 27 of the screw 26 thereby to hold the screw against longitudinal movement. By reason of the fact that the threads which occupy the opposite end portions of the screw are reversely inclined, the jaws will be moved in opposite directions when the screw is turned, as by the application of a suitable handle 34 (Fig. 7) to the squared end 35 of the screw. The handle 34 is retained by the operator for use upon a work holder when at station A for the purpose of opening and closing the jaws to remove a finished article and insert a fresh "blank".

Each gear 18 is normally held against turning by a locking bolt 36 (Fig. 6) that is reciprocable within a bore 37 of the block 14, the bolt being impelled upwardly by a spring 38 that is confined between the bottom of an enlargement of the bore and a collar 39 on the bolt thereby to insert the upper end of the bolt into a recess 40 of the gear. The lower end of the bolt 36 is provided with an eye 41 which receives the upper laterally directed end 42 of a rod 43. The rod 43 is connected at its lower end to the outer end of a lever 44 that is pivoted at 45 to a part of the turret. The inner end of the lever 44 is equipped with a roller 46 which traverses the upper edge of the inner wall of the channel 2. The foregoing parts are shown in Fig. 6 in the positions they occupy when the work holder is at station D; and here the roller 46 rides upon a cam 47 carried by the inner wall of the channel 2, so that at this station the inner end of the lever is elevated by the cam to depress its opposite end and draw downward the rod 43 and consequently the bolt 36 to disengage it from recess 40 of the gear 18 and unlock the gear, for a purpose which will presently be explained.

The main driving shaft of the machine is designated 50 and is shown as journaled at its right hand end (as viewed in Fig. 4) in a boss 51 of the housing 1, and at its other end, in a bearing 52 that is inserted through a comparatively large opening 53 in the left hand wall of the housing and which has a flange 54 that may be bolted or similarly connected to the wall. The machine may be driven from any suitable source of power, and the power may be introduced through a pulley 50^a secured to shaft 50 adjacent the bearing 52. The shaft 50 is supported intermediate its ends within spaced bearings 55 which are shown as integral parts of a worm wheel casing 56 that is supported centrally of the casing through integral arms 57. Between the bearings 55, a worm 58 is secured to the shaft 50 and the worm meshes with a worm wheel 60 within the casing 56 and which is keyed or otherwise secured to a vertical shaft 61 that is journaled within a centrally depending boss 62 of the casing 56, and within a bearing sleeve 63 of a beam 64 which extends across the upper end of the housing 1.

A cam shaft 66 is supported transversely of the housing 1, in the vertical plane of the shaft 61, in suitable bearings 67, 68 and 68^a that are applied respectively to the left and right hand sides of the housing. The cam shaft 66 is driven from the vertical shaft 61 through miter gears 69.

Supported in suitable brackets 70 (Fig. 4) which extend from the rear wall of the housing 1 is a shaft 71 that is driven through intermeshing gears 72 and 73, secured, respectively, to shafts 71 and 50 beyond the right hand side of the housing. At the left hand end of the shaft 71 a gear 74 is carried by a sleeve 75 that rides freely upon the shaft 71 and within the left hand bracket 70 and has fixed to its right hand end a clutch member 76 which is adapted to be engaged

by a sliding clutch member 77, splined to the shaft 71. The gear 74 meshes with a similar gear 78 (Figs. 3 and 4) that is secured to a shaft 79 supported in a vertical position to the rear of the housing in brackets 80, the upper end of the shaft carrying a gear 81 which meshes with the gear teeth 7 of the turret 3. It follows from this that when the machine is in operation, and the clutch members 76 and 77 are engaged through mechanism which I shall presently describe, that the vertical shaft 79 would be rotated to impart motion to the turret. This is caused to occur at intervals as I shall now explain.

The cam drum 82 is splined to the cam shaft 66 to the right of gears 69 (as viewed in Fig. 2) and a roller 83 on the end of a lever 84, is caused to bear laterally against the cam 85 of the drum through the action of a weight 86 connected to the lever by a flexible member guided over a pulley 87. The lever 84 is pivoted to a bracket 88 that projects inwardly from the right hand wall of the housing and the lever extends rearwardly through a slot in the back wall of the housing where it terminates in a fork 89 that engages within the groove of the clutch member 77. The parts are so timed that upon each rotation of the vertical shaft 61, the clutch comprising the members 76 and 77 will be rendered effective to rotate the turret the angular distance between successive stations, after which the clutch will be rendered ineffective through the action of the cam 85 so that the turret will remain at rest while the tools at the various stations B, C and D are operating upon the work. During this period of rest the turret is locked by a bolt 90 guided in a cavity in the upper end of a shoe 91 that is carried by a rod 92. The bolt is urged upward by a spring 93 and is limited in its upward movement by the plug which closes the cavity. The shoe 91 is cylindrical and is slidable within an aperture in the bottom wall of channel 2. The locking bolt in the present instance is situated at station D. The lower end of rod 92 is guided within an aperture of a lug 94 of the housing and is equipped with a roller 95 which bears upon a cam 96 on the cam shaft 66. Just before the turret is moved, the cam 96 permits the rod and consequently the locking bolt to drop, thereby to disengage the bolt from one of the recesses 97 of the turret so that, upon the engagement of the clutch members 76 and 77, the turret will be free to rotate. Before the turret reaches its next rest position the cam 96 elevates the rod 92 to frictionally engage the shoe 91 with the turret, thereby to retard the turret's movement. In the meantime, the locking bolt is depressed against the action of spring 93 and when a recess 97 is brought into register with the bolt the bolt is projected into the recess by the spring to lock the turret.

Situated at stations B, C and D are tools which are caused to operate upon the work by cams carried by the upper end of the central vertical shaft 61, the cams being keyed or otherwise secured to the shaft and confined between a collar 100 thereon, and a nut 101 applied to the threaded upper end of the shaft.

At station B brackets 103 and 104 are secured to and rise from the outer and inner sides, respectively, of channel 2. These brackets terminate at their upper ends in horizontal bearings within which the respective spindles 105 and 106 are journaled. The bearing of bracket 104 is cut away intermediate its ends to provide space for a pulley, the pulley being splined to the spindle so as to permit longitudinal movement of the spindle independently of the pulley. A cone pulley 107 is shown as secured to the outer end of the spindle 105. Sustained substantially parallel with the spindles 105 and 106, and journaled within a bearing member 108 that is secured to the side wall of the housing 1 below the bracket 103, is a shaft 109 that is driven from the driving shaft 50 through gears 110 and 111 that are secured respectively to the shafts 50 and 109, the inner end of the shaft being supported within a bearing socket in casing 56. A cone pulley 112 is situated on shaft 109 in the plane of the former cone pulley 107 that is carried by spindles 105; and a pulley 113 on the inner end of shaft 109 is in the plane of the pulley on spindle 106. Belts 115 and 116 are trained over the pulleys associated with the respective spindles 105 and 106. A cam 118, secured to the vertical shaft 61, serves to advance spindle 106 toward the work sustained by the work holder at station B; and weights 119 tend to retract the spindle in opposition to the cam by reason of their connection with the spindle through flexible elements 120 that are guided over sheaves 121 on opposite sides of the bearing of bracket 104, and which flexible elements have their forward ends attached to a member 122 that is swiveled to the spindle in any suitable manner. A tool, as in the present instance a drill 123, may be connected in the customary manner to each of the spindles 105 and 106. Under certain circumstances it may be found desirable or necessary to drive the opposed spindles 105 and 106 at different speeds, or to change the speed from time to time. I have provided for this by including the cone pulleys 107 and 112, previously referred to, and it is obvious that the inner set of pulleys over which belt 116 is engaged might be of the same type.

Guided through a bore of bracket 104 is a plunger 125 which carries a roller 126 at its rear end, the same engaging a cam 127 upon shaft 61. A spring 128, contained within the bore through which the plunger passes

and confined between an enlargement of the plunger and a plug 129 which closes the forward end of the bore, tends to press the plunger inwardly to engage its roller with the cam 127. The forward end of the plunger is notched to provide a hook which is arranged to be engaged by clips 130 attached to the rear faces of blocks 14 of the work holders. It may be explained that as a work holder moves from station A to station B, a roller 131 that is set into the outer face of the block 14 (Fig. 6), engages a stationary cam 132, shown (in Fig. 1) as carried by the outer flange or wall of the channel 2 and extending upwardly and over the turret, thereby to shift the work holder to the extreme limit of its inward movement so as to bring the clip 130 into register with the hooked end of the plunger 125 when the work holder arrives at station B.

It will be understood from the foregoing that as long as the machine is in operation, the spindles 105 and 106, and consequently the drills 123, are being constantly rotated, as is also shaft 61. The parts are so timed and the cams 118 and 127 are so shaped, as to cause spindle 106 to be advanced at half the speed of plunger 125. Consequently, the work holder will be shifted outwardly to engage the work with the outer drill and feed it thereon at substantially the same speed that the inner drill is inserted into the work; and as the spindle 106 and plunger 125 ride from the high points of their respective cams, the weights 119 and the spring 128 will retract them to their normal positions, the plunger returning the work holder to its former position at the inner side of the turret. Thus the first operation is performed upon the work at station B.

At stations C (Figs. 1 and 3) the holes bored at station B may be threaded by opposed taps which are supported and operate in the same general manner as the drills at station B. Brackets 135 and 136 rise from the outer and inner sides, respectively, of channel 2 and within their respective bearings 137 and 138 are journaled spindles 139 and 140. Spindle 140 is reciprocable within its bearing, and weights 141 tend to retract the spindle, the weights being connected thereto by means of flexible elements 142 that are guided over sheaves 143, carried on opposite sides of the bearing 138, the elements having their ends connected, through a member 144, with the front end of the spindle. The spindles carry taps 145. A pusher 146 is slidable within a guideway in the bracket 136 and its upwardly extending inner end is arranged to engage the rear end of spindle 140. An antifriction roller 148 is carried by an extension of the pusher and engages a cam 150.

As shown clearly in Figs. 3 and 4, a shaft 152 extends through the rear wall of the housing 1 and is journaled in suitable bearings 153. A bevel gear 155 is secured to the forward end of the shaft 152 and meshes constantly with bevel gears 156 and 157. These gears are free upon shaft 50 and incorporate opposed clutch elements 158 and 159 respectively. Between these gears, a clutch element 160 is splined to shaft 50 and is adapted to be shifted into engagement with one or the other of the clutch members by a fork 161, which engages within the groove of the clutch element 160 and is pivoted to a bracket 162. The forward end of the fork has an anti-friction roller 163 which traverses a groove 164 in a drum cam 165 that is fastened to the cam shaft 66. A pulley 168 is fixed to the rear end of shaft 152 in the plane of a pulley on the outer end of spindle 139. A belt 170 is engaged about those pulleys so as to transmit motion from the shaft 152 to the spindle 139. Shaft 152 carries a second pulley that is located just to the rear of gear 155, and a belt 171 transmits motion from this pulley to a pulley 172 on a short shaft 173 that is journaled in a boss at the lower end of bracket 136. A pulley 175 is carried by the forward end of shaft 173 in the plane of a pulley splined to spindle 140, the bearing 138 being cut away to accommodate the latter pulley; and a belt 176 transmits motion to the last mentioned pulley from pulley 175. Thus it will be seen that the tap spindles are driven from shaft 152; and that shaft 152 is rotated first in one direction and then the other through the instrumentality of the shiftable clutch member 160 which connects first one and then the other of the bevel gears 156 and 157 to shaft 50, the clutch being actuated by the fork 161 which is rocked by the cam 165.

The work holder arrives at station C at the inner side of the turret and the cam 150 acts to project the inner tap into the corresponding bore of the work. The cam 150 is so shaped, however, as to advance the tap substantially twice as fast as the tap cuts into the work (assuming that both taps 145 have the same lead) so that the work is shifted bodily, together with the work holder, outwardly across the turret and fed onto the outer tap. Consequently, both taps are operating upon the work at substantially the same relative speed between the taps and work, and this continues until the bore is completely threaded, at which time cam 165 acts to shift the clutch member 160 and reverse the rotation of the tap spindles, the inner tap gradually withdrawing from the work and at the same time removing the work from the outer tap, the final result being that the parts are left in the positions which they occupied at the start of the operation.

The turret now moves a further one-quarter rotation to carry the work to sta-

tion D, the work holder engaging cam 180 as it approaches said station, thereby to be moved to the extreme outer side of the turret. As the work holder arrives at this station, the roller 46 (Fig. 6) on the arm 44 overrides cam 47 to rock the arm in a direction to draw downward rod 43 and plunger 36, thus retracting the plunger and disengaging its upper end from recess 40 of gear 18. The gear is now free to rotate. Upon its arrival at station D, gear 18 moves into mesh with a gear 181 on the upper end of a vertical shaft 182 that is supported in brackets 183 and 184. Below the latter bracket the shaft 182 has secured to it a clutch element 185 which is adapted to be engaged by a clutch element 186 having a hub 187 that is vertically reciprocable within a bearing aperture in a support 188. The hub 187 rides upon a cam 189 that is fastened to shaft 66, and the lower end of shaft 182 is piloted in a socket of the hub. The clutch element 186 incorporates a pulley over which a belt 190 is directed from a pulley 194 on shaft 71 (Figs. 2, 4 and 5). The cam 189 is designed to engage the clutch elements 185 and 186 immediately after the arrival of the work holder at station D and to prolong such engagement during the time that the tools operate upon the work at this point.

At station D I have elected to show groups of tools disposed at right angles to each other and that are reciprocable but non-rotating. As the work is turned by the mechanism above described, the horizontal tools may operate upon the side thereof, while the vertical tools perform operations on the top face, all of which is obvious. Those referred to as the "horizontal tools" are designated 195 and are carried at the outer end of a composite slide 196, guided within a horizontal bearing of a bracket 197 which rises from the inner flange of channel 2. Weights 198 tend to retract the slide by their connection therewith through flexible elements 199 with the slide, said elements being guided over the sheaves 200. The slide is made up of two relatively adjustable sections having ears 201 through which the reversely threaded opposite ends of a screw 202 operates. Thus by turning the screw the effective length of the composite slide may be altered. The slide carries a roller 204 at its inner end which engages a cam 205 on shaft 61. This cam acts to force the tools 195 into the work as the latter rotates. Through the adjustment of the composite slide above described, tools of various lengths may be used; the depth of cut regulated; irregularities in the cam 205 compensated for; and the wear of the tools taken up.

I shall now describe what I have referred to above as the vertical tools. 210 is a bracket which rises from the outer side of the machine and overhangs the work holder at station D. This bracket terminates at its inner end in a vertical boss 211 within which a tool spindle or carrier 212 is guided. The spindle is splined to the boss so as to be held against rotation with respect thereto but is capable of vertical movement. The limit of its downward movement is determined by the adjustment of the stop nut 213. A weight 214, applied to the upper end of the spindle, tends to depress the tools and drive them into the work as the work is rotated. When the boring or cutting operation is completed, the tools are retracted through the elevation of the spindle by means of a rocker arm 215 which is forked at its inner end to embrace a grooved collar 216 on the spindle, the outer end of the arm having connection through a link 217 with a loop or stirrup 218 which encircles a cam 219 on the cam shaft 66. As the cam rotates it depresses the loop and draws downward the link to rock the arm 215. The tools, designated 220, may be clamped within the holder 221, on the lower end of the spindle, either concentric or eccentric, with respect to the spindle, or parallel or at an angle thereto, for producing different effects upon the work.

During the remaining one-quarter turn of the turret, the work holder is carried to station A where it is held forward on the turret by a stationary cam 225. Here the operator may apply handle 34 to screw 32 to relax the jaws of the work holder and remove the finished article, after which he may insert a fresh "blank" before the work holder moves on to station B.

While the machine may rest with its base flange directly on the floor, I prefer to mount the machine upon a bed 226. This bed includes a platform section 227 of the same general outline as the base flange and to which said flange is fastened by cap screws 228. A trough 229 inclines downwardly from the front of the bed about the platform section, and, at the rear right hand corner of the bed (as viewed in Figs. 1 and 4), deepens into a basin 230 (see Figs. 2 and 3). According to the usual practice, a lubricating oil or cooling solution may be conducted to the various tools by tubes properly arranged for the purpose, the same being omitted from the drawings for the sake of clearness; and in such a case the oil or solution drips off into trough 229 and drains into basin 230. A suitable pump (not shown) may draw the oil or solution from the basin and circulate it through the tubes above mentioned.

It will be observed upon referring to Fig. 1 that a series of grooves or channels 10

are provided in addition to the four that are occupied by work holders in the present disclosure. By the particular arrangement herein shown, six work holders, equally spaced about the turret, may be used in place of the present four. In such an event additional tools are also provided, the same being spaced sixty degrees apart, rather than ninety degrees as in the present instance. Upon referring to Fig. 4 it will be seen that the wall of the housing 1 has finished surfaces 240 for the application of brackets for carrying these additional tools; and these tools may be operated from some moving part of the machine as, for example, from cam shaft 66. It will be noted that this shaft protrudes some distance beyond its end bearings to accommodate further driving means.

When six work holders are carried by the turret it of course becomes necessary to move and stop the turret six times during each complete rotation. To accomplish this end, the cam drum 82 is arranged to be shifted to the left along shaft 66 from its present position so that the cam portion 85 is caused to be in contact with the roller 83 of arm 84 for a shorter period of time than otherwise, for it will be recalled that the turret is moved by reason of and during the engagement of the clutch members 76 and 77. The cam drum is shifted by means of a fork 242 which engages within a groove of the drum and has a lateral extension 243 that is slidable within a guideway of the housing. This guideway extends through a boss 244 and beyond which the fork extension is provided with a handle 245 by means of which it may be shifted. The fork extension has a series of holes 246 which are adapted to be brought into register with a hole in the boss, and a suitable pin 247 may then be inserted through the aligning holes of the boss and fork to lock the latter in either of its positions. To allow for the variable throw of the fork lever 84, which results from the shifting of the cam drum, while the movement of the clutch element 77 remains the same, I pivot the fork proper 89 to the lever 84 and maintain them normally in alignment by a spring 250.

While I have designated only two alternative arrangements providing respectively for four and six work holders, and have shown means for attaching only two extra sets of tools to the machine, and have provided for only two positions of the drum cam, upon shaft 66, it will be understood that it is illustrative only of the wide adaptability of the machine and that it is within the spirit of my invention to make provision for any desired number of work holders and their tools together with appropriate adjustments for altering the movements of the turret. Along this same line, I provide accommodations for additional cams upon the central vertical shaft 61; in the present illustration, suitable spacers occupying the space that might be otherwise taken up by cams.

In some uses of the machine it might be found necessary or desirable to rotate the work, through something less than 360° between certain ones of the stations, and to provide for such an exigency I include a rack 255 that is situated, in the present showing, between stations B and C, the rack being hinged at 256 to a part projecting upward from the outer flange of the channel 2 so that the rack may be thrown to one side if not needed. As the turret rotates, the gears 18 of the workholders engage the rack and are rotated so as to present the work to the tools at station C at a different angle from that which it occupied with respect to the tools at station B. Before the gears 18 can be rotated however, it is necessary to unlock them by withdrawing the locking pins 36 from their recesses 40 and this is accomplished by locating a cam 258 on the inner flange of the channel 2 in the radial zone of the rack 255 so that as the rollers 46 of arms 44 override this cam, the gears carrying the work will be freed for rotation.

From this description, it will be seen that my machine is capable of performing numerous kinds of operations on various sorts of articles by converting the machine slightly to meet the requirements of the different pieces of work, the principle and mode of operation of the machine remaining the same under all circumstances.

Having thus described my invention, what I claim is:—

1. In a machine of the character set forth, the combination of opposed tool carriers, means for supporting a piece of work between and in operative relation to tools supported by said carriers, and further means for advancing the work into contact with one tool while moving the other tool into engagement with the work.

2. In a machine of the character set forth, the combination of opposed tool carriers, means for supporting a piece of work between and in operative relation to tools supported by said carriers, and further means for advancing the work into contact with and withdrawing it from one tool while moving the other tool into engagement with and retracting it from the work.

3. In a machine of the character set forth, the combination of opposed tool carriers, means for supporting a piece of work between and in operative relation to tools supported by said carriers, and means for advancing one of the tools into engagement

with the work and for moving the work through the intervention of said tool into contact with the other tool.

4. In a machine of the character set forth, the combination of opposed taps, means for supporting a piece of work between and in operative relation to the taps, mechanism for driving the taps first in one direction and then the other, and means for advancing one of the taps into engagement with the work and for moving the work through the intervention of said tap into contact with the other tap.

5. In a machine of the character described, the combination of opposed taps, means for driving said taps first in one direction and then the other, means for supporting a piece of work between and in operative relation to the taps, and mechanism for moving one tap toward and from the other whereby the movable tap is caused to engage and operate upon the work and at the same time move the work into contact with the other tap.

6. In a machine of the character set forth, the combination of opposed tool carriers, a work holder sustained between and in operative relation to tools supported by said carriers, means for engaging the work holder and moving it so as to present the work to one tool, and means for moving the other tool carrier to cause its respective tool to overtake the work and operate upon the same.

7. In a machine of the character set forth, the combination of opposed tool carriers, a holder supporting a piece of work between and in operative relation to tools supported by the carriers, means for shifting the holder to engage the work with and remove it from one tool, and means for simultaneously moving the other tool into contact with the work and withdrawing it therefrom.

8. In a machine of the character set forth, the combination of opposed tools, a carrier movable transversely between the tools, a work holder movably supported by the carrier, means for moving the carrier intermittently and for arresting its movement with the work holder between the opposed tools, a plunger, the work holder and plunger having parts that are adapted to interlock as the work holder arrives between the tools, means for actuating the plunger to shift the work holder in a direction to present the work to one tool, means for advancing the other tool toward and into engagement with the work, and retracting means for the last mentioned tool and plunger.

9. In a machine of the character set forth, the combination of opposed tools, means for driving the tools, a holder for supporting a piece of work between and in operative relation to the tools, means for moving the holder to present the work to one tool, means for simultaneously moving the other tool into engagement with the work, the driving means of one of the tools being of variable speed.

10. In a machine of the character set forth, the combination of a turret supported for rotation, work holders carried by the turret, an actuating member situated at the axis of the turret, a support between the turret and actuating member, a tool spindle reciprocable within the support radially of the turret, a slide guided within said support and having a portion disposed beyond the inner end of the spindle, and means for adjusting the distance between the spindle and said portion of the slide, the slide having a portion for cooperation with the actuating member.

11. In a machine of the character set forth, the combination of a stationary tool, a carrier movable past the tool, a work holder rotatably supported by the carrier, said work holder involving a driving member, a driving member supported adjacent the carrier and with which the first mentioned driving member is adapted to cooperate when the work is in operative relation to the tool, means for locking the work holder against rotation, mechanism for rendering said means ineffective thereby to unlock the work holder as the work is presented to the tool, mechanism for arresting the movement of the carrier when the aforesaid driving members are in cooperation, and means for operating the second driving member when the carrier is at rest.

12. In a machine of the character set forth, the combination of a turret, work holders rotatably supported by the turret, tools situated at stations spaced about the course of the turret, means for moving the turret intermittently to present the work holders successively to the stations, each work holder involving a driving member, and a movable track located between the adjacent stations and adapted to be placed in a position wherein the driving member of each work holder will cooperate with the track as the work holder is carried past the same.

13. In a machine of the character set forth, the combination of a turret, work holders rotatably supported by the turret, a stationary tool, means for moving the turret intermittently to present the work holders successively to the tool, each work holder involving a driving member, a driving member situated adjacent the turret and into cooperation with which the driving member of each work holder is adapted to be brought as the work holder is presented in operative relation to the tool, means for locking each work holder against rotation, mechanism for rendering said

means ineffective thereby to unlock the work holder when its driving member is in cooperation with the second mentioned driving member, and means for driving the second mentioned member when the work holder is unlocked.

14. In a machine of the character set forth, the combination of a turret, work holders rotatably supported by the turret, each work holder involving a driving member, a lock for securing each work holder against rotation, a tool carrier, a tool adapted to be supported by the carrier and into operative relation with which the successive work holders are adapted to be brought, a weight for impelling the tool carrier in a direction to engage the tool with the work, means for retracting the tool carrier against the action of the weight, a driving member with which the driving members of the work holders are arranged to cooperate when the work is in operative relation to the tool, and means for unlocking the work holder and for rotating the second mentioned driving member, said last mentioned driving member being operative when the work is presented to the tool.

15. In a machine of the character set forth, the combination of a turret, work holders rotatably supported by the turret, each work holder involving a driving member, a lock for securing each work holder against rotation, a tool carrier, a tool adapted to be supported in various positions by the carrier and into operative relation with which the successive work holders are adapted to be brought, a weight impelling the tool carrier toward the work, means for retracting the tool carrier against the action of the weight, a driving member with which the driving members of the work holders are adapted to cooperate when the work is in operative relation to the tool, means for unlocking the work holder, and mechanism for rotating the second mentioned driving member when the work is presented to the tool.

16. In a machine of the character set forth, the combination of a turret, work holders rotatably supported by the turret, means for locking each work holder against rotation, each work holder involving a driving member, means for moving the turret intermittently to present the work holders successively at a given station, a tool situated at said station and with which the work is adapted to engage, a driving member situated at said station and arranged to mesh with the driving members of the work holders, a member carried by the turret and having operative connection with the lock of each work holder, a cam with which said member is adapted to cooperate and thereby be actuated to unlock the work holder, and means for operating the last mentioned driving member when a work holder occupies the station.

17. In a machine of the character set forth, the combination of a frame, a turret supported thereby for rotation, work holders rotatably supported by the turret, each work holder involving a driving member, a locking bolt for securing each work holder against rotation, an actuating member for withdrawing the bolt from locking position, a tool supported by the frame at a given station, mechanism for intermittently moving the turret to present the work holders successively to the tool, a driving member situated at said station and with which the driving member of each work holder is adapted to cooperate, a cam carried by the frame and wherewith the aforesaid actuating member is adapted to be engaged to unlock the corresponding work holder, and means for operating the last mentioned driving member when the driving member of the work holder is in cooperation therewith.

18. In a machine of the character set forth, the combination of a frame, a turret supported thereby for rotation, work holders rotatably supported by the turret, each work holder involving a gear, a locking bolt for securing each work holder against rotation, an actuating member for withdrawing each bolt from locking position, tools supported by the frame at stations spaced about the course of the turret, mechanism for intermittently moving the turret to present the work holders successively to the tools, a rack situated between certain ones of said stations and with which the gears of the work holders are adapted to mesh as they are moved past the rack, and a cam carried by the frame and wherewith each of the aforesaid actuating members is adapted to be engaged to unlock its respective work holder when in the vicinity of the rack.

19. In a machine of the character set forth, the combination of a turret supported for rotation, work holders rotatably supported by the turret, means for moving the turret to present the work holders to a given station, means for rotating each work holder when it occupies said station, a support situated at said station, a tool carrier vertically reciprocable within said support, means for clamping tools in various positions to said carrier, a weight applied to said carrier for impelling the tool carrier toward the work holder, adjustable means for limiting the movement of the tool carrier toward the work, a rocker arm pivotally supported intermediate its ends and having one of its ends operatively connected to the tool carrier, a cam, a stirrup encircling the cam, and connections between the stirrup and the opposite ends of the aforesaid rocker arm.

20. In a machine of the character set forth, the combination of a turret supported for rotation, work holders rotatably supported by the turret, tools situated at various stations about the course of the turret, means for moving the turret to present the work holders successively at the several stations, and means individual to certain of said stations for rotating the work holders.

21. In a machine of the character set forth, the combination of a turret, means for moving the turret intermittently, a brake for arresting the movement of the turret, said brake comprising a shoe having a cavity, a plunger guided within said cavity, a spring for projecting the plunger, the turret having recesses for the reception of the plunger, and means for engaging the brake shoe with the turret to retard the movement of the same before the plunger is brought into register with a recess of the turret.

22. In a machine of the character set forth, the combination of a pair of tools disposed at right angles to each other, means for supporting a piece of work in a position to be acted upon by said tools, a cam in substantially the plane of one of said tools for moving the same toward the work, a shaft carrying said cam, a second shaft disposed at right angles to the first, driving connections between said shafts, and connections between the second shaft and the other tool for controlling the latter's movement.

23. In a machine of the character set forth, the combination of a work carrying turret, inner and outer opposed tools disposed at stations spaced apart about the course of the turret, means for driving the tools, and an actuating member for moving the inner tool toward and into engagement with the work and for moving the work outwardly into engagement with the outer tool.

24. In a machine of the character set forth, the combination of an annular turret, opposed tools situated at stations about the course of the turret, work holders supported by the turret for movement radially thereof, means for moving the turret intermittently to present the work holders to the successive stations, means for driving the tools, an actuating member situated centrally of the turret, and means for driving the actuating member, said member acting to move the inner tools outwardly into contact with the work and for simultaneously shifting the work holders outwardly to present the work to the outer tools.

25. In a machine of the character set forth, the combination of an annular turret, opposed tools situated at stations about the course of the turret, work holders supported by the turret for movement radially thereof, means for moving the turret intermittently to present the work holders to the successive stations, means for driving the tools, that of certain of the tools being of variable speed, an actuating member situated centrally of the turret, and means for driving the actuating member, said member acting to move the inner tools outwardly into contact with the work and for shifting the work holders outwardly to present the work to the outer tools.

26. In a machine of the character set forth, the combination of a work carrying turret, tools supported in angular relation to each other and in operative relation to the turret for simultaneous operation upon angularly disposed parts of the same piece of work, an actuating member for operating one tool, means for operating the other tool, and driving mechanism having operative connection with said actuating member and said means.

27. In a machine of the character set forth, the combination of an annular work carrying turret, horizontally disposed tools supported inside the turret and in operative relation to work carried thereby, vertically disposed tools supported in operative relation to the work, and means for actuating said tools.

28. In a machine of the character set forth, the combination of a turret supported to rotate in a horizontal plane, horizontally and vertically disposed tools situated about the course of the turret, means for actuating said tools, the horizontally disposed tools being immovable in a direction transversely of the turret, and means for moving work supported by the turret transversely thereof into contact with the last mentioned tools.

29. In a machine of the character set forth, the combination of a turret supported to rotate in a horizontal plane, groups of tools situated about the course of the turret, the tools of certain of said groups being angularly disposed to each other.

30. In a machine of the character set forth, the combination of a frame, a turret supported thereby for rotation in a horizontal plane, work holders rotatably sustained by the turret, driving means carried by the frame and into cooperation with which the work holders are brought by the movement of the turret, and sets of tools disposed about the course of the turret for operation upon the work, the tools of one set being disposed at an angle to each other and arranged for simultaneous operation upon the work.

In testimony whereof, I hereunto affix my signature.

NATHAN F. FRETTER.