

March 1, 1932.

J. W. HUGHES

1,847,342

AUTOMATIC NUT FINISHING MACHINE

Filed Nov 18, 1926

8 Sheets-Sheet 1

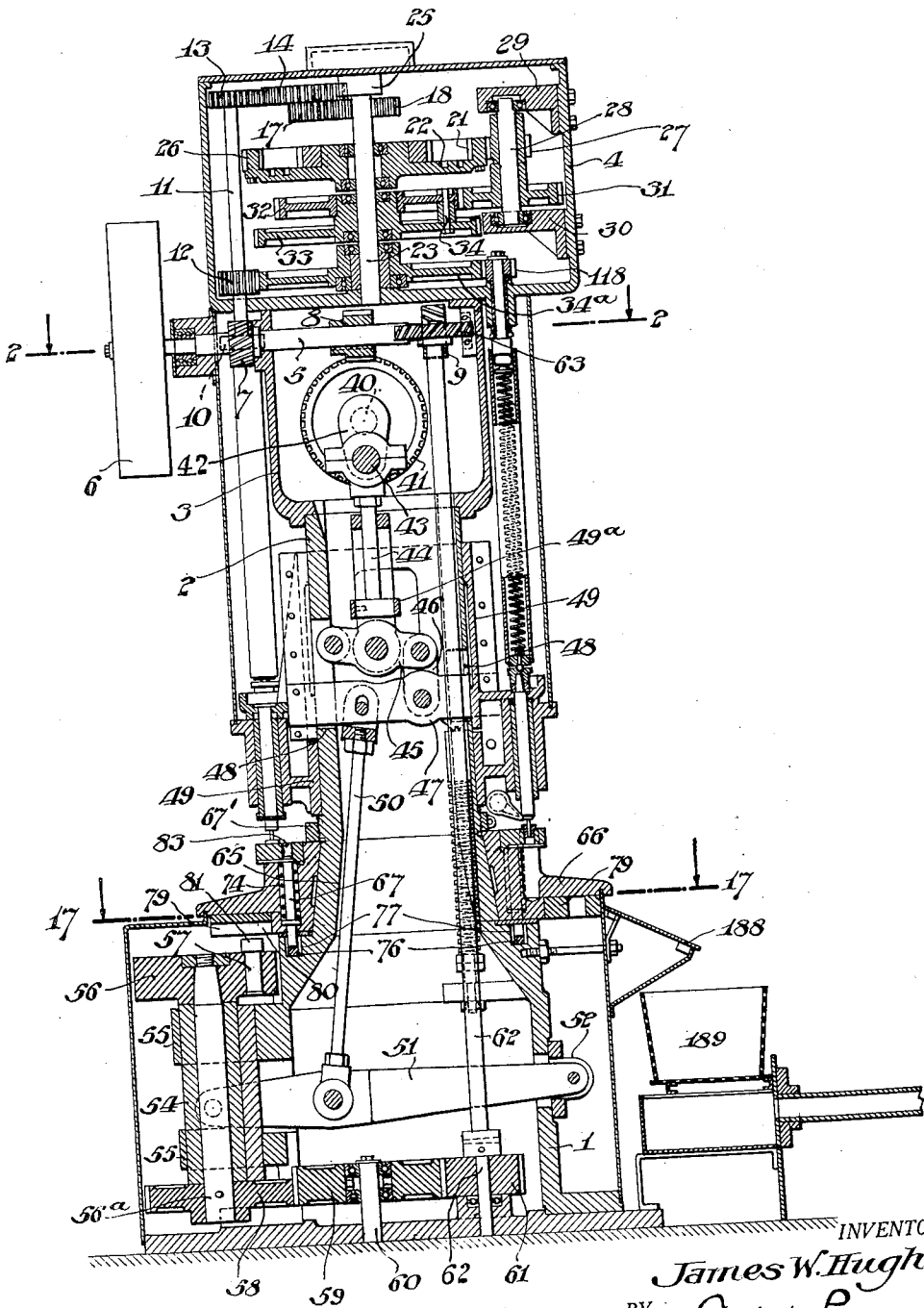


Fig. 1.

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8 Sheets-Sheet 2

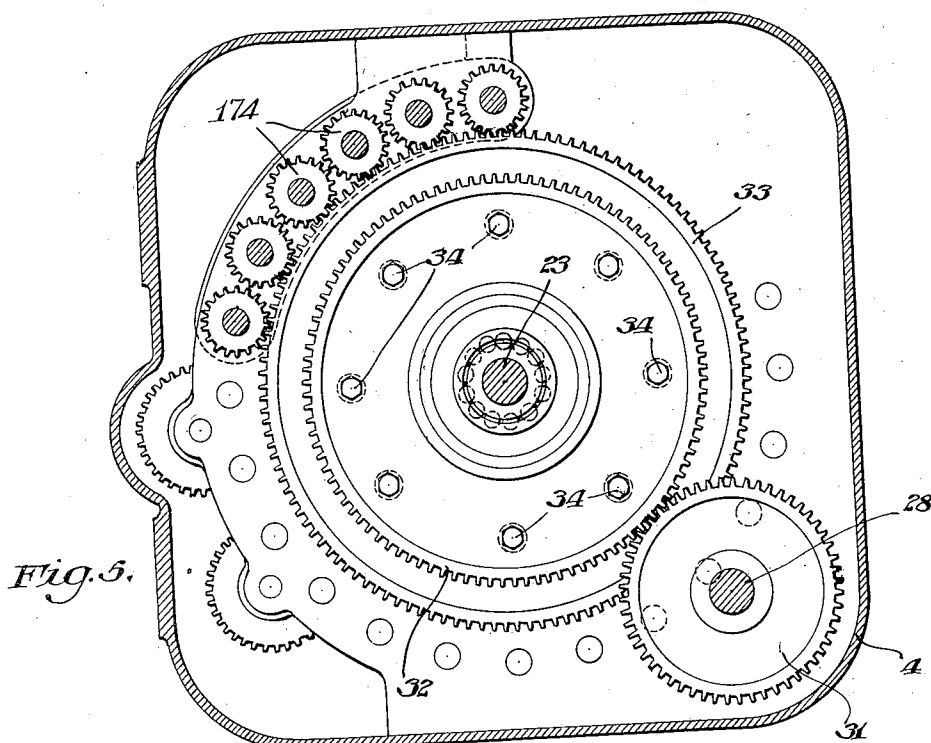
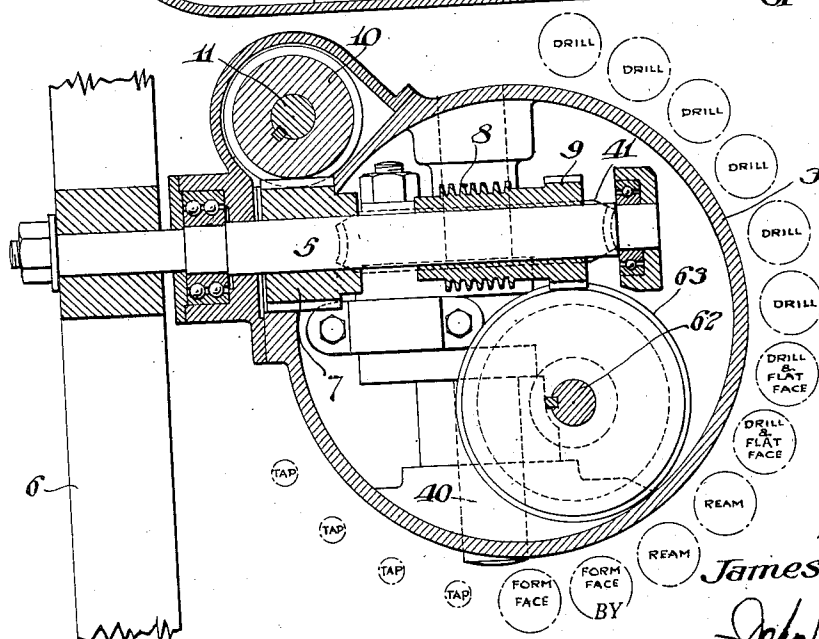


Fig. 2.

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Fig. 4.

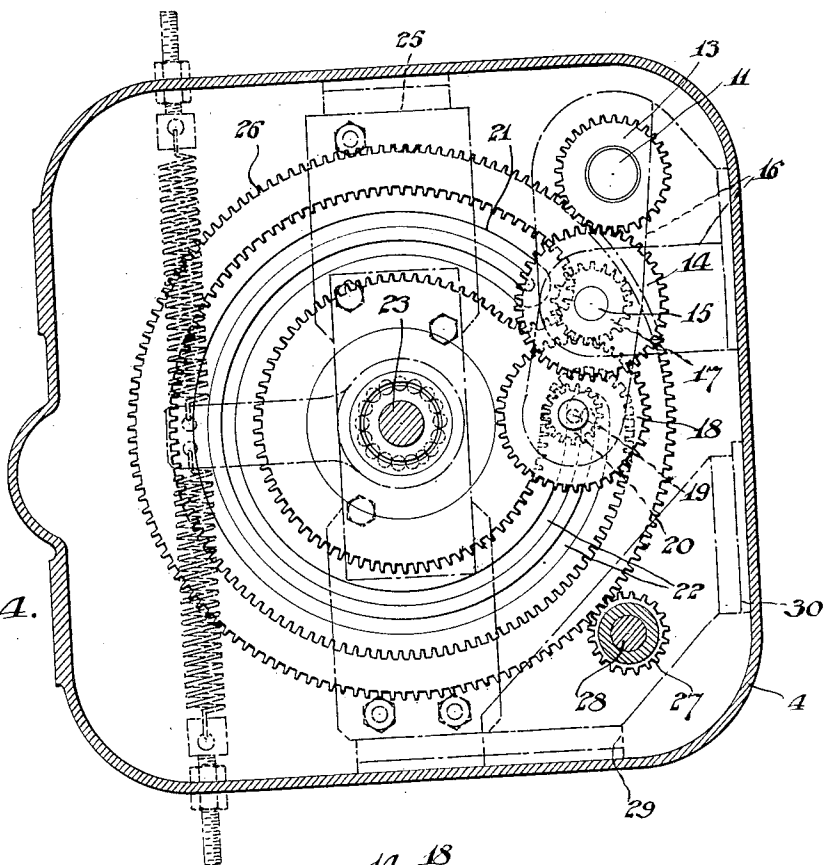
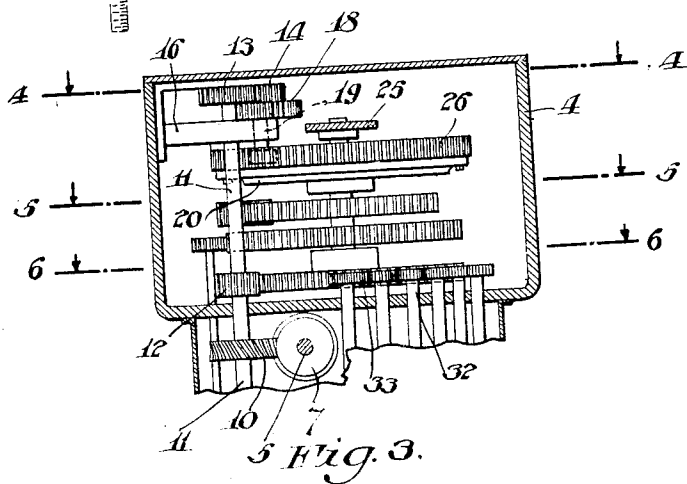


Fig. 3.

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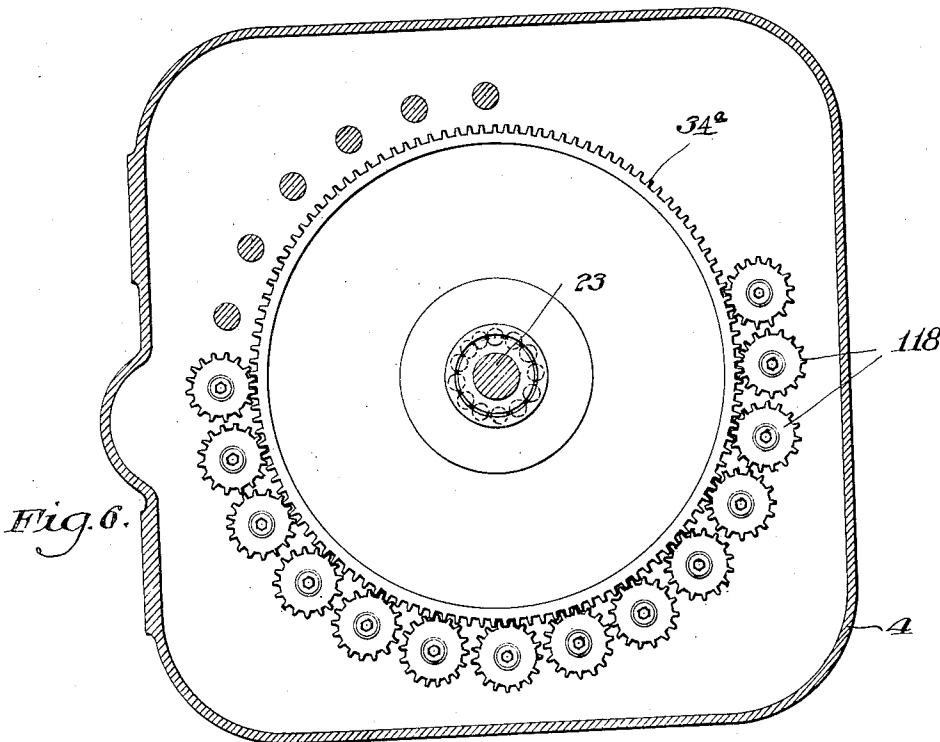
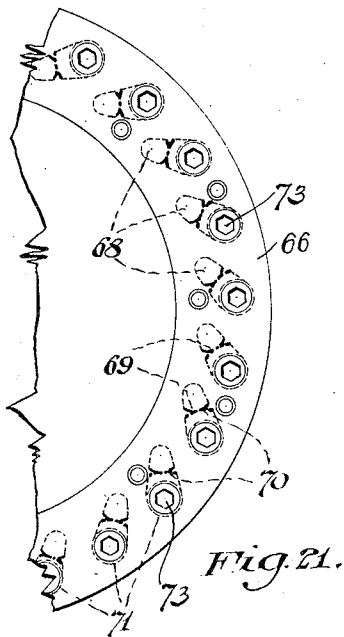
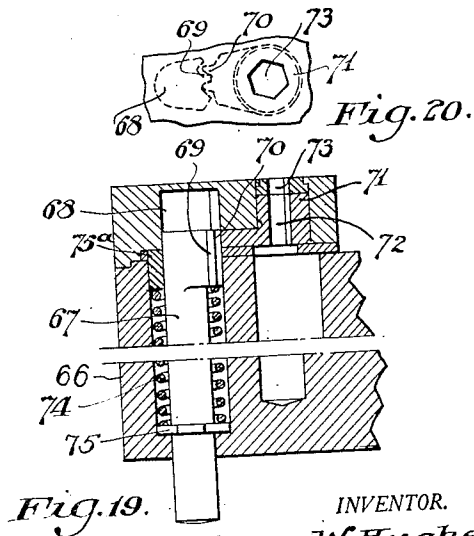


Fig. 19.

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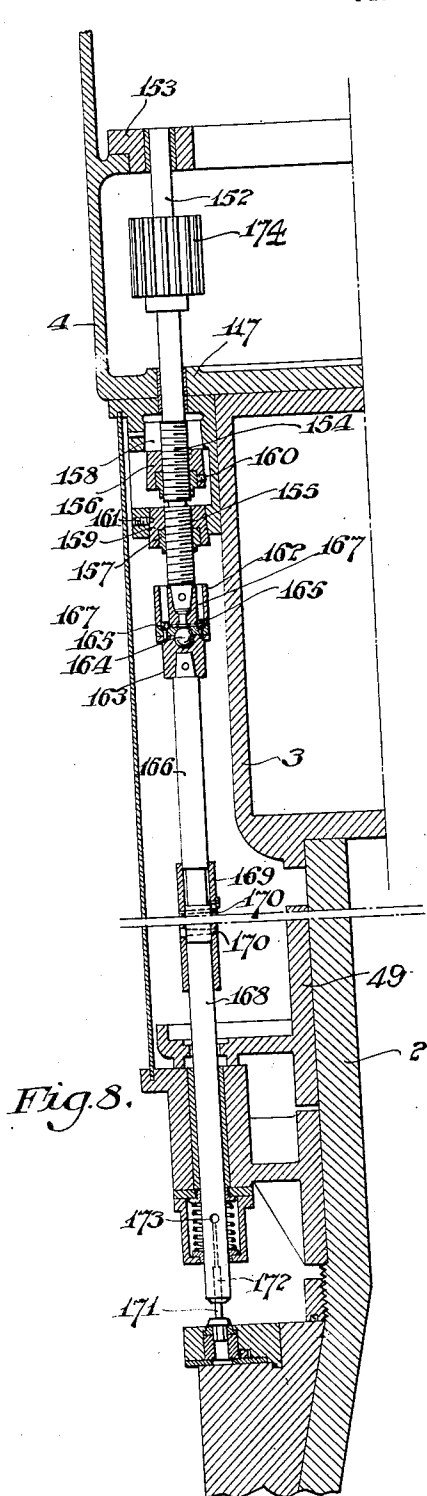
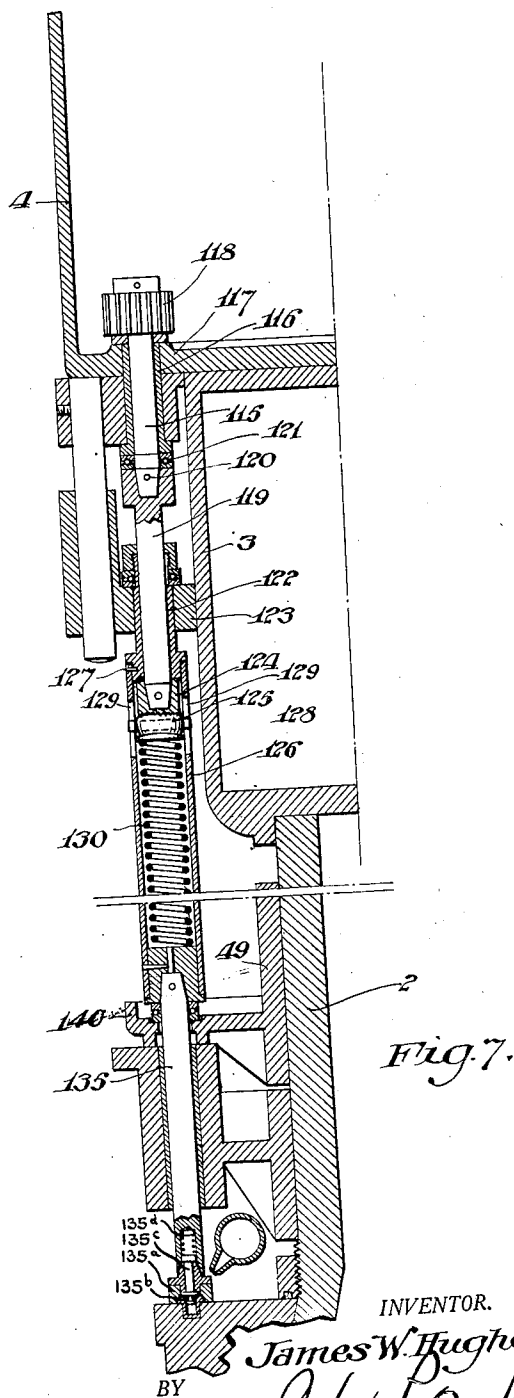
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AUTOMATIC NUT FINISHING MACHINE

Filed Nov 18, 1926

8 Sheets-Sheet 5



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1,847,342

AUTOMATIC NUT FINISHING MACHINE

Filed Nov 18, 1926 8 Sheets-Sheet 6

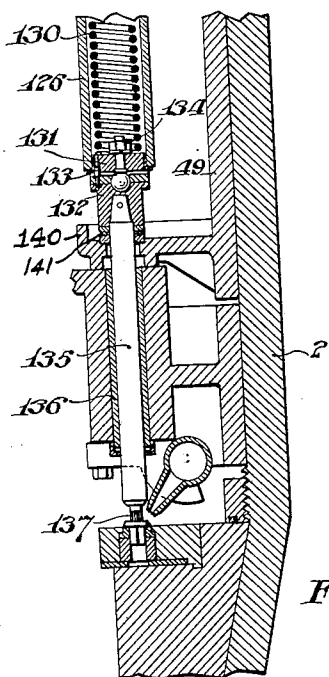


Fig. 9.

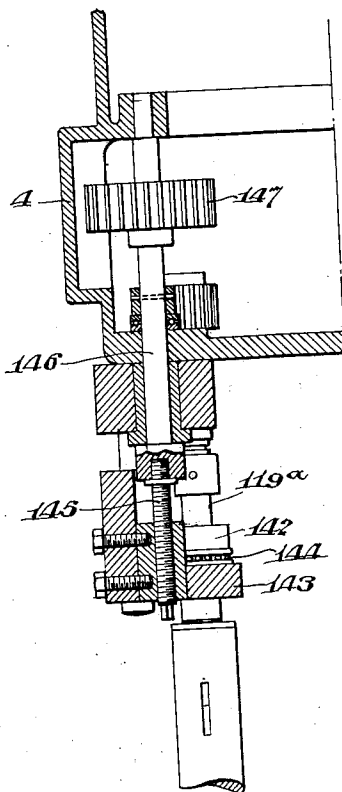


Fig. 10.

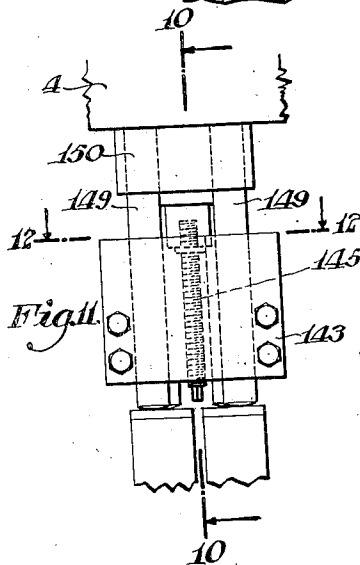


Fig. 11.

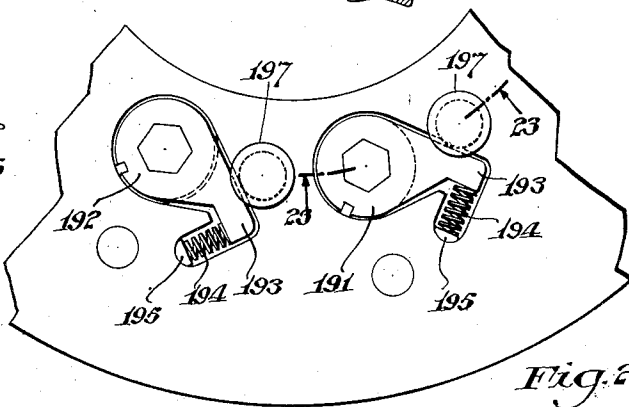


Fig. 22.

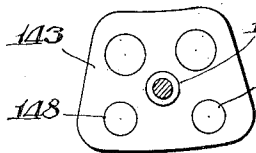


Fig. 12.

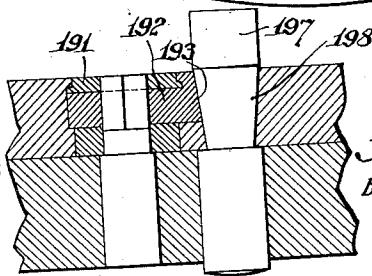


Fig. 23.

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AUTOMATIC NUT FINISHING MACHINE

Filed Nov 18, 1926

8 Sheets-Sheet 7

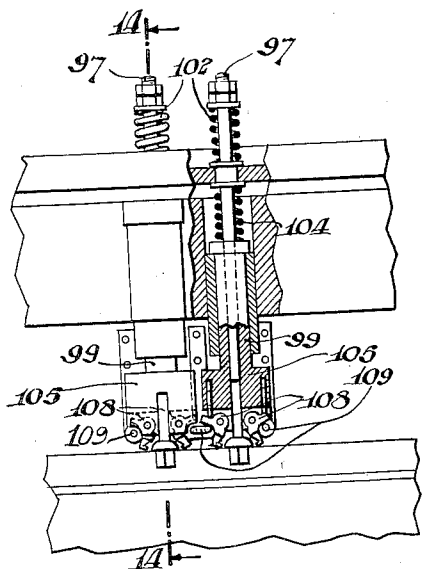


Fig. 13.

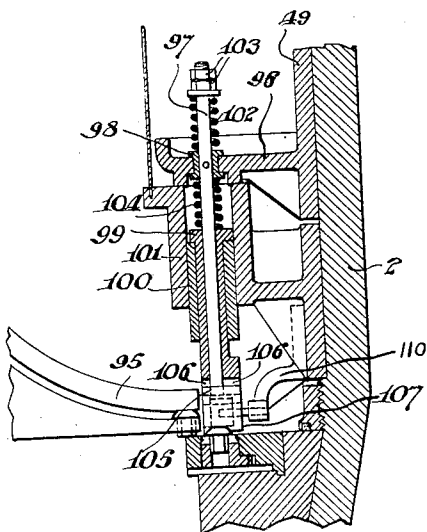


Fig. 14.

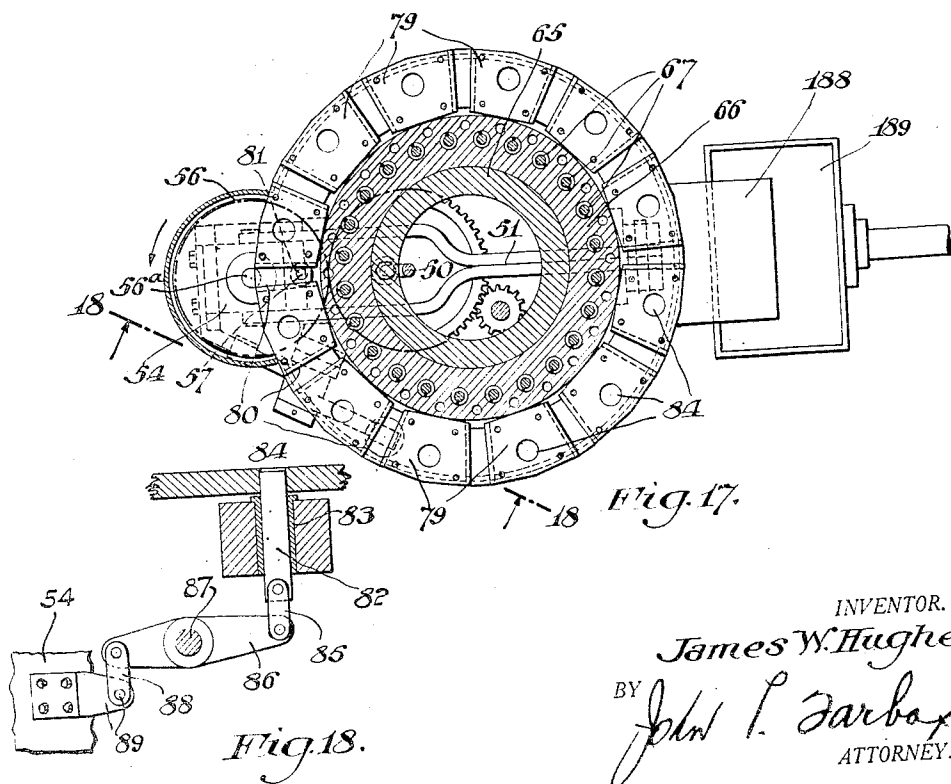


Fig. 18.

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1,847,342

AUTOMATIC NUT FINISHING MACHINE

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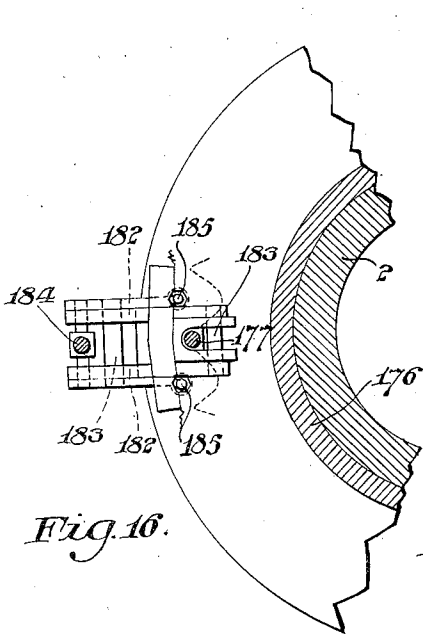


Fig. 16.

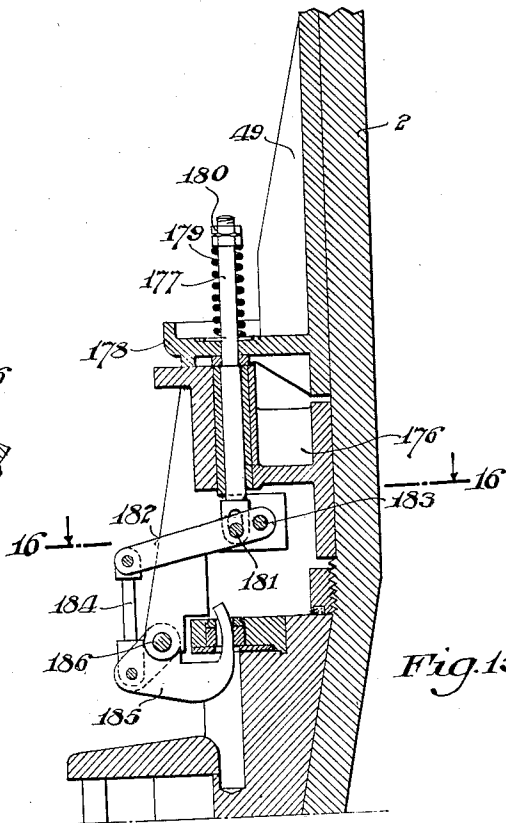
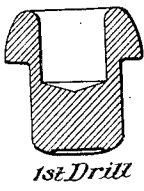


Fig. 15.

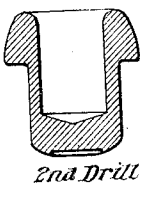
Fig. 24.



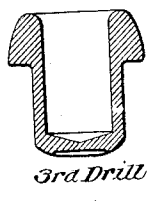
Blank



1st Drill



2nd Drill



3rd Drill



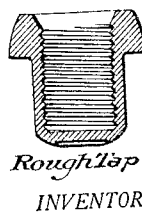
Facing and Bottoming



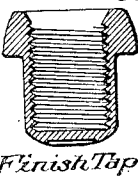
Reaming and Countersinking



Ball Seating



Rough Lap



Finish Tap

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BY John P. Parbo, ATTORNEY.

UNITED STATES PATENT OFFICE

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AUTOMATIC NUT FINISHING MACHINE

Application filed November 18, 1926. Serial No. 149,077.

This invention relates to automatic machines and has particular reference to an automatic machine for operating on nut blanks.

While capable of general use, the machine illustrated and to be described in detail hereinafter is intended primarily for operating on nut blanks having a prismatic wrench receiving portion and a conical or ball shaped head, such nuts being particularly useful for detachably fastening a vehicle wheel to a wheel hub.

The primary object of the present invention is to provide a machine of this general character which shall be capable of performing a plurality of operations on the blank and yet be relatively compact and occupy a comparatively small floor space.

Another object is to provide a machine which shall automatically feed the blanks to a rotating work support, position the blanks on said support, and then in succession drill the bore, face the conical or ball shaped end of the blank and also bottom the bore, ream and countersink the bore, ball seat the conical head, rough tap the bore, and finally finish tap the bore and eject the finished nut.

Another object is to provide an automatic machine of this general character which shall include means for feeding the work spindles in such manner as to relieve the tools of all feeding strains and thus obviate overloading or danger of breaking the same.

A further object is to provide a machine which shall be capable of operating at high speeds, and which shall perform the various operations with great accuracy and reliability.

A still further object is to provide a machine of the aforesaid character wherein the various parts shall be so arranged that the tools thereof shall be readily accessible so that they may be easily and quickly removed or replaced when necessary.

With these and other objects in view, the invention may be stated to consist in the various novel features of construction and arrangement or combination, all of which will

be fully described hereinafter and pointed out in the appended claims.

In the drawings wherein I have shown an illustrative embodiment of my invention,

Fig. 1 is a vertical sectional view through a machine constructed in accordance with my invention;

Fig. 2 is a transverse sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical sectional view through the drive gearing housing at the top of the machine but at right angles to that shown in Fig. 1;

Figs. 4, 5 and 6 are horizontal sectional views taken respectively on the lines 4—4, 5—5, and 6—6 of Fig. 3;

Figs. 7 and 8 are fragmentary vertical sectional views through one of the facing spindles and one of the tap spindles respectively;

Fig. 9 is a fragmentary detail vertical sectional view through a drilling spindle;

Fig. 10 is a fragmentary vertical sectional view taken on the line 10—10 of Fig. 11 and illustrating the mechanism for raising and lowering certain of the spindles;

Fig. 11 is a fragmentary front elevation of a pair of the spindles and the raising and lowering mechanism therefor;

Fig. 12 is a horizontal sectional view taken on the line 12—12 of Fig. 11;

Fig. 13 is a fragmentary view, partly in elevation and partly in section of the blank feeding and positioning mechanism;

Fig. 14 is a vertical sectional view taken on the line 14—14 of Fig. 13;

Fig. 15 is a fragmentary vertical sectional view showing the nut ejector mechanism;

Fig. 16 is a horizontal view taken on the line 16—16 of Fig. 15;

Fig. 17 is a horizontal sectional view taken on the line 17—17 of Fig. 1 and showing the work supporting table and associated mechanism;

Fig. 18 is a detail sectional view taken on the line 18—18 of Fig. 17 and showing the work supporting table lock mechanism;

Fig. 19 is a detail vertical sectional view through the work supporting table and illustrating one of the chuck mechanisms for holding the nut blanks;

Fig. 20 is a top plan view thereof;

Fig. 21 is a fragmentary plan view of the work supporting table;

Fig. 22 is a similar view but showing a modified form of clutch mechanism;

Fig. 23 is a sectional view taken on the line 23—23 of Fig. 22; and

Fig. 24 is a view showing the various operations performed on the nut blanks by the machine.

Describing the various parts by reference characters, 1 denotes a suitable base, from which rises a hollow column 2 that supports at its upper end a crank housing 3, which in turn supports a gear casing 4.

Journalled in crank housing 3 is a drive shaft 5 that is provided at its outer end with a drive pulley 6 which may be connected with a suitable source of power, not shown. Shaft 5 has fastened thereto, three drive pinions as indicated at 7, 8 and 9. Pinion 7 meshes with a pinion 10 that is carried on a vertically disposed shaft 11 which is journalled in gear casing 4. This shaft mounts a drive pinion 12 which drives a plurality of work spindles to be referred to hereinafter, and also a pinion 13 at its upper end which meshes with a gear 14 (Figs. 1, 3 and 4) that is carried by a stub shaft 15, the latter being journalled in brackets 16 that project from a side wall of gear casing 4. Stub shaft 15 also carries a pinion 17 which meshes with a gear 18 that is mounted on a second stub shaft 19 journalled in the upper of the aforementioned brackets 16. This stub shaft also has mounted thereon a pinion 20 which meshes with an arcuate rack 21 that has a continuous guide groove 22 formed adjacent the teeth of said rack, and this groove receives the reduced end of stub shaft 19 and serves to accurately maintain the pinion 20 in mesh with said arcuate rack at all points. As shown in Fig. 1, the arcuate rack is journalled on a vertically disposed shaft 23 which is seated in a socket formed in the lower wall of gear casing 4 while the upper end thereof is secured to a bracket 25 extending transversely of the gear casing. The arcuate rack plate is also provided with gear teeth on its peripheral edge as indicated at 26 and these teeth mesh with a pinion 27 that is fastened to a vertical shaft 28, such shaft being journalled in brackets 29 and 30 which project from a side wall of gear casing 4. Also fastened to shaft 28 is a gear 31 which meshes with a larger gear 32 that is journalled on vertical shaft 23. A larger gear 33 also journalled on shaft 23 is fastened to gear 32 by bolts 34 so as to be rotatable therewith and this larger gear 33 has meshed therewith a plurality of pinions (Fig. 5) which drive the rough tapping spindles, and the finish tapping spindles, each of which will be more fully described hereinafter.

The operation of the spindle drive mecha-

nism thus far described will now be given. Power from any suitable source is applied to pulley 6 which rotates shaft 5 and pinion 7. This pinion rotates shaft 11 through its connection through pinion 10, and hence rotates drive pinion 12 which meshes with a large horizontal gear 34—a that is journalled on the vertical shaft 23. Rotation of gear 34—a drives a plurality of work spindles that drill the bore, face and bottom the bore, ream and countersink, and ball seat the nut blank and each spindle has its drive pinions meshed therewith as shown in Figs. 1 and 6. Rotation of shaft 11 also drives pinion 13 which rotates gear 14, pinion 17, gear 18, pinion 20 and arcuate rack plate 21. The rack plate through its peripheral teeth 26 drives pinion 27, shaft 28, gear 31 and gears 32 and 33, the latter driving the aforementioned tap spindles through their respective pinions meshed therewith. Assuming the pinion 20 meshed with the inner series of gear teeth of the arcuate rack plates, it will be apparent that through the aforementioned connections, the tap spindles will be driven in a given direction of rotation, however when the pinion 20 reaches the end of the inner series of rack teeth it will roll to the outer series of rack teeth and hence drive the rack plate in an opposite direction and through the above described connections will also reverse the direction of rotation of the tap spindles. The various parts are preferably so arranged and timed that when the arcuate rack plate is rotating in one direction, the tap spindles will complete their threading on the nut blanks and when reversed will remove the taps therefrom and permit the next series of nut blanks to be aligned therewith.

The mechanism for receiving the nut blanks and moving them with a step by step circular motion beneath the tool spindle will now be described.

Journalled transversely of the crank housing 3, and at right angles to drive shaft 5, is a crank shaft 40 which is driven by a gear 41 fastened thereto and meshing with pinion 8 on the drive shaft. A crank 42 is fastened to shaft 40 and carries a crank pin 43 which in turn carries a connecting rod 44 that is pivotally connected at one end to the vertical column 2 while at the opposite end said lever is pivotally connected through a link 46 to a cross arm 47, the latter extending through apertures 48 in the side walls of the column 2 and being secured to a sleeve 49 that is slidably mounted on the column 2. The cross arm 47 has pivotally connected thereto a connecting rod 50 which is attached at its opposite end to a lever 51 intermediate the ends thereof. One end of lever 51 is pivotally mounted on a bracket 52 extending from base 1 while the opposite bifurcated ends of said lever have pivotally mounted therein a block 54 (Figs. 1 and 17) which is

journalled for vertical movement in a pair of bearing brackets 55 that project from the base 1. A vertically disposed shaft 56a is journalled in block 54 and at its upper end said shaft is fitted with a disk 56 that carries a pin 57, while the lower end of shaft 56a is fitted with a gear 58 that meshes with an intermediate gear 59 having a face somewhat broader than gear 58 so as to form a driving connection therewith through all positions of vertical movement of block 54 and shaft 56a. Gear 59 is journalled on a stub shaft 60 which projects upwardly from the base 1 and this gear meshes with a drive pinion 61 that is mounted on a vertical shaft 62, the latter being journalled at its lower end in base 1 and at its upper end in the crank housing 3. A spiral gear 63 mounted adjacent the upper end of shaft 62 meshes with pinion 9 on the main drive shaft.

Journalled on the truncated portion 65 of column 2 (Fig. 1) is an annular table 66 which is retained in position by a collar 67 threaded on the column just above the truncated portion thereof. This table is provided with a plurality of clutches or chucks which receive the nut blanks, securely hold them while the various tools operate thereon, and then release them to be ejected as will be explained hereinafter. Each clutch mechanism, as shown in detail in Figs. 19, 20 and 21 comprises a spring pressed rod 67, which extends vertically through the lower face of the nut table, and at its upper end said rod is fitted with a head 68 having one face thereof formed with a segmental spiral gear 69. This segmental gear meshes with a similar gear segment 70 formed on a clutch member 71 that is journalled in a recess in the table and provided with an aperture 72 of a prismatic cross section to receive the prismatic wrench receiving portion of the nut blank. Normally aligning with the aperture 72 is a similar aperture 73 formed in an annular disk that is seated on the upper face of the table. A spring 74, interposed between a removable collar 75 on the lower portion of the rod 67 and a collar 75a loosely surrounding the upper part of the rod and seated against a fixed shoulder, tends normally to urge the rod downwardly thereby rotating clutch member 71 to cause the side walls of aperture 72 to move out of alignment with those of aperture 73 and hence bind the prismatic portion of the nut blank securely in the table. The clutches are released at the proper time, so that the nut blank may be ejected, by the lower end of rod 67 riding up on a cam 76 (Fig. 1) positioned in an annular groove 77 that is formed in the base portion of column 2. Upward movement of each rod 67 compresses spring 74 and by virtue of the spiral teeth 69 and 70 each clutch member 71 rotates to align the side walls of apertures 72 and 73 and

hence free the nut blank. The mechanism for ejecting the freed blank will be described in detail hereinafter.

Fastened to the lower face of the table 66 are a plurality of segmental blocks 79 (Fig. 17) which are spaced apart to define radial grooves 80, each of which is adapted to receive the head 81 of pin 57 (Fig. 1) at predetermined intervals and rotate the table through a predetermined arc. The pin 57 and grooves 80 in the table define a Geneva movement to rotate the table with a step by step movement. During the intervals of rest and while the tools are operating on the nut blanks, the table is locked against movement by a pin 82 (Fig. 18) which moves upwardly through an aperture 83 in the column 2 and into one of a plurality of apertures 84 in the table, the apertures 84 being arranged therein so that each one aligns successively with pin 82 at the various periods of rest of the table. Pin 82 is pivotally connected through a link 85 with one end of a lever 86 that in turn is pivoted at 87 to an offset projecting from column 2. The opposite end of lever 86 is pivotally connected through a link 88 to a strap 89 that is fastened to the vertically movable block 54.

A description of the operation of the mechanism for receiving the nut blanks and moving the table with a step by step circular motion will now be given. Rotation of drive shaft 5 is transmitted through pinion 8 and gear 41 to crank shaft 40 which in turn causes a vertical movement of connecting rod 44 and lever 45. Vertical movement of lever 45 is transmitted to cross arm 47 and sleeve 49 which in turn causes lever 51 to oscillate vertically through the medium of connecting rod 50 and thereby raises and lowers guide block 54 which is attached to the free end of lever 51. Meanwhile rotation of drive shaft 5 is transmitted through pinion 9 and gear 63 to vertical shaft 52 which in turn rotates gears 61, 59, and 58, and also shaft 56a which is fitted with the disk 56 and pin 57. The disk 56 and pin 57 rotate continuously at a uniform speed and at the proper time interval the block 54 is raised which carries the pin 57 upwardly and into engagement with one of the aforementioned radial slots or grooves 80 in the lower face of the table. Rotation of pin 57, which is disposed at a predetermined radius on disk 56, carries the table through a predetermined arc, which in the present instance is a distance equal to that between two of the nut receiving apertures as two of the nut blanks are operated on simultaneously. When the table has moved this distance, the pin 57 will become disengaged from the slot or groove in the table and thereafter the crank mechanism will lower the block 54 and associated parts so that the disk and pin may rotate freely without engaging the table until the tools have completed the work on the nut

blanks and they are to be again advanced to the next position whereupon the cycle is again repeated. As the block 54 moves downwardly leaving the table at rest, the strap 89 pulls downwardly on one end of lever 86 and raises the opposite end thereof to carry pin 82 into an aperture 84 in the table and thus lock the table against movement. As the block 54 moves upwardly to again engage Geneva pin 57 with the table, the locking pin 82 is removed from the table aperture and hence the table is free to rotate. During each period of rest, a pair of nut blanks are automatically fed to the table and positioned in a pair of apertures 72 and 73 therein by a mechanism to be described hereinafter. The apertures 72 and 73 are aligned at the ejecting and receiving stations by the clutch rods 67 riding up on the aforementioned cam 76, but as soon as the table rotates, these rods ride off the cam and the springs 74 force the rods 67 downwardly to lock the positioned nut blanks securely in the table as previously described.

The mechanism for feeding and positioning the nut blanks is shown in detail in Figs. 13 and 14. The nut blanks are fed from a suitable hopper (not shown) down a pair of inclined chutes 95 with the ball headed portions thereof upward and the prismatic wrench receiving portions downward. These nut blanks move down the chutes by gravity and each nut blank is automatically aligned with the receiving apertures 72, 73 in the table and then pressed therein by a mechanism to be described. Projecting from the sleeve 49 on column 2 is a supporting bracket 96 in which is mounted a pair of spaced and vertically disposed rods 97. Each rod is engaged through a bushing 98 in the bracket and extends downwardly through a bushing 99 positioned within a sleeve 100 that is slidable in a bracket 101 projecting from the column 2. A spring 102 interposed between bushing 98 and nuts 103 threaded on the upper end of rod 97, and a similar spring 104 interposed between bushings 98 and 99 serve to resiliently support the rod. The lower end of each rod terminates in a flattened portion 105 that is disposed in a slot 106 in the lower end portion of bushing 99, and the lower edge of this flattened portion is provided at the rear with a downwardly extending projection 107 that serves as a stop to limit the travel of the nut blanks along a radius of the table. Fastened to the lower portion of each bushing 99 is a pair of pivoted fingers 108 that are adapted to engage beneath the head of each nut blank after it leaves the chute. These fingers and the stop projection 107 serve to accurately align the nut blank over the receiving apertures in the table, such positioning taking place while the sleeve 49 is in its upper position. As the sleeve 49 moves downwardly as previously described, the rod 97 moves

downwardly therewith to push the nut into the aperture in the table, and after the prismatic portion of the nut enters the aperture in the table, the fingers 108 are released from the nut by pins 109 which engage projections thereon and swing the fingers about their pivots. The pins 109 project laterally from suitable brackets 110 that extend from the column 2. Continued downward movement of sleeve 49 and bracket 96 carries rod 97 downwardly and hence the lower end of this rod pushes against the head of the nut blank until it is completely seated in the aperture in the table with the head of the nut in contact with the table as shown in Fig. 14. On the upward stroke of sleeve 49 the loading mechanism is raised from the nut blank and the table is free to rotate as previously described. It will be understood, of course, that in the present instance two loading units are provided as shown in Fig. 13 so that two nut blanks will be positioned in the table simultaneously.

The tool spindle mechanism for performing the various operations on the nut blanks will now be described and in the present instance, although the number of spindles may obviously be varied to fit different conditions, comprises six drill spindles, two facing and bottoming spindles, two reaming and countersinking spindles, two ball seating spindles, two rough tapping spindles and two finish tapping spindles making a total of sixteen work spindles. It will be noted at this point that the nut blanks are operated on by the tools in pairs, that is, two nut blanks are fed to the table at once, and are then operated on in pairs by the various spindles and finally are ejected two at once from the machine.

The work spindles, comprising six drill spindles and two each of facing and bottoming spindles, reaming and counter-sinking spindles, and ball seating spindles, are driven from gear 34a at a constant speed and in the same direction of rotation, while the remaining four tap spindles are driven from gear 33 and rotate in one direction while threading the nut blanks and in a reverse direction when raised from the work.

Each drill spindle is identical in construction adjacent its upper portion with the facing spindles, one of which is illustrated in Fig. 7 and reference to this figure may be had for the drive and construction thereof, while the lower end portion of the drill spindle is shown in Fig. 9. Referring to Fig. 7, each spindle comprises a vertical shaft 115 which is journaled in a bushing 116 that extends vertically through the lower wall 117 of gear casing 4, such wall extending beyond the side walls of crank housing 3. The upper end of each drill spindle shaft is fitted with a pinion 118 which meshes with the aforementioned gear 34a, (as clearly shown

in Fig. 6) while the lower end of this shaft is socketed into the end of a shaft 119 and is rotatable therewith by a pin 120 extending transversely therethrough. A suitable thrust bearing 121 is interposed between the bushing 116 and enlarged head of shaft 119 to receive the upward thrust of the drill. Shaft 119 extends through a sleeve 122 that is journaled in a bracket 123 projecting from crank housing 3 and the lower end of this shaft is socketed and pinned to a member 124 that is formed with a ball shaped head 125. The lower end of sleeve 122 is enlarged to receive the upper end of a tubular shaft 126 which is fastened thereto at 127. A flat key 128 extends transversely through member 125 and has the ends thereof positioned in elongated vertical slots 129 formed in tubular shaft 126 thereby to provide a driving connection therebetween. A spring 130 is positioned in tubular shaft 126 and abuts the ball shaped head 125 of member 124 at its upper end while the lower end (as shown now in Fig. 9) abuts a plug 131 that is fitted in the lower end of tubular shaft 126. This plug is fastened to an annular socket member 132 by headed screws 133 threaded into said member and having the heads thereof projecting into elongated bores in the plug thereby providing a connection which will transmit rotation and also permit a limited vertical movement of the member 132 and plug relative to each other. A bolt 134 threaded in plug 131 and having a ball shaped head seated in socket member 132 permits a limited universal movement between the plug and socket member by virtue of the connection therebetween just described. Socket member 132 has fitted therein, one end of a shaft 135 that is journaled in a bushing 136 which is carried by an arm that projects from column 2. The lower end of this shaft carries a drill indicated at 137 which is detachably connected thereto in any approved manner, not shown. From the construction above described, it will be evident that rotation of gear 34 will rotate the pinions 118 and shafts 115 which in turn transmit their motion to their respective shafts 119. Each shaft 119 being connected to the tubular shaft 126 through key 128 as above described causes said tubular shaft to rotate therewith and in turn rotate socket member 132, shaft 135 and the tool carried thereby. The drills are raised in pairs while the nut blanks are positioned thereunder by a bracket 140 which projects from the vertically movable sleeve 49 on column 2. Each bracket carries a thrust bearing 141 for each spindle which is interposed between the bracket and the socket member 132. As the sleeve 49 is raised at a predetermined time, as previously described, the socket members 132 of each pair of drill spindles are raised within the tubular shafts 126 against the ten-

sion of springs 130 and on downward movement of sleeve 49, the drills are engaged with the work, the sleeve 49 continuing downward and leaving the springs 130 to feed the drills into the nut blanks. The limited universal connection at 132 permits the various parts to operate without binding and insures free and easy movement thereof. The first two drills carry the bores in the nut blanks substantially one third the total distance, the second pair of drills carry the bores substantially another third of the total distance, while the third pair of drills carry the bores the last third of the distance to which the blanks are drilled, as shown in Fig. 24.

The next operation consists in facing off the top surface of the blanks and bottoming the bores, as shown in Fig. 24. This operation is carried out on two blanks simultaneously by a pair of spindles similar to the aforementioned drill spindles except that the feed of the tools for bottoming and facing is not dependent entirely on the springs 130 but instead is positively controlled by a feed screw to be described. Referring to Figs. 10, 11 and 12, it will be noted that the shaft 119^a of each spindle is fitted with an annular collar 142 and a bracket 143 between which is interposed a thrust bearing 144. The bracket 143 is common to both spindles and is formed with a vertically disposed screw threaded bore which receives a feed screw 145 that is carried by a shaft 146, the latter extending upwardly through the gear casing 4 and carrying a gear 147 that meshes with the reversible gear 33, as shown in Fig. 5. Bracket 143 is also provided with a pair of spaced parallel apertures 148 which receive spaced parallel guide rods 149 that depend from a block 150 that is fastened to gear casing 4. Rotation of reversible gear 33 drives gear 147 and shaft 146 thereby rotating feed screw 145 to raise or lower the bracket 143 depending on the direction of rotation of the gear 33. The bracket 143 limits the downward feed of the spindles by the springs therein by virtue of its connection through thrust bearing 144 and collar 142. The next operation on each pair of nut blanks consists in reaming the bore and countersinking the upper end portion thereof, as shown in Fig. 24, and the operation is carried out by a pair of spindles similar to those used for facing and bottoming except that the appropriate tool is used. After this operation, the surface of the spherical head of the nut blanks are machined by an operation known as ball seating and two nut blanks are operated on by a similar pair of spindles fitted with the appropriate tools.

The "box" tool by means of which the spherical head is machined forms another of the novel elements of the invention and is shown in Fig. 7 of the drawings. The tool carrying spindle 135 is driven and fed by

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means similar to those described in connection with the drill spindles. When used for this forming process, however, the arrangement differs in some details. The spindle 135 rotates in the sleeve 49 with a much larger clearance than usual, in this case being about fifteen thousandths. The forming tool 135^a is centered by a conical pilot pin 135^b which is formed on the end of a sliding pin 135^c, pressed downward by the spring 135^d. This construction, combined with the relatively loose floating fit of spindle 135 in its bearing provides for absolutely accurate centering of the "box" forming tool and hence, the spherical head of the nut, with the previously drilled, faced and reamed surfaces.

The final operations consist in rough tapping and finish tapping the blanks. This operation is divided into two steps to lessen the work on the taps and also to insure a clean cut thread. Each pair of threading spindles is identical in construction and one of such spindles is shown in detail in Fig. 8. A vertically disposed shaft 152 is journaled at its upper end in a shelf 153 projecting from the side walls of gear casing 4 and at its lower end in the lower wall or base 117 of said casing. The lower end of this shaft is provided with two threaded portions 154 and 155 one being a right hand thread and the other a left hand thread and each threaded portion has engaged thereon a block 156 and 157 respectively. These blocks are adapted to seat within recesses 158 and 159 formed in a supporting member 160 and fastened thereon by set screws 161. In actual use, only one of the threaded blocks 157 or 156 is seated within its recess and fastened by screw 161 depending upon whether the nut blanks are to be tapped with a right or left hand thread. The lower end of shaft 152 is fitted with an enlarged coupling block 162 and this block and a similar block 163 are united for a limited universal movement by means of a ball 164 and screws 165 having enlarged cylindrical heads 166 that project into bores 167 in block 162. Block 163 is carried by the upper end of a shaft 166 which is connected at its lower end to a shaft 168 through a sleeve 169 and shear pins 170 that are adapted to shear in event of binding by the tap. The lower end of shaft 168 is socketed to receive a tap 171 and this socket communicates with a bore 172, which in turn opens into an oil manifold 173 surrounding the lower end of the shaft.

In operation, rotation is imparted to each shaft 152 by a broad faced pinion 174 secured thereto and meshed with the reversible gear 33 in the gear casing 3, as shown in Fig. 5. Rotation of shaft 152 is transmitted through the above described connections to the tap, meanwhile the entire spindle is fed downwardly by the screw threaded portion 155 engaging block 157 in the present illustration while block 156 rotates with the threaded

portion 154. The various parts are so proportioned that when the tap reaches the bottom of the bore in the nut blank the reversible gear 33 will reverse its direction of rotation and the tap will rotate in an opposite direction and be withdrawn from the work. If the thread of the nut is to be of a hand opposite to that above described, an idler gear is used to reverse the rotation of gear 174, the block 157 is released from its aperture 159, and block 156 is seated in its aperture 158 and secured therein by set screw 161. It will thus be obvious that with the proper tap, the direction of rotation on the down and up stroke of the spindle will be reversed from that described above.

During the tapping operation, oil is fed under pressure to manifold 173 from a suitable source and flows through bore 172 to the tap, thence down the flutes of the tap into the bore of the nut blank and forces out the metal chips while lubricating the tap.

It will also be understood that I provide in the present instance two spindles for rough tapping the blanks simultaneously and two other spindles for finish tapping the blanks simultaneously and all of these spindles are substantially identical in construction with that described above.

The ejector mechanism for removing the completed nuts from the table will now be described, and reference is had to Figs. 15 and 16. Journaled in a bracket 176 which projects from annular column 3 is a rod 177 which is reduced in diameter at its upper end portion to define a shoulder. This reduced portion projects through a laterally extending projection 178 on sleeve 49 and is fitted thereabove with a spring 179 and suitable nuts 180. The lower end of rod 177 is connected through a pin and slot connection indicated at 181 to a pair of levers 182 which are pivoted at 183 to bracket 176. The opposite ends of these levers are connected through a link 184 to a pair of knockout fingers 185 that are pivoted at 186 to bracket 176. These knockout fingers are adapted to enter the apertures in the table that receive the nut blanks and force said blanks or finished nuts upwardly therefrom.

In operation, on the upward stroke of sleeve 49, the rod 177 is raised by projection 178 forcing spring 179 upwardly and this upward force is transmitted through nuts 180 to rod 177. Upward movement of the rod lifts levers 182 and link 184 thereby pulling fingers 185 about their pivots and disengaging them from the table apertures. Thereupon the table rotates to bring two finished nuts in alignment with the knockout fingers. As the sleeve 49 descends, the projection 178 thereon engages the shoulder on the rod and forces said rod downwardly and by the aforementioned connections with the fingers, projects said fingers upwardly into the table ap-

ertures to disengage the finished nuts therefrom. By virtue of the curvature of the fingers, as best shown in Fig. 15, the finished nuts are projected to the outer periphery of the table onto a downwardly sloping shelf 188 (Fig. 1) and into a foraminated basket 189 to permit the oil to drain therefrom.

In Figs. 22 and 23 I have shown a modified form of clutch mechanism for retaining the nut blanks securely in the table while the various work spindles are operating thereon. In this instance, a plurality of inserts 191 each having a hexagonal aperture therethrough are positioned in an annular series about the top face of the table. Directly beneath each insert is journaled for limited rotary movement, a clamping element 192 which is provided with a hexagonal aperture therethrough and also with a projection 193, the outer end of which is engaged by a spring 194 seated in a recess 195 in the table. Spring 194 tends normally to rotate the clamping element 192 in a counter clockwise direction as viewed in Fig. 22 to position the aperture therein out of alignment with the aperture in the insert 191 and thereby clamp a nut blank securely in the table. This rotary movement of each clamping element 192 is limited, however, by a cam pin 197 which projects through the table and is formed with a tapered portion 198 that is engaged by the projection 193. The lower end of each pin is adapted to project in an annular cam groove, as previously described in connection with the first mentioned nut blank clamping mechanism. In operation, each clamping mechanism is unlocked by the pin 197 moving downwardly thereby causing the tapered portion 198 to force projection 193 and clamping element clockwise thereby aligning the apertures in the insert and clamping element. After the nut blank has been positioned therein, the cam pin moves upwardly due to the cam groove and the spring 194 then rotates the clamping element counter clockwise to bind the nut blank against the stationary insert.

The detail operation of each mechanism of the machine has been given and for a detailed description thereof reference may be had to that portion of the specification; however a general operation of the whole machine will now be given.

The nut blanks are fed from a suitable hopper, not shown, down chutes, and are placed, two at once in the nut blank receiving apertures in the table, while the same is at rest and in a manner already described. The table now rotates over an arc of a predetermined angle by means of the above described Geneva mechanism. This movement of the table actuates the nut blank locking mechanism, as above described to securely lock the nut blanks in the table apertures, and also positions two of the blanks under the first

pair of drilling spindles. The table comes to rest and the first pair of drill spindles descend and drill the two blanks a distance substantially one third of the total depth of the bore. The actual depth drilled will, of course, depend on the hardness of the metal of the blanks and also as to the sharpness of the drills. At a predetermined time, the drill spindles are raised and the table rotates through a similar arc to position the aforementioned nut blanks under the second pair of drill spindles. Meanwhile another pair of nut blanks have been fed to the following pair of apertures in the table and these are now positioned under the first drill spindles. During the next cycle of operation, the second pair of drill spindles carry the bore in the nut blanks substantially two thirds of the total distance and at a predetermined time these as well as the first pair of drill spindles are raised and the table again rotates over a predetermined arc. This operation continues with a step by step motion of the table, each period of rest serving to position two new blanks in the table, and permit the various pairs of work spindles to perform their operations. These operations consist of drilling the bore, facing off the top conical surface of the nut and bottoming the bore, reaming the bore and countersinking the upper peripheral edge thereof, ball seating the conical surface of the nut, rough tapping the bore and finally finish tapping the bore. The nuts are then ejected by the ejecting mechanism above described.

During the operation of the various work spindles, oil is fed under pressure to the tools through suitable pipes and manifolds illustrated in the drawings but forming no part of the present invention.

It will be understood, that while I have illustrated and described the above mechanism as being particularly suited for operating on nut blanks, that other articles could be operated on equally well by various tools which might be mounted in the spindles.

I claim:—

1. A machine of the character set forth comprising a work support journaled for rotary movement and having a plurality of radially disposed slots therein, a chute for feeding articles to said support, means for retaining said articles on said support, an element rotating at a constant speed normally disposed out of operative relation with said support, means for moving said element toward and from said support at predetermined intervals thereby to bring the element successively into operative relation with the support and to engage said element with the radial slots in said support and move said support a predetermined distance, and tool devices disposed in operative relation to said support and adapted to operate on the article thereon.

2. A machine of the character set forth comprising a base, a column rising from said base, a gear housing carried by said column, gearing in said housing, a work support rotatably mounted on said column, clamping means for detachably retaining articles on said support, a plurality of tool devices arranged about said column, mechanism for rotating said support with a step by step motion, means for operating said gearing, and connections between said gearing and said tool devices adapted to rotate certain of said tool devices constantly in one direction and other of said tool devices in either direction, and a connection between said gearing and support rotating mechanism.

3. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column, means for rotating said support with a step by step motion, a sleeve movable longitudinally on said column, a plurality of tool devices arranged about said column and engaged with said sleeve, means for actuating said tools, and means for moving said sleeve at predetermined periods to move said tools toward and from said work support.

4. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column, a constantly rotating element carried by said base and adapted to engage said work support to rotate the same a predetermined distance, a sleeve movable longitudinally on said column, a connection between said sleeve and said constantly rotating element, a plurality of tool devices arranged about said column and engaged with said sleeve, means for actuating said tools, and means for moving said sleeve at predetermined periods to move said tools toward and from said work support and engage and dis-engage said rotating element with said work support.

5. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column, and having a plurality of apertures therein adapted to receive articles, means for securing said articles in said apertures, a constantly rotating element carried by said base, said element being normally in inoperative relation to said support but movable into operative relation therewith to engage said work support at predetermined intervals to rotate the same with a step by step motion, a plurality of tool devices arranged about said column, means for moving said tool devices toward said work support during periods of rest thereof, and means for driving said tool devices and said constantly rotating element.

6. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column, a constantly rotating element carried by said base normally in inoperative rela-

tion to said support but movable into operative relation therewith to engage the under side of said support to rotate the same through a predetermined distance, means for engaging said element with said support at predetermined intervals to rotate said support with a step by step motion, means for locking said support against rotation during each period of rest, a plurality of tool devices arranged about said column, means for moving said tool devices toward and from said support, and means for actuating said tool devices and said element.

7. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column, means for rotating said support with a step by step motion, means for locking said support against rotation during each period of rest, a sleeve movable longitudinally on said column, a plurality of rotary tool devices arranged about said column and engaged with said sleeve, means for rotating said tools, and means for moving said sleeve at predetermined periods to move said tools toward and from said work support.

8. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled on said column and having a plurality of apertures therein, means for automatically positioning articles in said apertures, a constantly rotating element carried by said base and adapted to engage said work support to rotate the same a predetermined distance, a sleeve movable longitudinally on said column, a connection between said sleeve and said constantly rotating element, a plurality of rotary tool spindles arranged about said column and engaged with said sleeve, means for rotating certain of said tool spindles in one direction and other of said tool spindles in either direction, and means for moving said sleeve at predetermined periods to move said tools toward and from said work support and engage and dis-engage said rotating element with said work support.

9. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled about said column, a chute for automatically positioning articles on said support, means for retaining said articles in position on said support, a constantly rotating element adapted to engage said support to rotate the same through a predetermined arc, a plurality of tool spindles disposed about said column, mechanism for raising the tools from said articles during movement of said support and lowering said tools into engagement with the work during each period of rest of the support, and means for releasing the article retaining means and ejecting the completed article from said support in the relative approach and separation movement of said tools and support.

10. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled about said column, a drive shaft journaled in said column, a Geneva mechanism for rotating said support with a step by step motion, a plurality of spindles disposed about said column and in operative relation to said support, a gear train for driving said spindles operatively connected to said drive shaft, and a connection between said drive shaft and said Geneva mechanism.

11. A machine of the character set forth comprising a base, a column rising from said base, a work support journaled about said column, a drive shaft journaled in said column, a sleeve journaled for longitudinal movement with respect to said column, a Geneva mechanism for rotating said support with a step by step motion, a plurality of tool spindles disposed about said column, gearing for rotating said spindles operatively connected with said drive shaft, a connection between said drive shaft and said sleeve to move the same longitudinally of said column, means operatively connected with said sleeve and said tool spindles to raise and lower the same, and an operative connection between said drive shaft and said Geneva mechanism.

12. A machine of the character described, comprising a plurality of tool spindles and a rotatable work support, indexing means to cause successive registration of said work support with said spindles including a continuously rotating member adapted to engage the work support to index the same and means to move said member successively in and out of operative relation with said support, whereby the interval between indexing movement may be increased relative to the interval consumed by the indexing movement.

13. A machine of the character described comprising a rotatable work support and a plurality of tool spindles, a Geneva gear to effect successive indexing of said support relative to said spindles, and means for effecting a longitudinal disengagement of the elements of said gear to render it temporarily inoperative.

In testimony whereof he hereunto affixes his signature.

JAMES W. HUGHES.