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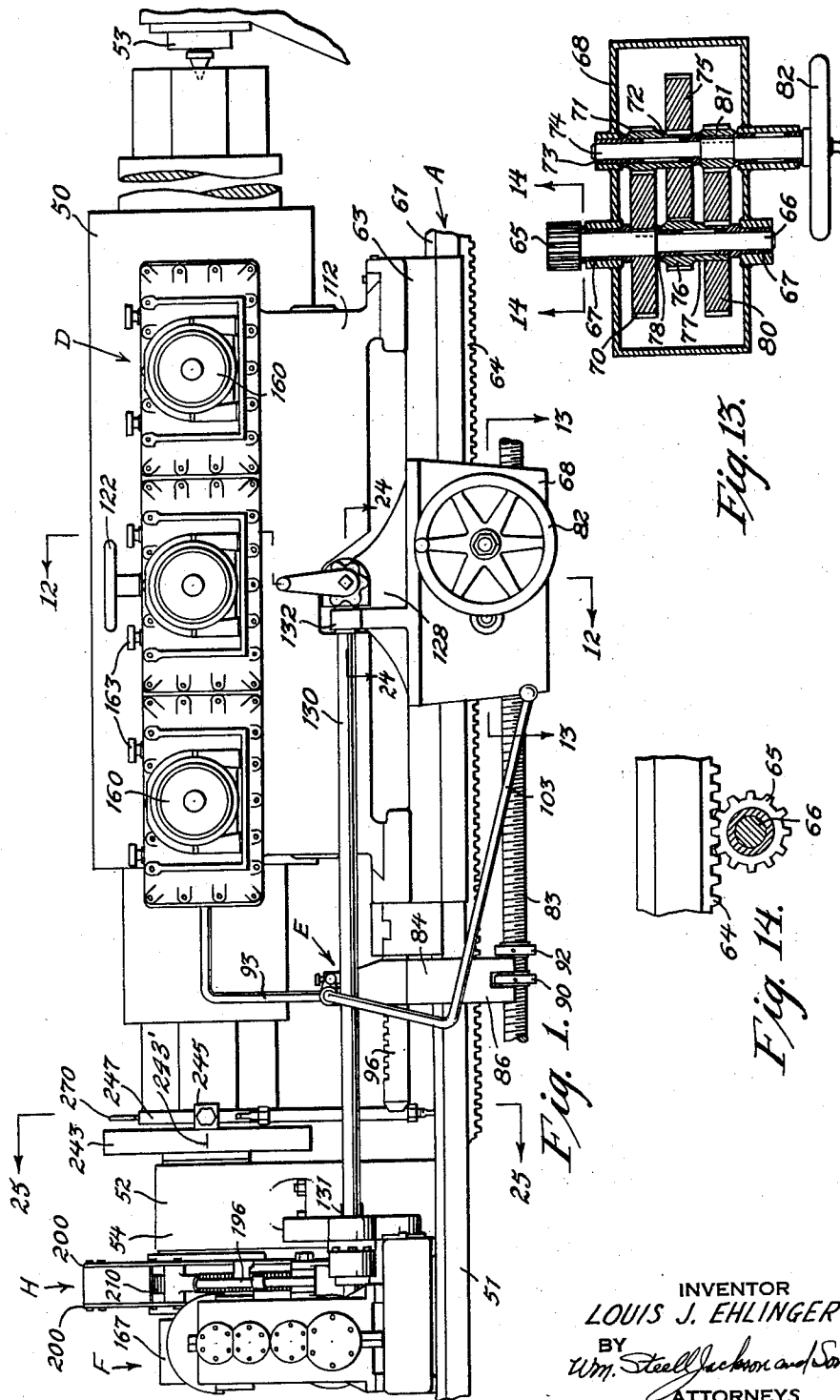
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2,924,153

MACHINE FOR CUTTING DESIGNS ON ROLLS

Filed July 6, 1954

15 Sheets-Sheet 1



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MACHINE FOR CUTTING DESIGNS ON ROLLS

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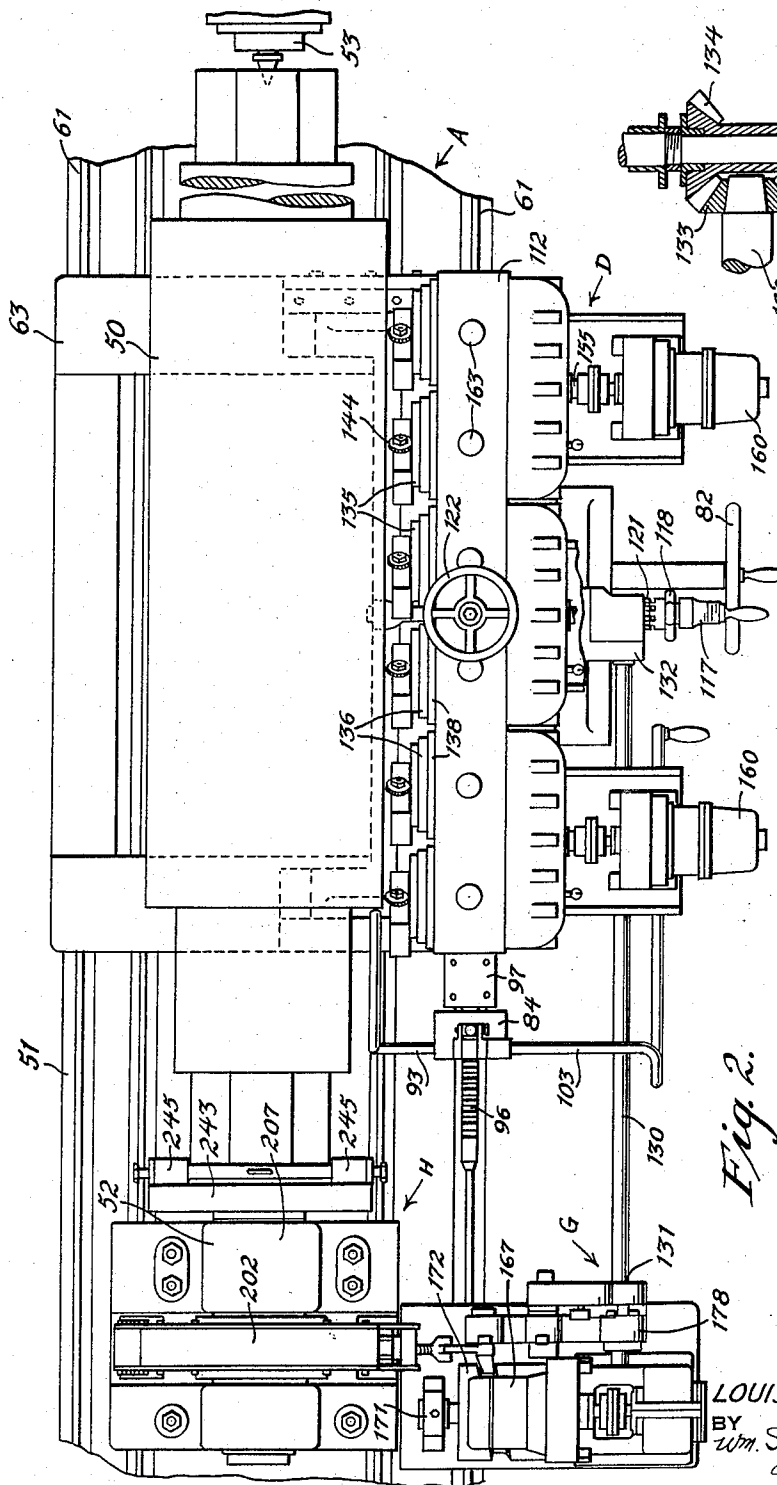


Fig. 2.

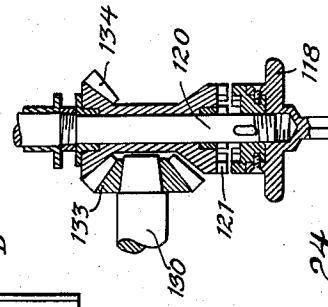


Fig. 24.

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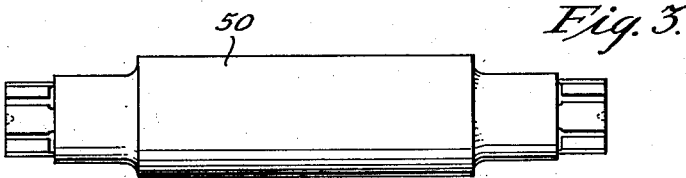
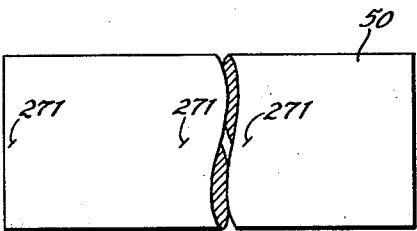
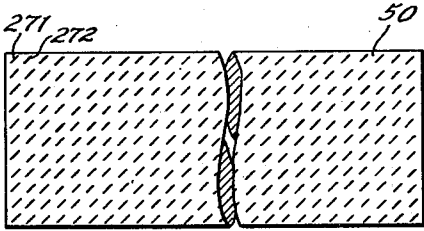
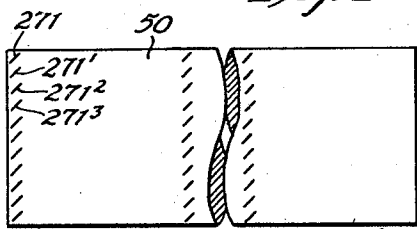
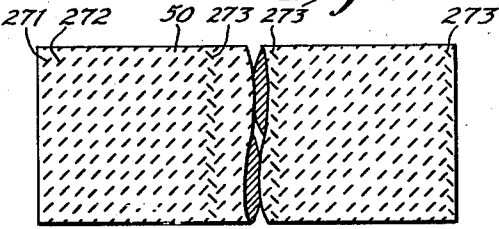
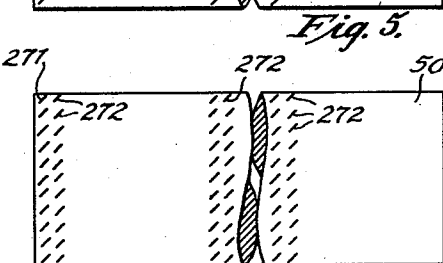
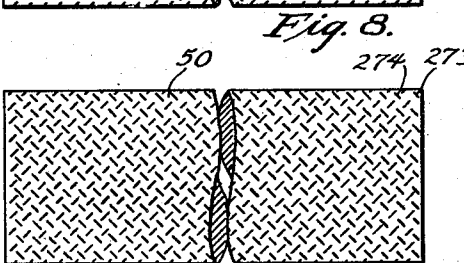
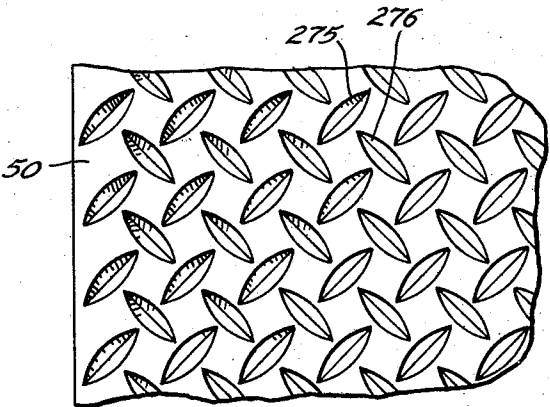
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MACHINE FOR CUTTING DESIGNS ON ROLLS

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15 Sheets-Sheet 3



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MACHINE FOR CUTTING DESIGNS ON ROLLS

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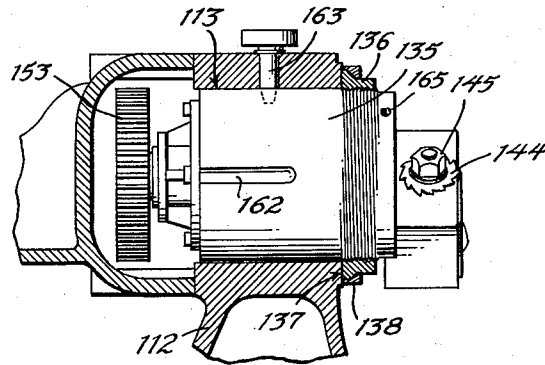


Fig. 19.

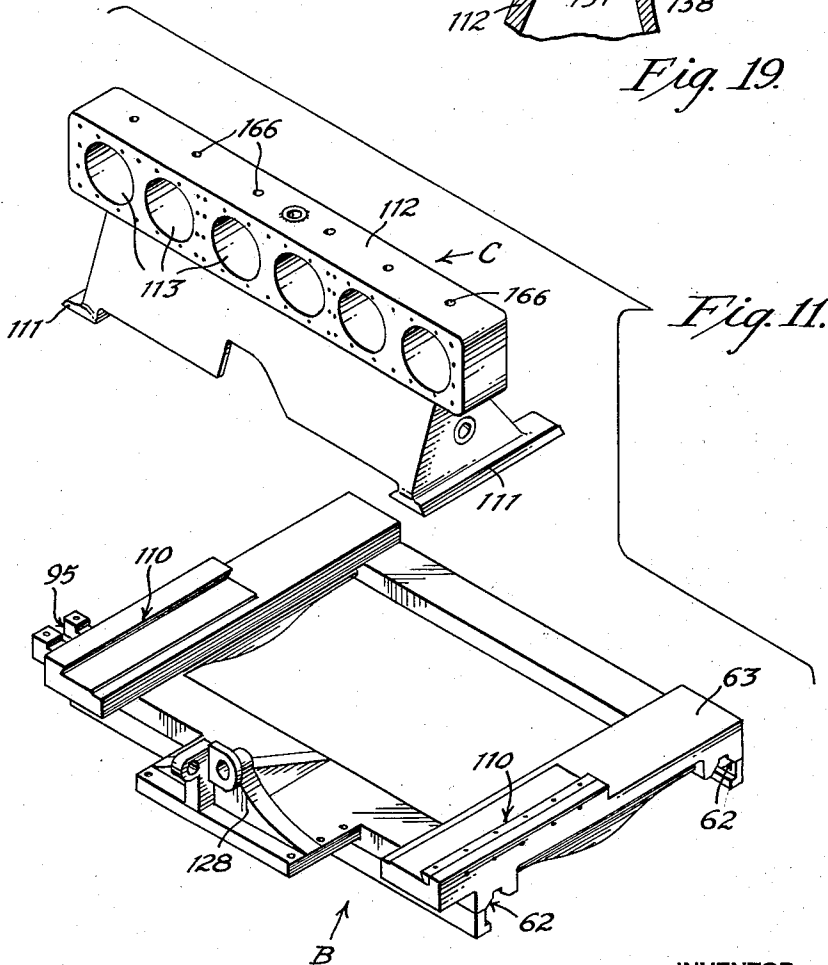


Fig. 11.

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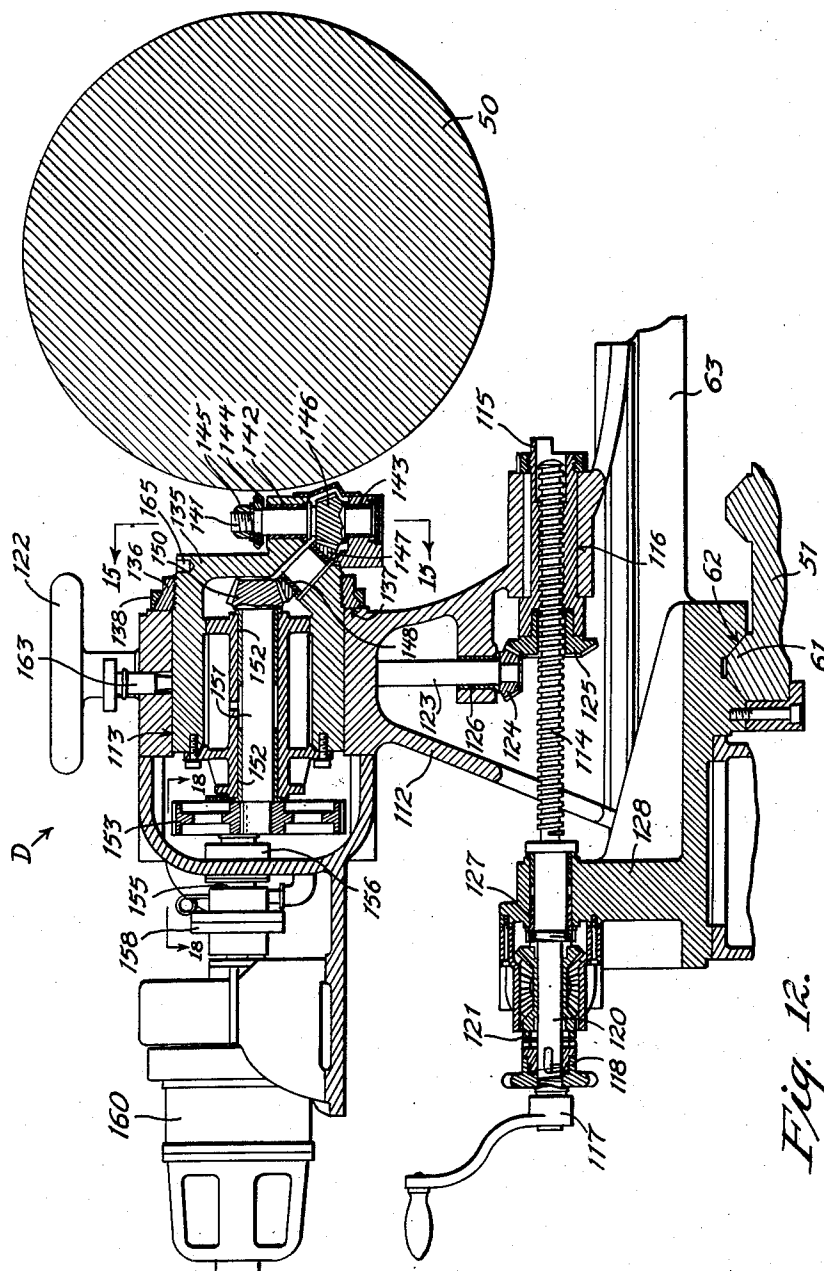


Fig. 12.

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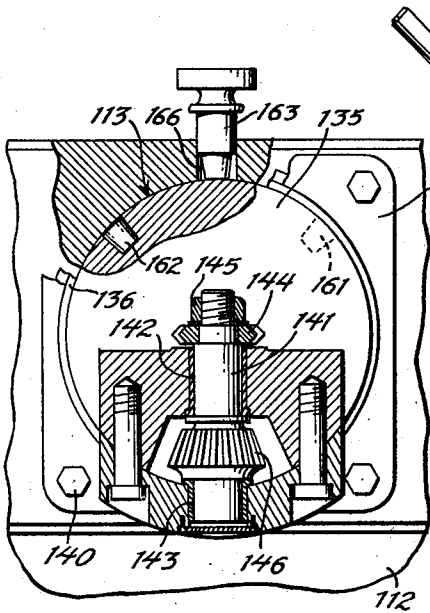


Fig. 15.

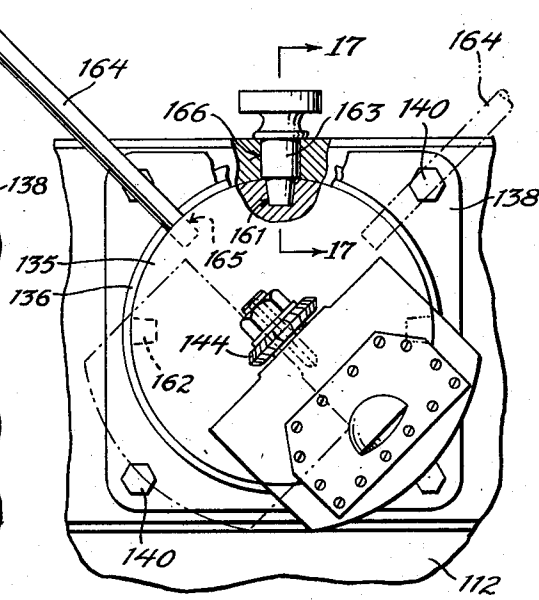


Fig. 16.

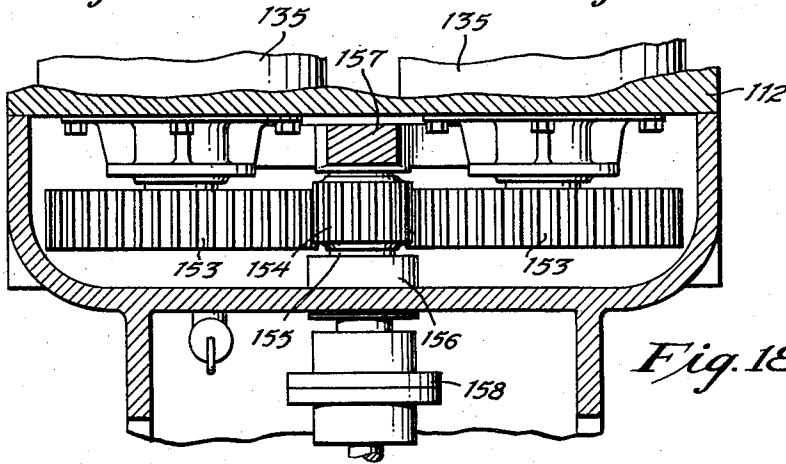


Fig. 18.

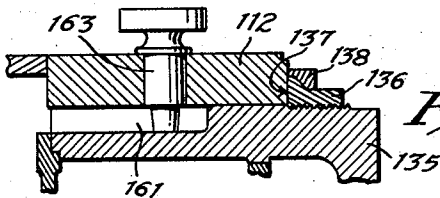


Fig. 17.

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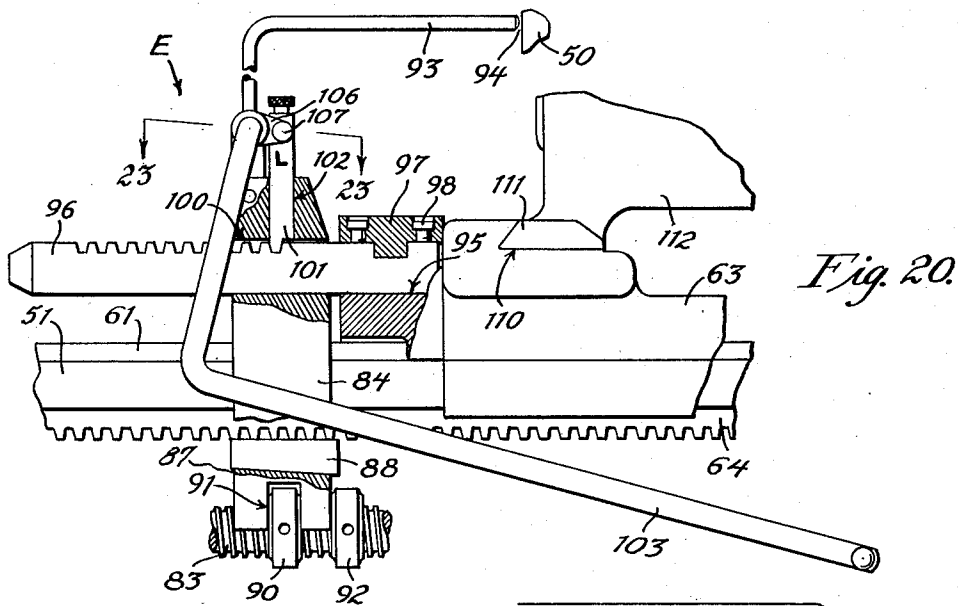


Fig. 20.

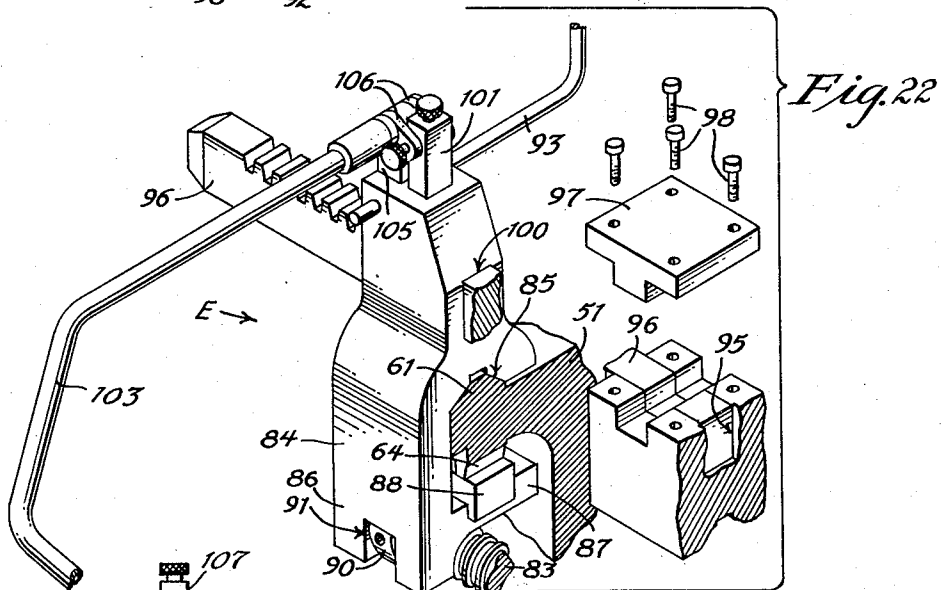


Fig. 22.

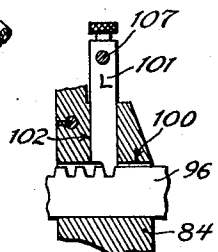


Fig. 21.

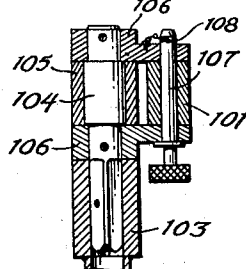


Fig. 23.

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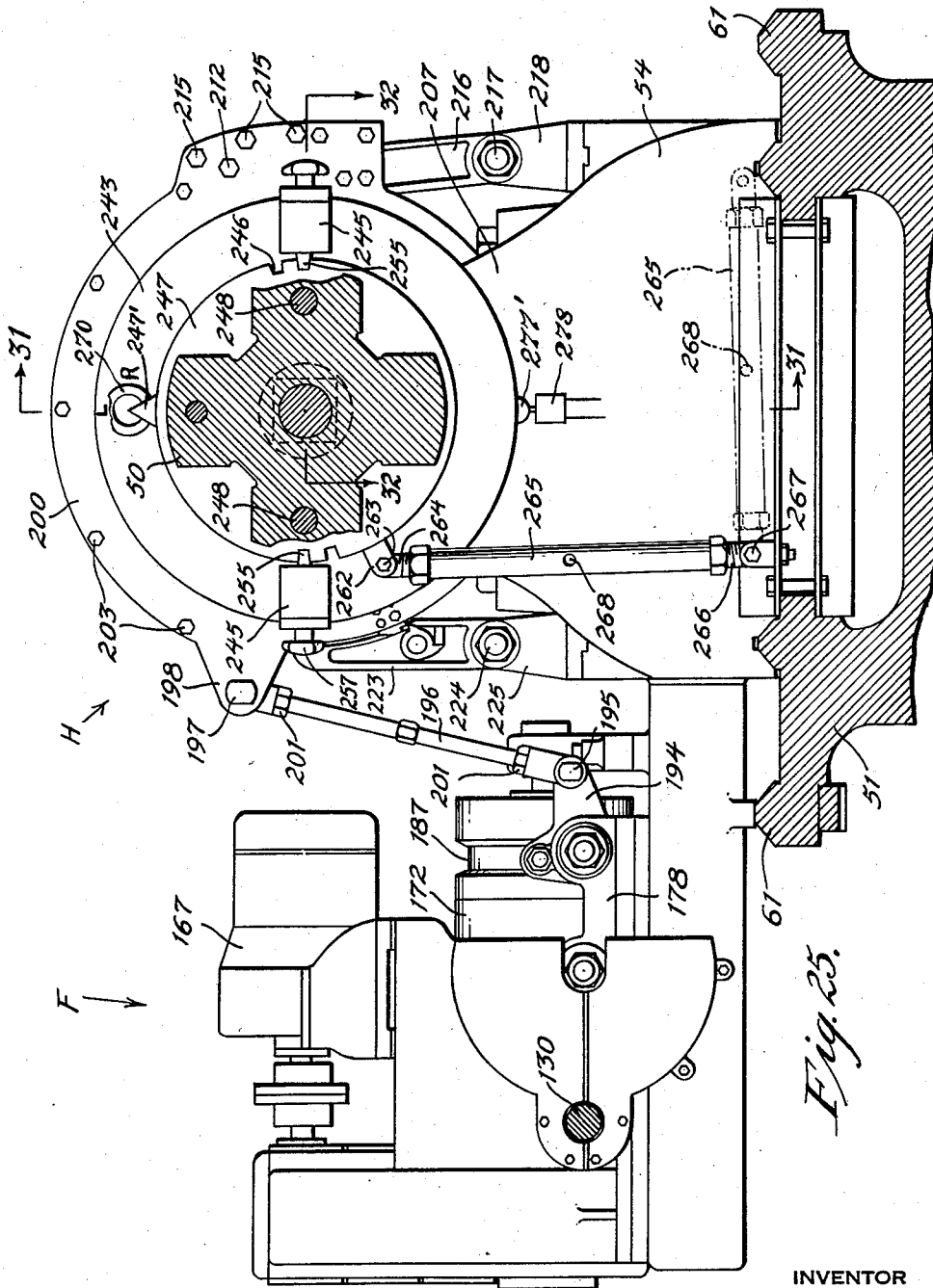


Fig. 25.

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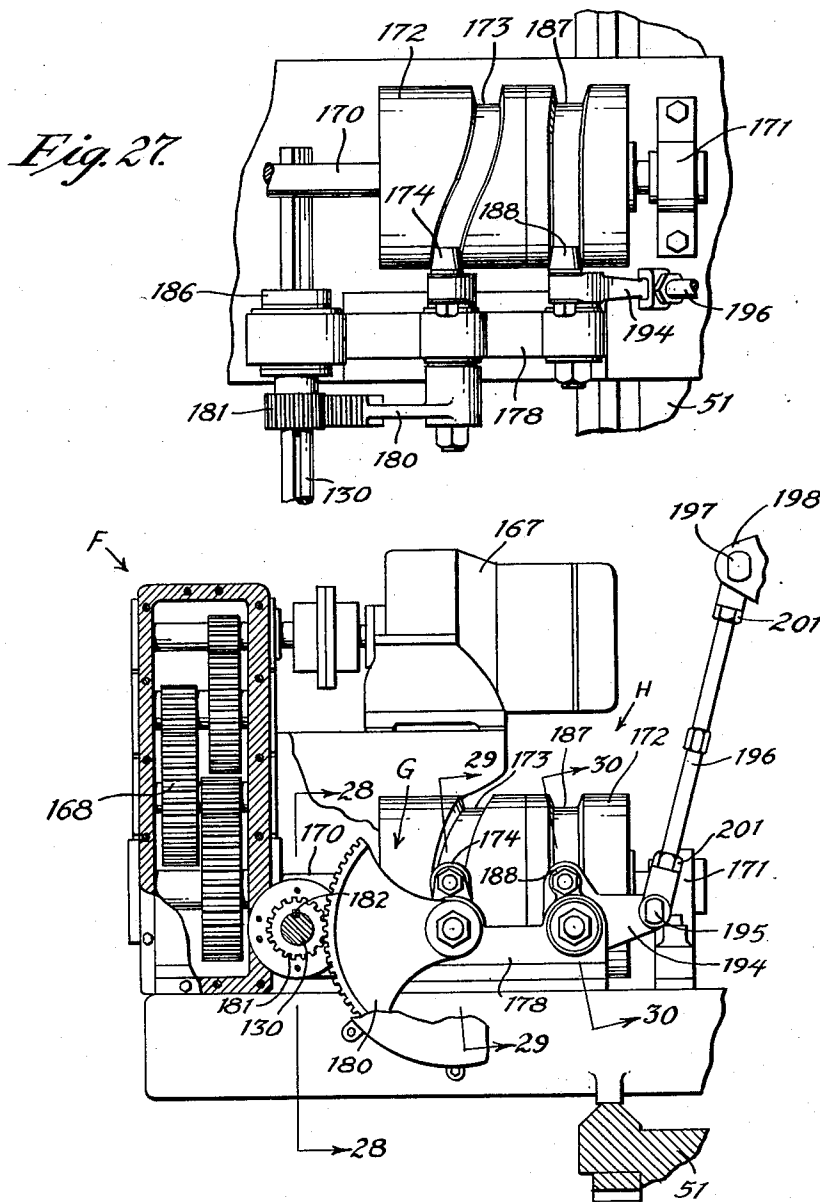
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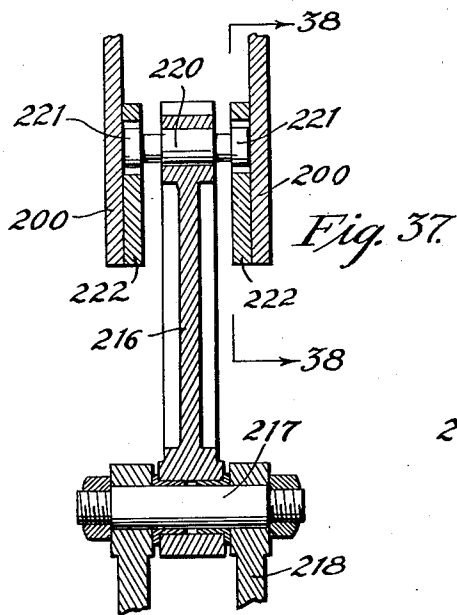
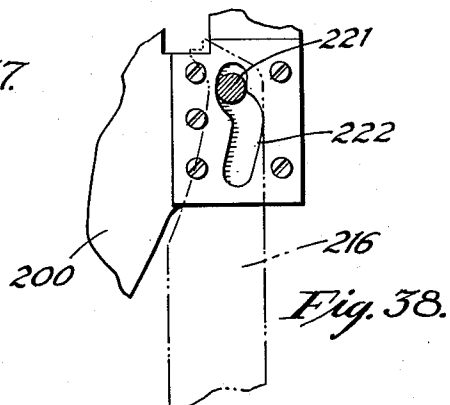
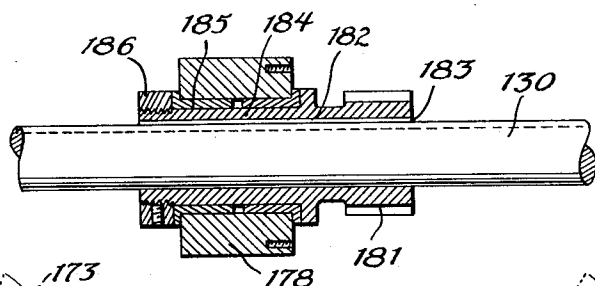
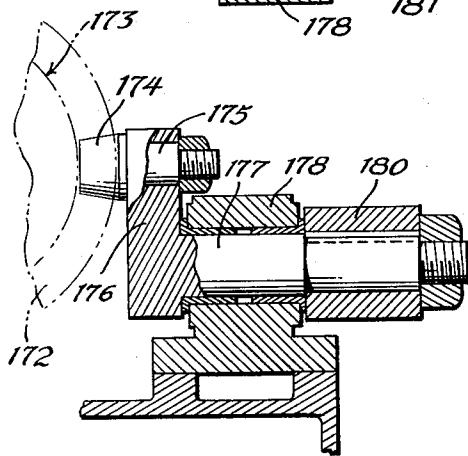
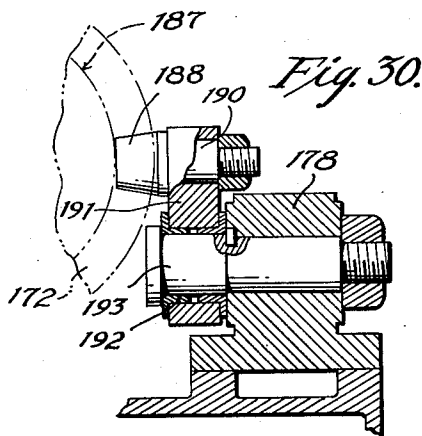


Fig. 29.

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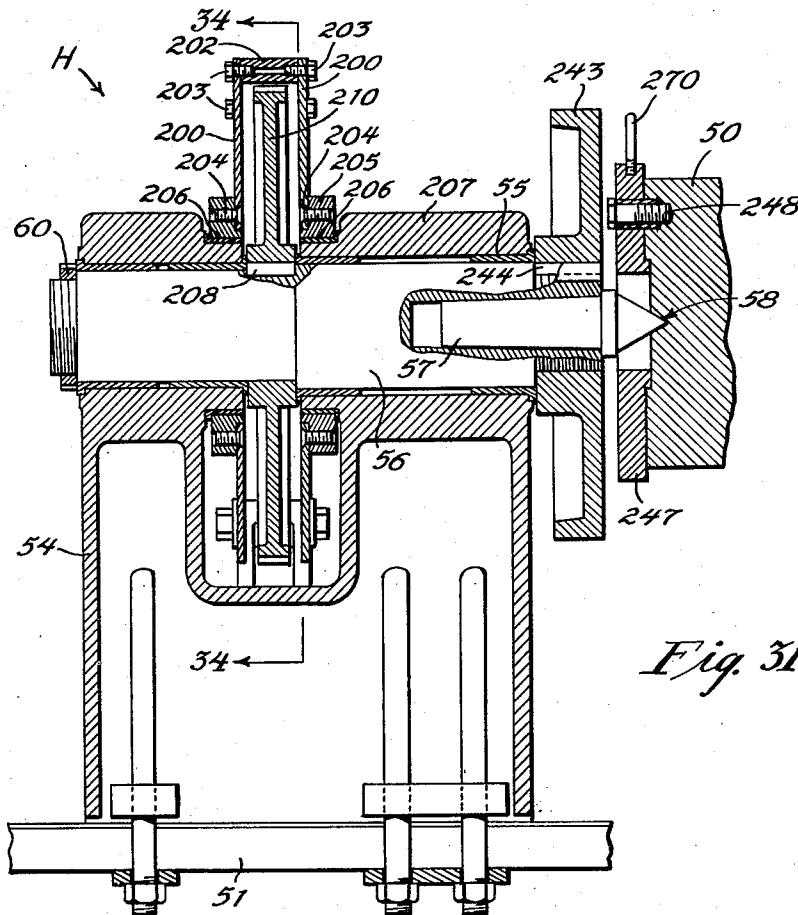


Fig. 31.

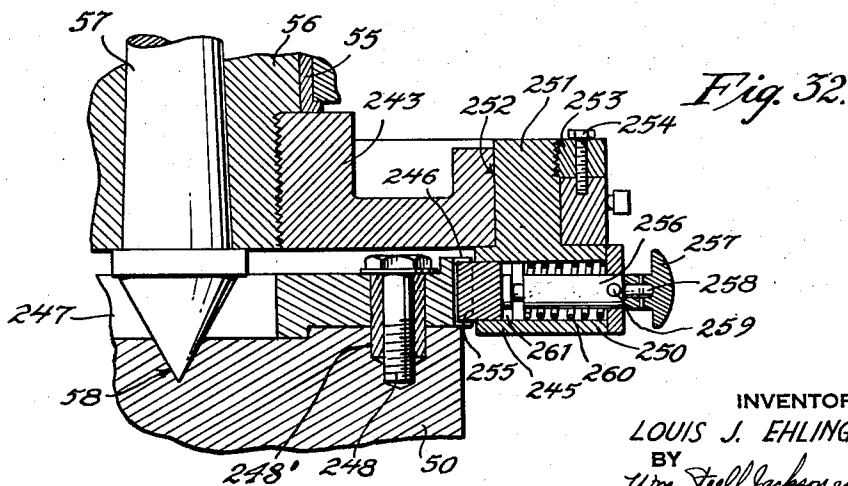


Fig. 32.

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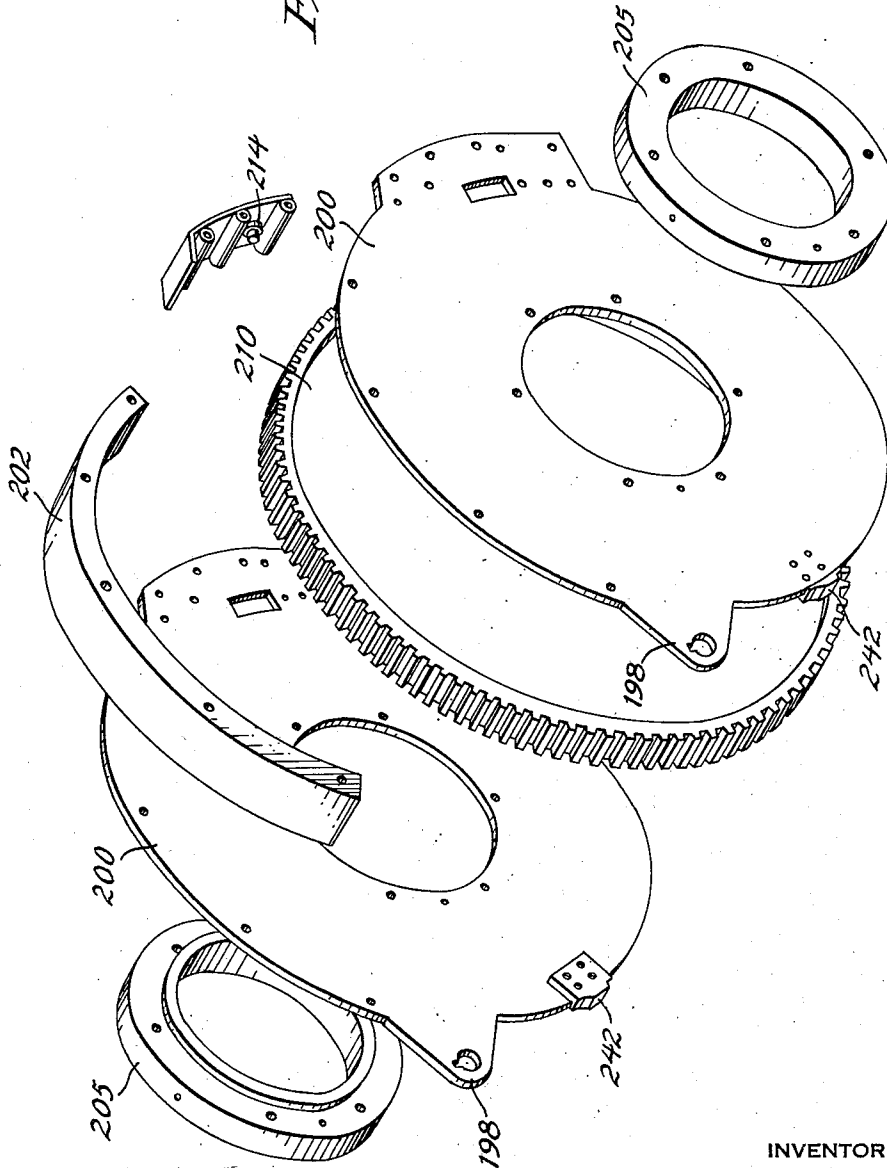
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Fig. 33.



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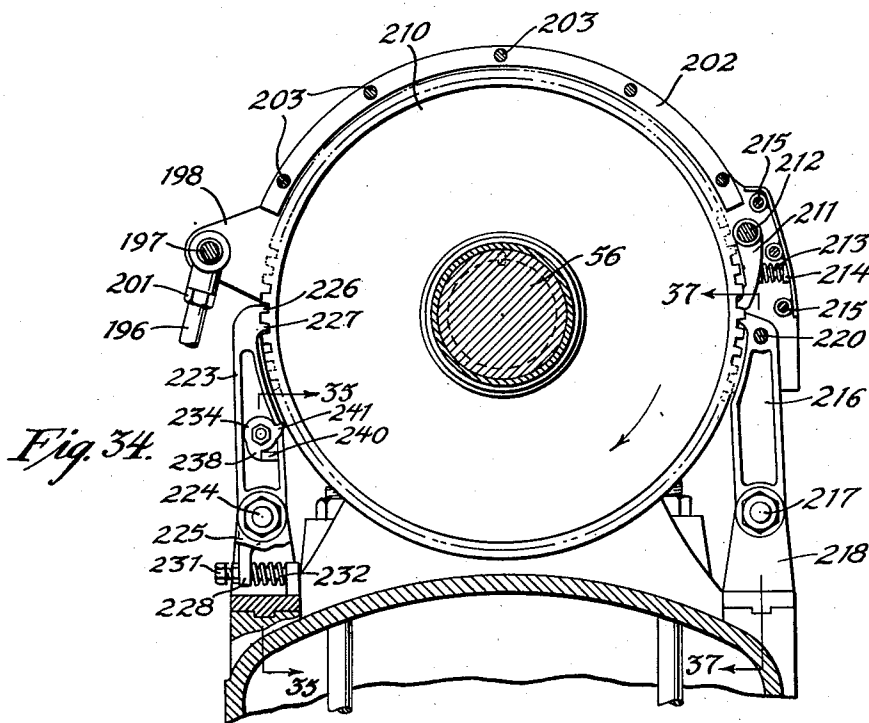


Fig. 34.

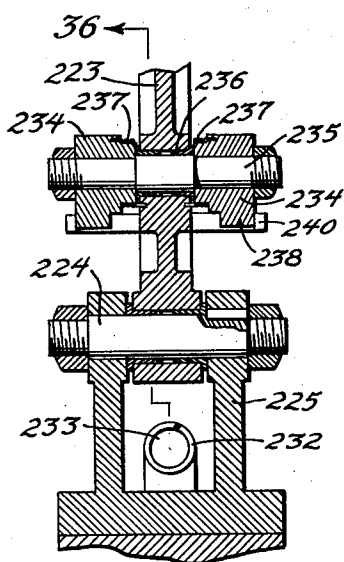


Fig. 35.

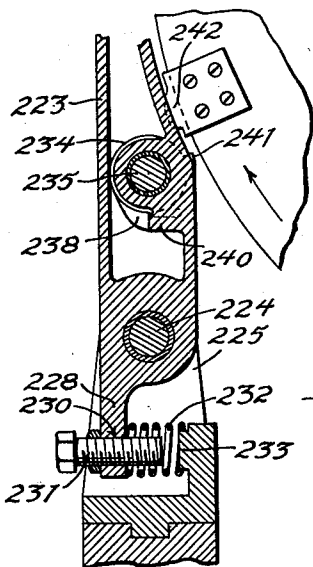


Fig. 36.

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MACHINE FOR CUTTING DESIGNS ON ROLLS

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Fig. 39.

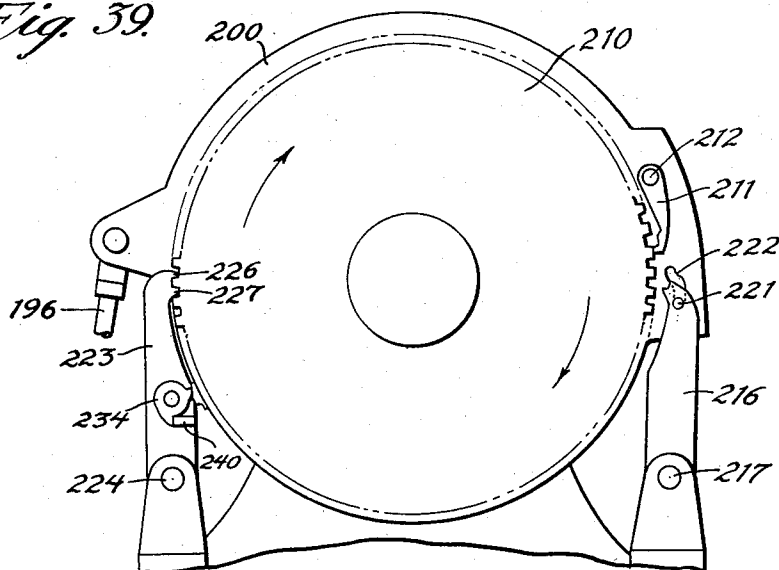
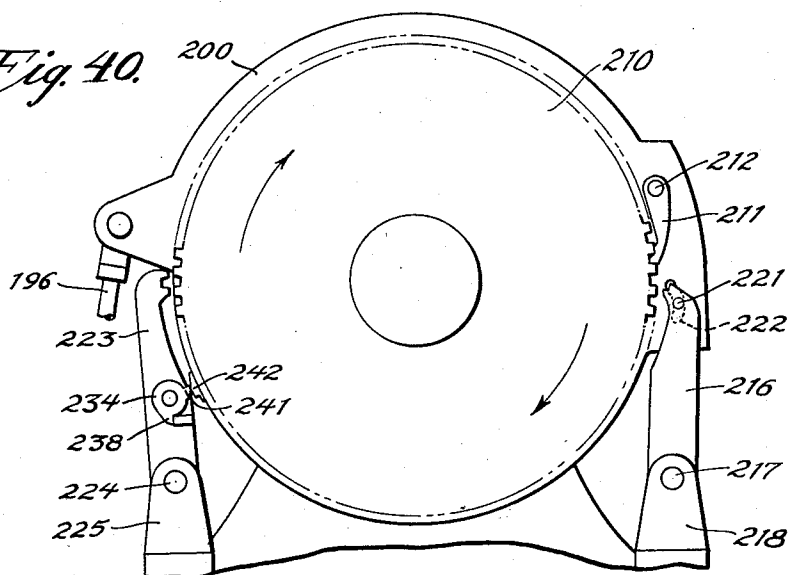


Fig. 40.



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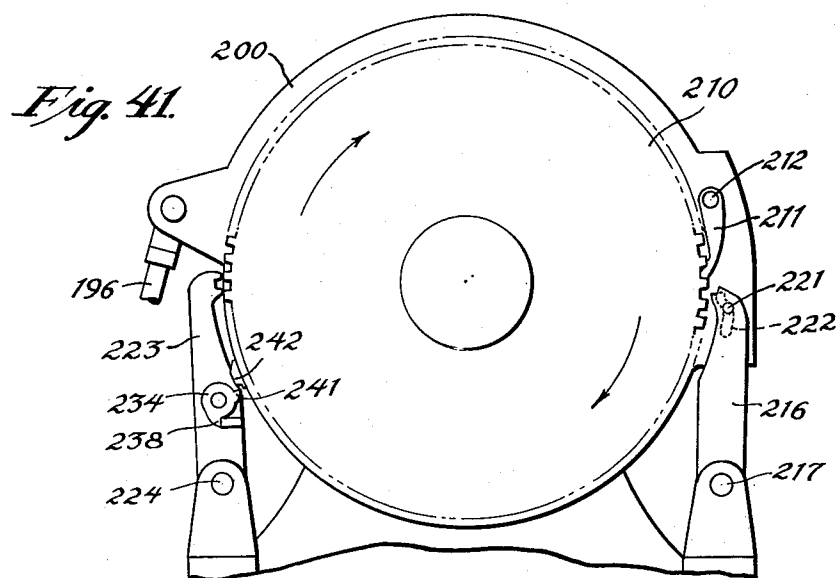
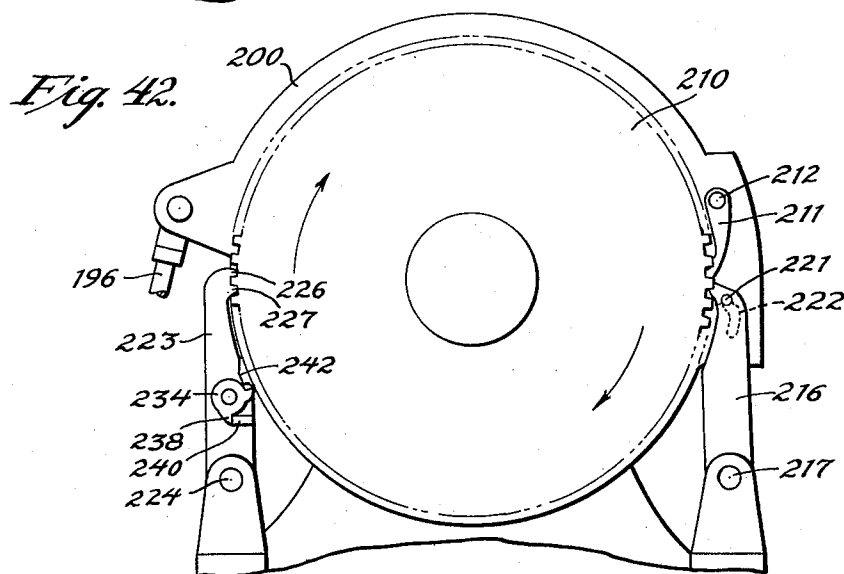
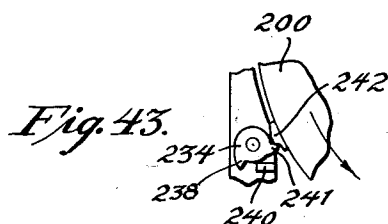
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MACHINE FOR CUTTING DESIGNS ON ROLLS

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15 Sheets-Sheet 15



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MACHINE FOR CUTTING DESIGNS ON ROLLS

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Application July 6, 1954, Serial No. 441,215

3 Claims. (Cl. 90—56)

The present invention relates to mechanism for machining the surfaces of rolls.

A purpose of the invention is to obtain more accurate positioning of cutters in machining the surfaces of rolls, such as rolling mill rolls, and to permit rapid and very accurate registry of successive machining points in reference to other machining points, both angularly and longitudinally, as well as diagonally.

A further purpose is to mount a longitudinal carriage on a bed, to provide a cross feed carriage on the longitudinal carriage, to locate cutters on the cross feed carriage, and to automatically advance and retract the feed of the cross feed carriage and adjust the indexing position of a work roll operated upon by the cutters.

A further purpose is to employ a double cam, having a track for control of angular indexing, and a track for control of cross feed, the track for control of angular indexing having an ineffective portion at a position where a track for control of cross feed has an effective portion, with means operatively connected to the track for control of angular indexing, and means operatively connected to the track for controlling cross feed for changing cross feed.

A further purpose is to provide a turnable indexing plate, cam means for retracting and advancing the indexing plate, means for pivotally mounting the work roll on its axis, and indexing wheel or gear connected axially to the work roll, and an operative pawl on the indexing plate engaging the gear with advance of the indexing plate.

A further purpose is to provide a stop pawl engaging the indexing gear, cam means operative between the indexing plate and the stop pawl for moving the stop pawl into and out of engagement with the indexing gear, a trip cam on the indexing plate, and trip means on the locking pawl for releasing the locking pawl at a predetermined position on the forward motion of the indexing plate.

A further purpose is to provide release mechanism on the trip means for permitting the trip cam to pass beyond the trip means without releasing the locking pawl on retraction of the indexing plate.

A further purpose is to mount the cutters on swingable heads and provide detent means for holding the cutters in one of a plurality of selected positions.

A further purpose is to provide driving shafts for the individual cutters, cutter heads for the individual cutters jouralling the driving shafts, detent means for securing the cutter heads in one of a plurality of predetermined positions and gearing common to the driving shafts of the individual cutters, and driving such cutters in all angular positions of the cutter heads.

A further purpose is to employ an indexing gear having indexing teeth, automatic means for driving the indexing gear forward tooth by tooth, a driving plate connected to a work roll, tooth recesses in the driving plate which give one-half space at the roll for adjustment to

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the indexing gear, and chuck means connected to the indexing gear for selectively engaging one or another of the tooth recesses to secure one-half tooth spacing.

A further purpose is to provide a longitudinal indexing rack secured to the longitudinal carriage, a longitudinal chuck secured to the rack, and locking key means making engagement of the chuck to a selected position along the longitudinal rack.

A further purpose is to reverse the locking key means to obtain a one-half chuck tooth adjustment of the locking key position.

A further purpose is to mount a set-up gauge extending from the longitudinal chuck to a position adjacent the end of the work roll, and to mount the chuck adjustably on a lead screw to position the chuck adjustably for the desired position of the set-up gauge.

A further purpose is to provide a cutter head having a central driving shaft, a first 45° bevel gear on the central drive shaft, a second 45° bevel gear angularly disposed at the forward end and engaging the first 45° bevel gear, a third 45° bevel gear forward of the second, and meshing with the second, a cutter shaft jouralled in the head at right angles to the axis of the head extending inwardly, and a cutter on the cutter shaft at the axis of the head.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which my invention may appear, selecting the forms shown from the standpoint of convenience in illustration, satisfactory operation and clear demonstration of the principles involved.

Figure 1 is a fragmentary front elevation of the complete assembly.

Figure 2 is a fragmentary plan of the complete assembly as shown in Figure 1.

Figure 3 is a front elevation of a typical rolling mill roll of the type which is being machined in accordance with the invention.

Figure 4 is a diagrammatic fragmentary front elevation of the roll of Figure 3, showing the first operation of cutting.

Figures 5 to 9 inclusive show successive steps in cutting the roll, the operation being completed in Figure 9.

Figure 10 is an enlarged fragmentary elevation of the completed roll face.

Figure 11 is an enlarged exploded perspective view showing the cross feed carriage and the longitudinal feed carriage, eliminating extraneous components.

Figure 12 is a vertical section on the line 12—12 of Figure 1.

Figure 13 is a plan section on the line 13—13 of Figure 1.

Figure 14 is a vertical section on the line 14—14 of Figure 13.

Figure 15 is a vertical section on the line 15—15 of Figure 12.

Figure 16 is a rear elevation of the cutter head in operating position.

Figure 17 is a section on the line 17—17 of Figure 16.

Figure 18 is a plan section on the line 18—18 of Figure 12.

Figure 19 is a fragmentary view, partly in section, showing one of the cutter heads in position in the cross feed carriage.

Figure 20 is a fragmentary enlarged front elevation, partly in section, of the longitudinal indexing assembly.

Figure 21 is a fragmentary view, partly in section, of the longitudinal indexing chuck with the indexing key reversed for cutting diamonds of the opposite hand.

Figure 22 is an exploded perspective view, partly in section, of the longitudinal indexing parts.

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Figure 23 is an enlarged section on the line 23—23 of Figure 20.

Figure 24 is an enlarged plan section on the line 24—24 of Figure 1 showing the clutch for engaging the handle for adjusting the cross carriage.

Figure 25 is an enlarged vertical section on the line 25—25 of Figure 1.

Figure 26 is an enlarged fragmentary elevation, partly in section, of the cam and associated parts.

Figure 27 is a fragmentary plan view of the cam, drum and associated parts.

Figure 28 is a section on the line 28—28 of Figure 26 showing the feed shaft and gear.

Figure 29 is a section on the line 29—29 of Figure 26 showing the cam follower for the feed gear.

Figure 30 is a section on the line 30—30 of Figure 26 showing the cam follower for circumferential indexing.

Figure 31 is a section on the line 31—31 of Figure 25 showing the indexing cam.

Figure 32 is a section on the line 32—32 of Figure 25 showing clutch details.

Figure 33 is an exploded perspective view showing major circumferential indexing parts which are inside the indexing cam.

Figure 34 is a section on the line 34—34 of Figure 31 showing circumferential indexing parts inside the indexing cam.

Figure 35 is a section on the line 35—35 of Figure 34.

Figure 36 is a section on the line 36—36 of Figure 35.

Figure 37 is a section on the line 37—37 of Figure 34.

Figure 38 is a section on the line 38—38 of Figure 37.

Figures 39, 40, 41 and 42 are diagrammatic axial views showing successive stages of operation in turning the indexing wheel.

Figure 43 is a fragmentary axial view showing a portion of the structure of Figures 39 to 42 in return position.

Describing in illustration but not in limitation and referring to the drawings:

In many rolling operations it is necessary to employ rolling mill rolls having recesses or depressions on the roll surface conforming to a pattern. The production of such rolls in the past has been extremely tedious, and has involved a great deal of set-up time for machining. Furthermore, a slight error in location of an individual recess involved in a pattern is likely to result either in spoiling the roll, necessitating a costly repair, or producing irregular products when the roll is used.

The invention is applicable particularly for rolling mill rolls which are used in making floor plate of the character which are employed on the floors of ships, industrial plants, industrial equipment and the like, having a raised pattern produced in steel, stainless steel, aluminum, magnesium or some other metallic material. The invention is applicable to the production of rolls for rolling sheets and plates of other characters, whether in metal, plastic, or other material, as well as to printing rolls for textiles or the like.

In accordance with the invention, it is possible to produce several symmetrical recesses at one time by a group of cutters operating in unison and then to index the cutters very accurately and automatically to produce successive angularly displaced cuts. The group of cutters are then accurately indexed longitudinally to the next position and in this position the automatic angular indexing continues until cuts have been made around the roll at that position. After all cuts have been made at a particular diagonal direction, for example right hand, the mechanism is adapted for accurate indexing to accomplish precise cutting of a left hand series of recesses. The possibility of making an error in location of an individual cut and thus spoiling the roll or requiring a costly repair on the roll is largely eliminated, and it is possible with a high degree of precision to make

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several different rolls which are alike in location of the recesses and in recess contour.

Furthermore when it is necessary to face or turn down the roll, the recesses can be recut very accurately without danger of cutting into wrong locations or cutting new recesses which do not register with the remainder of the recesses previously cut.

Thus the invention lends itself to the production of new rolls having machined or patterned surfaces, and also to the recutting of patterns after the roll has been surfaced, and thus slightly reduced in diameter.

The main assemblies of the mechanism of the invention are the bed assembly A, the longitudinal carriage assembly B, the cross carriage assembly C, the cutter assembly D, the longitudinal indexing assembly E, the cam assembly F, the feed assembly G and the circumferential indexing assembly H.

The roll 50 is supported from a main frame 51 of a lathe by a head stock 52 and a tail stock 53. The head stock includes a housing 54 having bearings 55 (Figures 31 and 32) which support a spindle 56 having a center 57 which is located in a center recess 58 at one end of the roll. The spindle is held in place by a retainer 60.

The bed has longitudinal ways 61 which engage guide surfaces 62 (Figures 1, 11 and 12) on a longitudinal carriage frame 63, so as to permit the longitudinal carriage B to slide along the ways to any desired position. The longitudinal carriage is manipulated longitudinally along a rack 64 on the bed of the lathe by pinion 65 (Figures 1, 13 and 14), on shaft 66 journaled at 67 in gear housing 68. Shaft 66 is keyed to reduction gear 70 which meshes with pinion 71 on sleeve 72 moving freely on bearings 73 around shaft 74. The sleeve 72 is keyed to reduction gear 75 which meshes with pinion 76 on sleeve 77 which turns on bearings 78 freely around shaft 66. Sleeve 77 is keyed to reduction gear 80 which meshes with pinion 81 keyed to shaft 74 and carrying adjustment hand wheel 82.

A screw 83, normally part of the lathe, extends longitudinally, and for the purposes of the present invention is stationary. Mounted stationarily but longitudinally adjustable on the screw 83, is longitudinally indexing assembly E. This comprises a longitudinal indexing chuck 84 (Figures 20 to 23) which has a guide 85 engaging the way 61 on the lathe bed, and has a depending portion 86 which extends down and under the rack 64, providing an abutment 87 beneath the rack which enables the chuck to be locked with respect to the lathe by wedge 88 extending between the rack 64 and the abutment 87. Portions of the depending part 86 of the chuck extend down to engage screw 83, and one adjustment nut 90 on screw 83 operates in recess 91 at the bottom of the chuck to locate the chuck when the wedge 88 is relaxed. A second adjustment nut 92 engages the right side of the chuck (Figure 20) when it is locked in position. Once the chuck has achieved its correct adjusted position it will normally remain in that position indefinitely.

A set-up gauge 93 extends from the top of the chuck and achieves a position in predetermined relation of the end of the roll as by inserting a feeler gauge in the space 94 between the end of the set-up gauge and the roll. The set-up gauge is conveniently used to locate the correct position of the chuck 84 at the beginning of the machining operation on a particular roll.

The longitudinal carriage B contains at the left end a socket 95 which receives a longitudinal indexing rack 96, the rack being held in place by a cover and locking plate 97 secured by screws 98. The rack 96 extends through a longitudinal opening 100 in the chuck 84, and is engaged by a toothed key 101 extending vertically in an opening 102 in the top of the chuck 84. The key is locked in position in engagement with a particular tooth of the rack, by handle 103 which is fastened on shaft 104

journalled in bracket 105. Rigidly mounted on the shaft 104 are arms 106 which pivotally engage pin 107 which pivots in the key 101, and permits raising or lowering of the key by manipulation of the indexing handle 103.

The tooth key 101 is reversible in the opening 102 to determine a half tooth change in position in reference to the rack by removing pin 107 after extracting cotter pin 108 and reversing the toothed key as shown in Figure 21. This reversal will be accomplished when shifting from one hand (right or left) of diagonal diamond cutting to the opposite hand to permit the partial overlapping of the diamonds as later explained. The marking L in Figures 20 and 21 shows that the toothed key is there set to cut left hand diamonds.

The cross assembly C slides on cross ways 110 best seen in Figure 11 of the longitudinal carriage. Guides 111 are provided on the bottom of cross carriage frame 112 which has a plurality, suitably six, of recesses 113 extending in the transverse direction for mounting cutters as later explained.

The manipulation of the carriage cross ways is accomplished by cross carriage lead screw 114 (Figure 12) which engages in nut 115 journalled in the cross carriage at 116. The cross feed may be operated in several different ways. The cross feed adjustment handle 117 is mounted on clutch element 118 keyed to and slidable on a shaft portion 120 which is suitably in continuation of the screw 114. Thus the handle 117 can adjust the feed screw. The clutch will normally be engaged except when an individual feed screw must be backed off to change cutters.

The machine is preferably initially set up as follows:

All cutters are adjusted at 136 until they each engage the face of the roll. Then the cutters are started and each is fed forward $\frac{3}{32}$ inch or for the desired depth of cut. Next the hand wheel is turned backward till the zeros of the clutch elements 118 and 121 coincide and the clutch is engaged.

The clutch feed can also be manually adjusted from a position above the mechanism by hand wheel 122 on shaft 123 carrying bevel gear 124 which cooperates with bevel gear 125 which is rigidly connected with rotatable nut 115. The shaft 123 is journalled in the cross feed carriage housing at 126.

The screw is journalled at 127 on an upwardly extending portion 128 of the longitudinal carriage.

Cross feed is also automatically accomplished by feed shaft 130 journalled at one end at 131 on the cam mechanism to be described, and journalled at the other end at 132 in the upward extension 128 of the longitudinal carriage. The said shaft 130 carries at one end a bevel gear 133 (Figure 24) which engages a cooperating bevel gear 134 loose on the cross lead screw 114. Cooperating clutch element 121 is on the same member as bevel gear 133 so that when the clutch is engaged shaft 130 will drive the feed screw.

The cylindrical recess 113 in the cross feed carriage receives cutter heads 135 (Figures 12 to 19) which have threaded on their forward ends adjustment rings 136, which engage between a shoulder 137 on the forward end of the cross feed carriage, and a locking plate 138 which is secured by bolts 140 to the cross feed carriage. Thus the head can be turned as later explained but retains the axial position determined by the adjustment ring 136. The position of the adjustment ring on the individual head can be changed in aligning all cutters into the same line.

The individual head has a cutter shaft 141 which is journalled at 142 and 143 generally radially of the head and carries a cutter 144 of milling cutter type secured by nut 145 and also carries bevel gear 146. The bevel gear 146 meshes with a 45° cooperating bevel gear 147 journalled at 148 in the head and the bevel gear 147 in turn meshes with a 45° cooperating bevel gear 150

on driving shaft 151 journalled in the head at 152. The other end of the shaft 151 carries gear 153 which meshes with pinion 154 on shaft 155 journalled at 156 and 157 in the cross feed carriage. The shaft 155 connects by flexible coupling 158 with cutter driving motor 160 which is common to each pair of cutters.

The cutter head has a pair of positioning grooves 161 and 162, 90° out of phase, which in adjusting position receive locking pin 163 in the cross feed carriage. A turning bar 164 is removably introduced into a recess 165 in the cutter head, to aid in turning the cutter head from the left hand to the right hand diagonal position as best seen in Figure 16, or vice versa. The pin 163 extends through an opening 166 in the cross feed carriage.

The feed mechanism (Figures 1, 2, 25 to 30) in automatic operation is driven by motor 167 at the extreme left end of the device, while drives reduction gears 168, which in turn drive cam shaft 170 journalled at 171 on the frame, and carrying a double barrel cam 172. The cam has a cutter feed track 173 which is engaged by follower roller 174, pivotally mounted on shaft 175 which is secured on follower arm 176 on shaft 177 journalled in cam lever bearing 178 on the frame. Shaft 177 carries segment 180, which meshes with pinion 181 keyed on feed shaft 130 already described. Pinion 181 is held on feed shaft 130 by key 182 (Figure 28) in elongated keyway 183, which extends through pinion 181 and also through an extension 184 from the pinion which is journalled at 185 in the follower lever bearing. The extension 184 is held by retainer 186.

The cam 172 also has an angular indexing track 187 which guides follower roller 188 (Figure 30) on shaft 190 journalled in follower arm 191 which is journalled at 192 on shaft 193 which is rigidly mounted on the follower journal bearing. The arm 191 forms part of a bell crank (Figures 25 and 26) having a separate arm 194 which makes pivotal connection at 195 with a link 196 pivotally connected at 197 at the opposite end with an extension 198 from indexing plates 200. The link 196 is provided with left hand and right hand threads at the opposite ends which engage clevises at the pivots, to permit adjustment, and locking nuts 201 on the respective threads secure the link in any particular adjusted position.

The indexing plates 200 (Figures 31 to 43) are joined together at the circumference by spacer 202, secured by bolts 203. At the radial interior edge, the indexing plates are joined by screws 204 to hubs 205 which journal at 206 on indexing head 207.

The indexing head also journals the rotating spindle 56 as earlier explained, which is keyed at 208 to indexing wheel (gear) 210 which at its circumference is engaged by three different pawls. The operating pawl 211 is pivoted at 212 on the indexing plates 200, and is urged toward engagement with the teeth of the wheel by helical compression spring 213 acting from spring seat 214 which is secured to the indexing plates by bolts 215. It will be evident that operating pawl 211 turns with the indexing plates.

Stop pawl 216 is pivoted at 217 on bracket 218 from the indexing head. Stop pawl 216 near its tooth end which engages the indexing wheel has a shaft 220 journalled on the stop pawl and provided at its opposite ends with followers 221 (Figure 38) which engage in cams 222 secured to the indexing plates 200.

An opposing locking pawl 223 is pivoted at 224 on bracket 225 from the indexing head, and has two-tooth engagement at 226 and 227 with the indexing wheel, rather than single-tooth engagement as in the case of the other pawls. The locking pawl 223 has on the opposite side of the pivot an extension 228 (Figure 36) which is threaded at 230 to receive a spring retaining adjustment bolt 231 which extends inside one end of a helical compression spring 232, the opposite end of which engages in a spring retainer 233 on the indexing head.

The locking pawl 223 carries, intermediate between its pivot and its teeth, trips 234, which are mounted on shaft 235 (Figures 35 and 36) journaled at 236 on the locking pawl, at an intermediate point between its pivot and its teeth. The trips 234 are urged toward circumferential limiting position by torsional springs 237 having engagement at the ends respectively in the trip and the pawl and urging the pawl counterclockwise in Figure 36. In the circumferential limiting position trip dogs 238 engage stops 240 on the outside of the locking pawl (Figures 34, 35 and 36), and in that position trip dogs 241 are disposed inwardly into the path of trip cams 242 which are mounted on the indexing plates. In movement of the locking plate clockwise in Figures 34 and 36, the trip cams engage the dogs 241 on the trips and the trips are not free to move because of the engagement of dogs 238 with stops 240, and so the entire locking pawl is cammed out of engagement with the indexing wheel. On reverse movement, however, the trip cams 242 deflect dogs 241 out of the way by turning the trip without moving the locking pawl outwardly. This motion is shown in Figure 43.

Considering now Figures 39 to 42 in detail, it will be evident that the index wheel has one tooth for every indexing position.

As seen in Figure 39, motion of the indexing plates in the direction of the arrows in Figure 39 has caused the cam 222 to engage follower 221 and force stop pawl 216 into retracted position as shown. Operating pawl 211 is engaging the outside of one of the indexing teeth of the indexing wheel and locking pawl 223 is in full engagement with two teeth of the indexing wheel.

In the next position as shown in Figure 40, the indexing plates have continued their motion clockwise, until operating pawl 211 has been forced by its spring into engagement with the next tooth of the indexing wheel.

Stop pawl 216 has not moved appreciably, but trip cams 242 have engaged dogs 241 on the trips, and forced locking pawl 223 out of engagement with the indexing wheel. The indexing wheel is now completely unlocked and free to turn under the motion of operating pawl 211.

In the next position as shown in Figure 41, with the indexing wheel fully unlocked, operating pawl 211 has advanced the indexing wheel, while stop pawl 216 is still held out of engagement with the indexing wheel by its cam. Trip cams 242 have moved past trip dogs 241 on the trips, allowing locking pawl 223 to move inward into engagement with the ends of the teeth under the action of its spring.

In the next position of the indexing mechanism as shown in Figure 42, the operating pawl 211 has advanced the indexing further forward, and cam 222 has forced stop pawl 216 into engagement with one of the teeth, while locking pawl 223 has engaged two of the teeth, clamping the indexing wheel against further motion forward. In this position a row of recesses in the work roll will be machined.

The indexing cam will next retract the indexing plates until the operating pawl engages the next succeeding tooth, prior to assuming the position of Figure 39 on the next cycle. During this retraction motion the indexing plates carry the trip cam past the trips, simply turning the trips as shown in Figure 43 without displacing the locking pawl 223 from the indexing wheel. In this position of the indexing mechanism the feed cam advances the cutters to engage the work and completes the machining operation at one row of positions.

The indexing motion is transmitted to the work roll 50 by a face plate 243 which is keyed on spindle 56 by key 244, and which carries at diametrically opposite positions chucks 245 (Figure 32), each of which engages selectively in one of the teeth 246 on the outside of driving plate 247 which is secured by bolts 248 on the end of the work roll, extending through hardened bushings or dowels 248' and surrounds the center 57. Each chuck

comprises a housing 250 which has a mounting extension 251 which extends into an opening 252 in the face plate, and is held by threaded retainer 253 secured by bolts 254. The chuck housing 250 has a chuck plunger 255, which has a shank 256 extending through the back of the housing, and provided with a handle 257 and a projection 258 which engages the outside of the housing under the action of helical compression spring 260 which forces the plunger into engagement in the driving plate. The plunger desirably has a separable head which is held removably in T head slot 261. The chucks can be retracted and held in retracted position by projection 259 engaging the outside of the chuck housing when the chuck is retracted and rotated.

The teeth 246 in the driving plate are spaced an integer plus one-half times the teeth spacing of the indexing plate, so that by shifting the chuck engagement from one tooth 246 to the other it is possible to obtain a half-tooth difference in spacing which is required in setting up for the left hand cuts rather than the right hand cuts, or vice versa. An index pointer 247' on the driving plate aligns with marks R on the face plate when the chucks are set for cutting right hand diamonds, and with mark L for left hand diamonds. Mark 243' on the face plate (Figure 1) is a reference mark for check purposes.

The driving plate has an extension 262 (Figure 25) which pivotally connects at 263 to screw 264 of a roll jack 265 which has an opposed screw 266 pivoted at 267 in the frame. By turning the roll jack housing through a bar inserted at 268, right and left hand threads on the respective screws manipulate the driving plate to adjust the heavy roll from one chuck tooth engagement in the driving plate to another. When the roll jack is not in use it is detached by removing the pivot bolt at 263, and the roll jack is shown at 263 in disassembled position by the dot-and-dash lines.

For use in picking up the work roll by a crane, a lifting lug is provided at 270 in the driving plate.

In operation, the driving plate is attached to the work roll and the work roll is assembled on the centers. The setup gauge is brought to the correct position to the end of the roll by adjusting nuts 90 and 92. Starting with a setting of the cutters which may be in the right hand diagonal position as shown, the roll is adjusted to suit chucks 245 on the face plate so that they engage the notches for teeth in the driving plate which correspond to the right hand setting of the cutters. The drum cam is then started in operation, by starting its motor, and the cutters are started in operation by starting the cutting motors. The drum cam moves the cutters into engagement with the work roll and makes initial cuts 271, suitably six in number, corresponding to Figure 4. As the drum cam continues to turn it indexes the work roll successively to make cuts 271', 271², 271³ etc., forming at each of the six longitudinal positions a complete ring of cuts as shown in Figure 5. When the machine has provided the series of rings of cuts shown in Figure 5, the drive is automatically shut off by abutment 277' on the face plate tripping motor control limit switch 278 (Figure 25) supported from the frame. The machine is then adjusted longitudinally to make the next longitudinal series. The cam with crossfeed is stopped approximately at the end of the back operating stroke, and the adjustment is made by manipulating the longitudinal feed by moving longitudinal indexing handle 103 to release key 101 from longitudinal indexing rack 96, and then adjusting hand wheel 82, one tooth distance, and then lowering the longitudinal indexing key to its engagement with the next tooth then the cam is started and row 272 completed.

In the new position as shown in Figure 6, a succession of rings of cuts 272 are made, and then the cutters are adjusted longitudinally as already described. This is repeated until the entire roll is covered with rings of right hand cuts as shown in Figure 7. After the roll is cov-

ered with left hand cuts as shown in Figure 7, the setup is changed to make right hand cuts. This is accomplished by withdrawing locking pin 163 on each cutter and shifting the cutter angularly by the turning bar 164 to the right hand position, and restoring the locking key. The longitudinal indexing is adjusted by one-half tooth distance by removing pivot pin 107 in Figures 20 and 23, reversing key 101 and restoring pivot pin 107.

Likewise the angular indexing is shifted one-half tooth distance on the indexing plate by attaching the roll jack to the driving plate, releasing the plungers of chucks 245 from the teeth 246, advancing the driving plate angularly by one-half tooth distance on the indexing wheel and then restoring the plungers of chucks 245 to the next tooth 246 of the driving plate.

The adjustment now places the cutters in position to make a series of rings of left hand cuts 273 as shown in Figure 8, under the control of the indexing and feed cams. After the first of the left rings 273 have been cut, the longitudinal index is changed by hand as already described and the machine is operated to make the remaining left hand cuts 274, etc. in Figure 9.

The final result is to produce on the surface of the roll of Figure 10 right hand diamond or leaf depressions 275 and left hand diamond or leaf depressions 276 in diamond relationship with one another as shown, so that a floor plate or other material can be produced by rolling through the roll against a similar roll or a plain roll or a roll having similar cooperating raised portions corresponding to the depressions of Figure 10.

It will be evident that the drum cams are designed so that while both cams turn at all times, one cam always has a straight or ineffective portion opposite a deflecting portion on the other cam and vice versa.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claims.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In mechanism for machining recesses on the surface of a working roll, means for mounting said working roll turnable about an axis, an indexing plate turnable about said axis, cam means for advancing and retracting said indexing plate around said axis, an indexing gear connected to said working roll and rotating with said working roll about said axis, an operative pawl on said indexing plate engaging said indexing gear for advancing

said indexing gear around said axis, a stop pawl engaging said indexing gear at selective positions and when engaged preventing forward motion of said gear, a locking pawl engaging said indexing gear at selective positions and when engaged preventing motion in both directions, cam means operative between said indexing plate and said stop pawl for moving said stop pawl into and out of engagement with said indexing gear, a trip cam on said indexing plate for releasing said locking pawl, and trip means on said locking pawl engaged by said trip cam for releasing said locking pawl at a predetermined position on the forward motion of said indexing plate.

2. Mechanism of claim 1, in combination with release mechanism on said trip means for permitting said trip cam to pass beyond said trip means without releasing said locking pawl on retraction of said indexing plate.

3. In mechanism for machining recesses on the surface of a working roll, means for mounting said working roll to turn about an axis, a driving plate connected with said working roll and turnable with the working roll about said axis, an indexing gear having indexing teeth and turnable about said axis, automatic means for driving said indexing gear tooth-by-tooth about said axis, tooth recesses in said driving plate being spaced one-half tooth distance with respect to said indexing gear, and chuck means connected to said indexing gear and operating on said driving plate for selectively engaging one or the other of the tooth recesses in the driving plate to secure one-half tooth advance.

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