

Dec. 4, 1945.

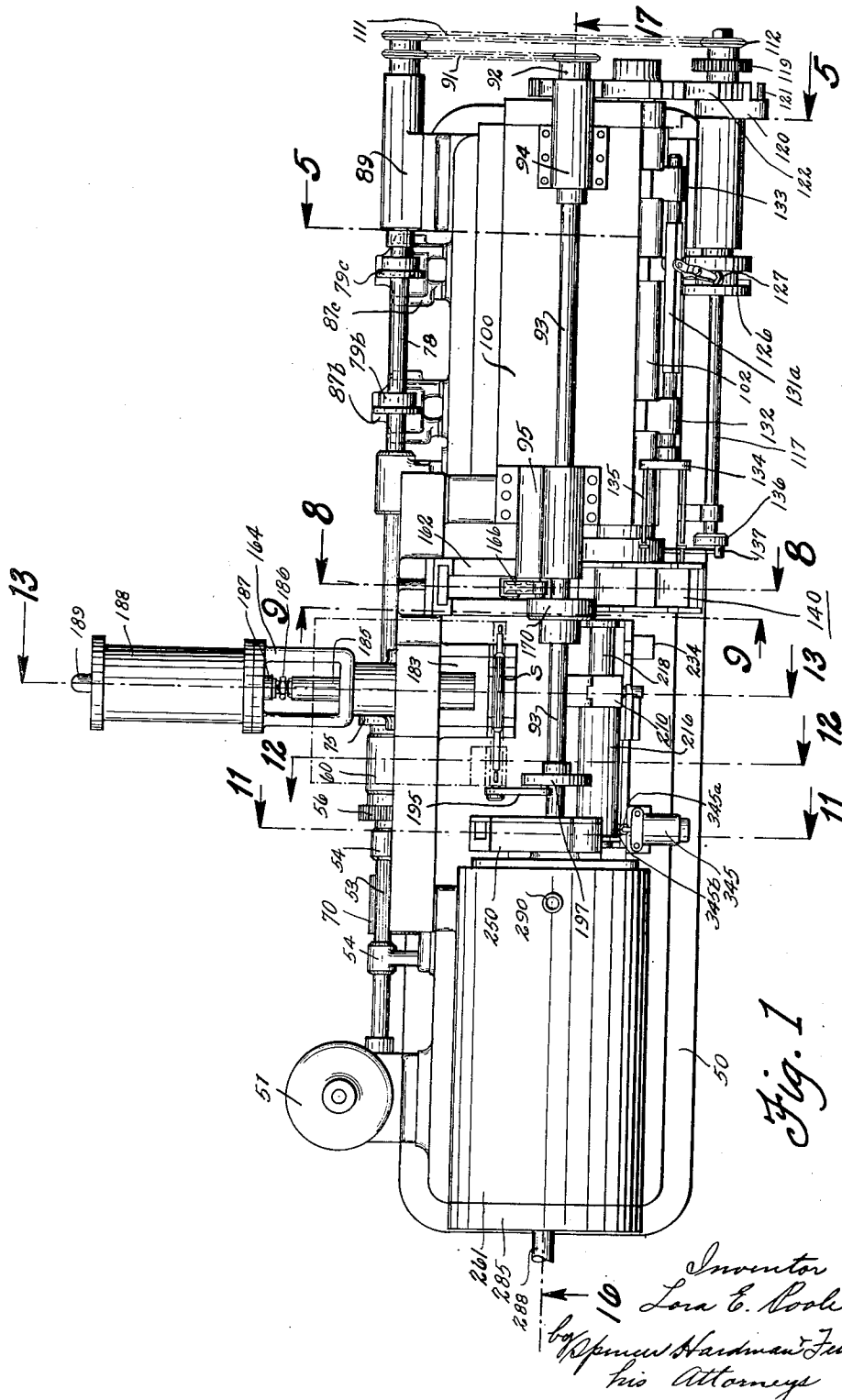
L. E. POOLE

2,390,170

MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

Filed Feb. 9, 1942

16 Sheets-Sheet 1



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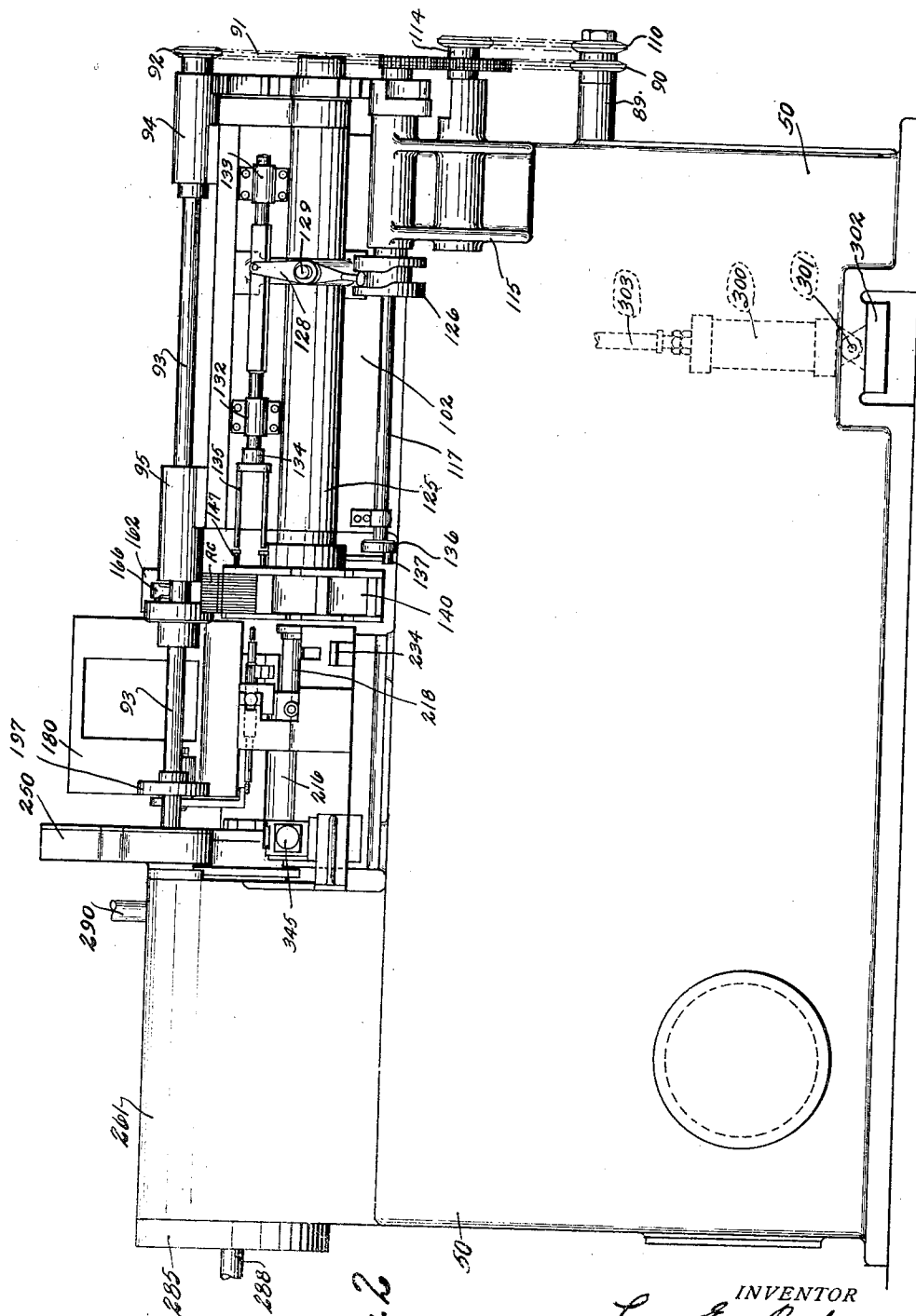
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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

Filed Feb. 9, 1942

16 Sheets-Sheet 2

*BY*

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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

Filed Feb. 9, 1942

16 Sheets-Sheet 4

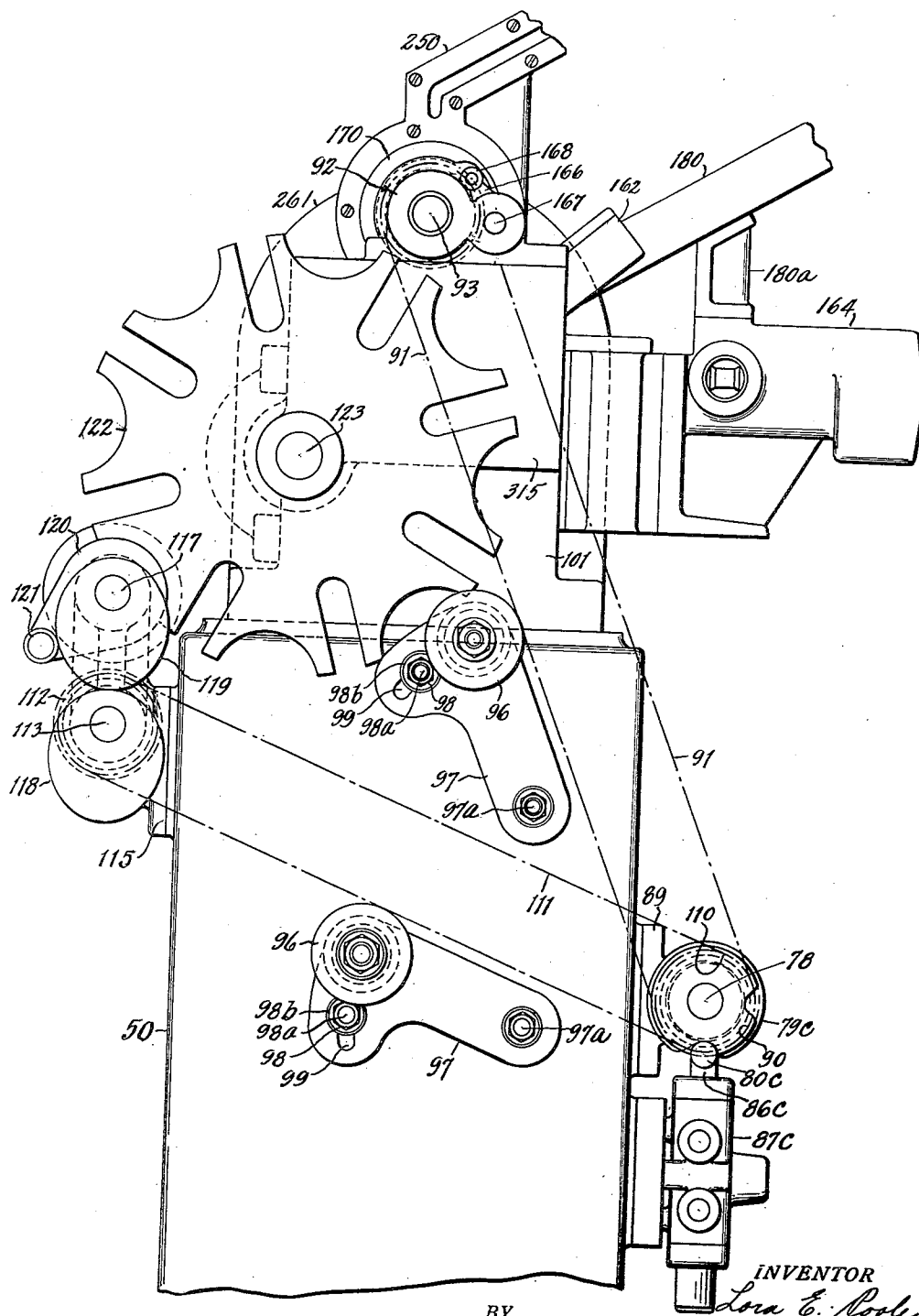


Fig. 4

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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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16 Sheets-Sheet 5

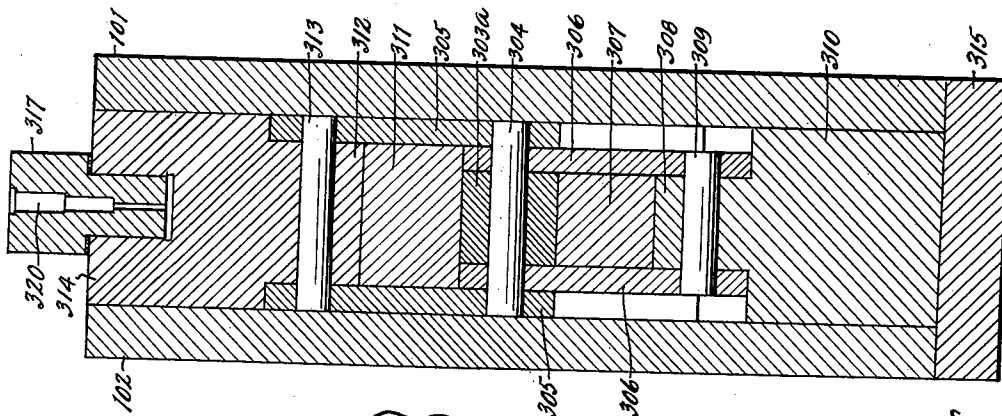


Fig. 6

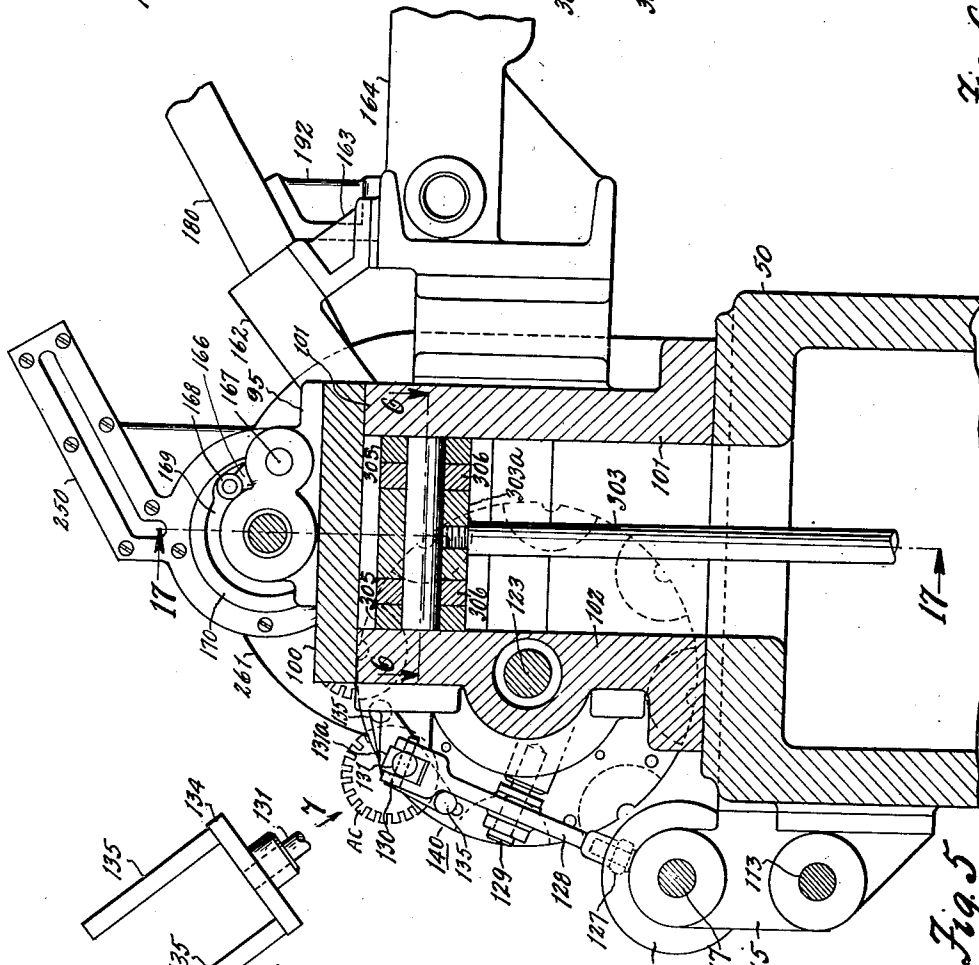


Fig. 5

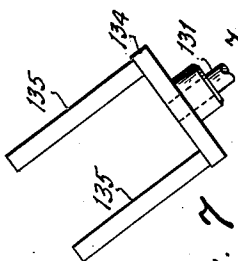


Fig. 7

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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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16 Sheets-Sheet 6

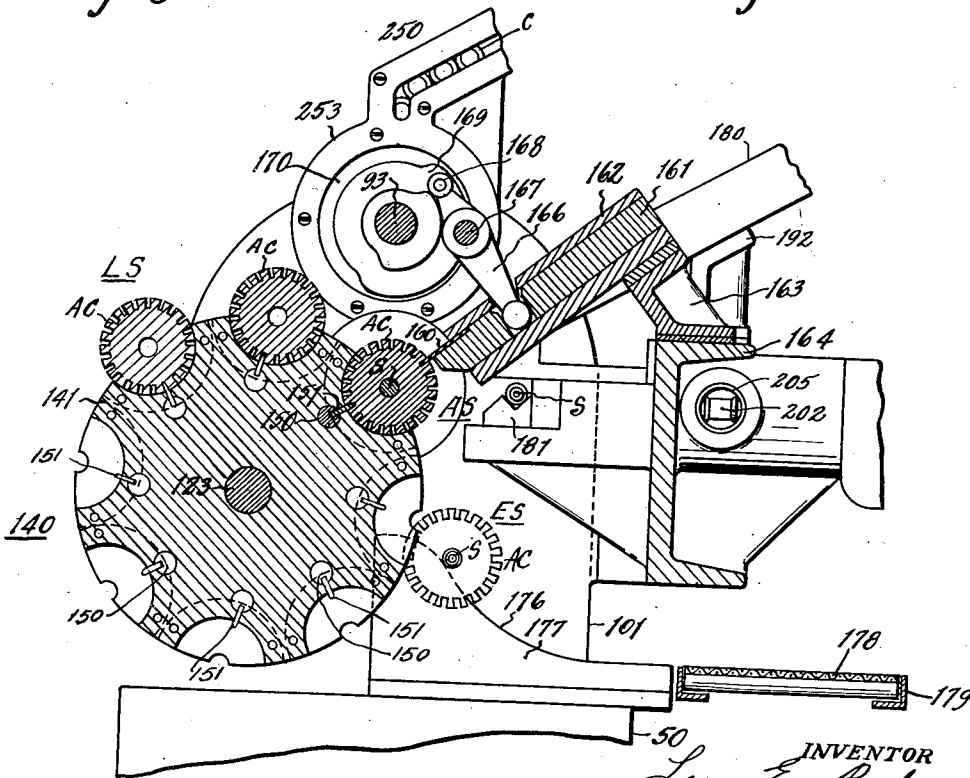
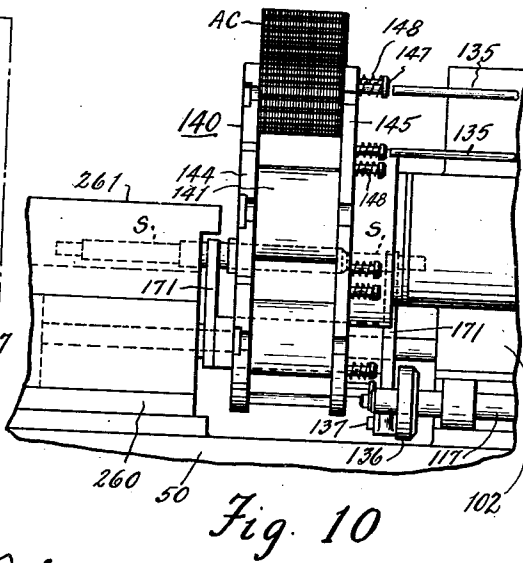
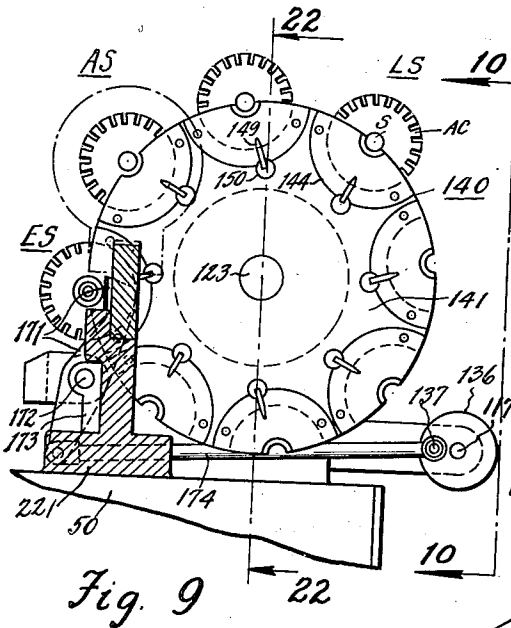


Fig. 8

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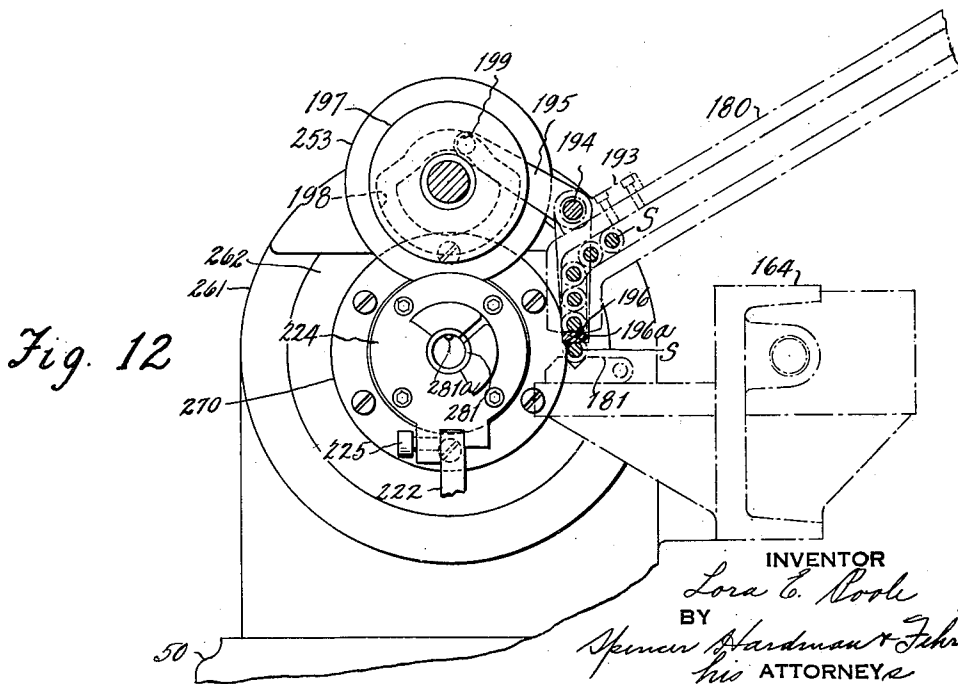
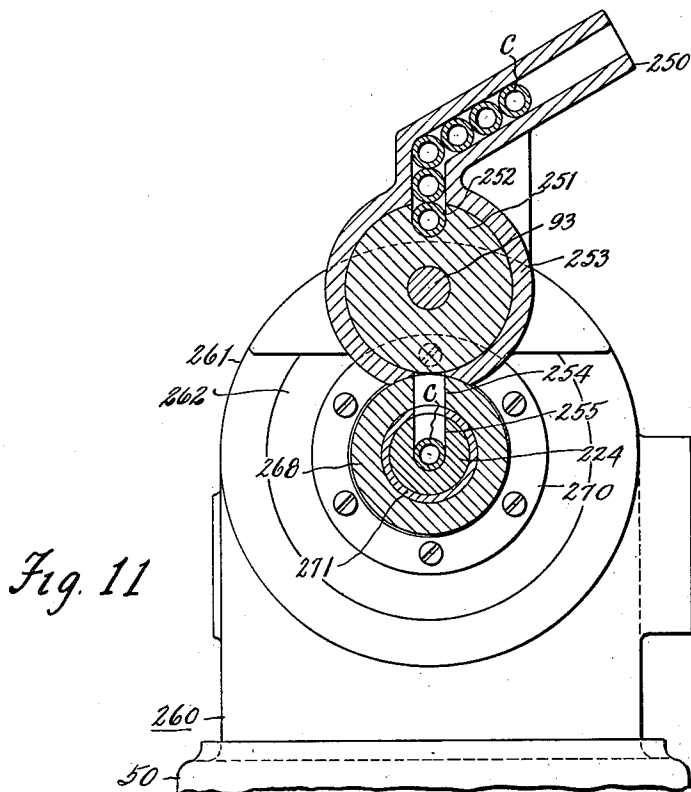
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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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16 Sheets-Sheet 7



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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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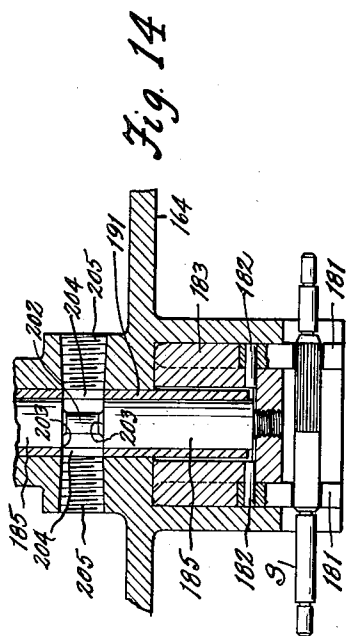


Fig. 14

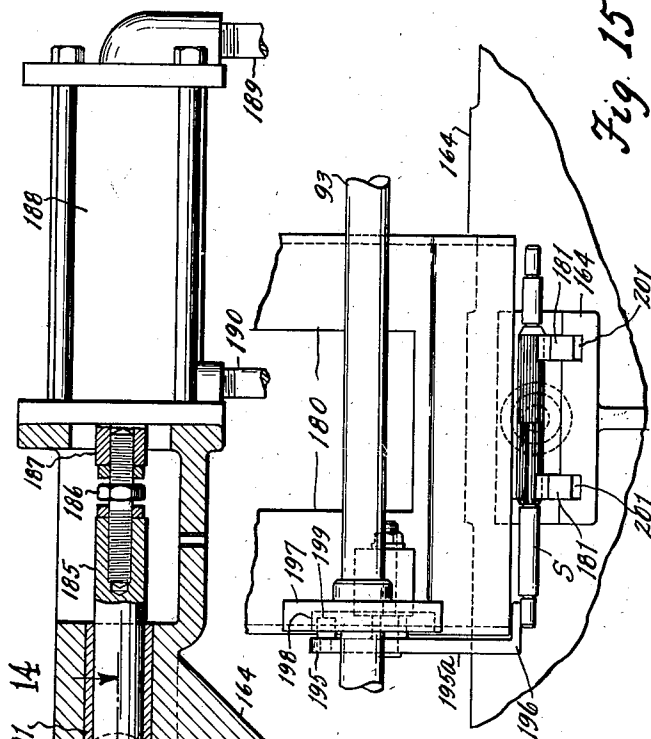
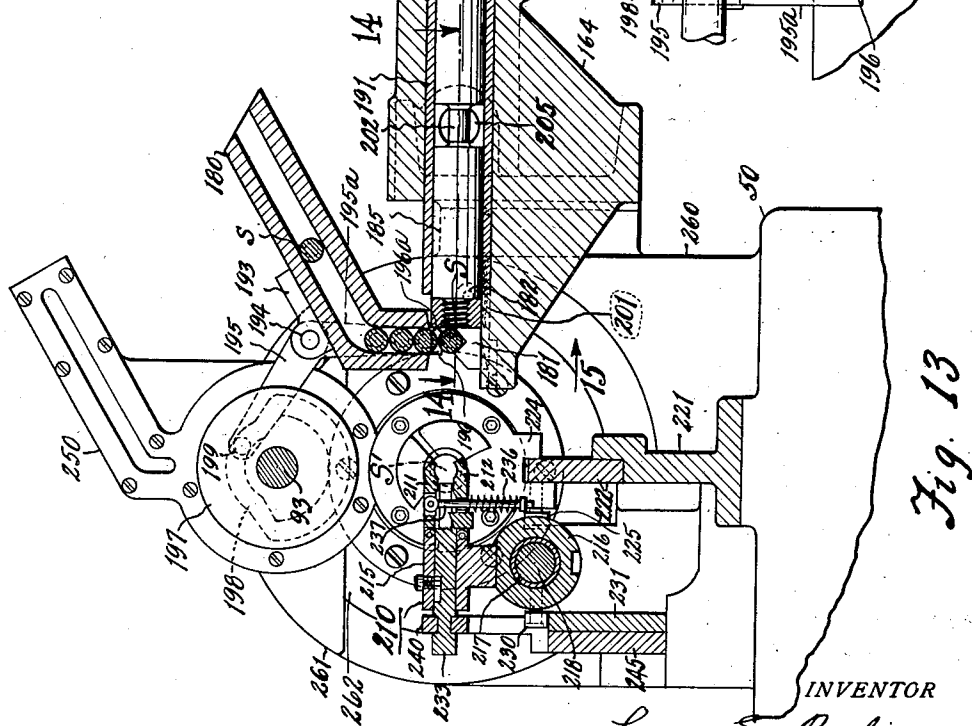


Fig. 15



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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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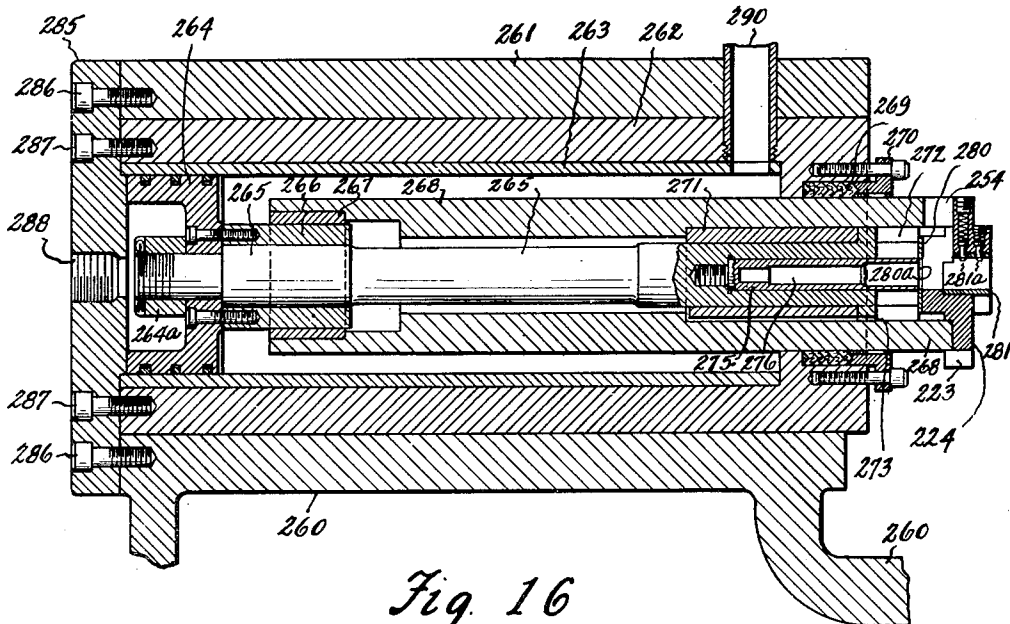


Fig. 16

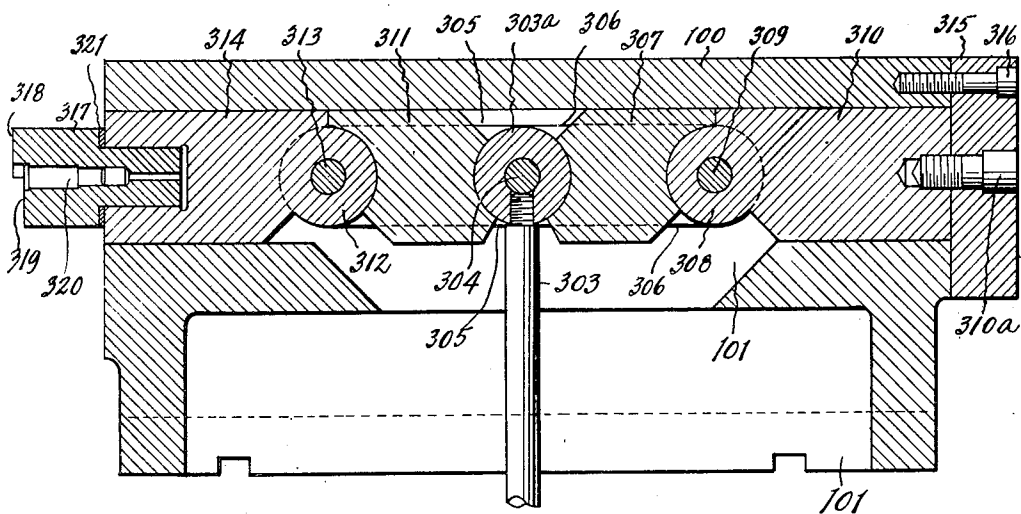


Fig. 17

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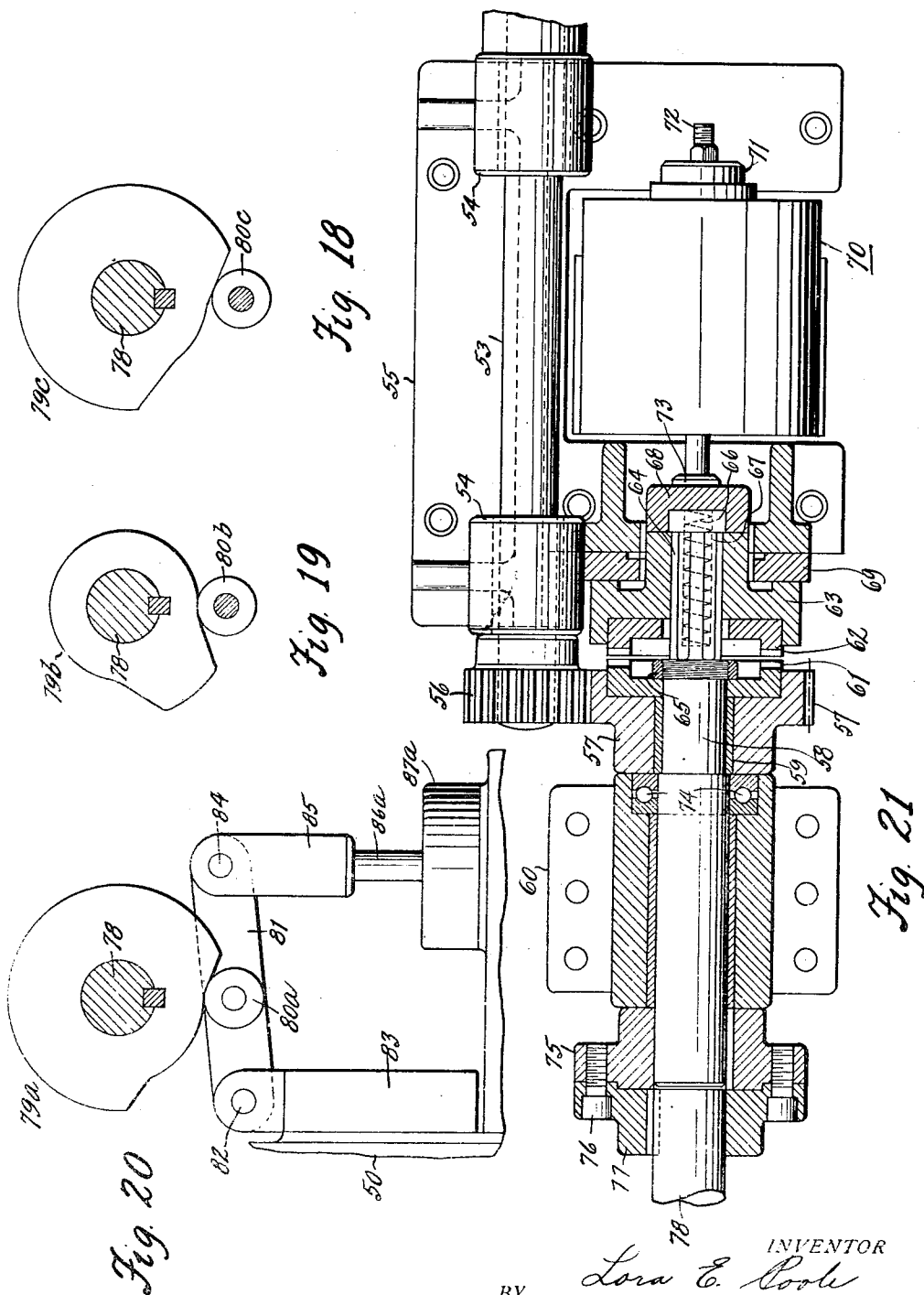
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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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16 Sheets-Sheet 10



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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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16 Sheets-Sheet 11

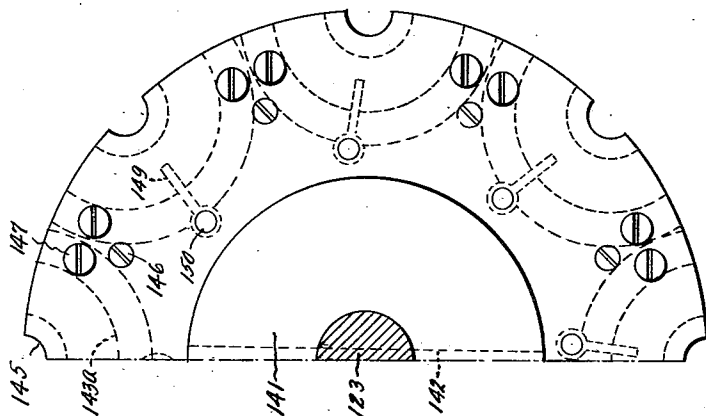


Fig. 24

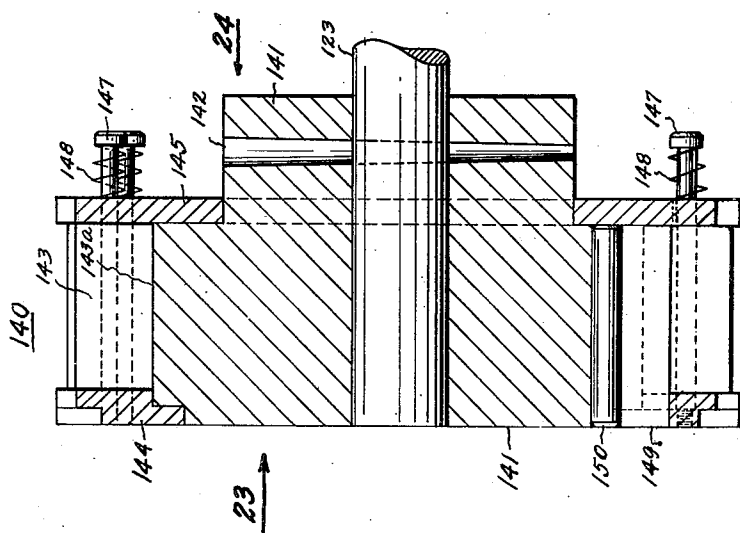


Fig. 22

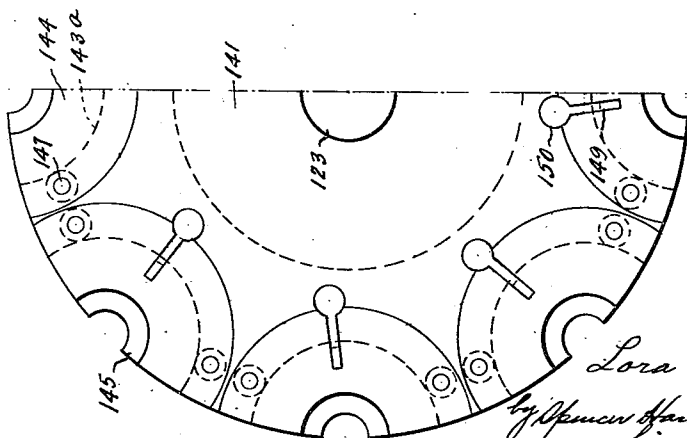


Fig. 23

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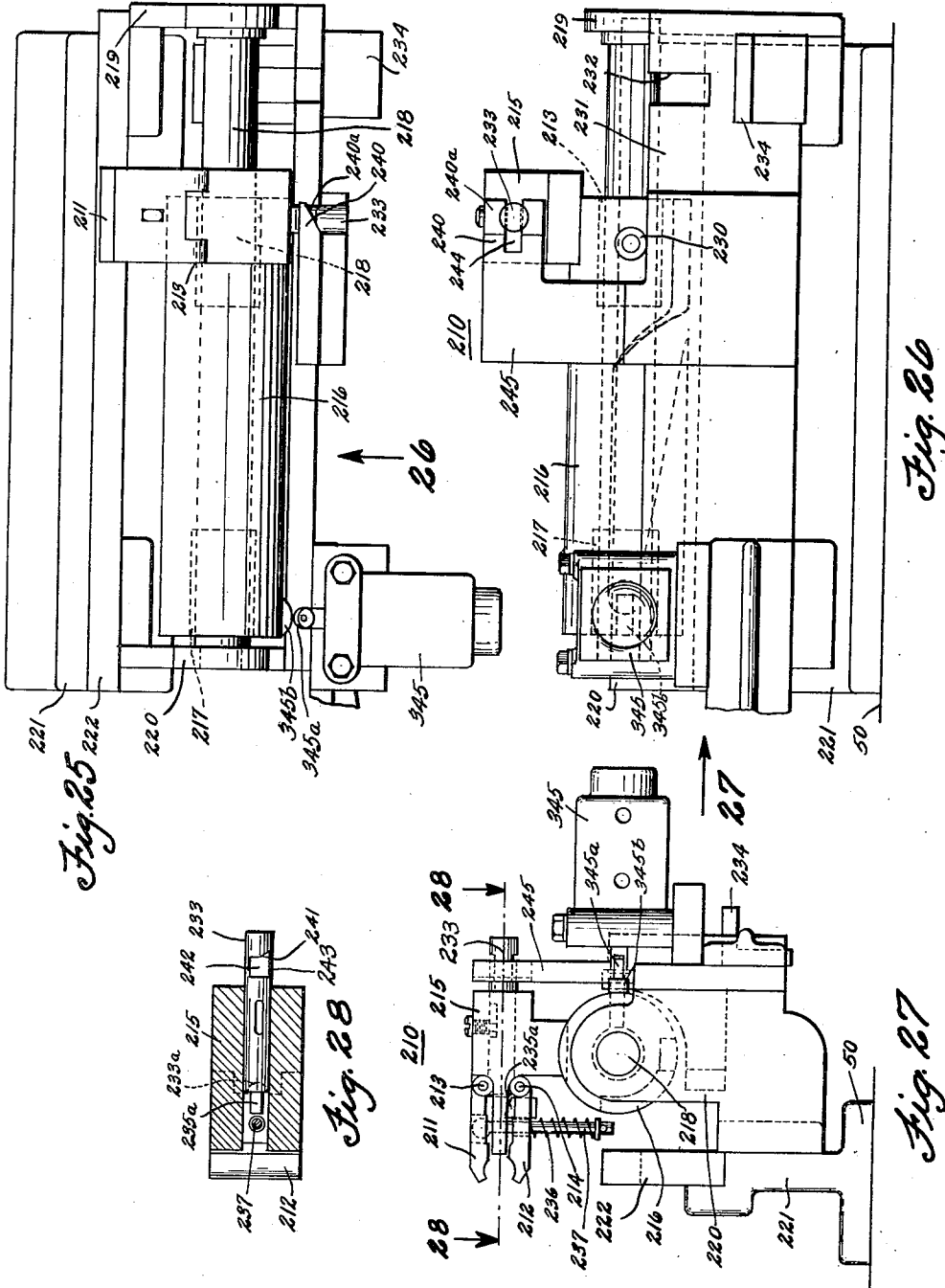
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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

Filed Feb. 9, 1942

16 Sheets-Sheet 12



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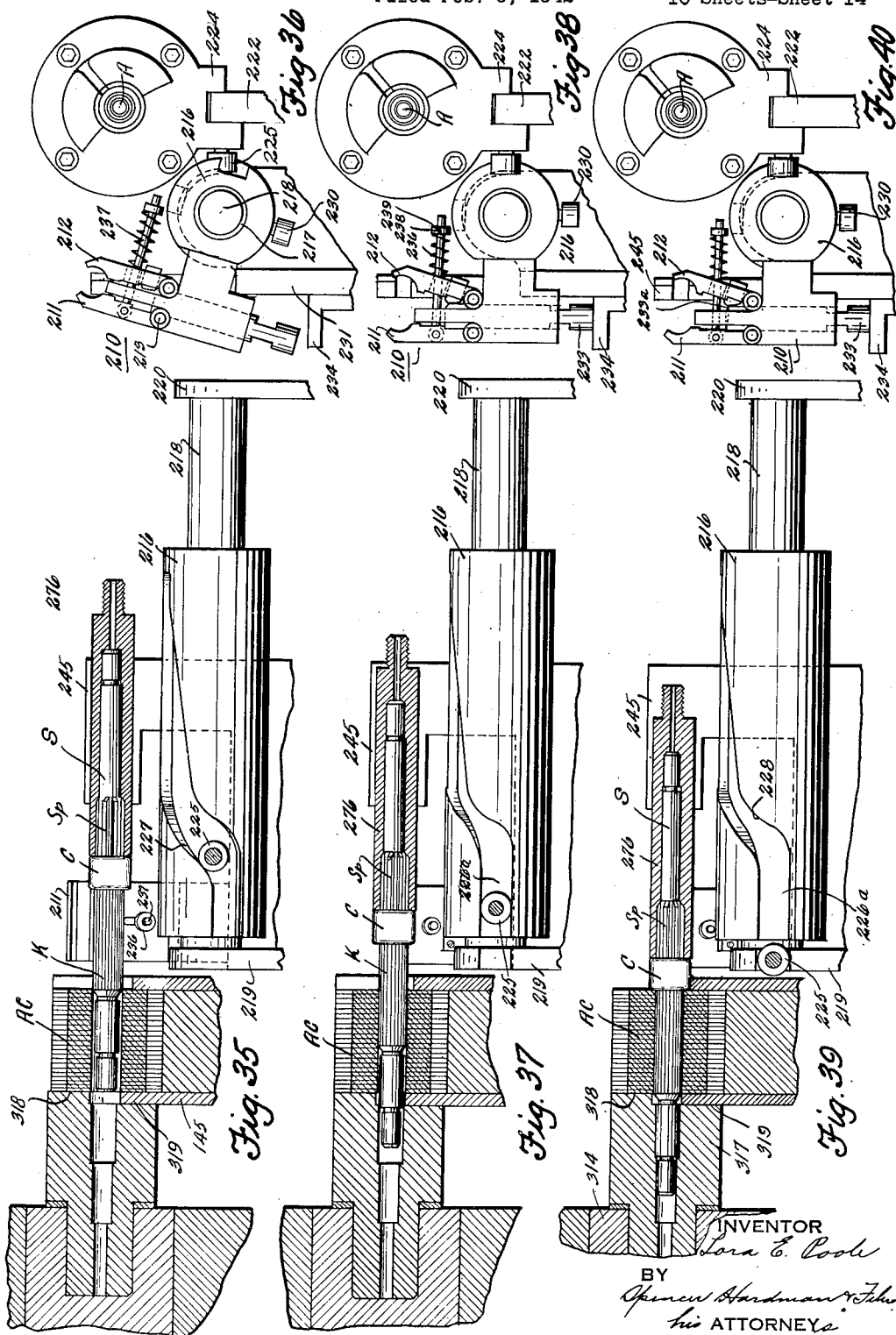
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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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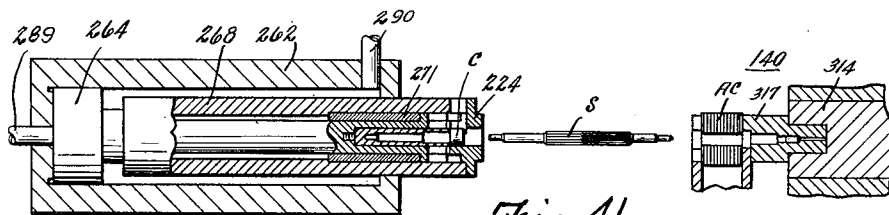


Fig. 41

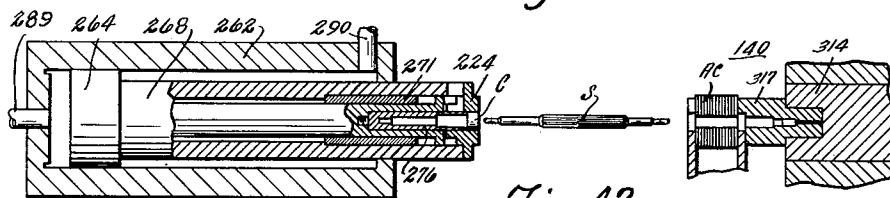


Fig. 42

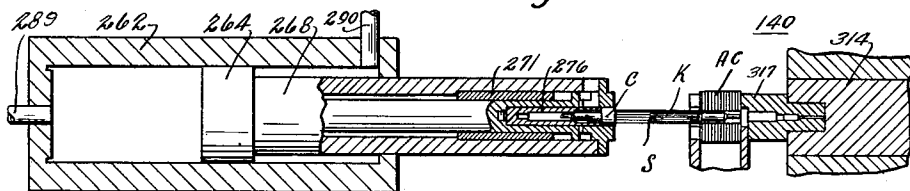


Fig. 43

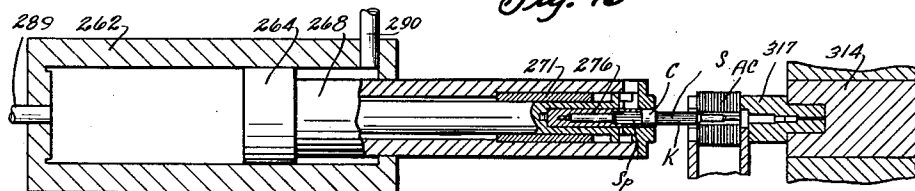


Fig. 44

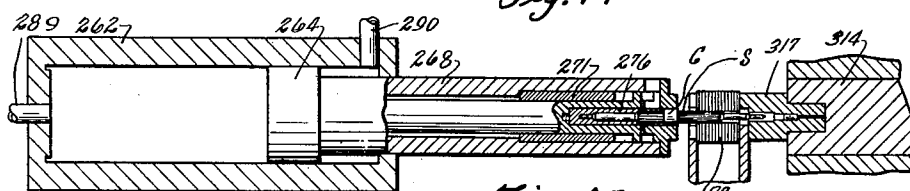


Fig. 45

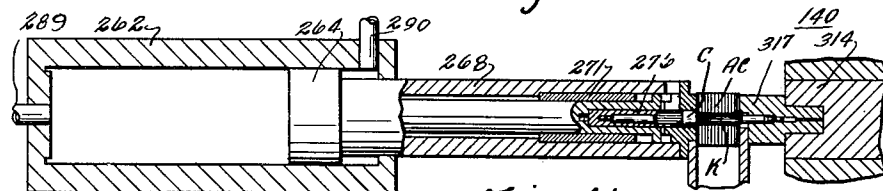


Fig. 46

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MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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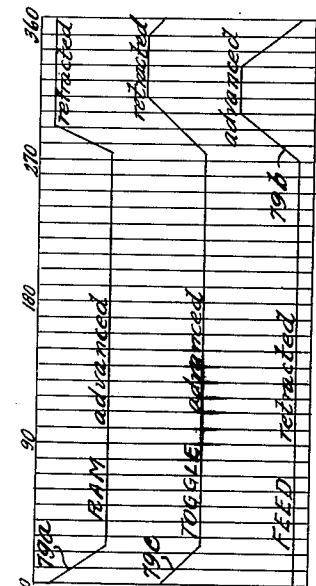


Fig. 48

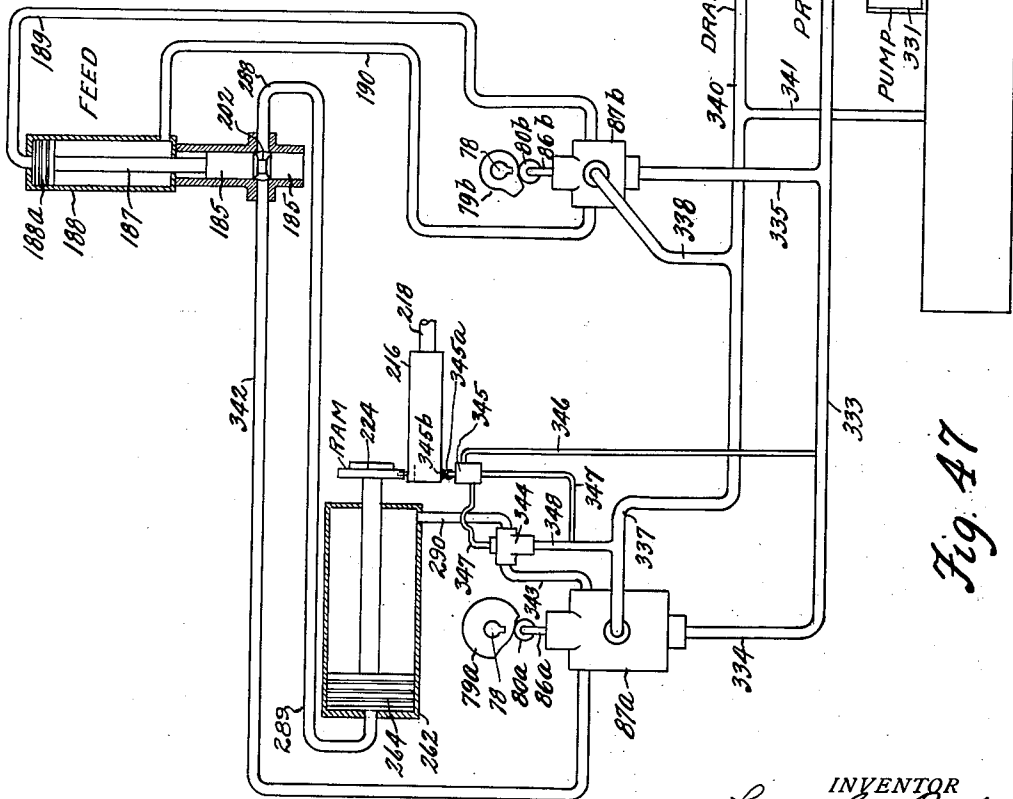


Fig. 47

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UNITED STATES PATENT OFFICE

2,390,170

MACHINE FOR ASSEMBLING SHAFTS AND ARMATURE CORES

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Application February 9, 1942, Serial No. 430,031

42 Claims. (Cl. 29-205)

This invention relates to a machine for manufacturing armature for dynamo-electric-machine having slotted laminated cores which are retained in assembly with their supporting shafts by providing the shafts with knurled portions which are slightly larger in diameter than the diameter of the central openings through the cores, and by forcing the knurled portion of the shaft through the central openings of the cores.

The object of this invention is to provide a machine for effecting the assembly of the shafts with the cores in a facile manner. To accomplish this object, I provide a rotary conveyor having work holders, each for receiving the quantity of core laminae sufficient to form a core and for retaining the laminae in slot-aligned relation. The conveyor is moved intermittently to carry the cores successively from a loading station to a work station when the shaft is assembled and then to a work ejecting station. I provide a shaft magazine chute through which the shafts gravitate to a magazine feed which moves the lowermost shaft into alignment with the central hole of the core at the work station. I provide a mechanical hand which grasps the shaft so aligned and which supports the shaft for axial movement toward the core. I provide a collar magazine chute for receiving metal rings or collars which are to be press-fitted upon the shafts and forced against one side of the cores. I provide a collar feed which permits the lowermost collar in the chute to descend into alignment with the shaft aligned with the core. I provide a ram having a pocket for receiving the descending collar and for locating it in alignment with the shaft and providing a central bore for receiving a part of the shaft. The ram is movable toward the shaft and core to cause the collar to be placed around the shaft and to cause the knurled portion of the shaft to be forced through the core and the collar to be forced around the knurled portion of the shaft and against one side of the core. During movement of the ram, the mechanical hand moves the shaft axially to enter it into the hole of the core while the ram moves the collar around the shaft. Means are provided for moving the mechanical hand laterally away from the shaft so that the ram is free to complete the assembly of the shaft, collar and core. During the assembling operation and concurrently with the movement of the ram a pressure block is moved so as to engage a part of the core and the face of the work holder opposite to the ram so that the force of the ram is exerted directly against the pressure block and not against the work holder as a whole. During assembly a laminae aligner plate engages a core slot positively to maintain the laminae in alignment. Before the conveyor moves the assembled work to the ejecting station, the ram and

the pressure block are retracted. At the ejecting station, an ejector operates automatically to eject the assembled shaft, collar and core which gravitate down an incline to a belt conveyor.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view of a machine embodying the invention;

Fig. 2 is a front view of the machine;

Fig. 3 is a back view of the machine;

Fig. 4 is a right end view of the machine looking in the direction of arrow 4 of Fig. 1;

Fig. 5 is a sectional view on the line 5-5 of Fig. 1;

Fig. 6 is a sectional view on the line 6-6 of Fig. 5;

Fig. 7 is a fragmentary view in the direction of arrow 7 of Fig. 5;

Fig. 8 is a fragmentary sectional view on the line 8-8 of Fig. 1;

Fig. 9 is a fragmentary sectional view on the line 9-9 of Fig. 1;

Fig. 10 is a fragmentary view on the line 10-10 of Fig. 9;

Fig. 11 is a fragmentary sectional view on the line 11-11 of Fig. 1;

Fig. 12 is a fragmentary sectional view on the line 12-12 of Fig. 1;

Fig. 13 is a fragmentary sectional view on the line 13-13 of Fig. 1;

Fig. 14 is a sectional view on line 14-14 of Fig. 13;

Fig. 15 is a fragmentary view taken in the direction of arrow 15 of Fig. 13;

Fig. 16 is a fragmentary sectional view on the line 16-16 of Fig. 1 showing a longitudinal sectional view of the ram and its operating means;

Fig. 17 is a fragmentary sectional view on the line 17-17 of Fig. 5 showing a longitudinal sectional view of the pressure block and its operating means;

Fig. 18 is a fragmentary sectional view on line 18-18 of Fig. 3;

Fig. 19 is a fragmentary sectional view on line 19-19 of Fig. 3;

Fig. 20 is a fragmentary sectional view on line 20-20 of Fig. 3;

Fig. 21 is a fragmentary view partly in longitudinal section of a portion of the mechanism located below the bracket 21 (dot-dash lines) of Fig. 3;

Fig. 22 is a sectional view of the conveyor on line 22-22 of Fig. 9;

Fig. 23 is a fragmentary side view of the conveyor looking in the direction of the arrow 23 of Fig. 22;

Fig. 24 is a fragmentary side view of the conveyor looking in the direction of arrow 24 of Fig. 22;

Fig. 25 is a plan view of the mechanical hand and its operating mechanism;

Fig. 26 is a front view thereof looking in the direction of arrow 26 of Fig. 25;

Fig. 27 is an end view thereof looking in the direction of arrow 27 of Fig. 26;

Fig. 28 is a sectional view on line 28—28 of Fig. 27;

Figs. 29, 31, 33, 35, 37 and 39 are fragmentary views partly in longitudinal section (axially of the shaft being assembled) showing the successive positions of the mechanical hand and its operating mechanism;

Figs. 30, 32, 34, 36, 38 and 40 are end views respectively of the parts shown in Figs. 29, 31, 33, 35, 37, 39;

Figs. 41 through 46 show diagrammatically longitudinal sectional views of the ram, work holder and pressure block and show the various stages of the assembly of the collar, shaft and core;

Fig. 47 is an hydraulic diagram of the controls;

Fig. 48 is a chart showing certain functions of the machine.

Drive and valve control

Referring to Fig. 3, a base 50 supports an electric motor 51 which drives reduction gears in housing 52. These gears drive a shaft 53 journaled in bearings 54 carried by a bracket 55 attached to base 50. Referring also to Fig. 21, shaft 53 carries gear 56 meshing with gear 57 mounted upon but not directly driving shaft 58 journaled in bearing 59 carried by bracket 60 attached to base 50. Gear 57 carries a jaw clutch element 61 for engaging a jaw clutch element 62 carried by a disc 63 slidably connected with splines 64 of shaft 58. A nut 65 secures gear 57 and clutch element 61 to shaft 58. A spring 66 in recess 67 of shaft 58 bears against a disc 68 attached to disc 63; and spring 66 urges clutch element 62 away from clutch element 61 and the latter against a stationary plate 69 having a lug 69a for engaging a notch 69b in part 63 at the end of one revolution.

Clutch elements 61 and 62 are engaged by a solenoid 70 attached to base 50 and having an armature 71 carrying a rod 72 which pushes a button 73 against disc 68. When the solenoid 70 is energized, armature 71 moves toward the left to effect the engagement of the clutch elements, the thrust of the engagement being taken up by bearing 74 carried by bracket 60. Shaft 58 is connected by coupling parts 75, 76 and 77 with shaft 78. The solenoid 70 is connected with a current source by a push button (not shown) which the operator pushes to initiate each cycle of operation of the machine.

Shaft 78 carries a cam 79a engaging a roller 80a on a lever 81 pivoted at 82 upon a bracket 83 attached to base 50. Lever 81 is connected by pin 84 with clevis 85 attached to a valve rod 86a for operating the valves of a valve unit 87a which controls the admission of pressure fluid to a pressure cylinder for moving the ram to be described.

Shaft 78 is journaled in brackets 88 and 89 attached to base 50. Shaft 78 carries a cam 79b which engages a roller 80b attached to a valve rod 86b which operates the valves of a valve unit 87b which controls the admission of pressure fluid to a cylinder which contains a piston for operating the shaft magazine feed to be described.

Shaft 78 carries a cam 79c which engages a

roller 80c attached to a valve rod 86c, which operates the valves of a valve unit 87c which controls the admission of pressure fluid to a cylinder which contains a piston connected with a toggle mechanism to be described for actuating the pressure block which cooperates with the work holder which is aligned with the ram.

Shaft 78 carries a sprocket gear 90 (Figs. 1 and 4) connected by chain 91 with sprocket gear 92 which drives a shaft 93 journaled in brackets 94 and 95 (Figs. 1 and 3) carried by a plate 100 which is carried by frame sides 101 and 102 (Fig. 5). An idle gear 96 (Fig. 4) carried by bracket 97 engages chain 91 to take up slack. Bracket 97 is pivoted on stud 97a and is secured in adjusted position by tightening a nut 98 on a stud 98a (secured to base 50) against a washer 98b and the latter against the bracket 97. Stud 98a extends through an arcuate slot 99 in the bracket 97.

Shaft 78 carries a sprocket gear 110 connected by chain 111 with a sprocket gear 112 attached to shaft 113 journaled in bearing 114 (Fig. 2) provided by bracket 115 (Fig. 4) attached to base 50. Bracket 115 provides a bearing 116 supporting a shaft 117 connected with shaft 113 by elliptical gears 118 and 119.

Shaft 117 drives a Geneva gear arm 120 carrying a roller 121 for driving a Geneva gear 122 attached to a shaft 123 journaled in bearings 124 and 125 provided by frame side 102 (Figs. 1 and 5). Shaft 117 carries a barrel cam 126 for engaging a roller 127 (Fig. 5) on a lever 128 pivoted on a screw 129 and having a forked end connected by a pin 130 with the portion 131a (of rectangular cross-section) of a rod 131. Rod 131 has round portions slidable horizontally in brackets 132 and 133. The left end of rod 131 is attached to a plate 134 carrying pusher pins 135 (also Fig. 7) for a purpose to be described. Shaft 117 carries a crank disc 136 carrying a crank pin 137 for a purpose to be described.

The armature core conveyor

The armature core conveyor is designated in its entirety by numeral 140 in Figs. 22, 23 and 24. It comprises a hub 141 attached by a pin 142 to shaft 123 so as to be turned thereby intermittently by the operation of the Geneva gear 122 (Fig. 4). Hub 141 provides core-receiving-recesses 143 having cylindrical bottoms 143a. The left ends of the recesses are provided by plates 144 movably supported by the hub 141 and the right ends of the recesses are provided by a single annular plate 145 attached by screws 146 to the hub 141. Plates 144 are movable longitudinally of shaft 123 and are attached to long screws 147 passing through plate 145 and the hub 141. Between the heads of screws 147 and plate 145 are located springs 148 which cause the screws 147 and the plates 144 to be urged toward the right in Fig. 22. Each work holder recess receives a blade 149 welded to a rod 150 supported by the hub 141.

The blades 149 are each located so as to enter a core slot of a laminated core designated AC placed within the recess. At the loading station of the conveyor 140, the screws 147 are engaged by the pushers 135 and moved toward the left by the action of cam 126 upon lever 128 and rod 131 so as to separate the plate 144 (then at the loading station) from the plate 145 so as to permit the facile entry of the stock of core laminae between the plates 144 and 145. Before the conveyor 140 moves this work holder to the operating station, the pushers 135 are retracted from

the screws 147 to release the springs 148 which cause the plate 144 to be urged against the core and thus to grip the core between the plates 144 and 145.

The retractible laminae aligner

In Figs. 8 and 9 the loading station is marked LS, the operating or assembling station is marked AS, and the ejecting station is marked ES. The direction of rotation of conveyor 140 is clockwise in Fig. 8 and counter-clockwise in Fig. 9. After the core AC arrives at the station AS, its laminae are aligned also by a blade 160 attached to a sliding bar 161 guided by a frame 162 attached to a bracket 163 attached to a channel bracket 164 integral with bracket 165 attached to frame side 101. Bar 161 is actuated by a lever 166 supported on a pivot rod journaled in the bearing bracket 95 and carrying a roller 168 received by the race 169 of a cam 170 attached to shaft 93. Shaft 93 makes one revolution for every one-eighth revolution or indexing movement of shaft 123. Cam 170 causes blade 160 to extend into a core slot after the core AC arrives at the station AS and before the assembly operation starts. After the assembling operation, the blade 160 is retracted from the core AC before the core moves from the station AS to the station ES.

The core ejector

After the core AC arrives at the station ES, the shaft S with which it has been assembled (at station AS) is engaged by a pair of levers 171 (Fig. 3) pivoted at 172 (Fig. 9) upon a bracket 173 attached to support 221 and connected at 174 with a rod 175 pivoted upon the crank pin 137 of crank disc 136 driven by shaft 117. Lever 171 moves counter-clockwise (Fig. 9) to cause core AC to move out of the work-holder recess 143 which had received it; and the assembly of shaft S and core AC rolls down the inclined surfaces 176 of plates 177 (Fig. 8) supported by base 50 and from thence upon a conveyor belt 178 moving in a channel 179.

Shaft magazine chute and feed

Referring to Fig. 13, the shafts S descend through a chute 180; and the lowermost shaft is permitted at a certain time to descend upon V-blocks 181 attached by pivot pins 182 to a slide 183 screw threadedly connected at 184 with a rod 185 which is connected by an adjustable rod 186, (having threaded ends of opposite thread pitch) with a piston rod 187 connected with a piston (not shown) in a cylinder 188 having pipe connections 189 and 190 with valve unit 87b (Fig. 47). When the valve rod 86b is down, oil into pressure flows under cylinder 188 through pipe 189 and oil is discharged through pipe 190 so that V blocks 181 move left to carry a shaft S into alignment with a core with which the shaft is to be assembled. When valve rod 86b is up, the connections are reversed so that oil flows into cylinder 188 through pipe 190 so that V block 181 moves right into the position shown in Fig. 13.

Rod 185 slides in a bearing sleeve 191 carried by bracket 164 which supports the cylinder 188. Chute 180 is supported by a bracket 192 (Figs. 4 and 5) and chute 180 supports a bracket 193 in which a shaft 194 is journaled. Shaft 194 carries a bell crank lever 195. The lowermost portion 195a of this lever carries a lug 196 having a V-edge 196a, said lug being located normally

so as to separate the left end portions of the two lowermost shafts. When in this position the lug is effective to prevent the shaft immediately above that supported by blocks 181 from coming into engagement with the splined or knurled portions of the shaft so supported as not to interfere with the movement of the shaft which is supported by the blocks 181 to the position S' where it is in alignment with the opening in the armature core. This permits the free movement of the lowermost shaft S without becoming engaged with the knurled or splined portions of the shaft above. After the V blocks 181 have been moved by the rod 185, as already described, and have moved a shaft to the position S' (Fig. 13) in which position it is grasped by a mechanical hand 210, the construction and operation of which will be described later, and the rod 185 and blocks 181 have been returned to their normal position, the lug 196 moves toward the left (Fig. 13) to permit the lowermost shaft then in the chute to descend upon the V blocks 181; and then the lug 196 moves toward the right to maintain separation between the two lowermost shafts. These movements of the lug 196 are effected by a cam 197 having a race 198 engaging a roller 199 on the end of arm 195. Cam 197 is driven by shaft 93.

During movement of the V blocks 181 toward the left they are resiliently supported by leaf springs 201 which permit the V blocks 181 to yield and move downwardly in case the shaft S is not exactly aligned with the opening between the fingers of the mechanical hand (to be described).

By providing the rod 185 with an annular groove 202 defining shoulders 203, said rod 185 constitutes a valve for controlling ports 204 in bearing sleeve 191, said ports being in alignment with threaded holes 205 with which pipes are attached as shown in the hydraulic diagram (Fig. 47), which will be described fully later. For the present it is sufficient to state that when rod 185 is in normal position pressure fluid may flow from one threaded opening 205 to the other for the purpose of operating the ram which assembles the shaft of the core. When the rod 185 has moved toward the left from the position shown in Fig. 13 to locate a shaft S in alignment with the ram the passage referred to will be shut off so that the ram can not be operated until the rod 185 returns to normal position.

The mechanical hand

Referring to Figs. 13, 25 through 28, after the shaft S arrives at position S' (Fig. 13) it is grasped by a mechanical hand 210 having fingers 211 and 212 pivoted at 213 and 214 respectively upon a block 215 attached to a sleeve 216 having bushings 217 rotatable upon and slidable along a rod 218 supported by brackets 219 and 220 attached to an inverted T-bar 221 supported by base 50. T-bar 221 supports a rail 222 received by a notch 223 in a plate 224 attached to the ram (to be described). Plate 224 carries a roller 225 received by a groove 226 formed in the side of sleeve 216 and providing cam surfaces 227 and 228, so that the sleeve 216 may be rotated at certain times when the plate 224 moves along the rail 222. At other times the sleeve 216 is not permitted to rotate due to the fact that a roller 230 carried by the sleeve 216 engages a rail 231 supported by the brackets 219 and 220. At the times that it is desired to rotate the sleeve 216 the roller 230 is aligned with

a notch 232, as shown in Fig. 31. This allows the hand 210 to move successively into the position shown in Figs. 34, 36 and 38. During the movement the fingers 211 and 212 become separated for a purpose and in a manner to the described later.

Bar 233 has a cam 233a which strikes a cam 235a on a block 235 attached to finger 212 thereby causing the latter to move down against the action of a spring 236 encircling a rod 237, having at its lower end a washer 238 held by a pin 239 and attached to finger 211, said spring 236 bearing against the underside of the finger 212. During the return of the hand 210 to normal position, the bar 233 is retracted from engagement with the cam block 235 of finger 212. During the first part of the return movement of the hand 210 from the position shown in Fig. 40 to that position shown in Fig. 30, the hand rotates into horizontal position as shown in Fig. 32 and then moves toward the left (Fig. 25) into the normal position shown in Fig. 25. During this latter movement, the bar 233 is cammed toward the left (Fig. 13) or toward the right in Figs. 27 and 28, by the cooperation of stationary fingers 240 with shoulders 241 provided by bar 233. As shown in Fig. 28 the shoulders 241 are at the right side of notches 242 in the bar 233, said notches being separated by a neck 243 (Fig. 27) which is received by the notch 244 which separates the fingers 240. Fingers 240 have inclined surfaces 240a which engage the shoulders 241 to cam the bar 233 toward the right (Fig. 28) or toward the left (Fig. 13) when the hand 210 moves and returns to the normal position shown in Figs. 13 and 27. Fingers 240 are integral with a bracket 245 attached to rail 231. The operation of the hand 210 will be more fully explained in connection with the operation of the ram.

The collar magazine chute and feed

Referring to Fig. 11, the rings or collars C descend through a chute 250 and the lowermost collar C in the chute rests upon a disc 251 rotated by shaft 93 and having a notch 252 for receiving a collar C at the proper time. When a collar C is so received, it is retained by the housing 253 which surrounds the disc 251. When the disc 251 rotates 180° from the position shown in Fig. 11, the collar C falls through a passage 254 and into a pocket 255 of the ram end plate 224 (Fig. 16).

The assembling ram

Referring to Fig. 16, the base 50 supports a frame 260 providing a tubular housing 261 containing a cylinder 262 containing a lining sleeve 263 receiving a piston 264 connected with a rod 265 and a sleeve 266 slidable through a bushing 267 in one end of the ram 268 slidable through the packing 269 in the right end wall of cylinder 262, said packing being secured by a gland or stuffing bushing 270. Rod 265 is slidable through a bushing 271 in ram 268, said bushing being notched at 272 to receive lugs 273 provided by the rod 265. Rod 265 contains a liner 275 having a central, stepped bore 276 of a shape adapted to receive a portion of a shaft S. The liner 275 is in alignment with a hole 280a in a plate 280 attached to the ram end plate 224. Plate 224 carries a liner 281 into which the collars C are pushed by the ram liner 275. Spring pressed plungers 281a yieldingly retain a collar C in liner 281. Plate 224 being prevented from rotating by engagement with rail 222 (Fig. 13), prevents

rotation of ram 268; therefore hole 254 remains in alignment with shaft 93 in Fig. 11. Cylinder end plate 285 is attached by screws 286 to housing 261 and by screws 287 to cylinder 262. End plate 285 has a tapped hole 288 for making connection with a pipe 289 conducting a pressure fluid to the left side of piston 264. Pipe 290 conducts pressure fluid to the right side of piston 264. Pipes 289 and 290 are connected with valve unit 87a (Figs. 3 and 47). When valve rod 86a is up the piston 264 is forced toward the left into the normal position shown in Fig. 16. When the rod 86a is down, the piston 264 is forced successively into the positions shown in Figs. 41 through 46.

Workholder pressure block

Referring to Figs. 2, 5, 6 and 17, and 47, a cylinder 300 pivoted at 301 on a plate 302 supported near the bottom of the frame 50 encloses a piston 300a connected by a rod 303 with an eye 303a, Fig. 17. A pin 304 passes through eye 303a and bars 305 and 306, see Fig. 6. A pin 309 passes through extension 308 of block 310 and through bars 306. A pin 313 passes through the extension 312 of block 314 and through bars 305. A block 307 is confined between the cylindrical surfaces of eye 303a and block extension 308. A block 311 is confined between the cylindrical surfaces of eye 303a and the extension 312 of block 314. Block 310 is attached by screws 310a to plate 316 which is attached by screws 314 to plate 100 and frame side walls 101 and 102. Block 314 supports a pressure block 317 having a surface 318 adapted to engage core AC as shown in Fig. 29 and a surface 319 adapted to engage work holder plate 145. Block 317 has a central recess 320 for receiving an end of armature shaft S. Before the work holder 149 is indexed, pressure fluid is admitted to the top end of cylinder 300 in order to force rod 303 downwardly from the position shown in Fig. 10 in order to break the toggle and to move the block 317 toward the right in Fig. 17 or toward the left in Fig. 29. After the work holder 140 has been indexed in order to bring a shaftless core AC into alignment with the ram 317, pressure fluid is admitted to the lower end of the cylinder 300 in order to straighten the toggle as shown in Fig. 17.

Operations of the mechanical hand

The operations of the mechanical hand will now be described with reference to Figs. 29 through 40. When the shaft S has been moved into a position in alignment with the aperture within the core AC and has been gripped by the mechanical hand, the parts are in a position corresponding to that shown in Fig. 30 and with the roller 225 at a position within the groove 228 somewhat to the right of the cam surface 227 of such groove. As the ram starts moving toward the left, the engagement of the ram insert 275 with the collar C first moves the parts substantially to the position shown in Fig. 29 where the end of the shaft S is closely adjacent the core and the roller 225 is in engagement with the cam surface 227. Further movement of the ram to the left carries the parts into the position shown in Fig. 31 where the knurled portion K of the shaft is brought into engagement with the end laminations of the core AC and the sleeve 216 is carried along, by reason of the engagement of the roller with the cam surface, until it reaches a place where it can move no further to the left. During this movement there is no rotation of the

shaft 216 as it has been carried along with the roller 225, but the sleeve has been released for rotation because of the fact that the roller 230 which is carried by the shaft has been placed in vertical alignment with the notch 232 of plate 231. Upon further movement of the ram to the left, the insert 275 which engages the collar C causes the latter to be moved from the location shown in Fig. 31 to that shown in Fig. 33 while the shaft S remains substantially stationary and the coaction of the roller 225 with the cam surface 227 causes the sleeve 216 to be rotated from the position shown in Fig. 32 to that shown in Fig. 34 which causes the retraction of the mechanical hand 210 from the shaft S which is then supported by the ram insert 275 and the core AC which is held in fixed position by the workholder 140. The rotation of the sleeve 216 is brought about during this movement because the sleeve can no longer move to the left and the engagement of the roller with the cam surface 227 must effect rotation of the sleeve.

During the rotation of the sleeve 216, the mechanical hand 210 supported thereby is disengaged from the shaft S and the fingers are separated, as shown in Fig. 34, the finger 225 being moved against the pressure of the spring 236, the spring yielding to permit this disengagement. After disengagement from the shaft, the spring causes the closing of the fingers, as shown in Fig. 36, but at the end of the leftward motion of the ram, the fingers are again separated as shown in Fig. 40, for a purpose to be set forth later.

On further movement of the ram insert 275 leftward to the position shown in Fig. 35, the movement of the collar C along the splined portion of the shaft to a position adjacent the knurled surface of the shaft S as shown in such Fig. 35 is brought about. During this movement of the ram, the sleeve 216 is rotated still further in clockwise direction until it assumes a position such as shown in Fig. 36, by reason of the coaction of roller 225 with the cam 237. As the ram continues its movement to the left, the roller 225 will pass into the portion 226a of the groove 226, to the position shown in Fig. 37, and this movement will force the knurled portion K of the shaft S partly into the aperture within the collar AC and will effect further rotation of the sleeve 216 so that the parts assume the position shown in Fig. 38. Further and final movement of the ram to the left will not produce any further rotational movement of the sleeve 216 because the part 226a of the groove 226 is parallel to the axis of the sleeve, but during this movement of the ram, which carries the parts from the position shown in Fig. 37 to that shown in Fig. 39, the shaft S is moved further toward the left until the knurled portion K thereof is pushed all of the way through the armature core AC and the collar C is forced against the right side of the core AC. When this movement of roller 225 to the left has been completed, it has passed completely out of engagement with the groove 226, as shown in Fig. 39, and the leftward movement of the ram has been completed.

It will be apparent from the foregoing that by the time the roller 225 has been moved far enough to the left to reach the part 226a of groove 226, the rotation of sleeve 216 in a counterclockwise direction, referring to Fig. 30 for example, will have been completed. When this movement of rotation of the sleeve has been completed, the bar 233 will have engaged the shelf 234 and will have been moved so as to force finger 212 away

from finger 211 against the action of spring 236, to the position shown in Fig. 40. The bar 233 remains in such position by reason of friction of the parts during the return of the ram to normal position and the reverse or clockwise rotation of the sleeve and the return of the hand to horizontal position, which takes place when the ram is returned.

During the retraction of the ram the roller 225 re-enters the groove 226 and, by reason of the cam surface 228, rotates the sleeve 216 in a clockwise direction to carry the hand from the position shown in Fig. 40 back to that shown in Fig. 30, and during this movement of the hand the finger 212 must pass under the shaft S then in alignment with the ram. To do this the finger 212 must be in the position shown in Fig. 40, and for this reason the fingers of the hand are maintained in separated position during this movement, as previously described. Rotation of sleeve 216 clockwise is followed by its horizontal movement toward the right back to the position shown in Fig. 30; and, during this last horizontal travel of the sleeve 216, the cams 241 are caused to engage the cams 240a of fingers 240 (Fig. 25) in order to effect the retraction of the bar 243 from the cam block 235 and thus permit the spring 236 to restore finger 212 to its normal position. During the retraction of the ram and the restoration of the hand to normal position the pressure block 217, which counteracts the pressure of the ram against the core and workholder, is moved to the left (Fig. 29) or the right (Fig. 17) by causing the rod 303 to move down to break the toggle and thus shorten the distance between pins 309 and 313.

Operation of the ram

The operation of the ram will be described in detail with respect to Figs. 41 through 46 and also Fig. 16. When pressure fluid is admitted through the pipe 289, the piston 264 begins to move toward the right while the sleeve 268 remains stationary due to the fact that it is frictionally held by the packing 269 (Fig. 16). Therefore, there is relative movement between sleeve 268 and the piston 264; and during this relative movement, the collar C is moved from the position shown in Fig. 41 to that shown in Fig. 42. After the lost motion between the piston 264 and sleeve 268 is taken up, both these parts move together as shown in Figs. 43, 44, 45 and 46. It is shown in Fig. 43 that the collar C is caused to move over the shaft S while the shaft S is moved into contact with the core AC, the knurled portion K in the shaft being just about to enter the central hole in the core. In Fig. 44, the collar C is pushed over the splined portion SP of the shaft to a position where it begins to engage the knurled portion K. Between the position shown in Figs. 44 and 45 the collar C and the shaft S move together while the knurled portion of the shaft S is pushed into the core AC. Finally, as shown in Fig. 46, the knurled portion K is pushed all the way through the core AC and the collar C is located against the end of the core.

The hydraulic system

The hydraulic system which controls the movements of the shaft feeder, the ram and the pressure block will now be described with respect to Figs. 47 and 48. Rotor 330 operates a pressure pump 331 to withdraw a pressure fluid from a stationary tank 332 and to force the same through a pipe 333 and branch pipes 334, 335 and 336 to

valve units 87a, 87b and 87c respectively, having their drain ports connected by branch pipes 337, 338 and 339 respectively with drain pipes 340 and 341 leading back to the tank.

Valve unit 87a has a high pressure outlet connected by pipe 342 and pipe 288 with the left end of cylinder 262, valve 185 of the shaft feed mechanism controlling the connection between these pipes. The other high pressure outlet of valve unit 87a is connected by pipe 343 with a relief valve 344 connected by pipe 289 with the right end of cylinder 262. Relief valve 344 is controlled by a pilot valve 345 having a high pressure inlet connected by pipe 346 with pressure pipe 333 and having a high pressure outlet pipe 347 connected with relief valve 344. Pilot valve 345 has a lower pressure outlet or drain connected by pipe 347 with a drain pipe 348 connected with the drain port of valve 344 and with drain pipe 337.

Valve unit 87b has high pressure outlet ports connected by pipes 189 and 190 with the ends of cylinder 188.

Valve unit 87c has two high pressure outlet ports connected by pipes 350 and 351 with the ends of cylinder 300.

Fig. 48 shows the operations produced by cams 79a, 79b and 79c during 360° of rotation and shaft 78 which rotates clockwise in Figs. 21 and 47. During about the first 25° rotation of shaft 78, cams 79a and 79b are moving the valve stems 86a and 86b downwardly and these stems are held down until about 275°. During this time pressure fluid is being admitted to the left end of cylinder 262 and to the bottom end of cylinder 300 thereby causing the ram and the toggle operated pressure block to advance toward the work. As the ram plate 224 advances, the sleeve 216 is moved toward the right to release the pilot valve 245 having a plunger 345a which is actuated by a cam 345b on the sleeve 216. At about 290° rotation of shaft 78, cam 79a has released the stem 86a to allow a spring (not shown) to restore the valve unit 87a to its normal position whereupon the pipes 289 and 342 are connected through the valve unit 87a with the drain 337, and the pressure pipe 334 is connected through valve 87a with pipe 343, valve 344 and pipe 290. This causes pressure fluid to be admitted to the right side of the piston 264 to cause the ram to move toward the left carrying with it the sleeve 216 and bringing the cam 345b into engagement with stem 345a of valve 345. The valve 345 then causes pressure pipe 346 to be disconnected from pipe 347 and pipe 347 to be connected with drain pipe 348. Relief valve 344 then becomes operative to connect pipe 343 partly with pipe 348 (which is a drain pipe) and partly with pipe 290, thereby placing a very much reduced pressure on the right hand side of piston 264 to keep the ram in its retracted position while requiring a pump to operate under a very much reduced load.

At about 310° the valve stem 86c of valve unit 87c is released by cam 79c thereby placing pipe 350 in communication with drain 339 and pipe 351 in communication with pump 331 whereupon the toggle is broken and pipe 317 is retracted from the work.

While the ram and toggle are retracted the workholder conveyor is indexed to a new position to bring a new core AC into alignment with the ram and in position to receive a shaft S which is then projected by the shaft feed mechanism into alignment with the ram. At about 300° of rotation of shaft 78, the valve stem 86b of valve unit 87b is pushed down in order to place pressure pipe

338 in communication with pipe 189 and to connect pipe 190 with drain 335. Then piston 188a (connected by rod 189 with the feeding mechanism including V-blocks 181, Fig. 13) moves to the left in Fig. 13 or down in Fig. 47, to move a shaft S to the position S', in Fig. 13. While pin 188 is down in Fig. 47, rod 185 cuts off communication between pipes 342 and 288. At 330° cam 79b releases valve stem 86b whereupon a spring (not shown) so controls valve unit 87b as to place pressure pipe 335 in communication with pipe 190 and to connect pipe 189 with drain pipe 338.

The groove 202 in rod 185 is so located that the communication between pipes 288 and 342 can not be established until piston 188a has been fully retracted in Fig. 47 or to the right in Fig. 13. This provision safeguards V-blocks 181 from engagement by the ram head in case of failure of retraction of these V-blocks which might occur due to sticking of the valve in valve unit 87b.

The operator of the machine fills the workholder recesses with core laminations and sees to it that the collar chute and the shaft chute are filled with parts. The filling of these chutes is done by an assistant who generally stands at the back of the machine or facing (Fig. 3). The operator who stands at the front of the machine or facing Fig. 2, initiates the cycle of operations of the machine by pressing a push button switch (not shown) which energizes solenoid 70 in order to connect shaft 78 with an electric motor through a one-revolution clutch. The operation closes the push button switch only long enough for the clutch to become engaged and then it remains engaged during one revolution of shaft 78 and then it automatically becomes disengaged. In this way the starting of the machine is under the full control of the operator who sees to it that all of the parts are in condition to be assembled before the machine is set into motion.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, a mechanical hand having fingers for gripping a shaft and holding it in alignment with the core aperture when the core is at the assembling station, means for pressing the shaft into the aperture of the core so as to assemble the core upon said shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moving into contact with the core and then for causing the hand to be retracted from the shaft while the shaft is being pressed into said aperture, and means for actuating the conveyor moving means and the shaft pressing means in timed relation.

2. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, a mechanical hand having fingers for gripping a shaft and

holding it in alignment with the core aperture when the core is at the assembling station, a shaft magazine, means for feeding a shaft from the shaft magazine to the fingers of the hand, means for pressing the shaft into the aperture of the core so as to assemble the core upon said shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moving into contact with the core and then for causing the hand to be retracted from the shaft while the shaft is being pressed into said aperture, and means for actuating the conveyor moving means, the shaft feeding means and the shaft pressing means in timed relation.

3. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, a mechanical hand having fingers and a spring for urging the fingers into shaft gripping relation whereby the shaft is held in alignment with the core aperture when the core is at the assembling station, means for pressing the shaft into the aperture of the core so as to assemble the core upon said shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moving into contact with the core and then for causing the hand to be moved laterally away from the shaft while the shaft is being pressed through the core, means responsive to the lateral movement of the hand away from the shaft for causing one of the fingers to be separated from the other finger and to be there retained, said hand moving means including provisions responsive to the return of shaft pressing means to normal status for causing the hand to return to normal position, means responsive to the return of the hand to normal position for causing the finger separating means to return to normal, nonoperative status whereby the spring is effective to cause the separated fingers to assume their normal position, and means for actuating the conveyor moving means and the shaft pressing means in properly timed relation so that the movement of the conveyor does not interfere with the proper operation of the shaft pressing means or the actuation of the fingers which hold the shaft in alignment with the core aperture.

4. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, a mechanical hand having fingers and a spring for urging the fingers into shaft gripping relation whereby the shaft is held in alignment with the core aperture when the core is at the assembling station, means for pressing the shaft into the aperture of the core so as to assemble the core upon said shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moving into contact with the core and then for causing the hand to be moved laterally away from the shaft while the shaft is being pressed through the core, means responsive to the lateral movement of the hand away from the shaft for caus-

ing one of the fingers to be separated from the other finger and to be there retained, said hand moving means including provisions responsive to the return of shaft pressing means to normal status for causing the hand to return to normal position, means responsive to the return of the hand to normal position for causing the finger separating means to return to normal, nonoperative status whereby the spring is effective to cause the separated fingers to assume their normal position, a shaft magazine, means for feeding a shaft from the shaft magazine to the fingers of the hand, said fingers of the hand being separated by the shaft during its movement from the magazine into the location in alignment with the core at the assembling station, and means for actuating the conveyor moving means, the shaft feeding means and the shaft pressing means in properly timed relation so that movement of the conveyor does not interfere with the proper operation of the means for feeding a shaft from the magazine, the shaft pressing means or the operation of the fingers which hold the shaft in proper position for insertion in the core armature.

5. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a ram in alignment with the shaft to be assembled and operable to push the shaft into said aperture, said ram having a central recess for receiving an end portion of the shaft, the inner wall of the recess being so constructed as to engage the shaft to move it when the ram is operated, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, means for moving the ram and collar retaining means, and means for actuating the conveyor moving means and for controlling the ram moving means in properly timed relation so that the movement of the conveyor does not interfere with the proper operation of the ram and associated mechanism.

6. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a ram in alignment with the shaft to be assembled and operable to push the shaft into said aperture, said ram having a central recess for receiving an end portion of the shaft, the inner wall of the recess being so constructed as to engage the shaft to move it when the ram is operated, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, means for moving the ram and collar retaining means, a collar magazine, means for feeding a collar from the collar magazine to the pocket, and means for actuating the conveyor moving means and the collar feeding means and for controlling the ram moving means in properly timed relation, so that

the movement of the conveyor does not interfere with the proper operation of the ram and the collar feeding means.

7. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders having an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a shaft magazine, means for feeding a shaft from the shaft magazine to the shaft holding means, a reciprocable ram for pressing the shaft into the aperture of the core so as to assemble the core upon the shaft, said ram having a recess for receiving an end of the shaft, the inner end wall of the recess being so constructed as to engage the shaft to move it as the ram is moved, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, a collar magazine, means for feeding the collar from the collar magazine to the pocket, means for moving the ram and the collar retaining means and means for actuating the conveyor moving means, the collar feed, the shaft feed and the ram and collar retaining means in properly timed relation so that the movement of the conveyor does not interfere with the operation of the mechanism for feeding the collar and shaft or the operation of the ram.

8. A machine for assembling armature core and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders having an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a shaft magazine, means for feeding a shaft from the shaft magazine to the shaft holding means, a reciprocable ram for pressing the shaft into the aperture of the core so as to assemble the core upon said shaft, said ram having a recess for receiving an end of the shaft, the inner end wall of the recess being so constructed as to engage the shaft to move it as the ram is moved, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, a collar magazine, means for feeding the collar from the collar magazine to the pocket, means for moving the ram and the collar retaining means therein, means responsive to movement of the ram toward the core for moving the shaft holder away from the shaft after the shaft has engaged the core and means for actuating the conveyor moving means, the collar feed, the shaft feed and the ram and collar retaining means in properly timed relation so that the movement of the conveyor does not interfere with the operation of the collar and shaft feeding means and the operation of the ram.

9. A machine for assembling laminated, centrally apertured armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to support a group of core laminae, each work holder having a pair of spaced plates for engaging the end laminae, springs for normally

urging the plates together to grip the laminae, means operating at the loading station of the conveyor work holder for causing separation of the plates to facilitate placing a group of laminae between them, means for positioning a shaft in alignment with the core at the assembling station, means for pressing the shaft through the central aperture of the core, means for moving the conveyor, and means for actuating the conveyor moving means, the work-holder-plate separating means and the shaft pressing means in properly timed relation so that the movement of the conveyor does not interfere with the proper operation of the separating means or the shaft pressing means.

10. A machine for assembling laminated, centrally apertured, slotted armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to support a group of core laminae, each work holder having a stationary aligning bar engageable between lamination teeth defining a slot of the core, a movable laminae aligning bar at the assembling station of the conveyor work holder, means for moving the movable aligning bar into and out of another slot of the armature core, means for positioning a shaft in alignment with the core at the assembling station, means for pressing the shaft through the central aperture of the core, means for moving the conveyor, and means for actuating the conveyor moving means, the movable-aligning-bar moving means, and the shaft pressing means in properly timed relation so that the movement of the conveyor does not interfere with the proper operation of the means for operating the aligning bar or the shaft pressing means.

11. A machine for assembling armature cores and shafts, comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a shaft magazine, means for feeding a shaft from the shaft magazine to the shaft holding means, a ram for pressing the shaft into the aperture of the core so as to assemble the core upon the shaft, said ram having a recess for receiving an end of the shaft, the inner end wall of the recess engaging the shaft to move it, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, a collar magazine, means for feeding the collar from the collar magazine to the pocket, means for moving the ram and the collar retaining means, a pressure block for receiving pressure from the end of the core remote from the shaft pressing means, means for moving the pressure block into and out of pressure receiving position, and means for automatically controlling the operation of the conveyor moving means, the collar and shaft feeding means, the ram moving means and collar retaining means, and the operating means for the pressure block in properly timed relation so that the several means operate in proper sequence and without interference, the operation of the pressure block and the operation of the ram as it pushes the shaft into the core aperture being effective only when the conveyor is stationary.

12. A device for assembling armature cores and

shafts, having, in combination, a work holder for receiving an armature core provided with a central aperture for receiving a shaft, a mechanical hand having fingers for gripping a shaft and a spring for urging said fingers into gripping relation with said shaft in order to hold the shaft in alignment with the core aperture when the core is in the work holder, means for pressing the shaft into the aperture so as to assemble the core upon the shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moving into contact with the core and then for causing the hand to be moved laterally away from the shaft while the shaft is being pressed into the core, means responsive to such lateral movement of the hand for causing the fingers to be separated from each other and to be retained in separated position, said hand moving means including mechanism responsive to the return of the shaft pressing means to normal status for causing the hand to return to normal position and means responsive to the return of the hand to normal position for causing the finger separating means to return to normal non-operative status so that the spring is effective to cause the separated fingers to assume their normal position.

13. A device for assembling armature cores and shafts, having, in combination, a work holder for receiving an armature core provided with a central aperture for receiving a shaft, a mechanical hand having fingers for gripping a shaft and a spring for urging said fingers into gripping relation with said shaft in order to hold the shaft in alignment with the core aperture when the core is in the work holder, means for pressing the shaft into the aperture so as to assemble the core upon the shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moved into contact with the core and then for causing the hand to be moved laterally away from the shaft while the shaft is being pressed into the core, means responsive to such lateral movement of the hand for causing the fingers to be separated from each other and to be retained in separated position, said hand moving means including mechanism responsive to the return of the shaft pressing means to normal status for causing the hand to return to normal position, means responsive to the return of the hand to normal position for causing the finger separating means to return to normal non-operative status so that the spring is effective to cause the separated fingers to assume their normal position, a shaft magazine and means for feeding a shaft from the magazine to a position to be engaged by the fingers of said hand, said fingers being separated by its movement from the magazine into its position in alignment with the core.

14. A device for assembling armature cores and shafts, having, in combination, a work holder for receiving an armature core provided with a central aperture for receiving a shaft, a mechanical hand having fingers for gripping a shaft and a spring for urging said fingers into gripping relation with said shaft in order to hold the shaft in alignment with the core aperture when the core is in the work holder, means for pressing the shaft into the aperture so as to assemble the core upon the shaft, means actuated by the shaft pressing means for causing the hand to move with the shaft as the shaft is moved into contact with the core and then for causing the hand to be moved laterally away from the shaft while the

shaft is being pressed into the core, means responsive to such lateral movement of the hand for separating the fingers by moving one of said fingers away from the other while the last named finger remains stationary, said hand moving means including mechanism responsive to the return of said shaft pressing means to normal status for causing the hand to return to normal position and means responsive to such movement of the hand for causing the finger separating means to return to normal non-operative status, so that the spring is effective to restore the finger which has been moved to its original position.

15. A machine for assembling armature cores and shafts comprising a work holder for supporting an armature core provided with a central aperture for receiving a shaft, means for gripping the shaft and for holding said shaft in alignment with the core aperture when the core is supported in the work holder, means for pushing the shaft into said aperture so as to assemble the core on the shaft while it is held by said gripping means, means for disengaging the shaft gripping and holding means from the shaft when the shaft has been moved into engagement with the core.

16. A machine for assembling armature cores and shafts comprising a work holder for supporting an armature core provided with a central aperture for receiving a shaft, means for gripping the shaft and holding it in alignment with the core aperture when the core is supported in the work holder, means for pushing the shaft into said aperture so as to assemble the core on the shaft, means actuated by the shaft pushing means for causing the gripping device to move with the shaft during the assembling operation and until the shaft is moved into the core and for causing the gripping device to be disengaged from the shaft while the shaft is being pushed fully into the core.

17. A machine for assembling armature cores and shafts comprising, a conveyor having a plurality of work holders thereon, each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor so as to move a core from a loading station to an assembling station, means for gripping the shaft and holding it in alignment with the core when the core is at an assembling station, means for pushing the shaft into the aperture of the core so as to assemble the core upon the shaft, means operable by the shaft pushing means for causing the gripping means to move with the shaft while the shaft is moved into engagement with the core and for causing the gripping means to be disengaged from the shaft while the shaft is pushed fully into the aperture, and means for controlling the action of the conveyor moving means and shaft pushing means in properly timed relation so as to cause the several mechanisms to be operated in proper sequence and without interference.

18. A machine for assembling armature cores and shafts comprising a work holder for supporting an armature core provided with a central aperture for receiving a shaft, means for gripping the shaft and holding it in alignment with the core aperture when the core is supported in the work holder, a shaft magazine and means for feeding a shaft from said magazine to the gripping device, means for pushing the shaft into the aperture of the core so as to assemble said core on the shaft, means actuated by the shaft pushing means for causing the gripping device to move

with the shaft as the shaft is moved into engagement with the core and for causing the gripping device to be disengaged from the shaft when the shaft is being pushed fully into the aperture in the core, and means for controlling the shaft feeding means and shaft pushing means in properly timed relation so that such means operate in proper sequence and without interference.

19. A machine for assembling armature cores and shafts comprising, a conveyor having a plurality of work holders thereon, each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor so as to move a core from a loading station to an assembling station, means for gripping the shaft and holding it in alignment with the core when the core is at an assembling station, a shaft magazine and means for feeding a shaft from the magazine to the shaft gripping device, means for pushing the shaft into the aperture of the cores so as to assemble the core upon the shaft, means operable by the shaft pushing means for causing the gripping means to move with the shaft while the shaft is moved into engagement with the core and for causing the gripping means to be disengaged from the shaft while the shaft is pushed fully into the aperture, and means for controlling the action of the conveyor moving means, the shaft feeding means, and shaft pushing means in properly timed relation so as to cause the several mechanisms to be operated in proper sequence and without interference.

20. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon, each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor so as to move a core from a loading station to an assembling station, means for holding the shaft in alignment with the core aperture when the core is at an assembling station, means for pushing the shaft into the aperture in order to assemble the core on the shaft, a pressure block movable into engagement with the core and work holder at the end of the core remote from the shaft pushing means in order to absorb the pressure created by the operation of pushing the shaft into the core, means for moving the pressure block into and out of operative position, and means for controlling the operation of the conveyor moving means, the means for moving the pressure block and the shaft pushing means in properly timed relation so that the conveyor means is stationary during operation of the pressure block and the operation of the shaft pushing means as the shaft is forced into the core aperture.

21. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for holding a shaft in alignment with the aperture in said core, a ram in alignment with the shaft when the latter is in position to be assembled with the core, said ram having a central recess for receiving an end portion of the shaft, the inner wall of said recess being adapted to engage the shaft to move it when the ram is moved, means movable with the ram and providing a pocket adjacent the operating end of the ram for retaining a collar in alignment with the shaft, and means for moving the ram and collar locating means to push the shaft into said aperture and assemble the collar on the shaft.

22. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for holding a shaft in alignment with the aperture in said core, a ram in alignment with the shaft when the latter is in position to be assembled with the core, said ram having a central recess for receiving an end portion of the shaft, the inner wall of said recess being adapted to engage the shaft to move it when the ram is moved, means movable with the ram and providing a pocket adjacent the operating end of the ram for retaining a collar in alignment with the shaft, a collar magazine, means for feeding a collar from the magazine to said pocket, and means for moving the ram and collar locating means to push the shaft into said aperture and assemble the collar on the shaft.

23. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for holding a shaft in alignment with the aperture in said core, a ram in alignment with the shaft when the latter is in position to be assembled with the core, said ram having a central recess for receiving an end portion of the shaft, the inner wall of said recess being adapted to engage the shaft to move it when the ram is moved, means movable with the ram and providing a pocket adjacent the operating end of the ram for retaining a collar in alignment with the shaft, a collar magazine, means for feeding a collar from the magazine to said pocket, means for moving the ram and collar locating means to push the shaft into said aperture and assemble the collar on the shaft, and means for controlling the operation of the collar feeding means and the means for moving the ram so that such means operate in properly timed relation and without interference.

24. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, a mechanical hand having fingers resiliently holding the shaft in alignment with the aperture in the core and disengageable from the shaft when the latter is moved into the core aperture, a reciprocating ram in alignment with the shaft when the latter is in alignment with the core aperture and provided with a part for engaging one end of the shaft so as to move the shaft into the aperture when the ram is operated, a rod parallel to the shaft, a sleeve supporting the hand and supported by the rod for longitudinal movement along the rod and rotary movement around said rod to effect operation of the mechanical hand, means operable as the ram is operated to produce rotary movement of the sleeve in both directions, means blocking rotation of the sleeve in a direction to disengage the hand from the shaft until the shaft engages the core so that the hand and ram are moved together until the shaft is adjacent the core aperture said blocking means then becoming ineffective so as to permit rotation of the sleeve to retract the hand from the shaft as the pushing of the shaft into the core aperture begins, said sleeve rotating means being so constructed that the return movement of the ram causes the hand to be first moved into alignment with the ram and then longitudinally with the ram back to normal position.

25. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central

aperture for receiving a shaft, a mechanical hand having fingers resiliently holding the shaft in alignment with the aperture in the core and disengageable from the shaft when the latter is moved into the core aperture, a reciprocating ram in alignment with the shaft when the latter is in alignment with the core aperture and provided with a part for engaging one end of the shaft so as to move the shaft into the aperture when the ram is operated, a rod parallel to the shaft, a sleeve supporting the hand and supported by the rod for longitudinal movement along the rod and rotary movement around said rod to effect operation of the mechanical hand, a cam follower movable with the ram, cams provided by the sleeve and engageable by the follower so as to produce rotary movements of the sleeve in both directions during longitudinal movements of the ram, means blocking rotation of the sleeve in a direction to disengage the hand from the shaft until the shaft engages the core so that the hand and shaft are moved together until the shaft is adjacent the core aperture, said blocking means then becoming ineffective so as to permit rotation of the sleeve to retract the hand from the shaft as the pushing of the shaft into the core aperture begins, and said cams being so designed that the return movement of the ram first causes the sleeve to rotate the hand into alignment with the ram and then causes the hand to move longitudinally with the ram back to normal position.

26. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for holding a shaft in alignment with the aperture in said core, a shaft magazine, means for feeding a shaft from the shaft magazine to said shaft holding means, a ram for pushing the shaft into the core aperture, said ram having a recess for receiving one end of a shaft, the inner end of said recess being adapted to engage the shaft to move it as the ram is moved, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, a collar magazine, means for feeding a collar from said magazine to the collar retaining pocket, means for moving the ram and collar retaining means to push the shaft into the armature core and assemble a collar on said shaft and means for automatically controlling the operation of the shaft feeding means, the collar feeding means and the ram operating means so that such instrumentalities are operated in properly timed relation and without interference.

27. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for holding a shaft in alignment with the aperture in said core, a shaft magazine, means for feeding a shaft from the shaft magazine to said shaft holding means, a ram for pushing the shaft into the core aperture, said ram having a recess for receiving one end of a shaft, the inner end of said recess being adapted to engage the shaft to move it as the ram is moved, means movable with the ram and providing a pocket for retaining a collar in alignment with the shaft and at the operating end of the ram, a collar magazine, means for feeding a collar from said magazine to the collar retaining pocket, means for moving the ram and collar retaining means to push the shaft into the armature core and assemble a collar on said shaft, means responsive to movement of the ram

toward the core for moving the shaft holding means away from the shaft after the shaft has engaged the core, and means for automatically controlling the operation of the shaft feeding means, the collar feeding means and the ram operating means so that such instrumentalities are operated in properly timed relation and without interference.

28. A machine for assembling laminated, centrally apertured, slotted armature cores comprising a work holder for supporting a group of core laminae and provided with a stationary aligning bar engageable between lamination teeth defining a slot in the core, a movable aligning bar also adapted to engage between the teeth on the laminae, means for moving said movable bar into and out of another slot in the core concurrently with the assembling of a shaft in the core, means for positioning a shaft in alignment with the core aperture, means for pushing the shaft into said aperture and means for automatically controlling the operation of the operating means for the movable bar and the shaft pushing means in properly timed relation so that the movable bar is engaged in an armature slot when the shaft is pushed into the armature.

29. A machine for assembling laminated, centrally apertured, slotted armature cores comprising a work holder for supporting a group of core laminae, said work holder having a pair of spaced plates for engaging the end laminae of a group, springs normally urging the plates toward each other to grip the laminae, means for separating the plates so as to facilitate placing of a group of laminae in the work holder, means positioning a shaft in alignment with the core aperture and for holding the shaft in such position, means for pushing the shaft into the core aperture and means for controlling the shaft positioning and holding means, the shaft pushing means and the plate separating means in properly timed relation.

30. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for positioning and holding a shaft in alignment with the core aperture, means for pushing a shaft into the core aperture, means for holding a collar in alignment with the shaft, means operable by the shaft pushing means for pressing said collar around the shaft and means for controlling the operation of the shaft positioning and holding means, and the shaft pushing means so that the several means are operated in properly timed relation and without interference.

31. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, means for positioning and holding a shaft in alignment with the core aperture, means for pushing a shaft into the core aperture, means for holding a collar in alignment with the shaft, means operable by the shaft pushing means for pressing said collar around the shaft, a collar magazine, means for feeding a collar from said magazine to the collar holding means, and means for controlling the operation of the shaft positioning and holding means, the collar feeding means and the shaft pushing means so that the several means are operated in properly timed relation and without interference.

32. A machine for assembling laminated, cen-

trally apertured, slotted armature cores comprising a work holder for supporting a group of core laminae and provided with a stationary aligning bar engageable between lamination teeth defining a slot in the core, a movable aligning bar also adapted to engage between the teeth on the laminae, means for moving said movable bar into and out of another slot in the core concurrently with the assembling of a shaft in the core, means for positioning a shaft in alignment with the core aperture and for holding the shaft in its aligned position, a shaft magazine, means for feeding a shaft from said magazine to the shaft positioning and holding means, means for pushing the shaft into said aperture, and means for automatically controlling the operation of the operating means for the movable bar, the shaft feeding, holding and pushing means so that the several means are operated without interference in properly timed relation and the movable bar is engaged in an armature slot when the shaft is pushed into the armature.

33. A machine for assembling laminated, centrally apertured, slotted armature cores comprising a work holder for supporting a group of core laminae and provided with a stationary aligning bar engageable between lamination teeth defining a slot in the core, a movable aligning bar also adapted to engage between the teeth on the laminae, means for moving said movable bar into and out of another slot in the core concurrently with the assembling of a shaft in the core, means for positioning a shaft in alignment with the core aperture and for holding the shaft in its aligned position, a shaft magazine, means for feeding a shaft from said magazine to the shaft positioning and holding means, means for pushing the shaft into said aperture, and for assembling a collar on the shaft, a collar magazine, means for feeding a collar from the magazine to the collar assembling means, and means for automatically controlling the operation of the means for operating the movable bar and the several means for feeding and assembling the shaft and collar with the armature so that the several means are operated without interference in properly timed relation and the movable bar is engaged in the armature slot to hold the laminae properly aligned while the shaft and collar are assembled with the armature.

34. A machine for assembling armature cores and shafts comprising a work holder for receiving an armature core provided with a central aperture for receiving a shaft, a gripping device for holding the shaft in alignment with the aperture in the core and disengageable from the shaft when the latter is pushed into said aperture, a reciprocating ram in alignment with the core aperture and operable to engage an end of said shaft and push the shaft into said aperture as the ram is moved in one direction, a rod parallel to the path of movement of the ram, a sleeve supporting said gripping device slidably and rotatably mounted on the rod, means operable in response to the movement of the ram toward the core to move said sleeve bodily with the ram for a predetermined distance while rotary movement of the sleeve is prevented, so as to move the gripping device so that the shaft is moved to a position adjacent the core aperture, means effective when such movement of the sleeve is completed to cause rotation of the sleeve in a direction to disengage the gripping device from the shaft, said means for moving the sleeve being effective upon the first part of the reverse

movement of the ram to rotate the gripping device back to its gripping position and after completion of such rotary movement of the sleeve, to carry the sleeve with the ram to its original normal position.

35. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, means for pushing a shaft into the aperture of said core so as to assemble the core upon said shaft, means for holding the laminae of the core in exact alignment while the shaft is being pushed into the core, and means for operating the conveyor moving means, the shaft pushing means and the aligning means in properly timed relation.

36. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core successively from a loading station to an assembling station and then to an ejecting station, means for holding a shaft in alignment with the core aperture when the core is at an assembling station, means for pushing a shaft into the aperture of the core when the core is at the assembling station so as to assemble the core upon said shaft, means for holding the laminae of the core in exact alignment during the assembling operation, means for ejecting the assembled core and shaft from the work holder at the ejecting station, and means for operating the conveyor moving means, the shaft pressing means, the aligning means and the ejecting means in properly timed relation.

37. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core successively from a loading station to an assembling station and then to an ejecting station, means for holding a shaft in alignment with the core aperture when the core is at an assembling station, means for pushing a shaft into the aperture of the core when the core is at the assembling station so as to assemble the core upon said shaft, means for retracting the shaft holding means after the shaft has been pushed into contact with the core, means for holding the laminae of the core in exact alignment during the assembling operation, and means for operating the conveyor moving means, the shaft pushing means, the retracting means and the aligning means in properly timed relation.

38. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having

an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core successively from a loading station to an assembling station and then to an ejecting station, means for holding a shaft in alignment with the core aperture when the core is at an assembling station, a shaft magazine adapted to receive a plurality of shafts, means for feeding a shaft from the shaft magazine to the shaft holding means, means for pushing a shaft into the aperture of the core when the core is at the assembling station so as to assemble the core upon said shaft, means for holding the laminae of the core in exact alignment during the assembling operation, means for operating the conveyor moving means, the shaft feeding means, the shaft pushing means and the aligning means in properly timed relation.

39. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, means for holding a collar in alignment with the shaft, means for pushing the shaft into the core armature and for forcing the collar on the shaft, and means for operating the last named means, conveyor moving means, and in properly timed relation so that the movement of the conveyor does not interfere with the assembling of the collar and armature on the shaft.

40. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon each of said work holders being adapted to receive an armature core formed of a plurality of laminae and having an aperture for receiving a shaft which extends axially through the core, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a collar magazine, means for feeding collars from said magazine, means for retaining a collar fed from the magazine in alignment with the shaft, means for pushing a shaft into the core aperture and for forcing the aligned collar on said shaft, and means for operating the last named means, the collar feeding means and the conveyor moving means in properly timed relation so that the movement of the conveyor does not interfere with the operation of the feeding and assembling means.

41. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon, each of which is adapted to receive an armature core having a control aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a reciprocable ram assembly comprising a ram and a ram sleeve surrounding the ram and having a pocket for lo-

cating a collar in alignment with the shaft at the operating end of the ram, said ram being movable relatively to the ram sleeve and positioned in alignment with the core aperture when the core is at the assembling station, and having a collar retainer in advance of the pocket and a central recess for receiving an end portion of the shaft, the recess being so constructed that the inner end wall of such recess engages the shaft to move it when the ram is operated, a piston for reciprocating the ram assembly, said piston being connected to the ram but normally spaced from the end of the ram sleeve remote from the collar retainer, a cylinder adapted to receive fluid under pressure for operating the piston, said piston operating on the advance stroke to first move the ram relative to the ram sleeve in order to move the collar from said pocket to the collar retainer, said piston then operating to move the whole ram assembly to push the shaft into the core aperture and force the collar on the shaft, said piston operating on the return stroke to first move the ram to its normal position and then to move the ram assembly to its original position, and means for controlling the supply of pressure fluid to the piston in timed relation to the operation of the conveyor moving means so that the movement of the conveyor does not interfere with the proper operation of the ram assembly.

42. A machine for assembling armature cores and shafts comprising a conveyor having a plurality of work holders thereon, each of said work holders being adapted to receive an armature core having a central aperture for receiving a shaft, means for intermittently moving the conveyor in order to move a core from a loading station to an assembling station, means for holding a shaft in alignment with the core aperture when the core is at the assembling station, a reciprocable ram in alignment with the shaft to be assembled and operable to push the shaft into said aperture, said ram having a part for engaging one end of the shaft as the ram is moved in one direction, a mechanical hand having fingers resiliently holding the shaft in alignment with the core aperture at the assembling station, a rod paralleling the shaft, a sleeve supporting the hand and supported by the rod for longitudinal movement along the rod and for rotary movement around the rod, a cam follower movable with the ram, cams formed on the sleeve and engaged by the follower to produce rotary movement of the sleeve in both directions as the ram is reciprocated, means blocking rotation of the sleeve in a direction to carry the hand laterally away from the shaft until the shaft engages the core whereby the hand and ram move together a certain distance and then the hand is retracted from the shaft as the pressing of the shaft into the core aperture begins, while the return movement of the ram causes the sleeve to first rotate the hand about the rod into alignment with the ram and then causes the sleeve to move longitudinally with the ram back to normal position, means for moving the ram, and means for actuating the conveyor moving means and controlling the ram moving means in properly timed relation so that the movement of the conveyor does not interfere with proper operation of the ram.

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