

Dec. 8, 1931.

L. E. POOLE

1,835,120

COMMUTATOR ASSEMBLING MACHINE

Filed April 12, 1927

9 Sheets-Sheet 1

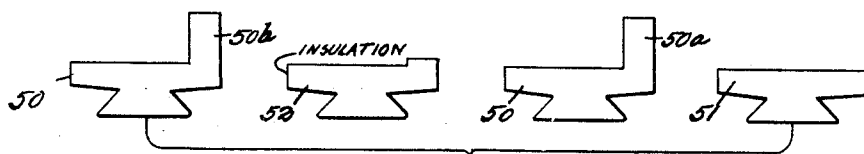
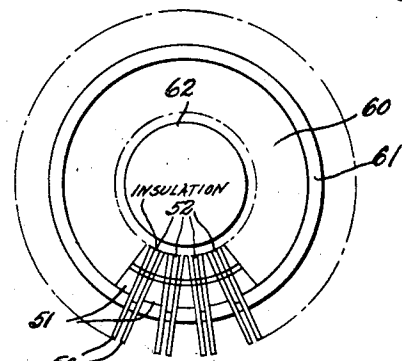


Fig. 1



OLD FORM FOR MANUALLY  
ASSEMBLING COMMUTATOR PIECES  
FIG. 2.

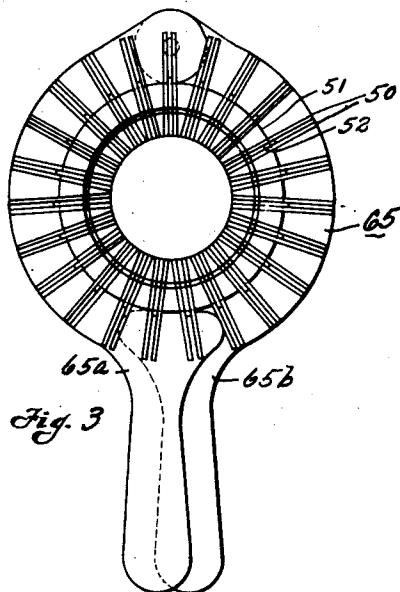


Fig. 3

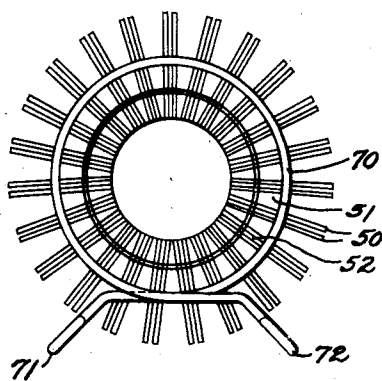


Fig. 4

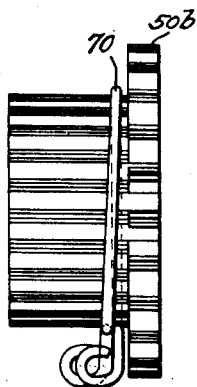


Fig. 5

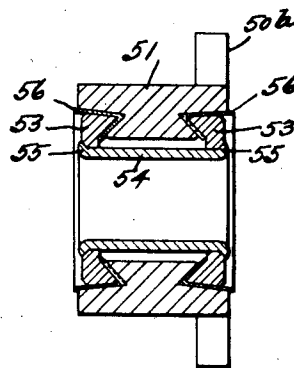


Fig. 6

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9 Sheets-Sheet 2

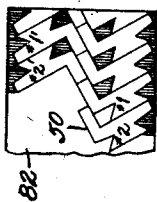


Fig. 7

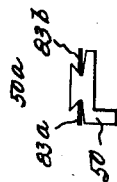


Fig. 10

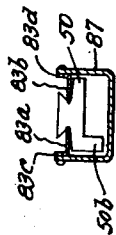
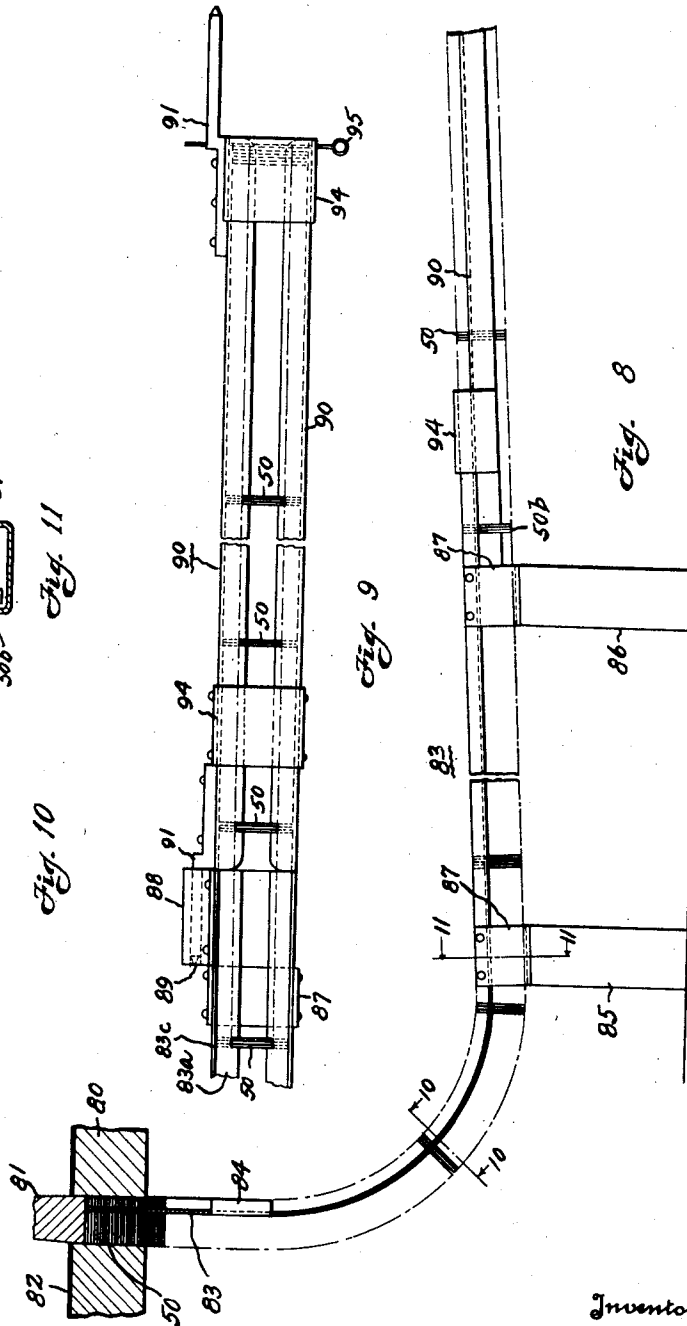


Fig. 11



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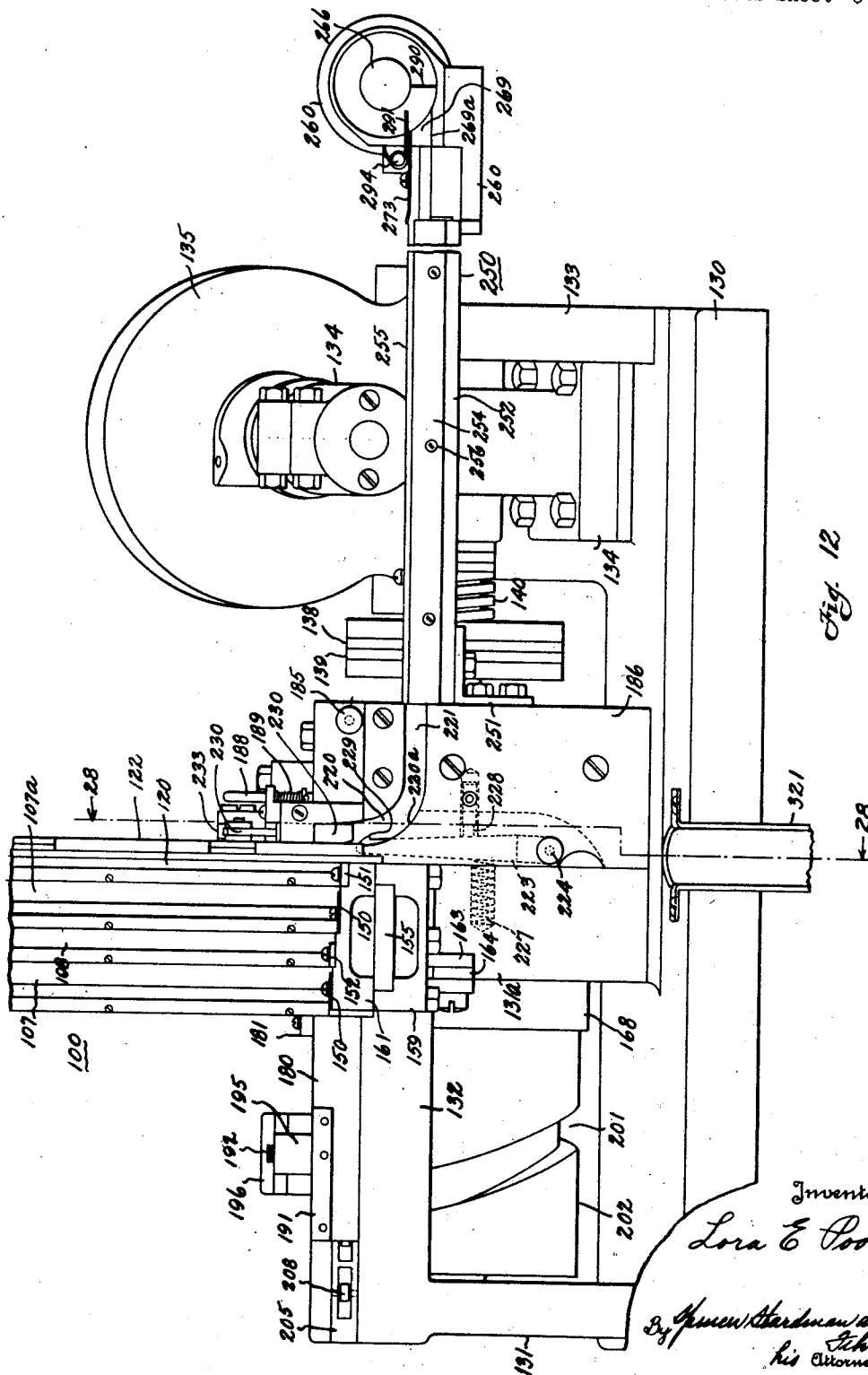
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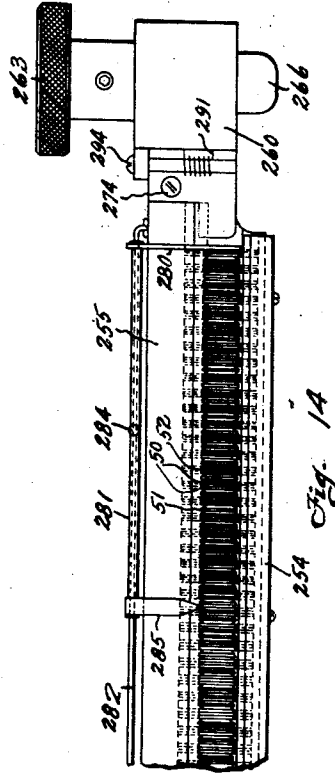
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1,835,120

COMMUTATOR ASSEMBLING MACHINE

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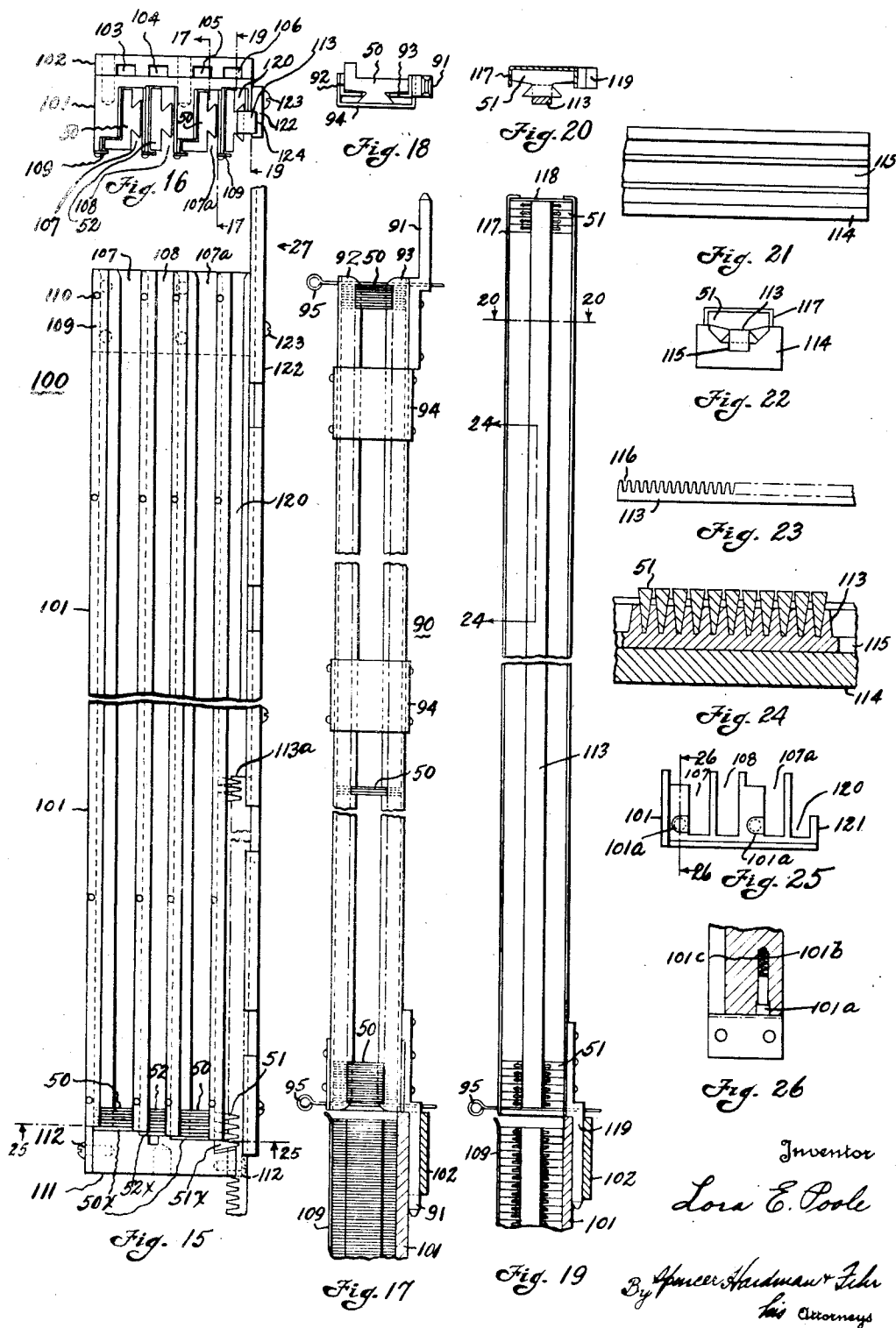
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Filed April 12, 1927

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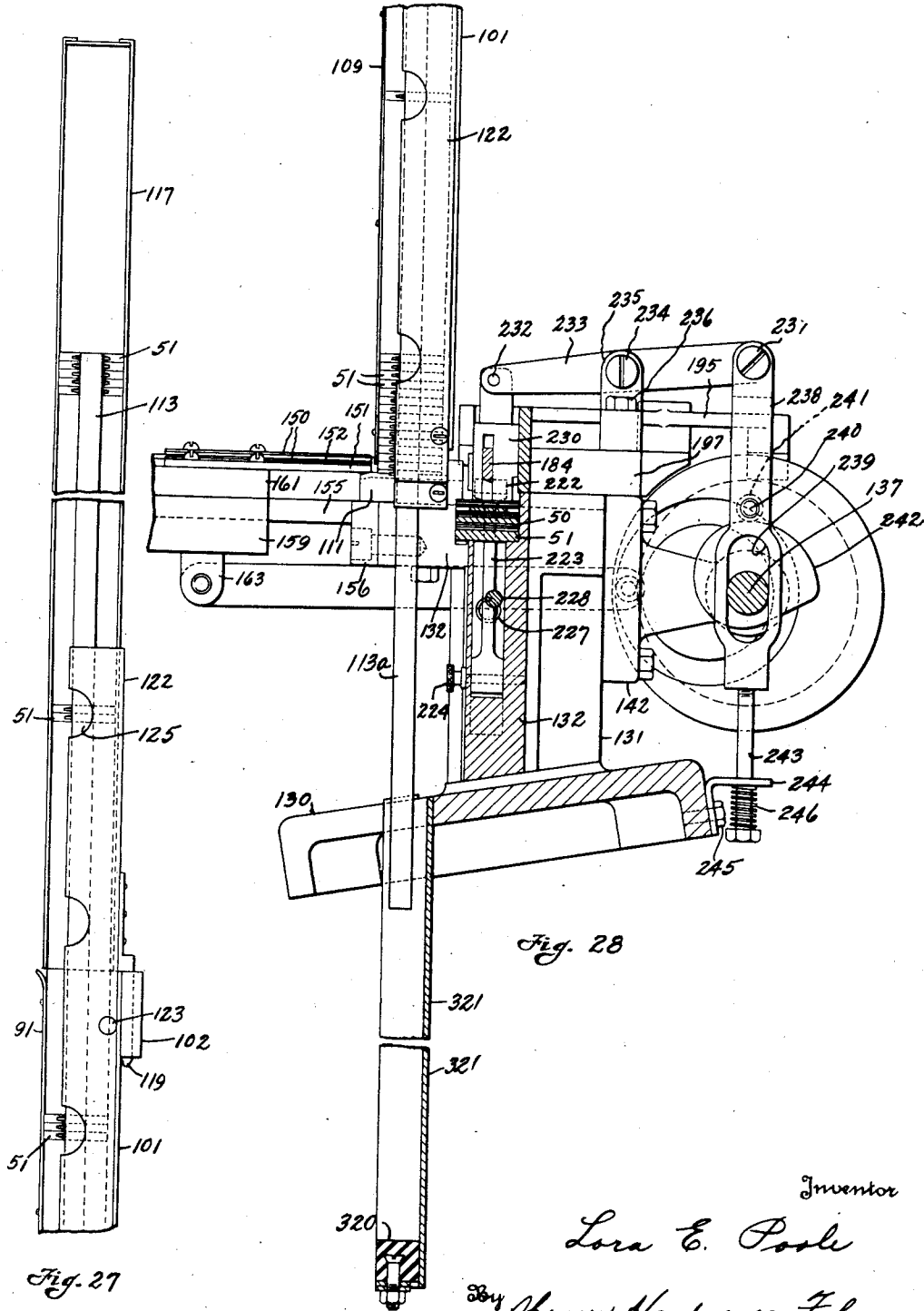


Fig. 28

Fig. 27

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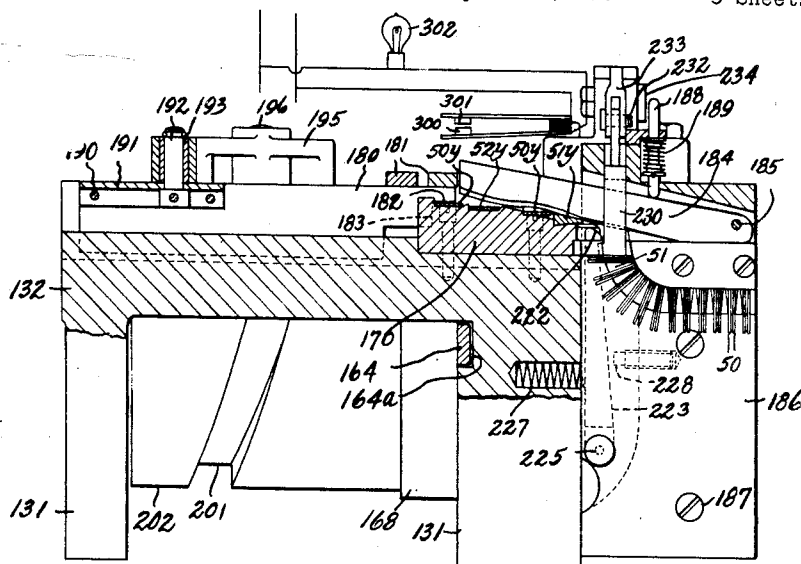


Fig. 29

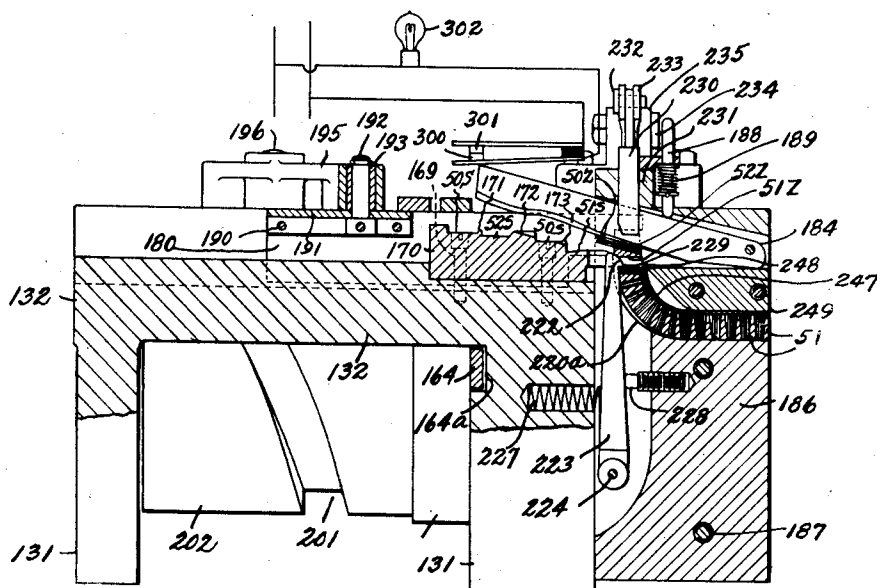


Fig. 30

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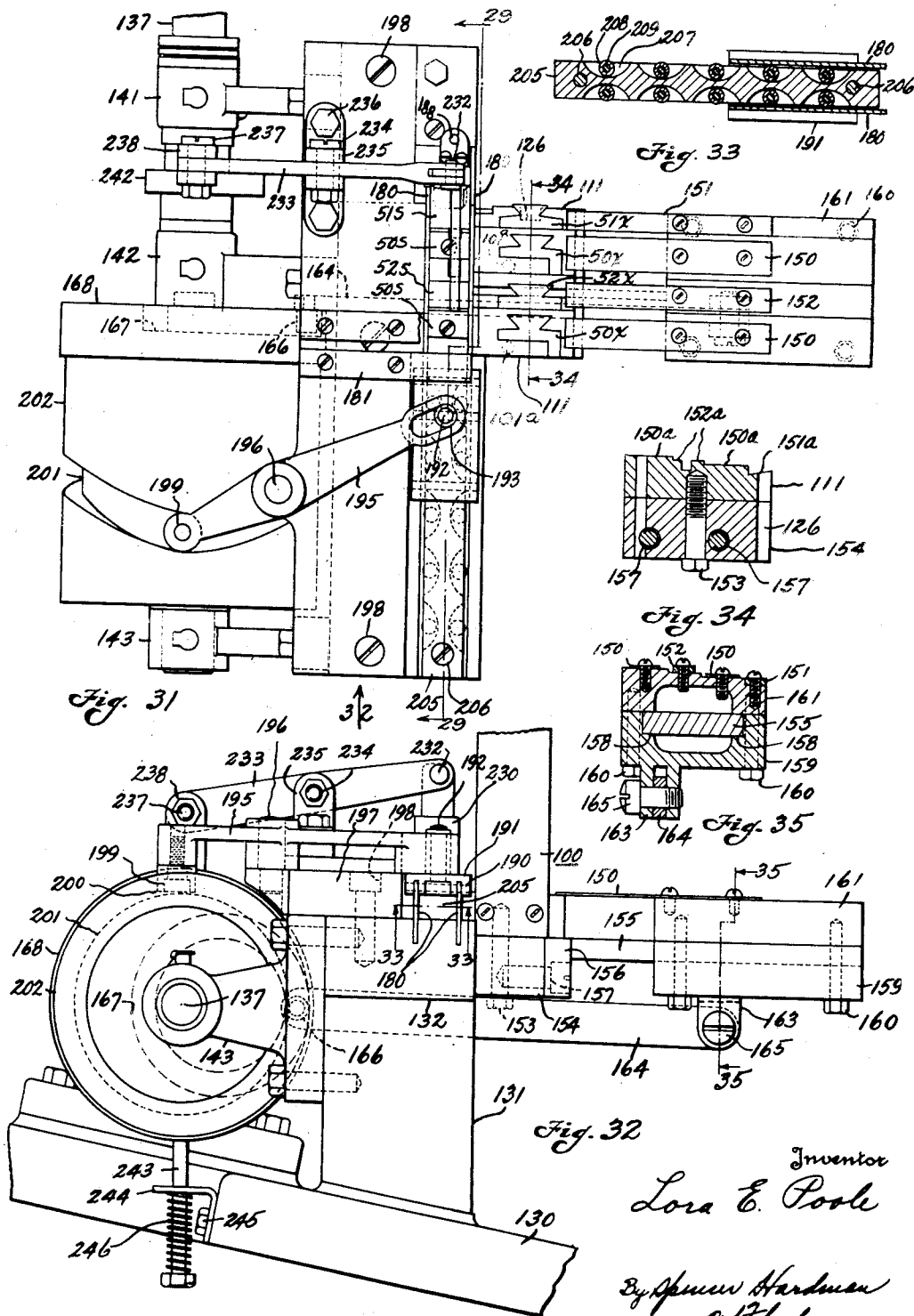
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COMMUTATOR ASSEMBLING MACHINE

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9 Sheets-Sheet 8



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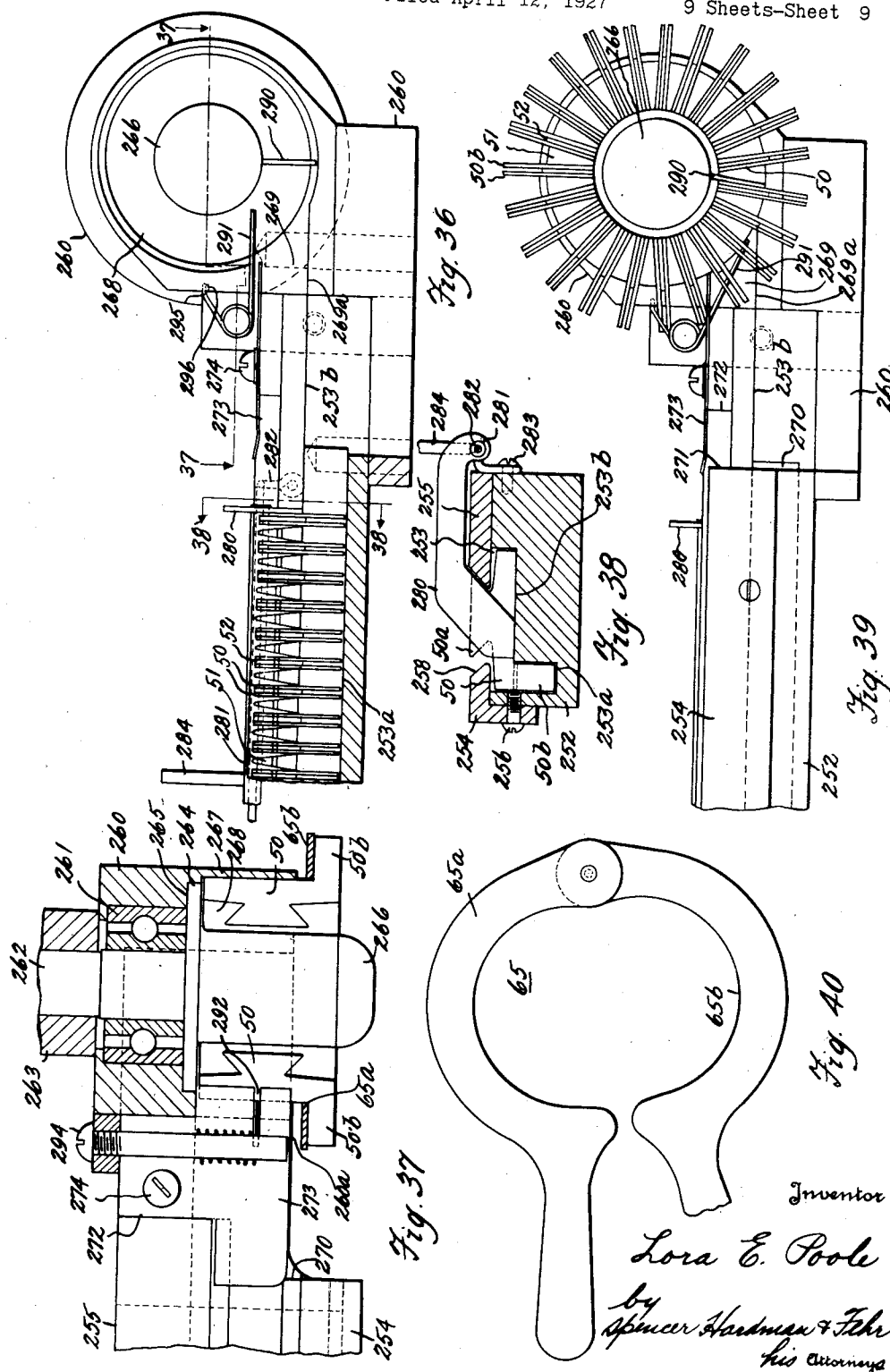
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COMMUTATOR ASSEMBLING MACHINE

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9 Sheets-Sheet 9



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## UNITED STATES PATENT OFFICE

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## COMMUTATOR ASSEMBLING MACHINE

Application filed April 12, 1927. Serial No. 183,080.

This invention relates to the manufacture of commutators for dynamo electric machines and more especially to the type of commutator which comprises an annulus of conducting pieces and insulating pieces which are insulatingly supported by a central core which is adapted to be mounted upon a shaft.

It is an object of the present invention to reduce the cost of manufacturing commutators of this type; and with this aim in view, the present invention provides a machine for automatically arranging conducting and insulating pieces in orderly recurrent sequence and apparatus for quickly forming an annulus of these pre-arranged pieces. A further object of the invention is to provide means for temporarily maintaining in assembled relation the pieces of material forming the annulus so that these pieces may be removed from the apparatus referred to and be transported to a machine which permanently joins the material with a supporting core.

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 form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a composite side view of the various pieces of material included in each group or sequence of commutator parts which recur in the annulus of material.

Fig. 2 is a plan view of a fixture which has been used heretofore in assembling of commutator pieces by manual operation.

Fig. 3 shows an end view of the commutator annulus and the use of a clamping device for temporarily maintaining the annulus in assembled relation while removing the annulus from the fixture in which it is formed.

Fig. 4 is an end view of a commutator looking at the end opposite to that shown in Fig. 3, and Fig. 4 shows a resilient wire clamp which is applied to the commutator annulus before removing the clamp shown in Fig. 3.

Fig. 5 is a side view of the annulus and wire clamp shown in Fig. 4.

Fig. 6 is a longitudinal sectional view of a completed commutator.

Fig. 7 is a plan view showing a method of punching sheet metal pieces from a strip of sheet copper with the minimum waste.

Fig. 8 shows a form of chute and rack which receives the work pieces as they fall through the die of a punch press.

Fig. 9 is a fragmentary plan view of the apparatus shown in Fig. 8 and attached thereto, a portable magazine for the work pieces.

Figs. 10 and 11 are sectional views taken respectively on the lines 10—10 and 11—11 of Fig. 8.

Fig. 12 is a front elevation of a machine and apparatus for arranging the conducting and insulating pieces in orderly recurring sequence and for facilitating the arrangement of a group of such pieces in a circular row or annulus.

Fig. 13 is a top plan view of the machine shown in Fig. 12.

Fig. 14 is a fragmentary plan view of a portion of the apparatus shown in Fig. 13.

Fig. 15 is a front view of the magazine which is permanently attached to the machine.

Fig. 16 is a top plan view thereof.

Fig. 17 is a side view of one of the portable racks which is shown attached to the magazine shown in Fig. 15, the section in Fig. 17 being taken on the line 17—17 of Fig. 16.

Fig. 18 is an upper end view of the rack shown in Fig. 17.

Fig. 19 includes a fragmentary view partly in section of the upper end of the magazine, the section being taken on the line 19—19 of Fig. 16, and a side view of the rack or stacking bar for feeding to the assembling machine pieces which are wedge-shaped in cross section and will be hereafter known as the commutator segments.

Fig. 20 is a sectional view on the line 20—20 of Fig. 19.

Fig. 21 is a fragmentary plan view of a trough in which the commutator segments are assembled upon a stacking bar shown in Fig. 23.

Fig. 22 is an end view of the trough as shown in Fig. 21.

Fig. 23 is a fragmentary side view of the

stacking bar for supporting the commutator bars.

Fig. 24 is a fragmentary sectional view taken on the line 24—24 of Fig. 19 but is drawn to a scale twice the size of Fig. 19.

Fig. 25 is a bottom plan view of the upright member shown in Fig. 15 and forming a part of the magazine which is fixed to the machine.

Fig. 26 is a sectional view on the line 26—26 of Fig. 25.

Fig. 27 is a fragmentary side view of the upper end of the magazine looking in the direction of the arrow 27 in Fig. 15, and

Fig. 27 also shows a view of the portable magazine shown in Fig. 19 with the magazine stacking bar partly in the magazine and partly in the portable rack.

Fig. 28 is a fragmentary sectional view taken approximately on the line 28—28 of Fig. 12.

Fig. 29 is a longitudinal sectional view of the machine taken approximately on the line 29—29 of Fig. 31.

Fig. 30 is a view similar to Fig. 29 showing the apparatus in a different position of operation.

Fig. 31 is a plan view of a part of the assembling mechanism, the magazine being removed from the machine.

Fig. 32 is an end view of the mechanism shown in Fig. 31, looking in the direction of the arrow 32 of Fig. 31.

Fig. 33 is a sectional view on the line 33—33 of Fig. 32.

Fig. 34 is a sectional view on the line 34—34 of Fig. 31.

Fig. 35 is a sectional view on the line 35—35 of Fig. 32.

Fig. 36 is a fragmentary front elevation of a portion of the apparatus for assembling an annulus of the commutator pieces which have been assembled in regular order by the machine.

Fig. 37 is a sectional view on the line 37—37 of Fig. 36.

Fig. 38 is a sectional view on the line 38—38 of Fig. 36.

Fig. 39 is a view similar to Fig. 36 but showing the annulus of commutator segments before removal from the apparatus in which they are arranged.

Fig. 40 is a view of the clamp which is applied to the annulus before removing from the assembling apparatus.

Figs. 1 to 6 inclusive, Fig. 24 and Figs. 37 to 40 inclusive are drawn to a larger scale than the other figures which are drawn approximately to the same scale.

One form of commutator to which the present invention is applicable is shown in Figs. 1 to 6 inclusive. This commutator includes an annulus of flat, sheet metal riser bars 50, metal segments 51 which are wedge-shaped in cross section and pieces 52 of flat

sheet insulating material such as mica. These pieces are arranged in regular recurrent sequence to form an annulus of pieces which are maintained permanently assembled by clamping rings 53 and a tube or core 54 having its ends flared at 55 against the rings 53. The rings 53 are insulated from the metal pieces of the annulus by non-conducting insulating members 56. Heretofore it has been the practice to assemble the pieces 50, 51 and 52 within an annular chamber 60 provided by a fixture which comprises a cylindrical wall 61 surrounding a central cylindrical post 62, the wall and post being supported by a suitable base. It is obvious that considerable labor is involved in picking up the pieces 50, 51 and 52 and assembling them in regular recurrent sequence to form the annulus. In the commutator shown, each commutator bar is composed of three metal pieces namely a metal segment 51 and two of the riser bars 50 on each side of the segment. For example, if there are 23 commutator bars there will be 69 metal pieces and 23 insulation pieces making a total of 92 pieces to be picked up one at a time from trays in which they are placed in disorderly fashion, and to be assembled in orderly relation.

The present invention provides chutes upon which the pieces 50 and 52 are automatically stacked in orderly fashion as they are punched from flat material. There are portable racks upon which the pieces are shoved from the chutes so that the pieces may be transported from the punch presses to the magazine of the apparatus for automatically assembling the commutator pieces. Only the metal segments 51 are placed one by one upon a stacking bar which is passed through the magazine of the assembling machine. The assembling machine assembles the pieces in orderly fashion but in a straight row in a chute which leads to an annular passage into which a predetermined quantity of orderly arranged pieces are moved by manual operation by the attendant of the assembling machine. After the annulus of commutator pieces has been assembled there is placed about it a clamping tool 65 which is shown in Figs. 3 and 40. This tool is used to maintain the pieces in assembled relation while they are being removed from the assembling apparatus. Before removing the tool 65 the operator will place around the annulus a resilient spring wire band 70 as shown in Figs. 4 and 5. This band is normally of less diameter than the diameter of the body portion of the commutator annulus, hence the band must be expanded by pressure applied to the handles 71 and 72 before the band can be placed over the commutator as shown. When the handles 71 and 72 are released the band will contract about the commutator annulus so that it may be transported to a machine for

assembling the V-rings 53 and the central tube or core 54 as shown in Fig. 6.

Having presented briefly the nature of the work performed by the apparatus embodying the present invention, I will now present a detailed description of this apparatus.

Referring to Figs. 7 to 11 inclusive, numeral 80 designates the die member of a punch press and 81 the punch for punching out from a sheet of commutator metal 82 the riser bars 50. The sheet 82 is operated upon by a gang of two punches which punch the stock in such manner that the only waste is represented by the shaded portions in Fig. 7. It will be understood that the bars 50 which are numbered 1 and 2 are punched simultaneously with the bars numbered 1' and 2' respectively. As the bars 50 are placed through the opening in the die 80 by the punch, they are fed to a chute 83 comprising spaced bars 83a and 83b which are received by the notches of the bar adjacent its dovetail tang 50a and thus support each bar and prevent its becoming dislodged from the chute. The bars 83a and 83b are tied together by spaced tie bars 84. The bars 83a and 83b are curved to guide the pieces 50 from the die 80 to a slightly upwardly inclined straight portion of the chute 83 which is supported upon a floor by legs 85 and 86. At the straight portion of the chute 83 the bars 83a and 83b are provided with upwardly extending flanges 83c and 83d respectively in order to stiffen these bars. The legs 85 and 86 are attached to U-shaped straps 87 which maintain the bars 83a and 83b in spaced relation. The outer end of the chute 83 is provided with a socket member 88 having a square hole 89 which receives a plug member 91 which is secured to a portable rack 90.

Each rack 90, as shown in Figs. 9, 17 and 18 comprises two angle bars 92 and 93 held in parallel spaced relation by bridges 94. The rack 90 is provided with a bayonet joint plug 91 at each end, one of the plugs fitting with the socket 88 of the chute 83 and the other plug fitting with a socket to be described provided by the rack which is fixed to the assembling machine. Pins 95 extend through suitable aligned holes provided adjacent each end of the angle bars 92 and 93 and also through each of the plugs 91. As shown in Fig. 17, each pin 95 prevents the work pieces 50 from falling from either end of the rack. The racks 90 may be used for storing the mica pieces 52 as well as the riser bars 50. Three of these racks 90 are assembled at the same time with the fixed magazine 100 shown in detail in Figs. 15, 16, 25 and 26. The magazine 100 comprises a frame 101 to which is attached a grooved member 102 providing sockets 103, 104, 105 and 106. The sockets 103, 104 and 105 receive the bayonet plugs 91 of three magazines 90 in order

that risers 50 and mica pieces 52 may be fed as indicated in Fig. 16 into suitable formed channels 107, 108 and 107a, respectively, which are provided by the magazine frame 101. The walls defining these channels each carries a strip 109 attached by pins 110. Each strip assists in maintaining the work pieces within the channel adjacent thereto. It will be understood that each rack 90 contains a stack of work pieces, a stack being represented by showing the work pieces at intervals in Fig. 17. After the racks 90 have been assembled with the magazine 100 the lower pins 95 are withdrawn so as to permit the work pieces to descend from the portable racks to the fixed magazine. Some of these work pieces are indicated in Fig. 15 at the bottom of the magazine resting upon a bottom plate 111 to which the frame 101 is secured by screws 112.

It is evident that since the work pieces 50 and 52 have parallel sides they may be piled one upon the other to form a vertical stack; but since the segment bars 51 are wedge-shaped in cross section they cannot be placed in a vertical stack or piled one on top of the other, therefore the present invention provides a notched stacking bar 113 shown particularly in Figs. 23 and 24. This bar is placed first in an assembling trough 114 having a channel 115 adapted to receive the bar 113 and to support it laterally and to receive the segments 51 and prevent them from moving endwise as shown in Fig. 22. Each notch 116 of the bar 113 receives a segment 51. After the bar 113 is full of segments and before the bar is removed from the trough 114 a long pan 117 is placed in inverted position upon the segments 51 with the closed end 118 of the pan bearing against a segment at one end of the bar 113. Then the assembled parts shown in Fig. 22 are inverted so that the pan 117 will rest upon the table and the trough 114 will be on top. Then the trough 114 is removed leaving the pan 117, segments 51 and spacing bar 113 in assembled position. Then the pin 95 is passed through aligned holes adjacent the free end of the pan 117 and through its bayonet plug 119. The operator grasps this assembly intermediate its ends in such a manner that the bar 113 is pressed against the pan 117, so that the parts are maintained assembled. Then the operator inserts the plug 119 in the socket 106 provided by the magazine 100. Then the pin 95 is withdrawn and the bar 113 and segments movable therewith will descend until the lower end of the bar strikes the upper end of a bar 113a which had previously been allowed to descend into the chute or groove 120 in the frame 101. If there were no bar 113 previously in the chute 120 the bar first entering the chute would descend until the lowermost segment 51 carried by the bar would touch the bottom plate 111 as shown in

Fig. 15. It will be understood that the bar 113 is stacked full of segments although the segments are shown in Fig. 19 only at either end of the bar. The omission of a segment from one of the teeth 116 of the bar 113 will make no difference as the bar is stopped in its downward motion by its lowermost segment striking the bottom member 111 of the magazine 110. It is apparent from Fig. 25 that the chute 120 is defined by a short outside wall 121. To this wall is attached a plate 122 by screws 123. The plate 122 extends from below the magazine frame 101 to a substantial distance above it as indicated particularly in Fig. 27. The plate 122 is provided with a groove 124 for guiding the stacking bar 113; and the plate 122 is provided with finger recesses 125 to allow for the manipulation of the bar 113 and its segments after this bar has started down the chute 120. Referring to Figs. 28 and 31 it will be noted that the bottom plate 111 is provided with a notch 126 which permits the passage of the bar 113 below the magazine but causes the downward motion of the bar 113 to be arrested each time the lowermost segment 51 carried thereby strikes the bottom plate 111.

Having described the portable racks and the fixed magazine, and having shown how the work pieces are fed by gravity to the bottom or fixed magazine and upon the bottom plate 111 thereof, I will next describe the mechanism for pushing the bottom work pieces marked 50x, 52x, 50x and 51x in Figs. 15 and 31 from the position at the bottom of their respective stacks in the magazine 100 to positions 50y, 52y, 50y and 51y spaced from the magazine and the mechanism for moving these pieces from the last named position into positions 50z, 52z, 50z and 51z in which piece 51 is on the bottom.

The assembling machine comprises a base 130 supporting a frame 131 including top plate 132, a pedestal 133, a reduction gear housing 134 and an electric motor 135 for driving the machine. In Fig. 13, 135 designates the motor shaft which is connected by gearing not shown and located in the gear box 134 with a shaft 136. The shaft 136 is connected with a shaft 137 by friction clutch members 138 and 139 connected respectively with these shafts. These clutch members are yieldingly maintained in engagement by a spring 140. Thus the machine is protected in case something goes wrong and the motor is not stopped. The shaft 137 is journaled in brackets 141, 142 and 143 which are attached to the frame members 131 and 132.

I will now describe the mechanism for moving the work pieces from the stacks in the magazine to positions offset from these stacks.

The mechanism for withdrawing the work pieces from the stacks includes finger 150,

finger 152, finger 150 and a finger 151 which are respectively adapted to move along the surfaces 150a, 152a, 150a and 151a, respectively, which surfaces respectively support the work pieces 50x, 52x, 50x and 51x as shown in Figs. 31 and 34. The magazine bottom plate 111 is attached by screws 153 to a plate 154 which may be integral with the top plate 132 of the frame 131. To the plate 154 is attached a horizontal guide bar 155. This guide bar is provided with a downwardly extending lug 156. Screws 157 pass through lug 156 to attach the bar 155 to the plate 154. The bar 155 is received by grooves 158 provided in a slide 159 which is attached by screws 160, to a slide 161, thus providing a unitary structure which is slidable relative to the guide 155. Fingers 150, 151 and 152 are attached by screws 162 to the slide member 161. The slide member 159 is provided with a notched lug 163 which receives one end of a link 164 attached by a screw 165 passing through aligned holes in the lug 163. The link 164 is slidable through a notch 164a (see Fig. 29) provided in the leg 131a of the frame 131 and carries at its left hand end as viewed in Fig. 32 a cam roller 166. The roller is received by circular cam race or groove 167 provided in a disc 168 and the groove 167 is eccentric to the axis of the shaft 137 which supports the disc 168. Rotation of the disc 168 will produce reciprocation of the fingers 150, 151 and 152, thereby causing the pieces 50x, 52x, 50x and 51x to be moved toward the left as viewed in Fig. 31 upon surfaces 50s, 52s, 50s and 51s respectively provided by a block 170 attached by screws 169 to the frame top 132 (see Figs. 29 and 30). As the riser bars 50a, 50a are moved from underneath their stacks in the magazine 100, each of the riser tangs of these bars is engaged by a plunger 101a urged against the riser by a spring 101b. Each plunger is guided by the walls of a recess 101c in the magazine frame 101 (see Fig. 26). The locations of the plungers 101a are designated by the circles 101a in dot-and-dash lines in Fig. 31. The plungers 101a apply frictional resistance to the movements of the risers 50 to cause them to be moved by the fingers 150 without cocking.

The work pieces which are located upon the block 170 are designated by numerals 50y, 52y, 50y and 51y to designate the new position of the work pieces. It will be noted that between the first surface 50s, on the left, and surface 52s in Fig. 30 there is an upwardly projecting ridge 171. Between the surface 52s and the surface 50s to the right of it there is a ridge 172. There is a ridge 173 between the last named surface 50s and the surface 51s. By mechanism to be described, the work pieces are moved from the positions 50y, 52y, 50y and 51y into the positions 50z, 52z, 50z and 51z. The mechanism

engages first the work piece 50y to the left of the work piece 52y and moves it over the ridge 172 and drops it upon the piece 52y. Then the first piece 50y and the piece 52y are moved over the ridge 172 and dropped upon the second piece 50y. Then the three pieces 50y, 52y and 50y are moved over the ridge 173 and dropped over the piece 51y and then all of the pieces are moved together into the position shown in Fig. 30. The ridge 171 prevents the piece 50y to the left from contacting with the piece 52y in such a manner as to cause its movement before the piece 50y has been superposed upon the piece 52y. The ridges 172 and 173 operate in similar fashion so that the work pieces will be moved in regular order and stacked in superposed relation as shown in Fig. 30. The mechanism for moving the pieces from the positions 50y, 52y, 50y and 51y in Fig. 29 to the positions shown in Fig. 30 designated by numerals 50z, 52z, 50z and 51z will now be described.

This mechanism comprises two slides 180 which are guided laterally by the table 132 and are retained by cross bars 181. Each slide 180 is provided with an extension 182 which is spaced above the piece 50y to the left, a distance sufficient to permit the piece 50y to slide over to the ridge 171, to permit the first piece 50y and the second piece 52y to slide together over the ridge 172 and to permit the three pieces 50y, 52y and 50y to slide over the ridge 173 and upon the piece 51y. Thus the slides 180 permit stacking the pieces but limit vertical separation of the pieces from the supporting block 170. The edge 183 of each slide 180 engages the left edges of each of the work pieces to move them toward the right. A bar 184 is pivoted at 185 upon a block 186 attached by screws 187 to the frame 131 and a plunger 188 is urged by a spring 189 against the bar to urge the bar against the work pieces and the block 170 supporting them. Thus the work pieces are yieldingly maintained in position while the slide 180 moves from its position shown in Fig. 29 to the position shown in Fig. 30. The bar 184 causes a frictional resistance to be placed on the work pieces in order to resist their sliding toward the right. This resistance tends to keep the bars in place as they are moved from their position shown in Fig. 29 toward the right. If this resistance were not placed upon them they might rebound from the surface 183 of the slides 180 as this slide suddenly strikes them, and, in rebounding, they would become dislodged and would not stack properly.

The slides 180 are attached by pins 190 to a block 191 carrying a stud 192 which provides a bearing for a roller 193. The roller 193 is received by a slot 194 in the end of a lever 195 which is pivoted by a stud 196 carried by a plate 197 which is attached by screws 198

to the frame table 132. The lever 195 carries a stud 199 providing a shoulder for a roller 200 which is received by the cam slot 201 of a drum cam 202 driven by the shaft 137. The bars 180 are located on opposite sides of a block 205 attached by screws 206 to the table top 132. The block 205 is provided with recesses 207 each receiving a roller 208 bearing on a pin 209. The rollers provide anti-friction guides for the two slide bars 180 as clearly shown in Figs. 12 and 33.

When the work pieces are moved to the position 50z, 52z, 50z and 51z as shown in Fig. 30 they are about to enter an arcuate chute 220 which is shown empty in Fig. 12. This chute merges with a horizontal chute 221 and both chutes are formed in the block 186. The bar 184 presses the pieces against the rounded nose 222 of a latch 223 pivoted upon a pin 224 which is removable by withdrawing the pin handle 225 accessible from the exterior of the block 186. The lever 223 is urged by a spring 227 against an adjustable stop screw 228 threaded in the block 186. Those work pieces which have previously been placed in the chutes 220 and 221 are prevented from backing up by the engagement of the last one to be entered with the shoulder or hook 229 of the latch lever 223. While the bars 180 are being moved from the position shown in Fig. 30 to that shown in Fig. 29, the fingers 150, 151 and 152 will be moved toward the left from the position shown in Fig. 31 to withdraw other work pieces from the magazine and place them upon the block 170, and while this is going on the work pieces in the positions 50z, 52z, 50z and 51z will be moved from the position above the nose of the lever 223 to the position below the lever hook 229 by a plunger 230 which is guided by a part 231 and which is connected by a pin 232 with a lever 233 which is fulcrumed upon a screw 234 carried by a bracket 235 which is attached by screws 236 to the plate 197. The lever 233 is connected by a screw 237 with a link 238 having a slot 239 through which the shaft 137 passes. The link 238 carries a screw 240 providing a shoulder for a cam roller 241, which is engaged by a cam 242 attached to the shaft 137. The link 238 is screw-threadedly connected to a bolt 243 which passes through a bracket 244 attached by screws 245 to the machine base 130. A spring 246 is located between the bracket 244 in the head of the bolt 243 and tends to maintain the cam roller 241 in engagement with the cam 242. The cam 242 is so located with respect to the cams 202 and 168 that the mechanisms operated by these cams will be so coordinated that the withdrawing of work pieces from the magazines and transferring them to the assembling block 170 will take place while the work pieces in locations 50z, 52z, 50z and 51z will be transferred to the chute 220 by the plunger

230. During the last mentioned movement the segment 51 $\alpha$  will be pushed against the nose 222 of the lever 223 to move the same counterclockwise. After the top work piece 50 $\alpha$  has passed the hook 229 of the lever, the lever 223 will snap back again to retain the work in the chute. As more work pieces are added the work will be progressively moved down the chute 220 and into the chute 221 and will keep on moving toward the right into a horizontally arranged magazine 250 which is supported at one end by a bracket 251 attached to the block 186 and at the other end by the pedestal 133. The work pieces are pressed against the cylindrical surface 220 $\alpha$  of the chute 220 by a resilient leaf spring member 247 which is slidably anchored at 248 and is fixed at 249. This member tends to keep the work pieces in position within the chutes 220 and 221 and prevent, by its frictional engagement with them, movement of the work pieces toward the left as viewed in Fig. 28. As will be apparent from the description which follows, the use of such a device as the spring 247 is not necessary after the pieces are moved into the horizontal magazine 250.

The magazine or chute 250 comprises a block 252 to which the bracket 251 is attached as shown in Fig. 12, this block being provided with an L-shaped channel 253 which supports the work pieces in inverted position as shown in Fig. 38. The lower part 253 $\alpha$  of the channel receives the tangs 50 $\beta$  of the riser bars 50. The dovetails of all the pieces (dovetails 50 $\alpha$  of bars 50 are shown) are located between retaining plates 254 and 255 which are secured to the block 252 by screws 256 and 257 respectively. The beveled edge 258 of the plate 254 is spaced from the adjacent edge of the dovetails of the work pieces as shown in Fig. 38. This is done to permit removal of any of the work pieces from the channel 253 in case the work pieces are improperly assembled. The series of pieces which are in correct order may be separated from those pieces which are in incorrect order, and the incorrectly assembled pieces may be withdrawn by moving them in the direction of the arrow 259 as shown in Fig. 13 in order that the right hand ends of the work pieces as viewed in Fig. 38 will be clear of the left edge of the bar 255. After each of the work pieces to be removed has been moved into this position it may be manipulated so that it can be withdrawn from the channel 253. After the incorrectly assembled pieces have been removed, the correctly assorted pieces which were shoved ahead toward the right of the magazine may be moved back against those which have been orderly assembled and thus the row of orderly assembled pieces is intact.

A block 260 is attached to the right hand end of the block 252. The block 260 is suitably apertured to receive an anti-friction bear-

ing 261 which supports a shaft 262 carrying an operating handle 263 (see Fig. 13). The shaft 262 is provided with a flange 264 bearing against a shoulder 265 provided by the block. The shaft 262 includes a cylindrical portion 266 extending through a recess in the block, which recess is bounded in part by a cylindrical wall 267. The space between the wall 267 and the cylinder 266 provides an annular recess 268 in which the annulus of commutator pieces is formed. The annular chamber 268 is connected by a passage 269 with the channel 253. The bottom portion 253 $\alpha$  of this channel terminates at the line 270 in Figs. 39 and 37. The plate 254 ends at the line 271 and the plate 255 ends at the line 272. The surface 253 $\beta$  at the bottom of the main portion of the channel 253 is flush with the surface 269 $\alpha$  of the channel 269. The work pieces are yieldingly maintained upon the surface 253 $\beta$  and 269 $\alpha$  by a resilient sheet metal member 273 attached to the bar 252 by screw 274. The channel 253, the cooperating plate 254 and the passage 269, all may be said to form different parts of the means for guiding the segments into the annular recess 268.

Before moving the assorted work pieces from the magazine or chute 250 the operator will apply a gauge which will indicate the correct number of pieces required to form the annulus. The gauge includes a plate 280 adapted to enter the channel 253 and attached to a tube 281 which is slidable upon a rod 282 attached by screws 283 to the block 252. The rod 281 carries an operating handle 284 and a pointer 285 which will indicate the space between the last work piece of the group and the first work piece which is to be left behind when the group is to be separated for movement into the annular channel 268. The plate 280 is placed in the channel at the right of the first work piece on the right as viewed in Fig. 14 and the plate while in this position is moved toward the left so as to take up all the space between the work pieces which are in the magazine 250. The pointer 280 will be at the right position for indicating the point of separation. For example, if the commutator is one having in effect 23 bars there will be 23 groups of work pieces, 4 in a group, hence 92 pieces. The pointer will point to the space between the 92nd piece and the 93rd piece from the plate 280. By a suitable tool such as a screw-driver, the operator will separate the group of 92 pieces from those remaining in the magazine and will move them quickly through the channel 252 and into the annular channel 268. The first piece to enter the channel may be one of the riser bars 50. This will strike a thin metal vane 290 which is connected to the cylinder 266 and which, initially, should be located approximately as shown in Fig. 36. After the pieces are moved counterclockwise, through the channel 268, the vane 290 will

move with them and will tend to resist the rapid movement of the work pieces into the channel on account of the inertia of the mass of the shaft 262. Hence the vane 290 will tend to keep the work pieces from separating while they are being moved to the uppermost portion of the channel 268; and, while the pieces are descending, they will tend to fall against the vane 290. Hence the vane will keep these parts from separating unduly from those which are above and are on the right hand side of the vertical center line of the cylinder 266. As the vane 290 descends it will strike the end 291 of a spring which extends through a notch 292 in the plate 293 and which is coiled about a screw 294 carried by the block 260. The other end 295 of the spring is retained by recesses 296 in the block. The spring is biased into position shown in Fig. 36 and resists movement of its end 291 by the vane. The spring 291 therefore retains the work pieces as they are brought adjacent to the point of opening of the channel 269 into the channel 268. The spring end 291 will engage some of these pieces as shown in Fig. 39 so as to maintain all of them in a form of an annulus or a circular row of pieces.

As shown in Fig. 37, there will be a space between the riser portions 50b and the vertical wall 260a of the block 260 so as to provide room for applying the hand clamp 65, the clamping levers of which are indicated at 65a and 65b in Fig. 37. After this is done and while the clamp is applied as shown in Fig. 3, the assembled work is removed from the block 260 and then the resilient clamping band 270 is applied and then the clamp 65 may be removed. Thus the work of the machine and the operator attending it is completed and the work is ready for assembling to a complete commutator.

In case any of the work pieces do not come out from under the stacks in the magazines upon the block 170 so that less than the required number are on the block at any one time, it is apparent that the bar 184 shown in Fig. 29 will not be elevated to the maximum height when the work pieces are transferred to the position shown in Fig. 30. This fact is taken advantage of in providing a signal to indicate whenever the machine is working properly. The bar 184 is elevated to the maximum height when all the work pieces are in position as shown in Fig. 30; and there will be sufficient movement of the bar 184 to close switch contacts 300 and 301 to complete an electric circuit to a signal lamp 302. Thus the lamp will burn for a brief period during each cycle of machine operation. If the lamp should fail to burn, the operator will know that the machine is not operating properly and will be on the lookout for groups of pieces in the magazine 250 which have not been properly assorted. As a drafting expedient,

certain views such as Fig. 28 have been drawn so that the magazine frame is vertical and the base 130 is inclined. The machine is installed so that the base is horizontal and the magazine is inclined.

After the uppermost piece 51 is withdrawn from the stacking bar 113a it will fall from the magazine base 111 through the slot 126 until its lower end strikes a rubber cushion 320 carried at the lower end of a channel 321 supported by base 130. The channel 321 being inclined when the machine is installed for use, the bar 113 will lean against the channel 131 while the bar rests upon the cushion 320.

It is apparent from the foregoing description of the machine and assembling apparatus that annuli of commutator parts may be assembled more rapidly than heretofore then when the assembling has been done by picking the pieces one at a time from trays. The machine and one operator can perform the work of several people, thus reducing materially the cost of this assembling operation. Since the work of moving the pieces from the horizontal magazine 250 to the annular chamber 268 requires only a part of the operator's time while at the machine, the operator may attach the portable racks containing work pieces to the fixed magazine of the machine.

While the form of 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. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, means for removing the pieces singly from their respective rows, and automatically controlled means for juxtaposing the pieces in a predetermined order.

2. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, means for removing the pieces singly from their respective rows, means for juxtaposing the pieces in a predetermined order, a delivery magazine, and means for moving said juxtaposed pieces into the delivery magazine.

3. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, means for removing the pieces singly from their respective rows, means for superposing the pieces in a predetermined order, a delivery magazine, and means for moving the superposed pieces into the delivery magazine.

4. Apparatus for assembling in recurrent

sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, means for removing the pieces singly from their respective rows, and for arranging them edge-to-edge in a predetermined order, and means for locating the pieces side-to-side in predetermined order.

5 10 5. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, means for removing the pieces singly from their respective rows and for arranging them edge-to-edge in a predetermined order, means for superposing the pieces in a predetermined order, a delivery magazine, and means for moving the superposed pieces into the delivery magazine.

6. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating said pieces in orderly edge-to-edge relation, means for receiving said pieces and supporting said pieces in said last named relation, a delivery magazine, and means for moving the pieces from said support and for placing the pieces in the delivery magazine in a predetermined order.

7. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating said pieces in orderly edge-to-edge relation, means for receiving said pieces and for supporting said pieces in said last named relation, said support having ridges separating the portions upon which the pieces rest, a delivery magazine, and means for starting movement of the pieces consecutively so that the first one to be moved is caused to slide over a ridge and then upon the second piece to be moved, and the first and second piece to be moved together over a ridge and upon the third piece to be moved, etc., in order finally to form a stack of pieces with the last one to be moved upon the bottom of the stack, said means then moving the stack of pieces into the delivery magazine.

8. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating

said pieces in orderly edge-to-edge relation, in positions offset from the bottoms of the stacks in said magazine, a delivery magazine, and means for stacking said pieces in predetermined order and for moving them in a stack into the delivery magazine.

9. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, a delivery magazine, and mechanisms for removing the pieces singly from their respective rows in the first mentioned magazine, and for causing them to be assembled in a predetermined sequence and to be moved into the delivery magazine.

10. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, a delivery magazine, a mechanism for removing the pieces singly from their respective stacks in the first mentioned magazine and for causing them to be stacked in a predetermined sequence and to be moved into the delivery magazine.

11. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, a delivery magazine, means for moving the pieces singly from their respective rows in the first mentioned magazine and concurrently in the same direction into locations offset from the rows, in order to place the pieces in edge-to-edge relation, and means for moving the pieces in a direction transverse to the first mentioned direction of movement and to cause them to be juxtaposed in a predetermined order and to be moved into the delivery magazine.

12. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, a delivery magazine, means for moving the pieces singly from the bottoms of their respective stacks and concurrently in the same direction into locations offset from the stacks in order to place the pieces in edge-to-edge relation, and means for moving the pieces in a direction transverse to the first mentioned direction of movement and to cause them to be stacked in a predetermined order and to be moved into the delivery magazine.

13. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bot-

toms of their respective stacks and locating said pieces in orderly edge-to-edge relation, a delivery magazine, means for supporting said pieces in edge-to-edge relation and having provisions whereby movement of a piece edgewise toward the delivery magazine will cause the piece to slide upon an adjacent piece, and means for collecting the pieces into a stack and for delivering the stack to the magazine, said means comprising a member which engages the pieces progressively to cause the first one moved to slide upon the second, and the first and second to move together upon the third, etc., in order to form a stack of pieces, the bottom piece of which is the last one to be started moving toward the delivery magazine.

14. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating said pieces in orderly edge-to-edge relation, a delivery magazine, means for supporting said pieces in edge-to-edge relation and having provisions whereby movement of a piece edgewise toward the delivery magazine will cause the piece to slide upon an adjacent piece, means for collecting the pieces into a stack and for delivering the stack to the magazine, said means comprising a member which engages the pieces progressively to cause the first one moved to slide upon the second, and the first and second to move together upon the third, etc., in order to form a stack of pieces, the bottom piece of which is the last one to be started moving toward the delivery magazine, and means for resiliently urging the pieces toward the support during their movement toward the delivery magazine.

15. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating said pieces in orderly edge-to-edge relation, a delivery magazine, means for supporting said pieces in edge-to-edge relation and having provisions whereby movement of a piece edgewise toward the delivery magazine will cause the piece to slide upon an adjacent piece, means for collecting the pieces into a stack and for delivering the stack to the magazine, said means comprising a member which engages the pieces progressively to cause the first one moved to slide upon the second, and the first and second to move together upon the third, etc., in order to form a stack of pieces, the bottom piece of which is the last one to be started moving toward the deliv-

ery magazine, and a pivoted bar movable against the pieces and a spring for urging the bar toward the pieces during the movement of the pieces toward the delivery magazine.

16. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks and locating said pieces in orderly edge-to-edge relation, a delivery magazine, means for stacking the pieces in orderly relation and for delivering them to the delivery magazine, and means for locking the pieces in the delivery magazine.

17. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator, comprising a magazine having a channel for receiving the commutator pieces, and a part providing an annular channel leading from the magazine channel in order to provide an annular row of pieces when they are moved from the magazine channel into the annular channel.

18. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator, comprising a magazine having a channel for receiving the commutator pieces, a part providing an annular channel leading from the magazine channel in order to provide an annular row of pieces when they are moved from the magazine channel into the annular channel, and means for preventing any pieces which have been moved into the annular channel moving into the magazine channel.

19. Apparatus for the manufacture of commutators comprising, in combination, a punch press for punching commutator pieces from flat sheet material, means for stacking them as they leave the punch press die, a portable rack attachable to the punch press stacking means for receiving pieces from the stacking means as they accumulate, and a machine for arranging different commutator pieces in orderly fashion and having a magazine for containing stacks of pieces, and means attached to the machine magazine for supporting one or more of said portable racks.

20. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly side-by-side relation, a delivery magazine, and means for moving the arranged pieces into the delivery magazine.

21. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for ar-

ranging the pieces in orderly edge-to-edge relation, means for arranging the pieces in orderly side-by-side relation, a delivery magazine, and means for moving the arranged pieces into the delivery magazine.

22. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly edge-to-edge relation, means for stacking them, a delivery magazine, and means for moving the stack of pieces into the delivery magazine.

23. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly edge-to-edge relation, and means for arranging the pieces in orderly side-by-side relation.

24. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly side-by-side relation, and cyclically operable means for moving a certain number of pieces from said arranging means.

25. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, automatically controlled means for arranging the pieces in orderly side-by-side relation, means for delivering pieces one-by-one to the arranging means, and means for moving a certain number of pieces from said arranging means.

26. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging pieces in orderly edge-to-edge relation and means for stacking them in a certain order.

27. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for stacking the pieces in a certain series, a delivery magazine, and means for moving the stacked pieces into the delivery magazine.

28. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator, comprising a magazine for receiving the commutator pieces, and means communicating with said magazine for guiding the pieces delivered from the magazine into annular formation.

29. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator comprising, in combination, means for assembling the pieces in orderly relation, means for moving the pieces from the assembling

means, and means for receiving pieces delivered from the assembling means and for guiding the pieces into annular formation.

30. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator comprising, in combination, means for arranging the pieces in orderly edge-to-edge relation, means for assembling the pieces in side-to-side relation, means for moving the pieces from the assembling means, and means for receiving pieces delivered from the assembling means and for guiding the pieces into annular formation.

31. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator, comprising in combination, a magazine for holding rows of commutator pieces, means for removing the pieces from the rows and for assembling them in orderly relation, means for moving the pieces from the assembling means, and means for receiving pieces delivered from the assembling means and for guiding the pieces into annular formation.

32. A method of assembling an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator which consists in assembling a number of pieces in orderly side-by-side relation, in moving them as a row while guiding them into annular formation, and in clamping them together while retained in annular formation.

33. A method of assembling an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator which consists in arranging them in orderly edge-to-edge relation, in moving them edge-wise while causing them to be brought into side-to-side relation in order to form a recurrent series of orderly arranged pieces, in moving them as a row while guiding them into annular formation, and in clamping them together while retained in annular formation.

34. The method of assembling an orderly arranged row of metallic and insulating pieces for the manufacture of a commutator which consists in arranging them in orderly edge-to-edge relation, and in moving them edgewise while causing them to be brought into side-to-side relation in order to form a recurrent series of orderly arranged pieces.

35. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator comprising, in combination, a part providing an annular channel and a side opening leading to the channel, and means for moving the pieces sidewise through the side opening and into the channel.

36. Apparatus for providing an annulus of orderly arranged metallic and insulating

pieces for the manufacture of a commutator comprising, in combination, a cup-shaped member provided with a side opening, a rotatable cylindrical body located within the member coaxially therewith and cooperating with said member to provide an annular channel, and means for moving the pieces sidewise through the side opening and into the channel.

37. Apparatus according to claim 36 in which the rotatable cylindrical body carries a vane movable within the annular channel for the purpose specified.

38. Apparatus according to claim 35 in which means are provided for preventing pieces from moving from the annular channel into the side opening.

39. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator, comprising in combination, a receiving magazine, means for assembling the pieces in orderly side-by-side relation in the magazine, and means for gauging a certain number of pieces and comprising a part locatable in the path of movement of the row of pieces in the magazine and movable with the row of pieces as the row moves and an indicator movable with said part and located at a fixed predetermined distance from said part.

40. A rack separably attached to a chute for holding commutator pieces provided with dove-tail tangs, comprising in combination, spaced parallel members having edge portions capable of extending into the notches defined by the tangs of the commutator pieces and means attached to one of said parallel members for connecting the rack and the chute.

41. Means for handling commutator pieces between a punch press, which forms from sheet material pieces having dove-tail tangs, and a machine for assembling the pieces in orderly relation, said handling means comprising, in combination, a rack for holding the pieces and consisting of spaced parallel bars which have portions for confining the dove-tail tangs as the pieces are delivered from the punch press, said rack having a transfer portion removable from that which is stationary relative to the punch press, and an assembly machine magazine having means for supporting the transfer portion of the rack and for receiving pieces therefrom.

42. Commutator manufacturing apparatus comprising, in combination, means for forming commutator pieces from sheet material, means for assembling the pieces in orderly relation and having a magazine for receiving the pieces, and means for receiving the formed pieces as they are delivered from the forming means and for guiding them into the magazine of the assembling means.

43. A device for holding a stack of commutator pieces which have non-parallel sides

and for permitting them to be fed to apparatus for assembling commutator pieces, said device comprising a bar having transverse notches each for receiving one of said pieces and a stationary member for guiding the bar as it moves relative to the assembling apparatus and for preventing movement of the pieces from the bar until the pieces are removed by the apparatus.

44. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving rows of commutator pieces, two of said rows having similar pieces, automatically controlled means for removing the pieces singly from their respective rows, and means juxtaposing the pieces in a predetermined order.

45. Apparatus for providing an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator comprising, in combination, a cup-shaped member provided with a side opening, a rotatable cylindrical body located within the member coaxially therewith and cooperating with said member to provide an annular channel, means for moving the pieces sidewise through the side opening and into the channel, and a finger resiliently urged into the annular channel and path of movement of the vane for the purpose specified.

46. In a device for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising the combination of means for supporting the pieces singly, said support having ridges separating the portions upon which the pieces rest, with a delivery magazine, and means for starting movement of the pieces consecutively so that the first one to be moved is caused to slide over a ridge and then upon the second piece to be moved, and the first and second pieces to be moved together over a ridge and upon the third piece to be moved, etc., in order finally to form a stack of pieces with the last one to be moved upon the bottom of the stack, said means then moving the stack of pieces into the delivery magazine.

47. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a magazine for receiving stacks of commutator pieces, means for moving the pieces singly from the bottoms of their respective stacks, means for preventing certain of said pieces from cocking so as to locate said pieces in orderly edge-to-edge relation, a delivery magazine, and means for delivering them to the delivery magazine.

48. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed,

comprising in combination, means for locating said pieces in orderly edge-to-edge relation, a delivery magazine, means for stacking the pieces in orderly relation, means for moving the arranged pieces into the delivery magazine, and means for locking the pieces in the delivery magazine.

49. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a delivery magazine, means for stacking the pieces in orderly relation, means for delivering them into the delivery magazine, means for restricting the passage of and for locking them in the delivery magazine.

50. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, a delivery magazine, means for stacking the pieces in orderly relation, means for delivering them into the delivery magazine, resilient means for restricting the movement of the pieces in the magazine, and means for locking the pieces in the magazine.

51. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly edge-to-edge relation, means for stacking them, a delivery magazine, means for moving the stack of pieces into the delivery magazine, and means for indicating the proper stacking of the pieces.

52. Apparatus for assembling in recurrent sequence the metallic and insulating pieces of which a commutator annulus is composed, comprising in combination, means for arranging the pieces in orderly edge-to-edge relation, means for stacking them, and means for indicating to the operator the proper stacking of the pieces.

53. A rack for holding commutator pieces provided with dove-tail tangs and comprising spaced parallel members having edge portions capable of extending into the notches defined by the tangs of the commutator pieces, and removable means at each end of said rack for holding the commutator pieces in the rack.

54. A removably mounted rack for holding commutator pieces provided with dove-tail tangs, comprising in combination, spaced parallel members having edge portions capable of extending into the notches defined by the tangs of the commutator pieces, the rack being so constructed and arranged as to receive the commutator pieces in one end of the rack and deliver them at its other end.

55. A method of assembling an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator which consists in arranging them in a row

in orderly side-to-side relation, and in moving them as a row while guiding them into annular formation.

56. A method of assembling an annulus of orderly arranged metallic and insulating pieces for the manufacture of a commutator which consists in arranging them in a row in orderly side-to-side relation, in moving them as a row while guiding them in annular formation, and in clamping them together while retained in annular formation.

57. In a machine for assembling commutator segments, a ring chamber for arranging the segments circularly, and a guide for the segments terminating in the ring chamber.

58. In a commutator making machine, a ring chamber having an opening at one side for the introduction of commutator segments tangentially, said chamber being open at the front to permit withdrawal of the segments after they have been circularly arranged.

59. Means for assembling commutator segments in circular form comprising a ring chamber, a guide entering it tangentially, and a stop at one side of the mouth of the chute where it enters the ring chamber for temporarily supporting the foremost segment and holding it out of the way of the segments entering the ring chamber.

60. In a commutator making machine, a chute for guiding commutator segments, said chute curving at the forward end to arrange the segments substantially circularly, the curved portion being of less depth than the segments whereby the ends of the latter may project and thus afford an opportunity for them to be grasped and withdrawn in an axial direction.

61. In a commutator making machine, a ring chamber for arranging commutator segments circularly, having an opening at one point of its periphery, and a main chute approaching the opening tangentially, said chute having two parts, one at the front and one at the back for guiding the segments, the front part terminating short of the ring chamber whereby one end of the segments in the ring chamber may project to enable them to be grasped and withdrawn from the ring chamber in an axial direction.

62. In a commutator making machine, a ring chamber for arranging commutator segments circularly, a main chute for conducting the commutator segments to the ring chamber, and means for introducing said segments into said chute in a definite sequence.

63. In a machine for assembling prismatic segments having wedge-shaped cross sectional conformation in circular arrangement comprising a ring chamber, a guide through which the segments may be moved laterally to the ring chamber, and means for so moving the segments.

64. In a machine for assembling prismatic segments having wedge-shaped cross sectional conformation in circular arrangement, the combination of a ring chamber, a guide channel entering the ring chamber tangentially and through which the segments may be advanced laterally, means for so advancing the segments through the channel and means formed and arranged in the ring chamber whereby the segments may be removed therefrom axially after having been circularly arranged therein.

65. In a machine for assembling prismatic segments having wedge-shaped cross sectional conformation, a ring chamber for arranging the segments circularly, a guide extending tangentially of the ring chamber and through which the segments may be moved laterally to the ring chamber, means for introducing segments into the ring chamber and means for moving the segments laterally through the guide.

66. In a device for assembling elements circularly, a ring chamber for arranging the elements circularly, a guide extending tangentially of the ring chamber and means for introducing the elements through the guide into the ring chamber.

67. In a machine for assembling commutators and the like having a channel in which the segments are to be assembled, a magazine for one type of segment, a second magazine for a second type of segment, means for transferring segments from the magazines into the channel in alternate relation and means for forcing the segments through the channel.

68. In a machine for assembling commutators and the like having a channel in which the segments are to be assembled, means for transferring segments to the channel in sequence, first from one magazine and then from the other and means for forcing the segments through the channel.

69. In a machine for assembling commutators, a main assembly channel for receiving commutator segments, ducts leading into said channel means associated with each duct for moving commutator segments there-through and into the assembly channel and means for forcing the said segments through the channel.

70. In a machine for assembling commutators, a main assembly channel for receiving commutator segments, ducts leading into said channel, means associated with each duct for moving commutator segments there-through and into the assembly channel, means for introducing commutator segments into said ducts and means for forcing the said segments through the channel.

71. In a machine for assembling commutators, a main assembly channel for receiving commutator segments, ducts leading to said channel, means associated with each duct for moving commutator segments therethrough

and into the channel, means for controlling said first named means so that commutator segments enter the channel from said ducts in a definite relative sequence, means for introducing commutator segments into said ducts and means for forcing the segments through the channel.

72. In a machine for assembling commutators, a main assembly channel for receiving commutator segments, magazines containing commutator segments and means for ejecting commutator segments from said magazines into said channel in a definite sequence, one of said magazines being formed and arranged to support wedge-shaped commutator segments in stacked relationship.

73. In a machine for assembling commutators, a magazine for supporting wedge-shaped commutator segments in stacked relationship, said magazine comprising a channel for guiding the segments and means within the channel for supporting the stack of segments in a vertical pile.

74. In a machine for assembling commutators, a magazine for feeding wedge-shaped commutators successively into the assembling machine, said magazine providing means for supporting said wedge-shaped commutators in a vertical pile.

75. In a machine for assembling commutators, a magazine for feeding wedge-shaped commutators successively into the assembling machine, said magazine comprising a channel for guiding and supporting a stack of commutator segments, and means, movable within the channel, for supporting the segments in a vertical stack.

76. In a machine for assembling commutators, a frame, a main assembly channel formed in said frame, ducts formed in said frame and extending from said assembly channel, magazines for containing commutator segments arranged in said frame in position to drop commutator segments into said ducts, reciprocating members operating along said ducts, whereby to move segments there-along and into said assembly channel, one of said magazines being arranged to support wedge-shaped commutator segments in a vertical stack.

77. In a machine for assembling commutators, a frame, a main assembly channel formed in said frame, ducts formed in said frame and extending from said assembly channel, magazines for containing commutator segments arranged in said frame in position to drop commutator segments into said ducts, reciprocating members operating along said ducts whereby to move segments there-along and into said assembly channel, and a sliding rack cooperating with one of said magazines to support wedge-shaped commutator segments in vertically stacked relationship therein whereby said wedge-shaped com-

mutator segments may be fed easily and regularly into said assembly machine.

78. In a machine for assembling commutators, an assembly channel, means for moving preformed commutator segments radially into said assembly channel and means for forcing said aligned segments through the channel.

In testimony whereof I hereto affix my signature.

LORA E. POOLE.

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