

[54] **APPARATUS FOR IMPRINTING OBJECTS SUCH AS BOTTLES AND THE LIKE**

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[22] Filed: **Nov. 30, 1971**

[21] Appl. No.: **203,288**

[52] U.S. Cl. **101/40, 101/123, 101/126, 198/33 AB, 198/162**

[51] Int. Cl. **B41f 17/18**

[58] Field of Search
101/38-40, 123, 124, 126, 35; 198/33 AB, 179, 162, 165, 160

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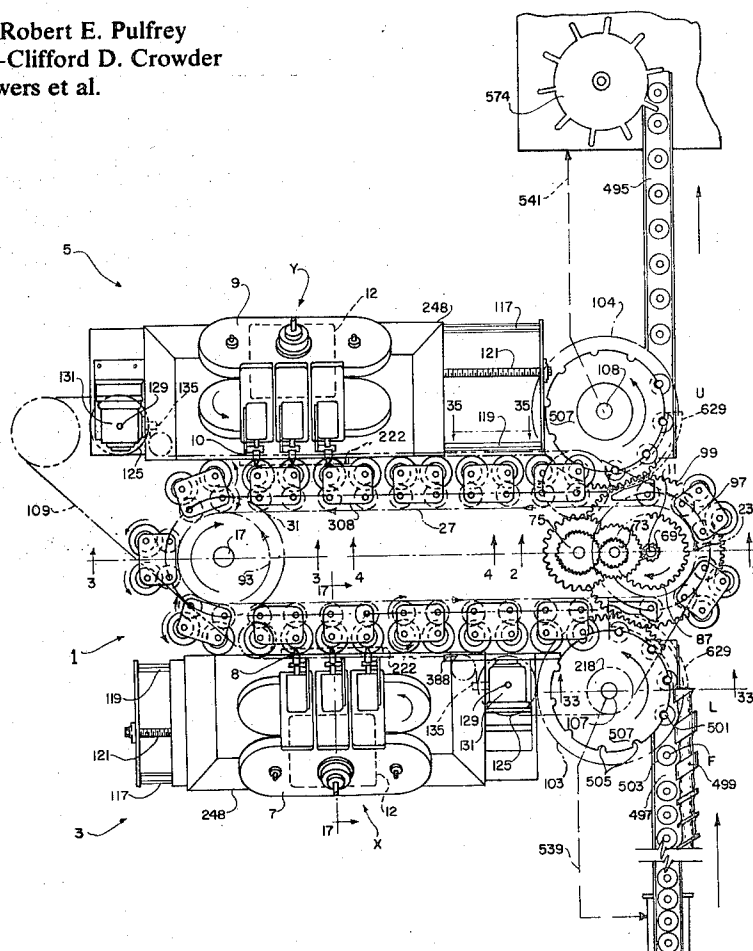
Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Clifford D. Crowder
Attorney—Irving Powers et al.

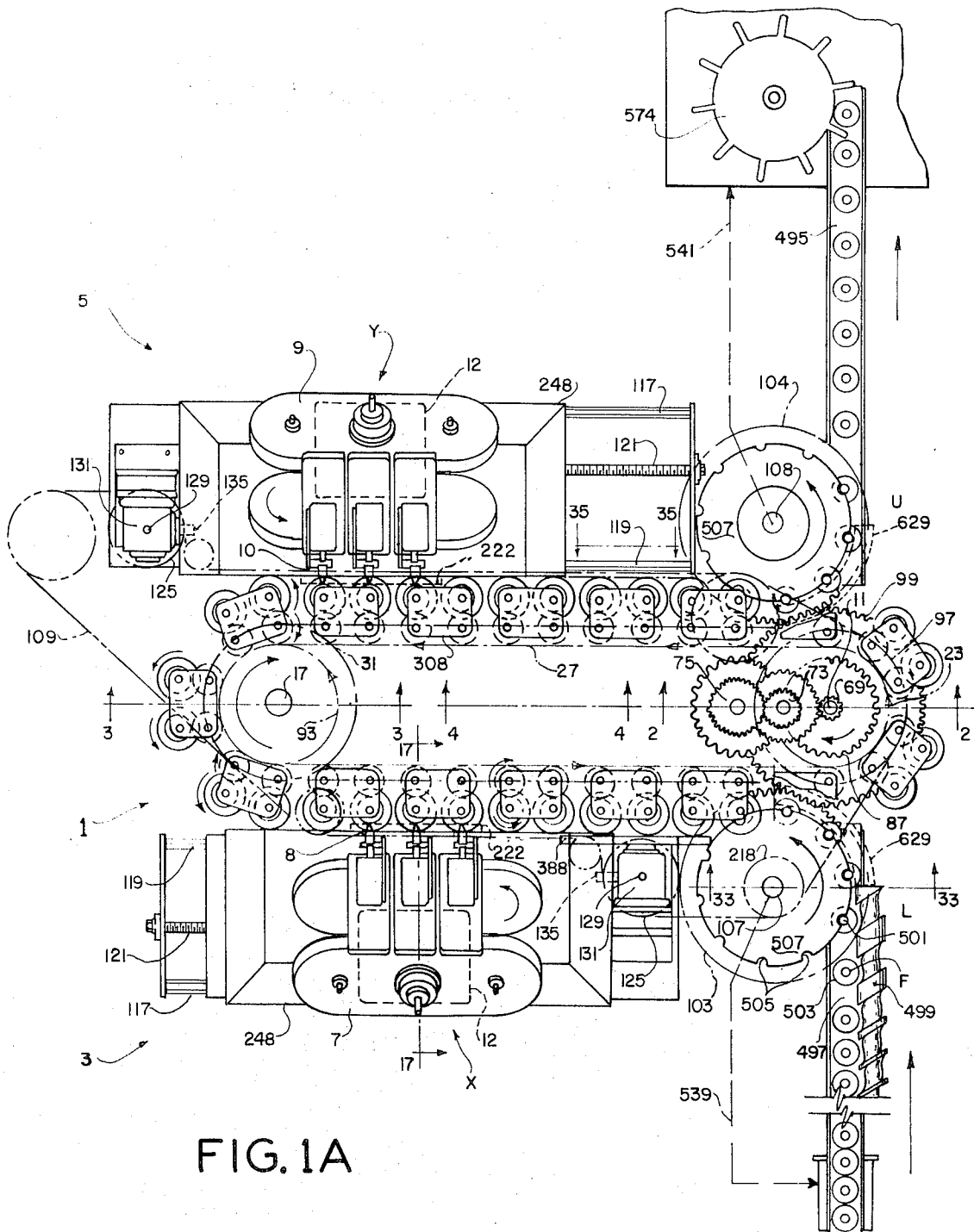
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ABSTRACT

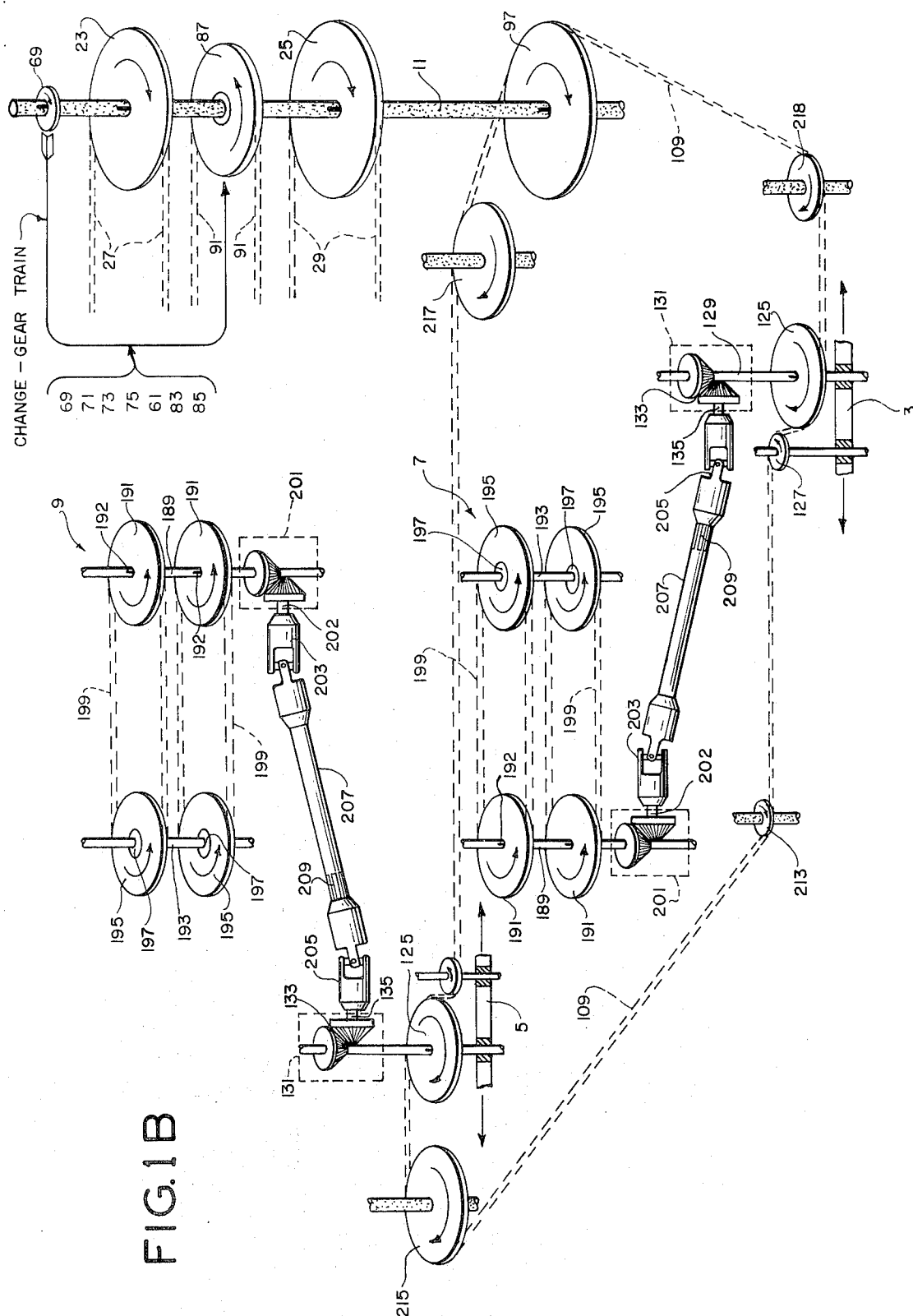
The invention comprises a vertical bottle conveyor, two movable carriages adjacent thereto with a stencil-screen and a squeegee-circulating conveyor supported on each of the carriages. The squeegee conveyor and the screen are subject to three independent adjustments relative to the bottle conveyor to accommodate various sizes and shapes of bottles. In addition each screen is adjustably tiltable. Each squeegee conveyor slants over a color pool on its support to pick up color by its squeegee strikers and deliver color to one side of the screen for striking therethrough to sides or necks of bottles which substantially roll on the other side of the screen. Each squeegee during travel is driven toward each screen under air pressure, and is air returned, there being included positive mechanical safety return means. Cam means, upon air return, properly positions the strikers to pick up color from rotary drums which lift color from the color pool. Bottles moving from a loading station are fed serially to centering bottle hangers and then to dual rotary bottle carriers on the bottle conveyor. Included are bottle registration means and clutches for initiating substantial rolling of the bottles on the screens. The inputs to the clutches are driven from the bottle conveyor in all positions of the carriages. Change gears are provided to obtain for any bottle diameters equal linear speeds on opposite sides of each screen of striking squeegees and of substantially rolling bottles.

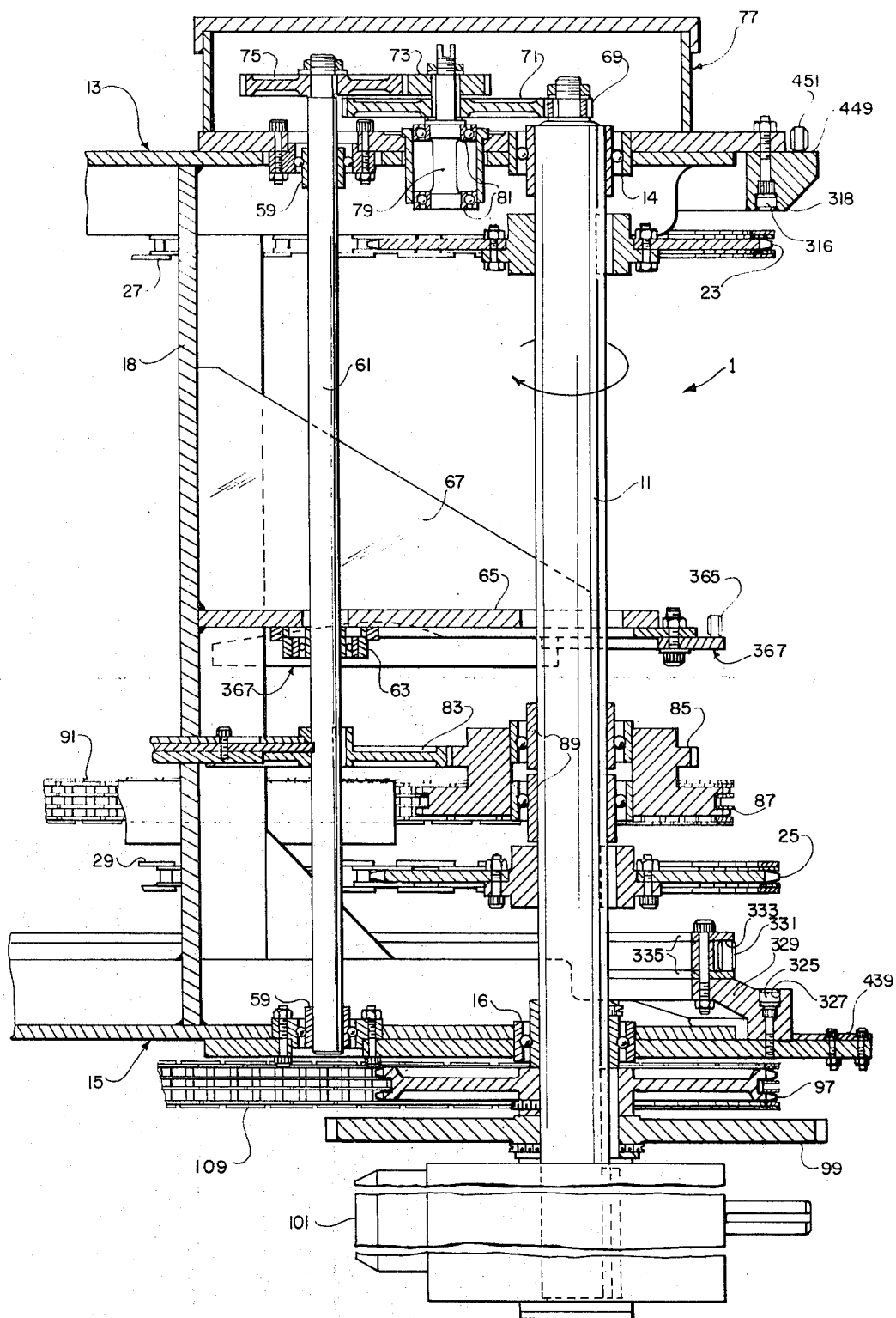
46 Claims, 58 Drawing Figures





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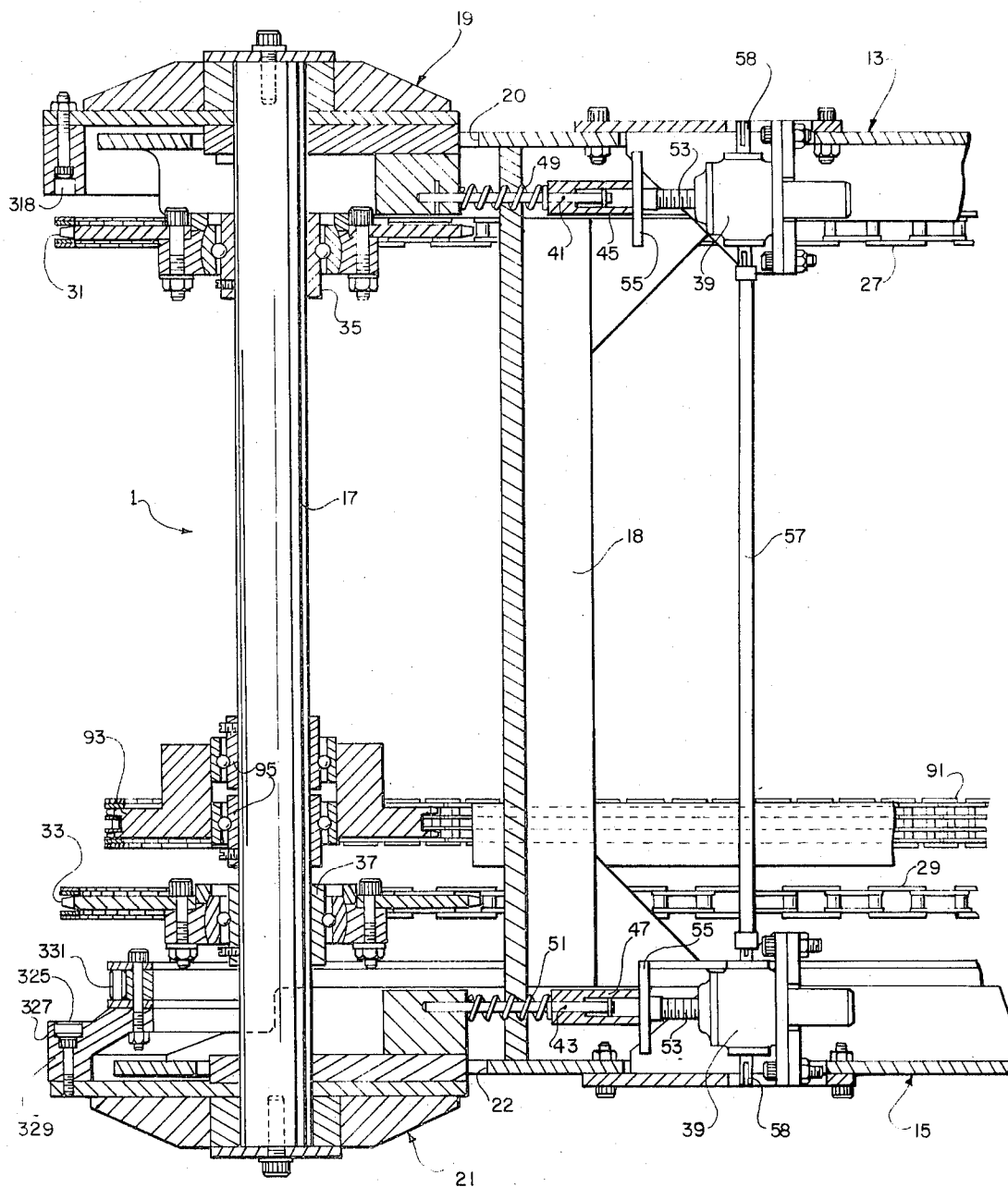


FIG. 3

FIG. 4

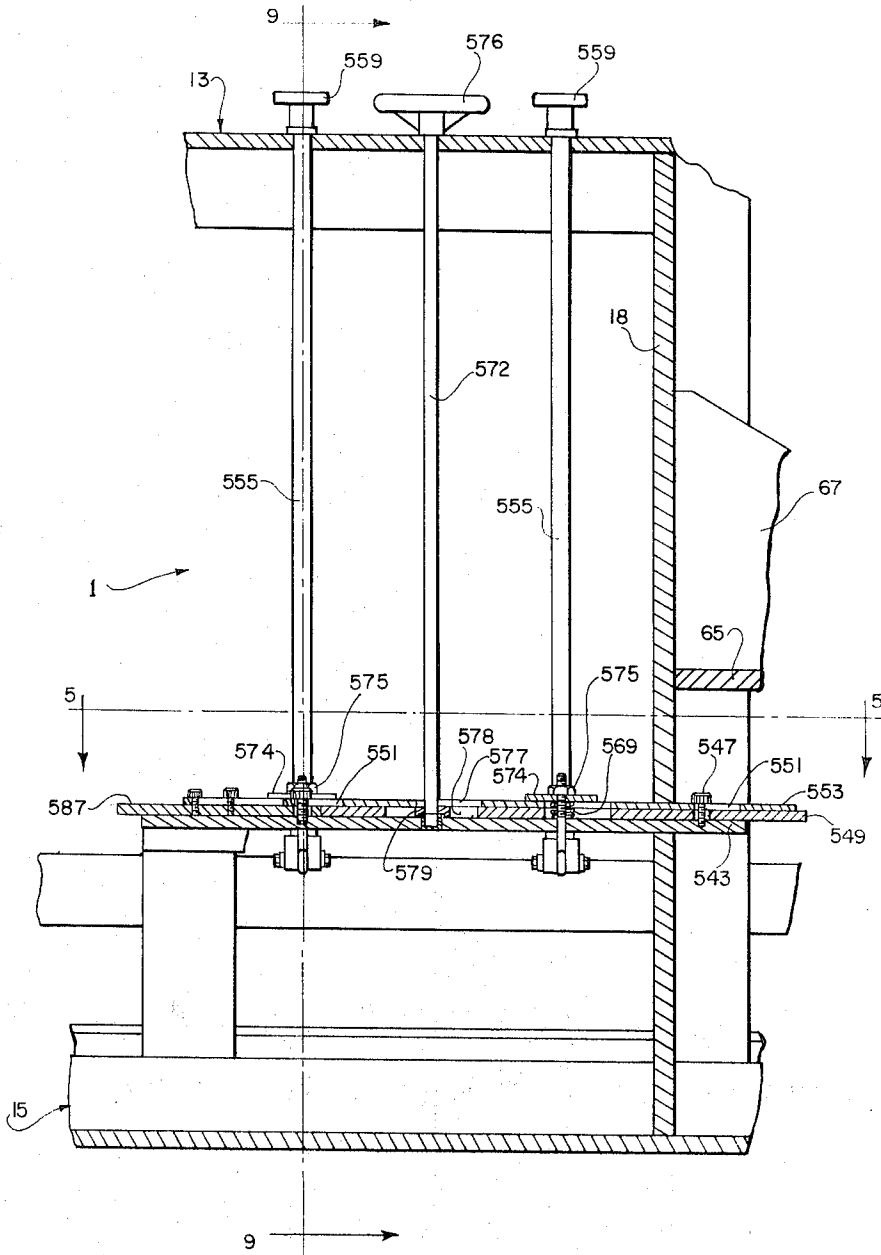


FIG. 5

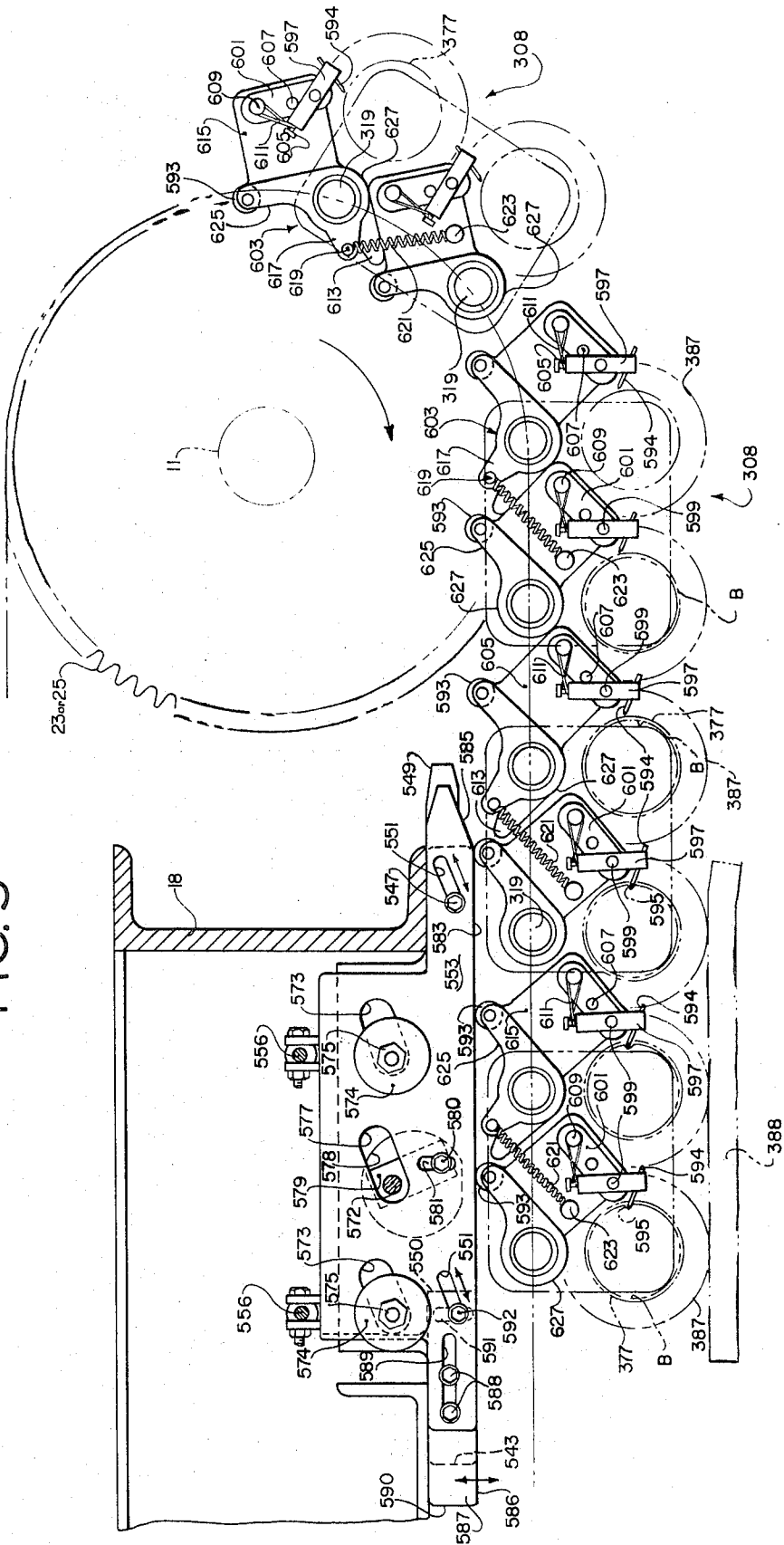


FIG.6

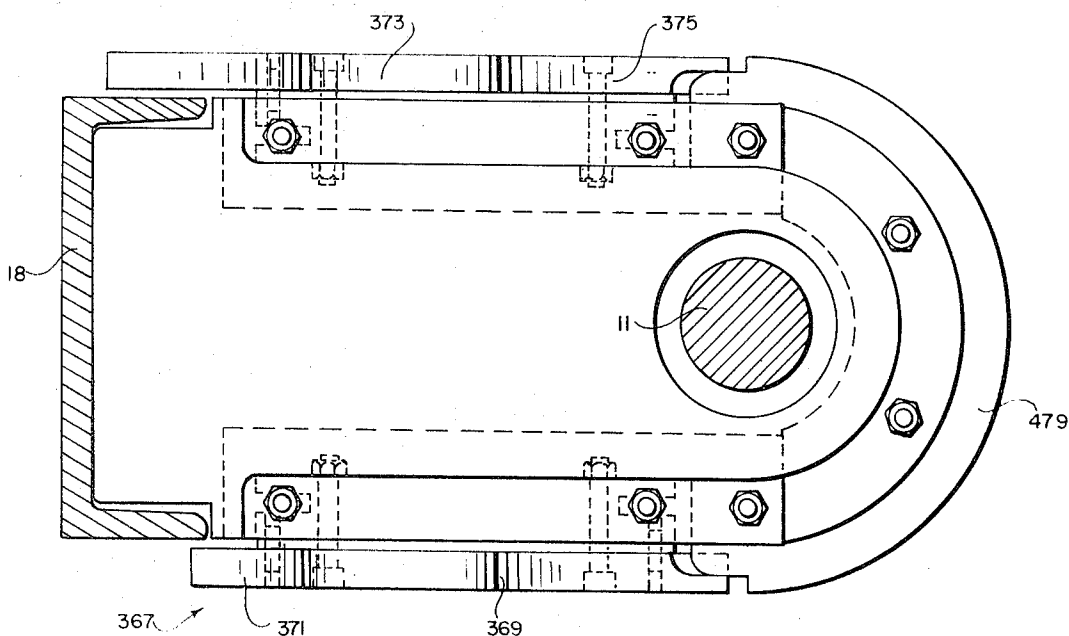


FIG.7

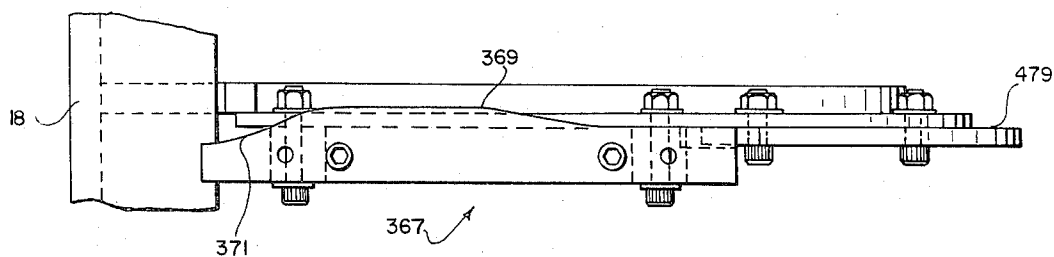
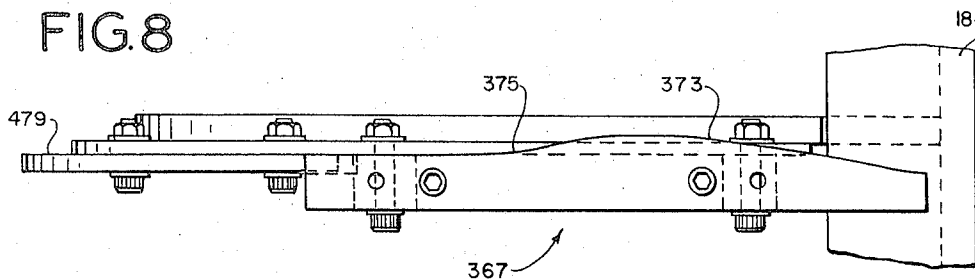


FIG.8



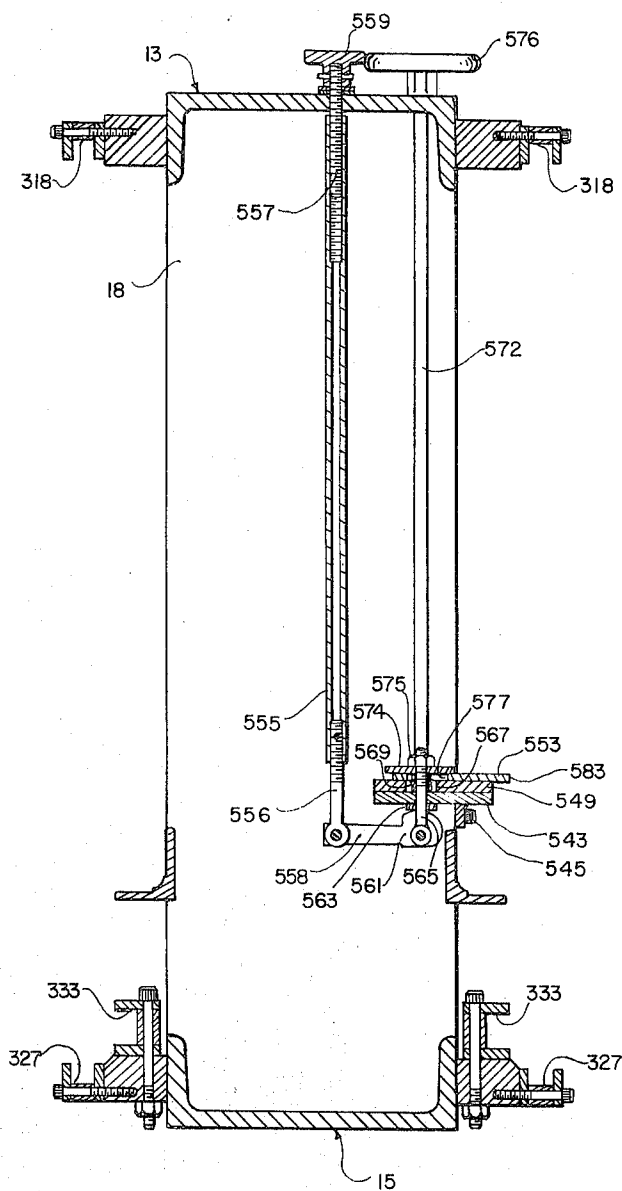
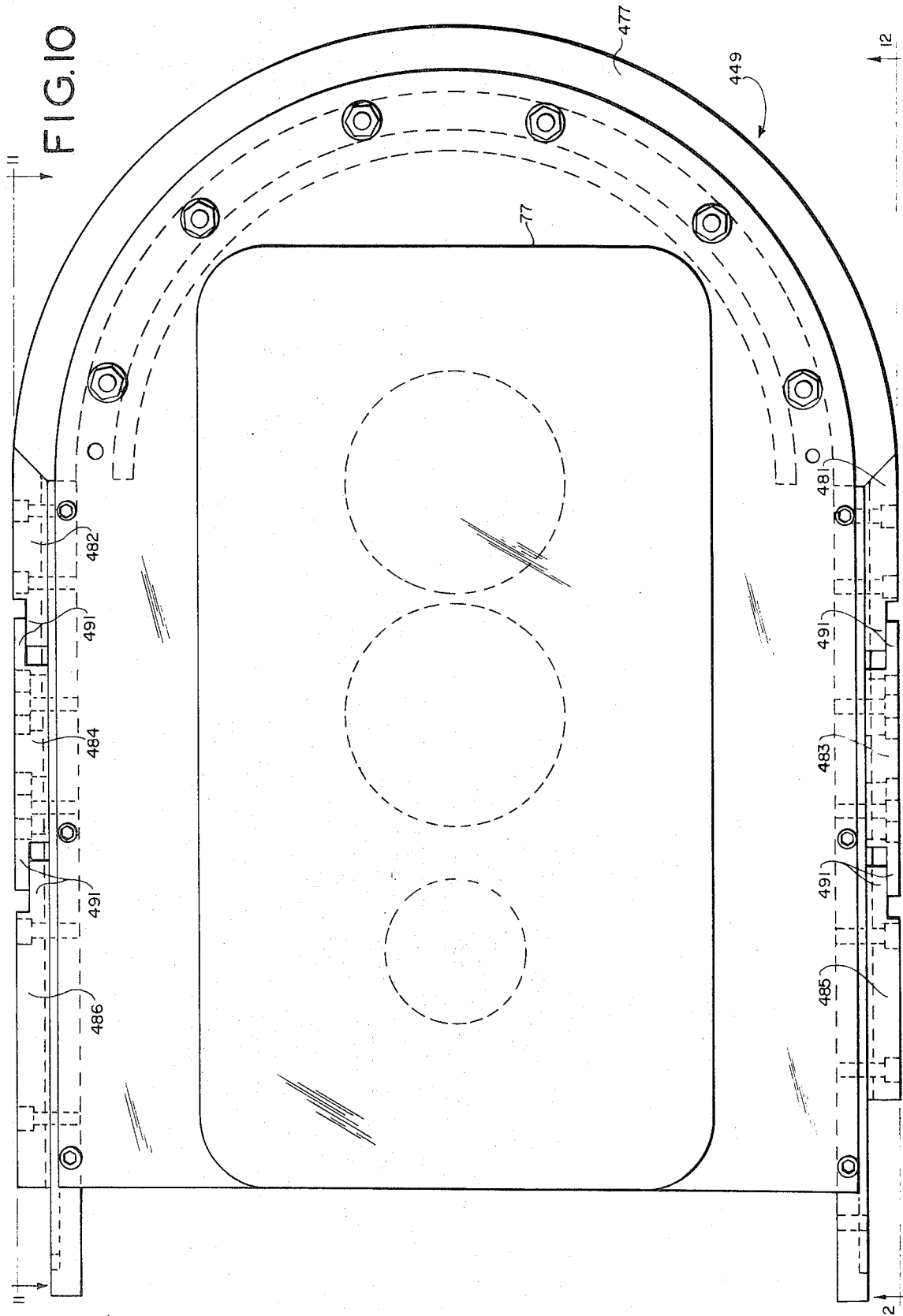


FIG. 9



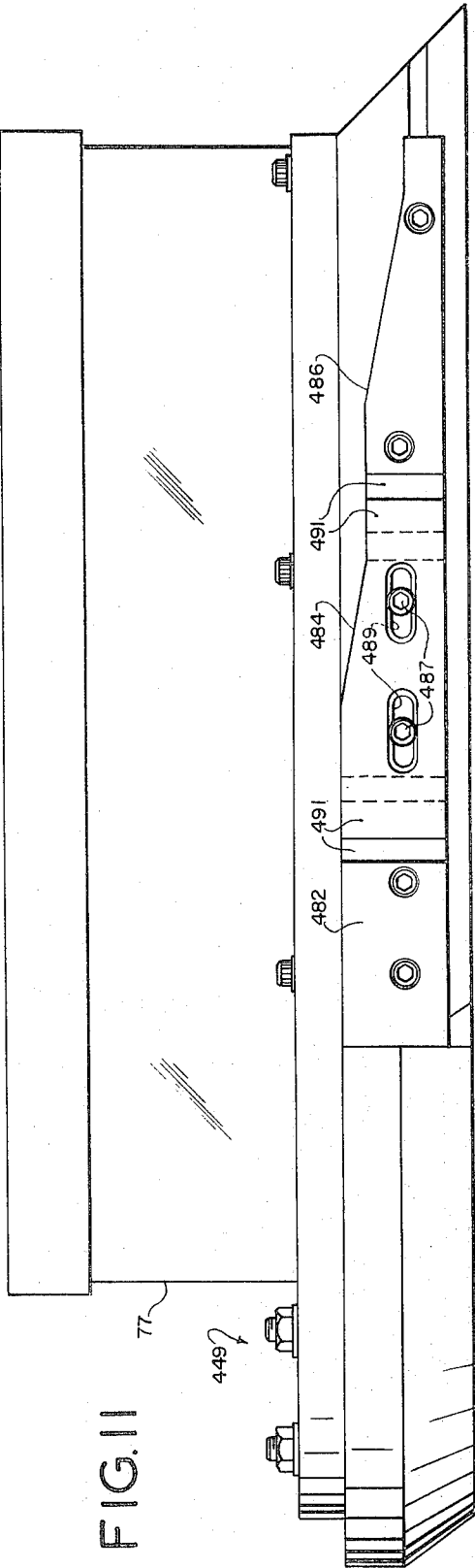
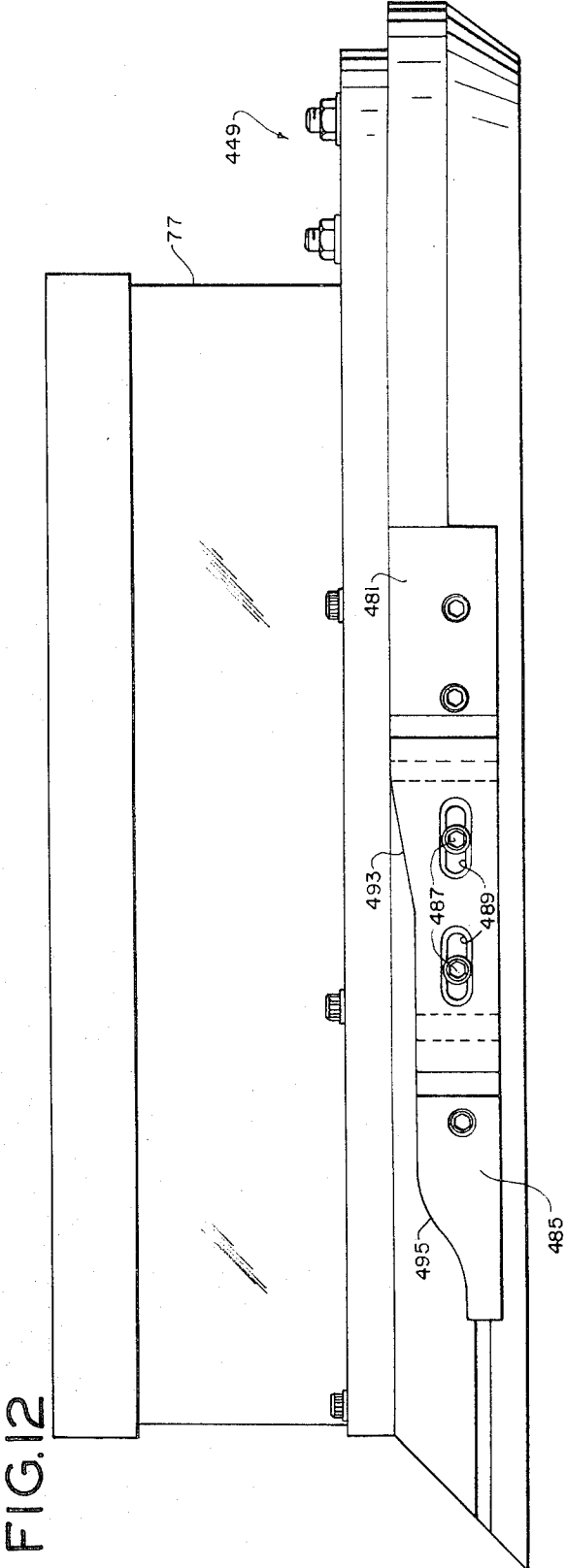


FIG. 13

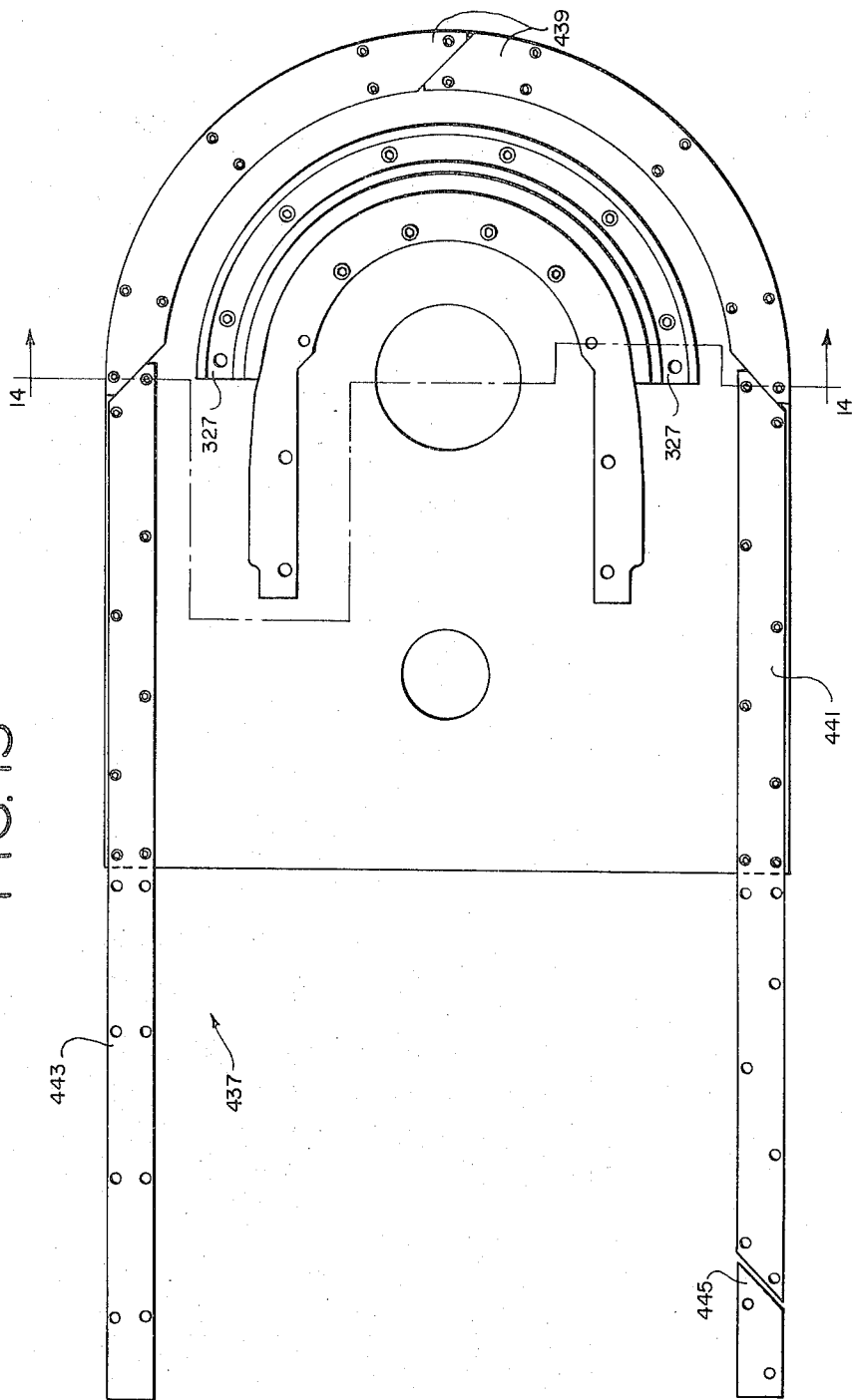
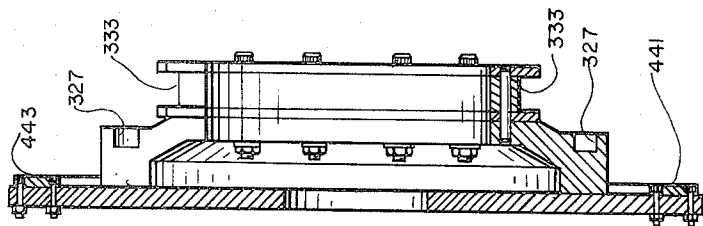
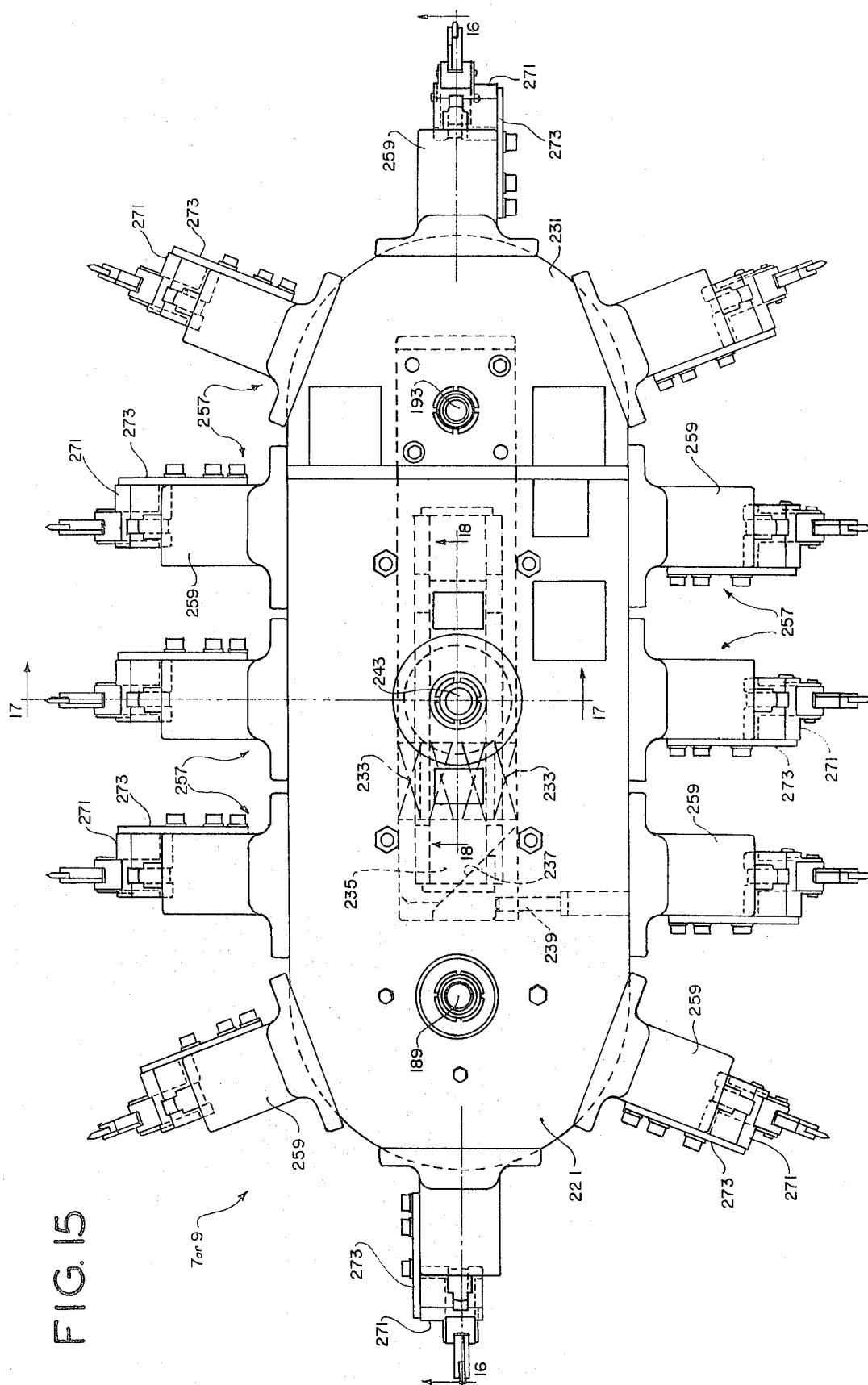


FIG. 14





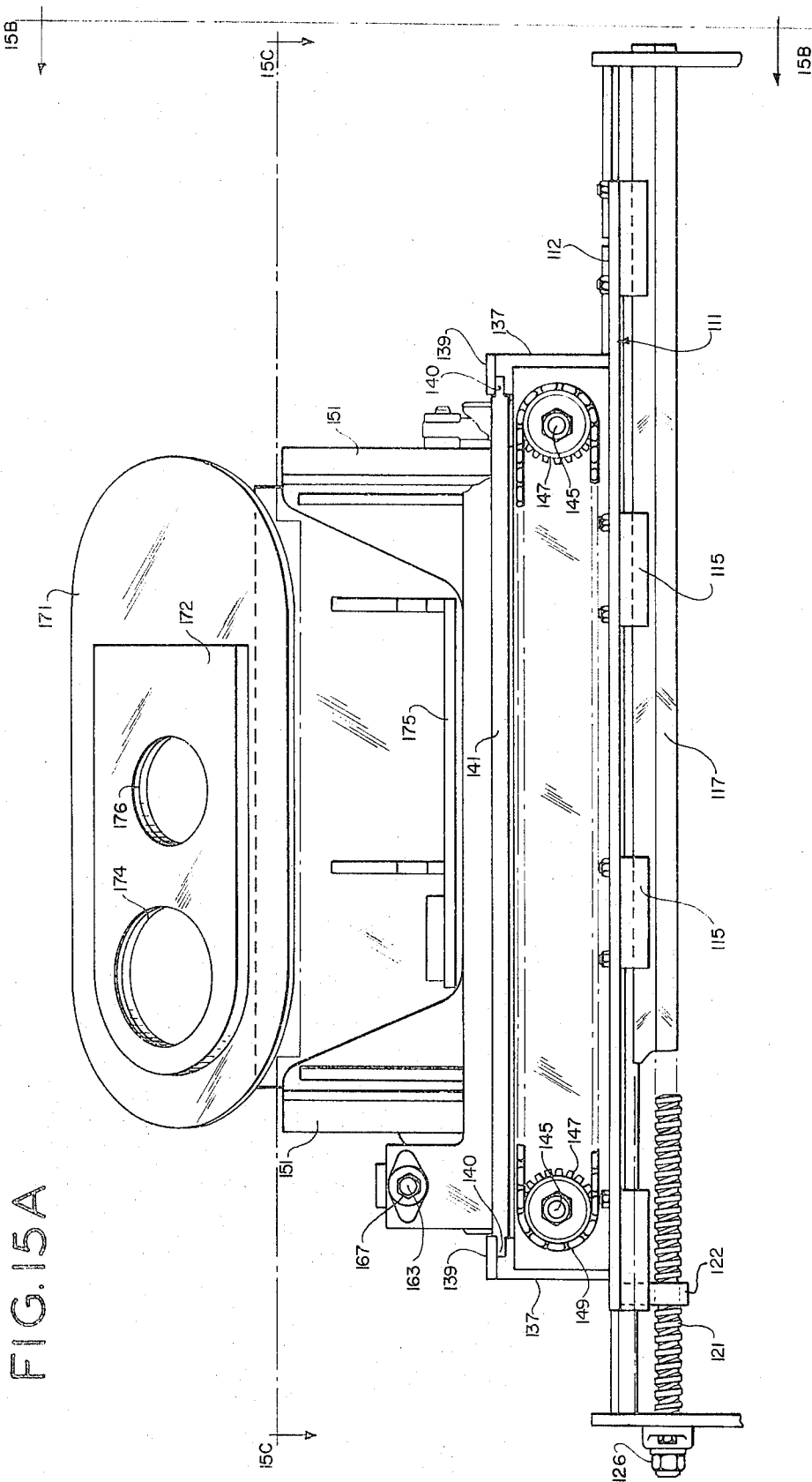


FIG. 43

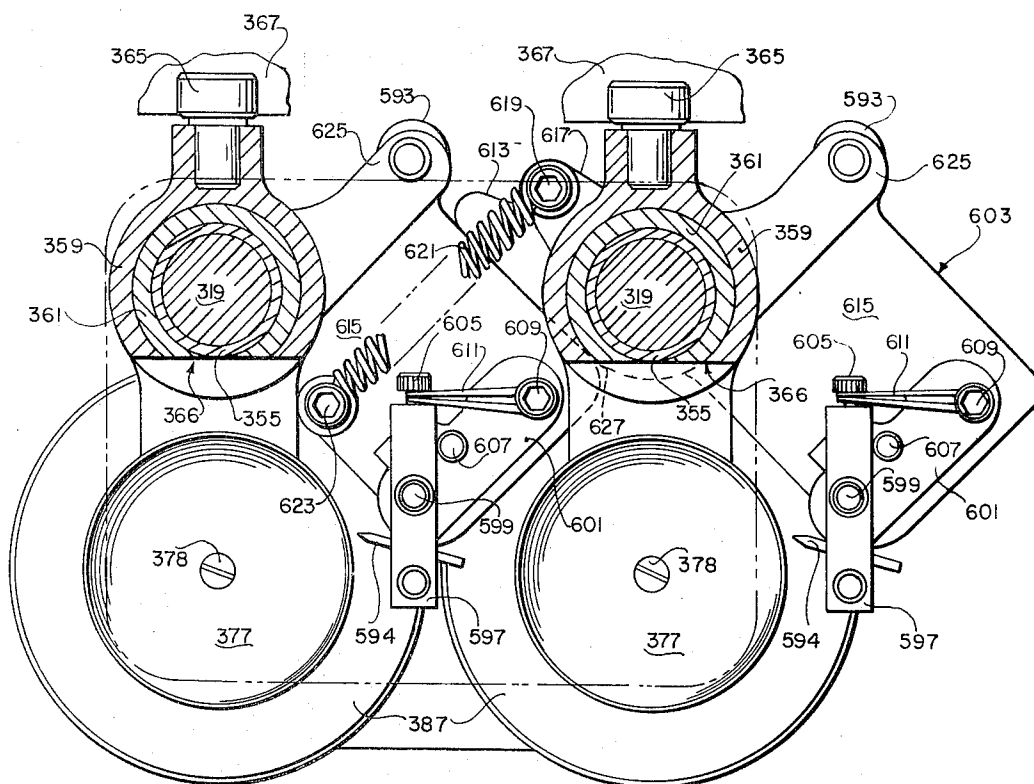


FIG. 15B

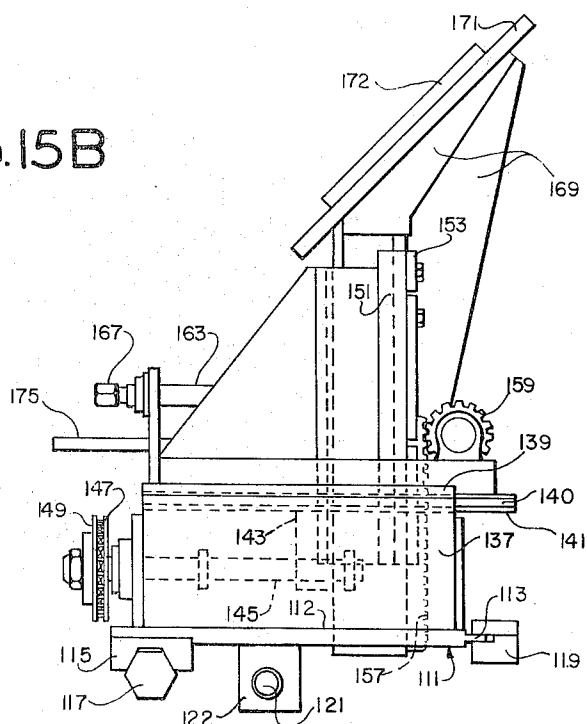
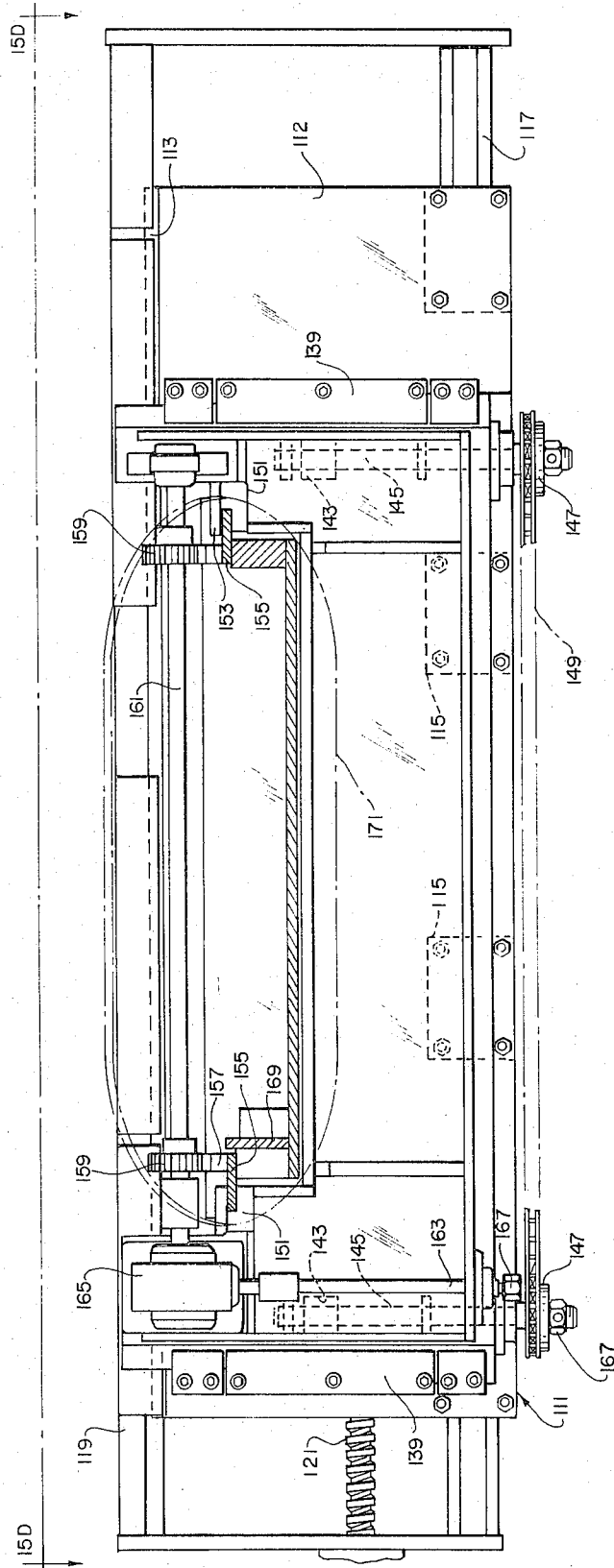


FIG. 15C



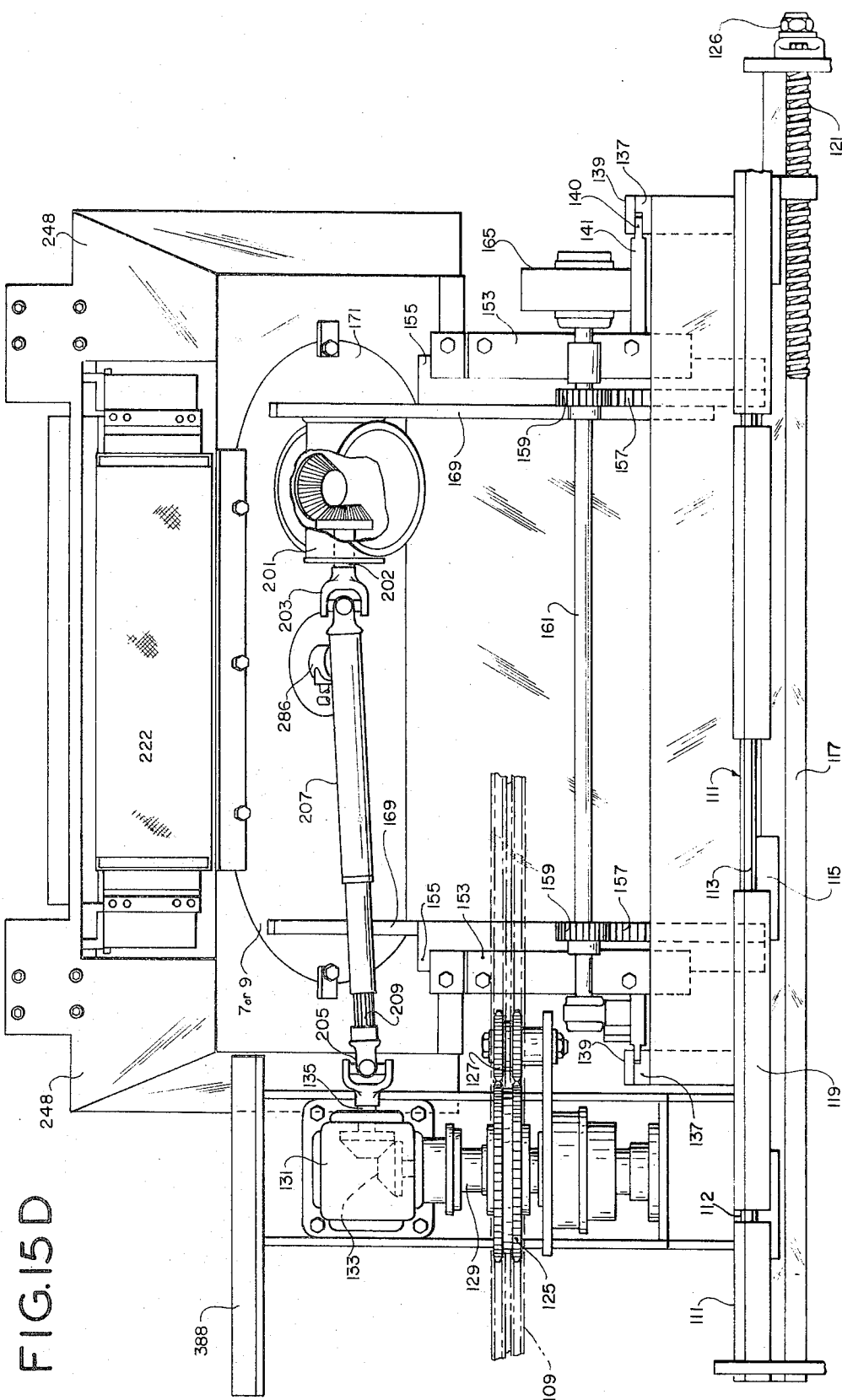


FIG. 16

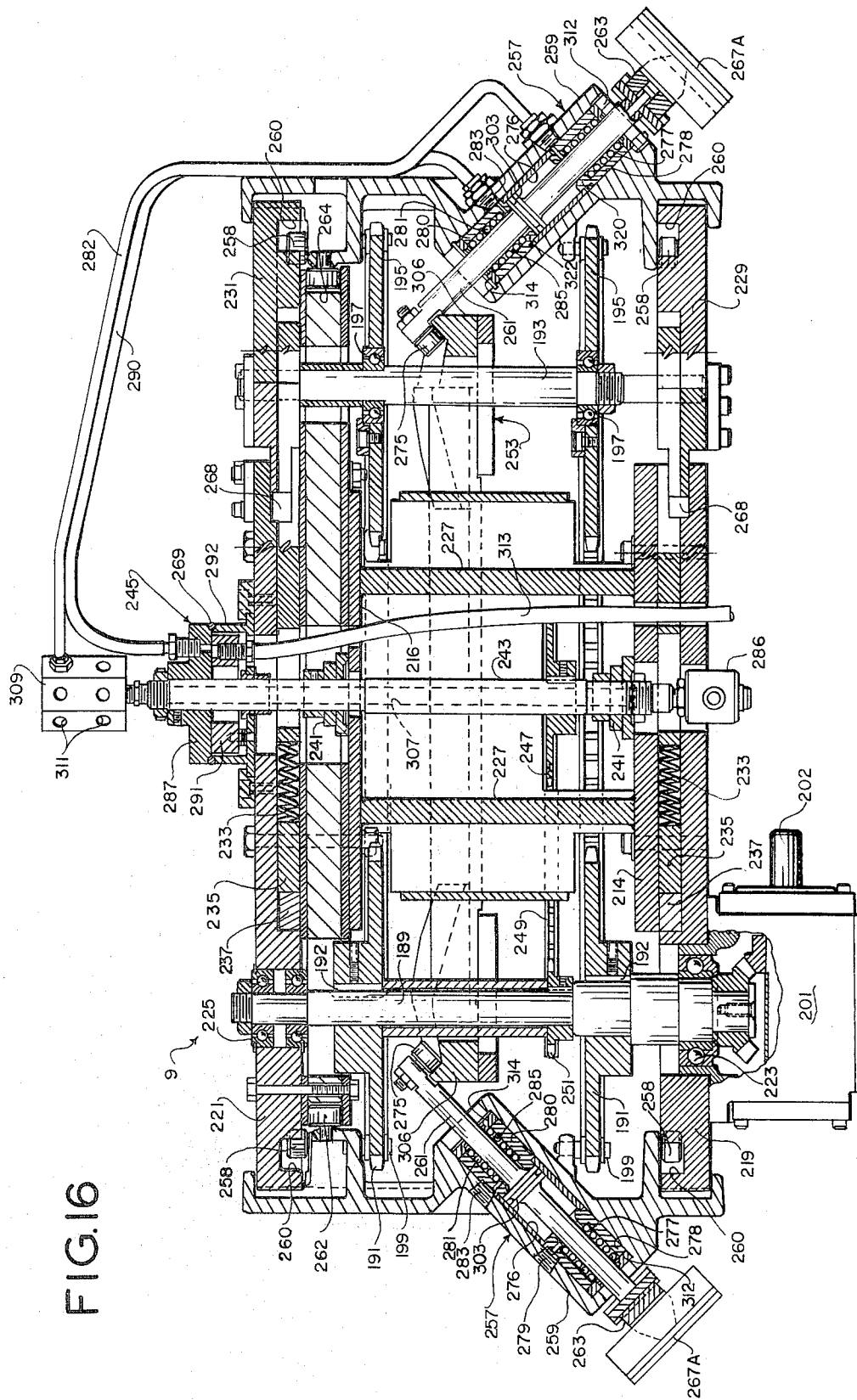
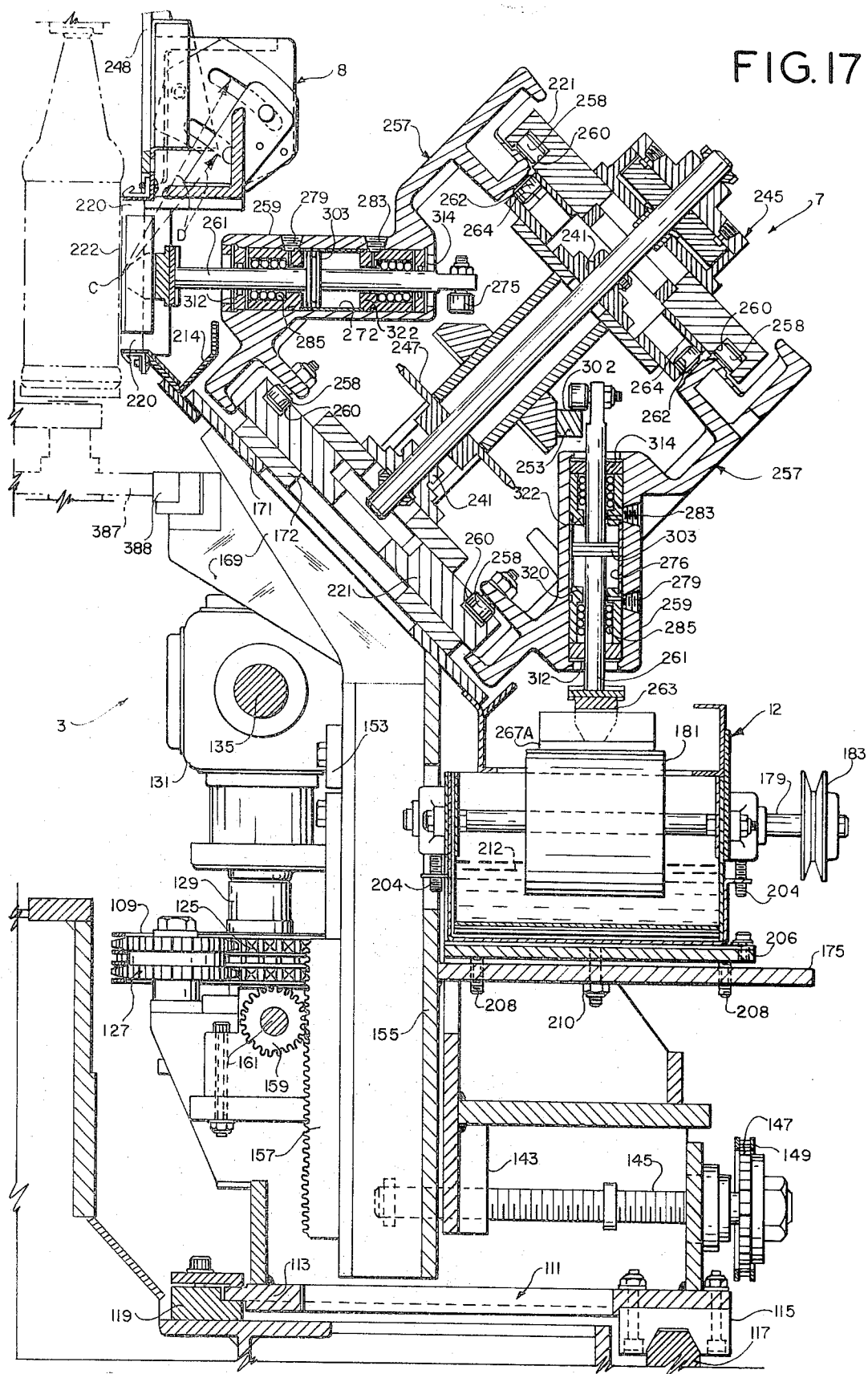


FIG. 17



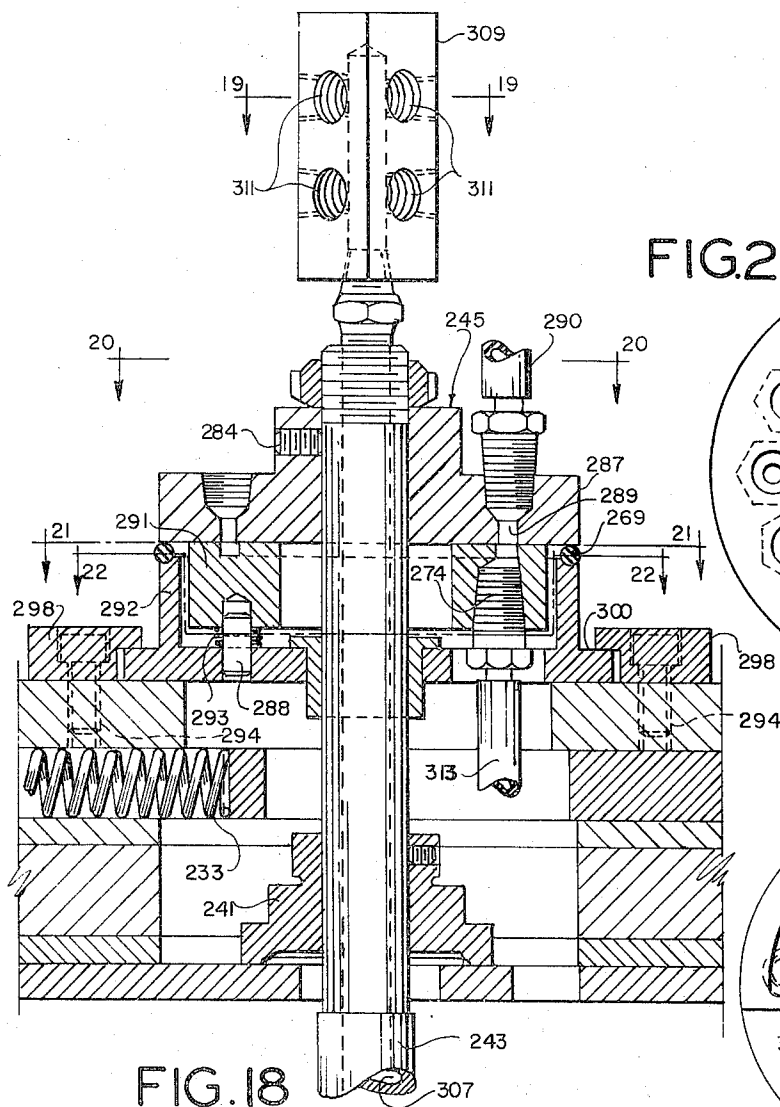
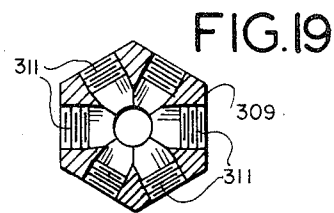
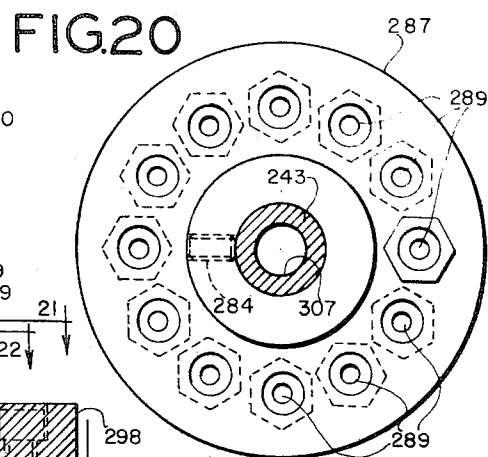
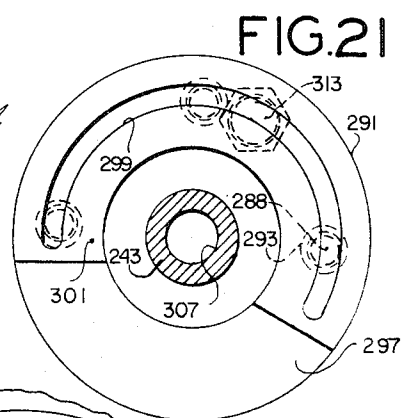
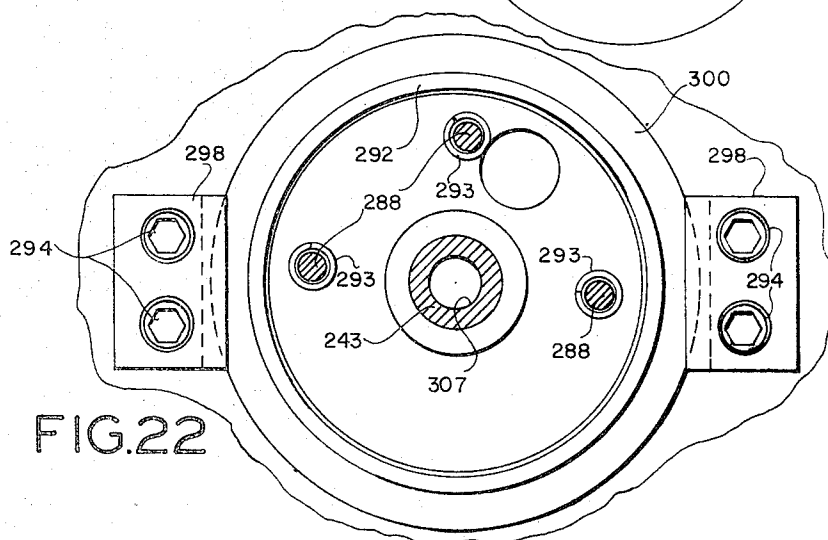


FIG. 23

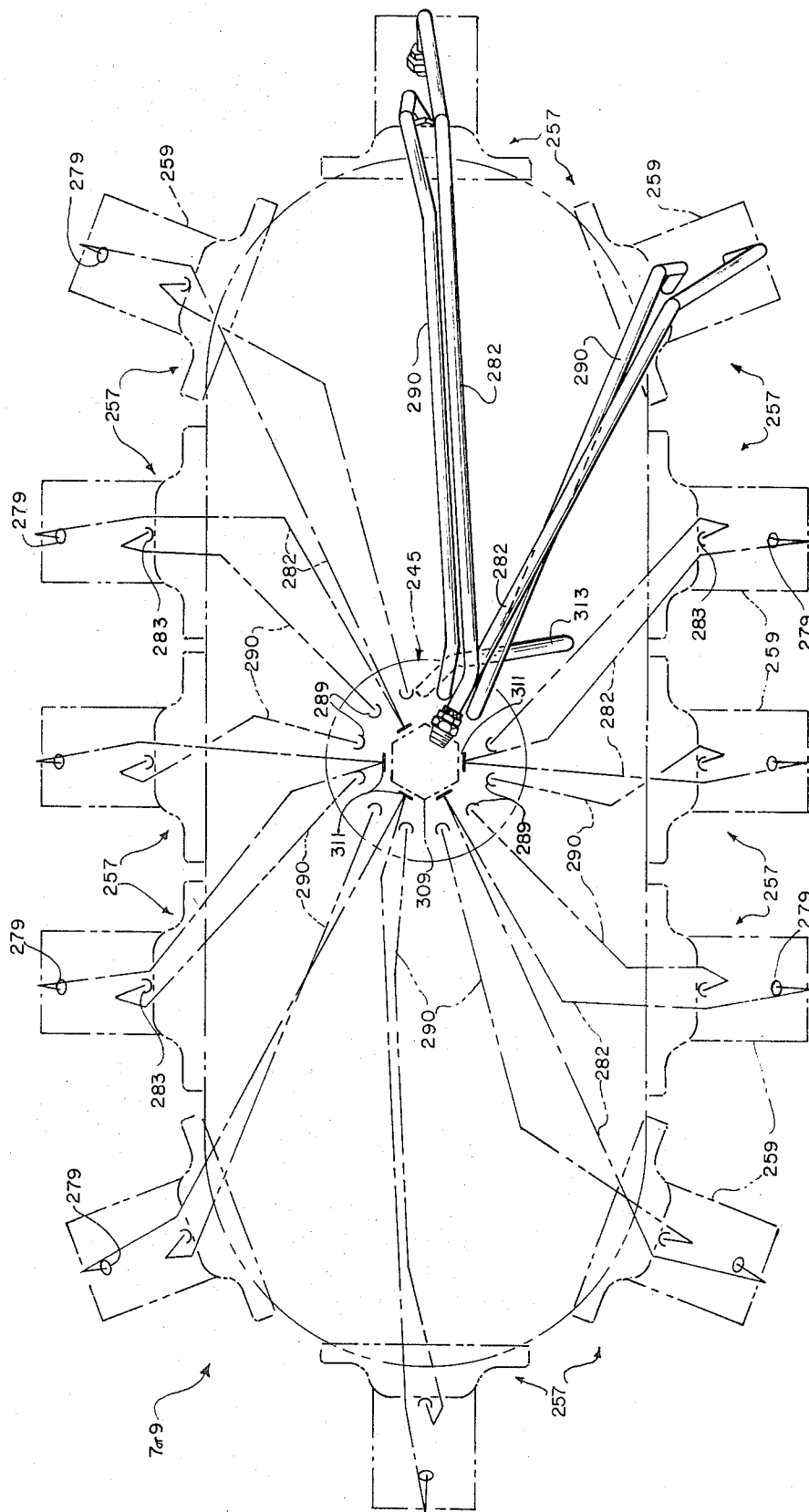


FIG.24

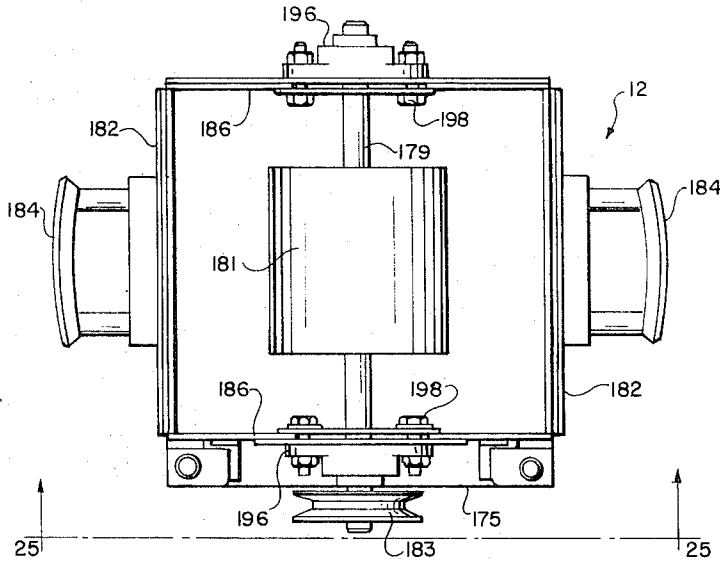


FIG.25

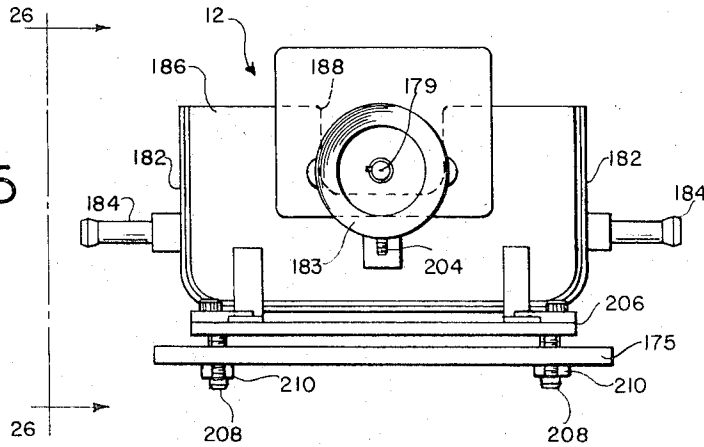


FIG.26

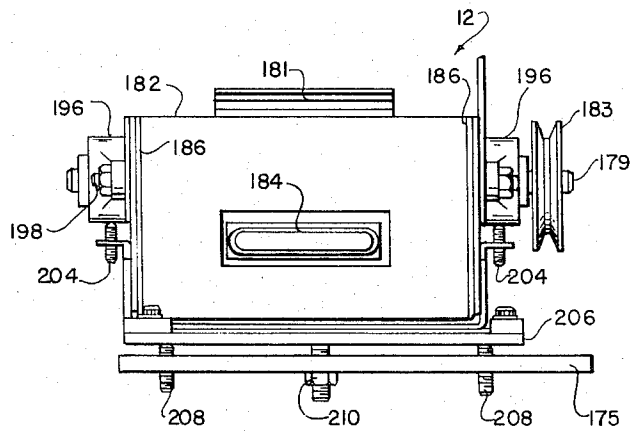


FIG.27

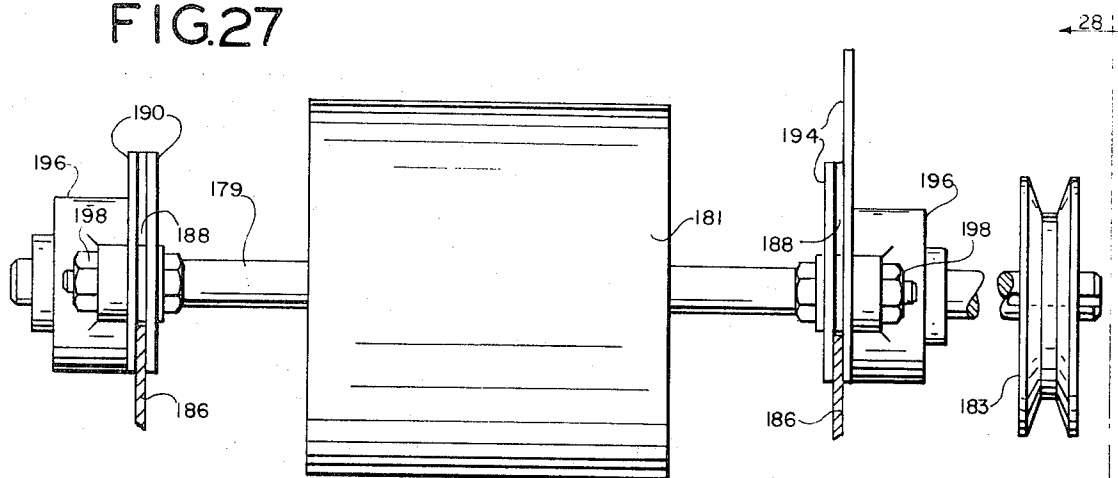


FIG.33A

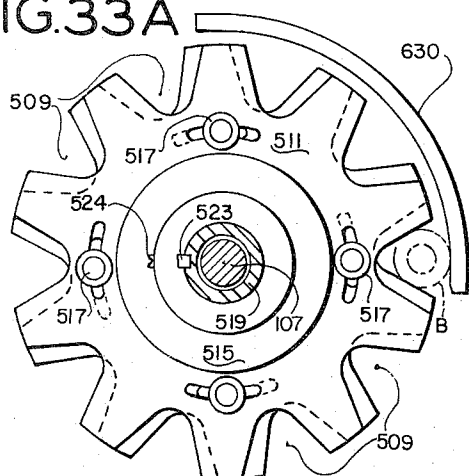
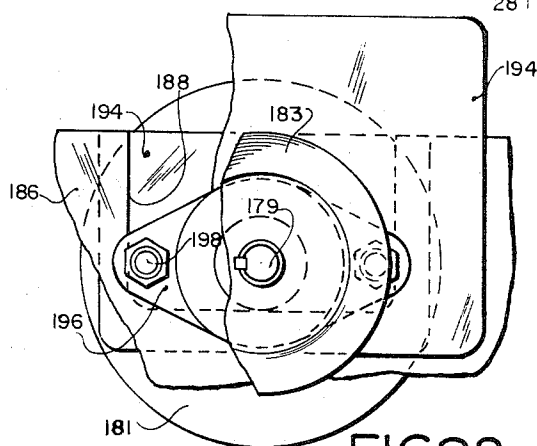


FIG.28

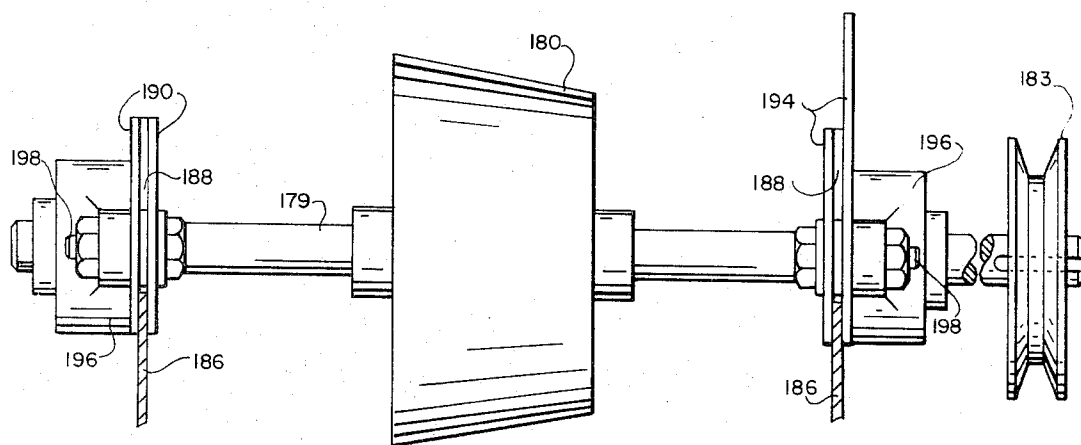


FIG.29

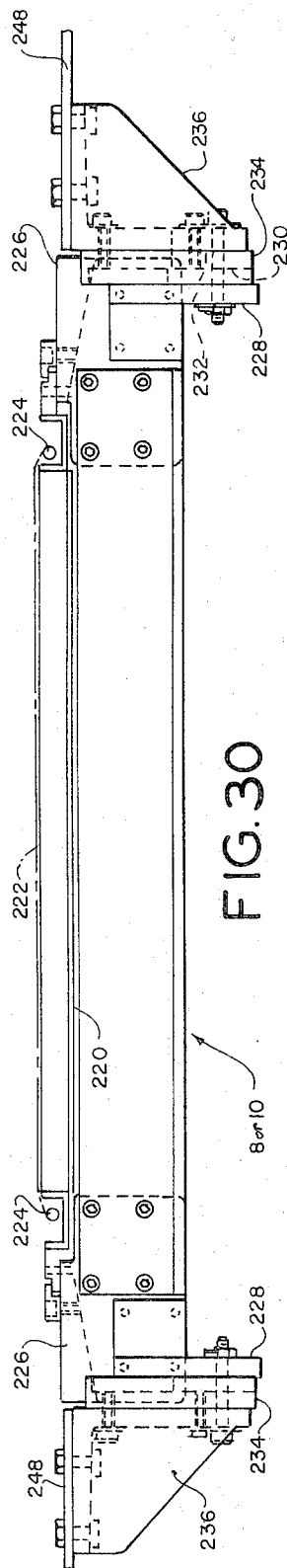


FIG. 30

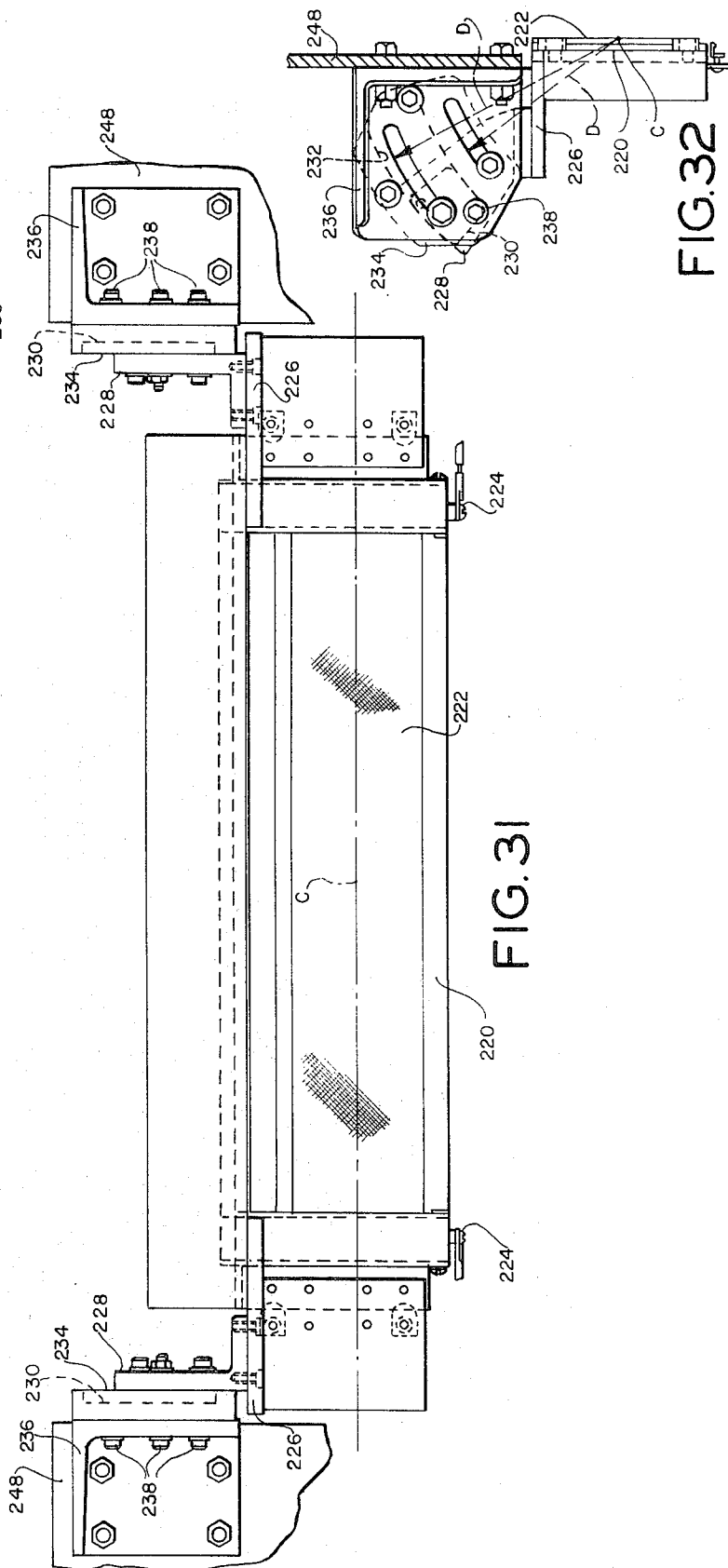
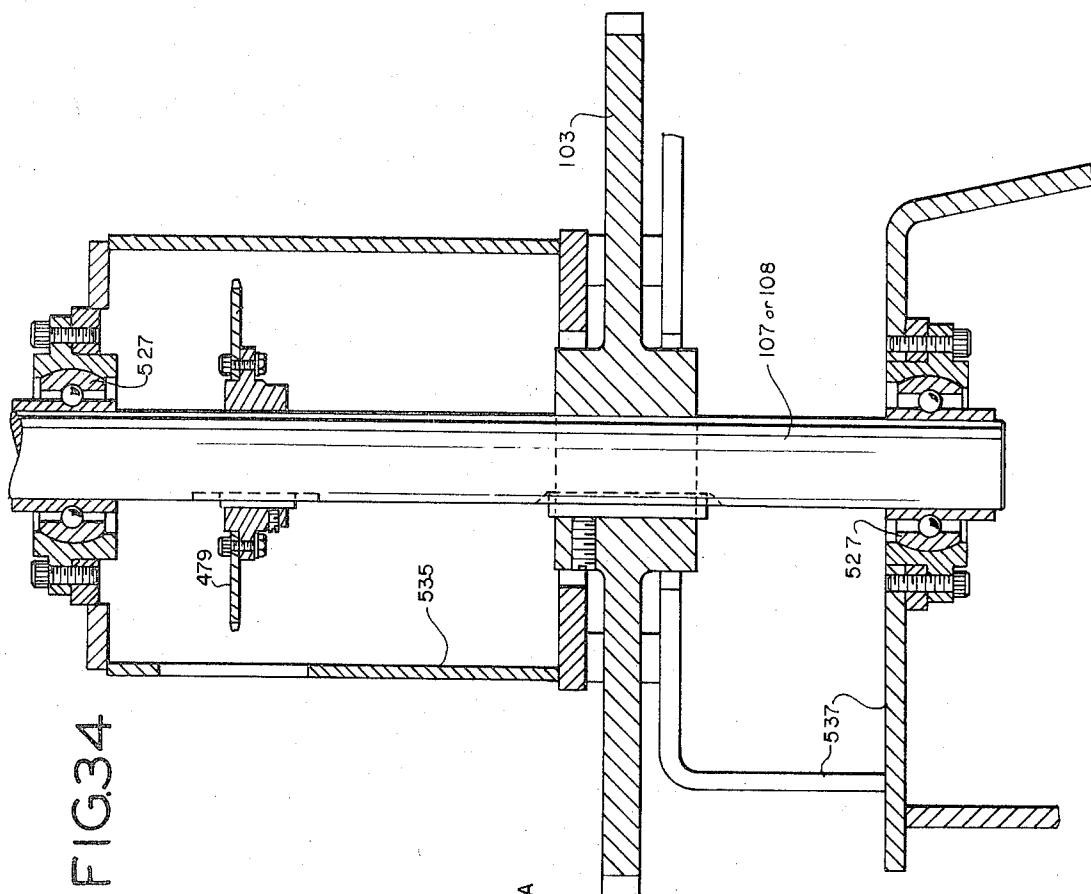
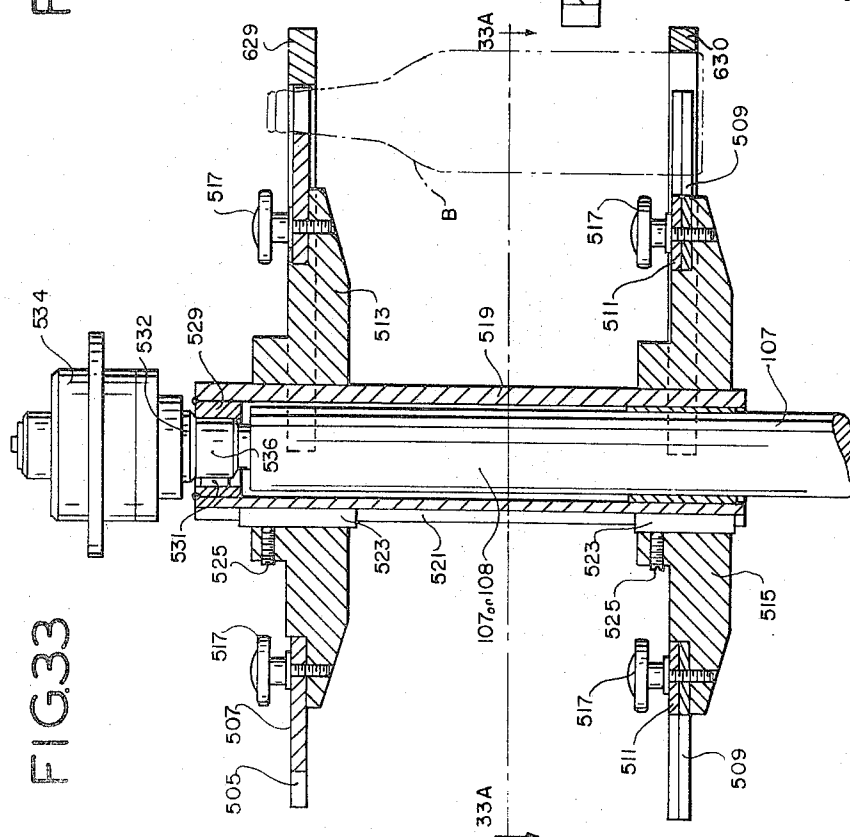


FIG. 31

FIG. 32



4314



336

FIG.36

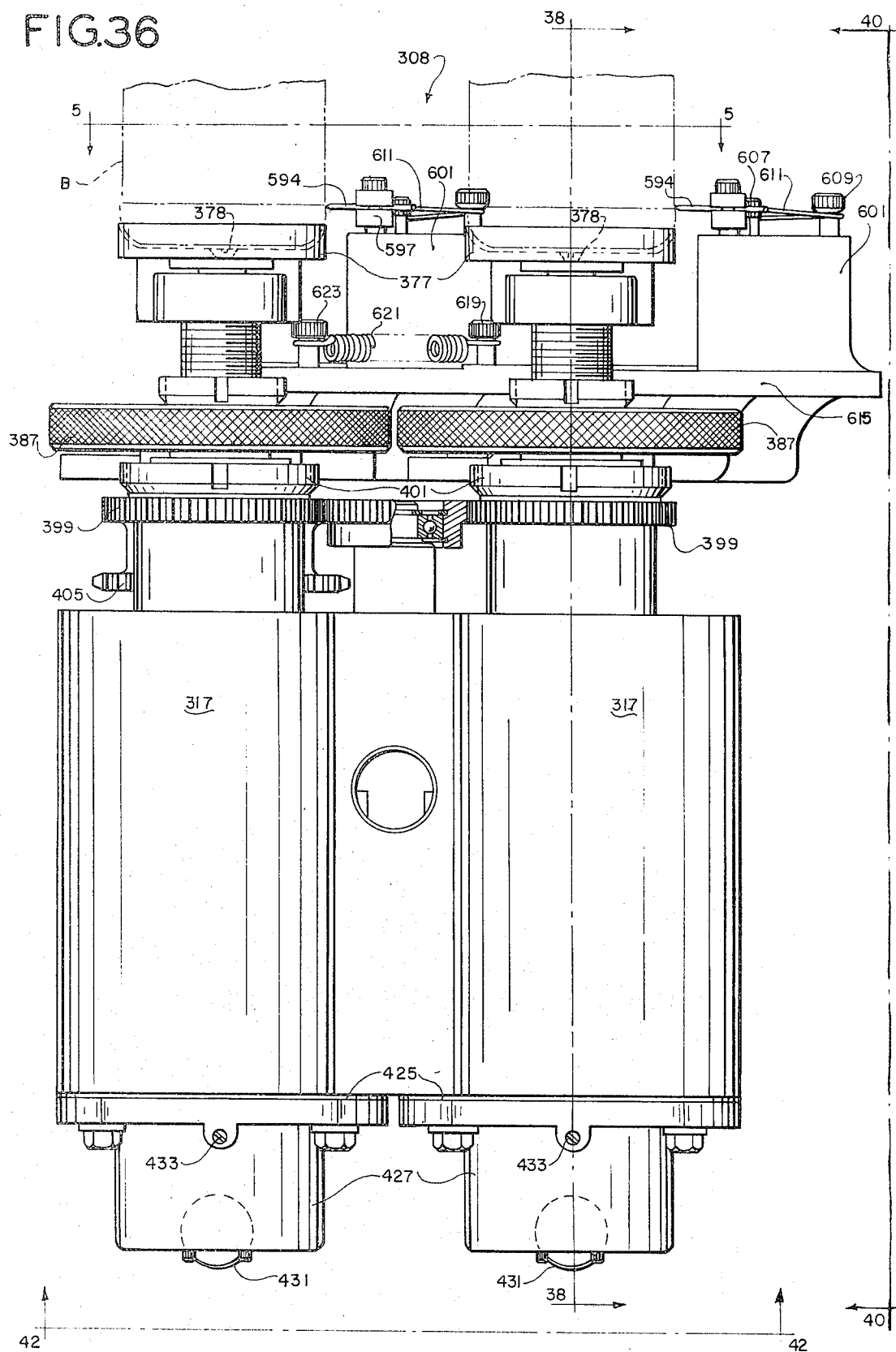


FIG. 37

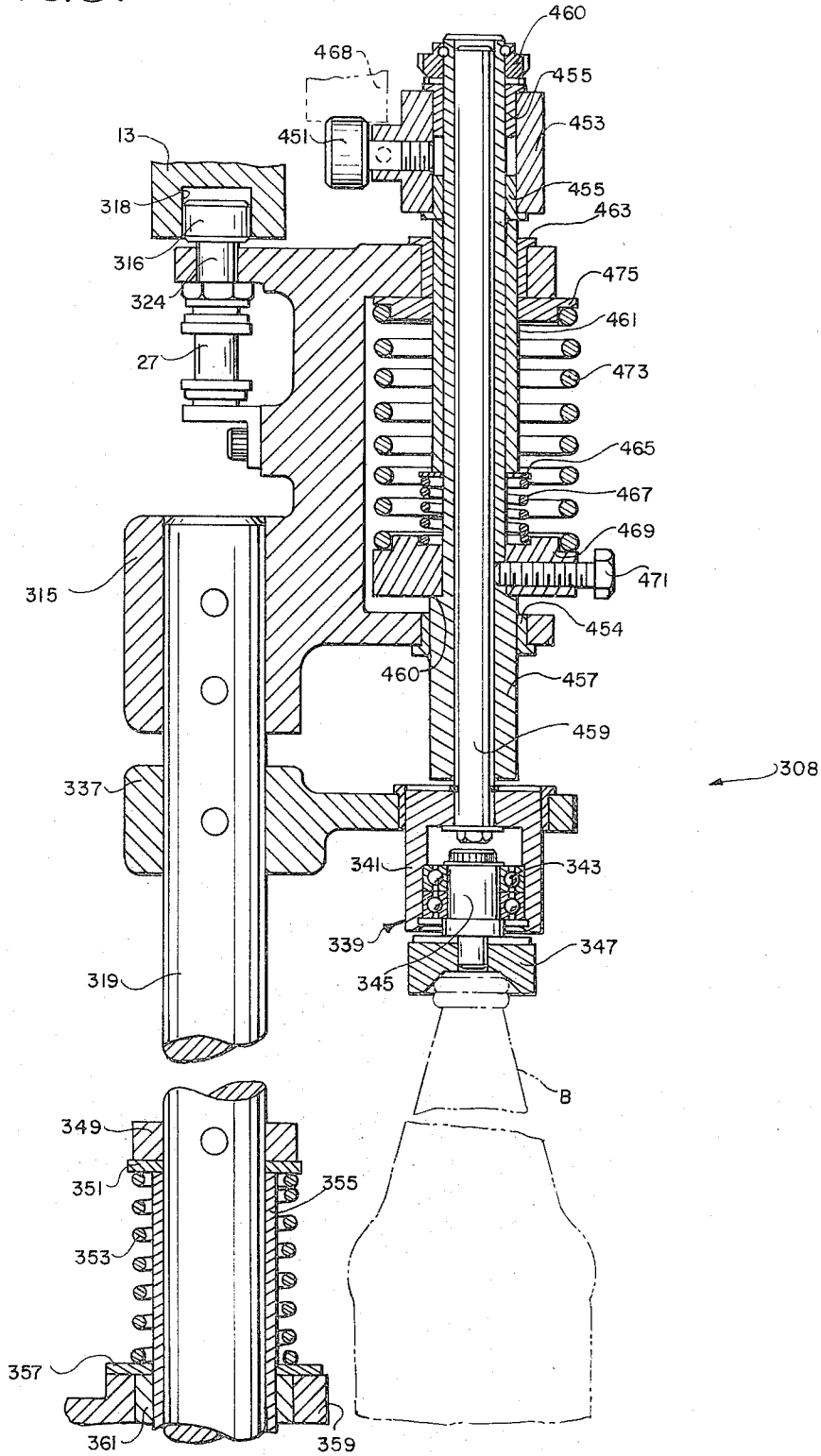


FIG.38

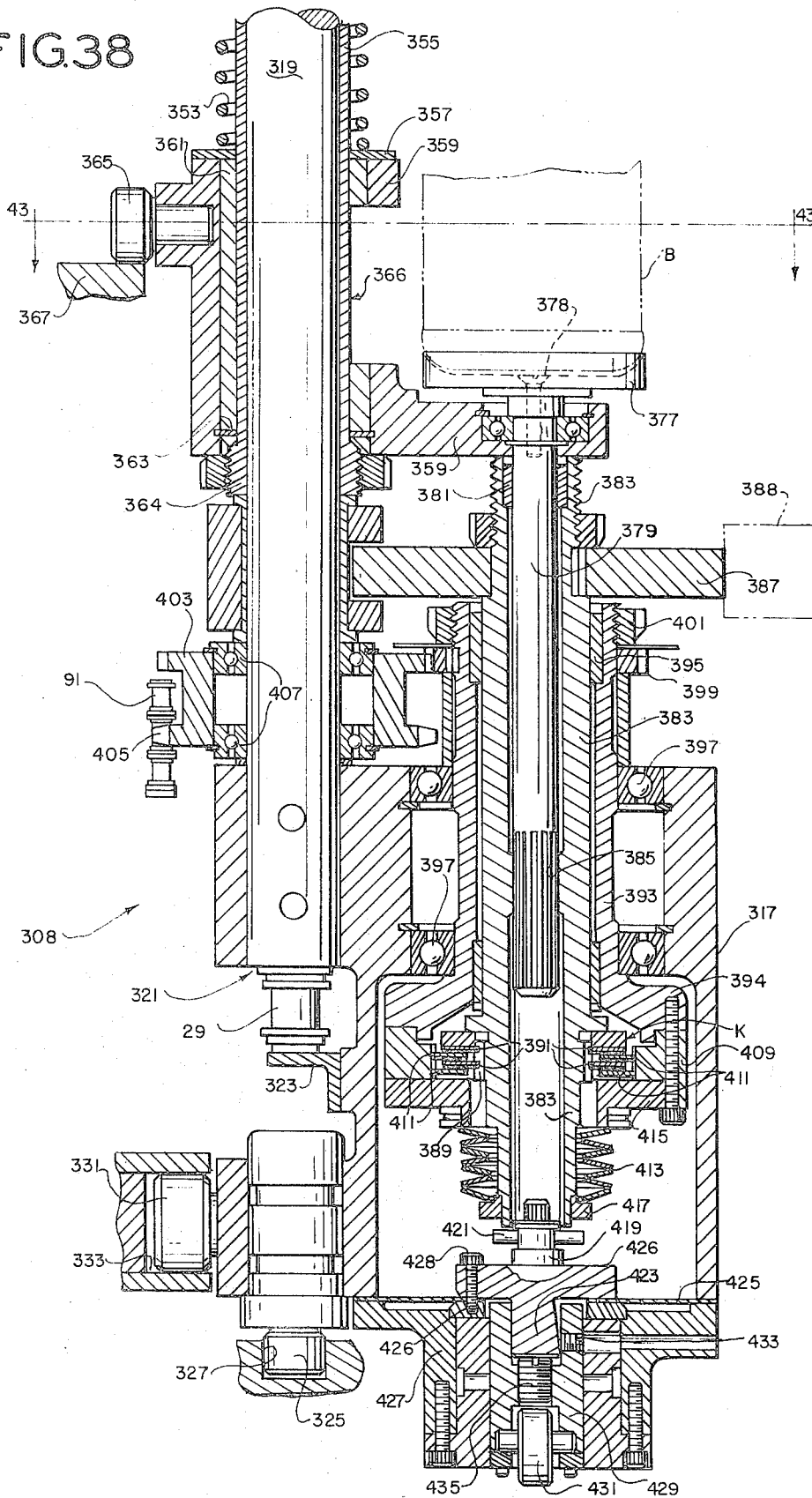


FIG.39

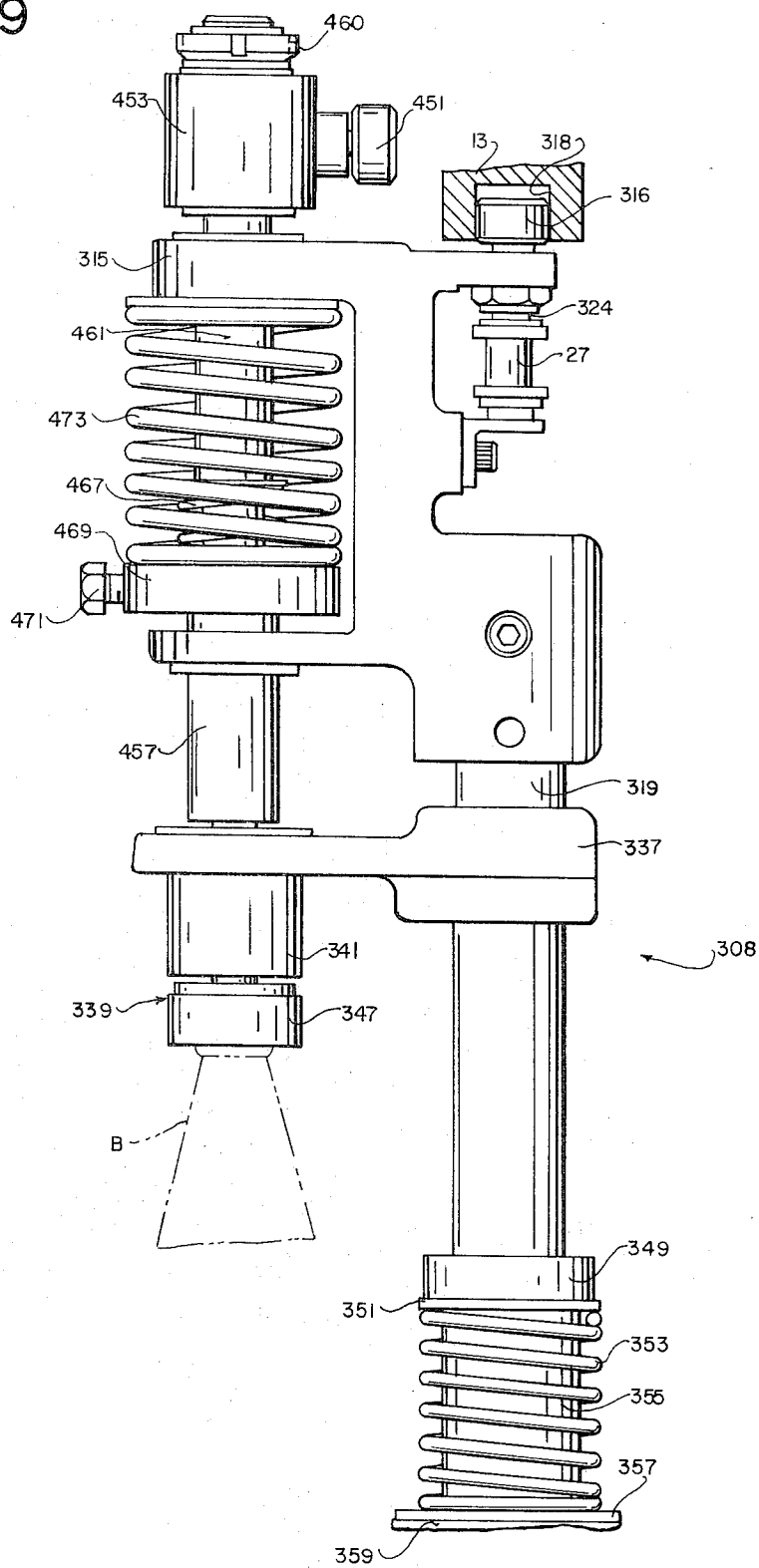


FIG.41

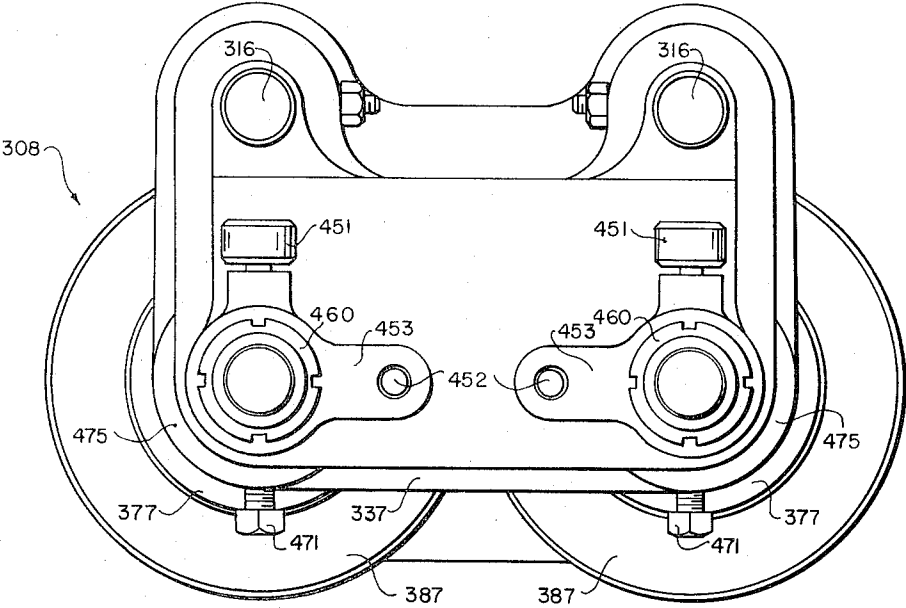


FIG.42

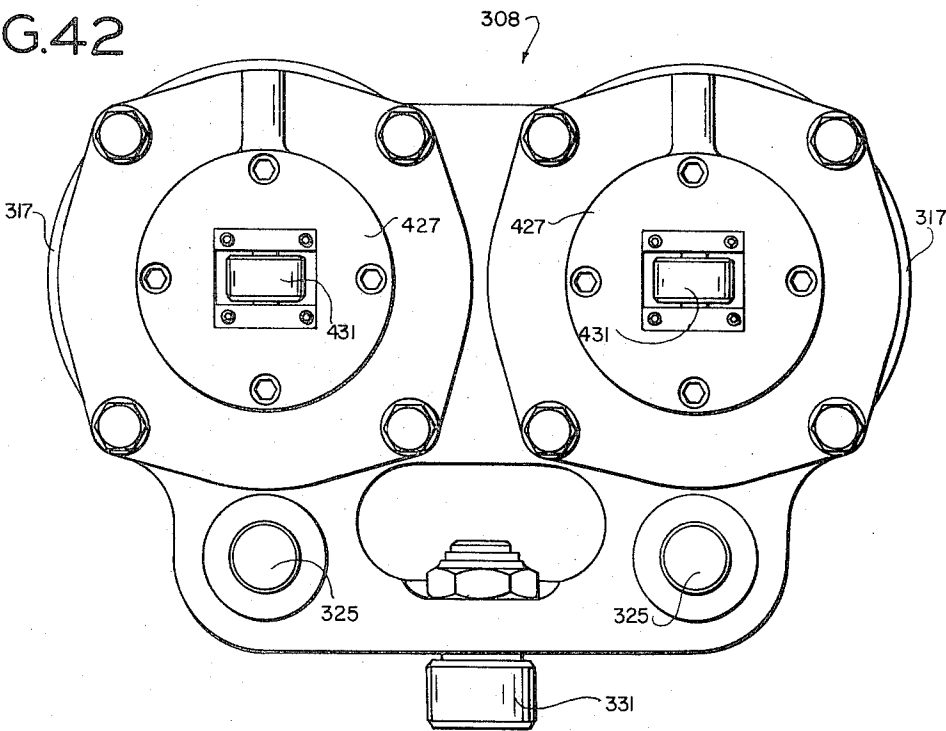


FIG.44

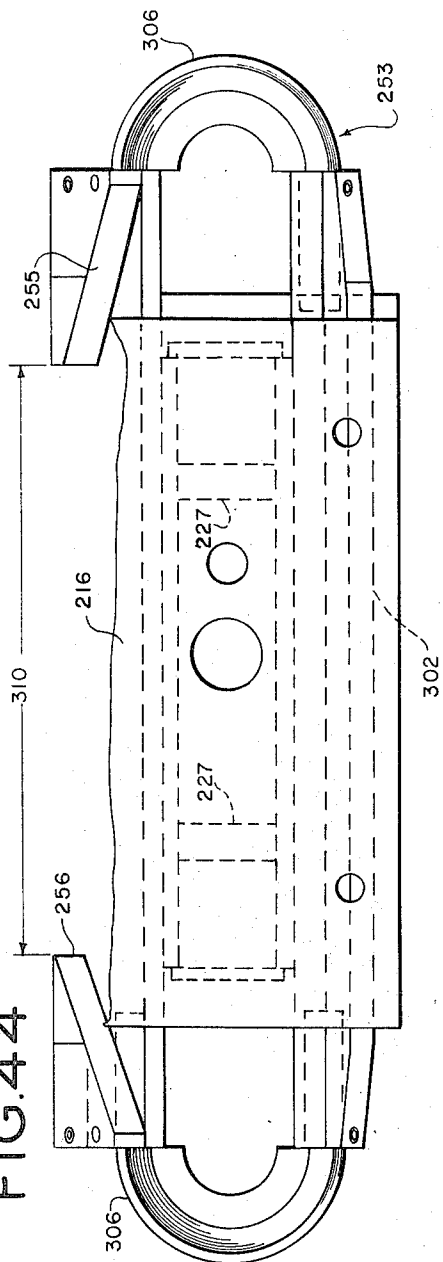


FIG.46

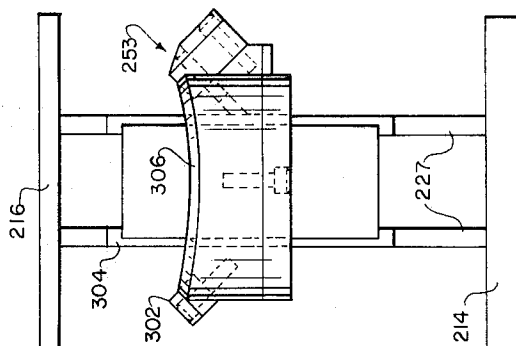


FIG.45

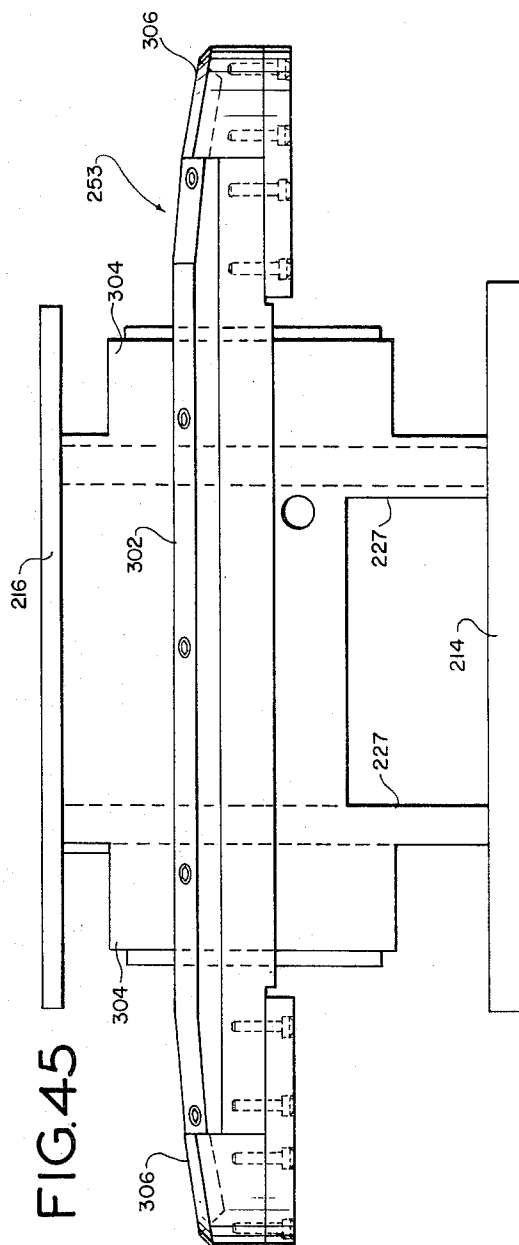


FIG.48

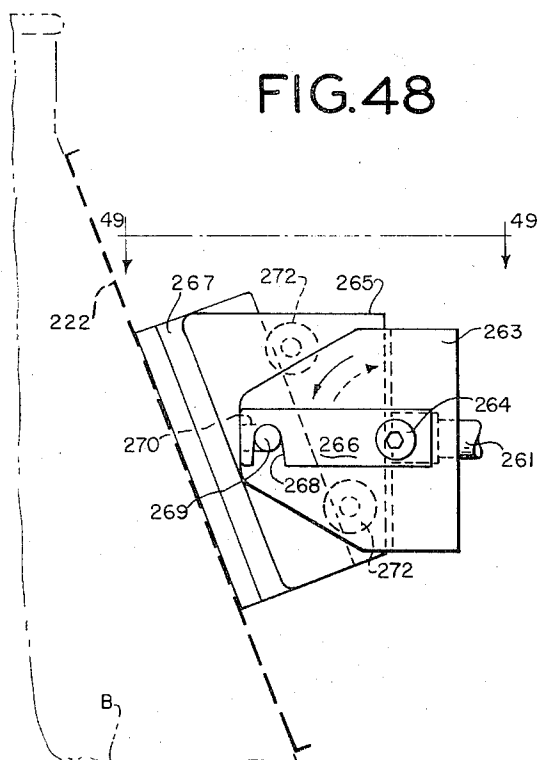


FIG.49

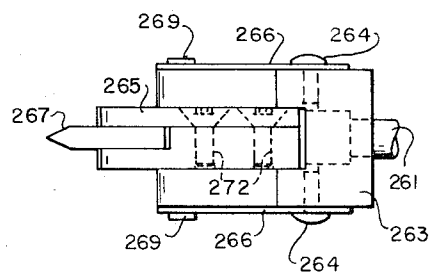


FIG.47

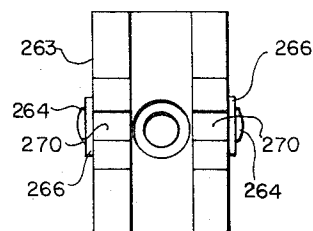


FIG.51

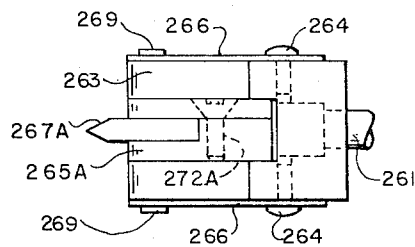
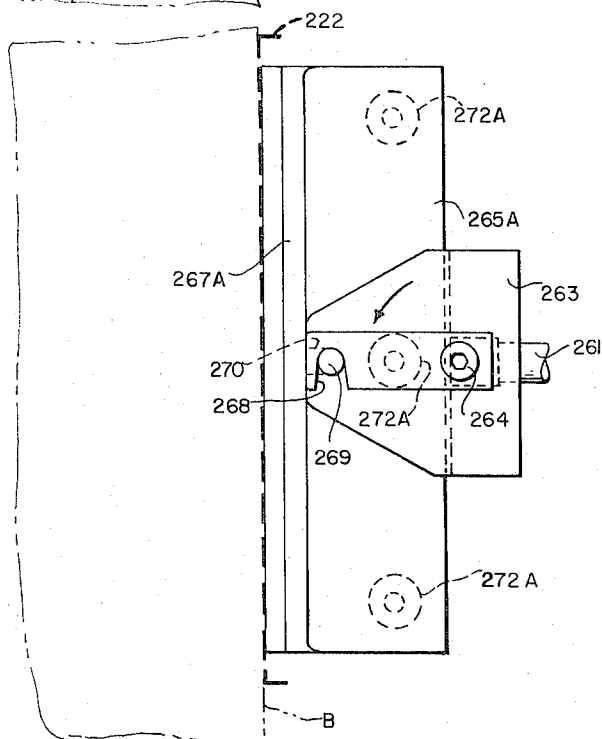
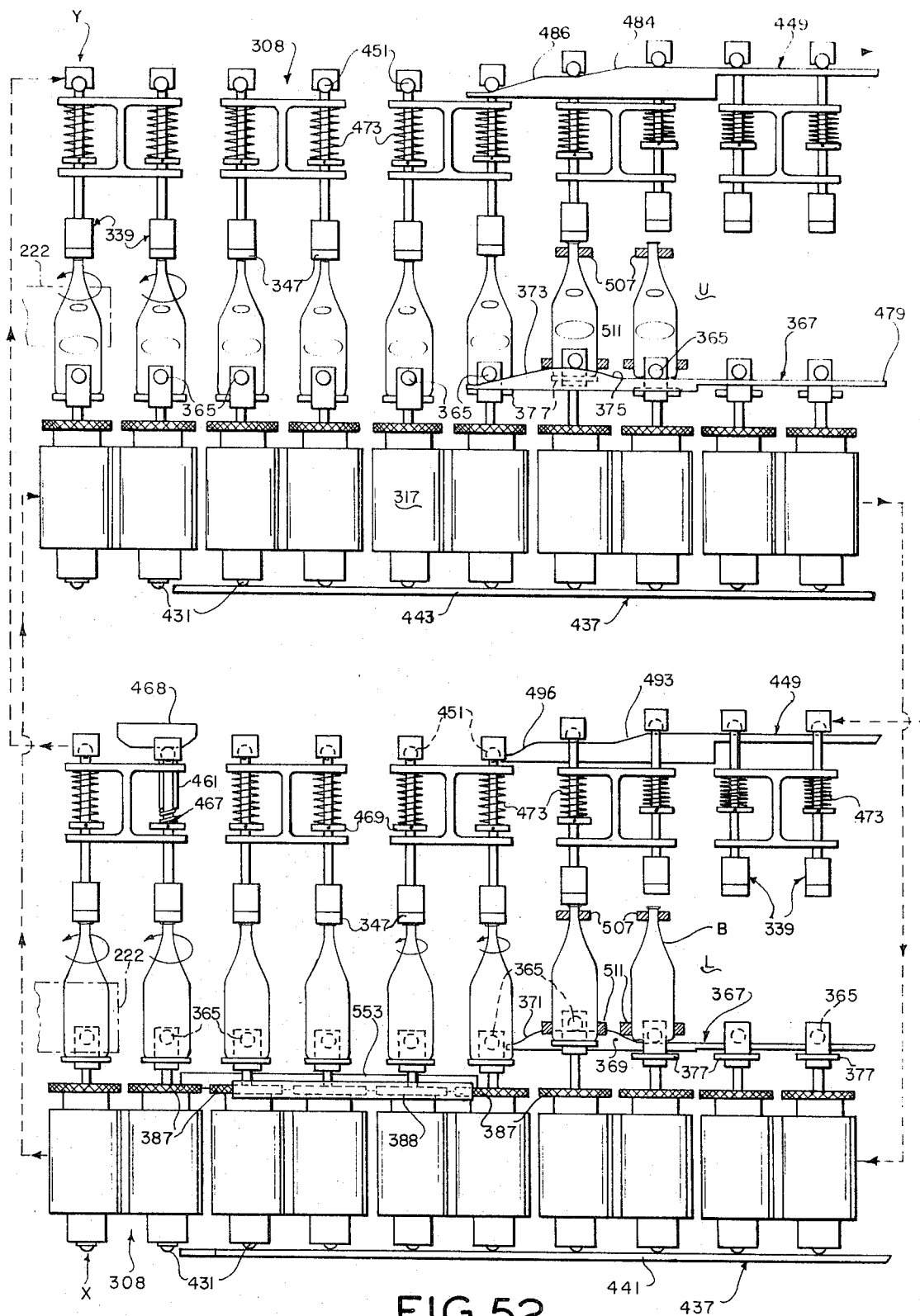


FIG.50





APPARATUS FOR IMPRINTING OBJECTS SUCH AS BOTTLES AND THE LIKE

BACKGROUND OF THE INVENTION

The invention is an improvement upon stencil-screen article imprinting apparatus such as set forth, for example, in U.S. Pat. Nos. 2,767,647, 3,237,555, 3,251,298 and 3,543,680. Complications involved in making adjustments at inaccessible locations on former machines to accommodate runs of a wide variety of articles are excessive. Moreover, the operating speeds of these machines have been comparatively low, particularly in those moving intermittently with concurrent vibrations, all of which have led to high initial and upkeep costs.

SUMMARY OF THE INVENTION

By means of the present invention there is provided a continuously operating, comparatively trouble-free, high-speed bottle or like article-imprinting machine which has highly accessible means for adjustments and is simple to set up for a wide variety of production. Accurate registration of imprints on articles is obtained in various colors on a wide variety of article sizes and shapes. Loading and unloading are very convenient.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a fragmentary diagrammatic plan view of the machine showing certain bottle and squeegee conveyors, parts being omitted for clarity;

FIG. 1B is an oblique diagrammatic view illustrating driving elements for several squeegee conveyors;

FIGS. 2, 3 and 4 are vertical sections taken approximately on lines 2—2, 3—3 and 4—4 respectively of FIG. 1A;

FIG. 5 is a horizontal section taken on lines 5—5 of FIGS. 4 and 36 showing registration means;

FIG. 6 is a plan view of a base-chuck cam arrangement;

FIG. 7 is a front elevation of FIG. 6;

FIG. 8 is a rear elevation of FIG. 6;

FIG. 9 is a vertical section taken on line 9—9 of FIG. 4;

FIG. 10 is a plan view of a cam arrangement for chucking of articles;

FIG. 11 is a rear view taken across line 11—11 of FIG. 10;

FIG. 12 is a front view taken across line 12—12 of FIG. 10;

FIG. 13 is a plan view of a cam arrangement for opening and closing chuck-driving clutches;

FIG. 14 is a section on line 14—14 of FIG. 13;

FIG. 15 is a diagrammatic plan of a squeegee conveyor;

FIG. 15A is a fragmentary front elevation of a carriage for slantingly supporting the squeegee conveyor illustrated in FIGS. 15, 16 and 17, certain drive parts at the right-hand end being omitted;

FIG. 15B is a right-end elevation viewed across line 15B—15B of FIG. 15A;

FIG. 15C is a fragmentary horizontal section taken on line 15C—15C of FIG. 15A;

FIG. 15D is a rear elevation of the carriage shown in FIG. 15A being viewed across line 15D—15D of FIG. 15C, with driving parts added, said driving parts omitted from FIGS. 15A, 15B and 15C being shown at the left;

FIG. 16 is a section on line 16—16 of FIG. 15;

FIG. 17 is a section on lines 17—17 of FIGS. 1 and 15;

FIG. 18 is a vertical section taken on line 18—18 of FIG. 15 and illustrating an air distributor valve;

FIGS. 19, 20, 21 and 22 are cross sections taken on lines 19—19, 20—20, 21—21 and 22—22, respectively, on FIG. 18;

FIG. 23 is an air conduit diagram for the squeegee conveyor shown in FIGS. 15, 16 and 17;

FIG. 24 is a plan view of a color container;

FIG. 25 is a view across line 25—25 of FIG. 24;

FIG. 26 is a view across line 26—26 of FIG. 25;

FIG. 27 is a view illustrating a cylindrical color lifting drum and appurtenant parts;

FIG. 28 is a broken view across line 28—28 of FIG. 27;

FIG. 29 is a view similar to FIG. 27 but showing a different shape of a color lifting drum;

FIG. 30 is a plan of a tilting stencil screen assembly;

FIG. 31 is a front elevation of FIG. 30;

FIG. 32 is a right-end view of FIG. 31;

FIGS. 33 and 34 are upper and lower portions of a cross section taken approximately on line 33—33 of FIG. 1A;

FIG. 33A (adjacent FIGS. 27—29) is a cross section taken on line 33A—33A of FIG. 33 but reduced in scale;

FIGS. 35 and 36 are upper and lower portions of a cross section taken on line 35—35 of FIG. 1A;

FIGS. 37 and 38 are upper and lower sections taken on line 37—37 of FIG. 35 and line 38—38 of FIG. 36, respectively;

FIG. 39 is a view across line 39—39 of FIG. 35;

FIG. 40 is a view across line 40—40 of FIG. 36;

FIG. 41 is a plan view across line 41—41 of FIG. 35;

FIG. 42 is a bottom view across line 42—42 of FIG. 36;

FIG. 43 (adjacent FIG. 15B) is a cross section on line 43—43 of FIG. 38;

FIG. 44 is a plan view of a squeegee control cam, parts being broken away;

FIG. 45 is a front elevation of FIG. 44;

FIG. 46 is a right-end view of FIG. 45;

FIG. 47 is an end view of a clevis used for interchangeably mounting strikers;

FIG. 48 is a side elevation illustrating a short striker in the clevis of FIG. 47 for use on bottle shoulders;

FIG. 49 is a plan view across line 49—49 of FIG. 48 showing the short striker of FIG. 48;

FIG. 50 is a view like FIG. 48 illustrating a long striker in the clevis of FIG. 47 for use on bottle sides;

FIG. 51 is a view like FIG. 49 illustrating the long striker of FIG. 50; and

FIG. 52 is a diagram illustrating certain functions.

Scales for the various views have been variously selected for best clarification of the parts illustrated by the respective figures.

Corresponding reference characters indicate corresponding parts throughout the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, the apparatus in general comprises a substantially vertical main bottle conveyor 1 (FIG. 1A) for effecting parallel linear bottle movements with the bottle axes substantially vertical. FIGS. 2, 3 and 4 show features in vertical sections at right, left

and middle portions respectively of FIG. 1A. Flanking opposite straight sides of the conveyor are first and second assemblies 3 and 5 which are individually movable on guides along the opposite sides of bottle conveyor 1. The assemblies 3 and 5 support identical squeegee conveyors 7 and 9, respectively (parts of which are further illustrated in FIGS. 15-23 and 44-46). Thus the combinations of (3,7), (5,9) constitute what may be called first and second movable printing stations respectively. The squeegee conveyors 7 and 9 of these assemblies slant outwardly over color containers 12 in the assemblies 3 and 5, respectively. The containers 12 are shown in detail in FIGS. 24-29. They provide for outside color pools, one under each slanted squeegee conveyor 7 or 9. Carried with the squeegee conveyors 7 and 9 are identical tilttable stencil screens 8 and 10, respectively (better shown in FIGS. 30-32). Thus the movable assemblies 3 and 5 each include an inside tilttable stencil screen (8 or 10), an outside color container 12 to provide a color pool, and a squeegee conveyor (7 or 9) for carrying color from its pool to its stencil screen (FIGS. 15-17), each squeegee conveyor being adjustably mounted upon its carriage. The adjusting means is shown in detail in FIGS. 15A, 15B, 15C and 15D.

As shown in FIGS. 2-4, conveyor 1 comprises a live vertical drive shaft 11 (FIG. 2), rotatably supported by bearings 14 and 16 in a pair of upper and lower rigid head and base assemblies 13 and 15, respectively, connected by supporting columns 18. At 17 is a vertical dead shaft affixed to upper and lower supports 19 and 21 which slide in slots of the upper and lower assemblies 13 and 15, respectively. Keyed to the live shaft 11 are identical upper and lower sprockets 23 and 25 in driving mesh with upper and lower bottle-carrier chains 27 and 29 which are also in mesh with sprockets 31 and 33 on dead shaft 17 (FIG. 3). Sprockets 31 and 33, by means of bearings 35 and 37, are rotatable on shaft 17 as idlers. By sliding the supports 19 and 21 on the frame assemblies 13 and 15, the dead shaft 17 may be moved in parallel with respect to the live shaft 11 to effect proper chain tensioning by use of two screw jacks 39 provided on frame assemblies 13 and 15. Pins 41 and 43 extending from heads 19 and 21 telescope sleeves 45 and 47 through interposed springs 49 and 51. Screws 53 of the jacks 39 have heads 55 engaging the sleeves 45 and 47 to adjustably compress the springs 49 and 51, thereby resiliently tensioning chains 27 and 29. Jacks 39 are cross-connected for synchronous action by a geared cross-coupling shaft 57, thereby obtaining equal adjustments of the ends of shaft 17. Each jack has an operating spindle 58 to either of which may be applied an operating crank or the like (not shown).

Additional bearings 59 in the upper and lower frame assemblies 13 and 15 support a rotatable countershaft 61 (FIG. 2). A central bearing 63 for countershaft 61 is carried on a bracket 65 supported by a gusset 67 extending from one of the columns 18 between assemblies 13 and 15. Live shaft 11 drives the countershaft 61 at reduced speed through a change-speed, change-gear train 69, 71, 73, 75 located in an upper gear case 77. Case 77 is openable by conventional means (not shown). The gear cluster 71,73 of this train is on stub shaft 79 supported in bearings 81 in the upper frame assembly 13. By interchanging gears 69, 71, 73 and 75 with others like them but of different pitch diameters,

the rotational speed of the countershaft 61 may be changed.

Keyed to countershaft 61 is a gear 83 which meshes with gear 85 clustered with a double sprocket 87. The cluster 85,87 rotates around live shaft 11 on bearings 89. Double sprocket 87 drives the outside reaches of a triple bottle-turning chain 91 extending to a double idler sprocket 93 carried on bearings 95 on dead shaft 17. Chain 91 is driven by the train of parts 69, 71, 73, 75, 61, 83, 85, 87 extending from shaft 11 of conveyor 1. Thus, under a constant speed of live shaft 11, the speed of the bottle-turning chain 91 may be varied by changing gears 69, 71, 73 and 75. The shaft 11 is driven from its lower end from a speed-reducer 101 which in turn is driven from a conventional variable-speed input drive (not shown).

Near the lower end of live shaft 11 are keyed a double sprocket 97 and a gear 99. Gear 99 meshes with equal gears 103 and 104 on vertical shafts 107 and 108 respectively (FIG. 1A), which drive bottle hanging spools described below. The pitch diameter of the double sprocket 97 equals that of sprockets 23 and 25. Sprocket 97 drives a double chain 109. Thus the tangential speeds (around their sprockets) and consequently the linear speeds elsewhere of chains 27, 29 and 109 are the same. The purpose of chain 109 is to provide a drive for the squeegee conveyors 7 and 9 in any of various positions that the assemblies 3 and 5 may assume along its side of the bottle conveyor 1.

Referring to FIGS. 15-17, each of the assemblies 3 and 5 comprises a carriage 111 formed with lateral members 113 and 115 which ride on fixed guides or tracks 117 and 119 extending along the sides of the bottle conveyor 1. A lead screw 121, threaded through a nut 122 on and under each carriage 111, is rotatable but axially fixed relatively to the guides 117,119 and serves to adjust the position of the respective carriage 111 along the length of its guides 117,119 whereby each printing station assembly 3 and 5 may be adjusted in position along its side of the bottle conveyor 1. The screw 121 may be turned by suitable means applied to its head 126. Conventional locking means (not shown) serves to hold each carriage 111 in any adjusted position along a side of the article conveyor 1.

At one end of each carriage 111 is mounted a transmission housing 131 (FIGS. 15D and 17). Beneath it is supported an external horizontally disposed double drive sprocket 125 (FIGS. 1B, 15D and 17). Sprocket 125 is at the level of chain 109. Adjacent sprocket 125 is a horizontally disposed double idler sprocket 127 also level with chain 109 for guiding the chain 109 into mesh around sprocket 125 to drive it. Sprocket 125, constituting a branch drive, drives a vertical shaft 129 extending into the housing 131. In FIGS. 15A, 15B and 15C these sprocket and transmission parts are omitted but the supporting platform for them on carriage 111 is shown at 112. At the upper end of the shaft 129 in housing 131 is a right-angle, bevel-gear drive 133 (see FIGS. 1B and 15D). This drives a stub shaft 135 extending laterally from the housing 131, the purpose of which appears below.

On each carriage 111 (FIGS. 15A, 15B, 15C and 15D) are transverse guides 137 including locking plates 139 for sliding parts 140 of a first cross-sliding lower support 141 having depending nuts 143 for screws 145 borne in the carriage and threaded through the nuts 143. Each screw 145 carries a sprocket 147 connected

by a chain 149 for a 1:1 rotation of the screws, whereby the transverse position of the carriage 141 may be varied.

The cross-slider 141 includes vertical guides 151 having locking plates 153 for a second and vertically sliding support 155. This second support 155 includes two vertical racks 157 meshing with pinions 159 on a shaft 161 borne in the first support 141 driven from a shaft 163 also borne in the first support 141. This occurs through a right-angle worm-gear drive 165. By turning a head 167 on shaft 163, the shaft 161 may be turned so as to raise or lower the slider 155 through action of the pinions 159 on the racks 157. The worm-gear drive 165 is irreversible in the sense that the shaft 161 may be driven in either direction from the shaft 163, but shaft 161 will not in reverse drive shaft 163. Thus, any vertically adjusted position of the slider 155 will be self-locking against gravitational force on the racks 157.

Each vertical sliding support 155 includes an angle bracket 169 which supports a plate 171 angled at 45° with respect to the horizontal. Each plate 171 supports a squeegee conveyor, 7 or 9 as the case may be (shown best in FIG. 17). Thus each squeegee conveyor is maintained at 45° with respect to the vertical position of the bottle conveyor 1. As illustrated in FIGS. 1A and 17, each extends upwardly and outwardly over its respective color container 12, the latter being adjustably bolted to a bracket 175 as shown in FIGS. 17, 24, 25 and 26. The bracket 175 forms a rigid extension from the second support 155.

Supported in bearings on the sides of the color container 12 is a cross shaft 179 on which is mounted a drum 181. This drum may be cylindrical as shown at 181 in FIGS. 24, 27 and 28, or conical as shown at 180 in FIG. 29, for purposes to be described. The shaft 179 and drum 180 or 181 are driven from a sheave 183, powered through a belt from a suitable motor (not shown) carried on bracket 175. Walls 182 of each container 12 are provided with handles 184 for convenient removal and replacement with different colors therein. The other walls 186 are notched as shown at 188. At the notches 188 the walls are sandwiched between pairs of plates 190 at one end of shaft 179 and 194 at the other end. These form dams. Each outer dam-forming plate 190 and 194 carries a bearing 196 held by bolts 198 extending through the inner plates. Thus by loosening the bolts 198 the dams 190 and 194 may be moved up or down by screws 204 with resulting vertical movement of the shaft 179. Thus the elevation of either drum 181 or 180 may be adjusted while preventing overflow of paint through notches 188 when the bolts 198 are tightened and the container filled. The containers 12 as a whole rest on plates 206 adjustable in elevation by screws 208 held by locknuts 210. An appropriate level of color to be maintained is shown at 212.

Each of the stencil screens 8 and 10 (FIGS. 1A, 17 and 30-32) comprises a frame 220 supporting conductive wire mesh 222 which is electrically heated in conventional manner between terminals 224. Heating thins thick color for easy passage through the screen. If this is not required the screen may be composed of a fabric mesh such as rayon. The frame 220 carries end members 226 to which are attached ears 228. The ears 228 each carry an arcuate lug 230 operative in an arcuate groove 232 formed in a piece 234 bolted by means of three studs 238 to the sides of brackets 236 connected

to a shroud part or splash fence part 248 of the respective squeegee conveyor served by the screen. The arcs defining the grooves 232 have collinear virtual centers C lying centrally in the plane of the wire mesh 222 of the screen so that it may be tilted around a line through the center of its area. This is indicated by the radial darts D in FIGS. 17 and 32. This arrangement avoids the need for readjusting the lower squeegee conveyor support 141 when the tilt of the screen 222 is adjusted.

From the above it will be seen that each squeegee conveyor 7 and 9, including its color container 12 and the screen 222, is as a whole orthogonally movable, which is to say along a side of the article conveyor 1, and transversely and vertically with respect thereto. In addition each screen 222 may be tilted from a vertical position (for use on bottle sides) to angular positions (for use on bottle necks).

Referring to FIGS. 1B and 15-23, each squeegee conveyor 7 or 9 has a live drive shaft 189 (FIGS. 1B and 16) carrying a pair of equal sprockets 191, keyed at 192, and a dead shaft 193 carrying equal idler sprockets 195 on bearings 197. Chains 199 for circulating squeegee carriers connect the pairs of sprockets 191 and 195. A right-angle bevel gear drive 201 (FIGS. 1B, 15D and 16) is provided for each live shaft 189. This has a stub input shaft 202. The bevel-gear drive 133 with its driving sprocket 125 moves at the fixed level of chain 109 along a side of the article conveyor 1, while the bevel-gear drive 201 (along with the squeegee parts driven thereby) is movable transversely and vertically relative thereto. To connect the relatively movable drives 133 and 201 there are used two universal joints 203 and 205 connected to the stub shafts 202 and 135 respectively. A splined telescoping shaft 207 connects joints 203 and 205. The splines are numbered 209. Thus, the squeegee conveyors 7 and 9, at any desired transverse or vertical positions, may be driven from the constant-level sprocket 125. Under adjustments along chain 109 the sprockets 125 roll on the chain 109 which may or may not be moving. This occurs with a 90° arc of mesh brought about by the idler sprocket 127 mounted on each slider 111. As shown in FIG. 1B, the lower sprocket 97 on live shaft 11 drives the chain 109 which is led over a course including idler sprockets 213, 215, 217 and 218 carried on shafts which are borne in the fixed framework of the machine (FIG. 1B). The shafts 11, 213, 215, 217 and 218 are stippled for easy identification of this fact in FIG. 1B. However, the bearings for the shaft of idler 215 are adjustable in the framework of the machine as indicated by the darts on FIG. 1B for properly tensioning the chain 109. The course of chain 109 includes reaches on opposite sides of the main conveyor 1, each reach moving parallel to the main conveyor length.

Referring to FIGS. 15-17, these show one of the identical squeegee conveyors 7,9 supported upon one of the identical angled plates 171 as shown in FIG. 15A. Attached to each plate 171 is a positioning plate 172. Openings 174 and 176 extend through plates 171 and 172. Each of the conveyors 7 and 9 has at one end a fixed bottom plate assembly 219 on which is mounted the aforesaid right-angle drive 201. Above the bottom plate assembly 219 is a top plate assembly 221. These assemblies are rigidly connected by central spacing supports 227 extending from a lower plate 214 to an upper plate 216. Live shaft 189 is supported in bearings

223 and 225 in the bottom and top plate assemblies 219 and 221.

At the opposite end of each conveyor 7,9 is a movable lower plate assembly 229 rigidly connected with another movable plate assembly 231 joined by a dead shaft 193. These assemblies 229 and 231 are slidable with respect to the upper and lower plate assemblies 219, 221. Interposed between the assembly 219,221 on the one hand and the plate assembly 229,231 on the other hand are compression springs 233. These bias apart the plate assemblies. The springs 233 are variably compressed by means of a horizontally sliding wedge 235 operated by a cross sliding wedge 237 operated by transverse manually operated screws such as shown at 239 (FIG. 15).

The live shaft 189 drives the sprockets 191. Shaft 193 carries idler sprockets 195 on bearings 197. Chains 199 connect these sprockets. The chains 199 are tensioned by wedging the adjustable tensioning springs 233.

Bearings 241 in the upper and lower plate assemblies 219,221 rotatably support a central rotatable shaft 243 for operating an air distributor valve 245 shown more particularly in FIGS. 18-22. Shaft 243 has a sprocket 247 affixed thereto which is driven by a chain 249 from a smaller sprocket 251 affixed to the live shaft 189. The connecting structure 227 supports a squeegee cam rail 253 also shown in FIGS. 44-46 and to be described more in detail below.

The conveyor chains 199 support twelve squeegee carriers 257 which, when the live shaft 189 rotates, will circulate around the squeegee assembly. Each of these carriers 257 carries follower rollers 258 guided in tracks 260, and also rollers 262 guided in tracks 264. The tracks are constructed in the lower plate assemblies 219,229. The tracks 260 have suitable tongue-and-groove overlaps as indicated at 268 to constrain the follower rollers 258 and 262 under any adjustments for chain tensioning.

Each squeegee carrier 257 is provided with a lined cylinder 259, the center line of which extends at a 45° angle with respect to the center lines of the shafts 189 and 193. Reciprocable within the lining of each cylinder 259 is a piston rod 261 carrying at its inner end a follower roller 275 engaging the squeegee control cam 253. The rod 261 at its outer end supports a clevis 263 which is slotted as shown at 270 (FIGS. 47-50). Rotatably attached to the outsides of the legs of the clevis 263 by screws 264 are catch bars 266. Each bar is notched as at 268. In the case of FIG. 48, gudgeons extend from clamp plates 265 which are held together by screws 272. The plates 265 are shaped so as angularly to hold between them a short resilient squeegee striker blade 267 for use with stencil screen 222 when tilted for use on bottle shoulders as illustrated in FIG. 48. The gudgeons 269 extending from the plates 265 are held in place in slots 270 by notches 268 at the ends of the catch bars 266 when the latter are turned as indicated by the solid dart in FIG. 48. When the catch bars 266 are lifted as shown by the dotted dart, the clamp plates 265 and the striker blades 267 held thereby may be removed from the clevis 263 for replacement (as shown in FIG. 50) by gudgeons 269 which in this case extend from longer clamp plates 265A held together by screws 272A. Plates 265A hold a long resilient striker blade 267A for use with the stencil screen 222 when vertically disposed for use on bottle sides, as shown in FIGS.

48-51. Thus the squeegee striker blades 267 and 267A are quick-detachable.

Referring to FIG. 15, a crosshead 271 is attached to each piston rod 261 with its end face slidable on a plate 273 bolted to each barrel 259. This arrangement prevents rotation of the rods 261 and of the squeegee blades 267 or 267A around the axes of the piston rods 261. At the inner end of each rod 261 the cam follower roller 275 cooperates with the cam rail 253. The shape of the rail 253 is detailed in FIGS. 44-46. It has a straight reach 302 attached to wings 304 extending from the supports 227 and has curved ends 306 terminating in downwardly sloping drop and lift parts 255 and 256 respectively, leaving an open reach 310 between them. The open reach is adjacent the location at which the screen 222 is mounted.

Referring to FIGS. 16 and 44-46, it will be seen that there is no need for making the cam rail assembly 253 in telescoping sections to accommodate for chain tensioning adjustments, because its guide surfaces engaged by follower rollers 275 (FIG. 16) slope at 45°, the same as the 45° movements of the rollers 275 and the piston rods 261. Thus when the squeegee carriers 257 are adjusted endwise, the positions of the cylinders 259 relative to the rods 261 may change without affecting the rod positions, sufficient clearances being provided for the purpose between the piston strokes and the cylinder ends. In FIG. 16 the maximum separation between shafts 189 and 193 is illustrated.

In each barrel 259 is a piston 303 carried on the respective piston rod 261. Each piston slides in a cylindrical insert liner 276 and divides the barrel 259 into a lined outer compartment 277 and a lined inner compartment 281. These outer and inner liners are lettered 278 and 280 respectively. They include packing heads 312 and 314 respectively and also inner air-passing stops 320 and 322 respectively. Compartment 277 has a port 279 connecting it with a low-pressure air supply through a manifold 309. Each compartment 281 has a port 283 connecting it with a high-pressure air supply through the air distributor valve shown generally at 245. In each compartment 277 and 281 is a linear roller bushing 285 which, for example, may be of the type known as a Thompson ball bushing, to provide antifric-tion reciprocation of each rod 261 within cylindrical end liners 278 and 280.

Connection to suitable piping from a constant comparatively low-pressure air source (not shown) is made through a swivel joint 286 at the lower end of shaft 243 which is hollow as shown at 307. Connected at the upper end of hollow shaft 243 is a manifold 309. This has twelve outlets 311 connected by flexible air lines 282 with the twelve inlets 279 of the front compartments 277 of the twelve barrels 259, respectively. Thus a constant supply of low-pressure cushioning air is maintained on the outsides of pistons 303.

Referring to FIGS. 16 and 18-23, an air distributor 245 for high-pressure air is located at the upper end of shaft 243. It includes a rotary valve plate 287 attached by set screws 284 to the upper end of rotatable shaft 243. Plate 287 has twelve high-pressure air outlets 289 connected by flexible connector lines 290 with the air inlets 283 respectively to the rear sections 281 of the barrels 259. Plate 287 is engaged on its underside by an upwardly biased plate 291, bias being provided by springs, one of which is shown at 293. Plate 291 does not rotate, being held by fixed pintles 288 extending

into suitable holes in plate 291. The pintles 288 are surrounded by the springs 293. The pintles extend through the bottom of a fixed casing 292. Casing 292 has a lower flange lower flange by means of which it may be held in any adjusted position by loosening or tightening holding screws 294 of clamping bars 298. Packing 269 is provided between the fixed casing 292 and the rotatable valve plate 287.

The plate 291 is made with an elevated platform 301 in which is an arcuate groove 299 (FIGS. 18-22). A connection 274 is provided between the groove 299 and a pipe 313 which supplies air at comparatively high pressure from a source not shown. The platform 301 is that which sealingly engages the bottom of the rotary valve plate 287 so that as the latter turns high-pressure air is successively delivered to groups of the outlets 289 through the rotating groove 299. Plate 291 also has a depression 297 which, as the depression is sequentially faced by the outlets 289, releases pressure from the lines 290 and thus from the rear compartments of the barrels 259.

Arrangement is made to rotate the valve plate 287 once while any given squeegee carrier 257 completes its circuit. Thus two and two-fifths revolutions of live drive shaft 189 occur in order to rotate the distributor valve plate 287 once and carry a given squeegee carrier around its circuit. As a result, the flexible lines 282 and 290 will not entangle as they circulate. However, they flex to compensate during rotation for different lengthwise reaches from valve 245 to the different distances therefrom of the carriers 257 as the latter circulate.

When comparatively high-pressure air reaches a port 283, the corresponding squeegee is driven outward. As it does so, its follower is forced down against high part 302 of cam 253 so that the strikers 267A pass tangentially above cylindrical drum 181; or strikers 267 pass tangentially above the conical drum 180. After passing from high part 302 each roller 275 rides over a drop portion 255 of cam 253 and then down, at which time the respective squeegee striker 267 or 267A engages the properly tilted screen. On the other side of the screen is a rolling bottle as will be described below. The action of the high-pressure air above each piston 303 is against that of the low-pressure air below it. Thus the resilient strikers 267 serially sweep the stencil screen 222. When the valve 245 releases pressure in a line 290 the low-pressure air supplied over lines 282 returns the piston 303 and retracts the respective striker 267 from the screen 222. It is possible that failure of air pressure may occur in lines 282, in which event the necessary retraction from the screen of the strikers would not occur, with resulting damage to the squeegee mechanism. Lift portion 256 of cam 253 mechanically pulls the strikers from the screen before they reach the end of the screen, thus positively avoiding damage to the machine should the low-pressure air fail. In either event at a time after a follower roller 275 takes a position above the track of cam 253, the distributor valve reinstates the high pressure inside of the respective piston to drive it out so as to engage the respective follower 275 with the cam track. This properly positions the respective striker blade 267 or 267A to move tangentially to color drum 181 or 180 as the case may be.

As above indicated, squeegee strikers are successively to move along each screen 222 as successive bottles are rolled on the other side tangentially to the successive lines of strike. To accomplish this the actions of the

bottle conveyor 1 are synchronized with the actions of the squeegee conveyors. This is accomplished for any adjusted positions of the printing stations 3 and 5 thereby simplifying set-up procedures. Thus the driving chains 27,29 of bottle conveyor 1 support dual bottle carriers 308 (FIGS. 1 and 35-38). Each bottle carrier assembly 308 comprises an upper bracket 315 attached by pins 324 to the upper chain 27. Pins 324 carry follower rollers 316 which move in an upper groove 318 in the upper frame part 13. Attached to and extending downwardly from an overhanging part of the body 315 are two posts 319. These are attached at their lower ends to a double-clutch housing 317 (FIG. 38) in which lubricant is carried. Showing of a lubricant charge is omitted. The lower chain 29 is attached to the lower ends of the posts 319 by attachments 321 and to the housing 317 by a bracket 323 (FIG. 38). The clutch housing supports a lower follower roller 325 which runs in a groove 327 in a piece 329 attached to the lower frame part 15. The clutch housing also includes a horizontal follower roller 331 which runs in a horizontal groove 333 formed by spaced plates attached to the lower frame assembly 15. Each pair of posts 319 below the upper body 315 has attached thereto an auxiliary bracket 337. This bracket 337 in suitable bearings slidably supports a pair of finish chucks 339, each consisting of a vertically slidable cup 341. Bearings 343 within each cup 341 support a spindle 345 which at its lower end carries a resilient holder 347 for bottle lips which carry the usual finish.

Attached to each cup 341 is a rod 459 around which is positioned a quill or sleeve 457. Quill 457 is vertically slidable in a lower bearing 454 in the lower overhanging part of body 315. It is stepped at 460 to support a collar 469 held thereto by a set screw 471 which also holds together the rod 459 and quill 457. At its upper end the quill 457 is slidable through two bearing bushings 455 in a lifter 453 which slides on the quill 457. Fastened to one side of lifter 453 is a follower roller 451. On the upper end of quill 457 is a collar 460 by which, when lifter 453 is raised, so also are the quill 457, the collar 469 and the rod 459 to lift the finish chuck 339. Each lifter 453 is prevented from rotating by a pin 452 extending downward therefrom and slidable in a hole 456 in the top of body 315.

A spring 473 of comparatively low spring rate reacts between the lower collar 469 and an upper collar 475 biased against the overhanging upper part of body 315. A spring 467 of comparatively high spring rate is located between the lower collar 469 and a second quill or sleeve 461 surrounding quill 457. The upper end of sleeve 461 is engaged by the lowermost bushing 455 of lifter 453. The lower end of sleeve 461 engages a washer 465 located on the upper end of a spring 467. The lower end of spring 467 engages the collar 469. When the lifter 453 is depressed by engagement of its follower 451 with a fixed cam 468 (see also FIG. 52) the sleeve is driven down to compress spring 467 so as to apply extra clamping load on a bottle when clamped under chuck 339 in a manner to be described.

On a mid portion on each post 319 is attached a collar 349 which through a washer 351 bears on the top of a spring 353 (FIGS. 37 and 38). The spring 353 surrounds a sleeve 355 and seats on a washer 357 carried on the upper surface of a movable intermediate bracket 359. Bracket 359 has attached to it a bushing 361 (FIGS. 38 and 43) held by means of a snap ring 363.

Threaded to an enlarged lower end of sleeve 355 is a supporting nut 364 for the bracket 359. A clearance flat 366 extends across bracket 359 and bushing 361 (FIG. 43). Carried on a bracket 359 is a follower roller 365 which rides on a base chuck cam 367 shown in FIGS. 2 and 6-8. Cam 367 has a rise portion 369 and a drop portion 371 on the front side of the bottle conveyor. On the rear side of the bottle conveyor this base chuck cam is found with a rise portion 373 and a drop portion 375. Thus, when the follower 365 passes over the rise 369, the bracket 359 is lifted and then descends when the drop 371 is reached. When rise 373 is reached, bracket 359 again rises and finally descends at drop 375 of base chuck cam 367. This action raises and lowers the rotatable base chuck 377. Chuck 377 is in the form of a metallic plate (FIG. 38) removably held by a screw 378 on a spindle 379 supported in a bearing 381 within a sleeve 383 to which it is downwardly splined as shown at 385. Thus, as bracket 359 rises and falls under spring 353 so does base chuck 377, along with any bottle B whose bottom is supported by the chuck. Chuck plates 377 of various diameters may be assembled on the spindle 379 to accommodate bottles having various base diameters.

Keyed to sleeve 383 is a driving disk 387, the margin of which is knurled (FIGS. 36 and 38). When the disk 387 turns so does the base chuck 377. Disk 387 is initially turned by rolling on a friction strip 388 affixed to the carriage 3 for bottle registry to be described below. Only one strip 388 is required, being carried by the carriage 3 (FIGS. 1A, 15D and 38). At its lower end, sleeve 383 carries outer splines 389 for connection with inner splined clutch plates 391, so that the sleeve 383 and plates 391 rotate together. Sleeve 383 is carried coaxially in a clutch driving quill 393 enlarged at its lower end to form part of a clutch container, as shown at 394. Bolted to the enlarged part 394 of member 393 is a driving clutch ring 409 and a clutch end plate 415. These also form part of the clutch container. To the ring 409 is internally splined a set of driving clutch plates 411. When the clutch K thus constituted is closed, as shown in FIG. 38, sleeve 383 may be driven from the clutch driving member 383, thereby driving the base chuck 377. When the clutch K is open, base chuck 377 is free to be rotated by the disk 387. The splines 385 permit base chuck 377 to be moved up and down, whether or not sleeve 383 is rotating.

Quill 393 is carried on an upper bearing 395 around sleeve 383 and also in two sets of bearings 397 within clutch housing 317. The quill 393 has keyed to it a gear 399 locked by a nut 401. Gear 399 meshes with a gear 403 formed in a cluster with a single sprocket 405 which is carried in bearings 407 around post 319. Sprocket 405 is in mesh with the central reach of the triple chain 91. Relative motion between the speed of chain 91 and the speed of bottle carrier chains 27 and 29 determines the rate at which the cluster turns, and as a consequence the rate at which the clutch drive member 393 rotates. The speed of chain 91 may be changed by change-gears 69, 71, 73, 75.

Clutch plates 391 and 411 are biased toward clutch-closed position by means of a spring in the form of a stack of conventional Belleville conical spring washers 413 (FIG. 38). These react between clutch plate 415 and a collar 417 on the sleeve 383. In FIG. 38 the clutch is shown closed.

At 419 is shown a lifter carrying a cross pin 421 for engagement with the lower end of sleeve 383, thereby when lifted to open the clutch by separating its plates 391 and 411. The lifter 419 is bolted to an imperforate flexible metal diaphragm 425 by a clamp ring 426 and screws 428. On the bottom of lifter 419 is a tapered boss 423 which extends through a central sealed opening in the diaphragm. Diaphragm 425 has the purpose of retaining lubricant within clutch housing 317 while permitting vertical motion of lifter 419.

The outer rim of the diaphragm 425 is held in place by a bolted two-part cap 427. Cap 427 slidably contains a movable sleeve 429 carrying a follower roller 431 held in place by cross bars. An upper socket in the sleeve 429 contains the tapered boss 423. A set screw 435 is used in sleeve 429 to determine the position of the boss 423 in the socket therein so that the elevation of follower 431 may be adjusted. A transverse set screw 433 on the taper of boss 423 locks it in its position as adjusted by set screw 435.

Follower 431 engages a clutch-operating cam 437 (FIGS. 13 and 14). This cam has a two-piece curved end track 439 with a straight portion 441 on the front of the bottle conveyor and a straight portion 443 on the rear of the conveyor. At the end of the portion 441 is one of a number of terminal parts 445 of various lengths which may be interchanged. Follower 431 initially engages straight section 441, thereby raising follower 431 to cause the clutch to be held open until section 445 is again reached. Thus when follower 431 drops off the left end of the cam part 445, clutch K closes, thereby transmitting motion from sprocket 405 to base chuck 377 via gears 403, 399 and clutch drive members 393, 409, 415. When follower 431 arrives at the rearward cam portion 443, it is again lifted to open clutch K.

As above stated, each driving disk 387 engages the resilient friction strip 388 as shown in FIGS. 1A, 5, 17 and 38. Thus there are two means for rotating a bottle held between base chuck 377 and finish chuck 399; first by the knurling of disk 387 on the strip 388, and thereafter by closure of clutch K. Disk 387 leaves strip 388 before clutch K closes.

FIGS. 10-12 (to an enlarged scale) illustrate a finish chuck cam 449 the operations of which are coordinated with base chuck cam 367. Finish chuck cam 449, as shown in FIGS. 2 and 52, is above base chuck cam 367. It controls the follower 451 (FIG. 37) which is pinned to sleeve 453 which carries bearings 455 slidable around quill 457. Quill 457 surrounds push rod 459 attached to finish chuck 339. Sleeve 461 which surrounds quill 457 abuts the lower end of bearings 455 and passes through bushing 463 in body 315, so that it may slide up and down. Its lower end terminates at washer 465 engaging the upper end of the high-spring-rate spring 467. The lower end of spring 467 seats on ring 469 held in place by set screw 471 with the quill 457. The low-spring-rate spring 473 reacts between ring 469 and seating ring 475 engaging the upper part of body 315. An acceleration cam 468 (FIGS. 37 and 52) is also engageable by follower roller 451 (FIG. 52). Cam 468 is affixed to the framework of the bottle conveyor.

Finish chuck cam 449 (FIGS. 10-12) has a semicircular end track 477 which is above the semicircular end track 439 of base chuck cam 367 (FIG. 6). The upper follower rollers 451 (FIG. 37) ride finish chuck

cam 449 which is shown in FIGS. 10-12. The lower followers 365 (FIG. 38) ride base chuck cam 367 shown in FIGS. 6 and 7. Thus their functions are coordinated as shown in FIG. 52. Each semicircular portion 477 of finish chuck cam 449 is extended by three sections 481, 483, 485 (FIGS. 10-12) at the bottle receiving part of the machine, and three sections 482, 484, 486 extending from the printed bottle delivering end of the machine. End sections 481, 482 and 485, 486 are fixed while the center sections 483, 484 are attached by bolts 487 passing through slots 489. Adjacent portions of sections 481 and 483 on the one hand and 483 and 485 on the other hand are provided with slidable interdigitating extensions 491. Sections 482 and 484 on the one hand and 484 and 486 on the other hand are likewise provided with slidable interdigitating extension 491. These are provided for timing adjustments. Sections 483 and 485 provide successive drop actions for the lower followers 365 and sections 484 and 482 provide successive lift actions for them.

Bottles are brought into the machine as shown in FIG. 1A, over a conventional feeder belt 497 and spaced by a known type of a variable-pitch screw 499. This brings the necks 501 of the bottles into notches 505 of an upper star wheel 507 from which the bottles hang (FIG. 33). The lower ends 503 of the bottles are at this time located in notches 509 of a lower double star wheel 511. Single wheel 507 and double wheel 511 are quick-replaceable on hubs 513 and 515, respectively, to accommodate various bottle neck and base shapes. Quick-detachable screw connectors between the star wheels and their supporting hubs are shown at 517. The supporting hubs 513 and 515 surround a sleeve 519 which has a spline 521 for the reception of keys 523 held by set screws 525. The purpose of this is that by loosening the set screws vertical movement on the sleeve is provided to accommodate various sizes of bottles. Sleeve 519 is connected with the upright shaft 107. This is accomplished through a welded connection with a collar 529 which is keyed at 531 to an input member 532 of an overload clutch 534, the output of which is connected to the upper end 536 of shaft 107. At the lower end of shaft 107 is keyed the gear 103 which is driven by the gear 99 keyed to the main shaft 11 of bottle conveyor 1. The lower end of the shaft 107 is supported in bearings 527 mounted in fixed parts 535 and 537 of the machine framework (FIG. 34). Gear 99 also meshes with the gear 104 which is on the shaft 108 of FIG. 1A. Carried on shaft 108 is gear 104 and another set of parts like those shown in FIGS. 33 and 34. The star wheels of these parts deliver to an output conveyor 495. It is to be understood that the shaft 107 drives the bottle input conveyor 497 and screw 499 by a suitable drive indicated conventionally at 539 on FIG. 1A; also that shaft 108 drives the output conveyor 495 by a suitable drive indicated conventionally at 541. A sprocket 479 on each shaft 107 and 108, through suitable chain drives (not shown), supplies the motive power for these drives 539 and 541 (see FIG. 34). A sprocket 544 also driven by drive 541 transfers the bottles from conveyor 495. Fences 629 and 630 serve to guide bottles from conveyor 497 into notches 505 and 509 at the loading station L and to remove them at the unloading station U. These fences are shown by dotted lines on FIG. 1A and by solid lines on FIG. 33.

Since most bottles have two opposite side seams or mold flashings over which printing is to be avoided,

means for properly registering the bottles in their metal base chucks 377 are required to print between the seams. Such means are illustrated in FIGS. 2, 4, 5, 9, 36 and 43. Thus at 543 is shown a fixed supporting bracket which is attached to the machine framework by screws 545 (FIG. 9). Threaded into the bracket 543 are two studs 547 and 592 which pass through holes in a spacer plate 549. These hold the spacer plate 549 in place relatively to the bracket 543. The studs at their upper ends extend through two angular slots 551 in a registry cam in the form of a plate 553 which is slidable on the spacer plate 549 when not locked in place. Locking means are provided comprising hollow internally threaded pull rods 555 operative to be drawn up by draw screws 557 threaded into their upper ends. Affixed to the draw screws 557 are hand wheels reacting on the upper frame member 13. At their lower ends the pull rods 555 are provided with eye bolts 556 which are pivoted to arms 558 of cams 561, the working surfaces of which engage washers 563 under the fixed bracket 543. To the cams 561 are pivoted draw bolts 565 passing through guide openings 567 in bracket 543. The draw bolts 565 pass through compression springs 569 located in large enough holes in the spacer plate 549 to accommodate them. The draw bolts 565 also pass through angled slots 573 in the registry cam plate 553 above which are clamp washers 574. Washers 574 are under head nuts 575 on the draw bolts 565. Thus by manipulating the hand wheels the washers 574 may be pulled down toward bracket 543 to clamp and lock the cam 553.

Provision for adjusting the position of the cam plate 553 when unlocked is as follows: A control rod 572 having a hand wheel 576 at its upper end above member 13 passes through an angled slot 577 in cam plate 553 and a large clearance hole 578 in the spacer plate 549. This hole is large enough to permit swinging therein of a lever 579 which is attached to the control rod 572. At the end of the lever 579 is a pin 580 extending through a transverse slot 581 in the cam plate 553. Thus when the rod 572 is turned the cam plate will be driven by pin 580 in slot 581 to move in a direction parallel to the slots 551, 573 and 577 thereby adjusting the working edge 583 of the cam out or in as suggested by the double-pointed dart in FIG. 5. Slots 551 effect the guiding on pins 547. Slots 573 and 577 are simply to provide clearances around rods. The cam edge 583 has a ramp at its follower-receiving end as shown at 585. Beneath its other end and in the plane of the spacer plate 549 is a terminal piece 587 carrying pins 588 extending through a longitudinal slot 589 in 553. Plate 549 is notched as shown at 550 to receive one end of the terminal piece 587. A pin 592 threaded into the bracket 543 extends through the angle slot 551 in cam 553 and through a transverse slot 591 in terminal piece 587. Thus, as cam plate 553 is adjusted, the terminal piece 587 is movable with the cam edge 583 only in a direction to keep their edges 586 and 583 collinear, but the terminal piece 587 is constrained from moving in a direction parallel to the edge 583. Thus its end 590, which functions as a follower drop-off point, remains fixed under all adjustments of the collinear edges 586 and 583 transversely to their combined length.

The purpose of the adjustable cam edge 583 is to control follower rollers 593 of bottle registry apparatus illustrated in FIG. 5. This operates in connection with the resilient friction strip 388 which is carried by the

squeegee conveyor assembly 3. No such adjustment is required in connection with the squeegee conveyor assembly 5. The knurled disks 387 roll on the strip 388 to initially turn the metal base chucks 377, which occurs while their corresponding driving clutches in the housings 317 are open (FIGS. 5 and 38). Bottles B supported by these chucks 377 are thus turned, friction between the bottoms of the bottles and the chucks being sufficient until the bottles are prevented from rotating. In the latter event, any base chuck may continue to rotate by slippage on the lower surface of the bottle carried thereby but such action is minimized by terminating the friction strip 388 to terminate friction rolling just before clutch K is closed. To hold a bottle in a desired registered position, pins 594 (FIGS. 5, 40 and 43) are provided having pointed ends for engaging the bottle sides in their planes in which are located the usually provided printing registration index means 595 which may be dimples in the glass (as shown) or suitable projecting lugs having a predetermined relationship to the bottle seams. Each pin 594 is carried at one end of a lever 597 pivoted at 599 to a raised platform part 601 of a lower shelf part 615 of a rocker 603. On the other end of each lever 597 is a fastener 605. At 607 is a stop for lever 597. At 609 is a fastener pin. Between each pair of fasteners 605 and 609 is a tensile member such as a simple easily renewable rubber band 611 (preferred), or this may be a tension spring. By this means the points of the pins 594 are biased against the bottle sides. When a knurled disk 387 rolls on strip 388 the bottle is first rotated by the light friction between it and its supporting chuck 377 until its stop 595 reaches the point of a respective pin 594 whereupon the pin point engages the stop 595 and the bottle rotation stops in proper registered position for subsequent printing between its seams. At about this time the respective knurled disk 387 reaches the end of the friction strip 388. If not quite so, it continues to rotate but slippage occurs either between the respective base chuck 377 and the bottle supported thereby, or between disk 387 and the strip 388. However, the bottle remains stationary at least until pin 594 is withdrawn in the manner shown below.

Each carrier 308 comprises two posts 319 (FIGS. 1, 5 and 43). With parts moving in a direction indicated by the curved arrow in FIG. 5, one of the posts in a carrier leads and the other trails. Around each post 319 swivels a rocker 603 each of which includes a lower flat part 615. These parts support the above-mentioned members carrying the registry pins 594. Each also carries a clevis 625 and a cam follower roller 593. Parts such as 615 also swivel on the trailing posts. These each include tongues 613 and 617. On each tongue 617 is a pin 619. Each part 615 swivelling around a leading post is without a tongue such as 617, its pin 619 and tongue 613. Each part 615 on a leading post includes a pin 623 but such pins are absent from the parts 615 around the trailing post. A spring 621 connects the pins 619 and 623. As a result, when the carriers 308 are moved around the sprockets (23,25) the members 615 are placed in predeterminate relationships by engagement of the trailing tongues 613 with the leading flat parts 615. This state of affairs continues as the carriers leave the sprockets until the successive rollers 593 come into engagement with the edges 583,586 of cam 553. This successively stretches the springs 621 (as shown in FIG. 5) so that a trailing part 615 is pulled anticlockwise

until a corner of it engages a hub 627 of the leading part 615 on the next carrier 308. This places the next roller 593 in position for subsequent engagement with cam 553. The reaction thus engendered also tends to rotate the leading part 615 clockwise to engage its roller 593 with the cam edge 583. This clockwise movement also resiliently engages the point of the respective pin 594 with the bottle sides to register them as above described. The knurled disks 387 leave the friction strip 388 before the rollers 593 disengage from the edge 583 and the extension 586 thereof formed by the terminal piece 587. Since terminal piece 587 does not move in the direction of the movements of the rollers 593 when adjustments are made to the cam 553, the points of the pins 594 always leave the bottle stops 595 at the same time.

Operation is as follows:

Power is applied to the main drive shaft 11 of the vertical bottle or article conveyor 1 (FIGS. 1A, 1B and 2). This drives the main conveyor chains 27 and 29 on sprockets 23, 25, 31 and 33. Chains 27 and 29 support the dual bottle carriers 308 and circulate them.

Shaft 11, through the change-speed train 69, 71, 73, 75, 61, 83 and 85, also drives the sprocket 87 which drives the triple chain 91 in a direction opposite to that of chains 27 and 29 (FIGS. 1B and 2). Triple chain 91 meshes with the sprockets 405 on the bottle carriers 308 (FIG. 38), thereby through gears 403 and 399 to turn bottles B on base chucks 377 when clutch K is closed for rolling their sides or necks on the tiltable screens 222 (FIGS. 31-32).

The drive shaft 11 through sprocket 97 (FIG. 2) also drives the triple chain 109. Chain 109 (FIG. 1B) drives the input sprockets 125 on the carriages 3 and 5 in any of their adjusted positions along the front and back sides of the bottle conveyor 1 (FIG. 1A). The squeegee conveyors 7 and 9 on the carriages 3 and 5 are each driven from the respective sprockets 125 on carriages 3 and 5 through the respective trains 129, 131, 205, 207, 203, 201 (FIG. 1B). Thus the twelve squeegee strikers 267 (FIGS. 48-50) of each conveyor 7 and 9 are circulated to pick up color successively from the drum 180 or 181 and then when pneumatically pushed toward one side of the heated screens 222 striking along them where backed up by rolling bottles on the other side. This occurs by action of the mechanisms above described in connection with FIGS. 15-22. The striking velocities of the strikers 267 along the screen equal the velocities of the rolling contacts of bottles on their other sides in the cases of cylindrical bottle sides being imprinted. In the case of tapered bottle necks or sides, pure rolling contact is approximated except in one plane of each bottle neck, but the deviation from rolling contact in adjacent pulses is minor and can be compensated for by modifying distortions of the stencil patterns on the stencil screens. The above-described perpendicular and transverse adjustments provided for the squeegee conveyors 7 and 9 on the carriages 3 and 5 provide for adjusting the screens 222 to various bottle diameters and printing levels on the bottles.

For rolling or substantial rolling contact of sides or necks of bottles on a screen, smaller bottles must be turned faster and larger ones slower. This is provided for by changing the reverse speed of chain 91. This is accomplished by substituting another set of change gears for the set 69, 71, 73, 75 (FIG. 2). The bottles are

driven to roll on the screens only when clutch K is closed.

Rolling of disk 387 on the strip 388 (FIGS. 1A, 2 and 17) turns the bottles B in base chucks 377 for registration before clutch K closes. There is only one strip 388 provided on the first squeegee carrier to be passed by bottles circulated by the bottle carrier 1.

The drive shaft 11, by gear 99, also drives gear 103 on shaft 107 and gear 104 on shaft 108, thus driving the pairs of star wheels 507 and 511 at the loading and unloading stations L and U respectively (FIGS. 1A, 33 and 34). The notches 505 in the upper star wheels support the bottles B vertically by their upper finish ends F as the bottles approach the loading station L and leave at the unloading station U. The lower notches 509 hold them vertical. The screw 499 at the loading station sends the ends F into notches in the star wheels on shaft 107 as the bottles approach on the feeder conveyor 497. The screw and conveyor are actuated by drive 539. The inner fence 496 of conveyor 495 removes the bottles from their supporting notches 505 and 509 at the unloading station U. The curved fences 629 and 630 prevent the bottles from being urged out of the notches while they change directions.

Complete timing is as follows for operations by the six control cams, i.e., base chuck cam 367, registry cam 553 with strip 388, finish chuck cam 449, clutch-operating cam 437, acceleration cam 468 (see FIG. 52) and squeegee-operating cams 253 (see FIGS. 16, 17 and 44-46). The travel along the front reach of conveyor 1 from loading station L is illustrated at the bottom of FIG. 52 and the opposite travel to unloading station U along its rear reach is illustrated at the top. Connecting dashed-line darts at the sides show directions of movement. The portions of travel around the sprockets 23, 25, 31, 33 are omitted from this figure except insofar as these darts suggest them.

Referring to FIG. 52, as the unprinted bottles B enter the front reach of the bottle conveyor 1, they are hung by the pair of star wheels 507 and 511 at the loading station L. As the dual bottle carriers 308 swing around the right-hand end of the conveyor and then to the left, their lower follower rollers 365 riding on the base chuck cam 367 meet the rise 369 to elevate the bottle chucks 377 into engagement with the bottoms of the bottles. This lifts them. At the same time, the upper follower rollers 451 move on the finish chuck cam 449 (with springs 473 compressed). Thus they reach the drop 493, thereby engaging the finish chucks 347 with the top finish ends of the bottle necks. This occurs as the base chucks 377 rise, thereby chucking the hung bottles under spring compression preparatory to leaving the star wheels.

Next, the lower followers 365 descend the drop portion 371 of cam 367 while at the same time the upper followers 451 descend on the drop portion 496 of the finish chuck cam 449. This lowers the bottles to printing level and expands springs 473 to reduce (but not eliminate) the chucking force so that subsequently the bottles, when unimpeded, are rotated by light frictional force between the bottoms and the base chucks 377. Comparatively slow rotation of the lightly chucked bottles is then brought about by rolling of the disks 387 on the friction strip 388 mounted on the first squeegee carriage 3. During this period, the registry cam 553 is engaged by the rollers 593 (FIG. 5) so as resiliently to press the end points of the fingers 594 against the sides

of the bottles. Then when the dimples 595 of the rotating bottles reach the fingers 594, the bottle rotations are stopped thereby to place the bottles in proper registered position. Until the disks 387 leave strip 388, the base chucks may continue comparatively slowly to rotate while slipping on the bottoms of the bottles. This occurs under the light pressure from low-spring-rate springs 473. By these means bottle breakage is prevented, particularly in the case of comparatively weak nonreturn bottles. Some slippage may also occur at this time between disks 387 and friction strip 388.

When the rollers 593 leave the registry cam 553, the fingers 594 are withdrawn from the dimples 595, thus freeing the registered bottles for rotation. To avoid slip during desired rapid acceleration from rest, the cam 468 is engaged by rollers 451, thereby driving down sleeves 461 against the high-spring-rate springs 467. This temporarily increases the chucking forces until rollers 451 leave the acceleration cam 468. Until cam 468 has been reached, the lower follower rollers 431 of the carriers 308 have been riding the clutch-operating cam 437 to hold clutch K open while compressing the Belleville springs 413. The rollers 431 leave cam 437 allowing the Belleville springs to close the clutches K just as springs 467 are compressed. Then rotation of the bottles is accelerated under strong chucking force to prevent slippage between the driving base chucks and the bottle bottoms. Any substantial slippage at this time would spoil registration. The increased chucking force during acceleration is brought about by the increased compression afforded by springs 467 when a follower 451 engages cam 468. The speed of bottle rotation after acceleration is greater than that which occurs while turning it into registered position.

As the bottles turn, they advance to the first stencil screen 222 carried on fence 274 of squeegee conveyor 7. At this point the squeegee strikers are successively air-driven toward line engagement with the screen 222 where successive bottles have rolling line engagement on its other side. Thus advance of the strikers along one side of the screen is at the rolling speeds of the bottles on its other side. This action strikes color through the screen stencil to imprint the rolling bottles one after another. When the end of the screen is reached by each striker 267, it is air-returned from the screen to force its respective control follower 275 definitely against cam 253. This properly positions the strikers 267 for subsequent tangential engagements with color drum 180 or 181. If return air pressure fails, the lift portion 256 of cam 253 will retract the strikers to prevent damage thereto during circulation until pressure can be restored. Start of the first screen engagement at the first printing station X is shown at the lower left on FIG. 52.

The bottle carriers 308 after the strikers leave the first screen travel around the left end of the conveyor from its front reach to its rear reach (FIG. 1A) as indicated by the left-hand dashed-line darts on FIG. 52. The bottles continue to rotate since clutch K remains closed. Therefore, re-registration of bottles is not required. Then the bottles roll on the second screen 222 of the second squeegee conveyor 9 at printing station Y. As in the case of conveyor 7, the strikers 267 of squeegee conveyor 9 are driven toward, along and away from this screen. Then continuing to rotate, the printed bottles advance toward the unloading station U. In doing so, the lower followers 365 reach the rise portion 373 of base chuck cam 367 as the upper follow-

ers 451 reach the rise portion 486 of finish chuck cam 449. This lifts the bottles out of the printing plane and into position to be received and hung in the notches 505 and 509 of the second set of star wheels 507 and 511, respectively, located at the unloading station U. 5 Finally, the lower followers 365 descend on drop portion 375 of cam 367 while the upper followers 451 ascend the rise portion 484 of the finish chuck cam 449. This releases the bottles as hung in the star wheels. From there they proceed to the conveyor 495, being 10 guided thereto by the second fences 629, 630.

From the above it will be seen that the invention has the following advantages: The carriages 3 and 5 may be moved into various longitudinal printing station positions on the supporting guides 117 and 119 without 15 changing synchronism between the actions on the stencil screens of the squeegee strikers on one side of each screen and the rolling contact actions of the bottles on their other sides.

The vertical and lateral adjustments of the squeegee 20 conveyors 7 and 9 for various bottle sizes and printing levels are convenient to make, as is also the tilting adjustment for the stencil screen.

Printing on various sizes and shapes of bottles may be accomplished in multicolors at various levels. Printing 25 on sides of bottles at one screen and on the tapering necks of bottles on another tilted screen is easily coordinated with the use of interchangeable color lifting drums in the color containers. Although the disclosure shows the use of two squeegee conveyors, more may be employed by lengthening the apparatus. 30

The use of initial comparatively low bottle chucking force allows for chuck slip to effect registration. Comparatively high-pressure bottle chucking during acceleration from stationary registered positions of the bot- 35 tles to spinning velocity avoids loss of registration.

The pneumatic operation of the strikers simplifies structure for controlling them. By control of the air pressure, operating conditions on the screens may be 40 conveniently optimized.

Color containers for carrying various colors may be stocked for quick interchangeable application to the squeegee carrier assemblies, thus minimizing down time for cleaning and refilling of the containers.

In view of the above, it will be seen that the several 45 objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the 50 above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus for printing round articles such as bottles and the like each having a central axis and printing registration index means on its round surface, comprising:

a main conveyor including a drive shaft, a series of 60 article carriers connected to the conveyor for advancement thereby along a path toward a printing station;

article supporting means on the carriers for holding the articles in positions of their axes parallel to one 65 another as the articles are advanced;

means for rotating said article supporting means to rotate each article on its axis at a comparatively

low speed of rotation as the article is being advanced;

means on each article carrier engageable with and then releasable from said index means on each article to arrest rotation of the article at a registry position thereof while proceeding toward the printing station;

means for accelerating each article from its arrested position to a comparatively higher speed of rotation before the printing station is reached;

means at the printing station for printing on the articles as they are conveyed by the conveyor through the printing station;

each article supporting means including a clutch having an input member and an output member to which an article supporting and rotating base chuck is connected;

a change-speed drive extending from the drive shaft of the main conveyor;

branch drives extending from the change-speed drive to said clutch input members respectively for effecting said acceleration and comparatively high-speed rotation of the articles when the respective clutches are closed;

means for holding each clutch open during the comparatively low-speed rotation of the articles; and means for successively closing the clutches thereafter.

2. Apparatus according to claim 1 wherein said low-speed rotating means is independent of said change-speed and branch drives for rotating the clutch output members when the respective clutches are open.

3. Apparatus according to claim 2 including finish chucks and spring-actuated forcing means for pressing the finish chucks toward the tops of the articles; and means operative at a loading station preparatory to the start of said comparatively low-speed article rotation first to partially drop the finish chucks and lift said base chucks toward the partially dropped finish chucks to clamp the articles axially under spring force, then to lower both chucks to lower the articles while clamped.

4. Apparatus according to claim 3 including cam 45 means operative during said acceleration for increasing the clamping force exerted by said spring means without substantially changing the vertical positions of the articles.

5. Apparatus according to claim 4 wherein said spring-actuated forcing means comprises a first spring of comparatively low spring rate which is compressed during said article lifting and lowering operations, and a second spring of comparatively high spring rate which is compressed by said cam means to increase force on the finish chuck in the lowered positions of the articles. 55

6. Apparatus according to claim 3 including means at an unloading station located beyond the printing station for raising the base and finish chucks together and then raising the finish chuck while lowering the base 60 chuck.

7. Apparatus according to claim 6 including rotatable first and second spools at said loading and unloading stations respectively, each spool having an upper flange and a lower flange, notches in the upper flanges for the reception and hanging of articles by their upper finish ends in elevated positions, notches in the lower flanges to hold the articles vertical; and

means for driving said spools from the drive shaft of said conveyor in directions to feed hung articles to the conveyor by the first spool and to receive articles from the conveyor for hanging by the second spool.

8. Apparatus according to claim 7 including an article conveyor for inserting articles into the notches of the first spool for hanging, and an article conveyor for taking hung articles from the notches of the second spool.

9. Apparatus according to claim 1 wherein said change-speed drive comprises a train of changeable gears between said conveyor drive shaft and a counter-shaft carrying a sprocket meshed with a chain; and wherein said branch drives each comprise a sprocket on an article carrier and a gear set driven therefrom and connected with an input of a clutch on the respective article carrier, each of the last-named sprockets meshing with said chain.

10. Apparatus according to claim 1 wherein said printing means comprises a carriage adjacent said main conveyor;

a squeegee conveyor having a support on the carriage for moving squeegees, a stencil screen attached to the squeegee conveyor, means for driving the squeegee conveyor to effect substantially constant squeegee speed along the screen, said support including means for adjusting the position of the squeegee conveyor to and from the main conveyor and vertically relatively thereto;

whereby changes in the change-speed drive, with appropriate adjustments in said support, can be made to obtain substantially constant rolling contact speed on one side of the screen of articles of different lengths, diameters and shapes, with said rolling contact speed being equal to the constant speed of the squeegees along the other side of the screen.

11. Apparatus according to claim 10 including a drive disk connected to each rotatable article supporting means; and

track means affixed to the carriage for rolling engagement therewith by said disk in any adjusted position of the carriage along the main conveyor.

12. Apparatus according to claim 10 including as part of each article supporting means a base chuck rotatable thereby, means for initially applying sufficient chucking force through each article to its base when in the chuck to cause the chuck to rotate the article but to allow slip at the chuck and the base of the article only when the article is arrested; and

means for thereafter applying greater chucking force on each article during acceleration to effect rapid attainment of said comparatively high speed rotation without slip during acceleration.

13. Apparatus for printing round articles such as bottles and the like each having a central axis, comprising: a main conveyor having a drive shaft, a series of article carriers connected to the conveyor for advancement thereby along a path from an article loading hanger at a loading station, through a printing station and to an article unloading hanger at an unloading station;

rotatable base and finish chucks each vertically movable toward and away from each other on the carriers for axially engaging the articles in hanging positions in the article loading hanger as the articles are advanced, upper cam control means for operating

engagement with the finish chucks and lower cam control means for operating engagement with the base chucks at the loading hanger located at the loading station;

spring means in said carriers biasing the finish chucks against their cam control means and toward the finish ends of the articles;

said upper cam control means being operative at the loading station to lower the finish chucks under spring action and said lower cam control means adapted simultaneously to lift said base chucks to clamp the articles axially under spring force, both of said cam control means adapted then to lower both chucks simultaneously to lower the article under spring force, said upper and lower cam control means being engaged with the finish and base chucks at the loading station to first lower the finish chucks and raise the base chucks into clamping engagement with the articles with the force of said spring means biasing the finish chucks toward the articles and base chucks and then lowering both chucks simultaneously with the articles therebetween under the force of said spring means;

drive means for rotating the chucks and their clamped articles in their lowered positions until the hanger at the unloading station is reached; and means at the printing station for printing on the articles as they are conveyed by the conveyor through the printing station.

14. Apparatus according to claim 13 including upper and lower cam control means at the article unloading hanger located at the unloading station for first raising both the base and finish chucks to a level to be received by said article hanger at the unloading station and then raising the finish chuck while lowering the base chuck to hang the articles in the article unloading hanger.

15. Apparatus according to claim 14 wherein each hanger is in the form of a spool, each spool having an upper flange and a lower flange, notches in the upper flanges for the reception and hanging of articles by their upper finish ends, and notches in the lower flanges to hold the articles vertically.

16. Apparatus according to claim 15 wherein each lower flange includes means for varying the sizes of its notches to accommodate articles of various body diameters in held vertical positions.

17. Apparatus according to claim 16 wherein each said lower flange comprises two relatively rotatable plates, each plate having V-shaped registrable and partially registrable marginal notches therein, and means for locking the plates in any one of various partially registered and registered positions in relation to one another.

18. Apparatus according to claim 13 wherein said drive means for rotating the chucks in their clamped conditions comprises sprockets on the respective carriers connected through gears with the base chucks; a drive chain meshed with all the sprockets; and a change-speed gear train between said drive shaft and said chain.

19. Apparatus for printing on articles such as bottles or the like having round surfaces and central axes comprising:

a horizontal endless multiple-chain conveyor; a series of article carriers attached to the chains and spaced at intervals thereon;

each article carrier including a means to hold an article in a generally vertical position with the article rotatable on its axis;
 means for continuously driving the conveyor to carry the articles with their axes moving in vertical planes past several printing stations;
 printing means at each printing station, each printing means being movable in parallel with one of said planes and comprising a stencil screen having a striking area, and squeegee driving means for moving squeegee strikers into moving engagement along the screen;
 means for continuously rotating each article on its axis for substantial rolling contact on one side of each screen at the velocity of a squeegee on the other side of the respective screen as the articles travel through each printing station;
 means for synchronizing the continuous rotational velocity of the article and the velocity of the squeegees of the several printing stations; and
 means for adjusting each squeegee driving means including its screen both vertically and perpendicularly with respect to one of said planes.

20. Apparatus according to claim 19 including means for tilting each screen on an axis passing through its striking area, said strikers having interchangeable mountings for proper screen engagements at various screen tilts.

21. Apparatus for imprinting round articles of various diameters comprising:

a stencil screen which is both vertically and horizontally adjustable;

an article conveyor including a drive shaft and a number of carriers, a rotatable support on each carrier for at least one of said articles, first conveyor chain means driven at a certain velocity from said drive shaft and supporting a series of said carriers for movement in a first direction adjacent one side of the screen, a sprocket and gear means driven thereby on each carrier for rotating the supported article in substantial rolling engagement with one side of the screen;

a timing chain driven from said drive shaft and continuously meshing with all of the sprockets thereby to effect said rotation of articles at substantially constant speeds of rolling engagements with said screen; and

change-speed means removably interposed between the drive shaft and said timing chain for altering the speed of the timing chain thereby to provide rotation of articles of various diameters at substantially constant speeds in rolling engagement with said screen.

22. Apparatus for printing on round articles such as bottles or the like having central axes comprising:

article carriers having rotatable supporting chucks thereon for rotatably holding articles;

a vertical conveyor having a chain drive to which the carriers are attached for moving the carriers with the axes of the articles in substantially vertical positions, said conveyor including an input drive shaft; at least one carriage movable to various positions alongside the chains;

a squeegee conveyor supported by the carriage, a stencil screen on the squeegee conveyor, drive means on the squeegee conveyor for moving squeegees along the screen;

said carriage supporting an input drive sprocket, means on the carriage for adjusting the position of its supported squeegee conveyor and screen vertically relative to the axes of the article and to and from their paths, said carriage also including a flexible drive connecting said input drive sprocket with the drive means of the squeegee conveyor in any adjusted position of the latter relative to the supporting carriage;

a drive disk on each chuck having rolling engagement with a friction strip supported on the carriage to rotate each article into a registry position at a comparatively low angular velocity;

releasable lock-up means on the article carriers for stopping article rotation in registry positions of each;

an endless first chain driven by said drive shaft and extending along said vertical conveyor, said first chain being meshed with said drive sprocket to drive it in any location of the carriage;

an endless second chain driven by a change-speed drive from said drive shaft; and

a sprocket which is gear-connected to each chuck and meshed with said second chain for rotation of chucks and articles at comparatively high angular speeds adapted by changes in said change-speed drive for substantially constant speeds of rolling contact of articles of various sizes with the screen after said lock-up means is released.

23. Apparatus according to claim 22 wherein there are several like carriages and supported squeegee conveyors located to be passed in sequence by the article carriers, only the first of which carriages supports the friction strip.

24. Apparatus according to claim 23 including means for closing said chucks lightly while the disks of the chucks roll on said friction strip so as to permit slippage of the articles in the chucks when the articles are locked up against rotation.

25. Apparatus according to claim 24 including a drive clutch for each chuck and means to hold the drive clutch open during article registration but to close it thereafter to accelerate the articles to said comparatively high angular speed.

26. Apparatus according to claim 25 including means for strongly chucking the articles during said acceleration.

27. Apparatus according to claim 26 including a removable color container carried by each squeegee conveyor, a color elevating roller in each container for lifting color for tangent engagement by striking elements of the squeegees as these elements move toward the screen.

28. Stenciling apparatus comprising:

a squeegee conveyor having a rigid framework; guide grooves and rotatable drive and idler shafts in said framework, sprockets on said shafts; and endless conveyor chain means driven by said drive shaft;

carriers connected to said chain means for circulation of the carriers in closed paths, each carrier including thereon

followers in said guide grooves,

an air cylinder,

a piston rod in each cylinder which has outer and inner ends extending from the respective cylinder, each rod carrying a double-acting piston in

its cylinder, each outer rod end supporting a squeegee assembly;

a fixed cam supported by said framework and engageable by said followers, said cam having endwise drop and lift portions with open space therebetween thereby to limit outward movements of the followers and their connected piston rods throughout first parts of the paths of the latter and intermittently to free them as the carriers move along second parts of their paths, a stencil screen adjacent the open space;

means for intermittently distributing air under elevated pressure to the insides of the pistons to drive the squeegees out and the followers against the cam to limit outward squeegee-assembly movement until said open space is traversed by the followers in the second parts of their paths during which the squeegee assemblies are driven out toward the screen, said distributor thereafter disconnecting the air supply and releasing air pressure from the insides of the pistons; and

means for inwardly returning the pistons before the second parts of said paths are reached.

29. Apparatus according to claim 28 wherein said means for inwardly returning the pistons comprises means for constantly maintaining air under lower pressure on the outsides of the pistons whereby upon said release of said elevated pressure the lower-pressured air returns the pistons with their connected rods, squeegee assemblies and followers to positions of the latter for re-engagement with the cam when the distributor re-establishes said one air pressure inside of the pistons, whereby the outer positions of the squeegee assemblies while traversing the second parts of their paths are predetermined by engagement of their followers with the cam.

30. Apparatus according to claim 29 wherein: said stencil screen is tiltable and carried by said rigid framework, said squeegee assemblies including quick-detachable means for attaching variably angled striker blades for engagement with the tiltable screen according to its tilt;

a container supported by said carrier for carrying a pool of color; and

means connected with the container for adjustably supporting and rotating drums of various cylindrical and conical shapes to dip into the color pool and lift color for engagement by striker blades at various angles of attachment thereof.

31. Apparatus according to claim 30 including:

an article conveyor for moving articles along a vertical plane, and means for supporting the squeegee conveyor for two right-angled adjustments parallel to said plane and one adjustment perpendicular thereto.

32. Apparatus according to claim 31 wherein said means for supporting the squeegee conveyor comprises a carriage movable on guide rails adjacent the article conveyor in a direction parallel to said plane, a first support member on the carriage and adjustable perpendicularly with respect to said plane, and a second support for the squeegee conveyor, said second support being mounted on the first support and adjustable perpendicularly to the direction of carriage movement and parallel to said plane.

33. Apparatus according to claim 32 including: a first drive member on said carriage;

a second drive member connected to the drive shaft of the squeegee conveyor and supported upon its said rigid framework; and

a flexible drive connection between said drive members.

34. Apparatus made according to claim 33 wherein said flexible drive connection comprises a set of gears driven by a sprocket on the carriage, a set of gears connected with said squeegee conveyor drive shaft, a universal joint connected with each set of gears, and a telescoping drive-shaft connection between said universal joints.

35. Apparatus made according to claim 34 including a chain driven from the article conveyor and moving in a straight line adjacent to and parallel to the direction of movement, said sprocket meshing with said chain.

36. Apparatus for imprinting round articles such as bottles or the like comprising:

an article conveyor for moving articles along a path, rotatable supports on the article conveyor for the articles;

a carriage, a stencil sheet on the carriage disposed to be engaged by the sides of said articles as they move along said path;

squeegee assemblies having color striking blades respectively;

a tilted squeegee conveyor on the carriage, said carriage being movable relatively to the article conveyor, means in said tilted squeegee conveyor for circulating the color striking blades in an endless path such that said blades move in one angular aspect over a first horizontal part of the path adjacent the stencil sheet to engage it and horizontally over a second part of the path in a different angular aspect;

means for applying color to the squeegee striking portions as they move horizontally along said second part of the path;

synchronizing means connected between the conveyors for driving the squeegee conveyor comprising a sprocket on the carriage, a drive connection from said sprocket to the squeegee conveyor and a first chain which is driven by the article conveyor, said chain meshing with said sprocket in any position that the carriage may assume to drive the squeegee conveyor to move said blades along a first side of said stencil sheet;

means including a group of sprockets for driving the rotatable article supports to rotate in a common direction for substantial rolling contacts of articles along the second side of said stencil sheet; and

a second chain driven by the article conveyor and continuously meshed with said group of sprockets to rotate them at a speed for substantial rolling contact on said second side of the stencil sheet equal to the speeds of said blades along the first side of the sheet.

37. Apparatus according to claim 36 wherein said stencil sheet is tiltable and each striking blade has a quick-detachable connection into the assembly of which it forms a part, whereby blades having various angles of attachment may be employed in accordance with the tilt of the stencil sheet.

38. In bottle printing apparatus, an assembly for supporting a circulating squeegee conveyor next to a bottle conveyor comprising:

rails adjacent to the bottle conveyors, a carriage guided by and movable along said rails; transverse guide means on said carriage, a first movable support adjustable in said transverse guide means;

vertical guide means on the first support, a second support for the squeegee conveyor and adjustable in said vertical guide means;

first drive means on the carriage, second drive means on the squeegee conveyor; and

a flexible driving connection between said first and second drive means.

39. Apparatus for printing round articles such as bottles and the like having central axes, comprising:

an endless article conveyor movable in a generally horizontal endless path;

a series of article carriers carried by the article conveyor spaced at intervals along it;

rotatable chucking means on each article carrier for axially clamping articles as they are carried;

means for continuously driving the conveyor to move the articles successively past first and second printing stations, each station including a stencil screen;

means for lightly chucking the article, means for rotating the lightly chucked articles at a certain angular velocity, locking them in registered positions, and then releasing them in said registered positions before the first printing station is reached;

means for strongly chucking the articles after they have reached registered positions; and

means for then accelerating them to a higher angular velocity for rolling on the screen at the first station and continuing said rotation at said higher angular velocity under said strong chucking for rolling on the screen at said second printing station.

40. Apparatus as set forth in claim 39 including a clutch having input means and output means for said article acceleration and rotation, and means for interconnecting the input and output means, a sprocket forming turning input means for each chuck input means;

an endless drive chain in constant mesh with each sprocket;

said output means including a disk; and

a fixed track upon which the disk rolls for rotating the clutch output and the interconnecting means when the clutch is open.

41. Apparatus for printing on bottles having a printing registration index comprising:

an endless conveyor movable in a generally horizontal endless path;

a series of bottle carriers carried by the conveyor spaced at intervals along the conveyor;

each bottle carrier being adapted to hold a bottle in generally vertical position with the bottle rotatable on its vertical axis;

means for continuously driving the conveyor to carry the bottles through a printing station;

means on each carrier cooperable with the registration index of a bottle carried by each carrier to arrest rotation of said bottle in a registered position;

first means for rotating each bottle on its vertical axis at a relatively low speed for registration before it travels through the printing station; and

second means for rotating each bottle at a relatively high speed for printing as it travels through the printing station, said second means being driven in

timed relation to the conveyor so that, for any given size of bottle, there is a fixed relation between the linear speed of the conveyor and the speed of rotation of a bottle, said second means also being adapted for change to vary said relation for printing on bottles of different sizes.

42. Apparatus for printing on bottles or the like comprising:

an endless conveyor movable in a generally horizontal endless path;

a series of bottle carriers carried by the conveyor spaced at intervals along the conveyor;

each bottle carrier being adapted to hold a bottle in generally vertical position with the bottle rotatable on its vertical axis;

means for continuously driving the conveyor to carry chucked bottles through a printing station;

means for rotating each bottle at printing speed as it travels through the printing station, said bottle rotating means being driven by said conveyor drive

means so that, for a given size of bottle, there is a fixed relation between the linear speed of the conveyor and the speed of rotation of a bottle, said

means being adapted for change to vary said relation for printing on bottles of different sizes; and

means driven by said conveyor drive means for driving said rotating means thereby to fix the relation between the linear speed of the conveyor and the rotational printing speed of the bottle, said driven means being changeable to adjust the fixed relation for different sized bottles.

43. Apparatus as set forth in claim 42 for printing on bottles having a printing registration index, further comprising means on each carrier cooperable with the registration index of a bottle chucked in the chucks on the carrier to arrest rotation of said bottle in a registered position, and means for rotating the chucked bottles at a relatively low speed for registration before they travel through the printing station.

44. Apparatus for printing on bottles or the like comprising:

an endless conveyor movable in a generally horizontal endless path;

a series of bottle carriers carried by the conveyor spaced at intervals along the conveyor;

each bottle carrier carrying at least one set of chucks substantially in vertical alignment with each other and each being movable toward and away from the other respectively between closed and open positions for chucking a bottle in generally vertical position;

means for continuously driving the conveyor to move the carriers successively through a loading station,

a printing station and an unloading station, said chucks being adapted to be opened for entry of a bottle therebetween and closed to grip the bottle;

means at the loading station for entering a bottle vertically between each set of opened chucks and, with the bottle traveling at substantially the same speed as the conveyor, closing the chucks to grip the bottle;

means at the printing station for printing on the bottles as they are conveyed by the conveyor through the printing station; and

means at the unloading station for holding a bottle, opening the chucks, and moving the bottle away from the conveyor.

45. Apparatus for printing on bottles or the like comprising:
 an endless conveyor movable in a generally horizontal endless path;
 a series of bottle carriers carried by the conveyor spaced at intervals along the conveyor;
 each bottle carrier being adapted to hold a bottle generally vertical position with the bottle rotatable on its vertical axis;
 means for continuously driving the conveyor to carry the bottles through at least two printing stations;
 means for rotating each bottle on its vertical axis for printing as it travels through each printing station;
 printing means at each printing station comprising a

screen and squeegee means movable along the screen;
 means for synchronizing the rotational velocity of the bottles and the velocity of the squeegee means movement along the screens of the several printing stations; and
 means mounting at least one of said printing means for adjustment longitudinally with respect to the path of the conveyor.
 46. Apparatus as set forth in claim 45 having means mounting each printing means for vertical adjustment and for lateral adjustment with respect to the path of the conveyor.

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